Study association between vitamin d_3 with liver function and kidney in student

Israa Ali Hussein

Department of Chemistry, College of Science, Karbala University, Karbala, Iraq

Correspondence Author: Israa Ali Hussein

Received 14 Jul 2023; Accepted 23 Aug 2023; Published 4 Sep 2023

Abstract

This investigation examined how much vitamin D3 students in the Education of Education have in relation to their liver and kidney health. In 2023, 90 samples (20–30 years old, 52 men, and 38 women) were gathered.1.12 - 2018.2.12. The measurement of (Vitamin D3, Urea, Uric acid, Creatinine, AST and ALT) was completed in this study. Each parameter has been divided into two categories based on its vitamin D3 status. Vitamin D3 samples that fall into the first group G1 are those that have an adequate amount, whereas samples that fall into the second group G2 have insufficient levels of the vitamin. The findings were as follows: Vitamin D3 levels significantly decreased in deficient patients when compared to sufficient subjects (P 0.05). Females and rural participants both had greater rates of vitamin D3 insufficiency than males and urban subjects. While there was no discernible variation in ALT level between G1 and G2 samples, there was a substantial rise in ALT enzyme among G2 samples when compared to G. There were no discernible variations in the levels of urea, uric acid, or creatinine between the two groups.

Keywords: vitamin d_3, kidney, liver and other functions

Introduction

Vitamin D is a water-soluble vitamin Fat [1], a steroid hormone Which affects more than 1000 in the body human [2], and there are two basic forms of the vitamin D, the first is vitamin D2 (ergocalciferol). Ergocalciferol which can be obtained from its raw material Ergosterol Which is found in plants, and can be obtained It exposes the sterol to sunlight or UV rays [3, 4]. The second is vitamin D3 (Colecalciferol) and is It comes from the skin and can be obtained through 7-dehydrocholestrol and animal foods [5].

The most important source of vitamin D3 is dermal composition which contributes more than 90% of the vitamin concentration [6]. Vitamin D is required to at least two important hydroxyl steps in metabolism [3], and for the purpose of vitamin conversion D2 and vitamin D3 into effective compounds that require two steps Catalyzed by enzymes, the first step occurs in liver turns vitamin D2 and vitamin D3 into 25-hydroxy vitamin D3 [25(OH)D3] with coenzyme effect 25-hydroxylase, and the second step occurs in kidneys convert 25-hydroxyvitamin D3 to 1,25-dihydroxy vitamin D3 [1,25(OH)2D3). It is mediated by the enzyme 1-α-hydroxylase, which is active vitamin [7]. Vitamin D3 deficiency is associated with many factors including cardiovascular disease and depression, Hipping [8]. Nor will bone rickets in weak children that the immune system, and diabetes mellitus, cancer [9], and asthma [10]. Asthma, hemophilia [11] Parkinson's disease [12].

It is a vitamin deficiency D3 is a global health problem as a result of its association with many of chronic and acute diseases, as there are more than a billion. Almost everyone has a vitamin deficiency or insufficiency D3 is around the world, and the incidence is declining Vitamin levels are particularly high Middle Eastern girls and women, and vitamin deficiency. D_3 includes a large number of infants and children and adolescents, pregnant women, and the elderly [13]. Aim This study aimed to assess the level of vitamin D3 and identify the prevalence of vitamin deficiency with liver function and the kidneys.

Materials and methods

Collection of blood samples and preparation of serum 90 blood samples (52 males and 38 females) were collected from students of the College of Education to investigate vitamin D3 deficiency among healthy students whose ages ranged between 20-30 years. The tubes were left at room temperature for ten minutes until coagulation was completed, then they were placed in the centrifuge for 10 minutes at a speed of 3000 rpm, then the serum was withdrawn with a micropipette and placed in clean and sterile tubes and kept in a frozen state at a temperature of ˚C-20 To perform the required biochemical tests.

The level of vitamin D3 [14], liver function [15], aspartate aminotransferase (AST), alanine amino transaminase-ALT, and kidney function (urea [16]), uric acid [17], creatinine [18] were measured). Among the companies are Monobined-USA, Randox-England, Randox-England, Randox-England, Vitro-Germany, Biolabo-France, respectively. The results were analyzed statistically using the statistical program (SPSS), by using the T-Test test, at a probability level of $p \leq 0.05$.

Results

The prevalence of vitamin D3 deficiency among the sampled individuals. The level of vitamin D3 was measured for 90 samples using the ELISA technique. The results showed that the number of samples whose vitamin D level was within the normal range (greater or equal to 30 ng / cm3) was 13 samples,

i.e. 14.4%, while the number of samples that have a level of vitamin less than the normal level was 77 samples, meaning that the percentage of deficiency was 85.56% in student, as in Figure (1).

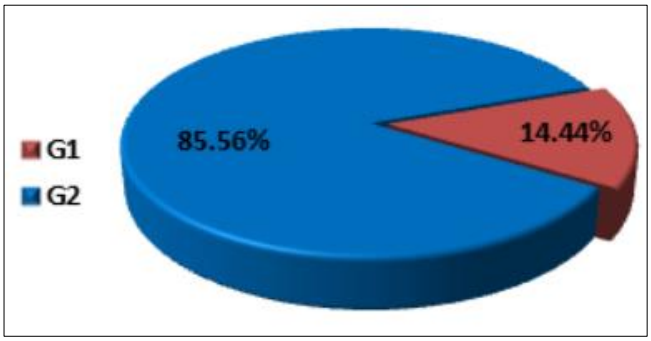

Fig 1: deficiency prevalence of Vitamin D3 Samples is included in the study

The prevalence of vitamin D deficiency among males and females of the samples under study was also studied. The results of the current study showed that the percentage of males who had a deficiency in the level of vitamin D3 was 80.77% (42 from a total of 52) compared to 19.23% (10 from 52) They have a normal level of the vitamin, as shown in Figure (2). As for the prevalence of deficiency.

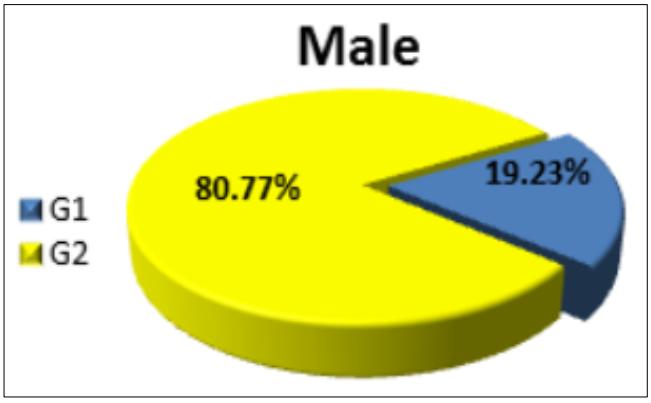

Fig 2: Prevalence of vitamin D3 deficiency among male students

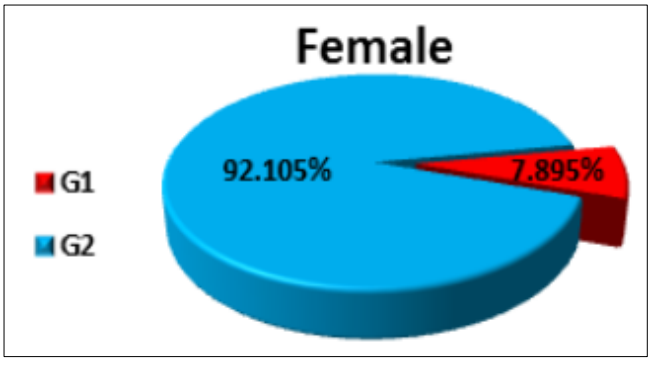

Fig 3: Prevalence of vitamin D3 deficiency among female students

The prevalence of vitamin D3 deficiency among rural and city residents was also studied, as the results showed that the percentage of vitamin D3 deficiency among students of city residents was 93.3% (42from a total of 45) compared to 3% (3 from a total of 45) who had a normal level of the vitamin. As shown in Figure (4). As for students from rural areas, the prevalence of vitamin D deficiency was 35 (77.8% D3 from a total of 45) compared to 22.2% (10 from a total of 45) of the samples that had sufficient vitamin D3, as shown in the figure. (5).

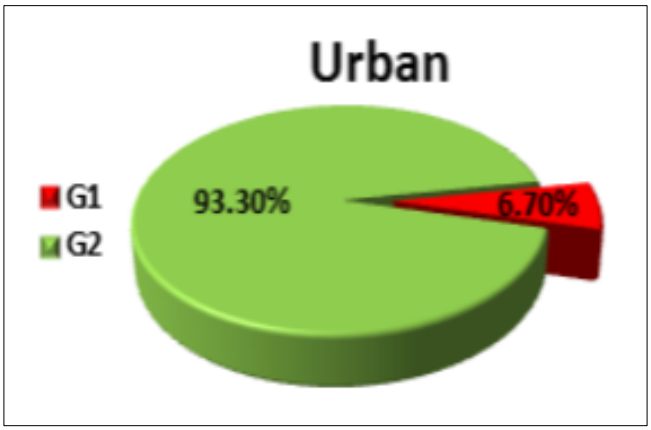

Fig 4: Prevalence of vitamin D3 deficiency among students living in urban areas

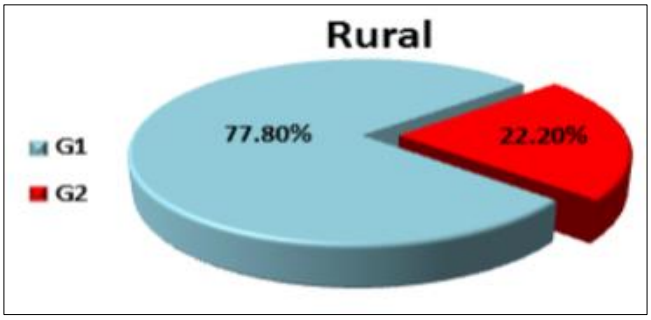

Fig 5: Prevalence of vitamin D3 deficiency among students living in Rural areas

Vitamin D level

The samples under study were divided into two groups accustomed to the level of vitamin D3. Table (1) shows the average ± the standard deviation of the vitamin level for group G1, in which the level of vitamin is more than or equal to 30 ng / cm3, and the second group, G2, in which the level of vitamin is less than 30 ng/cm3.

Table 1: Mean ± standard deviation for the vitamin D3 level of the samples

Mean ±S.D (ng/ml)		P≤
G1 n=13))	G2 n=77))	
35.5 ± 3.58	16.9± 6.22	0.05

It is clear from the results above that the level of vitamin D decreased significantly and at the level of probability ($p \leq 0.05$) in group G2 who had a deficiency in the level of vitamin compared to group G1 who had a normal level of it.

The effectiveness of liver enzymes depending on the level of vitamin d

The level of activity of the AST and ALT enzymes was

evaluated among university students. The samples were divided into two groups. Group G1 includes samples with a vitamin D3 level higher than 30 ng/cm3, while Group G2 includes samples with a vitamin D level less than 30 ng/cm3. 3, and Table (2) shows the average ± standard deviation for both enzymes.

Table 2

Parameters	Mean ± SD		P≤
	G1(n=13)	G2(n=77)	
AST(U/L)	11.2± 4.79	14.6±8.72	N.S
ALT(U/L)	5.2±1.58	8.2±4.33	0.05

The table above shows that there is no significant difference. The rate of activity of the AST enzyme between the two groups and at the probability level $p \geq 0.05$. As for the effectiveness of the enzyme ALT increased significantly at a probability level of 0.05 P≥ in group G2 who have a deficiency in the level of vitamin D3 compared to group G1 who have its Normal level of vitamin.

Kidney function depending on vitamin d level

The levels of urea, creatinine, and uric acid were assessed among students of the College of Education, and the samples were divided into two groups that were accustomed to the level of vitamin D3, as group G1 included Students who have a normal level of vitamin D3 (or equal to 30 ng/cm3), while the second group, G2, is for students who suffer from vitamin D3 deficiency (less than 30 ng/cm3) and as shown in Table (3)

Table 3: Assessment of renal function depending on the level of vitamin d

Parameters	Mean ± SD		*p* value
	G1(n=13)	G2(n=77)	
Urea (mg/dl)	33.6±7.97	36.9 ±10.65	N.S
Uric acid (mg/dl)	4.2 ±0.89	3.6±1.53	N.S
Creatinine (mg/dl)	1±0.36	1.11± 0.30	N.S

The table above shows that there are no significant differences in the levels of urea, creatinine, and uric acid. The two groups had a deficiency in vitamin levels compared to the G1 group, which had sufficient vitamin levels Vitamin.

Discussion

The results of the current study indicate that the high prevalence of deficiency among students of the College of Education is higher than the results of the Issa and Ibraheem and [19], who indicated that the percentage of deficiency It was 33.91% among healthy subjects Kufa. As well as the results of Darwish and [20]. Who indicated that the percentage of female shortages in Karbala. It was 15%, while its inadequacy was 56.25%. The literature did not see the existence of a study to investigate about Vitamin D3 deficiency among Iraqi university students. However, many studies have examined the prevalence of deficiency Vitamin D3 in patients and healthy subjects Sulaiman and his group [21] indicated that the percentage of vitamin deficiency D3 was 89.1% of the University of the Borders University chalet is one of them one Saudi universities, the study attributed reasons high vitamin D3 deficiency that most females wear A black veil with full body coverage is prohibited sunlight, while males had the most opportunity to be exposed to the sun because of their clothes and more opportunity to be outside the home compared to females. He pointed out Al-Elq and [22]. That the percentage of deficiency was very high. It reached 96.0% among students of the Faculty of Medicine/University King Faisal-Dammam/Saudi Arabia, so it was recommended. The study takes the necessary precautions to address the deficiency and educate students about the necessity of undergoing periodic examination of Vitamin level to avoid the major effects resulting from Vitamin deficiency, and found Sharif and her group [23]. The prevalence of vitamin D3 deficiency among colleges Girls/Qatar University (Aviation Studies) was 43.6%, and brown-haired females had the greatest luck. In their deficiency, as 65% of the samples that she suffers from a deficiency in dark-skinned women skin and 10% of brown skin And 25% of white-skinned females. In Jordan, it was found that the prevalence of vitamin deficiency was D3: 31.2% among female students and 20.5% among female employees of the Hashemite University, and they indicated that the percentage of deficiency that It has to do with long periods of exposure to sunlight While age or type of work had no relationship to level Vitamin deficiency [24]. Studies have not indicated Research the prevalence of vitamin D3 deficiency among categories. Not only for young people, but also for all age groups Gordon and his group [25] indicated that 24.1% of Healthy adolescents in the United States of America that they suffer from vitamin deficiency, and 33.33% are Ben Tab Schools whose ages range from (5-10) years In Rajasthan in India who had Vitamin level is less than 25 ng/cm3 [26]. The reason for the decrease in vitamin levels in the present study may attribute it to malnutrition and habituation. On fast food, as well as the poverty of the Iraqi table with seafood and lack of interest in institutions Health by educating people about the importance of eating healthy foods Supported by vitamins and the importance of dietary diversity and attention Eat foods rich in vitamins, such as yolks Eggs, beef, liver, milk, cheese, and baba. The vitamin is a fat-soluble vitamin Which an adult needs in the amount of 200 units international/day, any factor affecting absorption Intestinal fat can affect absorption Vitamin [27, 28]. The role of sunlight cannot be neglected Lack of exposure to sunlight in Iraq may be. It has a major role in the spread of vitamin deficiency among individuals Society, and this may be due to high temperatures. In the summer, in addition to the lack of open entertainment centers, as well as social customs Especially with regard to females and the difficulty of exposure direct sun for long periods. The prevalence rate Vitamin D3 deficiency among females Males The results of our current study agree with the results Several studies have indicated that the ratio The prevalence of vitamin D3 deficiency was higher among females Males, Al-Elq and [29] indicated that the percentage of deficiency Among females, it was 99.03% compared to 92.64%. For students of the Faculty of Medicine, King Faisal University / Dammam, Likewise, in

Iran, there was a shortage of female students In Shiraz, 51.2% compared to 44% in Shiraz Males [30]. As for school students, Kaddam and his group [31] indicated that the prevalence of deficiency Ben schoolgirls were 69.2% for females and 30.1% for females % among males, and Shin and his group [32] indicated that 98.9% of adolescents in Korea suffer from vitamin D3 deficiency Compared to 100% of females who had this level Vitamin D3 level is less than 30 ng/cm. The high percentage of deficiency in females is due to the current study focuses on religious and social considerations related to clothing as well as excessive exposure to radiation The sun is out and there is also the fear of dis-colouration from light to dark, and not eating enough food Rich in vitamin D3, and sometimes used in meals Plants without animals, as well as nutritional deficiencies fortified with Vitamin D3, if available, it may be empty. It is a result of commercial fraud and lack of health oversight. On the products available in the market, especially milk Fortified with Vitamin D3 and some dairy products. So, It is necessary to conduct educational campaigns to raise awareness The risk of vitamin D3 deficiency, which has recently become called the silent epidemic [33]. It is clear from the results above that there is a percentage of deficiency Vitamin D3 was better than the city compared to the students from rural residents, the results of our current study are consistent with the results of many studies that indicated Prevalence of vitamin D3 deficiency among regional residents Urban compared to rural residents. In a study, the first of its kind among urban residents in However, it was found that the percentage of decrease was 87.1%, and it was the percentage is higher among females, which reached 89% compared to males. It was 84.9% among males, which was the highest percentage of decrease Among females under the age of 20 and those over 80 Year [34]. Suryanarayana [35] and his group indicated that the prevalence of D3 deficiency among the Vietnamese population Urban elderly in hyderabad hindi reported 56.3% with symptoms of high blood pressure and high blood pressure BMI value. The results of our current study are consistent with the results of Fang and his group [36] who indicated that the ratio The deficiency was widespread among urban residents compared to rural residents in Tianjin area. In the Sun, especially in females, and in a study i returned First, the level of vitamin D3 was compared with Ben Tab University in rural Narowal, Pakistan and the students are from the city of Lahore, as it was found that the percentage of deficiency Ala'i bin Tab Naruwal was compared to the students of Lahore, although all studies indicate that the percentage of decrease is the highest among the city's population in comparison. In the countryside, the study attributed this difference to: The dietary pattern in rural areas is strictly vegetarian Mostly, especially with low standards For residents of rural areas [37]. Vitamin D3 deficiency may occur in urban areas to less exposure to the sun compared to rural areas Consequently, the skin production of vitamins decreases on the food pattern and housing design in the city Where closed houses are all reasons that may cause a shortage Vitamin. It appears from the results of the current study that Average ± standard deviation for students who suffering from vitamin D3 deficiency is higher than the rate ± standard deviation of Sulaiman study results and his group [21], as it was 7.59±1.9 ng/cm3 Female students of the Shaliyya Border Region University/Saudi Arabia, I am also aware of the average vitamin level of female students Medical Group in Saudi Arabia, which reached 6.41 ± 3.1 ng/cm3 [22], while it was very close to the results Ardawi and his group [38] as the average vitamin level for samples suffering from vitamin deficiency, 17 ng /cm 3. Vitamin D3 deficiency leads to: Imbalance in the metabolism of calcium, phosphorus, and bones. Its deficiency results in a decrease in the efficiency of the intestines Absorption of dietary calcium and phosphorus [39]. Vitamin D3 deficiency leads to a weakening of the body's ability to Dealing with infections, especially viral ones [40]. Increase However, deficiency is a risk factor associated with an increased incidence Asthma attacks [41]. Another study indicates that irrigation Chronic urticaria is associated with widespread vitamin deficiency D3. The spread of deficiency is also linked to the occurrence Inflammation [42], in addition, a study has proven. The effectiveness of vitamin D3 as an antimicrobial [43], and one A deficiency in its level may lead to psoriasis that affects wild skin [44]. Abdul Rahman [45] in a study conducted to determine the relationship vitamin D level and colon cancer and the rectum indicates that high levels of it has been associated with a lower risk of colon cancer and the rectum and lower death rates. If it decreases Vitamin D3 is very common among patients who suffer from Liver disease, and it may be affected by vitamin deficiency. It affects liver function by a mechanism that is not understood [46], Kasapoglu and his group [47] indicated that vitamin deficiency D3 in healthy people may be a risk factor for fatty liver disease, according to the mechanism of fat flow from Adipose tissue to accumulate in the liver. the results in our current study, there was no significant difference in level AST enzyme between the two groups, and this is not consistent with the results Göçmen and Özkanea [48], who indicated that there was a significant decrease in the level of the AST enzyme in Children who have sufficient levels of vitamins.

Compared to children whose vitamin level they have low. Not many studies have covered it the relationship between AST enzyme activity and vitamin levels. This is because this enzyme is specialized for diseases Muscular and cardiac diseases more than liver diseases. The results of the current study indicate an increase significantly in the level of ALT enzyme in the samples that It has a low level of vitamins in comparison with samples that have a sufficient level of it and agree the results of our current study combined with the results of Göçmen and Özkanea and [49] who conducted their study on children Healthy people aged 3-16 years and indicated the presence of A significant increase in the ALT enzyme in children who have a vitamin D3 level of less than 20 ng/cm3 compared to children who have a sufficient level Of vitamin. This is because the ALT enzyme is an indicator More than one enzyme is responsible for causing liver damage AST and [50], as people with liver disease are susceptible Vitamin D deficiency due to malabsorption Fats and a lack of bile salts, which are necessary. It is very important for intestinal absorption of vitamins D and E A defect in liver function

causes impairment in the process of addition hydroxyl group that occurs in the liver and reduces the liver's production of bound vitamins with protein [51]. Barchetta and his group [52] point to Presence of vitamin D3 receptors in the liver, Vitamin levels have an inverse relationship with inflammation Acute liver disease [53], as most studies have shown Vitamin D3 insufficiency was associated with progression Chronic liver disease [54] Such as vitamin D3 deficiency It may be an important indicator for diagnosing kidney disease Early, according to a study published in the magazine American Journal of Kidney Diseases, as it was found that people Those who suffer from vitamin D3 deficiency may They are twice as likely to become infected with urine Albuminuria compared to people who They have a normal level of vitamins and are free of excess Five years after suffering from vitamin deficiency, which is An early sign of kidney disease, as the kidneys are normal Do not pass up albumen because of its importance to the body and still does The role of vitamin D3 deficiency in causing kidney damage. It is not clear, as some research confirms this role Some of them deny the existence of a relationship between vitamin deficiency and kidney function [55]. Many studies have indicated Until a deficiency in vitamin D3 levels is always accompanied by It was found that vitamin D3 receptor activators Vitamin D receptor–VDR which includes Paricalcitol and Calcitriol may contribute to Therefore, the level of creatinine in blood serum increases Decrease in glomerular filtration rate filtration rate-GFR, it is still not clear yet the increase in serum creatinine was due to a decrease in. it true in the GFR or in low creatinine intake [56-58] or to a decrease in creatinine excretion Body [59], an increase in the level of creatinine in the serum. The blood may need to be deficient in vitamin D3 A long period that extends to years, especially as it progresses in age, this explains the results of our current study. The creatinine level did not change significantly though Noticeable increase in blood serum creatinine level for the second group, it is possible that desertion occurs. The shortage did not extend for years. The results of our current study showed that there is no A significant difference in the level of uric acid. The results of our current study are consistent with the results of both groups Thakkinstian and his group [60] on the effects of vitamin deficiency D3 is low in serum uric acid levels Blood, although many studies It indicated that high uric acid is associated with vitamin D3 deficiency, this relationship is subject to the genetic aspect [61], as it has been found that individuals who Overweight and obese people who suffer Of vitamin D3 deficiency suffer from an increase in the level Uric acid and increased risk of high blood pressure Cardiovascular disease and kidney disease.

References

1. Ardesia M, Ferlazzo G, Fries W. Vitamin D and inflammatory bowel disease. BioMed Research International, 2015, 2015.
2. Joshi SR. Vitamin D paradox in plenty sunshine in rural India-an emerging threat. JAPI, 2008, 56.
3. Du C, Yang S, Zhao X, Dong H. Pathogenic roles of alterations in vitamin D and vitamin D receptor in gastric tumorigenesis. Oncotarget. 2017;25;8(17):29474.
4. Jäpelt RB, Jakobsen J. Vitamin D in plants: a review of occurrence, analysis, and biosynthesis. Frontiers in plant science. 2013;13(4):136.
5. Bikle DD. Vitamin D metabolism, mechanism of action, and clinical applications. Chemistry & Biology. 2014;2021(3):319-29.
6. Mathieu C, Gysemans C. Vitamin D and diabetes. Av Diabetol. 2006;22(3):18793.
7. Holick MF. Sunlight and vitamin D for bone health and prevention of autoimmune diseases, cancers, and cardiovascular disease. The American journal of clinical nutrition. 2004;80(6):1678S-88S.
8. Calvo MS, Whiting SJ, Barton CN. Vitamin D intake: a global perspective of current status. The Journal of Nutrition. 2005;135(2):310-6.
9. Ali Ali OA. Vitamin D levels in Adult patients with Hemophilia. Unversity of Gaziantep, 2018.
10. Hatem AK, Lateef HF. The state of Vitamin D in Iraqi Patients with Parkinson Disease. Al-Kindy College Medical Journal. 2017;13(1):137-41.
11. Palacios C, Gonzalez L. Is vitamin D deficiency a major global public health problem? The Journal of steroid biochemistry and molecular biology. 2014;144:138-45.
12. Holick MF. Vitamin D Status: Measurement, Interpretation and Clinical Application. Ann Epidemoil. 2009;19(2):73-78.
13. Reitman S, Frankel S, Amer J. Clin. Path. 1957;28:56.
14. Young DS. Effects of Drugs on Clinical Laboratory Tests. Third Edition. 1990;3:612.
15. Krieg M, *et al*. J. Clin. Chem. Clin. Biochem. 1986;24:863.
16. TIETZ NW. Text book of clinical chemistry, 3rd Ed. C.A. Burtis, E.R. Ashwood, W.B. Saunders, 1999, 1241-1245.
17. Issa AM, Ibraheem SA. Alterations of vitamin" D" level in sera of Iraqi population. Journal of Kerbala University. 2007;5(1):58-64.
18. Darwish LAAI. Vitamin D status in healthy femal individuals. ALKufa Unversity Journal of Biology, 2018, 10(1).
19. Sulaiman AH, Abukanna AM, Alenezy AA, Balla AA. Prevalence of Vitamin D deficiency among University Female Students in Northern Border Region of Kingdom of Saudi Arabia (KSA). Annals of Medical and Health Sciences Research, 2017.
20. Al-Elq AH. The status of vitamin D in medical students in the pre-clerkship years in a Saudi Medical School. J Fam Community Med. 2012;19:100-104.
21. Sharif Elham, Rizk Nasser, Jasim Ameena, Mohamed Asma. The Prevalence of Vitamin D3 Deficiency Among College Females at Qatar University (Pilot study). First regional nutrition conference. Qatar University.
22. Qatatsheh A, Tayyem R, Al-Shami I, Al-Holy MA, Al-Rethaia AS. Vitamin D deficiency among Jordanian university students and employees. Nutrition & Food Science. 2015;45(1):68-82.
23. Gordon CM, DePeter KC, Feldman HA, Grace E, Emans

SJ. Prevalence of vitamin D deficiency among healthy adolescents. Archives of Pediatrics & Adolescent Medicine. 2004 Jan;158(6):531-7.
24. Sharawat I, Sitaraman S, Dawman L. Prevalence of Vitamin D Deficiency among Healthy School Children in Jaipur District, Rajasthan, India. International Journal of Pediatrics. 2015 Jan;3(4.2):801.
25. Holick HL. Biochemistry and physiology-Aspect of Nutrition. 4th Ed. Mosbey, 2004.
26. Jhon GR. competitive protein binding redio assay for 25(OH) D3. Journal Clinical Endocr. Metab. 1971;33:9925.
27. Al-Elq AH. The status of Vitamin D in medical students in the preclerkship years of a Saudi medical school. Journal of Family & Community medicine. 2012;19(2):100.
28. Faghih S, Abdolahzadeh M, Mohammadi M, Hasanzadeh J. Prevalence of vitamin d deficiency and its related factors among university students in Shiraz, Iran. International Journal of Preventive Medicine. 2014;5(6):796.
29. Kaddam IM, Al-Shaikh AM, Abaalkhail BA, Asseri KS, Al-Saleh YM, Al-Qarni AA, Al-Shuaibi AM, Tamimi WG, Mukhtar AM. Prevalence of vitamin D deficiency and its associated factors in three regions of Saudi Arabia: A cross-sectional study. Saudi medical journal. 2017;38(4):381.
30. Shin Y, Kim K, Lee C, Shin H, Kang M, Lee H, *et al*. High prevalence of vitamin D insufficiency or deficiency in young adolescents in Korea. Journal of Pediatrics. 2012;171:1475-1480. doi: 10.1007/s004310-1746-012-European.
31. Sharawat I, Sitaraman S, Dawman L. Prevalence of Vitamin D Deficiency among Healthy School Children in Jaipur District, Rajasthan, India. International Journal of Pediatrics. 2015 Jan;3(4.2):801.
32. Ning Z, Song S, Miao L, Zhang P, Wang X, Liu J, *et al*. High prevalence of vitamin D deficiency in urban health checkup population. Clinical Nutrition. 2016;31;35(4):859-63.
33. Suryanarayana P, Arlappa N, Sai Santhosh V, Balakrishna N, Lakshmi Rajkumar P, Prasad U, *et al*. Prevalence of vitamin D deficiency and its associated factors among the urban elderly population in Hyderabad metropolitan city, South India. Annals of Human Biology. 2018;45(2):133-9.
34. Fang F, Wei H, Wang K, Tan L, Zhang W, Ding L, *et al*. High prevalence of vitamin D deficiency and influencing factors among urban and rural residents in Tianjin, China. Archives of Osteoporosis. 2018;13(1):64.
35. Butta, Yasmeen F, Alavi n. Comparison of Vitamin D levels between urban and rural college students.
36. Ardawi MS, Qari MH, Rouzi AA, Maimani AA, Raddadi RM. Vitamin D status in relation to obesity, bone mineral density, bone turnover markers and vitamin D receptor genotypes in healthy Saudi pre-and postmenopausal women. Osteoporosis International. 2011;22(2):463-75.
37. Holick MF. Vitamin D deficiency. New England Journal of Medicine. 2007;357(3):266-81.
38. Chesney RW. Vitamin D and The Magic Mountain: the anti-infectious role of the vitamin. The Journal of pediatrics. 2010;156(5):698-703.
39. Abbas RS, Abdulridha MK, Shafek MA, Najim HD. Correlation between Endogenous Vitamin D Status and Body Mass Index in Asthmatic Patients Receiving Adjuvant Vitamin D3 Supplement. Karbala Journal of Pharmaceutical Sciences. 2017;13:106-21.
40. Boonpiyathad T, Pradubpongsa P, Sangasapaviriya A. Vitamin D supplements improve urticaria symptoms and quality of life in chronic spontaneous urticarial patients: a prospective case-control study. Dermato-Endocrinology. 2016;8(1):e983685.
41. Youssef DA, Miller CW, El-Abbassi AM, Cutchins DC, Cutchins C, Grant WB, *et al*. Antimicrobial implications of vitamin D. Dermato-Endocrinology. 2011;3(4):220-9.
42. Al-Dhubaibi MS. Association between Vitamin D deficiency and psoriasis: An exploratory study. International Journal of Health Sciences. 2018 Jan;12(1):33.
43. Skaaby T, Husemoen LL, Borglykke A, Jørgensen T, Thuesen BH, Pisinger C, *et al*. Vitamin D status, liver enzymes, and incident liver disease and mortality: a general population study. Endocrine. 2014;47(1):213-20.
44. Kasapoglu B, Turkay C, Yalcin KS, Carlioglu A, Sozen M, Koktener A. Low vitamin Dlevels are associated wıth increased risk for fatty liver disease among non-obese adults. Clinical Medicine. 2013;13(6):576.
45. Özkan EA, Göçmen AY. Association Between Thyroid Function Tests, Liver Enzymes and Vitamin D in Healthy Children. 2016;9(1):7-12.
46. Kwo PY, Cohen SM, Lim JK. ACG Clinical guideline: evaluation of abnormal liver chemistries. The American Journal of Gastroenterology. 2017;112(1):18.
47. Dufour DR, Lott JA, Nolte FS, Gretch DR, Koff RS, Seeff LB. Diagnosis and monitoring of hepatic injury. I. Performance characteristics of laboratory tests. Clinical Chemistry. 2000;46(12):2027-49.
48. Malham M, Jørgensen SP, Ott P, Agnholt J, Vilstrup H, Borre M, *et al*. Vitamin D deficiency in cirrhosis relates to liver dysfunction rather than aetiology. World Journal of Gastroenterology (WJG). 2011;17(7):922.
49. Barchetta I, Carotti S, Labbadia G, Gentilucci UV, Muda AO, Angelico F, *et al*. Liver vitamin D receptor, CYP2R1, and CYP27A1 expression: relationship with liver histology and vitamin D3 levels in patients with nonalcoholic steatohepatitis or hepatitis C virus. Hepatology. 2012;56(6):2180-7.
50. Barchetta I, Carotti S, Labbadia G, Gentilucci UV, Muda AO, Angelico F, *et al*. Liver vitamin D receptor, CYP2R1, and CYP27A1 expression: relationship with liver histology and vitamin D3 levels in patients with nonalcoholic steatohepatitis or hepatitis C virus. Hepatology. 2012;56(6):2180-7.

51. Ding N, Ruth TY, Subramaniam N, Sherman MH, Wilson C, Rao R, *et al*. A vitamin D receptor/SMAD genomic circuit gates hepatic fibrotic response. Cell. 2013;153(3):601-13.
52. Putz-Bankuti C, Pilz S, Stojakovic T, Scharnagl H, Pieber TR, Trauner M, *et al*. Association of 25-hydroxyvitamin d levels with liver dysfunction and mortality in chronic liver disease. Liver Int. 2012;32:845-851. [CrossRef] [PubMed].
53. 2017 National Kidney Foundation, Inc., 30 East 33rd Street, New York, NY 10016, 19010-622-800. We subscribe to the HONcode principles of the Health on the Net Foundation.
54. Bentli R, Taskapan H, Toktaş H, Ulutas O, Ozkahraman A, Comert M. Significant Independent predictors of vitamin D deficiency in inpatients and outpatients of a nephrology unit. International Journal of Endocrinology, 2013, 2013.
55. Xiao X, Wang Y, Hou Y, Han F, Ren J, Hu Z. Vitamin D deficiency and related risk factors in patients with diabetic nephropathy. Journal of International Medical Research. 2016;44(3):673-84.
56. Christiansen C, Rødbro P, Christensen M, Hartnack B, Transbol IB. Deterioration of renal function during treatment of chronic renal failure with 1, 25-dihydroxycholecalciferol. The Lancet. 1978;312(8092):700-3.
57. Perez A, Raab R, Chen TC, Turner A, Hollck M. Safety and efficacy of oral calcitriol (1, 25-dihydroxyvitamin D3) for the treatment of psoriasis. British Journal of Dermatology. 1996 Jun;134(6):1070-8.
58. Agarwal R, Hynson JE, Hecht TJ, Light RP, Sinha AD. Short-term vitamin D receptor activation increases serum creatinine due to increased production with no effect on the glomerular filtration rate. Kidney International. 2011;80(10):1073-9.
59. Thakkinstian A, Anothaisintawee T, Chailurkit L, Ratanachaiwong W, Yamwong S, Sritara P, *et al*. Potential causal associations between vitamin D and uric acid: Bidirectional mediation analysis. Scientific reports. 2015;5:14528.
60. Nath SD, Voruganti VS, Arar NH, Thameem F, Lopez-Alvarenga JC, Bauer R, *et al*. Genome scan for determinants of serum uric acid variability. Journal of the American Society of Nephrology. 2007;18(12):3156-63.
61. John P. Forman, Instructor in Medicine, Brigham and Women's Hospital, Brigham and Women's Hospita, 2017.