MEDICAL SCIENCE

Assessing women's knowledge of the effects of vitamin D on the menstrual cycle and its associated symptoms

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ABSTRACT

Background: Vitamin D has numerous important roles. Recent research has demonstrated that vitamin D also reduces menstrual cycle-related symptoms, however comparatively few studies have been conducted purely on this topic. This study is to determine the level of awareness on the effects of vitamin D on the menstrual cycle among women in Makkah, Saudi Arabia. *Methods:* A cross-sectional survey was conducted from August 2022 to January 2023 in Makkah, Saudi Arabia. Using an online questionnaire, a random sample of 385 females aged ≥15 years were surveyed to obtain data. The data were analyzed with R Studio (version 4.1.1) and Fisher's exact test. In addition, Pearson's Chi-squared test was performed to compare participants who were aware of the connection between vitamin D and the menstrual cycle to those who were not. *Results:* According to the study, 22.4% of respondents were aware of the relationship between vitamin D and menstruation cycle symptoms. Furthermore, 37.2% thought vitamin D alleviated the intensity of those symptoms. For 46.6% of the participants, the average age at the onset of puberty was 10-12 years and only (5.2%) reached puberty after the age of 15. The p-value for the connection between the age at which the subjects started puberty and the severity of menstrual cycle symptoms was 0.019. *Conclusion:* Women in Makkah city, Saudi Arabia, are not aware of the correlation between vitamin D and menstruation. In addition to expanding our understanding of this connection, we must strive to raise public awareness of it.

Keywords: Vitamin D, menstrual cycle, women, symptoms, knowledge.

1. INTRODUCTION

One of the most essential vitamins is vitamin D; it comprises a group of fat-soluble steroids that are responsible for increasing the rate of absorption of

important minerals in the gastrointestinal tract. It also possesses many other important biological properties that affect humans' quality of life (Ross et al., 2011). There are many sources of vitamin D; the most important ones include exposure to ultraviolet B radiation, eggs, milk and fatty fish, such as salmon and sardines. Sunlight is the main chief source of vitamin D; therefore, insufficient exposure to sunlight can lead to vitamin deficiency. This deficiency affects a significant number of systems within the body, including the skeletal and immune systems (Ismailova and White, 2022). As most vitamin D sources are found in animal products, poor nutrition or a vegetarian diet are also causes of vitamin D deficiency. Kidney and liver diseases, as well as obesity, are also causes of vitamin D deficiency (Pappa et al., 2008).

Due to the multiplicity of causes affecting it, Vitamin D insufficiency is a prevalent problem in many societies. Recently, in 2017, a study was conducted in Saudi Arabia. In three regions, including the western region, the incidence of vitamin D insufficiency was found to be 49.5% among students and 44% among employees (Kaddam et al., 2017). Vitamin D deficiency affects many systems within the body, including the immune system. Furthermore, multiple researches has demonstrated correlations between vitamin D insufficiency and frequent infections and diseases (Ismailova and White, 2022). Vitamin D plays important role in the musculoskeletal system and a lack of vitamin D can cause a significant loss in bone mass, in addition to pain (Ross et al., 2011).

Vitamin D deficiency's consequences may also be psychological. Indeed, many studies have shown that there is a relationship between vitamin D and mental health; individuals with insufficient vitamin D levels have a high risk of depression (Khan et al., 2022). Recently, many studies from around the world have shown that the menstrual cycle is also affected by vitamin D. For example, in 2021, a study was conducted in India showing that vitamin D deficiency may affect the length and regularity of the menstrual cycle (Singh et al., 2021). Moreover, in the United States (US), in another study conducted in 2021, it was shown that deficiency in vitamin D has been associated to specific physical premenstrual symptoms (PMS) such as breast fullness and generalized aches and pains (Alkhalaf et al., 2021). In addition, the same study showed that there is no relationship between the psychological symptoms caused by the menstrual cycle and vitamin D deficiency (Alkhalaf et al., 2021). Another study conducted in 2018, in Iran, indicated that high vitamin D supplementation dosages have a positive effect on the physical and psychological symptoms of PMS (Bahrami et al., 2018).

Moreover, to the best of our knowledge, vitamin D does not affect psychological symptoms caused by the menstrual cycle. Additionally, we do not know how aware women are of the importance of a natural level of vitamin D, particularly with regard to its mediating effect on their menstrual cycles, especially in the western region of the kingdom of Saudi Arabia. Menstrual problems are one of the most prevalent problems that women face in their lives and because vitamin D deficiency is one of the causes of menstruation problems, the aim of the current study is to assess the awareness of the effect of vitamin D on the menstrual cycle among women in the Makkah region of the Kingdom of Saudi Arabia (KSA) in 2022-2023.

2. MATERIALS AND METHODS

Study population

A cross-sectional study of the population of the city of Makkah was conducted between August 2022 to January 2023, western Saudi Arabia, was carried out. Data concerning a sample of 385 individuals were collected randomly using self-administered questionnaire forms.

The sample size was calculated using the sample size equation.

$$\text{Sample size (n)} = \frac{[\text{DEFF}\times Np\,(1-p)]}{[(d^2/Z^2_{1-\alpha/2}\times(N-1)+p\times(1-p)]}$$

Where n is the sample size and N is the study population of the city of Makkah, which is approximately 2,114,675 (General Authority for Statistics KSA, 2022). Moreover, p is the maximum percentage of the properties studied in any community, which is considered to be 50%. The hypothesized percentage of the frequency of a particular outcome in the population (p) may be calculated as follows: 50%+/-5. Confidence limits as a percentage of 100 (absolute +/-) (d) were set at 5%. Moreover, the design12 effect for the cluster surveys (DEEF) was set at 1.

In accordance with this formula, the sample size was calculated, thus resulting in a sample of 385 participants; this provided confidence levels of 95% and 5%, with the latter representing the lower acceptable limit. To correct for any possible data loss, in future studies, the sample size should be larger.

Questionnaire investigating women's awareness of the vitamin D's influence on menstruation symptoms

An online questionnaire was used to assess and evaluate women's awareness of the vitamin D's influence on menstruation symptoms. The targeted study population comprised women from the city of Makkah, Kingdom of Saudi Arabia, aged 15 years old and over, who used social media, such as Twitter and Telegram. The questionnaire was distributed on WhatsApp to previous batches of medical students with the assistance of their former professors. A computer-assisted Google questionnaire survey program was used. Subjects were collected randomly using a self-report questionnaire.

The standardized questionnaire included questions concerning the following

Socio-demographic characteristics, including age, nationality, educational level, marital status, likelihood of being pregnant, smoking status and occupational status

Illnesses, such as chronic diseases (diabetes, hypertension), thyroid problems, blood disorders, psychiatric problems and polycystic ovaries

Biometry, such as body mass index (BMI), which can be calculated as follows:

$$\text{BMI} = \frac{\text{Height (m)}}{\text{Weight (kg)}}$$

A BMI of 20 was considered normal, between 20 and 30 was considered overweight and >30 was considered obese.

Use of contraceptive pills and hormonal therapies

Vitamin D, precisely if participants assess their vitamin D levels and the test results, in addition to whether the participants take vitamin D supplements, the daily dosage of those supplements and the reason for taking vitamin D supplements.

Menstruation, specifically the age of menarche and the regularity of the menstrual cycle. Additionally, questions regarding associated menstrual symptoms and habits which relieve pain were included, as were questions pertaining to the severity of menstrual symptoms and psychological state.

Statistical Analysis

Data analysis was conducted using R Studio (R version 4.1.1). Frequencies and percentages were used to express categorical variables. We used Fisher's exact test or Pearson's Chi-squared test to assess the differences between participants who were aware and those who were unaware of the relationship between vitamin D and symptoms associated with menstruation. A p value of <0.05 indicated statistical significance.

3. RESULTS

Socio-demographic characteristics and medical history

We received responses from 385 participants; however, one participant declined to participate; therefore, 384 responses were analyzed. The majority of participants were aged between 15 and 25 years (83.9%), they were Saudi Arabian (90.9%) and single (83.9%). Students represented 77.1% of the studied sample. More than two-thirds of the participants had obtained a Bachelor's degree or higher (69.5%). Fewer than half of the participants had a normal BMI (44.0%). Regarding medical history, 5.2% of the participants had a chronic disease, 10.4% had a blood disorder and 8.3% had polycystic ovary syndrome. Moreover, 2.6% of the respondents were receiving a hormonal therapy and 2.6% were using contraceptive drugs (3.9%) (Table 1).

The factors associated with taking vitamin D supplements, as well as measuring vitamin D levels, are as follows. The results of the correlation analysis showed that participants who took recent vitamin D measurements were likely to be married (22.5% vs. 12.2%, $p = 0.014$), to have a blood disorder (14.7% vs. 8.2%, $p = 0.043$) and to have psychiatric problems (9.3% vs. 5.5%, $p = 0.049$). Additionally, a significantly higher proportion of participants who measured their vitamin D levels had taken vitamin D supplements compared with those who did not measure their vitamin D levels (64.3% and 15.7%, respectively, $p < 0.0001$). Other participants' characteristics were not associated with taking vitamin D measurements (Table 2).

Regarding the factors associated with taking vitamin D supplements, there were no significant differences between different demographics or between the groups based on the participants' clinical histories (Table 3).

There was a significant correlation between and the group that measured their vitamin D level, and the group that did not measure their vitamin D level and marital status; the p value was 0.014.

Moreover, there was a significant correlation between the group comprising participants with medical issues such as blood disorders (the p value was equal to 0.043) and the group comprising participants who had psychiatric disorders (the p value was

equal to 0.049). There was a highly significant relationship between the two groups that took vitamin D supplements; the p value was equal to <0.0001.

Table 1 Socio-demographic data and related medical history

Parameter	Category	N	%
Age (year)	Less than 15	2	0.5
	15-25	322	83.9
	26-35	32	8.3
	36-45	18	4.7
	More than 45	10	2.6
Nationality	Non-Saudi	35	9.1
	Saudi	349	90.9
Educational level	Below high school	7	1.8
	High school	110	28.6
	Bachelor or above	267	69.5
Marital status	Single	322	83.9
	Married	60	15.6
	Divorced	2	0.5
Pregnant if married	Yes	5	1.3
BMI (kg/m^2)	< 18.5	97	25.3
	18.5 to 24.9	169	44.0
	25 to 29.9	62	16.1
	30 or more	56	14.6
Job status	Student	296	77.1
	Non-employee	61	15.9
	Employee	25	6.5
	Retired	2	0.5
Medical history	Smoking	20	5.2
	Chronic diseases	20	5.2
	Thyroid problems	18	4.7
	Blood disorders	40	10.4
	Psychiatric problems	26	6.8
	Polycystic ovary syndrome	32	8.3
Use birth control pills (contraceptive drugs)	Yes	15	3.9
Receive a hormonal therapy	Yes	10	2.6

Table 2 Factors related to vitamin D measurement

Parameter	Category	Measured vitamin D				
		No, N = 255		Yes, N = 129		p-value
		N	%	N	%	
Age	Less than 15	1	0.4	1	0.8	0.124
	15-25	221	86.7	101	78.3	
	26-35	20	7.8	12	9.3	
	36-45	9	3.5	9	7.0	
	More than 45	4	1.6	6	4.7	
Nationality	Non-Saudi	23	9.0	12	9.3	0.928
	Saudi	232	91.0	117	90.7	
Educational level	Below high school	4	1.6	3	2.3	0.698
	High school	76	29.8	34	26.4	
	Bachelor or above	175	68.6	92	71.3	
BMI	< 18.5	70	27.5	27	20.9	0.325
	18.5 to 24.9	111	43.5	58	45.0	
	25 to 29.9	36	14.1	26	20.2	
	30 or more	38	14.9	18	14.0	
Marital status	Single	223	87.5	99	76.7	0.014
	Married	31	12.2	29	22.5	
	Divorced	1	0.4	1	0.8	
Job status	Student	199	78.0	97	75.2	0.157
	Non-employee	42	16.5	19	14.7	
	Employee	14	5.5	11	8.5	
	Retired	0	0.0	2	1.6	
Medical history	Smoking	11	4.3	9	7.0	
	Chronic diseases	10	3.9	10	7.8	0.267
	Thyroid problems	8	3.1	10	7.8	0.111
	Blood disorders	21	8.2	19	14.7	0.043
	Psychiatric problems	14	5.5	12	9.3	0.049
	Polycystic ovary syndrome	19	7.5	13	10.1	0.160
Use birth control pills	Yes	7	2.7	8	6.2	0.099
Undergoing any hormonal therapy	Yes	6	2.4	4	3.1	0.738
Taking vitamin D supplements	Yes	40	15.7	83	64.3	<0.0001

Table 3 Factors associated with receiving vitamin D supplements

Parameter	Category	Received vitamin D supplements				
		No, N = 267		Yes, N = 117		p-value
		N	%	N	%	
Age	Less than 15	2	0.7	0	0	0.422
	15-25	229	85.8	93	79.5	
	26-35	19	7.1	13	11.1	
	36-45	11	4.1	7	6	
	More than 45	6	2.2	4	3.4	
Nationality	Non-Saudi	24	9	11	9.4	0.897
	Saudi	243	91	106	90.6	
Educational level	Below high school	4	1.5	3	2.6	0.417
	High school	81	30.3	29	24.8	
	Bachelor or above	182	68.2	85	72.6	
BMI	< 18.5	75	28.1	22	18.8	0.165
	18.5 to 24.9	117	43.8	52	44.4	
	25 to 29.9	38	14.2	24	20.5	
	30 or more	37	13.9	19	16.2	
Marital status	Single	230	86.1	92	78.6	0.084
	Married	35	13.1	25	21.4	
	Divorced	2	0.7	0	0	
Job status	Student	204	76.4	92	78.6	0.205
	Non-employee	45	16.9	16	13.7	
	Employee	18	6.7	7	6	
	Retired	0	0	2	1.7	
Medical history	Smoking	12	4.5	8	6.8	0.342
	Chronic diseases	12	4.5	8	6.8	0.342
	Thyroid problems	9	3.4	9	7.7	0.065
	Blood disorders	26	9.7	14	12	0.511
	Psychiatric problems	15	5.6	11	9.4	0.174
	Polycystic ovary syndrome	23	8.6	9	7.7	0.764
Use birth control pills	Yes	9	3.4	6	5.1	0.404
Undergoing any hormonal therapy	Yes	5	1.9	5	4.3	0.181

Participants' awareness of the relationship between vitamin D and symptoms associated with menstruation

In the current study, 86 respondents were aware of the relationship between vitamin D and symptoms associated with menstruation (22.4%). Of the cohort, 143 participants (37.2%) believed that vitamin D improves one's quality of life and reduces symptoms associated with menstruation. Based on the univariate correlation analysis, participants' awareness of the relationship between vitamin D and symptoms associated with menstruation was not associated with any socio-demographic characteristics, medical history and vitamin D levels or whether the participant was taking vitamin D supplements (Table 4).

Table 4 Factors associated with participants' awareness about the relevance between vitamin D and symptoms associated with periods

Parameter	Category	Awareness				p
		No, N = 298		Yes, N = 86		
		N	%	N	%	
Age	Less than 15	2	0.7	0	0.0	0.924
	15-25	251	84.2	71	82.6	
	26-35	24	8.1	8	9.3	
	36-45	14	4.7	4	4.7	
	More than 45	7	2.3	3	3.5	
Nationality	Non-Saudi	26	8.7	9	10.5	0.621
	Saudi	272	91.3	77	89.5	
Educational level	Below high school	6	2.0	1	1.2	0.927
	High school	84	28.2	26	30.2	
	Bachelor or above	208	69.8	59	68.6	
BMI	< 18.5	76	25.5	21	24.4	0.595
	18.5 to 24.9	129	43.3	40	46.5	
	25 to 29.9	46	15.4	16	18.6	
	30 or more	47	15.8	9	10.5	
Marital status	Single	249	83.6	73	84.9	0.494
	Married	48	16.1	12	14.0	
	Divorced	1	0.3	1	1.2	
Pregnant	Yes	4	1.3	1	1.2	>0.999
Job status	Student	231	77.5	65	75.6	0.926
	Non-employee	46	15.4	15	17.4	
	Employee	19	6.4	6	7.0	
	Retired	2	0.7	0	0.0	
Medical history	Smoking	16	5.4	4	4.7	>0.999
	Chronic diseases	13	4.4	7	8.1	0.173
	Thyroid problems	15	5.0	3	3.5	0.773
	Blood disorders	32	10.7	8	9.3	0.701
	Psychiatric problems	23	7.7	3	3.5	0.169
	Polycystic ovary syndrome	26	8.7	6	7.0	0.605
Use birth control pills	Yes	11	3.7	4	4.7	0.752
Undergoing any hormonal therapy	Yes	7	2.3	3	3.5	0.700
Measured vitamin D level recently	Yes	97	32.6	32	37.2	0.420
Taking vitamin D supplements	Yes	88	29.5	35	40.7	0.051

Menstruation-related characteristics and their association with the relationship between vitamin D and symptoms associated with menstruation

The average age at the onset of puberty was 10-12 years among 46.6% of the participants and a similar proportion began puberty between the ages of 13 and 15 years. Only 5.2% of respondents reached puberty after 15 years and a significantly higher proportion of those participants (11.6%) were aware of the relationship between vitamin D and symptoms associated with menstruation, compared with only 3.4% of participants who were not aware (p = 0.019). More than half of the participants had a regular menstrual cycle (52.6%) and fewer than half of the respondents indicated that for them, menstruation usually lasts for two days (40.4%). Additionally, 9.0% of the respondents rated the severity of pain as grade one, 18.0% as grade two, 43.1% as grade three and 29.9% as grade four. The most common symptoms associated with menstruation were cramps in the lower abdomen (79.4%), lethargy and tiredness (77.6%) and lower back pain (69.3%). None of these symptoms were associated with participants' awareness of the link

between vitamin D and menstrual symptoms (Table 5). There was a significant relationship between the age at which puberty began, symptoms associated with menstruation and the p value, which was equal to 0.019.

Table 5 Period-related characteristics and their association with the relevance between vitamin D and symptoms associated with periods

Parameter	Category	Overall, N = 384		Awareness				p
				No, N = 298		Yes, N = 86		
				N	%	N	%	
Age of puberty (years)	Less than 10	6	1.6	5	1.7	1	1.2	0.019
	10-12	179	46.6	146	49.0	33	38.4	
	13-15	179	46.6	137	46.0	42	48.8	
	After 15	20	5.2	10	3.4	10	11.6	
Regular period	No	52	13.5	36	12.1	16	18.6	0.271
	Sometimes	130	33.9	101	33.9	29	33.7	
	Yes	202	52.6	161	54.0	41	47.7	
Symptoms associated with the period								
Heaviness in the breast	No	142	37.0	110	36.9	32	37.2	0.355
	Sometimes	115	29.9	94	31.5	21	24.4	
	Yes	127	33.1	94	31.5	33	38.4	
Abdominal distension	No	103	26.8	84	28.2	19	22.1	0.432
	Sometimes	100	26.0	74	24.8	26	30.2	
	Yes	181	47.1	140	47.0	41	47.7	
Cramps in the lower abdomen	No	23	6.0	17	5.7	6	7.0	0.604
	Sometimes	56	14.6	41	13.8	15	17.4	
	Yes	305	79.4	240	80.5	65	75.6	
Lower back pain	No	40	10.4	31	10.4	9	10.5	0.374
	Sometimes	78	20.3	56	18.8	22	25.6	
	Yes	266	69.3	211	70.8	55	64.0	
Lethargy and tiredness	No	22	5.7	18	6.0	4	4.7	0.103
	Sometimes	64	16.7	43	14.4	21	24.4	
	Yes	298	77.6	237	79.5	61	70.9	

The psychological state\mood that accompanies menstruation

Participants declared that the most common psychological symptoms during menstruation were crying (55.5%), anger (54.7%) and depression and sadness (48.4%); worry and anxiety were the least frequently reported symptoms (35.7%). None of these psychological symptoms were associated with an awareness of the link between vitamin D and menstrual symptoms (Table 6).

Table 6 The psychological state\mood that accompanies the period

Parameter	Category	Overall, N = 384		Awareness				P
				No, N = 298		Yes, N = 86		
		N	%	N	%	N	%	
Depression and sadness	No	76	19.8	57	19.1	19	22.1	0.521
	Maybe	122	31.8	92	30.9	30	34.9	
	Yes	186	48.4	149	50.0	37	43.0	
Worry and anxiety	No	125	32.6	98	32.9	27	31.4	0.838
	Maybe	122	31.8	96	32.2	26	30.2	
	Yes	137	35.7	104	34.9	33	38.4	
Anger	No	67	17.4	51	17.1	16	18.6	0.880
	Maybe	107	27.9	82	27.5	25	29.1	
	Yes	210	54.7	165	55.4	45	52.3	
Irritability and tension	No	97	25.3	76	25.5	21	24.4	0.958
	Maybe	116	30.2	89	29.9	27	31.4	
	Yes	171	44.5	133	44.6	38	44.2	
Overly nervous	No	118	30.7	87	29.2	31	36.0	0.343
	Maybe	103	26.8	79	26.5	24	27.9	
	Yes	163	42.4	132	44.3	31	36.0	
Crying	No	75	19.5	57	19.1	18	20.9	0.120
	Maybe	96	25.0	68	22.8	28	32.6	
	Yes	213	55.5	173	58.1	40	46.5	

4. DISCUSSION

This is the first study that investigates the level of awareness of the relevance between vitamin D and the menstrual cycle in the Makkah region. The goal of this study was constructed in accordance with the aims of a previous study that linked vitamin D deficiency with the severity of specific, physical, premenstrual symptoms (Alkhalaf et al., 2021). Vitamin D insufficiency in the population has been demonstrated several times in previous studies. In the work of Karczmarewicz et al., (2013), was found that 80% of the study population has low levels of vitamin D. In the work of Jukic et al., (2015), as many as 76% of women (484 out of 606) had vitamin D concentrations below 20 ng/ml; indeed, in accordance with the current study, the vitamin D level in these women was approximately 34.8%. Given that it was much lower, this result proffers a more positive outlook than the study that was conducted in Al-Baha, in which 49.1% of female participants were diagnosed with vitamin D deficiency (Abukhelaif et al., 2021). Another study conducted in the UAE showed that females are more likely to have vitamin D deficiency, at approximately 83% (Al-Zarooni et al., 2019). The present study shows that the measured bodies compositions are identical to the values reported by other authors, in that decreased concentricity of vitamin D is somehow associated with higher BMIs; this indicates that being overweight or obese is considered to be a risk factor with regard to vitamin D deficiency (Holick, 2007). Furthermore, other studies have shown that 60% of female participants spent less than one hour outdoors and 55% used sunscreen daily (Ibrahim et al., 2019).

Another study conducted in the United Kingdom, which investigated high-risk people, showed that 45% of women were unaware of the association between vitamin D insufficiency and menstrual symptoms (Alemu and Varnam, 2012). Furthermore, a recent study on Makkah schoolchildren found a higher incidence of vitamin D deficiency in females, which was primarily caused by restricted sunlight exposure (Kensarah and Azzeh, 2012). This might indicate that the 53.6% of females in the present study, who did not measure their vitamin D levels, might somehow, develop or already have vitamin D deficiency due to the practice of habits that were discussed in previous studies.

The primary goal of this study was to assess the level of knowledge that women have for the relationship between menstrual symptoms and their vitamin D level; their BMIs were also taken into account during this study. It has been established that vitamin D deficiency either causes or co-occurs with disturbed menstrual cycles (Jukic et al., 2015). In this study, it was found that women agreed on the presence of associated menstrual symptoms such as lower back pain, abdominal distension, lethargy, cramps and breast heaviness. These symptoms were found to usually last for two days, which is similar to the findings described by other authors, who found that vitamin D deficiency was relevant with an increased risk of specific physical premenstrual symptoms

(Alkhalaf et al., 2021). Moreover, regarding participants' knowledge of the effects of vitamin D, several studies revealed that knowledge of one's average level of vitamin D and the impact of vitamin D has been low.

According to Toher et al., (2014) 71% of pregnant women lacked knowledge of the impact of vitamin D. Another study in India showed that more than half of participants had a low level of knowledge concerning vitamin D deficiency in antenatal mothers (Kavitha et al., 2015); this is similar to the present study, wherein 60.2% of females had no knowledge of the impact of vitamin D, including if it is related to menstrual cycle symptoms. Moreover, there was no significant difference between women, in terms of knowledge, with regard to their age, marital status or educational level. An Australian study reported that being a female, being older, with a high educational level were indicators for having a higher level of knowledge (Sim et al., 2010). Similar results were detected in a French study, which argued that a higher wage was a predictor of a higher level of knowledge (Gupta et al., 2014). Conversely, in Al-Agha et al., (2016), a lower level of knowledge did not correlate with education level and in a study from the United Kingdom, older people showed a lower level of knowledge (O'connor et al., 2018).

Limitations

Our study has several limitations. Firstly, women's menstrual cycles were evaluated by filling out a questionnaire. For a fuller understanding of the relationship between menstrual cycle symptoms and vitamin D deficiency, it would be substantial to measure both vitamin D and hormone levels. Additionally, constant monitoring should occur, especially given that most studies indicate that the relationship between one's vitamin D level and the menstrual cycle has several confounding factors that may affect the results. As is the case with some disorders, for which it is possible to define their etiology (including pituitary insufficiency and thyroid disorders, as well as stress), most studies were unable to evaluate the levels of mental and physical stress in the study population that tend to primarily affect the menstrual cycle.

5. CONCLUSION AND RECOMMENDATIONS

This study aimed to inspect women's awareness of the leverage of vitamin D on the menstruation in the Makkah region of Saudi Arabia. Vitamin D plays a substantial role in the menstrual cycle and it affects menstrual cycle symptoms. This study has demonstrated that there is a low level of knowledge concerning the effect that vitamin D has on menstruation among the sample population. In addition, the results showed that the majority of participants' symptoms were related to vitamin D deficiency. Based on the results, we recommend that the relevant authorities put more effort into increasing awareness of the effect that vitamin D has on the menstrual cycle. This could be achieved through educational campaigns, videos on social media or even by creating a curriculum focusing women's health. Most importantly, we recommend that members of the community only obtain their information from reliable resources and that they check their vitamin D levels regularly.

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Author Contributions

Abeer Shaker Elmoursy Ali (design of the study, clinical selection, diagnosis and classification of the cases, interpreted biochemical laboratory investigations, preparing tables and figures, editing, styling, writing and revising of the main manuscript text), Bayan Fawaz Alzahrani (design of the study, writing and interpretation of results, writing manuscript), Amani Omar Safdar (design of the study, writing and interpretation of results, writing manuscript), Roua Fahad Alghamdi (design of the study, writing and interpretation of results, writing manuscript), Waad Ibrahim Barnawi (design of the study, writing and interpretation of results, writing manuscript), Waad Salem Almatrafi (design of the study, writing and interpretation of results, writing manuscript), Wesam Ahmed Nasif (revising of the main manuscript text, interpretation of results).

Ethical approval

This study approved by institutional review board (IRB) of MOH, Makkah, Saudi Arabia and Umm Al-Qura University (UQU) under approval NO (HAPO-02-K-012-2022-09-1179).

Informed consent

Not applicable.

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Conflict of interest

The authors declare that there is no conflict of interests.

Data and materials availability

All data sets collected during this study are available upon reasonable request from the corresponding author.

REFERENCES AND NOTES

1. Abukhelaif AE, Alzahrani SA, Al-Thobaiti LY, Alharbi AA, Al-Shumrani KM, Alghamdi YS. Assessment level of awareness of Vitamin D deficiency among the public residents of Al-Baha region, Saudi Arabia. Med Sci 2021; 25: 2728–36.
2. Al-Agha AE, Alorabi SH, Saeed SMWN, Shalabi NM. Awareness of Vitamin D and its Deficiency in Jeddah Population, Saudi Arabia. J Community Public Health Nurs 2016; 2:1–5. doi: 10.4172/2471-9846.1000120
3. Alemu E, Varnam R. Awareness of vitamin D deficiency among at-risk patients. BMC Res Notes 2012; 5:1–6. doi: 10.1186/1756-0500-5-17
4. Alkhalaf Z, Kim K, Kuhr DL, Radoc JG, Purdue-Smithe A, Pollack AZ, Yisahak SF, Silver RM, Thoma M, Kissell K, Perkins NJ, Sjaarda LA, Mumford SL. Markers of vitamin D metabolism and premenstrual symptoms in healthy women with regular cycles. Hum Reprod 2021; 36:1808–20. doi: 10.1093/HUMREP/DEAB089
5. Al-Zarooni AAR, Al-Marzouqi FI, Al-Darmaki SH, Prinsloo EAM, Nagelkerke N. Prevalence of vitamin D deficiency and associated comorbidities among Abu Dhabi Emirates population. BMC Res Notes 2019; 12:1–6. doi: 10.1186/S13104-019-4536-1
6. Bahrami A, Avan A, Sadeghnia HR, Esmaeili H, Tayefi M, Ghasemi F, Nejati-Salehkhani F, Arabpour-Dahoue M, Rastgar-Moghadam A, Ferns GA, Bahrami-Taghanaki H, Ghayour-Mobarhan M. High dose vitamin D supplementation can improve menstrual problems, dysmenorrhea and premenstrual syndrome in adolescents. Gynecol Endocrinol 2018; 34:659–63. doi: 10.1080/09513590.2017.1423466
7. Gupta AK, Jamwal V, Sakul MP, Malhotra P. Hypervitaminosis D and systemic manifestations: A comprehensive review. J Int Med Sci Acad 2014; 27:236–7.
8. Holick MF. Vitamin D Deficiency. N Engl J Med 2007; 357:266–81. doi: 10.1056/NEJMRA070553
9. Ibrahim OM, Al-Tameemi NK, Dawoud D. Knowledge and perceptions of vitamin D deficiency among the United Arab Emirates population. Asian J Pharm Clin Res 2019; 12:183–6. doi: 10.22159/AJPCR.2019.V12I18.33988
10. Ismailova A, White JH. Vitamin D, infections and immunity. Rev Endocr Metab Disord 2022; 23:265–77. doi: 10.1007/S11154-021-09679-5
11. Jukic AMZ, Steiner AZ, Baird DD. Lower plasma 25-hydroxyvitamin D is associated with irregular menstrual cycles in a cross-sectional study. Reprod Biol Endocrinol 2015; 13:1–6. doi: 10.1186/S12958-015-0012-5
12. 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 Med J 2017; 38:381–90. doi: 10.15537/SMJ.2017.4.18753
13. Karczmarewicz E, Czekuć-Kryśkiewicz E, Płudowski P. Effect of vitamin D status on pharmacological treatment efficiency Impact on cost-effective management in medicine Epidemiology of Vitamin D Deficiency in Poland. Dermatoendocrinol 2013; 5:1–6. doi: 10.4161/derm.25531
14. Kavitha D, Anjalakshi C, Venkataraman P, Rukumani J, Murali R. Knowledge, attitude and practice regarding vitamin D deficiency among antenatal mothers in Tamilnadu. Int J Pharma Bio Sci 2015; 6:486–97.
15. Kensarah OA, Azzeh FS. Vitamin D status of healthy school children from Western Saudi Arabia. Pak J Nutr 2012; 11:288–92.
16. Khan B, Shafiq H, Abbas S, Jabeen S, Khan SA, Afsar T, Almajwal A, Alruwaili NW, Al-Disi D, Alenezi S, Parveen Z, Razak S. Vitamin D status and its correlation to depression. Ann Gen Psychiatry 2022; 21:1–9. doi: 10.1186/S12991-022-00406-1
17. O'connor C, Glatt D, White L, Iniesta RR. Knowledge, Attitudes and Perceptions towards Vitamin D in a UK Adult

Population: A Cross-Sectional Study. Int J Environ Res Public Health 2018; 15:2387. doi: 10.3390/IJERPH15112387

18. Pappa HM, Bern E, Kamin D, Grand RJ. Vitamin D Status in Gastrointestinal and Liver Disease. Curr Opin Gastroenterol 2008; 24:176–83. doi: 10.1097/MOG.0B013E3282F4D2F3
19. Ross AC, Taylor CL, Yaktine AL, Del-Valle HB. Dietary Reference Intakes for Calcium and Vitamin D. Washington (DC): National Academies Press (US) 2011. doi: 10.17226/13050
20. Sim JJ, Lac PT, Liu ILA, Meguerditchian SO, Kumar VA, Kujubu DA, Rasgon SA. Vitamin D deficiency and anemia: A cross-sectional study. Ann Hematol 2010; 89:447–52. doi: 10.1007/S00277-009-0850-3
21. Singh V, Tamar N, Lone Z, Das E, Sahu R, Majumdar S. Association between serum 25-hydroxy vitamin D level and menstrual cycle length and regularity: A cross-sectional observational study. Int J Reprod Biomed 2021; 19:979–86. doi: 10.18502/IJRM.V19I11.9913
22. Toher C, Lindsay K, Mckenna M, Kilbane M, Curran S, Harrington L, Uduma O, Mc-Auliffe FM. Relationship between vitamin D knowledge and 25-hydroxyvitamin D levels amongst pregnant women. J Hum Nutr Diet 2014; 27:261–9. doi: 10.1111/JHN.12150