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Abdounasser Albasher Omar
Department of Chemistry, Faculty of Science - Gharyan, University of Gharyan, Libya.

Kawther Adaila
Department of Chemistry, Faculty of Science - Gharyan, University of Gharyan, Libya.

Mofida M. Alfaid
Department of Chemistry, Faculty of Science - Gharyan, University of Gharyan, Libya

Abdurrahman M Sweidan
MENA Research Group, School of Clinical and Applied Sciences, Leeds Beckett University, UK.

Ruqayah Kasheem
Department of Chemistry, Faculty of Education - Azawia, University of Azawia, Libya.

See next page for additional authors

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Abdounasser Albasher Omar, Kawther Adaila, Mofida M. Alfaid, Abdurrahman M Sweidan, Ruqayah Kasheem, Samia Emhemmed Abadi, Abdulnabi Ali Abushita, and Hafsa A. Alemam

ORIGINAL STUDY

Knowledge, Attitude, and Practice Regarding Vitamin D Among Adults in Western Libya: Assessment and Socio-demographic Influences

Abdounasser A. Omar [a,b,*], Kawther Adaila [a], Mofida M. Alfaid [a], Abdurrahman M. Sweidan [c,d], Ruqayah Kasheem [e], Samia E. Abadi [f], Abdulnabi A. Abushita [a], Hafsa A. Alemam [g]

[a] Department of Chemistry, Faculty of Science - Gharyan, University of Gharyan, Libya
[b] Department of Chemistry, Faculty of Science, University of Misurata, Libya
[c] MENA Research Group, School of Clinical and Applied Sciences, Leeds Beckett University, UK
[d] Department of Human Nutrition, Faculty of Health Sciences, University of Gharyan, Libya
[e] Department of Chemistry, Faculty of Education - Azawia, University of Azawia, Libya
[f] Department of Statistics, Faculty of Science - Gharyan, University of Gharyan, Libya
[g] Department of Environment, Food, and Biological Application, Libyan Center for Biotechnology Research, Tripoli, Libya

Abstract

Vitamin D deficiency is a widespread public health concern, necessitating a clear understanding of knowledge, attitudes, and practices (KAP) among populations. Therefore, this study was conducted to assess Libyan citizens' knowledge, attitude, and practice (KAP) regarding vitamin D in the western region of Libya. This study was carried out between June and September of 2021. A questionnaire was distributed across the study area and the complete responses were 314, with 62.7% were females and 37.3% were males. The scores were calculated as percentages and statistically tested. Additionally, the impact of some socio-demographic factors (age, gender, education level, job, and salary) on KAP towards vitamin D was investigated. The results revealed that nutritional knowledge of the participants (46.24%) was much lower than their general knowledge (80.99%), and that the scores of attitude and practice were 74.79% and 60.06%; respectively. Furthermore, socio-demographic factors such as gender, age, education, occupation, and salary were found to significantly influence practice scores. In conclusion, there's need for targeted public health interventions and educational campaigns to promote accurate understanding and healthier practices related to vitamin D among adults in Western Libya.

Keywords: Vitamin D, Knowledge, Attitude, Practice, KAP, Socio-demographic influences, Questionnaire

1. Introduction

Vitamin D is a steroid produced in the skin and regulates the expression of several genes in the human body [1]. It is a fat-soluble vitamin [2] that is essential for bone metabolism and bone health [3,4], and muscle functioning [3].

Vitamin D is transported through the bloodstream to the liver, where it is converted to its inactive form, 25-hydroxyvitamin D, before being converted to its active form, 1,25-dihydroxyvitamin D, in the kidneys. Other tissues in the body, including macrophages, the colon, and the prostate, have the required enzymatic machinery (25-hydroxyvitamin D-1-hydroxylase (CYP27B1) to synthesize 1,25-dihydroxyvitamin D locally [5–7].

The main source of Vitamin D is the exposure of human skin to solar ultra-violet B (UVB) radiation (290–315 nm) [5,8,9], and other sources are: diet and supplements [1]. The best dietary vitamin D source is fish (naturally high in vitamin D), with vitamin D content varying significantly depending on the

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* Corresponding author.
E-mail addresses: abdounasseomar@yahoo.com, abdounasser.omar@gu.edu.ly (A.A. Omar).

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species. Other dietary sources, such as eggs, meat, milk, and milk products, generally have a lower vitamin D content compared to fish [10]. Vitamin D is also present in fortified foods such as milk, orange juice, breakfast cereals, and yogurt [11]. Moreover, multivitamins with 400 international units (IU) of vitamin D are available, as well as supplements containing only vitamin D, in a variety of doses ranging from 400 to 50,000 IU [5]. These supplements are used to treat vitamin D–deficient individuals [5,12].

The quantity of vitamin D generated in the skin by sunlight is influenced by the incident angle of the sun, which is determined by latitude, season of the year (vitamin D production may be reduced or absent during the winter months), and time of day [8,9,13]. It is at its highest when the sun is at its zenith [9], meaning it reaches its peak when the sun is at its highest point. Factors known to have a negative impact on vitamin D production by sunlight include: skin pigmentation, as darker skin requires more sunlight exposure than fairer skin; ageing; sun protection behaviours such as sunscreen application [8,9,13] religion (covering most of the body with clothes when outdoors, especially for women); the rarity of outdoor activities; lifestyle; and nutritional differences [13].

Vitamin D deficiency is a global issue that affects developed as well as developing countries, subtropical and temperate regions, and populations of all ages [3,13]. The long-term effects of vitamin D inadequacy on calcium homeostasis have been linked to bone-related disorders, such as osteoporosis in adults, a disease that thins and weakens the bones, leaving them more prone to fracture [14–16]. Prolonged breastfeeding without vitamin D supplementation and low dietary calcium intake are known risk factors for childhood rickets [17]. Also, it has been found that low levels of vitamin D might be associated with a higher risk of diabetes mellitus, chronic kidney disease, cancer, cardiovascular disease, infection, and autoimmune disease [18]. Vitamin D insufficiency has a negative association with survival, as well as an inverse relationship between blood vitamin D levels and the cluster of abdominal obesity, hypertension, dyslipidemia, and hyperglycemia. Furthermore, low blood vitamin levels are also frequent in individuals with congestive heart failure and are associated with deadly stroke [1].

Although opinions differ on vitamin D levels in the body, there is a general agreement that serum levels of vitamin D < 10 ng/ml indicate severe deficiency [19], whereas the Endocrine Society's Clinical Practice Guideline defines serum vitamin D concentrations <20 ng/ml as deficient, 21–29 ng/ml as insufficient, and 30–100 ng/ml as sufficient [20].

Even though daily exposure to sunlight is the main source of vitamin D, high rates of vitamin D deficiency have been observed even in countries with adequate sunshine all year round, including North Africa and the Middle East [17]. This applies to Libya, the location of the current study, which is an Arab country located in North Africa and overlooking the Mediterranean Sea from the north. High rates of vitamin D deficiency have been documented in several major cities in Libya: Tripoli (87.7%) [21], Benghazi (76.1%) [22], and Misurata (80%) [23]. These high rates of vitamin D deficiency may be explained by social habits and behavioral attitudes. People in Libya, particularly women, tend to cover their bodies, which results in little exposure to the sun. This reduces the amount of vitamin D that this source can produce, which in turn contributes to vitamin D deficiency [22].

Knowing the facts about vitamin D sources is important for maintaining its level within the normal limits, but knowledge alone itself will not maintain the level of this vitamin within these normal limits unless accompanied by positive behavior and practice. Knowledge, attitude, and practice (KAP) surveys, which were developed in the 1950s in the fields of family planning and population research are popular in health-related topics, because they are easy to design, perform, analyze, and interpret [24]. By conducting vitamin D KAP surveys and evaluating the obtained data on people's knowledge, attitudes, and behaviors about this vitamin, vital information will be available to responsible medical authorities, allowing them to guide medical professionals to treat vitamin D insufficiency methodically.

A KAP survey of 148 medical students in Sebha, Libya, was designed to assess their vitamin D deficiency knowledge, attitude, and practice. The findings revealed that those students had insufficient practice, knowledge, and awareness of the importance of vitamin D deficiency. It also demonstrated that the majority of those students have a good understanding of the benefits of vitamin D [25].

The current study was conducted in Libya to investigate the general knowledge, nutrition knowledge, attitude, and practice of vitamin D among Libyans living in the western part of the country. Although a previous study in Libya has focused on a specific subgroup, medical students [25], to the best of the authors' knowledge, there is no previous study that has investigated KAP among the Libyan population. Therefore, there is a clear lack of population-based data assessing vitamin D-related KAP among the general adult population,

particularly in Western Libya, which the current study aimed to explore. Additionally, the study statistically investigated the variables, including age, gender, education level, occupation, and salary, which are expected to influence the variations in responses regarding KAP. Addressing this gap is essential for designing targeted public health interventions aimed at improving vitamin D awareness and practices in the Libyan community.

2. Methods

The current study is a cross-sectional study based on adopted questionnaire to assess KAP among adults (males and females) in western Libya.

2.1. Participants and questionnaire

This study, which targeted the western region of Libya, included both male and female adults (≥18 years), and it assessed knowledge, attitude and practice regarding vitamin D by filling out an online electronic questionnaire (google drive). Western Libya was chosen based on accessibility, the feasibility of data collection, existing networks, and higher population density, which made data collection easier within the study time frame. This study was carried in summer season because during this season participant are often more available, making it easier to reach and recruit volunteers of the Libyan population.

Participation in this study was voluntary, and informed consent was obtained from all participants prior they access the questionnaire. No personally identifiable information was collected. Before answering the questionnaire questions, each participant had to read and fill in a consent form, and without filling this form the participant couldn't have access to the questionnaire questions. The form states that participation is entirely voluntary, that each participant has the right to withdraw from the research at any time without any explanation needed, and that all replies and data will be treated strictly confidential. The form further states the identity of participants will not be linked to the research materials or the outcomes of the present study. And based on this, the participant authorized the research team to utilize his/her responses (for questionnaire questions) in this study.

Finally, the consent form concludes by asking the participants, “Do you agree to participate in this study?"

The questionnaire applied in the current study was developed in a previous study conducted in Iran [26]. It was adopted because it was validated by the researchers in that study, as well as for cultural similarity between the Iranian and Libyan populations. The questionnaire was selected following a standardized protocol that consisted of literature survey, focused group discussions, and expert opinions.

The adopted questionnaire, which was slightly modified (Supplement 1, https://bjeps.alkafeel.edu.iq/cgi/editor.cgi?article=1132&window=additional_files&context=journal), consisted of four assessment criteria, namely: general knowledge with 14 questions; nutritional knowledge with 5 questions; attitude with 11 questions; and practice with 9 questions. In addition to that, demographic data included: gender, age, marital status, location (city), education level, occupation and salary in Libyan Dinars.

The study was conducted over six months (April–September 2021), with three months dedicated to preparation and three months to data collection. The first period (April–June 2021) involved literature review, questionnaire selection and minor modifications to suit more the Libyan population. In the second period (July–September), The questionnaire was made available online and distributed at the end of June 2021 via social media and networking platforms such as Facebook, LinkedIn, Instagram, WhatsApp, Viber, and Telegram. The data collection period lasted three months with September 30th, 2021, was the deadline for accepting responses to the questionnaire.

2.2. Scoring method

All participants’ answers were evaluated on Likert scale.

For general knowledge criterion, the possible answers were “Yes/No/I don't know” which have been scored as 2/0/1 respectively.

The possible responses for items related to the “nutrition knowledge” (items 15–19) were “Yes/No/I don't know” and the scores of 0/2/1 were respectively assigned to all of them except for item 15, which has been scored as 2/0/1.

In the case of the “attitude” criterion (items 20–30), the possible responses “Strongly agree/Agree/No idea/Disagree/Strongly disagree” were scored from 5 to 1 respectively.

For the “practice” criterion (items 31–39) the possible answers were “Always/Often/Sometimes/Rarely/Never”. Scores of 5 to 1 were assigned to the responses of questions 31, 32, 33, 35, 37 whereas other questions’ responses (34, 36, 38, and 39) were scored (1–5).

The overall scores for each participant were converted to percentage ratio and the percentage ratio for each criterion was calculated.

2.3. Statistical analysis

Statistical analyses were performed using SPSS 25 (SPSS Inc., Chicago, IL, USA) and Minitab 17 (Minitab Inc., State College, Pennsylvania, US). Descriptive statistics included; maximum and minimum values (Max and Min), mean and coefficient of variation (CV%) to measure the relative dispersion.

The parametric unpaired t test (significant when $p < 0.05$) was used to compare the means of two groups (as in gender). The parametric test was conducted as the sample size was >30, indicating that the data close to the normal distribution. Furthermore, Levene's test was used to assess the homogeneity of variance (significant when $p > 0.05$). Finally, one-way analysis of variance (ANOVA) was used to compare the means of more than two groups, as in age, (significant when $p < 0.05$). When there were significant differences, a post hoc test (Tukey's test) was used to make pairwise comparisons.

3. Results

The total number of the participants was 325. Of these, 11 were excluded as their responses showed they were not living in the western region of Libya. Thus, 314 people were included in this study.

The socio-demographic data of participants are presented in Figs. 1–3. Females outnumbered men in this study, with a percentage ratio of 62.7% for females and 37.3% for males, implying that two-thirds of the participants were females.

In case of age, the number of participants decreased as the age interval increased, with the

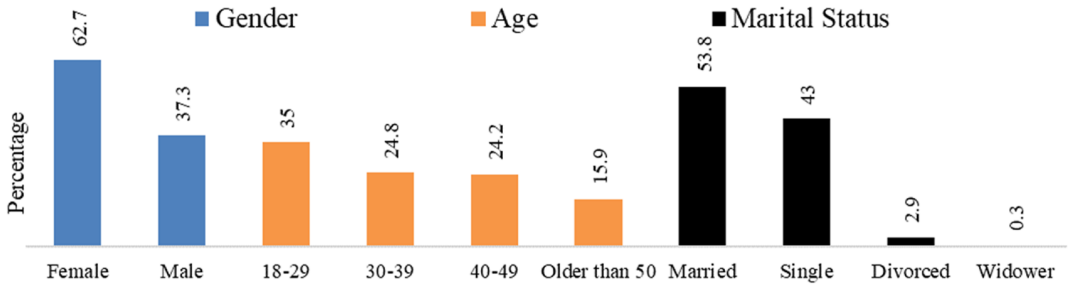

Fig. 1. Data of gender, age and marital status for the participants.

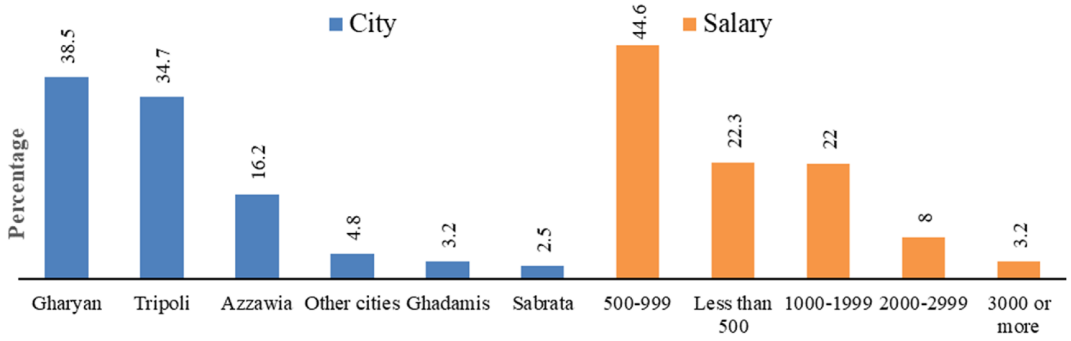

Fig. 2. Data of cities and salaries for the participants.

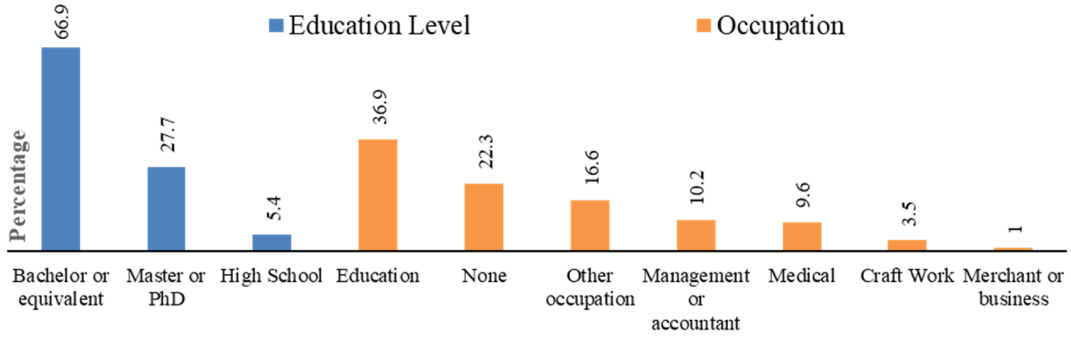

Fig. 3. Data of education level and occupation for the participants.

highest percentage (35%) for those aged 18–29 years and the lowest percentage (15%) for those aged older than 50 years.

The majority of participants were married (53.8%) or single (43%) and a few were divorced or widow/widower. Also, most of the participants were from the following city: Gharyan, the main city in Jabal Naffusa (38.5%); Tripoli, the Libyan capital (34.7%); Azzawia, the largest city west of Tripoli (16.2%). Cities with participant's percentage less than 1% were labeled as other cities, with 4.8% in total.

Moreover, the highest percentage of the participants (66.9%) held a university degree or its equivalent (Bachelor or licentiate or higher diploma), worked in education sector (36.9%) and earned between 500 and 999 Libyan dinars (44.6%).

3.1. General knowledge

Results revealed that most participants chose the correct answer (yes) for 11 items out of 14. The highest correct number of answers (n = 295; 93.9%) was for "Bone pain and fatigue are among the vitamin D deficiency symptoms" item followed by "Currently, vitamin D deficiency is one of the most important health issues in our country" Item (n = 275; 87.5%). In addition to that, nearly half of the participant chose the correct answer (yes) for two items: Vitamin D supplement intake requirements, differ in various seasons of the year (152; 48.4%) and "Normal level of vitamin for adults is greater than 30 ng/ml" item (155; 49.4%). Moreover, the only item for which the minority of participants (42; 13.4%) chose the right answer (yes) was "people with darker skin are more prone to vitamin D deficiency".

3.2. Nutrition knowledge

Most participants (n = 233; 74%) selected the correct answer (yes) for only one item, which was "fatty fishes are one of the main dietary sources of vitamin D". On the other hand, most participants (209; 66.6%) selected the incorrect answer (yes) for the item "Eggs are one of the main dietary sources of vitamin D.". Furthermore, nearly half of the participants selected the incorrect answer (yes) for the items "Dairy products are one of the main dietary sources of vitamin D" and "Fruits are one of the main dietary sources of vitamin D", while slightly more than the quarter of participants (90; 28.7%) selected the incorrect answer (yes) for "Meat and poultry are the main dietary sources of vitamin D." item.

3.3. Attitude

For all items (except one), the majority of participants (ranged 109–183 participants) chose the "agree" option. There were 109 (34.7%) participants for the item "In vitamin D deficiency, supplement intake is more effective compared to dietary intake and sun exposure" and 193 (61.5%) participants for the item "Taking supplements is necessary for treatment of vitamin D deficiency but not for its prevention". Additionally, the only item for which the predominant option was not "agree" was the item "Permanent using of sunscreens on face, neck and hands prevents the sun exposure required for production of vitamin D", for which 153 (47.7%) participants chose the "No idea" answer.

3.4. Practice

The range of participants for items where the correct response was "always" was 17–51 participants, with the highest number of participants (51; 16.2%) for the item "During the day I am directly exposed to sunlight (outdoors)", and the lowest number (17; 5.4%) was for the item "In order to be vitamin D sufficient, I consume fish at least twice a week".

3.5. Comparison between the criteria

As shown in Table 1 general knowledge had the highest score (80.99%), whereas nutritional knowledge had the lowest (46.24%). The coefficient of variation (CV%) for the responses for nutritional knowledge questions (40.64%) was nearly three times that of the other three criteria, indicating that responses are more variable in nutritional knowledge than the responses in the other three criteria, whose CV% were close to each other (12.18–17.54%).

3.5.1. Gender factor

In terms of gender, Levene's test results (Table 2) were significant ($p > 0.05$) indicating the homogeneity of variance between females and males' responses. The highest mean (82.39%) was recorded

Table 1. Descriptive statistics of the four criteria responses.

	Mean	[a]CV%	Minimum	Maximum
General knowledge	80.99	12.18	50.00	100.00
Nutritional knowledge	46.24	40.64	0.00	100.00
Attitude	74.79	12.01	27.15	99.55
Practice	60.06	17.54	28.86	84.36

[a] CV% is coefficient of variation.

Table 2. Two Independent Samples Test between female (F) and male (M) scores through the four criteria and overall average.

	Mean		Levene's test[a]	P[b]
	M	F		
General knowledge	78.54	82.39	0.327	0.001
Nutritional knowledge	44.96	47.01	0.142	0.351
Attitude	74.58	74.92	0.076	0.749
Practice	67.11	55.87	0.069	0.000
Average	66.29	65.05	0.335	0.81

[a] Significant when $p > 0.05$.
[b] Significant when $p < 0.05$.

for females in general knowledge, whilst the lowest mean (44.96%) was for males in nutritional knowledge. Females' scores were higher than that for males in all criteria except the practice criterion, and the difference was significant ($p < 0.05$) only in general knowledge (Table 2). When compared to females, males had a higher average of the four criteria, but this was not statistically significant. Males also had a higher practice score, and the difference was significant ($p < 0.05$).

3.5.2. Age factor

Table 3 shows that score difference across age intervals was significant ($p < 0.05$) only in the practice criterion and Tukey test, performed for this criterion, revealed that participants aged 18–27 years had a significantly lower score ($p < 0.05$) compared to all other age intervals (30–39, 40–49 and $\geq$ 50 years). Additionally, those aged $\geq$50 years had a significantly higher score ($p < 0.05$) compared to those aged 30–39 years. Other score differences between age intervals were not significant.

3.5.3. Education level factor

As shown in Table 4, score difference according to education level was significant ($p < 0.05$) only in the practice criterion, which was due to those participants holding PhD or Master's degrees scored significantly higher ($p < 0.05$) than those holding Bachelor or licentiate degrees. Other score differences between different education levels were not significant ($p > 0.05$).

Table 3. Results for ANOVA test regarding age factor effect on the four criteria.

	P[a]
General knowledge	0.325
Nutritional knowledge	0.381
Attitude	0.436
Practice	0.000
Average	0.469

[a] Significant when $p < 0.05$.

Table 4. Results for ANOVA test regarding education level factor effect on the four criteria.

	P[a]
General knowledge	0.130
Nutritional knowledge	0.893
Attitude	0.392
Practice	0.036
Average	0.188

[a] Significant when $p < 0.05$.

3.5.4. Occupation factor

Score difference according to occupation level (Table 5) was significant ($p < 0.05$) in general knowledge and practice criteria and insignificant ($p > 0.05$) in nutritional knowledge and attitude criteria. In terms of general knowledge, the reason was that unemployed participants and those working in medical or education sectors had a significantly higher score ($p < 0.05$) compared to those working in craft. On the other hand, the reason in terms of practice was that those working in craft had a significantly lower score ($p < 0.05$) compared to unemployed participants and all employed participants (except Management or accountant).

3.5.5. Salary factor

Table 6 shows that score difference according to salary was significant ($p < 0.05$) only in the practice criterion. Participants earning <500 Libyan dinars had a significantly lower score ($p < 0.05$) compared to those earning >500 Libyan dinars. Furthermore, participants with salaries of 2000–2999 Libyan dinars had a significantly higher score ($p < 0.05$) compared to those with salaries of 500–999 Libyan dinars.

Table 5. Results for ANOVA test regarding occupation factor effect on the four criteria.

	P[a]
General knowledge	0.023
Nutritional knowledge	0.414
Attitude	0.382
Practice	0.000
Average	0.284

[a] Significant when $p < 0.05$.

Table 6. Results for ANOVA test regarding salary factor effect on the four criteria.

	P[a]
General knowledge	0.351
Nutritional knowledge	0.303
Attitude	0.258
Practice	0.000
Average	0.258

[a] Significant when $p < 0.05$.

4. Discussion

Vitamin D is essential for calcium homeostasis, bone health, modulating the immune system, and preventing chronic diseases, including cardiovascular disorders, diabetes, and osteoporosis [27,28]. Although sunlight is abundant in Libya nearly all year round, vitamin D deficiency remains a major public health concern due to the influence of behavioral, cultural, and lifestyle factors that limit satisfactory sun exposure or dietary intake [29]. This study assessed the knowledge, attitude, and practice (KAP) towards vitamin D among adults (314 individuals, males and females) in the western region of Libya and offered an overview of existing awareness gaps, incorrect attitudes, inappropriate practices, and socio-demographic influences on practices related to vitamin D. However, it is important to keep in mind that the findings of this study rely on self-reported data and therefore indicate associations rather than cause-and-effect relationships, as clinical outcomes were not evaluated.

4.1. General knowledge

The general knowledge level among participants was satisfactory, with a mean score of 80.99%. Most respondents correctly identified that vitamin D deficiency can cause bone pain and fatigue and recognized its importance as a health issue. These findings are consistent with studies from other Arab countries such as Saudi Arabia, Syria, and Iraq, which also reported moderate to high awareness of the importance of vitamin D among the participants [30–32]. This could be attributed to increased media attention or effective public information campaigns on health issues related to vitamin D, either globally or locally within Libya. The findings of a study [3] conducted in Hong Kong have shown that media appeared to be the main source of information on vitamin D for the targeted population and had an important role in public health education.

However, in the current study only a minority (42 out of 314; 13.4%) of the participants acknowledged that darker skin reduces vitamin D synthesis. Similar results have been reported elsewhere [32,33]. In a study that was conducted in Iraq [32], only 29.4% of the participants believed that persons with dark skin are more prone to vitamin deficiency than those with fairer skin. Similarly, a study that was conducted in the United Arab Emirates [33] revealed that only 26.7% of the answers were correct regarding skin pigmentation being one of the factors affecting vitamin D synthesis through the skin. Comparing these results with the results of the current study, it is clear that Libyan participants were less aware of the impact of skin pigmentation on vitamin D production (13.4%) compared to those in Iraq (29.4%) [32] and the United Arab Emirates (26.7%) [33]. This suggests that awareness campaigns or educational interventions in Libya might have paid insufficient emphasis on physiological factors such as skin pigmentation.

Overall, while there is a good general awareness among the targeted population in western Libya, more targeted education is required to address biological factors that are known to affect vitamin D status.

4.2. Nutritional knowledge

Although all of the participants had a satisfactory level of general knowledge, their nutritional knowledge was the lowest mean score (46.24%) when compared to general knowledge, attitudes, and practices. The obtained results indicated widespread misunderstanding of dietary vitamin D sources among the citizens in the western region of Libya. While most participants correctly identified fatty fish as a key source of vitamin D, many incorrectly believed that eggs, dairy products, fruits, and meat are major sources for vitamin D. Vitamin D content in fish can reach several hundred μg/kg depending on the species and location, while in the other mentioned sources, vitamin D is present in quantities that are one-tenth or much less of that amount [34]. Thus, fish and fish products are major natural dietary sources of vitamin D compared to the other food sources. The current study's findings of adults' nutrition knowledge were consistent with those from Saudi Arabia [30] and Oman [35], where similar misconceptions about major sources of vitamin D were documented. The poor knowledge of foods content of vitamin D in the western region of Libya may be attributed to insufficient dissemination of information about vitamin D through media channels such as television programs, brochures, and newsletters. Additionally, in Libyan society there is incorrect common perception that foods such as meat, eggs, milk, and fruits are rich in most essential nutrients, almost regarded as if they provide a complete diet. Consequently, many who participated in the current study might have incorrectly believed that these foods are major sources of vitamin D.

These findings highlight the inadequate nutrition education in western Libya, indicating the need for focused public health interventions. Increasing vitamin D source knowledge will enhance food

intake and avoid the long-term health issues linked to deficiency.

4.3. Attitude

Generally, the overall attitude toward vitamin D reflected positive perceptions, with most participants agreeing on the importance of supplementation and sun exposure. However, uncertainty about sunscreen use and its effect on vitamin D production through skin was evident, with nearly half indicating "no idea."

Among the positive impacts of skin exposure to solar radiation is that UV radiation participates in the production of vitamin D through the skin; however, there are negative impacts of skin exposure to solar radiation that include sunburn and the development of skin cancer [36–38]. To lessen the negative impacts of the solar radiation, it is necessary to use means of photoprotection, including sunscreens such as creams and lotions with a UV filter [39,40]. Some researchers have devoted their effort and time to searching for alternatives for sunscreens that reduce vitamin D production. Recently, they focused on the development of nanoparticle-based and chromophore-based sunscreens designed to balance efficacy, safety, and cosmetic attributes [41]. These new products could be one of the solutions to compromising between skin care against negative impacts of the solar radiation, such as skin cancer, and its positive impacts, such as production of vitamin D. Educational initiatives are needed to improve the attitude of individuals towards the necessary precautions to maintain healthy skin while still benefiting from the sunlight.

4.4. Practice

Compared to general knowledge (average: 80.99%) and attitude (average: 74.79%) scores practice scores were lower (average: 60.06%). Only a small percentage of participants regularly engaged in good practices related to vitamin D such as regular sun exposure or frequent fish consumption. This gap between knowledge and practice aligns with a few studies from other countries where higher general knowledge did not reflect good practice [42,43]. A study conducted in Pakistan to evaluate KAP for vitamin D among healthy university students revealed that the participants had lower practice scores compared to general knowledge [42]. A similar result has been obtained in a study that was conducted in Malaysia to evaluate KAP related to vitamin D among Malay female office workers. Those females had a better knowledge score (66.7%) than practice score (56.2%). The authors have also reported that there was no association between knowledge and practice ($r = 0.08$, $p = 0.355$) [43].

The gap between knowledge and practice related to vitamin D can be attributed to different possible reasons. Cultural and social traditions, especially for females, can limit sun exposure, leading to a reduction of the effective practice related to vitamin D [13]. Additionally, in hot-climate countries, including Libya, discomfort from sun exposure for a long time may lead people to avoid outdoor activities, even when the benefits of sun exposure are understood. Furthermore, lack of the correct information about safe sun exposure and sunscreen types may have a serious impact on overall health. Another possible reason for this gap is the preference of some individuals to remain in a comfort zone rather than changing their lifestyle. Even when individuals understand the benefits of vitamin D, the effort or discomfort involved in changing habits may discourage good practices, potentially leading to vitamin D deficiency.

4.5. Influence of socio-demographic factors

Gender, age, education, occupation, and salary significantly influenced various aspects of vitamin D awareness and practices. Females demonstrated significantly higher general knowledge than males, possibly due to greater engagement in gaining health information among females [44–46] and that females are more interested in being educated about their health. However, males achieved higher practice scores than females, which could be attributed to the fact that males have more opportunities to be involved in good practices because of tradition and culture. Although individual items, such as sun exposure, were not analyzed separately by gender or any other factor, the overall difference in practice scores suggests that males may have greater exposure to sunlight. Socially, this may be explained by greater outdoor activity among males, while females may have more limited sun exposure due to cultural norms, clothing styles, or lifestyle patterns [13]. These factors may contribute to lower vitamin D-related practices among females despite relatively good awareness levels.

This suggests that while women may prioritize health education, men benefit from practical experiences that enhance their practices. Encouraging males and females to adopt a balanced approach to enhance knowledge and improve practice could lead to better health outcomes for Libyan citizens in

the western region and more harmony between knowledge and practice.

Additionally, younger participants (18–27 years) had significantly lower practice scores, which could reflect that younger adults are less likely to engage in activities or implement actions known to maintain normal serum vitamin D level. A similar result was reported by the authors of a study conducted in Ghana to evaluate KAP regarding vitamin D among adults in the Jaman South Municipality of Ghana. It was found that individuals aged 40 and above had better practice compared to younger people (18–24 years) [47]. Young adults tend to rely more on technology and to work (or study) indoors, which reduces their opportunities for spending time outdoors and enough exposure to the sun. On the other hand, old adults have sufficient free time and can therefore devote more time to outdoor activities. Moreover, old adults may have more health awareness, which makes them more inclined than young adults to gather information that improves their health practices.

As was expected, subjects with higher education (master's or PhD) exhibited better practices, possibly due to increased health literacy, which is supposed to enhance realizing the importance of vitamin D for overall health and therefore pursue appropriate sources for maintaining normal vitamin D level, whether through diet, sun exposure, or supplements. A study has revealed that students enrolled in medical and physical therapy programs performed better in practice regarding vitamin D than pharmacy and nursing students [48]. This is evidence that not only does education level have its impact on practice related to vitamin D, but also practices vary across education disciplines.

Similarly, practice score differences were also evident in terms of different occupations, with individuals in craft occupations having the lowest scores. This aligns with the results of other studies, which concluded that the type of occupation had its impact on practice related to vitamin D [49,50]. Some occupations may be associated with poor vitamin D practices, including those that require spending long hours in offices. On the other hand, occupations that require a high level of education or do not require long office hours may be associated with better vitamin D practices.

Lastly, categories of survey participants who have higher salaries were found to have better practice scores compared to those who have lower salaries. The possible reason for this is that lower salary can restrict beneficial practices by limiting access to vitamin food rich in vitamin D, including oily fish and fortified milk.

5. Limitations of the Study

To the best of our knowledge this is the first study that evaluated KAP toward vitamin D among adults in Libya, and the sample size is considered enough to achieve the aim. However, there are several potential limitations of this study: Firstly, the questionnaire is based on self-reporting, which could lead to recall bias. Secondly, this study included only participants from Western Libya, which may limit how well the findings reflect the entire Libyan population. Including more participants from different regions of the country (Eastern, Southern, and Western Libya) would help future studies provide more accurate and representative findings about the population across Libya. Thirdly, some potential determinants of vitamin D status, such as body mass index and biochemical measurements, were not considered. These confounding variables were not fully controlled using advanced statistical models. Fourthly, separate subgroup analyses for individual practices, such as sun exposure or vitamin D supplement intake, were not performed. This could have provided more helpful information. Overall, these limitations suggest caution when generalizing the findings of the current study.

6. Conclusion

This study revealed that adults in western Libya demonstrated a good level of knowledge and a positive attitude toward vitamin D; however, their nutritional knowledge and beneficial practices remain insufficient. Significant gaps persist in recognizing major dietary sources of vitamin D and maintaining consistent sun exposure. Socio-demographic factors, including gender, age, education level, occupation, and income, were found to significantly influence practice scores, thus they may contribute to vitamin D deficiency.

Despite the abundance of sunlight in western Libya, limited awareness of lifestyle-related determinants of vitamin D status continues to hinder effective prevention of vitamin D deficiency. Based on the results of the current study, the main barriers preventing adequate vitamin D in Libya, despite abundant sunlight, are limited awareness of lifestyle factors, poor knowledge of dietary sources, and inconsistent sun exposure habits. Additionally, socio-demographic factors such as education, income, and occupation influence practices, further contributing to the risk of vitamin D deficiency. Furthermore, the hot-climate often discourages outdoor activities, while misconceptions about safe sun exposure and the use of sunscreen further contribute to the problem. Together, these factors

help explain the gap observed between knowledge and actual practice, despite the abundance of sunlight in western Libya. Therefore, systematic public health interventions focusing on nutrition education, safe sun exposure practices, and awareness of vitamin D supplementation are necessary. The importance of vitamin D in maintaining health must be better understood and acknowledged by the general population. In order to do this, Libyan health authorities should increase public health awareness campaigns through various channels, including healthcare organizations, digital platforms, internet platforms, and learning and educational organizations.

Future studies should incorporate biochemical assessment of serum vitamin D levels. A quantitative assessment of serum vitamin D levels can help correlate attitudes, knowledge, and practices with actual values of vitamin D deficiency in the population being studied. There is a need to expand the study area to include participants from other Libyan regions, and to evaluate the impact of education programs aimed at improving both knowledge and practices. Moreover, qualitative approaches exploring cultural beliefs and sun exposure may provide deeper insights for public health strategies. Although the applied statistical tests were appropriate for the nature of the study and how it was designed and how the aims were formulated, more advanced statistical approaches such as multivariate regression analysis could provide better control for potential confounding variables, and this is recommended for future work.

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Conflict of Interest

None declared.

Ethical Approval

Due to the non-invasive nature of the study and conducted through an anonymous online questionnaire conducted, formal ethical approval was not required according to local institutional guidelines. Nevertheless, the study followed the accepted ethical principles for human research, including confidentiality, voluntary participation, and the right to withdraw at any time.

Data Availability

The datasets for this study are available from the corresponding author upon reasonable request.

Author Contributions

All authors contributed to the conceptualization, designing the methodology, data Formal analysis, and Writing the draft of this manuscript.

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