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Knowledge, Attitude and Practice (KAP) Towards Vitamin D Deficiency in the Jordanian Adult Population: A Cross-Sectional Study

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Abstract: Vitamin D deficiency is highly prevalent among the Jordanian population which is a public concern. Therefore, our study aimed to identify the population's Knowledge, Attitudes and Practices (KAP) towards vitamin D deficiency. A cross-sectional study was conducted among Jordanian adults≥18 years old between October 2018 and January 2019 using a structured questionnaire. Our present study observed that 99.7% of participants were aware of Vitamin D. Media and educational institutions (53.6 and 45.9%, respectively) were among the most important sources of information about vitamin D. The majority (82.6%) indicated sunlight as the most important source of vitamin D, 81.6% of them were aware that vitamin D prevents osteoporosis and 78% believed that its deficiency causes pain in bones and joints. However, their awareness of the current recommended daily dose was low (13.9%). Although, 60.4% of the population study were not concerned about their vitamin D levels, they showed a positive attitude towards sun exposure as two-thirds (72.3%) of them liked to be exposed to sun with a frequency of ≥2 times/week, for ≤29 min, preferring the early morning, irrespective of sunscreen products and ointments use (42.8%). Participants believed in taking vitamin D supplements (46.4%) and exposing themselves to sunlight (72.7%) among the positive practices towards improving their vitamin status. Based on our findings, we suggest that along with education and research strategies, vitamin D supplementation and fortification may be effective in improving vitamin D health in Jordan.

INTRODUCTION

Vitamin D (or cholecalciferol) is a fat-soluble vitamin that is synthesised primarily in the skin through activating 7-dehydrocholesterol by ultraviolet (UVB type) sunlight. The rest is acquired from nutritional sources, such as codfish, mushrooms, milk, eggs and fortified food[1]. It is metabolised rapidly to form 25-hydroxy vitamin D

25(OH)D in the liver. Another hydroxylation of 25(OH) D by 1-alpha hydroxylase occurs in the kidney, giving 1,25-dihydroxy vitamin D 1,25 D(OH)D which is considered the most active metabolite of vitamin D[2]. However, the levels of 25(OH)D more accurately reflect the body's vitamin D stores[3]. It is agreed that 25(OH)D levels>30 ng mL^{-1} are sufficient and levels of 21-29 ng mL^{-1} are considered insufficient whereas levels<20 ng mL^{-1} are considered deficient[4]. There is a high prevalence of vitamin D deficiency in pregnant, breastfeeding and postmenopausal women, infants, children and adolescents worldwide[5].

Vitamin D plays an important role in the homeostasis of calcium and phosphorous in blood[6]. Thus, it is necessary for bone health, where vitamin D deficiency, among other factors, participates in metabolic bone disorders that lead to osteomalacia in adults and rickets in children[7]. Vitamin D is also important for the prevention of many chronic diseases including cardiovascular diseases, hypertension, diabetes, metabolic syndrome, autoimmune diseases, cancer and depression and its deficiency is associated with an increased occurrence of infection[1].

Vitamin D deficiency is a global health problem[5]. Several studies have reported that women are commonly vitamin D-deficient in many Arab countries including Jordan[8-14]. This can be explained by limited sun exposure, lifestyle, dark skin color, hot climate and prolonged breastfeeding without calcium and vitamin D supplementation[1, 10, 11, 15].

In Jordan, many studies have examined vitamin D status in the population and these studies reported a high prevalence of vitamin D deficiency among different age groups and females, irrespective of various rates of vitamin D deficiency[16-23]. However, till date, no study has quantitatively investigated the basic knowledge of the population regarding vitamin D and its potential implications for public health, attitude and behaviour towards improving the level of vitamin D among Jordanian. Therefore, an understanding of the Jordanian people's awareness, knowledge and attitudes towards vitamin D could help guide interventions aimed at achieving adequate vitamin D status among them. To achieve this understanding, a random sample representative of the Jordanian population was questioned. The findings of this study will help to develop effective clinical and public health strategies to improve vitamin D status. This might be adopted by developing targeted health promotion and educational interventions concerning vitamin D deficiency in Jordan.

MATERIALS AND METHODS

Across-sectional study was carried out from October 2018 to January 2019. Both male and female adults (≥18 years) were included in the study. A structured questionnaire was self-administered to people attending pharmacies distributed in different districts in Jordan and to undergraduate students at Zarqa University. As students came from different districts, it was also assumed that they corresponded to a representative sample over the country. The questionnaire was also implemented online to reach a larger number of Jordanian people to assess their basic knowledge, awareness, attitudes and behaviour towards vitamin D and sunlight exposure. The questionnaire was adopted from similar studies conducted previously[24-28] and through consultation with academic dietitians and nutritionists. The questionnaires consisted of three sections including close-ended multiple choice questions. Section A was about the socio-demographic characteristics of the participants such as age, gender, social status, educational level and family monthly income. Section B consisted of questions assessing sources of primary information about vitamin D, knowledge regarding major sources of vitamin D, function and benefits of vitamin D, daily recommended dosage of vitamin D and the average time of sun exposure required to get enough of vitamin D. Part C was designed to evaluate attitude and behaviour towards sunlight such as time spent outdoors in the sun, frequency of sunlight exposure, preference for any specific season for sunlight exposure, pattern of protection and use of sunscreen, lifestyle practices such as smoking status and different practices to improve vitamin D level. All participants gave their written informed consent before participating in the study.

Statistical analysis: The collected data were analysed using the Statistical Package of Social Science Version 23 (SPSS Version 23). Descriptive statistics were used to characterise the study population. Frequency tables were constructed and presented as percentages.

RESULTS

The sociodemographic characteristics of the study population are presented in Table 1. A total of 642 people aged ≥18 years participated in the present study. The majority (90.3%) of the population study were 18-39 years and 8.6% were 40-59 years with only 1.1% representing ≥60 years of age. Females were 69.2% while males were 30.8% and most of the sample population were single (72.1%). Almost all the participants were highly educated (94.9%). The average monthly income for the family was <500 JOD (58.9%), followed by 500-999 JOD (29.3%). Most of the participants were residents of the middle of Jordan (86.4%), followed by those of the North (10.9%).

Knowledge and awareness of vitamin D: Table 2 presents the participant's knowledge and awareness about vitamin D. Almost all participants reported that they had heard about vitamin D. About half of them (53.6%) heard about vitamin D through media. Other options included

Table 1: The socio-demographic characteristics of participants (n = 642)

Characteristics	No. (%)
Total	642
Age (years)	
18-39	580 (90.3)
40-59	55 (8.6)
≥60	7 (1.1)
Gender	
Male	198 (30.8)
Female	444 (69.2)
Education (years of completed formal schooling)	
Illiterate	0
1-11	0
12	33 (5.1)
>12	609 (94.9)
Marital status	
Single	463 (72.1)
Married	164 (25.5)
Divorced	12 (1.9)
Widowed	3 (0.5)
Employment	
Unemployed	51 (79.6)
Pharmacist/Health sector	84 (13.1)
Governmental sector	31 (4.8)
Private sector	83 (12.9)
Family income/month (JOD)	
<500	378 (58.9)
500-999	188 (29.3)
1000-1499	37 (5.8)
>1500	39 (6.0)
Region	
North	70 (10.9)
Middle	555 (86.5)
South	17 (2.6)

educational institutions (45.9%), primary health care centres, physicians and medical professionals (36%) and relatives or friends (24.8%). When participants were asked about the normal range of vitamin D, approximately one-half of them (52.6%) answered they do not know, 38.3% were aware of the correct answer (20-50 ng L^{-1}) and the rest (9.0%) answered incorrectly.

The majority of participants (82.6%) agreed that sunlight is the most important source of vitamin D. As they were allowed to choose multiple options, fatty fish (36.8%), milk (43.5%), cheeses (20.6%), cod liver oil (16.8%), mushrooms (5.6%) and whole wheat cereals (10.4%) were also among the correct responses regarding the sources of vitamin D[28]. Among all participants, 20.9 and 16.8% incorrectly chose fruits and vegetables, respectively, assources of vitamin D.

Regarding the time needed to be spent outdoors in the sun to get enough vitamin D, 46.5% of participants answered incorrectly (<10 min/day), followed by 30% who reported the correct answer (10-20 min/day)[27, 28] while 23.2% of them thought that at least 30 min per day is needed to be spent under the sun to get enough vitamin D. The question about the daily recommended dose showed that only 13.9% of the participants knew the correct answer (600 IU)[29], 21.3% answered incorrectly and a large portion of respondents (64.8%) were unaware. Further, 50.3% of participants believed that taking calcium supplements helps maintain vitamin D levels, 23.4% answered negatively and 26.3% reported they do not know.

Table 2: Awareness and knowledge of the respondents about vitamin D

Variables	n (%)
Have you heard about vitamin D?	
Yes	640 (99.7)
No	2 (0.3)
From where you heard /learned about vitamin D? multiple answer selection possible)	
Media (Newspaper, magazines, T.V., Internet websites)	344 (53.6)
Educational institutions (school, college, university)	295 (45.9)
Primary health care centres, physician, medical professionals	231 (36)
Relatives, friends	170 (24.8)
What is the normal level of vitamin D? (ng L^{-1})	
<12	24 (3.7)
<20	34 (5.3)
*20-50	246 (38.3)
Do not know	336 (52.6)
What are the important sources of vitamin D? (multiple answer selection possible)	
*Sun	530 (82.6)
*Milk	279 (43.5)
*Fatty fish (e.g., tuna, salmon, mackerel)	236 (36.8)
*Egg yolk	197 (30.7)
*Cod liver oil	108 (16.8)
*Whole wheat cereals	67 (10.4)
Fruits	134 (20.9)
Vegetables	108 (16.8)
*Mushroom	36 (5.6)
*Cheese	132 (20.6)
Do not know	50 (7.8)

Table 2: Continue

Variables	n (%)
How much time do you need to spend in the sun to get enough Vitamin D?	
<10 min	293 (46.5)
*10-20 min	189 (30)
30-60 min	95 (15.1)
>1 h	51 (8.1)
Don't know	14 (2.1)
What is daily needs for vitamin D? (IU)	
200	113 (17.6)
*600	89 (13.9)
800	24 (3.7)
Do not know	416 (64.8)
Do you think taking calcium supplements helps in maintaining vitamin D levels in the body?	
Yes	323 (50.3)
No	150 (23.4)
I do not know	169 (26.3)
What are the causes of vitamin D deficiency? (multiple answer selection possible)	
Hereditary	78 (12.1)
Less exposure to sun	548 (85.4)
Lack of eating rich food with vitamin D	390 (60.7)
Kidney disease	40 (6.2)
Respiratory infection	12 (1.9)
Do not know	47 (7.3)
Do you know the function and benefits of vitamin D? (multiple answer selection possible)	
Prevents osteoporosis	524 (81.6)
Prevents general weakness	310 (48.3)
Prevents chronic diseases	120 (18.7)
Prevents cancer	118 (18.4)
Aids in calcium absorption	329 (51.2)
Good for vision	50 (7.8)
Do not know	15 (2.3)
What is/are the symptom/s of vitamin D deficiency? (multiple answer selection possible)	
Pain in joints and bones	501 (78)
Delayed growth of teeth	226 (35.2)
Delayed walking in children	279 (43.5)
Deformed knee joint among children	134 (20.9)
Muscle pain	200 (31.2)
Depression	208 (32.4)
Alopecia	65 (10.1)
Do not know	59(9.2)
Do you think that vitamin D deficiency is related to other diseases like: cardiovascular, diabetes, depression, hypercholesterolemia, cancer and multiple sclerosis?	
Yes	296 (46.1)
No	142 (22.1)
Do not know	204 (31.8)

Frequency (n); percentage (%), *indicates correct response

The participants showed good knowledge about the causes of vitamin D deficiency as 85.4% indicated thatit is due to insufficient exposure to sun and 60.7% indicated a lack of eating rich food with vitamin D, however, there was poor knowledge regarding other causes such as kidney disease (6.2%). The participants also showed a good awareness about the function and benefits of vitamin D as 81.6% positively indicated that it prevents osteoporosis and 51.2% of them answered that it aids in calcium absorption, followed by 48.3% who answered it prevents general weakness. Responses for other benefits were low with 18.4% indicating that vitamin D prevents cancer, 18.7% acknowledging that it prevents chronic diseases and a minority (7.8%) reporting that it is good for vision. When asked about the symptoms of vitamin D deficiency, 78% indicated pain in joints and bone, 35.2% selected delayed growth of teeth in children, 43.5% indicated delayed walking and 20.9% chose deformed knee joint in children. Approximately one-third (31.2%) of participants related muscle pain to vitamin D deficiency, 32.4% believed it causes depression and 10.1% related this issue to alopecia. A minority (9.2%) of them lacked this knowledge.

Regarding the question of whether there is a relation between vitamin D deficiency and other diseases such as cardiovascular diseases, diabetes mellitus, depression, hypercholesterolemia, cancer and multiple sclerosis, 46.1% answered positively, 22.1% negatively and 31.8% answered they do not know.

Practice and behaviour: Based on the results represented in Table 3, 39.6% of participants examined their vitamin D levels whereas 60.4% they did not. When asked about their feelings towards sun exposure, only 14.2% of

Table 3: Practice and behaviour of participants toward vitamin D deficiency

Variables	n (%)
Have you ever examined your vitamin D level?	
Yes	251 (39.6)
No	388 (60.4)
How do you feel about sun exposure?	
I like to expose to sun all the time	91 (14.2)
I like to expose to sun sometimes	373 (58.1)
I rarely expose to sun	116 (18.1)
I avoid exposure to sun	58 (9.5)
Do not know	4(0.6)
What time do you prefer to be exposed to sun?	
Early morning	518 (80.7)
Noon	22 (3.4)
After noon	42 (6.5)
I avoid sunlight	36 (5.6)
I usually go out at night but not during the day	19 (3.0)
Don't know	5 (0.8)
In which season do you like to be exposed to the sun?	
Summer	55 (8.6)
Autumn	21 (3.3)
Spring	294 (45.8)
Winter	263 (40.9)
All year	9 (1.4)
How frequently you are exposed to sun (times/week)?	
0-1	150 (23.4)
2-3	201 (31.3)
>3	281 (43.8)
Don't know	10 (1.5)
Duration of exposure	
15 min or less	313 (48.8)
15-29 min	168 (26.2)
30-60 min	98 (15.3)
>1 h	58 (9.0)
Don't know	5 (0.8)
What do you use most often as protection from sun? (multiple answer selection possible)	
Scarf	264 (41.8)
Neqab	25 (3.9)
Gloves	20 (3.1)
Umbrella	6 (0.9)
Sunscreens	275 (42.8)
Do not use any protection	259 (40.3)
Do you use sunscreen products containing SPF>15?	
Yes	192 (29.9)
No	312 (48.6)
Do not know	138 (21.5)
At what season you prefer to use the sunscreen?	
Summer	168 (26.2)
Winter	7 (1.0)
Both	195 (30.4)
Don't use	272 (42.4)
How often do you use sunscreen?	
Always	194 (30.2)
Sometimes	125 (19.5)
Rarely	71 (11)
Never used sunscreens	252 (39.3)
Do you exercise?	
Yes	189 (29.4)
Sometimes	287 (44.7)
No	166 (25.9)
Smoking status (cigarette)	
Non smoker	436 (68)
Ex-smoker	61 (9.5)
Current smoker	74 (11.5)
Narghile smoker	106 (16.5)
What practices do you apply to prevent vitamin D deficiency? (multiple answer selection possible)	
Exposure to sun light	467 (72.7)
Take vitamin D supplement	298 (46.4)
Drink 2 cups of milk	123 (19.2)
Not using SPF contain creams	57 (8.9)
Increase seafood in diet	46 (7.2)
None	11 (1.7)

Frequency (n); percentage (%)

respondents liked exposure to sun all the time, 58.1% liked to be exposed to sun sometimes, 18.1% preferred rare exposure to sun and 9.0% avoided exposure to sun. Majority of them (80.7%) liked to be exposed to sun in the early morning, 3.4% at noon, 6.5% afternoon, 5.6% avoid sunlight and 3.0% usually go out at night but not during the day. Participants preferred some specific season for sunlight exposure with 45.8% preferring spring, followed by 40.9% who liked winter and a minority liked the two remaining seasons-summer and autumn (8.6 and 3.3%, respectively).

Regarding the frequency of their direct sun exposure, 43.8% of them spend>3 times/week, 31.3% spend 2-3 times/week and 23.4% spend<2 times/week. They varied in their duration of exposure to the sun: 48.8% of them spent 15 min or less, 26.2% spent between 15 and 29 min per day, 15.3% spent between 30 and 60 min and only 9.0% of participants spent >1 h in the sun.

The participants used different protection methods. A total of 42.8% responded that they used sunscreen, 41.8% used scarf and 40.3% did not use any protection. Further, 29.9% of the participants ensured a sun protection factor level (SPF)>15 when purchasing sunscreen products. It was also observed that 26.2% of respondents applied sunscreen in summer, 30.4% applied sunscreen in both summer and winter seasons and 42.4% did not use sunscreen. About the frequency of applying sunscreen, 30.2% always used it, 19.5% sometimes used sunscreen, 11.0% rarely used it while approximately one-third of them (39.3%) never used sunscreen.

Regarding involvement in any exercise, 68.3% of participants responded that they did not participate in any activity. Regarding involvement in any exercise, 25.9% of participants responded that they do not participate in any exercise, 29.4% do exercise on a regular basis and 44.7% participate in an activity. When asked about smoking, 68% of the participants were not cigarette smokers, 11.5% were current cigarette smokers and 16.5% were narghile smokers.

Lastly, when the participants were asked about what practices they apply to prevent vitamin D deficiency, 72.7% believed that exposing themselves to sunlight is enough, 46.4% thought taking vitamin D supplements, 19.2% believed that drinking two cups of milk daily protects them from vitamin deficiency, 7.2% reported that increasing seafood in diet improves vitamin D level and only 8.9% thought that avoiding the use of sunscreen blockers improves vitamin D level.

DISCUSSION

Vitamin D has received enormous attention recently because its deficiency is a global issue[5]. Vitamin D deficiency is known to cause a variety of health diseases beyond bone health problems as confirmed by various studies[1]. Due to the increased prevalence of vitamin D deficiency in this country[17-23], there is a need to inform the general population about the source, role of vitamin D in daily life and practices to improve the level of vitamin D. This is the first study to highlight a very significant issue of current knowledge, awareness and understanding about vitamin D and behaviour of Jordanian population. This is accomplished by taking a representative sample consisting of general people attending pharmacies distributed in different regions of the country and Jordanian students from a leading private university in the middle of Jordan (Zarqa).

Knowledge and awareness: The results indicate that the Jordanian population sample heard about vitamin D (99.7%) and had good knowledge (38.3%) about the normal range of vitamin D. This is in line with previous studies[26-28, 30]. Media was the main source of information for approximately one-half of the participants in our study which is higher than that of the study performed in the UK (25.3%)[28]. Educational institutions were the second most common source (45.9%) for participants. An important finding of our study is the minimal role played by health care centres, physicians and medical professionals in developing health awareness among the general population in the society. This is in accordance with findings from a study in Kuwait where the role of physicians was poor[25].

About 80-90% of vitamin D is acquired by cutaneous synthesis under the action of sunlight while the rest (10-20%) is acquired through nutritional means[31]. Participants had good knowledge about this fact as 82.6% indicated the sun as a major source of vitamin D, in line with studies performed in the UK and Kuwait[25, 28, 29]. They also had good knowledge about other sources as they correctly chose from multiple options such as milk (43.50%), fish (36.8%), cheeses (20.6%), liver (16.8%) whole wheat cereals (10.4%) and mushrooms (5.6%), among the other important sources of vitamin D.

Despite having good knowledge about the sun as a source of vitamin D, more than two-thirds failed to provide a correct answer regarding the needed time to be spent in the sun to get enough vitamin D (10-20 min)[29]. This is consistent with a study from Oman[27]. A minority (13.9%) of participants were aware of the correct daily recommended dose of vitamin D (600 IU)[29] while the majority were unaware (64.8%). However, approximately half (50.3%) were aware of the role of calcium supplements in maintaining vitamin D levels.

Our study also showed that the participants had good knowledge about the causes of vitamin D deficiency as 85.9% related this to decreased exposure to sunlight, 60.7% indicated alack of eating food rich in vitamin D and a minority chose kidney diseases. In addition,

participants knew that vitamin D benefits bone health by preventing osteoporosis (81.6%) which agrees with the findings from a study from Oman[27]. About 48.3% agreed that vitamin D prevents general weakness, in line with the study from Oman (49.2%). Slightly more than half (51.2%) of the participants were aware of the role of vitamin D in aiding calcium absorption[6]. Responses about other benefits of vitamin D such as prevention of cancer and chronic diseases were low (18.4 and 18.7%, respectively). Awareness of these benefits should be increased by health promotion campaigns as was shown by a study conducted by Brand and colleagues[32] which demonstrated extremely high levels of awareness among their study participants after this type of campaign.

The results of the current study revealed good knowledge among participants about the effects of vitamin D deficiency as 78% believed it causes bone and joint pain which is in agreement with findings from a study from Kuwait (87.0%). Vitamin D affects muscular function by acting on specific receptors in skeletal muscle or through its effects on serum calcium and phosphate[33]. Approximately one-third of the participants (31.2%) related muscle pain to vitamin D deficiency which is higher than that of a study conducted in Kuwait (21%)[25]. The participants showed variation in their responses towards the effects of vitamin D deficiency on children including causing delayed growth of teeth (35.2%), delayed walking (43.5%) and deformed knee joints (20.9%). They also positively acknowledged the relationship between vitamin D deficiency and other diseases such cardiovascular, diabetes, depression, hypercholesterolemia, cancer and multiple sclerosis which is higher than responses gained in a study from Kuwait (29.5%)[25].

Attitude and behaviour: An interesting finding was that 39.6% of our surveyed people performed their laboratory test of vitamin D status without caring to know its level to take any action towards improving it in the case of deficiency. Several factors affect vitamin D levels including sunlight exposure, season and diet[21]. Although, majority of the participants reported good awareness regarding exposure to sunlight as a major source of vitamin D and their high interest in sun exposure (72.3%), resembling the positive attitude towards sun exposure in the UK[25]. Therefore, they exhibited a high sun exposure frequency (75.1%) and a moderate use of sunscreen and ointments (42.8%). Sunscreens can modify the effects of sunlight on cutaneous synthesis of vitamin D[34]. Thus, the use of sunscreen by a good proportion of the population indicates a decreased level of vitamin D in their serum. Our finding regarding sunlight exposure and use of sunscreens contrasts with that of a study performed in Kuwait (males and females) exhibiting a negative approach towards sunlight exposure by regular use of sunscreens and adopting other sun protective measures in their daily life leading towards inadequate amounts of vitamin D level[35]. Avoidance of sunlight exposure and higher use of sunscreen, especially in females have been reported as a major cause of vitamin D deficiency, especially in females in Saudi Arabia[36].

In this study, participants had a positive attitude towards sunlight as the majority of them reported they spent 15 min or less to 29 min daily in the sun, during the early morning which is in contrast to the behaviour of participants in the study from Kuwait[25]. They also preferred exposure during the spring and winter. This means that they receive sufficient vitamin D from sunlight during March and April but sunlight from November to February will not be effective, since, it will not stimulate cutaneous synthesis of vitamin D[37].

Exercise is believed to be a protective factor against developing low levels of vitamin D[38]. In our study, we found that approximately one-third of the participants did not exercise while a majority exercisedeitherregularly or sometimes. In particular, practicing different types of sports to develop healthy lifestyles is spreading among Jordanians.

This study also examined smoking as one of the lifestyle habits that spread in society which may cause vitamin D deficiency, since, smoking is an inducer of an enzyme that increases vitamin D metabolism in the liver, thus, leading to low serum levels of vitamin D[39]. This issue applies to cigarette smoking and water pipe smoking (narghile). Responses were low, probably because females represented the majority of the study population. A new phenomenon currently spreading in the sampled community is the use of electronic cigarettes which requires evaluation regarding their effect on vitamin D status.

To improve the levels of vitamin D, the participants indicated the practice of certain activities. Optimum exposure to sunlight and lifestyle modifications such as physical exercise, may help in preventing the deficiency state. Since, sunscreens may modify the effect of sunlight on cutaneous vitamin D synthesis[34], it is necessary to avoid using it all the time and it is advisable to spend 10-15 min in the sun before applying sunscreen products[24]. It would be desirable to clinically utilise vitamin D supplementation and food fortified with vitamin D to avoid the complications of vitamin D deficiency. In this study, around half of the participants believed in taking vitamin D supplements to improve their vitamin D status as one of positive attitudes. This issue is similar to them perception of a study from the UK (43.5%)[28].

CONCLUSION

The prevalence of vitamin D deficiency is a worldwide epidemic and an alarming issue in the countries of Middle East including Jordan. The threat of vitamin D deficiency to public health and its link to chronic diseases has been highlighted in a vast amount of literature review[5]. The present study quantitatively examined knowledge, attitude and practice towards vitamin D deficiency in a representative sample of the Jordanian population.

The majority of participants possessed good knowledge about vitamin D and they identified sun exposureas the main source of vitamin D. However, there is alack of consistency between knowledge and attitude towards improving vitamin D levels in their sera. This indicates the need to improve awareness among the Jordanian population by providing specific guidelines about the frequency, duration, optimum season and amount of exposure to sunlight required. Thismay be accomplished through organizing health promotion campaigns, workshops, conferences and health awareness programmes that require the participation of media and health care centres, physicians and health care professionals. These activities should emphasise physical exercise, outdoor activities, lifestyle habits such as smoking and the recommended daily dose of vitamin D to improve the status of this vitamin. Although, this study focused on adults >18 years old, it is important to convey this information to other sub-groups such as children, teenagers, pregnant, breastfeeding and menopausal women and elderly people, since, they are considered risk groups for developing vitamin D deficiency. Information should be explained accurately and clearly and transmitted into simple, food-based terms to reach illiterate people. There should also be effective strategies from the government to fortify a range of products with vitamin D to reachall population subgroups as done in many countries[28]. The role of health care professionals, especially physicians should be improved through research about the current Recommended Daily Allowance (RDA) which seems to be low[40]. A suggested reasonable approach is the annual monitoring of 25(OH)D concentration in a healthy population targeting the above-mentioned subgroups.

LIMITATIONS

There are some limitations to be considered in the present study. First, no questions were included about working hours which could be a barrier to sun exposure for a number of participants. Secondly, supplement use and kind of supplement should be investigated in more details. Finally, other sub-groups such as children, young people, elderly people and pregnant, menopausal and breastfeeding women should be targeted in such kind of studies, given that there is an association between maternal vitamin D levels and breastfeeding[31]. Therefore, future nationwide studies should consider assessing the serum 25(OH)D levels of participants.

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