Prevalence of Vitamin D deficiency and community awareness among women’s in Jeddah

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Abstract

Background: Recent studies shows that vitamin D deficiency is now one of the major global public health problem affecting about one billion people around the world. In past fifteen years, major research in this field has been done.

Introduction: Primary vitamin D deficiency is asymptomatic, then some common symptoms appear such as fatigue, general muscle pain, and weakness. The consequence of deficiency can be serious such as osteomalacia (adult rickets), children rickets and osteoporosis. Limited sun exposure, specifically in Saudi women wearing traditional clothes and deliberate avoidance of sun, inadequate vitamin D dietary intake causes vitamin D deficiency.

Methodology: A cross-sectional study was conducted on adult women between the age group of 18 to 65 in Jeddah. An electronic questionnaire-based survey was conducted through social media and total 490 subjects have participated in the survey and all of them are included in the study.

Results: According to the deficiency 223 participants been suffering from Vitamin D deficiency and 38 participants were normal and rest of them didn't check their vitamin D level. In this study, it is observed that 65.7% participants were exposed to sunlight for less than 10 minutes per day. Based on daily milk intake, it is observed that 19.8% of the participants drinks milk daily, while 80.2% do not.

Conclusion: According to our survey results and chi-square test calculations, there is no relation between progression in age, drinking milk and sun exposure with vitamin D deficiency. Also, we observed that there is no relation between genetic factors with vitamin D deficiency.

Keywords: Vitamin D; Deficiency; awareness; Saudi Arabia.

Introduction

These days the whole word is suffering from unhealthy lifestyle and bad habits that can lead to many disorders such as vitamin D deficiency and insufficiency. Recently it is a global public health problem affecting an estimated 1 billion people worldwide. The majority of our knowledge about vitamin D has been discovered over the past 15 years [1], and with the growing issue of deficiencies, more health connection with vitamin D levels are being made.

Vitamin D is a fat-soluble vitamin, it present in 2 forms, Vitamin D2 (ergocalciferol)
which is synthesized by plants and is not produced by the human body, Vitamin D3 (cholecalciferol) [2] the more potent form which is made in large quantities when person exposed to sunlight, it is more stable in various conditions as temperature, humidity, and storage so it remain active for a long time. Vitamin D3 is more effective in raising and maintaining the vitamin D blood test [3].

Vitamin D plays an important role in maintaining bone health and neuromuscular function. Once vitamin D3 is produced by UV radiation it is metabolized in the liver and kidney to 1,25-dihydroxyvitamin D which is tightly regulated by parathyroid hormone, keeps serum calcium and phosphate concentration within the normal level to maintain essential cellular function and promote mineralization of the skeleton [4] (Figure 1) [5].

![Figure 1: Functions of vitamin D](image)

The daily recommended intake of vitamin D is 600 (IU/day) [6]; Human can get vitamin D from sun exposure, dietary intake and dietary supplement. Ultra-violet radiation penetrates skin converting 7-dehydrocholesterol to previtamin D3, which is converted to vitamin D3 [7] [10] [8]. Vitamin D exists in many types of food such as seafood, shrimp, mushroom, egg yolk and fortified milk [9].

![Figure 2: Synthesis of vitamin D when exposed to sunlight and diet is taken.](image)

It is important to expose body to sunlight for 10 to 15 minutes daily in early morning hours and before the sunset [10]. Limited exposure to sunlight, specifically in Saudi women wearing traditional clothes and deliberate avoidance of sun [11], strict vegetarian diet and dark skin color (melanin pigmentation) causes vitamin D deficiency [12].
The consequence of deficiency can be serious such as osteomalacia (adult rickets), children rickets, osteoporosis, Secondary hyperparathyroidism, and high bone turnover [13]. Other complication which may occur includes hypertension, depression, multiple sclerosis, arthritis, type 2 diabetes, cardiovascular disease, and an increased risk of cancer[14]. Primary vitamin D deficiency is asymptomatic, some common symptoms which may appear are fatigue, general muscle pain, weakness, muscle cramps, joint pain weight gain, high blood pressure, headaches, and constipation or diarrhea [15].

Deficiency of vitamin D is determined by 25-hydroxyvitamin D level of less than 20 ng/mL (50 nmol/L), insufficiency when the level of 25-hydroxyvitamin D is 20 to 30 ng/mL (50 to 75 nmol/L). In deficiency cases oral vitamin D2 therapy is use (50,000 IU per week for eight weeks) when the level of vitamin D reaches the normal range, maintenance therapy needs to be maintained (vitamin D3 at 800 to 1,000 IU per day) [16]. Curing vitamin D deficiency is not as simple as taking a pill or getting more sun [1].

In 2013, a study has been done in Riyadh on male and female, the mean age was 37.43. In the result 29% of subjects were in the vitamin D deficiency group, 22.7% were in the relative insufficiency group, and 47.5% had normal levels of 25-hydroxy vitamin D. They observed that female gender was an independent predictor of vitamin D deficiency or insufficiency [17].

In a hospital-based study in 2011 in the sunny Eastern region of Saudi Arabia, a sample of 139 male and female have a high prevalence of a vitamin D deficiency despite > 65% of participants having adequate exposure to sunlight and > 90% reporting adequate intake of dairy products [18].

At the same year, another study has been done in Qassim, KSA on 1800 male and female above the age of 18 and the prevalence of deficiency/insufficiency among the healthy population was 67.8% [19].

In 2012, a cross-sectional study of 465 young adult Saudi females in Qassim, KSA; shows that the prevalence of hypovitamin D among young healthy Saudi females was 100% [9].

In 2012, a cross-sectional study was done on 50 Saudi married couples in Riyadh, KSA; the result was 70% women’s were suffering from vitamin D deficiency compared to 40% in men. The reason for such difference is men Saudi have higher sun exposure, more use of light clothes and more intake of milk and soft drinks [20].

In 2015, a study has been done in Riyadh, KSA on 2225 apparently healthy Saudi adolescents and 830 adults to observe the impact of vitamin D deficiency on several chronic diseases; the result was that girls and females had a significant deficiency in vitamin D than boys and men. Furthermore, Vitamin D deficiency is mostly associated with cardiometabolic risk factors in adolescent Arab boys, Vitamin D deficiency was significantly associated with diabetes mellitus type 2 in boys, and vitamin D insufficiency was significantly associated with abdominal obesity in boys [21].

This research will investigate the prevalence and community awareness of vitamin D deficiency in Jeddah’s women to achieve and maintain optimal vitamin D levels.

**Methodology**

From Oct 13, 2015 to Nov 13, 2015; we conducted a cross-sectional study on vitamin D deficiency among adult women between the age group of 18 to 65 in Jeddah. An electronic questionnaire based survey was made on Google drive then distributed randomly between women in Jeddah, Saudi Arabia through the social media application such as WhatsApp and Path applications.

Total 490 subjects responded to the questionnaire, all the subjects are included in the study. In the questionnaire, demographic data was taken and questions were mostly about daily life practice as dietary intake, daily sun exposure, and supplements they are using. The study was conducted for both who have the deficiency of vitamin D or not. It was approved by Ibn Sina National College research center for medical studies.

Statistical analysis was conducted with (SPSS v.21) program by the help of expert of statistical analysis. Many statistical tests were evaluated in this study such as the mean to
measure the probability of the distribution of values and variability of the values was described by the standard deviation. Univariate analysis for demographic data was accomplished by t-test and chi-square test, which was done to compare sets of observations. An association between the data was determined by correlation coefficient to see the linear relationship. Frequency and percentage were also calculated to achieve the objectives of the study.

**Results**

490 women were randomized and the demographic data of the study participants were, the percentage of women whose age between 18-24 years was 41.4%, but the percentage of women whose age between 25-34 years was 29.8%, and the percentage of those whose age between 35-44 years was 18.6%, but 8.2% were between 45-54 years and 2% of them were more than 55 years. The social status shows 56.3% of the study members were married, while 43.7% were single. According to pregnancy, 4.5% were pregnant, and 94.7% weren’t. Breastfeeding mother were 5.7%, and 92.2% weren’t, 59.2% have “Wheaten” skin, while 33.7% have “White” skin, and 7.1% of them have “Dark” skin (Graph 1).

The status of the study participants according to the duration of exposure to the sun show that 65.7% exposed to the sun less than 10 minutes a day, while 23.7% exposed to the sun in a range of 10-20 minutes a day, while 6.3% exposed to the sun in the range from 30 minutes to 1 hour, also 4.3% exposed to the sun more than 1 hour a day (Graph 2).

According to the time of exposure to the sun 38.6% of the participants exposed to the sun at 7-10 am, while 34.3% exposed to the sun from 11 AM-2 PM, while 27.1% exposed to the sun from 3-6 PM (Graph 3).

Based on daily milk intake, the results show that 19.8% of the participants used to drink milk daily, while 80.2% did not (Graph 4). 241 of the participants checked their Vitamin D level, while 249 were not (Table 1). According to the deficiency 223 of the participants have Vitamin D deficiency, while 38 do not have (Graph 5). The primary most common symptom that made the participants analyze their vitamin D level is ostealgia in which 61% are felt the pain in the bone; the second most common symptom was hypersomnia and fatigability which represented 48.5% of the sample. From the participants’ family history 45.1% have Vitamin D deficiency, while 8.2% have not.

The participants who are using calcium pills were 21.8%, while 78.2% were not (Graph 6). 46.6% of the participants are using vitamin D pills supplements, were 41.6% of them are using drops, while 11.8% are using injection (Graph 7). Total 86.7% sample think that there isn’t enough awareness against vitamin D deficiency in Jeddah, while 13.3% says that is enough awareness there (Graph 8).
Graph 1: shows the percentage of the duration of exposure to sunlight.

Graph 2: shows the percentage of the duration of exposure to sunlight.

Graph 3: shows the percentage of time participant expose to sunlight.

Graph 4: shows the percentage of daily milk intake.

Graph 5: shows the percentage of Vitamin D deficiency in the sample.

Graph 6: shows the percentage of calcium intake.

Graph 7: show the percentage of types of supplements they are using.

Graph 8: show the percentage of the awareness of vitamin D deficiency in Jeddah.
Prevalence of Vitamin D deficiency and community awareness among women’s in Jeddah

Hypotheses 1

There is a statistically significant relationship between the woman age and the deficiency of vitamin D:

The Ho the Null hypothesis was tested using Chi-square test which assumes that there is no relation relationship between the woman age and the deficiency of vitamin D, and the Ha which assumes that there is a relation between the two variables, and the results was as shown next:

Table 2: The result of Chi-square test

<table>
<thead>
<tr>
<th>Age</th>
<th>Count</th>
<th>% within Age</th>
<th>Do you have vitamin D deficiency</th>
<th>Total</th>
<th>Chi-Square</th>
<th>d.f</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-24</td>
<td>12</td>
<td>15.0%</td>
<td>No</td>
<td>68</td>
<td>80</td>
<td>2.403</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25-34</td>
<td>14</td>
<td>17.3%</td>
<td>No</td>
<td>67</td>
<td>81</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35-44</td>
<td>7</td>
<td>11.9%</td>
<td>No</td>
<td>52</td>
<td>59</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45-54</td>
<td>5</td>
<td>15.6%</td>
<td>No</td>
<td>27</td>
<td>32</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>55-65</td>
<td>0</td>
<td>0.0%</td>
<td>No</td>
<td>9</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>38</td>
<td>14.6%</td>
<td>No</td>
<td>223</td>
<td>261</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It is clear from (Table 2) that the Chi-square test calculated value equals (2.403) and it is less than the tabular value for the test on 4df and the p-value was (0.662) and it is larger than the level of significance 5%, then we accept NULL hypothesis and refuse the alternative that assumes that there is a relation between the woman age and the deficiency of vitamin D.

Hypotheses 2

There is a statistically significant relationship between the deficiency of vitamin D and the pregnancy:

The Ho the Null hypothesis was tested using Chi-square test which assumes that there is no relation relationship between the deficiency of vitamin D and the pregnancy, and the Ha which assumes that there is a relation between the two variables, and the results was as shown next:

Table 1: shows the frequency for those who checked their Vitamin D level.

<table>
<thead>
<tr>
<th>Choices</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>241</td>
<td>49.2</td>
</tr>
<tr>
<td>No</td>
<td>249</td>
<td>50.8</td>
</tr>
<tr>
<td>Total</td>
<td>490</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Table 3: The result of Chi-square test

<table>
<thead>
<tr>
<th></th>
<th>Do you have vitamin D deficiency</th>
<th>Total</th>
<th>Chi-Square</th>
<th>d.f</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pregnant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>Count</td>
<td>37</td>
<td>210</td>
<td>247</td>
<td></td>
</tr>
<tr>
<td>% within Age</td>
<td>15.0%</td>
<td>85.0%</td>
<td>100.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>Count</td>
<td>1</td>
<td>9</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>% within Age</td>
<td>10.0%</td>
<td>90.0%</td>
<td>100.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>Count</td>
<td>38</td>
<td>219</td>
<td>257</td>
<td></td>
</tr>
<tr>
<td>% within Age</td>
<td>14.8%</td>
<td>85.2%</td>
<td>100.0%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

d.f= Degrees of freedom
Sig.= significance level

It is clear from (Table 3) that the Chi-square test calculated value equals (0.189) and it is less than the tabular value for the test on 1df and the p-value was (0.664) and it is larger than the level of significance 5%, then we accept NULL hypothesis and refuse the alternative that assumes that there is a between the deficiency of vitamin D and the pregnancy.

Hypotheses 3

There is a statistically significant relationship between the deficiency of vitamin D and the skin color:

The Ho the Null hypothesis was tested using Chi-square test which assumes that there is no relation relationship between the deficiency of vitamin D and the skin color, and the Ha which assumes that there is a relation between the two variables, and the results was as shown next:

Table 4: The result of Chi-square test

<table>
<thead>
<tr>
<th>Skin color</th>
<th>Do you have vitamin D deficiency</th>
<th>Total</th>
<th>Chi-Square</th>
<th>d.f</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>Count</td>
<td>11</td>
<td>77</td>
<td>88</td>
<td></td>
</tr>
<tr>
<td>% within What’s your skin color</td>
<td>12.5%</td>
<td>87.5%</td>
<td>100.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dark</td>
<td>Count</td>
<td>4</td>
<td>15</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>% within What’s your skin color</td>
<td>21.1%</td>
<td>78.9%</td>
<td>100.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wheaten</td>
<td>Count</td>
<td>23</td>
<td>131</td>
<td>154</td>
<td></td>
</tr>
<tr>
<td>% within What’s your skin color</td>
<td>14.9%</td>
<td>85.1%</td>
<td>100.0%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

d.f= Degrees of freedom
Sig.= significance level

It is clear from (Table 4) that the Chi-square test value equals (0.961) and it is less than the tabular value for the test on 2df and the p-value was (0.618) and it is larger than the level of significance 5%, then we accept NULL hypothesis and refuse the alternative that assumes that there is a relationship between the deficiency of vitamin D and the skin color which leads to the false of the fourth study hypothesis.

Hypotheses 4

There is a statistically significant relationship between the deficiency of vitamin D and drinking milk daily:

The Ho the Null hypothesis was tested using Chi-square test which assumes that there is no relation between the deficiency of vitamin D and drinking milk daily, and the Ha which assumes that there is a relation between the two variables, and the results was as shown next:
Table 5: The result of Chi-square test

<table>
<thead>
<tr>
<th>Drink milk every day</th>
<th>Do you have vitamin D deficiency</th>
<th>Total</th>
<th>Chi-Square</th>
<th>d.f</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>Count</td>
<td>31</td>
<td>187</td>
<td>218</td>
<td></td>
</tr>
<tr>
<td></td>
<td>% within Drink milk every day</td>
<td>14.2%</td>
<td>85.8%</td>
<td>100.0%</td>
<td>0.122</td>
</tr>
<tr>
<td>Yes</td>
<td>Count</td>
<td>7</td>
<td>36</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td></td>
<td>% within Drink milk every day</td>
<td>16.3%</td>
<td>83.7%</td>
<td>100.0%</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>Count</td>
<td>38</td>
<td>223</td>
<td>261</td>
<td></td>
</tr>
<tr>
<td></td>
<td>% within Drink milk every day</td>
<td>14.6%</td>
<td>85.4%</td>
<td>100.0%</td>
<td></td>
</tr>
</tbody>
</table>

d.f= Degrees of freedom
Sig. = significance level

It is clear from Table 5 that the Chi-square test value equals (0.122) and it is less than the tabular value for the test on 1df and the p-value was (0.726) and it is larger than the level of significance 5%, then we accept NULL hypothesis and refuse the alternative that assumes that there is a relation between the deficiency of vitamin D and drinking milk daily which leads to the false of the fifth study hypothesis.

**Hypotheses 5**

There is a statistically significant relation between the deficiency of vitamin D and the genetic factor:

The Ho the Null hypothesis was tested using Chi-square test which assumes that there is no between the deficiency of vitamin D and the genetic factor, and the Ha which assumes that there is a relation between the two variables, and the results was as shown next:

Table (6): The result of Chi-square test

<table>
<thead>
<tr>
<th>Is anyone of your family has vitamin D deficiency</th>
<th>Do you have vitamin D deficiency</th>
<th>Chi-Square</th>
<th>d.f</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>112</td>
<td>19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I don't know</td>
<td>96</td>
<td>12</td>
<td>6.301</td>
<td>2</td>
</tr>
<tr>
<td>No</td>
<td>15</td>
<td>7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

d.f= Degrees of freedom
Sig. = significance level

It is clear from Table 6 that the Chi-square test calculated value equals (6.301) and it is larger than the tabular value for the test on 2df and the p-value was (0.726) and it is less than the level of significance 5%, then we refuse NULL hypothesis and accept the alternative that assumes that there is a relation between the deficiency of vitamin D and the genetic factor which leads that the sixth study hypothesis is true.

**Discussion**

A cross-sectional study was carried out on male and female Pre-Clerkship year of medical school at the King Faisal University, Dammam. They observed that vitamin D deficient was highly prevalent among medical students [22]. New study report in 2015 shows that 96% of adolescents in Saudi Arabia are vitamin D [23]. In pediatric clinic in Jeddah Clinic Hospital-Kandarah, Jeddah, KSA, A cross-sectional study was conducted and high prevalence of vitamin D deficiency in children living in Jeddah was observed [24]. In Riyadh, KSA despite the abundant sunlight the prevalence of hypovitaminosis D among young healthy Saudi females is 100%, the
etiology of the high prevalence of vitamin D deficiency were a lack of sunlight exposure and inadequate diet [9].

As the etiology of vitamin D deficiency is multifactorial. Many factors are contributing to the deficiency including aging (vitamin D synthesis capacity decreases with aging), skin pigmentation (synthesis decreases in the dark skin), restriction of the sun exposure and inadequate dietary intake. In our community, we observed that most of the women are not exposing adequately to the sunlight even in their homes. Also, the estimated dietary calcium and vitamin D intake are low in comparison to the recommendations.

Conclusion

At the end we concluded that there is no relation between progression in age, drinking milk and sun exposure with vitamin D deficiency. These outcomes didn’t match with previous studies due to wrong answering leads to opposite conclusion and small sample size. Also, we observe that there is no relation between genetic factors with vitamin D deficiency. Although it is a common health problem, we observed that there is little awareness about the risks of vitamin D deficiency, as most of the subjects didn’t check their vitamin D level at all.

Recommendations

Making advertisements about vitamin D deficiency in Saudi TV channels and increasing the number of awareness posters in public malls in Jeddah can greatly improve community awareness about local health issues.

Acknowledgment

We would like to thank the participants who responded to the questionnaire survey, the statistical analysis expert Ms. Reham Jawdah and her team.

Declaration

On behalf of all Co-Authors, the corresponding Author, states that this work is original and has not been published in whole or in part elsewhere.

Authorship (authors contribution or attribution)

Dr. Zelal designed the survey. Dr. Morouj and Amal distributed the survey, collected the results and wrote the first draft of the manuscript. Dr. Mohammed Gamal made the second draft, conclusion, and recommendation. Dr. Ahmed M Gouda made the final revision of the manuscript.

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