

# Maternal Awareness of Vitamin D Deficiency in Infants and up to the Age of 6 Years: A Cross Sectional Study in Jordan

Safa'a Al-Qudah<sup>1</sup>, Leyla Abuhussein<sup>1</sup>, and Samar Al Sbaihi<sup>2</sup>

<sup>1</sup>Al-Balqa' Applied University

<sup>2</sup>Affiliation not available

May 10, 2021

## Abstract

**Background:** Vitamin D Deficiency in children is a worldwide health problem. Yet, there is little known about awareness of parents regarding this issue in Jordan. The recent study aimed to assess the mothers' knowledge and practices toward vitamin D deficiency in infants and up to age of 6 years. **Methods:** an online questionnaire was distributed as Google Form on mothers of children between 0-6 years, assessing their knowledge about vitamin D, its deficiency, and their practices toward vitamin D deficiency for their children, Descriptive statistics and Chi-Square test were performed. **Results:** Most of mothers (64.8%) were aged between 30-40 years, and had education level of Bachelor's degree (63.3%). Sunlight was considered the main source of vitamin D (89.1%), while fish and eggs were the main dietary sources (63.5%, 65.5%, respectively). Vitamin D was considered important for bone and teeth health (93.9%). The majority of participants reported lack of sun exposure and decreased vitamin D rich foods as risk factors and rickets as complication of vitamin D deficiency (98.5%, 96.4%, 89.3%, respectively). Most of mothers (65.1%) indicated the time before 10 AM as the best time of day to expose baby/child to the sun. The majority of participants (82.2%) believe that vitamin D deficiency is a common health problem in children in our country, and 86.4% think they need more information on vitamin D deficiency in children. Age, nationality, nature of housing, and age group of children had an impact on knowledge's level of participants. **Conclusion:** Most of participants were aware of vitamin D sources, benefits, risk factors and complications of deficiency, although there was inadequate knowledge among respondents was found in certain domains of vitamin D. More education is required for mothers about vitamin D and its deficiency.

## Maternal Awareness of Vitamin D Deficiency in Infants and up to the Age of 6 Years: A Cross Sectional Study in Jordan

### Abstract:

**Background:** Vitamin D Deficiency in children is a worldwide health problem. Yet, there is little known about awareness of parents regarding this issue in Jordan. The recent study aimed to assess the mothers' knowledge and practices toward vitamin D deficiency in infants and up to age of 6 years.

**Methods:** an online questionnaire was distributed as Google Form on mothers of children between 0-6 years, assessing their knowledge about vitamin D, its deficiency, and their practices toward vitamin D deficiency for their children, Descriptive statistics and Chi-Square test were performed.

**Results:** Most of mothers (64.8%) were aged between 30-40 years, and had education level of Bachelor's degree (63.3%). Sunlight was considered the main source of vitamin D (89.1%), while fish and eggs were the main dietary sources (63.5%, 65.5%, respectively). Vitamin D was considered important for bone and teeth health (93.9%). The majority of participants reported lack of sun exposure and decreased vitamin D rich foods as risk factors and rickets as complication of vitamin D deficiency (98.5%, 96.4%, 89.3%, respectively).

Most of mothers (65.1%) indicated the time before 10 AM as the best time of day to expose baby/child to the sun. The majority of participants (82.2%) believe that vitamin D deficiency is a common health problem in children in our country, and 86.4% think they need more information on vitamin D deficiency in children. Age, nationality, nature of housing, and age group of children had an impact on knowledge's level of participants.

**Conclusion:** Most of participants were aware of vitamin D sources, benefits, risk factors and complications of deficiency, although there was inadequate knowledge among respondents was found in certain domains of vitamin D. More education is required for mothers about vitamin D and its deficiency.

**Keywords :** Vitamin D; awareness; deficiency; knowledge.

What is already known about this topic?

1. Vitamin D deficiency is a common global health problem among different age groups.
2. Vitamin D deficiency is prevalent in Jordan among children.
3. Little is known about awareness of parents in Jordan regarding vitamin D deficiency in children.

What does this article add?

This study assessed the mother's knowledge and practices toward vitamin D deficiency in infants and up to age of 6 years in Jordan.

The result of this study concluded that the Jordanian mothers had inadequate level of knowledge in certain domains of vitamin D such as some dietary sources, risk factors and complications of deficiency in addition to some practices undertaken by participants

## **Maternal Awareness of Vitamin D Deficiency in Infants and up to the Age of 6 Years: A Cross Sectional Study in Jordan**

### **Introduction:**

Vitamin D Deficiency (VDD) is a worldwide problem among children with prevalence rate ranging between 12-24% in developed countries among infants, toddlers and older children. <sup>1</sup> In Jordan, studies reported various rates of VDD among different age groups. A cross sectional study reported high prevalence rate of 77% among infants. <sup>2</sup> Higher prevalence rate (94.1%) among newborns was documented in another study <sup>3</sup> and 19.8% was the prevalence rate in a national survey of preschool children. <sup>4</sup>

Vitamin D is one of the vitamins which is soluble in fat, it presents in two forms: Vitamin D<sub>2</sub> (ergocalciferol) which is present in some plants and fungi, and vitamin D<sub>3</sub> which is synthesized in skin upon exposure to sunlight. <sup>5</sup> The most common dietary sources of vitamin D are fatty fish, cod liver oil, and vitamin D fortified foods, it is present in lower amount in vegetables and fruits. In human breast milk it is found in low amount. <sup>6</sup> Vitamin D is essential for calcium phosphorus balance, and bone development, it is important in immunity. <sup>7</sup> VDD may lead to rickets in infants and children. The most common risk factors for VDD include age groups (infants, adolescents, elderly), imbalance of diet, exclusive breast feeding, inadequate maternal vitamin D in pregnancy, inadequate sun exposure, fat malabsorption, medications such as anticonvulsants, use of sunscreen, dark skin color and others. <sup>8</sup>

Vitamin D is recommended by AAP in 2003 for all children in the first two months of life in a dose of 200 IU/day, which is modified in 2008 into 400 IU/day starting from the first few days through adolescence. <sup>9</sup>

To our knowledge, no descriptive studies have been conducted in Jordan to assess the level of knowledge and awareness about vitamin D regarding its importance, sources, complications and risk factors of its deficiency among the parents. So, we aimed in this study to assess the mother's knowledge and practices toward vitamin D deficiency in infants and up to age of 6 years in order to facilitate decision makers in designing interventions appropriate for the context of Jordan. A secondary aim is to identify the factors that have impact on mother's knowledge level.

**Methodology:**

This is an observational cross-sectional study conducted among mothers who have children of age 0-6 years. A questionnaire was designed to collect information by direct knowledge questions about vitamin D.

**Questionnaire:**

The questionnaire was designed by the authors after reviewing many studies about Vitamin D deficiency.<sup>10-13</sup> The questions were modified to meet the aims of study and validated by: a general pediatrician, and pediatric consultant, pediatric and newborn specialist. The final version of the questionnaire was translated to Arabic language and distributed online as Google form through WhatsApp and Facebook groups.

The questionnaire consisted of interface and three sections: demographics, vitamin D related knowledge and practices, vitamin D related perception. The interface explains the aim of the study and confirming the confidentiality of information.

Demographic data include general information such as age, nationality, residency place, work status, level of education, age group of children.

The section of vitamin D related knowledge and practices included six questions about sources, benefits, risk factors and complications of deficiency, relation with skin color and breast milk which were answered by “Yes”, “No”, or “I don’t know”, and ten multiple choice questions about practices undertaken by mother regarding vitamin D intake during pregnancy, breastfeeding, and toward their babies/children. The last section included six questions regarding mother’s perceptions toward vitamin D which were answered using five level Likert item scale (strongly agree, agree, neither agree nor disagree, disagree, strongly disagree).

**Statistical analysis:**

Data were analyzed by using version 26 of SPSS software. The analysis includes basic descriptive statistics (frequencies and percentages), and Chi-square test. Chi-square test was performed to assess the association between categorical variables and knowledge score at the 5 percent significance level ( $p < 0.05$ ). The knowledge level was divided into two groups after summation of total score: high knowledge (if total score is equal to or more than the mean total score), and poor (if total score is less than mean total score).

**Ethical Approval:**

The study was approved by the Ethics Committee of Al-Balqa Applied University. Approval number is 26/3/1/747. The submission of questionnaire by responders was considered consent to participate in the study.

**Results:**

A total of 783 participants filled in the questionnaire. Almost all are Jordanian (96.6%). More than 60% of respondents aged between 30-40 years and had bachelor’s degree. Most of participants live in a city and approximately 70% of them live in apartment. Not all mothers answered question concerning family income.

A total of 372 (47.5%) of mothers had children between 2-6 years. Table 1 shows the demographic and characteristic variables of participants.

**Table 1. Demographic Data of Participants (N=783)**

Characteristic Variable	Characteristic Variable	Number of respondents (N)	Percentage (%)
Age	< 30 yrs	204	26.1
	30 - 40 yrs	507	64.8
	> 40 yrs	72	9.2
Nationality	Jordanian	756	96.6
	Non – Jordanian	27	3.4
Place of residence	City	660	84.3

Characteristic Variable	Characteristic Variable	Number of respondents (N)	Percentage (%)
The region of residency	suburb	29	3.7
	Village	91	11.6
	Badia	3	0.4
	North of Jordan	172	22
	South of Jordan	33	4.2
Nature of housing	Middle of Jordan	578	73.8
	Independent house	239	30.5
	Apartment	544	69.5
Educational Level	Secondary or less	97	12.1
	Diploma	93	11.9
	Bachelor's degree	496	63.3
	High Graduate Studies	97	12.4
Work Status	House wife	433	55.3
	Employee	301	38.4
	own-business	49	6.3
Family Income	< 500 JD	232	29.6
	500 - 1000 JD	313	40
	> 1000 JD	206	26.3
	Not answered	31	4
What is the age group of your children?	< 2 yrs	142	18.1
	2-6 yrs	372	47.5
	Both groups	269	34.4

The number of respondents who were able to indicate the sources of vitamin D and its importance are shown in Figure1.

Most of respondents (89.1%) indicated the sunlight as the main source of vitamin D. More than 60% indicated that fish and eggs are considered of the major dietary sources. A small percentage of participants answered correctly that poultry and meat, vegetables and fruits are not of the major sources of vitamin D in the diet (36.3%, 25.5% respectively). Most of participants (93.9%) knew the importance of vitamin D in absorption of calcium which is necessary for bone and teeth development.

### Figure 1. Mother's Knowledge about Vitamin D Sources & Importance

Figure 2. shows the number of participants who answered correctly the questions concerning risk factors of vitamin D deficiency and its complications, its relation with skin color and breast milk.

More than 95% of participants knew that low sun exposure and reduced intake of vitamin D rich foods are risk factors of VDD. On the other hand, only 18.5% indicated that use of sunscreen is a risk factor for VDD. Most of respondents knew that VDD leads to rickets, but only 23.6% knew that epileptic seizures due to hypocalcemia is a complication of VDD. A small percentage answered correctly that vitamin D synthesis is affected by skin color and it is not present in large amounts in breast milk.

### Figure 2. Mother's Knowledge about Vitamin D Deficiency Risk Factors, and Complications

The number of respondents who have high and poor level of knowledge is shown in Figure 3.

### Figure 3. knowledge level of participants.

Table 2. shows the mother's practices toward vitamin D. More than 70% of mothers took vitamin D supplements during pregnancy in contrast to less than 50% took them during breast feeding.

Regarding mothers who have children of less than 2 years, 32.7% used breast feeding and milk formula together for feeding their babies. Only 21.6% of them tested vitamin D for their babies and more than

half gave their babies vitamin D supplements. More than half mothers expose their infants of less than six months to sun light.

On the other hand, only 23% of mothers who have children between 2-6 years tested vitamin D for their children and less than half gave vitamin D supplements for their children. More than 50% of mothers indicated that the best time for exposure of children to sun is before 10 a.m. The highest percentage of mothers exposed their children to sun 1-3 times weekly. Half of mothers got vitamin D supplements for their children by prescription from a private children’s clinic.

**Table 2. Mother’s Practices toward Vitamin D**

<b>Characteristic Variable</b>	<b>Number of respondents(N)</b>
<b>Intake of Vitamin D Supplements During Pregnancy.</b>	<b>Intake of Vitamin D Supplement</b>
Yes	562
No	221
<b>Intake of Vitamin D Supplements During Breast Feeding.</b>	<b>Intake of Vitamin D Supplement</b>
Yes	357
No	426
<b>Questions Concerning Mothers Who Have Children of less than 2 years: The Method of Baby Feeding:</b>	<b>Questions Concerning Mothers V The Method of Baby Feeding:</b>
Breastfeeding only	180
Breastfeeding and milk formula together	256
Formula milk only	142
<b>Testing of Vitamin D for Baby.</b>	<b>Testing of Vitamin D for Baby.</b>
Yes	169
No	426
<b>Given Vitamin D Supplements for Baby.</b>	<b>Given Vitamin D Supplements fo</b>
Yes	403
No	180
<b>Exposure of baby of less than 6 months old to the sun.</b>	<b>Exposure of baby of less than 6 m</b>
Yes	451
No	128
<b>Questions Concerning Mothers Who Have Children between 2-6 years: Testing of Vitamin D for Child</b>	<b>Questions Concerning Mothers V Testing of Vitamin D for Child</b>
Yes	180
No	439
<b>Given Vitamin D Supplements for Child.</b>	<b>Given Vitamin D Supplements fo</b>
Yes	337
No	238
<b>The best time of the day to expose your baby / child to the sun?</b>	<b>The best time of the day to expo</b>
Before 10 AM	510
10 AM – 3 PM	165
After 3 PM	38
Am not sure	70
<b>How Often Do You Expose your Baby/Child to Sun?</b>	<b>How Often Do You Expose your</b>
1-3 times Daily	305
1-3 Times Weekly	316
3-5 Times Weekly	102
>5 Times Weekly	60
<b>The Method of Getting Vitamin D Supplements:</b>	<b>The Method of Getting Vitamin</b>
without a prescription	107
By prescription from the private children’s clinic	395

Characteristic Variable	Number of respondents(N)
By prescription from a governmental hospital	58

Table 3. shows the number of respondents regarding vitamin D perceptions. Most of them were with the agreement that vitamin D supplements is important for overall health of infants and children, and vitamin D intake more than recommended allowance may be harmful. From all participants, 29.6% believed negatively that breast milk provides their babies with everything, so no need for vitamin D supplements. More than 70% agreed that the need for extra vitamin D during winter season is increased.

Over than 80% of mothers believed that vitamin D deficiency is a health problem common in children, and the need for more information about this issue is high.

**Table 3. Mother’s Perceptions toward Vitamin D**

Perception	Number of respondents (N)	Percentage (%)
<b>I believe that giving vitamin D supplements to infants/children is important for their overall health.</b>	<b>I believe that giving vitamin D supplements to infants/children is important for their overall health.</b>	<b>I believe that giving vitamin D supplements to infants/children is important for their overall health.</b>
Strongly agree	419	53.5
Agree	266	34
<b>Taking more vitamin D than the recommended amount may be harmful.</b>	<b>Taking more vitamin D than the recommended amount may be harmful.</b>	<b>Taking more vitamin D than the recommended amount may be harmful.</b>
Strongly agree	377	48.1
Agree	321	41
<b>My baby does not need to get extra vitamin D from nutritional supplements at the age of less than 6 months, because breast milk contains everything my baby needs.</b>	<b>My baby does not need to get extra vitamin D from nutritional supplements at the age of less than 6 months, because breast milk contains everything my baby needs.</b>	<b>My baby does not need to get extra vitamin D from nutritional supplements at the age of less than 6 months, because breast milk contains everything my baby needs.</b>
Strongly agree	74	9.5
Agree	157	20.1
<b>I think my child needs more vitamin D during the winter season.</b>	<b>I think my child needs more vitamin D during the winter season.</b>	<b>I think my child needs more vitamin D during the winter season.</b>
Strongly agree	184	23.5
Agree	374	47.8
<b>I believe that vitamin D deficiency is one of the common health problems for children in our country.</b>	<b>I believe that vitamin D deficiency is one of the common health problems for children in our country.</b>	<b>I believe that vitamin D deficiency is one of the common health problems for children in our country.</b>
Strongly agree	294	37.5
Agree	350	44.7
<b>I think I need more information on vitamin D deficiency in children.</b>	<b>I think I need more information on vitamin D deficiency in children.</b>	<b>I think I need more information on vitamin D deficiency in children.</b>
Strongly agree	280	35.8

Perception	Number of respondents (N)	Percentage (%)
Agree	396	50.6

In comparing demographic groups association with knowledge level, a significant difference was found among age groups, nature of housing groups, nationality, age group of children (p value 0.002, 0.011, 0.031, 0.004 respectively). On the other hand, no significant differences were found among educational level, region of residency, place of residency, work status, family income (p values 0.328, 0.411, 0.739, 0.979, 0.078 respectively).

**Table 4. The Impact of Demographic Variables on Knowledge Level**

Variable	High knowledge level	High knowledge level	Poor knowledge level	Poor knowledge level	X <sup>2</sup> P value
	N	%	N	%	
<b>Age</b>	<b>Age</b>	<b>Age</b>	<b>Age</b>	<b>Age</b>	<b>Age</b>
< 30 yrs	82	10.5	122	15.6	12.63 0.002*
30 - 40 yrs	266	34	241	30.8	
> 40 yrs	44	5.6	28	3.6	
<b>Nature of Housing</b>	<b>Nature of Housing</b>	<b>Nature of Housing</b>	<b>Nature of Housing</b>	<b>Nature of Housing</b>	<b>Nature of Housing</b>
Independent house	136	17.4	103	13.2	6.438 0.011*
Apartment	256	32.7	288	36.8	
<b>Nationality:</b>	<b>Nationality:</b>	<b>Nationality:</b>	<b>Nationality:</b>	<b>Nationality:</b>	<b>Nationality:</b>
Jordanian	384	49	372	47.5	4.671 0.031*
Non-Jordanian	8	1	19	2.4	
<b>Age group of your children</b>	<b>Age group of your children</b>	<b>Age group of your children</b>	<b>Age group of your children</b>	<b>Age group of your children</b>	<b>Age group of your children</b>
< 2 yrs	55	7	87	11.1	11.19 0.004*
2-6 yrs	205	26.2	167	21.3	
Both groups	132	16.9	137	17.5	

\*P-value <0.05 is considered statistically significant.

### Discussion:

To our knowledge, this is the first study in Jordan to assess the maternal awareness, perception regarding VDD in children, and the practices undertaken by mothers toward this problem. Evaluating the parent's knowledge level is important in developing plans and making decisions that help solving this issue.

The findings of the current study reported that half of participants were knowledgeable about vitamin D including its sources, benefits, risk factors and complications of deficiency.

Sunlight is the main source of vitamin D<sup>14</sup> which is well known to most of participants in the recent study. The results were similar to that found in a French study<sup>15</sup>. Only 0.5% didn't know that sunlight is the main source of vitamin D, this finding was lower than what found in previous study in which 13.7% of parents did not know that sunlight is a major source of vitamin D.<sup>16</sup>

Not all respondents indicated all dietary sources of vitamin D. More than 60% of our participants recognized

fish and egg as main dietary sources and 35%-60% quoted incorrect sources of vitamin D such as meat, poultry, fruits, and vegetables. These findings were compared to a previous Malaysian study in which 20%-30% of participants indicated fish and egg as main dietary sources and 4%-27% recognized incorrect sources of vitamin D.<sup>17</sup>

In a Chinese study, woman incorrectly stated vegetables as one of vitamin D sources.<sup>18</sup> In a Canadian study, only 26% of participants identified the sources of vitamin D<sup>19</sup>, and only 17% recognized sources of vitamin D other than sun in a study conducted on a group of New Zealand athletes.<sup>20</sup> Age had an impact on participant's knowledge score about vitamin D sources.

Almost all participants (93.9%) in the current study knew the importance of vitamin D in calcium absorption, bone and teeth health. These findings were high compared to results of a French study (78%) (15), Chinese study (12%-18%)<sup>18</sup>, and Pakistanian study (33%).<sup>21</sup> Age, nature of housing, educational level, family income had impact on benefit score.

Vitamin D production can be affected by factors which cause change in sun exposure such as season of the year, clothing, use of sunscreen, skin color.<sup>22</sup>

Our participants were knowledgeable about low sun exposure and low dietary intake of vitamin D as risk factors of VDD, but they lacked knowledge about sunscreen use as a risk factor. The last finding was lower than that reported in a previous study.<sup>17</sup>

The darker skin color, the more need for sun exposure to produce vitamin D.<sup>23</sup> In our study, the minority of participants knew that vitamin D synthesis through skin is affected by its color.

More than 50% of mothers answered incorrectly that breast milk contains large amount of vitamin D, although only 29% believed that it is enough to provide their babies with the required amount of vitamin D. The results of the recent study demonstrated the need for improvement of knowledge regarding vitamin D sources, and risk factors of deficiency.

Comparison of knowledge level among demographic groups showed significant difference for age groups. Similar findings were found in a previous study conducted in United Kingdom study<sup>24</sup> and supported by findings of study carried out among population in Hong Kong.<sup>18</sup> The level of education is not associated with knowledge level in our study. Different findings were found in a previous study.<sup>25</sup>

Vitamin D during pregnancy is important for calcium absorption, transport through placenta, for immunity, and for inflammation inhibition<sup>26</sup> VDD in pregnancy may increase the risk of pre-eclampsia, gestational diabetes Mellitus (GDM), low birth weight, respiratory and allergic diseases, skeletal deformities. So, it is recommended in a daily dose of 600 IU for all pregnant women.<sup>27</sup>

In the recent study, 71.4% of mothers received vitamin D supplements during pregnancy, this may reflect the high level of knowledge about vitamin D benefit in pregnancy. The rate of positive response to this question was significantly different among educational level groups in which most of mothers who received vitamin D supplements during pregnancy had baccalaureate degree compared to the lowest percentage who had secondary education or less ( $X^2 = 19.318$ ,  $P$  value=0.000). In contrast, lower percentage of mothers (45.7%) received vitamin D during breast feeding.

Only about 20% of mothers in the current study tested vitamin D for their babies/children. Vitamin D screening is not necessary in the following groups: children, adolescents, pregnant women, and patients who receive bone active medications.<sup>28</sup> On the other hand, 40%-50% of mothers gave vitamin D supplements for their babies/children, and 50% had gotten the supplements through private's children clinic. Only 7.4% of them got supplements through governmental hospitals, this reflects the need for vitamin D supplementation to be included as a health protocol given to all children free of charge.

In our study, a small proportion knew the best time of sun exposure. Similar findings found in previous study.<sup>10</sup>



By looking to practices undertaken by mothers, the need appears for improvement of knowledge level of mothers regarding duration of giving vitamin D supplements for their babies/children, the number of times of sun exposure, and the best time of sunning. This can be achieved through conducting an awareness and education campaign for mothers regarding VDD.

### Conclusion:

The study highlighted inadequate level of knowledge in certain domains of vitamin D such as some dietary sources, risk factors and complications of deficiency in addition to some practices undertaken by participants. The need appears for more campaigns to be held in order to aware the parents about vitamin D and to fill the gaps in knowledge. This may increase the awareness about vitamin D and improves vitamin D deficiency status in our country.

### Data Availability

Upon request, the data used in the recent study will be available from the corresponding author.

### Conflicts of Interest

None

### Funding Acknowledgement

The authors have no financial funding in this manuscript.

### References

1. Casey, C., Slawson, D. C., & Neal, L. R. Vitamin D supplementation in infants, children, and adolescents. *American family physician* .2010 ;81(6) :745-748.
2. Kassab, M., Shaban, I., Mohammad, K., & Creedy, D. K. Prevalence of hypovitaminosis D among jordanian healthy infants: a descriptive cross sectional study. *Journal of pediatric nursing* .2016; 31(2), e119-e125.
3. Khuri-Bulos, N., Lang, R. D., Blevins, M., Kudyba, K., Lawrence, L., Davidson, M., ... & Halasa, N. B. Vitamin D deficiency among newborns in Amman, Jordan. *Global journal of health science* .2014; 6(1), 162.
4. Nichols, E. K., Khatib, I. M. D., Aburto, N. J., Serdula, M. K., Scanlon, K. S., Wirth, J. P., & Sullivan, K. M. Vitamin D status and associated factors of deficiency among Jordanian children of preschool age. *European journal of clinical nutrition*.2015; 69(1) : 90-95.
5. Midtbø, L. K., Nygaard, L. B., Markhus, M. W., Kjelleve, M., Lie, Ø., Dahl, L., ... & Øyen, J. Vitamin D status in preschool children and its relations to vitamin D sources and body mass index—Fish Intervention Studies-KIDS (FINS-KIDS). *Nutrition* .2020;70, 110595.
6. Antonucci, R., Locci, C., Clemente, M. G., Chicconi, E., & Antonucci, L. Vitamin D deficiency in childhood: old lessons and current challenges. *Journal of Pediatric Endocrinology and Metabolism* .2018;31(3): 247-260.
7. Sassi, F., Tamone, C., & D'Amelio, P. Vitamin D: nutrient, hormone, and immunomodulator. *Nutrients* .2018. 10(11), 1656.
8. Chang, S. W., & Lee, H. C. Vitamin D and health-The missing vitamin in humans. *Pediatrics & Neonatology* .2019;60(3): 237-244.
9. Perrine, C. G., Sharma, A. J., Jefferds, M. E. D., Serdula, M. K., & Scanlon, K. S. (2010). Adherence to vitamin D recommendations among US infants. *Pediatrics* .2010;125(4): 627-632.
10. Al-Agha, A. E., Alorabi, S. H., NoorSaeed, S. M., & Shalabi, N. M. Awareness of vitamin D and its deficiency in Jeddah population, Saudi Arabia. *Journal of Community & Public Health Nursing* .2016;2(2).
11. Day, R. E., Krishnarao, R., Sahota, P., & Christian, M. S. We still don't know that our children need vitamin D daily: a study of parents' understanding of vitamin D requirements in children aged 0-2 years. *BMC public health* .2019;19(1) :1-14.

12. Taylor, J. A., Geyer, L. J., & Feldman, K. W. Use of supplemental vitamin D among infants breastfed for prolonged periods. *Pediatrics* .2010;125(1):105-111.
13. Amiri, P., Asghari, G., Sadrosadat, H., Karimi, M., Amouzegar, A., Mirmiran, P., & Azizi, F. Psychometric properties of a developed questionnaire to assess knowledge, attitude and practice regarding vitamin D (D-KAP-38). *Nutrients* .2017;9(5), 471.
14. Gupta, A. K., Jamwal, V., Sakul, M. P., & Malhotra, P. Hypervitaminosis D and systemic manifestations: a comprehensive review. *JIMSA* .2014; 27(4): 236-237.
15. Alshamsan, F. M., & Bin-Abbas, B. S. Knowledge, awareness, attitudes and sources of vitamin D deficiency and sufficiency in Saudi children. *Saudi medical journal* .2016;37(5), 579.
16. Hussein, A. S., Almoudi, M. M., Zen, S. A. N. M., Azmi, N. H., Schroth, R. J., & Hassan, M. I. A. Parental awareness and knowledge of vitamin D and its health benefits for children. *Journal of International Dental and Medical Research* .2018;11(3):916-924.
17. Kung, A. W., & Lee, K. K. Knowledge of vitamin D and perceptions and attitudes toward sunlight among Chinese middle-aged and elderly women: a population survey in Hong Kong. *BMC public health* .2006;6(1):1-7.
18. Boland, S., Irwin, J. D., & Johnson, A. M. A survey of university students' vitamin D-related knowledge. *Journal of nutrition education and behavior* .2015;47(1): 99-103.
19. Walker, N., Love, T. D., Baker, D. F., Healey, P. B., Haszard, J., Edwards, A. S., & Black, K. E. Knowledge and attitudes to vitamin D and sun exposure in elite New Zealand athletes: a cross-sectional study. *Journal of the international society of sports nutrition* .2014; 11(1):1-6.
20. Tariq, A., Khan, S. R., & Basharat, A. Assessment of knowledge, attitudes and practice towards Vitamin D among university students in Pakistan. *BMC public health* ,2020;20 (1): 1-10.
21. Kamboj, P., Dwivedi, S., & Toteja, G. S. Prevalence of hypovitaminosis D in India & way forward. *The Indian journal of medical research* .2018;148(5), 548.
22. Lowe, N. M., & Bhojani, I. Special considerations for vitamin D in the south Asian population in the UK. *Therapeutic advances in musculoskeletal disease* .2017; 9(6):137-144.
23. Alemu, E., & Varnam, R. Awareness of vitamin D deficiency among at-risk patients. *BMC research notes* .2012; 5(1):1-6.
24. Zadka, K., Pałkowska-Goździk, E., & Rosołowska-Huszcz, D. The state of knowledge about nutrition sources of vitamin D, its role in the human body, and necessity of supplementation among parents in central poland. *International journal of environmental research and public health* .2018; 15(7), 1489.
25. Curtis, E. M., Moon, R. J., Harvey, N. C., & Cooper, C. Maternal vitamin D supplementation during pregnancy. *British medical bulletin* .2018;126(1):57-77.
26. Marangoni, F., Cetin, I., Verduci, E., Canzone, G., Giovannini, M., Scollo, P., ... & Poli, A. Maternal diet and nutrient requirements in pregnancy and breastfeeding. An Italian consensus document. *Nutrients* .2016;8(10), 629.
27. Minisola, S., Colangelo, L., Pepe, J., Occhiuto, M., Piazzolla, V., Renella, M., ... & Cipriani, C. Vitamin D screening. *Journal of endocrinological investigation* .2020;1-5.

#### Hosted file

figures.pdf available at <https://authorea.com/users/412810/articles/521362-maternal-awareness-of-vitamin-d-deficiency-in-infants-and-up-to-the-age-of-6-years-a-cross-sectional-study-in-jordan>

#### Hosted file

Tables.pdf available at <https://authorea.com/users/412810/articles/521362-maternal-awareness-of-vitamin-d-deficiency-in-infants-and-up-to-the-age-of-6-years-a-cross-sectional-study-in-jordan>