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Knowledge, Attitude and Practice Regarding Vitamin D Among Primary Health Care Physicians in Riyadh City, Saudi Arabia, 2015

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Abstract: Vitamin D deficiency has been recognized as a worldwide epidemic, affecting even healthy population. The awareness and practices of primary health care physicians regarding vitamin D needs to be highlighted, as improving the knowledge of physicians will improve the knowledge of the public as a whole. This study aimed to address the knowledge, attitude and practice of primary health care physicians regarding vitamin D in Riyadh city, KSA. A cross-sectional study was conducted using a self-administered questionnaire among primary care physicians; currently working in Riyadh city, KSA. Descriptive statistics: mean, standard deviation, frequencies, percentage were calculated. Of the 158 eligible participants, there were 43.7% male. The mean participant's age of was 40.7 ± 9.6 years. Of all the participants; 51.3% showed good knowledge regarding vitamin D, while 48.7% showed poor knowledge; 55.1% had positive attitude. Participants were asked about patient features that would alert them to vitamin D status. Fatigue was shown to alert more male than female physicians participants (75.4% vs. 58.4%, p = 0.026). Participants were asked about ways of managing vitamin D deficiency. Nutrition advice was mostly given by older physicians (p = 0.044) and non-Saudis (p = 0.003). In conclusion, this survey identified a gap in knowledge and practice among Primary Health Care physicians. The confusion could be partly attributed to different guidelines and sources of information. This study showed that continuous medical education and online sources were the most common sources of information about vitamin D among physicians.

Keywords: KAP, Vitamin D, General Practitioner

1. Introduction

Vitamin D deficiency has been recognized as a worldwide epidemic, affecting even healthy population [1]. The US National Health and Nutrition Examination Survey 2005 to 2006 data showed that the overall prevalence rate of vitamin D deficiency in adults was 41.6% [2]. Furthermore, countrywide studies in India had found that the prevalence was as high as 70% to 100% in the general population [3]. Another recent study in Oman reported a high prevalence of vitamin D deficiency as well (87.5%) [4].

Despite the sunny desert climate of Saudi Arabia; vitamin D deficiency has been reported in different studies in Riyadh, Jeddah and the Eastern region of the kingdom [5-7]. A recent study conducted in Riyadh among King Abdulaziz medical city's out-patients in 2010 showed that the prevalence of vitamin D deficiency was 78.1% in females and 72.4% in males [8]. Two other studies conducted simultaneously in Jeddah reported a prevalence of 87.8% in males [9] and 86.3% in children [10].

Vitamin D is essential for absorption of dietary calcium and phosphorus from the intestine, thereby adequate levels of vitamin D is essential for promoting healthy bone growth and has protective effect against several bone manifestations [11]. Thus, vitamin D deficiency can lead to hypocalcaemia,

hypophosphatemia and increased parathyroid hormone which in turn will increase calcium resorption from bone, to compensate for the low level of calcium, leading to a variety of bone problems [11, 12].

Moreover, low calcium could cause seizures, tetany, stridor, hypotonia, and hyperreflexia, particularly in young children and low phosphorus may cause muscle weakness and discomfort, leading to standing or walking difficulties in children [12]. Vitamin D deficiency causes a wide range of complications starting from "in utero" to a late stage in life. These included; growth retardation, skeletal deformities and rickets in children, osteomalacia, precipitating or exacerbating osteopenia and osteoporosis, muscle weakness and an increased risk of falls and fractures in adults [11, 13].

Furthermore, vitamin D receptors were found in many tissues in the body and vitamin D deficiency was linked to a variety of extra-skeletal manifestations. It was found to be associated with an increased risk of many common cancers, type 1 diabetes, multiple sclerosis, Crohn's disease, rheumatoid arthritis, osteoarthritis, hypertension and cardiovascular heart disease [1, 11]. It was even linked to an increased incidence in schizophrenia and depression [11].

The definition of vitamin D "deficiency" is controversial; the US Endocrine Society defines it as 25-hydroxyvitamin D [25(OH) D] level below 20 ng/ml (50 nmol/L) and vitamin D "insufficiency" as a 25(OH) D of 21–29 ng/ml (52.5–72.5 nmol/L) [14]. On the other hand, the Institute of Medicine (IOM) considers a 25(OH) D level below 12 ng/ml (30 nmol/L) to be "at risk of deficiency", and a 25(OH)D level of at least 20 ng/ml (50 nmol/L) as "sufficient", while levels between 12 and 20 ng/ml (30 and 50 nmol/L) is considered to be "at risk for inadequacy" for some people [15].

Some groups are at higher risk of vitamin D deficiency or insufficiency; including elderly, due to the decline in skin production of vitamin D with age [16], dark skinned people, as melanin decrease the synthesis of vitamin D [17], wearing concealing clothing for cultural or religious reasons [18-20], obesity [2, 21] and housebound status [22]. Shortage in the food variety containing vitamin D, such as oily fish, egg yolk and fortified dairy products [15]. Therefore, the main source of vitamin D is the sunlight exposure, more specifically ultraviolet-B (UVB) [11]. The UVB radiation penetrates into the skin and converts 7-dehydrocholesterol to pre-vitamin D_3, which converts to vitamin D_3 [23].

On the other hand, UVB is associated with several types of skin cancer [24]; hence sun exposure should be balance between its benefits and harms. However, there is an ongoing debate about the recommended amount of sun exposure and vitamin D supplementation. The Institute of Medicine, assuming minimal sun exposure, recommended a dietary allowance of 400 International Units (IU) for infants, 600 IU for those aged 1-70 years and 800 IU for those above 70 [20]. While the US Endocrine Society recommended 400-1,000 IU for infants, 600-1,000 IU for children aged 1-18 years and 1,500-2,000 IU for those above 19 years [14].

Several measures should be undertaken to prevent vitamin D deficiency in the general population. These measures included intake of food fortified with vitamin D, currently bread and milk are fortified in Saudi Arabia [25]. Sunlight exposure is another important measure. However, since not much food is fortified in Saudi Arabia and due to lack of sun exposure [11, 26]; vitamin D supplement might be necessary to prevent vitamin D deficiency. Other studies found a relation between vitamin D deficiency and physical inactivity, thereby encouraging physical activity could be able to counter vitamin D deficiency [27].

Studies revealed that there are many gaps in the knowledge about vitamin D among population [5, 9]. One study among female students in Riyadh, showed that participants had limited knowledge about vitamin D and had a great trust in health care professionals in this regard [9]. Thus, clear messages are needed to be delivered to the population by health care personnel. In order to guarantee delivery of the correct messages, health professionals' knowledge about vitamin D should be evaluated.

Knowledge, Attitude and Practice (KAP) surveys were meant to assess respondents' Knowledge, Attitude and Practice; where knowledge is defined as "the capacity to acquire, retain and use information", attitude "the inclinations to react in a certain way to certain situations" and practice is "the application of rules and knowledge that leads to action". In a nutshell, KAP surveys are conducted to identify what people know (Knowledge), how they feel (Attitude) and what they do about the topic (Practice) [28].

In this context, a recent study in the UK was carried out to assess the health professionals' knowledge about vitamin D and found that 86% of respondents had correctly identified the main source of vitamin D, while only 78% identified vitamin D as being necessary for bone health and/or calcium absorption [29]. Another study in Australia, which assessed general practitioners' knowledge, attitude and practice about vitamin D, indicated confusing and insufficient knowledge in this respect despite their active practice [30]. Furthermore, a literature review showed that primary care professionals' knowledge, skills and attitude affect the delivery of primary prevention and health promotion among patients [31].

In summary, vitamin D deficiency has reached an epidemic in both developed and developing countries. If this issue is not well addressed, it could result in serious consequences. Literature review showed that population knowledge, attitude and practice concerning vitamin D was poor [5, 9]. Primary health care (PHC) physicians are an important source of health information [30, 32]. So, their knowledge and practices about vitamin D is essential for their roles. Awareness and practices of PHC physicians regarding vitamin D needs to be highlighted, as improving their knowledge will improve the knowledge of the public as a whole, in addition to the PHC physicians' role in treating vitamin D deficient patients through supplementation and advices. However, the literature review showed that there was lack of information in this regard. The current study aimed to address this gap by assessing the knowledge, attitude and practice of primary health care physicians regarding vitamin D. The current work aimed to assess the

KAP regarding vitamin D among PHC physicians in Riyadh city and compare the scores between King Khalid University Hospital (KKUH) and Ministry of Health (MOH) PHC physicians.

2. Materials and Methods

2.1. Study Design and Study Population

A cross sectional study was carried out in selected PHC centers of MOH representing the seven health administrative sectors of Riyadh city in addition to the PHC clinics in KKUH in Riyadh in the period from April to June 2014

2.2. Sampling

The sample size was estimated using the formula ($n = [Z_\alpha^2 P (1-p)] / d^2$), assuming that the prevalence was 61% [30] with a 95% confidence interval ($1- \alpha = 95\%$, $Z_\alpha = 1.96$) and a precision of 5%. Given that the total number of MoH and KKUH PHC physicians was 280, the sample size was estimated to be 158 participants. It has been anticipated none or incomplete response of 10%, to compensate for that; 186 respondents were recruited. As there were 240 and 40 eligible physicians in MoH PHCC and KKUH PHC clinics respectively; participants were selected based on proportional allocation of the physicians; 23 from KKUH PHC clinics and 135 from MoH PHCC. Furthermore; MoH PHCC were proportionally allocated among all the seven sectors of Riyadh city.

2.3. Participants/Study Population

Eligible participants included family medicine (FM) physicians and general practitioners (GP) who were practicing in MOH and KKUH during the study period. Specialists working in the PHCC were excluded from the study.

2.4. Data Collection Tool

A self-administered structured questionnaire was adapted from a previous Australian study [30]. Face and content validity was tested by experts. The questionnaire was composed of four sections;

2.4.1. Socio-demographic and Work Data

Age, gender, nationality, job title, place of work, years of experience and work load

2.4.2. Participant's Knowledge

Composed of twelve questions; the first question had four correct answers where each was scored as 0.25 point; the second had three correct answers each scored as 0.3 point. The other 10 questions had one correct answer scored as one point. All wrong answers were scored as 0 point. The total score ranged from 0 to 12 points (e.g. what are the natural sources of vitamin D in food?). The knowledge score median was used as the cutoff point for defining good and poor knowledge; a score equal to the median or more was considered as "good knowledge", while "poor knowledge" was defined as a score below the median.

2.4.3. Participant's Attitude

Composed of six items and scored using 5-Likert scale. For two questions (Information about vitamin D is not readily available for physicians) and (Clinical guidelines regarding vitamin D deficiency would be useful); the scale was reversely coded. Like the knowledge score a "positive attitude" was defined as scores equal to or more than the median attitude score, and a score below that was defined as "negative attitude".

2.4.4. The last Section Addressed

The topic of physician's practice with both open-ended and closed questions (e.g. in which ways do you manage vitamin D deficiency?).

2.5. Pilot Study

A pilot study of 20 PHC physicians currently working in Riyadh, was conducted to test the logistics of data collection, clarity of data collection tools and to estimate the timing for data collection.

2.6. Data Analysis Plan

Data was reviewed for accuracy and completeness; duplicated questionnaires were removed and incomplete questionnaires were completed by respondents whenever possible. Data was coded then SPSS software version 21 (SPSS Inc., Chicago, IL, USA) was used for data processing. Descriptive statistics (frequencies) were used to describe the physicians' demographic and work characteristics, knowledge, attitude and practices. The relationship between demographic and work characteristics with the knowledge, attitude and practice were tested using chi-square analysis ($\chi 2$). A p-value of ≤ 0.05 was considered statistically significant.

2.7. Ethical Considerations

Approval for this study was obtained from Institutional review board (IRB) of King Saud University (KSU) prior to study execution (IRB no. 14/4180). In addition, all participants received a written consent form. The informed consent was clear and indicated the purpose of the study, and their freedom to participate or withdraw at any time without any obligation. Furthermore, participants' confidentiality and anonymity were assured by assigning each participant with a code number for the purpose of analysis only. The study was not based on any incentives or rewards for the participants.

3. Results

3.1. Respondents' Characteristics

Of the 186 who responded to the questionnaire; 12 were excluded due to ineligibility (dentists and obstetricians), six due to inaccurate and/or minimal response and 10 due to

copied answers from other questionnaires. Out of the remaining 158 eligible participants; 44% were males. The mean participants' age was 41 ± 9.6 years. The majority were non-Saudis (80%) and general practitioners (48%). About 85% of the PHC physicians worked in MOH while 15% worked in KKUH. The mean years of practicing in PHC was 9.7 ± 7.7 years, and the majority worked 5 to 7 sessions per week (58%) (Table 1)

Table 1. *Socio-demographic and Work Characteristics of the studied sample.*

Variable	Category	n (%)
Sex (n = 158)	Male	69 (43.7%)
	Female	89 (56.3%)
Age (n = 152) Mean = 40.7±9.6	< 31 years	19 (12.5%)
	31-40 years	72 (47.4%)
	41-50 years	34 (22.4%)
	51-60 years	27 (17.7%)
Nationality (n = 155)	Saudi	28 (18.1%)
	Non-Saudi	127 (81.9%)
Job Title (n = 158)	Family Medicine Resident	46 (29.1%)
	Family Medicine Senior Officer	36 (22.8%)
	General Practitioner	76 (48.1%)
Work Place (n = 158)	MOH	135 (85.4%)
	KKUH	23 (14.6%)
Practicing years (n = 147) mean = 9.7±7.7	< 5 years	39 (26.5%)
	5-10 years	62 (42.2%)
	11-20 years	28 (19.1%)
	> 20 years	18 (12.2%)
Working session/week (n = 142)	1 – 4	22 (15.5%)
	5 – 7	91 (64.1%)
	8 – 10	29 (20.4%)

3.2. Knowledge Score of the Study Cohort

Of all the participants; 51% showed good knowledge (Figure 1), the median cutoff point of knowledge score was 3.2 out of 12. Male PHC physicians participants showed a slightly higher percentage of good knowledge than female participants (53% vs. 49%, p = 0.602). There was no significant difference regarding knowledge score among the different age groups (p = 0.900). A higher non-significant knowledge scores were observed among Saudi participants compared to non-Saudi participants (61% vs. 50%, p = 0.322). Family medicine senior officers (specialists or consultants) showed better knowledge scores compared with family medicine residents and GPs (67% vs. 46% and 47%, p = 0.108). PHC physicians working in KKUH PHC clinics showed a higher percentage of good knowledge than those working in MOH PHC centers (70% vs. 48%, p = 0.058). Highest knowledge scores were observed in participants practicing in PHC for 11-20 years (61%, p = 0.796), and those working 5-7 sessions per week (55%, p = 0.387). However, none of these observations were significant (Table 2).

Table 2. *Relationship between Participants' Knowledge scores and their demographic and work characteristics.*

	Knowledge Score n (%)		P-value*
	Poor	Good	
Sex			
Male	32 (46.4%)	37 (53.6%)	= 0.602
Female	45 (50.6%)	44 (49.4%)	
Age Group			
< 31 years	9 (47.4%)	10 (52.6%)	
31-40 years	33 (45.8%)	39 (54.2%)	= 0.900
41-50 years	18 (52.9%)	16 (47.1%)	
51-60 years	12 (44.4%)	15 (55.6%)	
Nationality			
Saudi	11 (39.3%)	17 (60.7%)	= 0.322
Non-Saudi	63 (49.6%)	64 (50.4%)	
Job Title			
Family Medicine Resident	25 (54.3%)	21 (45.7%)	
Family Medicine Senior Officer	12 (33.3%)	24 (66.7%)	= 0.108
General Practitioner	40 (52.6%)	36 (47.4%)	
Work Place			
MOH	70 (51.9%)	65 (48.1%)	= 0.058
KKUH	7 (30.4%)	16 (69.6%)	
Practicing years			
< 5 years	20 (51.3%)	19 (48.7%)	
5-10 years	29 (46.8%)	33 (53.2%)	= 0.796
11-20 years	11 (39.3%)	17 (60.7%)	
> 20 years	9 (50.0%)	9 (50.0%)	
Working session/week (n = 142)			
1 – 4	13 (59.1%)	9 (40.9%)	= 0.387
5 – 7	41 (45.1%)	50 (54.9%)	
8 – 10	16 (55.2%)	13 (44.8%)	

*Chi-square test was used to compare the percentages between the two groups

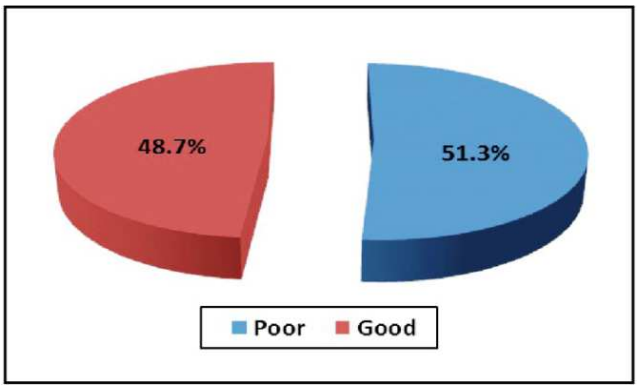

Figure 1. *Level of Knowledge of PHC Physicians Cohort.*

3.3. Confidence in Knowledge

Participants were asked about their confidence regarding their knowledge about vitamin D; the majority were very confident or confident (78%). A higher percentage was observed among those who had good knowledge compared to those with poor knowledge (88% vs. 69%, p = 0.005).

3.4. Source of Information

Participants were asked about their sources of information about vitamin D; the three most common sources were continuous medical education (59%), online/internet (51%) and medical journals (42%) (Figure 2).

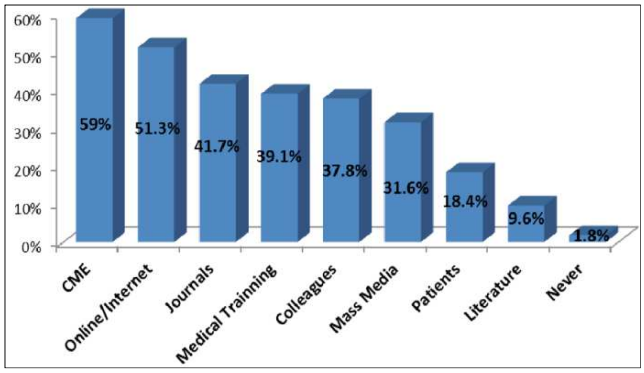

Figure 2. *Source of Information about Vitamin D Deficiency among Participants.*

3.5. Attitude Score of PHC Physician's Participants in the Study

Among the PHC physicians who participated in the study; 55% had positive attitude scores, the median cutoff point of attitude score was 21 out of 30. A significant difference was found between male and female participants, as male had a more positive attitude (67% vs. 46%, p = 0.010). Age groups less than 31 years and 51-60 years had more positive attitude than the other groups (68% and 70% respectively, p = 0.207). Saudi participants had higher attitude scores compared with non-Saudi (64% vs. 54%, p = 0.301). Positive attitude was observed more among family medicine residents and senior officers than GPs (61% and 58% vs. 50%, p = 0.456). Participants working in KKUH showed a more positive attitude compared to those working in MOH (70% vs. 53%, p = 0.130). A better attitude was observed in those practicing in PHC for more than 20 years (67%, p = 0.638), and those working 5-7 sessions per week (63%, p = 0.147). Those with good knowledge scores showed more positive attitude (63% vs. 47%, p = 0.041) (Table 3).

Table 3. *Relationship between Participants' Attitude scores and their demographic, work characteristics and Knowledge Level.*

	Attitude Score n (%)		P-value*
	Negative	Positive	
Sex			
Male	23 (33.3%)	46 (66.7%)	= 0.010
Female	48 (53.9%)	41 (46.1%)	
Age Group			
< 31 years	6 (31.6%)	13 (68.4%)	
31-40 years	35 (48.6%)	37 (51.4%)	= 0.207
41-50 years	17 (50.0%)	17 (50.0%)	
51-60 years	8 (29.6%)	19 (70.4%)	
Nationality			
Saudi	10 (35.7%)	18 (64.3%)	= 0.301
Non-Saudi	59 (46.5%)	68 (53.5%)	
Job Title			
Family Medicine Resident	18 (39.1%)	28 (60.9%)	
Family Medicine Senior Officer	15 (41.7%)	21 (58.3%)	= 0.456
General Practitioner	38 (50.0%)	38 (50.0%)	
Work Place			
MOH	64 (47.4%)	71 (52.6%)	= 0.130
KKUH	7 (30.4%)	16 (69.6%)	
Practicing years			
< 5 years	19 (48.7%)	20 (51.3%)	
5-10 years	26 (41.9%)	36 (58.1%)	= 0.638
11-20 years	14 (50.0%)	14 (50.0%)	
> 20 years	6 (33.3%)	12 (66.7%)	
Working session/week (n = 142)			
1 – 4	13 (59.1%)	9 (40.9%)	= 0.147
5 – 7	34 (37.4%)	57 (62.6%)	
8 – 10	14 (48.3%)	15 (51.7%)	
Knowledge Level			
Poor	41 (53.2%)	36 (46.8%)	= 0.041
Good	30 (37.0%)	51 (63.0%)	

*Chi-square test was used to compare the percentages between the two groups

3.6. PHC Physicians' Practice

3.6.1. Alerting Patients for Vitamin D Status

Participants were asked about the patient features that would alert them to vitamin D status. Fatigue was shown to alert more male than female PHC physicians participants (75% vs. 58%, p = 0.026). Participants aged 51-60 years were more alerted to people who wear concealing clothing for cultural or religious reasons (78%, p = 0.003) and patients having muscle aches and weakness (93%, p = 0.012) than other age groups. Non-Saudi participants were more alerted than Saudis to patients aged over 65 (84% vs. 54%, p = 0.001), those wearing concealing clothing (53% vs. 21%, p = 0.003), patients having muscles aches and weakness (84% vs. 50%, p < 0.001), women in general (71% vs. 46%, p = 0.013) and those who were pregnant or breast feeding (72% vs. 41%, p = 0.003).

Family medicine senior officers were more alerted to dark-skinned patients (47%, p = 0.023), while GPs were more alerted to those who had poor nutrition (82%, p = 0.013). PHC physicians participants working in MOH were more alert to patients with a past history of bone fractures (p = 0.033), having a poor nutrition (p = 0.002) and pregnant or breast feeding women (p = 0.007). Dark-skinned patients, those with past history of bone fracture or young patients alerted participants who had a better knowledge or attitude score more than others.

3.6.2. Investigating and Prescribing Vitamin D

The total number of patients seen by all respondents in an average week was 19,580 patients. Moreover, the total number of laboratory investigation ordered for serum vitamin D and vitamin D supplements prescribed by all those who responded in an average week were 1,233 tests and 2,005 prescriptions respectively.

3.6.3. Management of Vitamin D Deficiency

Participants were asked about the ways of managing vitamin D deficiency. Nutrition advice was mostly given by older PHC physicians (p = 0.044) and non-Saudis (p = 0.003). Calcium supplements were more approached by family medicine senior officers (p = 0.003) and those practicing for 11-20 years (p = 0.033). Advice to more natural sunlight was

given mostly by non-Saudis (p = 0.024) and participants with good knowledge (p = 0.031) (Table not included). Participants were also asked about the dose of vitamin D supplement. Younger participants, Saudis and family medicine senior officers were more often give correct answers than the other subgroups (p = 0.007, p = 0.021 and p = 0.001 respectively) (Table 4).

Table 4. *Dose of vitamin D supplement prescribed by the PHC physicians participants in the study for vitamin D deficiency adult patients (N = 151).*

	Answer n (%)		P-value*
	Wrong	Correct	
Sex			
Male	30 (44.8%)	37 (55.2%)	= 0.622
Female	41 (48.8%)	43 (51.2%)	
Age Group			
< 31 years	5 (26.3%)	14 (73.7%)	
31-40 years	38 (54.3%)	32 (45.7%)	= 0.167
41-50 years	15 (50.0%)	15 (50.0%)	
51-60 years	11 (42.3%)	15 (57.7%)	
Nationality			
Saudi	7 (25.0%)	21 (75.0%)	= 0.007
Non-Saudi	64 (53.3%)	56 (46.7%)	
Job Title			
Family Medicine Resident	20 (43.5%)	26 (56.5%)	
Family Medicine Senior Officer	10 (29.4%)	24 (70.6%)	= 0.021
General Practitioner	41 (57.7%)	30 (42.3%)	
Work Place			
MOH	68 (53.1%)	60 (46.9%)	= 0.001
KKUH	3 (13.0%)	20 (87.0%)	
Practicing years			
< 5 years	16 (41.0%)	23 (59.0%)	
5-10 years	33 (55.0%)	27 (45.0%)	= 0.318
11-20 years	12 (50.0%)	12 (50.0%)	
> 20 years	6 (33.3%)	12 (66.7%)	
Working session/week (n = 142)			
1 – 4	8 (36.4%)	14 (63.6%)	= 0.122
5 – 7	46 (52.9%)	41 (47.1%)	
8 – 10	9 (33.3%)	18 (66.7%)	
Knowledge Level			
Poor	39 (52.0%)	36 (48.0%)	= 0.223
Good	32 (42.1%)	44 (57.9%)	
Attitude Level			
Negative	33 (49.3%)	34 (50.7%)	= 0.632
Positive	38 (45.2%)	46 (54.8%)	

4. Discussion

4.1. Knowledge

This survey recognized some gaps in the participants' knowledge regarding strategies for preventing and managing vitamin D deficiency, which is somewhat similar to findings in similar surveys carried out on GPs in Australia and New Zealand [30, 32]. Although the current study showed higher knowledge scores among PHC physicians working at KKUH compared to those working in the MOH (70% vs. 48%), this difference was not statistically significant (p = 0.058).

4.2. Preventing Vitamin D Deficiency

The most common approach selected by participants to prevent vitamin D deficiency in the general population was adequate intake of vitamin D fortified foods, although that such food was deficient in Saudi Arabia [25]. A recent study among Saudi children and adolescents in Riyadh suggested that vitamin D level was influenced by physical activity [27]; a strategy that have been selected by about half the participants.

4.3. Sun Exposure and Vitamin D

Exposure to outdoor sunlight is the main source of vitamin D in both summer and winter time. However, due to restricted outdoor activities during summer season -very high temperature-, reliant was on the intake of vitamin D fortified food and supplements [34]. Most of the confusion among the PHC physicians was in time required and optimal time of the day for sun exposure and percentage of body exposed. A recent study conducted in Riyadh showed that the optimal time for sun exposure for vitamin D production was between 10 AM and 2 PM during winter season, while during summer season it's from 9 AM to 10:30 AM and from 2 PM to 3 PM [35]. However, in the current study about two thirds correctly identified the optimal sun exposure time during winter season, while only about one third correctly identified the optimal summer sun exposure time. It is well-known that melanin decreases the absorption of UV light and hence decreasing the production of vitamin D in dark-skinned people [11]. Hence more sun exposure time is required for people with dark skin compared to those with fair skin [36]. Though, a very small percentage of participants recognized that more time is required for people with dark skin. Confusion in sun exposure time among the survey participants was similar to the Australian findings [30].

4.4. Daily Recommended Dose & Tolerable Upper Intake Level

Different guidelines might have played a role in different responses regarding the daily recommended dietary allowance (RDA) of vitamin D; IOM recommends 600 IU for adults 70 or younger and 800 IU for above 70 years old [15]. On the other hand, Endocrine Society recommends 1500-2000 IU for all those aged 19 and older [14]. According to the IOM; the daily tolerable upper intake level for vitamin D is 4000 IU [15], however most participants selected 1000 IU.

4.5. Confident in Knowledge

The majority of participants were confident about their knowledge (73%), which was similar to the findings of the Australian survey (77%) [30]. However, both were much higher than those who reported being confident in the New Zealand (NZ) survey (54%) [32]. Confidence was partly influenced by their knowledge; hence the survey showed

higher confidence among those who had good knowledge compared to those who had poor knowledge (88% vs. 69%, p = 0.005).

4.6. Source of Information

This survey identified continuous medical education (58%) and online/internet (51%) as the most common sources of information about vitamin D among participants. Therefore, emphasizing the need of clear guidelines regarding vitamin D deficiency risk factors, prevention and management, and its availability online and during training in order to improve PHC physicians' knowledge.

4.7. Attitude

Statistically significant difference regarding the attitude score (positive vs. negative) was only shown in gender and the knowledge score; male participants and those having good knowledge were more likely to have positive attitudes. This put emphasis on improving knowledge as it goes along with a positive attitude. Lower rates of skin cancer have been reported in Saudi Arabia than Australia and NZ [37-39], hence less concern is given to skin cancer in Saudi Arabia than the latter two. That could be an explanation to the higher agreement to the statement "My patients needed to spend more time in the sun to get enough vitamin D to be healthy" in this survey compared to what was reported in the Australian and NZ surveys (80% in this survey vs. 60% and 58% in Australia and NZ, respectively). It could be also explained by the higher rates of vitamin D deficiency in Saudi Arabia (5-10), or due to the limited outdoor activities during day time in Saudi Arabia [27]. A slightly higher percentage of participants agreed that "Information about vitamin D is not readily available for physicians" (60% vs. 53% and 50% in Australia and NZ, respectively). Additionally, most participants agreed to the statement "Clinical guidelines regarding vitamin D deficiency would be useful" (94%). This once again highlights the importance of the existence and availability of clear guidelines regarding vitamin D. The higher percentage of positive attitude in those who had good knowledge reinforces that.

4.8. Practice

4.8.1. Alerting Patients for Vitamin D Status

Several factors were identified to influence the production of vitamin D which should alert PHC physicians to vitamin D status in patients presenting with specific features. These included physiological factors as dark-skinned and aged patients as there is reduced skin synthesis of vitamin D, or inadequate sun exposure due to wearing concealing clothing or housebound and institutionalized people, or it could be due to poor intake of vitamin D due to poor nutrition [11, 40]. Most features weren't recognized as alarming by many of the participants. Dark skin alerted family medicine senior officers and those with a better knowledge or attitude were more alert than others, yet it only alerted 29% of the all participants. Furthermore, given the culture of Saudi Arabia, PHC physicians should be aware that most of the population may not be getting enough sun exposure due to the veil and clothing; still only a few recognized it as an alarming feature (47%) compared to what was reported by the Australian physicians (95%) [30]. Increased knowledge and awareness about high risk groups of vitamin D deficiency will improve the practice.

4.8.2. Investigating and Prescribing Vitamin D

The study showed that vitamin D supplements were prescribed (2,005 prescriptions) by PHC physicians more than ordering a laboratory investigation for serum vitamin D (1,233 tests) in an average week. The empirical prescription of vitamin D supplements without ordering a laboratory investigation could be either due to the unavailability of the vitamin D laboratory investigation in some MOH PHC centers as mentioned by participants, or due to the known high prevalence of vitamin D deficiency in Saudi Arabia [5-10]. Despite the latter fact, the numbers of prescriptions and tests made were relatively small compared to the large number of patients seen (19,580 patients), highlighting the need to improve the health services.

4.8.3. Management of Vitamin D Deficiency

Approaches to treat vitamin D deficiency included adequate sun exposure and intake of food containing vitamin D and vitamin D supplements [11]. Nearly all participants recognized vitamin D supplements as an approach and most of them recognized sun exposure and nutrition advice. When participants were asked about the dose of vitamin D supplement; family medicine senior officers more often gave a correct answer than the other groups, which reflect the influence of experience in a better practice.

5. Study Limitations

The small sample size could be an explanation for failing to detect any statistically significant difference between many variables, and this limitation could be due to the small number of PHC physicians in Riyadh. This could be overcome in the future studies by increasing the sample size through including PHC physicians from PHC centers and clinics other than MOH and KKUH. In addition, the results of this survey could not be generalized to all PHC physicians in Riyadh, a limitation that could also be overcome by including participants from other governmental PHC centers. The long questionnaire is another limitation that may be a cause of missing data and non-response.

6. Conclusion and Recommendations

In conclusion, this survey identified a gap in the knowledge and practice among PHC physicians in both MOH and KKUH. The confusion could be partly attributed to different guidelines and sources of information. This study showed that continuous medical education and online sources were the most common source of information for vitamin D among PHC physicians. Hence, further development of

MOH website, improve training and CME, and clear guidelines should be available to enhance a better knowledge and improve their practice, thus aid in controlling the "vitamin D deficiency epidemic". A clear confusion was observed in sun exposure optimal time and the amount required for sufficient vitamin D production. An approach suggested by Bonevski et al., [30] who called for the need for "computerized desktop decision aids, with algorithms that take into account the complexities of skin type, weather and location" will provide an easy method in giving advices regarding sun exposure. Another issue was the relative low numbers of vitamin D prescriptions and tests made, highlighting the need of certain processes to monitor the PHC physicians' practices and indicators to know if they are following the guidelines in order to improve health services. Further studies with larger sample size and inclusion of other governmental PHC centers are recommended in able to increase the power and generalize findings.

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