



# **The Relation between Sleep Quality and Vitamin D Level among Female Adults Living at National Guard Residential City, Jeddah, 2018.**

Community Based Cross-Sectional Study

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## **Abstract**

### **Background:**

poor sleep quality and low vitamin D level have been considered as public health problems with a direct effect on health, both are easily preventable and treatable problems that often remain unrecognized. Although recent studies have reported a relationship between them, there is a lack of research on this relationship in Saudi Arabia.

### **Objectives:**

To determine the association between sleep quality and the vitamin D level among women  $\geq 18$  living at National Guard city, Jeddah, 2018.

### **Methods:**

The relationship between sleep quality and vitamin D level were assessed through a cross-sectional study where a total of 267 women who fulfilled the inclusion criteria were studied and recruited using multistage sampling. Face to face interview was used to collect the data. PSQI was used to measure sleep quality, and 25-OH Vitamin D Rapid test was used to measure the serum vitamin D level.

### **Results:**

Of the 267 participants interviewed, the prevalence of poor sleep quality was 57.3%, and the prevalence of vitamin D deficiency ( $< 50$  nmol/L) was 66.3%. A comparison of serum vitamin D levels groups and PSQI components showed that the vitamin D deficient group had higher total PSQI score, more sleep disturbances, and longer sleep latency and duration. However, the vitamin D supplement group had better sleep quality, higher habitual sleep efficiency, and less of daytime dysfunction symptoms. In logistic regression analyses, sufficient vitamin D level and using vitamin D supplements were significantly associated with increased probability of good sleep quality while increasing depression score was associated with poor sleep.



## Conclusion:

A significant association was found between good sleep quality and sufficient serum vitamin D level, supplementation of vitamin D was associated with good sleep quality which might have a preventing and therapeutic role in sleep disorders.

## Arabic Summary

العلاقة بين نوعية جودة النوم ومستوى فيتامين دال بين الإناث المقيمت في المدينة السكنية بالحرس الوطني  
بجدة، ٢٠١٨

### ملخص

#### المقدمة:

تعتبر نوعية النوم الضعيفة وانخفاض مستوى فيتامين دال من مشكلات الصحة العامة التي لها عواقب على الصحة، وكلاهما من المشاكل التي يمكن الوقاية منها بسهولة وعلاجها والتي تظل غير معروفة. على الرغم من أن الدراسات الحديثة قد أبلغت عن وجود علاقة بين جودة النوم ومستوى فيتامين دال، إلا أن هناك نقصاً في الأبحاث حول هذه العلاقة في السعودية وخصوصاً ضمن العامة.

#### الأهداف التفصيلية:

تحديد العلاقة بين نوعية النوم ومستوى فيتامين دال بين الإناث البالغات اللاتي يعشن في مدينة الحرس الوطني السكنية في جدة، ٢٠١٨.

#### الطريقة:

تم تقييم العلاقة بين نوعية النوم ومستوى فيتامين دال من خلال دراسة مقطعية، حيث تمت دراسة عينة تبلغ ٢٦٧ من النساء اللاتي استوفين معايير الاشتمال. تم اختيار المشاركات باستخدام أخذ العينات متعددة المراحل ومقابلتهن وجهاً لوجه لجمع البيانات وقياس جودة نوعية النوم باستخدام مؤشر بيتسبرغ لجودة النوم وقياس مستوى فيتامين دال باستخدام اختبار فيتامين دال السريع.



## النتائج:

من بين ٢٦٧ مشاركة تمت مقابلتهم في هذه الدراسة، كان معدل انتشار نوعية النوم السيئة ٥٧,٣٪ وانتشار نقص فيتامين دال كان ٦٦,٣٪. أظهرت مقارنة بين مجموعات مستويات فيتامين دال ومكونات المؤشر أن المجموعة التي تعاني من نقص فيتامين دال لديها مجموع نقاط أعلى في مجموع المؤشر واضطرابات نوم أكثر ومدة أطول في زمن الدخول في النوم ومدة النوم ككل. بينما المجموعة التي تتناول مكملات فيتامين دال تمتاز بنوعية نوم أفضل، كفاءة نوم أعلى وأعراض أقل للخلل الوظيفي خلال النهار. في تحليل الانحدار اللوجستي، ارتبطت نوعية النوم الجيدة بشكل كبير ب احتمال زيادة مستوى فيتامين دال الكافي واستخدام مكملات فيتامين دال، في حين ارتبطت زيادة درجة الاكتئاب مع نوعية النوم الضعيفة.

## الخلاصة:

تم العثور على ارتباط مهم بين نوعية النوم الضعيفة ونقص فيتامين دال في الدم، كما أن هناك علاقة بين مكملات فيتامين دال ونوعية نوم الجيدة والتي بالتالي قد يكون لها دور وقائي وعلاجي في اضطرابات النوم.

**Key words:** Sleep Quality, PSQI, Vitamin D, Vitamin D Supplements.

**الكلمات المفتاحية:** جودة النوم، مؤشر بيتسبرغ، فيتامين دال، مكملات فيتامين دال.

**Abbreviation:** PSQI: Pittsburg Sleep Quality index



## Introduction

Sleep is a fundamental lifestyle contributor to the health, recognized as a vital part of public health (Jackson, 2016). It contains three different components: effectiveness of sleep which includes quality and length of sleep (Jackson, 2016) (Ann Call-Schmidt and Richardson, 2003). Quality as a component of sleep effectiveness contains feeling refreshed upon awakening and the total number of hours of sleep obtained while in bed (Gominak and Stumpf, 2012) (Orfeu M. Buxton, 2013). Disturbance as being the second component includes interruptions to sleep and difficulty falling asleep (Ann Call-Schmidt and Richardson, 2003) (Cormier, 1987), and supplementation, which is the third component refers to augmentation of sleep through napping during the day (Ann Call-Schmidt and Richardson, 2003).

Healthy sleep in an adult population characterized by five main characteristics, Sleep efficiency  $\geq 85\%$  according to WHO (Germany, 2004), which is the ratio calculated by dividing the time spent in sleep to time spent in bed. Sleep latency which is the time person takes to initiate asleep with normal average  $<30$  minutes, sleep duration of seven to nine hours per night for adults, consolidated sleep which is uninterrupted sleep by arousals or awakenings [(Ramar and Olson, 2013), and no daytime dysfunction (daytime sleepiness symptoms while engaging in social activity) (Okubo *et al.*, 2014).

Poor sleep quality has recently focused on as one of the screening tools of mental health, and risk factor of depression in middle-aged and older individuals (Guo *et al.*, 2017) (Bhandari *et al.*, 2017) and an intervention to improve the sleep quality is an effective treatment for depression and other mental illness (Rusch *et al.*, 2015).



There is growing evidence showing that correcting vitamin D deficiency by supplements, diet, or sun exposure may improve the quality of sleep and the quality of life in general. However, the quantity and quality of this evidence are still limited in many respects.

Vitamin D is a fat-soluble vitamin that acts as a steroid hormone and is naturally present in foods, primarily produced endogenously by ultraviolet rays from sunlight striking the skin, vitamin D synthesis undergoes two hydroxylation for activation. The first occurs in the liver and the second in the kidney to form the 1,25-dihydroxy vitamin D (Ross *et al.*, 2001).

Vitamin D deficiency in Saudi Arabi recently has been defined newly as circulating serum vitamin D <50 nmol/l by the Prince Mutaib Chair for Biomarkers of Osteoporosis, 2016 (Al-Daghri *et al.*, 2017).

Up to the investigator knowledge, there was no study done to evaluate the potential relationship of vitamin D to sleep disturbance among the general population in Saudi Arabi and there was no study filled the gap and research using of vitamin D supplements and its association with sleep quality.



## Literature Review

The prevalence of sleep disorders varies markedly between regions of the world, in western countries it lies between 20–30% (Mollayeva *et al.*, 2016), and according to a global survey from ACNielsen in 2004, the sleep quality of people in Asian countries is getting worse and shorter in duration (Cherasse, 2011).

The prevalence of poor sleep quality among women was assessed in rural and urban Chinese older adults, which concluded to be 67.2% (Wang *et al.*, 2019) and 41.5% (Luo *et al.*, 2013), respectively. Furthermore, Among Ethiopian population another cross-section was done among population aged between 30 and 70 years in Ethiopia, the prevalence of poor sleep quality was 37% among women and 63% among men (Berhanu *et al.*, 2018).

In Saudi Arabia, the prevalence of poor sleep quality was reported in studies conducted among medical students, residents, and diabetic patients. one cross-section study conducted among 1205 residents in training showed that the prevalence of poor sleep quality was 86.3% (Alsaif, 2019) while it was 34.3% among the medical students at King Khalid University ('Sleep Disorders , Medicine & Integrative Medicine', 2016) and 55.4% of 307 diabetic patients in Jizan reported poor sleep quality (A. *et al.*, 2018). All of the studies that were done were targeted population with specific characteristics that could be differ than the general population.

Several studies have shown the relation between vitamin D deficiency and multiple behavioral circadian rhythms disruptions (Jung, Kang and Kim, 2019), (Cheng *et al.*, 2017) such as sleep disorders, night-time eating, and depression.

A systematic review and meta-analysis was conducted in 2018 by Gao Q to investigate the association between vitamin D deficiency and the risk of sleep where A total of nine observational studies involving 9397 subjects were included, reported that vitamin D deficiency had a significantly increased risk of sleep disorders and associated with poor sleep quality, short sleep duration, and sleepiness (Gao *et al.*, 2018).



In Korea, a significant correlation was found between serum vitamin D deficiency and poor sleep quality among 1472 electronic manufacturing workers industry in Korea in 2017 (Jung *et al.*, 2017), a case control study done in China by Bin Han in 2017 among patients undergoing maintenance hemodialysis also reported an association between vitamin D deficiency and poor sleep quality (Han *et al.*, 2017).

Several studies had been done to assess the most known vitamin D predictors like sun exposure diet and vitamin D supplements on sleep quality (Duzgun and Durmaz Akyol, 2017) (Marring *et al.*, 2017) (Mikic, Pietrolungo and St-Onge, 2018), (Fakhr-Movahedi, Mirmohammadkhani and Ramezani, 2018).

Vitamin D is the only vitamin that is a steroid hormone. It plays many physiological roles in the human body although the specific mechanism that related to sleep is not well understood, it may be linked to its ability to increase the affinity of neurotrophin receptor that would influence the activity of the neurotransmitters like serotonin and dopamine and to release these neurotransmitters that affect the brain function and development (Franca *et al.*, 2015). This role of vitamin D in the endocrine and autonomic nervous systems could lead to wide-ranging effects as a cardiovascular protective factor, anti-cancer agent, and sleep-wake cycle regulator (Pérez-Hernández *et al.*, 2016), (Chakraborti, 2011).

### **Vitamin D deficiency**

A community-based cross-sectional study was conducted in the Family Medicine Clinics at King Faisal Specialist Hospital and Research Centre in Riyadh, 2017, where 1723 patients' electronic records were reviewed. Alkhenizan, *et al.* stated that 61.5% had vitamin D deficiency and insufficiency with levels less than 50nmol/L among the whole population (Alkhenizan *et al.*, 2017).

A Systematic Review and Meta-Analysis was conducted in 2018 by Prof. Mir Sadat-Ali, *et al.* to determine the prevalence of Vitamin D deficiency in the Saudi population. Where a total of 26 studies (2008-2015) were identified and 20,787 subjects were included, reported that the overall vitamin D deficiency was 63.5% (Al-Alyani *et al.*, 2018).



This literature demonstrates the need to determine the sleep quality status, vitamin D status and the relationship between sleep quality, vitamin D levels and vitamin D's among the general population in Saudi Arabia, to early detect them and avoid their consequences on health.

### **Study setting**

The study was conducted in the National Guard city, which is located in Jeddah, Saudi Arabia. The city consists of five geographic districts. Each district contains a certain number of villas where they are arranged in an organized city planning structure. The total numbers of villas are 1,165 .

### **Study design and period**

The study was conducted using a cross-sectional design and implemented from October 1, 2018, to December 27, 2018.

### **Study population**

The population of National Guard residential city of women aged  $\geq 18$  years old who were according to the last community-based survey about 1180 women in 2018.

### **Exclusion criteria :**

- ❖ Subjects were receiving medications known to affect sleep or vitamin D level (osteoporosis drug therapy, chemotherapy, anticonvulsants, anti-tuberculosis drugs)(Rutering *et al.*, 2016).
- ❖ Subjects with mental illness or having chronic conditions such as asthma, diabetes mellitus, hypertension, history of cardiac, kidney or liver diseases(Kemple, O'Toole and O'Toole, 2016),(Koyanagi *et al.*, 2014)
- ❖ Pregnant women or those who are having children under two years living at home(Sedov *et al.*, 2018),(Aksu and Vefikulucay Yilmaz, 2019)
- ❖ Subjects are working on Shifts (Nena *et al.*, 2018)(Almetrek, 2014).



### **Sample size:**

The sample size calculated by using the single equation on Roasoft software package, the required sample size is 267 at 95% confidence level and 5% margin of error. Based on previous literature, the prevalence of sleep disorders reported being 33.8% among the general population (Ahmed *et al.*, 2017). Thus, 267 women should be interviewed.

### **Sampling technique**

Stratified random sampling was used to stratify the residential city into five major geographical districts, and each district contains a certain number of streets (12-15 main roads). After the stratification the systematic random was conducted to allocate to the selected house by selecting every 4th villa starting from the starting point of the street, the first house was selected by simple random sampling of the first four houses.

The study houses were identified and visited, one woman aged  $\geq 18$  years per household who met the inclusion criteria were randomly recruited and asked to participate in the research (the simple random sampling technique was the method that used to select one participant per household).

On a visit, two data collectors were visiting the selected house, and after the purpose of the study was briefed to the household and written informed consent signature taken. One of the data collectors was in charge for collect the blood sample to measure the vitamin D level, in meanwhile of waiting for the result, the other data collector was interviewing the participant and collecting the data by the questionnaire.

### **Data collection Tools:**

Relevant data were collected from the participants who were interviewed by the trained volunteers in their homes in the city, in the morning and afternoon, by using a questionnaire collects data and 25 OH Vitamin D Rapid test.



## **The questionnaire involved the following parts:**

### **Socio-demographic characteristics:**

Age, marital status, educational level, and occupation, vitamin D supplements.

### **Arabic valid and reliable Pittsburgh Sleep Quality Index was used:**

To evaluate sleep quality, participants were asked using PSQI to differentiate “poor” from “good” sleep quality by measuring 19 items grouped in seven components: subjective sleep quality, sleep duration, habitual sleep efficiency, sleep latency, sleep disturbances, use of sleeping medications, and daytime dysfunction over the last month (Buysse *et al.*, 1989). The scores of each statement ranged from 0=no difficulty, 1=mild difficulty, 2=moderate difficulty, and 3=severe difficulty. The scores of all components are summed up to yield global PSQI scores that ranged from 0 to 21. The global score of 5 and above indicate poor sleep quality, while score < 5 is defined as good sleep quality. Arabic version of the PSQI was designed and published (Suleiman *et al.*, 2009).

### **Clinical measurements**

Vitamin D was measured by using a reliable and valid portable device called: 25 OH Vitamin D Rapid test (Enko *et al.*, 2015), after pricking the participant's finger with a small needle (lancet), drops of blood collected and applied in the center of the sample well. The sample result displayed within 15 Minutes (Pfeiffer, 2002).

### **Data Analysis:**

Data entry and statistical analysis were conducted by using Statistical Package for Social Sciences (SPSS) version 25. Demographic and clinical data were analyzed by using descriptive statistics, including means, standard deviations and frequencies. The Mann-Whitney U was used to assess for significant differences in a scale of sleep quality score, sleep quality components to vitamin d status and supplements. This research used an alpha level of statistical significance of less than 0.05.



## Results:

A total of 267 female participants who completed the study were included in the analysis. More than half (51.3%) of participants were  $\geq 30$  Years, the age of participants was ranging from 18 to 72 years. More than half of the participants in our sample were married 54.7% and housewives or students 78.3%. Only of the participants, 21.7%, were employed. An education level of high school graduation or less was reported by 47.2% participants, while 52.8% reported a bachelor's degree or higher. 7.1% of the participants were on Vitamin D supplements. (Table 1).

*Table 1: Sociodemographic and participants' characteristics of the sampled (n =267) women adults in Jeddah,2018.*

Characteristics		n (%)
Age (Years)	< 30 Years	130 (48.7)
	$\geq 30$ Years	137 (51.3)
Social Status	Married	146 (54.7)
	Unmarried	121 (45.3)
Educational Status	$\leq$ High School Education	126 (47.2)
	$\geq$ Bachelor's Degree	141 (52.8)
Occupational Status	Employee	58 (21.7)
	Students	84 (31.5)
	Housewife's	125 (46.8)
Taking Vitamin D Supplements	Yes	19 (7.1)
	No	248 (92.9)

The prolonged sleep-onset latency (moderate and severe difficulty) reported by 118 (44.2%) (Table 2). The majority (83.5%) reported their sleep quality as fairly good to very good. Sleep duration more than 7 hours was 64.8% while only 94 (35.3%) reported that they had less than 7 hours of sleep per night,



165 (61.8%) of the precipitants had high sleep efficiency >85% and 39 (14.6%) had a low habitual sleep efficiency (<65%), 18 (6.7%) used sleep medication within the past month at the time of interview (Error! Reference source not found.).

Table 2: Frequencies of responses to selected questions of the PSQI (%).

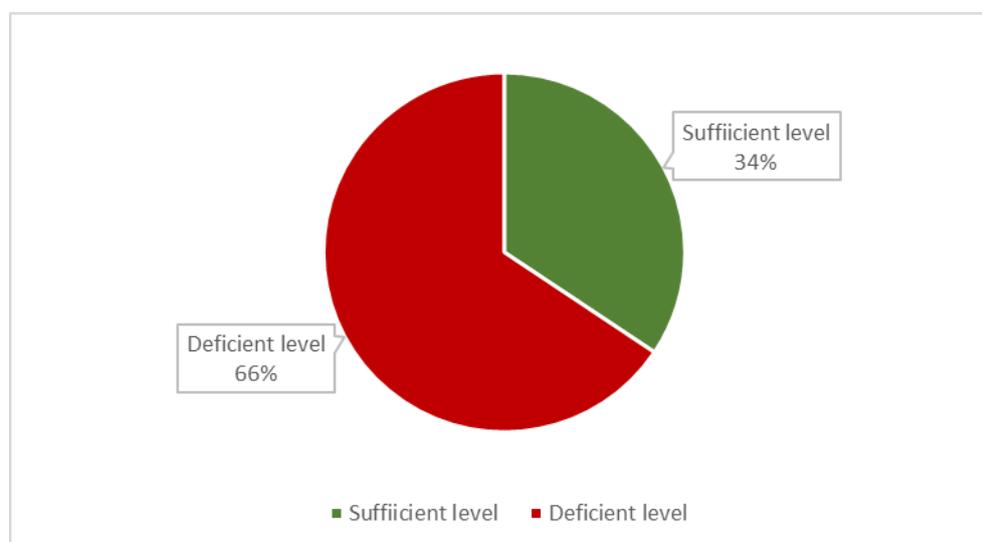
Variables (n = 267)	Value	Number	%
Sleep Duration	>7 hours	173	64.8
	6-7 hours	37	13.9
	5-6 hours	37	13.9
	<5 hours	20	7.5
Sleep Latency	No difficulty (0)	61	22.8
	Mild difficulty (1 -2)	88	33.0
	Moderate difficulty (3 - 4)	69	25.8
	Severe difficulty (5-6)	49	18.4
Daytime Dysfunction	No difficulty (0)	118	44.2
	Mild difficulty (1 -2)	90	33.9
	Moderate difficulty (3 - 4)	45	16.9
	Severe difficulty (5-6)	14	5.2
Sleep Efficiency	>85%	165	61.8
	75-84%	28	10.5
	65-75%	35	13.1
	<65%	39	14.6
Subjective Sleep Quality	Very good	138	51.7
	Fairly good	85	31.8
	Fairly bad	35	13.1
	very bad	9	3.4
Sleep Disturbance	No difficulty (0)	38	14.2
	Mild difficulty (1 to 9)	212	79.4
	Moderate difficulty (>9 to 18)	17	6.4
	Severe difficulty (> 18)	0	0.0
Use of Sleep Medication	Not during the past month	249	93.3



	Less than once a week	6	2.2
	Once or twice a week	9	3.4
	Three or more times a week	3	1.1
Sleep Quality Score	Good sleep	114	42.7
	Poor sleep	153	57.3

A high prevalence of 57.3% (n=153) of poor sleep quality was reported (Table2). The prevalence of vitamin D deficiency (<50 nmol/L) was 66.3% while the vitamin D sufficiency ( $\geq 50$  nmol/L) was 33.7% (Figure 1).

Figure 2: Vitamin D level among women living at National Guard city, Jeddah,2018.



Patients were classified into two subgroups as  $\geq 50$  nmol/mL serum vitamin D and <50 nmol/mL serum vitamin D. There was a significant difference among the vitamin D groups in PSQI total, Sleep latency,



Sleep duration and sleep disturbances ( $P = 0.04, 0.02, 0.02$  and  $0.001$  respectively). In all of the four components, the mean rank was less among the sufficient rather than the deficient group. (

Table )

Table 3: The differences in the overall PSQI score and each component of the PSQI according to serum vitamin D levels

	Vitamin D Level Group	Mean Rank	Sum of Rank	MW-U	<i>p</i>
PSQI Total Score	Sufficient	114.24	10282.00	6187.000	0.044
	deficient	133.31	21596.00		
Sleep Latency	Sufficient	112.87	10158.00	6063.000	0.022
	deficient	134.07	21720.00		
Sleep Duration	Sufficient	112.41	10116.50	6021.500	0.020
	deficient	134.33	21761.50		
Habitual Sleep Efficiency	Sufficient	116.62	10495.50	6400.500	0.069
	deficient	131.99	21382.50		
Sleep Disturbances	Sufficient	112.08	10087.00	5992.000	0.001
	deficient	134.51	21791.00		
Daytime Dysfunction	Sufficient	128.53	11567.50	7107.500	0.725
	deficient	125.37	20310.50		

\*Comparison made using the Mann-Whitney u test

Abbreviations: PSQI: Pittsburgh Sleep Quality Index, MW-U: Mann-Whitney u test



Patients were classified into two subgroups as on vitamin D supplements and not on vitamin D supplements group. There was a significant difference among the vitamin D supplements group in PSQI total, Habitual sleep efficiency, and Daytime dysfunction scores ( $P = 0.022$ ,  $0.022$ ,  $0.010$  respectively). In all of the three components, the mean rank was less among the supplement group rather than the group without supplements. (Table ).

*Table 4: The differences in the overall PSQI score and each component of the PSQI according to using vitamin D supplements.*

	Vitamin D supplements	Mean Rank	Sum of Rank	MW-U	<i>p</i>
PSQI Total Score	Yes	88.92	1689.50	1499.500	0.022
	No	127.98	29435.50		
Sleep Latency	Yes	120.03	2280.50	2090.500	0.742
	No	125.41	28844.50		
Sleep Duration	Yes	114.05	2167.00	1977.000	0.422
	No	125.90	28958.00		
Habitual Sleep Efficiency	Yes	92.97	1766.50	1576.500	0.022
	No	127.65	29358.50		
Sleep Disturbances	Yes	109.08	2072.50	1882.500	0.160
	No	126.32	29052.50		
Daytime Dysfunction	Yes	86.89	1651.00	1461.000	0.010
	No	128.15	29474.00		

\*Comparison Made using the Mann-Whitney u test



## Discussion:

High prevalence of poor sleep quality, reaching 57.3% was found among the participants. Comparison with other studies in Saudi Arabia was a challenge due to their scarcity among the general population. However, a similar proportion to the results in few studies from a different population (54%) of female university students reported poor sleep quality at King Faisal University (KFU) in AL-Hasaa (AL-Otaibi, 2016) and 67.9% among female health care workers in Riyadh city (Ajmi, 2015).

This prevalence is consistent with the result of the study that had done among Ethiopian adult women population (61.8%) while it is much higher than what was found previously among general adults women population in Spain (44.6%) and China (27.0%) (Madrid-Valero *et al.*, 2017)(Tang *et al.*, 2017). This variation could be either due to the different interview techniques used to evaluate sleep quality or different age and race of the study population.

Participants were more likely to report poor sleep quality may be due to the high unemployment rate which could lead to bedtime delay, irregular sleep-wake times, inadequate sleep hygiene and sleep fragmentation[(Sariarslan *et al.*, 2015)(Lisa J. Meltzer, 2012)(Nancy Foldvary-Schaefer, DO, no date) .

The overall vitamin D deficiency (<50nmol/mL) is 66.3%, which is similar to the prevalence in the last meta-analysis(2005-2015) that was published in 2018 and showed that the vitamin D deficiency in the healthy Saudi Arabian population was 63.5%(Al-Alyani *et al.*, 2018).

This study was conducted during the winter season but most of the participants were recruited in the early of October that means that we measured the vitamin D level of the fall season which may explain the high prevalence of low vitamin D level in the participants due to vitamin D level variations across the various seasons (Ks and Sa, 2019).



The current study showed that the low serum vitamin D levels were associated with poor PSQI score, prolonged sleep latency, longer sleep duration, and more sleep disturbances. Similar to the previous study that found that those with vitamin D deficiency had higher total PSQI scores and longer sleep latency than the healthy group (Jung *et al.*, 2017),(Gao *et al.*, 2018),(Bertisch *et al.*, no date).

The current study found that there is an inverse association between vitamin D status and sleep duration, and the vitamin D deficiency group had longer sleep duration than the healthy group. This result is inconsistent with the previous study, where there was a positive relationship between vitamin D status and sleep duration. Specifically, Miae Doo, et al. Who reported that the participants with deficient vitamin D serum have shorter sleep duration(Doo, 2018). However, this long-duration of sleeping among vitamin deficient group could be explained as a temptation from the subject to cope with and compensate for poor sleep quality.

This study found that the use of a vitamin D supplement may improve sleep quality, raise the habitual sleep efficiency, and reduce the daytime dysfunction symptoms during the day. This finding is in line with a previous double-blind clinical trial that showed that the use of vitamin D supplement reduces the sleep quality score and improve the habitual sleep efficiency (Mohammad Shahi *et al.*, 2017).

Although, there were studies that have been done to assess the association between the sleepiness and vitamin D level and demonstrate a significant inverse relationship between sleepiness and vitamin D level (McCarty *et al.*, 2012) ,but up to the researcher knowledge there were no studies have been done to assess the effect of the supplements on sleepiness and daytime function in specific.



## **Conclusion:**

Our study suggests that approximately 1 out of 3 adult women slept poorly, and 2 out of 3 had deficient serum vitamin D level. This study also showed that poor sleep quality is associated with vitamin D deficiency in this population. Furthermore, population-based studies with larger sample size and a longitudinal follow-up may help to determine the sleeping habits and the potential role of vitamin D supplementation in the treatment of individuals with poor sleep quality.

## **Strengths and Limitations:**

The strength of this study is that the data were obtained from the general population, at participant's home and by face-to-face interviews which were helping in collecting that amount and quality of data and absence of missing data. The gap of the previous study was filled by studying the diet habits, sun exposure, and vitamin D supplements use.

Our findings are limited by its cross-sectional observational design and the possibility of misclassification due to recall bias and retrospective measuring questionnaires for sleep quality. Our conclusions would be applied specifically to healthy women adults (the sample was not gender-balanced, all of our participants were females).

## **Conflicts of Interest**

No conflict of interest.

## **Ethical considerations**

The research was approved by the King Abdullah International Medical Research Center Ethics and Scientific Committee. Institutional Review Board (IRB) approval number: RJ18/055/J.



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This is Self-funded

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