



Original Article

Determining Levels Awareness of Vitamin D as a Silent Epidemic among the Population in Southern Saudi Arabia

Amal A. Abdulbaqi^{1*} , Rym Hassani¹ , Omaymah Radwan²

¹Assistant professor, Biology Department, University College of Darb, Jazan University, Jazan, Saudi Arabia

²Assistant professor, Department of Education, Educational Leadership, College of Education, University College of Darb, Jazan University, Jazan, Saudi Arabia

ARTICLE INFO

Article history

Receive: 2023-03-05

Received in revised: 2023-04-03

Accepted: 2023-05-06

Manuscript ID: JMCS-2304-2019

Checked for Plagiarism: **Yes**

Language Editor:

[Dr. Fatima Ramezani](#)

Editor who approved publication:

[Dr. Ali Hammood](#)

DOI:10.26655/JMCHMSCI.2023.10.9

KEYWORDS

Deficiency

Jazan

Saudi Arabia

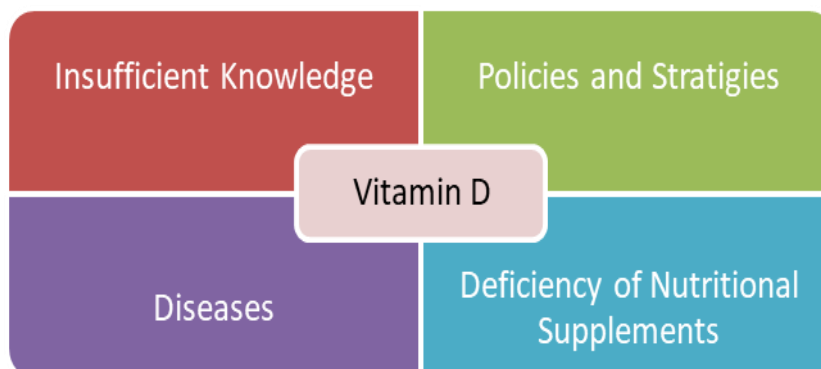
Silent Disease

Vitamin D

ABSTRACT

Vitamin D (VD) is an important nutrient for the human body because it is associated with many diseases. There were many health problems in which vitamin D deficiency had a role, the most important of which are rickets in infants and cardiovascular diseases, especially in areas where there is less awareness of the risks of vitamin D deficiency. Unfortunately, there is very little research on this topic in Saudi Arabia. Vitamin D deficiency and awareness of the importance of vitamin D among the population has not been investigated and evaluated at a level that could make the importance of vitamin D and the effects of its deficiency on health a clear phenomenon for everyone and they are aware of it. Accordingly, this study aimed to assess and identify the participants' awareness of the VD importance and the risks of its deficiency on general health of the population in the Jazan region. The results showed that 90% of the participants have awareness and knowledge of the VD importance, 67% do not know whether they suffer from a deficiency or not, 74% reported that VD deficiency causes osteoporosis, 52% reported that the reason for the high level of VD in the body is the intake of nutritional supplements, and 68% reported that increasing its level in the body leads to toxicity and excessive increase. This study concluded that VD deficiency is considered a silent epidemic and a major health problem for the residents of southern region in particular, and the rest of cities of Saudi Arabia in general.

GRAPHICAL ABSTRACT



* Corresponding author: Amal Abdulbaqi

✉ E-mail: abdulbaqi@jazanu.edu.sa

© 2023 by SPC (Sami Publishing Company)

Introduction

Vitamin D is secosterol and is considered as a nutrient whose function is to enhance the process of calcium absorption and a cofactor in physiological processes such as bone and calcium metabolism, metabolism, and works on the balance of phosphorus and calcium [1-4]. In addition, vitamin D prevents calcium excretion by re-absorption by the kidneys and plays an important role in calcium homeostasis in the bones, intestines, and kidneys [1, 3]. Vitamin D is of great importance because it is associated with many diseases, including cardiovascular diseases, diabetes, autoimmune diseases, rickets in infants, some skin diseases, obesity, neurological disorders, infections, and cognitive decline [1-6]. Therefore, at the present time, many studies have been conducted on vitamin D and its importance. Consequently, the increasing interest in vitamin D was shown by researchers and specialists in the health community and in the field of biomedical sciences, more than any other nutrients related to human health [3, 6]. In addition, some recent studies indicate that vitamin D deficiency and its prevalence are among the most important factors that lead to contract diseases and mortality [7, 8]. Furthermore, recent studies have reported that there is an association between vitamin D deficiency and (upper respiratory tract infection and the coronavirus disease (COVID-19)), and this indicates the seriousness of vitamin D deficiency in the event of an epidemic such as the Corona pandemic [9, 10].

Vitamins play a vital character when our bodies absorb them, but the body needs them in specific amounts to perform this role. Vitamin D is a unique food source obtained externally from foods rich in it and internally by shedding the ultraviolet radiation of sunlight on the skin [11]. In addition, Vitamin D is necessary for the proper intake of calcium in the biological system as it supports the inundation of calcium in the digestive system and its removal in the bone structure, and it also controls the number of calcium points in the plasma. One of the most common diseases associated with vitamin D is bone diseases such as rickets in children and

osteoporosis in adults [12]. Vitamin D deficiency has spread widely in many countries and it is considered a common epidemic because it affects about one billion people in the world [13], and for this reason, it is a source of concern for health and international organizations, especially through early stages of human growth of including infancy stage, followed by the childhood, and finally the stage adolescence [14, 15].

Despite Saudi Arabia being one of the countries that enjoy exposure to the sunshine most days of the year, as exposure to sunlight is an essential source for obtaining vitamin D [16], it was found the prevalence of vitamin D deficiency among the population was more than 80%, this result, according to a recent study conducted In Saudi Arabia [17, 18]. Moreover, several recent studies showed through their findings that vitamin D levels were low among the population (men, women, newborns, children, and adolescents) from different cities in Saudi Arabia [19-22]. The reason for high prevalence of vitamin D deficiency may be due to the Saudi population wears heavy clothing that may prevent sunlight from reaching the skin, in addition to the fact that the majority of the population does not practice outdoor activities, which makes their exposure to sunlight less [16]. In addition, there are several reasons for vitamin D deficiency and its spread as a silent epidemic, including the lack of sufficient vitamin D in the diet, the inability of the skin to produce it, misuse and absorption, increase in the body's requirement, dark skin pigmentation, veganism, ovo-vegetarianism, aging, obesity, gender where it is more prevalent in women, seasons when the prevalence of vitamin D deficiency increases (winter), and finally the pattern of clothing that covers the skin [22-24]. One of the most important risks of vitamin D deficiency is rickets in children, whether in the utero or during childhood, and osteoporosis in adults and the elderly, where the deficiency of this vitamin leads to softening of the bones, which causes fragile bone structure, pain, softness, muscle weakness, and increases the fractures incidence, especially hip fractures [12]. To benefit from vitamin D, it is necessary to know how it is produced, whether internally,

represented by vitamin D₃, or externally, by taking it represented by vitamin D₂ or vitamin D₃ [25]. This biological process is activated in three steps: first, Ultraviolet Burning (UVB) radiation penetrates the epidermal layer of the skin and stimulates the conversion of 7-DHC (7-dehydrocholesterol) into pre-vitamin D₃ [26], second, the transport of vitamin D₃ is mediated by the vitamin D protein binding (DBP) to the liver by circulation to form 25-hydroxyvitamin D (25(OH)D) [25], and third, the biologically active (1,25(OH)₂D) dihydroxyvitamin D of vitamin D is produced in the kidneys [27]. Finally, by diffusion, 1, 25-dihydroxyvitamin D enters cells and is activated by the vitamin D receptor (VDR) [28, 29]. More importantly, there is a recent study that reported that taking vitamin D supplementation in patients with respiratory tract infections reduces infections of their tract, and this indicates the importance of taking vitamin D doses for COVID-19 patients [30].

Every year, there are new cases of certain diseases appearing in Saudi Arabia, especially with regards to the problem of vitamin D deficiency as a silent epidemic as a large number of people are not even aware that they are affected by it and have no idea about how complicated their lives are because of it. Therefore, it was very important to address this problem, identify it, and determine the extent of its impact on the public health of the population in the Kingdom of Saudi Arabia, especially in the southern region, and to identify the extent of awareness of Saudi society in the southern region of the dangers of vitamin D deficiency and its impact on their lifestyle and increase its prevalence rate based on the descriptive approach. This was the main objective of this study, in addition to clarify the extent of the impact of vitamin D deficiency in different circumstances, the complications it causes, the role of sunlight, and good nutrition rich in vitamin D, through practical experiments on a group of rabbits.

Materials and Methods

Study setting, design, and participants

This study adopted the descriptive and experimental method and was conducted in the southern region during the period between October and December 2022 at Jazan University in Jazan, Saudi Arabia. The study targeted the southern Arabs including 148 males and females. In this study, the descriptive and experimental approaches were combined to achieve the main objective of the study information and data were collected through questionnaires as research tools for the analytical part and observations for the experimental part.

Analytical study

A survey was published on Twitter <https://twitter.com/00oo1990?s=21> and by questionnaire was to obtain information related to the awareness of the participants in the study about vitamin D, causes of deficiency, sources of obtaining it, and risks of deficiency of this vitamin in the human body.

Experimental study

The experiment was conducted on 3 groups of rabbits to reveal the causes of vitamin D deficiency, prevention methods, and the optimal system, to avoid vitamin D deficiency, and to know the effects of increasing *in vivo* vitamin D production.

Grouping and diet distribution

A total of six rabbits, one month old, weighing between 700-550 grams were purchased. The health status of the rabbits was confirmed, and they were fed food containing all the nutrients for a week, and then the rabbits were divided into 3 groups according to the healthy factor and the normal weight of the rabbits. After that, their meals were divided into 3 groups, which are shown in detail as follow:

First group: Two healthy rabbits are exposed to the sun for two hours a day with a supportive diet consisting of 3 meals as follows: The first meal is made up of, lettuce + oats + carrots + supportive vitamins, the second meal has cabbage + fodder + arugula or greens, and the third meal is based on feed + fish oil+ vitamin "D" drops. *Second group:* Two healthy rabbits are exposed to the sun for

two hours a day and a supportive diet containing 3 meals and add to them vitamin "D" at the beginning of the experiment 2 drops of the suspension solution, which is given to the children as a dose as follows (25 mg/mL, then gives it to Emily, which is a high dose (25 mg/mL)). Regarding their meals, the first meal is comprised of Lettuce + oats + carrots + supportive vitamins, the second meal consists, Cabbage + fodder + arugula or greens + 1 milli-vitamin "D" at a concentration of 25 mg/mL, and the third meal involves feed + fish oil. *Third group*: Two healthy rabbits at the beginning of the experiment were withheld from the sun and light for a month, and a poor diet was placed for them, which consisted of alfalfa and only two meals. The three groups were left for 45 days under the above-mentioned conditions for each group.

Ethical consideration

The ethical approval of this study was approved by the Research Ethics Committee No.: HAPO-10-Z-001 of Standing Committee for Scientific Research - Jazan University (No. REC-43/06/133/2022). Also, the use of rabbits as laboratory animals has been approved according to the guidelines approved by the Institutes of Health and the Special Committee on the Ethics of Experimental Animals No. 2022-050.

Results and Discussion

Participants' awareness of vitamin D, its importance and relationship to osteoporosis

A total of 148 participants agreed to answer the questionnaire of this study, and among the participants 63 (43%) were males and 85 (57%) were females, while 111 (75%) of the total participants belonged to cities and 37 (25%) belonged to villages. From [Figure 1](#), which shows the participants' awareness of vitamin D, its importance, and its relationship to osteoporosis, the results show that 90% of the participants have awareness and knowledge about the importance of vitamin D and the problems that vitamin D deficiency caused for human body. Regarded to the deficiency of vitamin D among the participants, the results showed that 67% did

not know whether they were suffering from a deficiency of vitamin D or not, that is, they did not conduct medical examinations to find out about it, while 33% were aware of their condition, whether they suffer from a deficiency of this vitamin or not. In addition, 74% of the participants reported that vitamin D deficiency causes osteoporosis, while 52% of them reported that the reason for the high level of vitamin D in the body from the normal level is the intake of nutritional supplements. In addition, 68% of the participants reported that an increase in the level of vitamin D in the body may lead to toxicity and excessive for this vitamin.

Experimental study of the effect of nutrition and nutritional supplements on vitamin D in rabbits

The effect of diet and nutritional supplements and their relationship to vitamin D was shown in three groups of rabbits. According to [Figure 2](#), the results showed at the beginning of experiment for the first group of rabbits that they were small in size, their bones were also small and weak, and they were characterized by lack of activity and lack of movement. After a month had passed, the rabbits showed external changes, represented by an increase in weight, size, activity, and hair density, and also internal changes represented in the widening of their bones, as the bones became stronger, more solid, and thicker. Moreover, the rabbits became faster in movement and activity, as depicted in [Figure 2](#). Accordingly, the most important results observed were that the first group of rabbits which were exposed to the sun radiation and fed a good diet had good phenotypic and internal characteristics.

Regarding the second group of rabbits, it was observed at the beginning that their bones and size are small, inactive, and slow in movement. After a week of following a good diet and taking vitamin D, an increase in the weight of rabbits was observed, and they had strength in their legs with noticeable activity. After one month had passed, some changes and symptoms were observed in these rabbits are loss of appetite and weight, frequent urination, diarrhea, and muscle weakness, as demonstrated in [Figure 2](#), and then 45 days after the start of the experiment, these symptoms led to the death of two rabbits as a

result of damage to the kidneys and liver completely due to excessive vitamin D. The most important results related to the second group of rabbits taken vitamin D as a nutritional supplement were that they witnessed good

phenotypic changes at the beginning of the experiment, while symptoms appeared after one month, which eventually led to their death, and this confirms the danger of taking nutritional supplements.

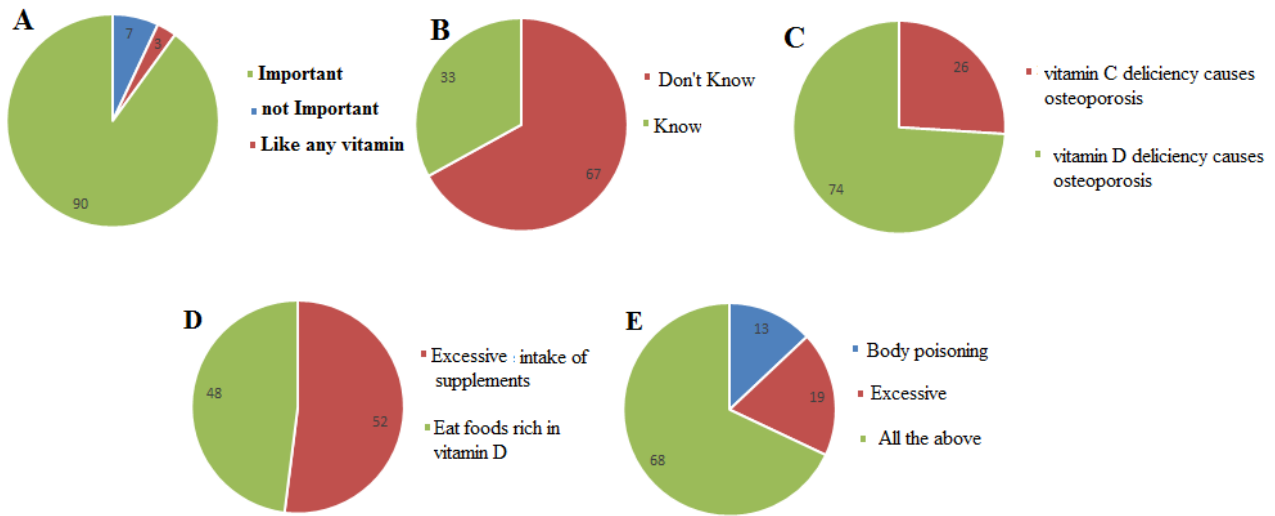


Figure 1: Participants' awareness of vitamin D, (A) its importance, (B) deficiency of vitamin D, (C) its relationship to osteoporosis, (D) high level of vitamin D to intake of nutritional supplements, and (E) its toxicity and excessive



Figure 2: Three groups of rabbits in terms of natural vitamin D, increasing vitamin D, vitamin D deficiency, and its symptoms

Finally, regarding the third group of rabbits, it was noticed at the beginning of the experiment that their health was good, then they were prevented from exposure to the sun radiation and suffered from malnutrition, and thus they became suffering from vitamin D deficiency. After a week, some symptoms and changes were observed in the rabbits, which are weight loss, limb numbness, lethargy, extreme thirst, different movement patterns, soft bones, bowed limbs, and rickets, as displayed in [Figure 2](#). The most important results observed in the third group of rabbits were that malnutrition and vitamin D deficiency led to osteoporosis and rickets.

The current study found that 90% of the participants have awareness and knowledge of the importance of vitamin D and the problems caused by its deficiency. Through this result, it can be mentioned that the residents of the southern region in Saudi Arabia have awareness and information related to vitamin D and its deficiency in the human body. This result is consistent with the results of a study conducted in Jeddah, Saudi Arabia, which found that 88.4% of the participants agreed on the importance of vitamin D, especially for the maintenance of teeth and bones [31]. These results indicate that Saudi society in general has awareness of the importance of vitamin D and the basic information related to it. In this study, we investigated the knowledge of the residents of the southern region (Jazan) about their health status related to vitamin D deficiency. The results of our study showed that 67% had no information about their vitamin D deficiency or non-deficiency, meaning that they did not conduct periodic medical examinations. Many recent studies have been conducted to determine the prevalence of vitamin D deficiency among the population and to know the extent of their awareness of their health status through the percentage of those who suffer from vitamin D deficiency [31-34]. The reason may be that the participants are not aware of their health status related to vitamin D deficiency, which is the lack of awareness of the necessity of conducting periodic examinations and paying attention to the quality of food rich in vitamin D. Furthermore, the need to be exposed

to sunlight and follow medical instructions related to vitamin D.

In our current study, it is important to highlight that 74% of the participants reported that vitamin D deficiency causes osteoporosis (OP). This finding is consistent with recent studies conducted in Beirut, Lebanon, Saudi Arabia, and Klang Valley, Malaysia [35-37]. In fact, based on this result, the knowledge and information related to osteoporosis (OP) resulting from vitamin D deficiency among Saudis were clear, but it is necessary to educate the Saudi society in general, and the residents of Jazan in particular, about osteoporosis and the risks that it poses. This disease may be caused by people who are less educated and who consume soft and caffeinated drinks frequently on a daily, as well as those who do not exercise, and are not exposed to sunlight. In addition, we found that 52% of the participants said that one of the reasons for the higher level of vitamin D in the body than the normal level is the intake of nutritional supplements, and 68% of them reported that the high level of vitamin D in the blood may lead to toxicity and excessive increase, and this may lead to risks significantly healthy. This means that there is a relationship between taking supplements and a high level of vitamin D in the blood, this finding is consistent with the findings of some previous studies, where found that there is a strong association between vitamin D supplementation and higher levels of vitamin D in the blood [20, 38-40]. According to these results, there are currently no studies recommending the need to take nutritional supplements to raise the level of vitamin D in the blood for individuals, as these supplements do not provide any proven health benefits. This is because increasing the intake of nutritional supplements may lead to poisoning because the increase in the level of vitamin D in the blood leads to an increase in plasma concentrations [24]. Finally, we evaluated and explained the effects of vitamin D deficiency, not being exposed to sunlight, and taking nutritional supplements as vitamin D supplements through practical application on three groups of rabbits. Previous studies have been conducted whose results are consistent with our findings [41, 42]. Moreover, we

conducted this experiment to clarify the importance of vitamin D. The results confirmed that varied and good food is the best source for obtaining vitamin D, as it can be obtained in balanced quantities, while the results showed the dangers of nutritional supplements when taken without consulting doctors and specialists. In addition, the aim of conducting the experiment on rabbits was to educate people about the need to pay attention to the diversity of food and to conduct medical examinations to find out their need for vitamin D, and to have awareness of damages of vitamin D deficiency and a culture about this silent epidemic.

Conclusion

In conclusion, this study sheds light on the awareness of participants from the southern region of Saudi Arabia of the importance of vitamin D and the effects of deficiency of this vitamin on health. It is the first study to assess the knowledge of Jazan population about vitamin D. It was noted that the participants had insufficient knowledge and awareness about vitamin D, its deficiency, and the negative effect of taking nutritional supplements, as well as the importance of sunlight exposure. We recommend that public health measures and policies should be taken and strategies should be implemented to prevent vitamin D deficiency and awareness programs and campaigns about vitamin D and nutritional supplements with the aim of improving the level of awareness and knowledge of vitamin D in Saudi Arabia. Moreover, there is a need to conduct extensive studies including other cities to determine and evaluate the level of vitamin D awareness, and health problems caused by deficiency, toxicity, or excess among the Saudi population.

Acknowledgements

The authors extend their appreciation to the Deputyship for Research and Innovation, Ministry of Education in Saudi Arabia for funding this research work through the Project No. RUP3-8.

Funding

The current research received specific support from RUP3-8-Jazan University.

Authors' Contributions

All authors contributed to data analysis, drafting, and revising of the article and agreed to be responsible for all the aspects of this work.

Conflict of interest

There are no conflicts of interest in this study.

ORCID

Amal Abdulbaqi

<https://orcid.org/0000-0003-2189-4966>

Rym Hassani

<https://orcid.org/0000-0002-9340-8835>

Omaymah Radwan

<https://orcid.org/0000-0002-6367-3742>

References

- [1]. Khadilkar A., Kajale N., Oza C., Oke R., Gondhalekar K., Patwardhan V., Khadilkar V., Mughal Z., Padidela R., Vitamin D status and determinants in Indian children and adolescents: a multicentre study, *Scientific Reports*, 2022, **12**:16790 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [2]. Bouillon R., Marcocci C., Carmeliet G., Bikle D., White J.H., Dawson-Hughes B., Lips P., Munns C.F., Lazaretti-Castro M., Giustina A., Bilezikian J., Skeletal and extraskeletal actions of vitamin D: current evidence and outstanding questions, *Endocrine reviews*, 2019, **40**:1109 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [3]. Hussein D.A., Ahmed G.S., Ahmed S.F., Salih R.Q., Kakamad F.H., Salih A.M., Hama Amin B.J., Abdalla B.A., Mohammed S.H., Salim R.O., Hamarrahim S.E., Pattern of vitamin D deficiency in a Middle Eastern population: A cross-sectional study, *International Journal of Functional Nutrition*, 2022, **3**:1 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [4]. Merzon E., Tworowski D., Gorohovski A., Vinker S., Golan Cohen A., Green I., Frenkel-Morgenstern M., Low plasma 25 (OH) vitamin D level is associated with increased risk

- of COVID-19 infection: an Israeli population-based study, *The FEBS journal*, 2020, **287**:3693 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [5]. de Oliveira L.F., de Azevedo L.G., da Mota Santana J., de Sales L.P.C., Pereira-Santos M., Obesity and overweight decreases the effect of vitamin D supplementation in adults: systematic review and meta-analysis of randomized controlled trials, *Reviews in Endocrine and Metabolic Disorders*, 2020, **21**:67 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [6]. Al-Daghri N.M., Vitamin D in Saudi Arabia: prevalence, distribution and disease associations, *The Journal of steroid biochemistry and molecular biology*, 2018, **175**:102 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [7]. Phudowski P., Kos-Kudła B., Walczak M., Fal A., Zozulińska-Ziółkiewicz D., Sieroszewski P., Peregud-Pogorzelski J., Lauterbach R., Targowski T., Lewiński A., Spaczyński R., Guidelines for preventing and treating vitamin D deficiency: a 2023 update in Poland, *Nutrients*, 2023, **15**:695 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [8]. Mailhot G., White J.H., Vitamin D and immunity in infants and children, *Nutrients*, 2020, **12**:1233 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [9]. Cui A., Zhang T., Xiao P., Fan Z., Wang H., Zhuang Y., Global and regional prevalence of vitamin D deficiency in population-based studies from 2000 to 2022: A pooled analysis of 7.9 million participants, *Frontiers in Nutrition*, 2023, **10** [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [10]. Mitchell F., Vitamin-D and COVID-19: do deficient risk a poorer outcome?, *The lancet Diabetes & endocrinology*, 2020, **8**:570 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [11]. Sampat N., Al-Balushi B., Al-Subhi L., Al-Adawi S., Essa M.M., Qoronfleh M.W., Vitamin D: Public Health Status Regional Gulf Region, *International Journal of Nutrition, Pharmacology, Neurological Diseases*, 2019, **9**:117 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [12]. Ahmed S.S., Vitamin D Deficiency among the Children: A Silent Epidemic in a Selected Rural Area of Bangladesh, *Journal of Enam Medical College*, 2020, **10**:93 [[Crossref](#)], [[Google Scholar](#)]
- [13]. Ganie M.A., Sahar T., Wani I., Rashid A., Robbani I., Nisar S., Charoo B.A., Bhat M.A., Gania M., Farooq Q., Vishnubhatla S., Vitamin D status among Kashmiri tribal population: A cross-sectional community-based study, *Indian Journal of Medical Research*, 2022, **156**:348 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [14]. Muthayya S., Rah J.H., Sugimoto J.D., Roos F.F., Kraemer K., Black R.E., The global hidden hunger indices and maps: an advocacy tool for action, *PloS one*, 2013, **8**:e67860 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [15]. Al Khalifah R., Hamad M.H., Hudairi A., Al-Sulimani L.K., Al Homyani D., Al Saqabi D., Bashiri F.A., Prevalence and Related Risk Factors of Vitamin D Deficiency in Saudi Children with Epilepsy, *Children*, 2022, **9**:1696 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [16]. Tuffaha M., El Bcheraoui C., Daoud F., Al Hussaini H.A., Alamri F., Al Saeedi M., Basulaiman M., Memish Z.A., AlMazroa M.A., Al Rabeeah A.A., Mokdad A.H., Deficiencies under plenty of sun: vitamin D status among adults in the Kingdom of Saudi Arabia, 2013, *North American journal of medical sciences*, 2015, **7**:467 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [17]. Alzahrani A.M., Emam L.S., Alsharif M.S., Hakami A.Y., Aga S.S., Clinical Identification of Hypovitaminosis D among Elderly Attending Primary Care Centre in Saudi Arabia, *Biochemistry Research International*, 2022, **2022** [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [18]. Alkhenizan A., Mahmoud A., Hussain A., Gabr A., Alsoghayer S., Eldali A., The relationship between 25 (OH) D levels (Vitamin D) and bone mineral density (BMD) in a Saudi population in a community-based setting, *PLoS One*, 2017, **12**:e0169122 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [19]. AlZahrani, W.I., Oommen, A., Role of vitamin D in the academic performance of health sciences students in Saudi Arabia, *Arab Gulf Journal of Scientific Research*, 2023, **41**:40 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [20]. Altowijri A., Alloubani A., Abdulhafiz I., Saleh A., Impact of nutritional and environmental factors on vitamin D deficiency, *Asian Pacific journal of cancer prevention: APJCP*, 2018, **19**:2569 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [21]. Alzaheb R.A., Al-Amer O., Prevalence and predictors of hypovitaminosis D among female

- university students in Tabuk, Saudi Arabia, *Clinical Medicine Insights: Women's Health*, 2017, **10**:1179562X17702391 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [22]. Al-Daghri N.M., Al-Saleh Y., Aljohani N., Alokail M., Al-Attas O., Alnaami A.M., Sabico, S., Alsulaimani M., Al-Harbi M., Alfawaz H., Chrousos G.P., Vitamin D deficiency and cardiometabolic risks: a juxtaposition of Arab adolescents and adults, *PloS one*, 2015, **10**:e0131315 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [23]. Wimalawansa S.J., Associations of vitamin D with insulin resistance, obesity, type 2 diabetes, and metabolic syndrome, *The Journal of steroid biochemistry and molecular biology*, 2018, **175**:177 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [24]. Bokhari, F.F., Albaik, M., Vitamin D and its deficiency in Saudi Arabia, In *Vitamin D Deficiency*, 2019, 3, IntechOpen. [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [25]. Sutaria N., Liu C.T., Chen T.C., Vitamin D status, receptor gene polymorphisms, and supplementation on tuberculosis: a systematic review of case-control studies and randomized controlled trials, *Journal of clinical & translational endocrinology*, 2014, **1**:151 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [26]. Cui, X., Gooch, H., Petty, A., McGrath, J.J., Eyles, D., Vitamin D and the brain: Genomic and non-genomic actions, *Molecular and cellular endocrinology*, 2017, **453**:131 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [27]. Uwitonze A.M., Murererehe J., Ineza M.C., Harelimana E.I., Nsabimana U., Uwambaye P., Gatarayihya A., Haq A., Razzaque M.S., Effects of vitamin D status on oral health, *The Journal of steroid biochemistry and molecular biology*, 2018, **175**:190 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [28]. Lorenzen M., Boisen I.M., Mortensen L.J., Lanske B., Juul A., Jensen M.B., Reproductive endocrinology of vitamin D, *Molecular and cellular endocrinology*, 2017, **453**:103 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [29]. Aloia J.F., Patel M., DiMaano R., Li-Ng M., Talwar S.A., Mikhail M., Pollack S., Yeh J.K., Vitamin D intake to attain a desired serum 25-hydroxyvitamin D concentration, *The American journal of clinical nutrition*, 2008, **87**:1952 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [30]. van Helmond N., Brobyn T.L., LaRiccia P.J., Cafaro T., Hunter K., Roy S., Bandomer B., Ng K.Q., Goldstein H., Mitrev L.V., Tsai A., Vitamin D3 Supplementation at 5000 IU Daily for the Prevention of Influenza-like Illness in Healthcare Workers: A Pragmatic Randomized Clinical Trial, *Nutrients*, 2023, **15**:180 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [31]. Alamoudi L.H., Almuteeri R.Z., Al-Otaibi M.E., Alshaer D.A., Fatani S.K., Alghamdi M.M., Safdar O.Y., Awareness of vitamin D deficiency among the general population in Jeddah, Saudi Arabia, *Journal of nutrition and metabolism*, 2019, **2019**:4138187 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [32]. Choi R., Cho S.E., Lee S.G., Lee E.H., Recent Information on Vitamin D Deficiency in an Adult Korean Population Visiting Local Clinics and Hospitals, *Nutrients*, 2022, **14**:1978 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [33]. Mohd Saffian, S., Jamil, N.A., Mohd Tahir, N.A., Hatah, E., Vitamin D insufficiency is high in Malaysia: A systematic review and meta-analysis of studies on vitamin D status in Malaysia, *Frontiers in Nutrition*, 2022, **9**:2861 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [34]. Cui A., Xiao P., Ma Y., Fan Z., Zhou F., Zheng J., Zhang L., Prevalence, trend, and predictor analyses of vitamin D deficiency in the US population, 2001–2018, *Frontiers in Nutrition*, 2022, **9**:2312 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [35]. Nohra J., Sacre Y., Abdel-Nour A., Mannan H., Evaluation of Knowledge, Attitudes, and Practices Related to Osteoporosis and Correlates of Perceived High Risk among People Living in Two Main Districts of Lebanon, *Journal of Osteoporosis*, 2022, **2022**:1188482 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]
- [36]. Tlt, A.E., Barghash, S.S., Al-Salamah, N.I., Knowledge, Attitude and Practice (KAP) Regarding Osteoporosis among General Population in Saudi Arabia, *British Journal of Medicine and Medical Research*, 2016, **13**:1 [[Google Scholar](#)], [[Publisher](#)]
- [37]. Chan C.Y., Subramaniam S., Chin K.Y., Ima-Nirwana S., Muhammad N., Fairus A., Ng P.Y., Jamil N.A., Abd Aziz N., Mohamed N., Levels of knowledge, beliefs, and practices regarding

osteoporosis and the associations with bone mineral density among populations more than 40 years old in Malaysia, *International journal of environmental research and public health*, 2019, **16**:4115 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]

[38]. Kmiec P., Zmijewski M., Waszak P., Sworczak K., Lizakowska-Kmiec M., Vitamin D deficiency during winter months among an adult, predominantly urban, population in Northern Poland, *Endokrynologia Polska*, 2014, **65**:105 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]

[39]. Dik D., Kaur M., Prevalence of vitamin D deficiency and associated risk factors among adults in Chandigarh, *International Journal of Advanced Medical and Health Research*, 2020, **7**:67 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]

[40]. Bouillon R., Manousaki D., Rosen C., Trajanoska K., Rivadeneira F., Richards J.B., The

health effects of vitamin D supplementation: Evidence from human studies, *Nature Reviews Endocrinology*, 2022, **18**:96 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]

[41]. Kocabaş R., Aköz M., The effects of vitamin D supplementation on healthy and hypercholesterolemic rabbits on levels of OSI and paraoxonase, *Turkish Journal of Biochemistry*, 2018, **43**:549 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]

[42]. Mäkitaipale J., Sievänen H., Sankari S., Laitinen-Vapaavuori O., Diet is a main source of vitamin D in Finnish pet rabbits (*Oryctolagus cuniculus*), *Journal of animal physiology and animal nutrition*, 2019, **103**:1564 [[Crossref](#)], [[Google Scholar](#)], [[Publisher](#)]

HOW TO CITE THIS ARTICLE

Amal Abdulbaqi, Rym Hassani, Omaymah Radwan. Determining Levels Awareness of Vitamin D as a Silent Epidemic among the Population in Southern Saudi Arabia. *J. Med. Chem. Sci.*, 2023, 6(10) 2338-2347

DOI: <https://doi.org/10.26655/JMCHMSCI.2023.10.9>

URL: http://www.jmchemsci.com/article_171355.html