ORIGINAL ARTICLE

Bali Medical Journal (*Bali MedJ)* 2023, Volume 12, Number 3: 3290-3293
P-ISSN.2089-1180, E-ISSN: 2302-2914

Circadian behavior and vitamin D status: a study on students at Faculty of Health, Universitas Nahdlatul Ulama Surabaya

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Received: 2023-05-02
Accepted: 2023-09-30
Published: 2023-11-22

ABSTRACT

Background: Vitamin D deficiency is still common in various community groups, including women of childbearing age. Not only because of a lifestyle that avoids the sun, but recent research has shown that circadian behavior, which includes eating and sleeping patterns, is associated with vitamin D deficiency. This study aims to provide information about female students' vitamin D status and circadian behavior to prevent further health problems.

Methods: This research was quantitative, analytic, and observational, with a cross sectional study approach. The population was students of the academic year 2019 in the Faculty of Health, Universitas Nahdlatul Ulama Surabaya, in 2022. The sample size was 50 people. Data collection includes circadian behavior with parameters of sleep patterns, eating patterns, and plasma vitamin D levels. Sleep pattern data was collected using The Pittsburg Sleep Quality Index (PSQI) questionnaire. Circadian eating pattern data was taken with 24-hour recall instruments. Plasma vitamin D levels were obtained by taking blood samples analyzed using the Fluorescence Immunoassay Rapid Quantitative Test method. Data analysis was performed using the Mantel-Haenszel statistical test on the SPSS program.

Results: The results showed that 80.0% of samples had a predominantly daytime (pDT) eating pattern, 64.0% had poor sleep quality, and 68.0% had vitamin D deficiency. Bivariate analysis for eating patterns and vitamin D status showed OR = 0.890 (0.197-4.012). Bivariate analysis for sleep pattern and vitamin D status showed OR value = 1.362 (0.385-4.817). However, the p-value indicates an insignificant correlation (p=0.880 and p=0.631).

Conclusion: The study shows poor sleep quality and predominantly daytime eating patterns are not risk factors for vitamin D deficiency.

Keywords: circadian behavior, eating pattern, sleep quality, vitamin D.
Cite This Article: Setiarsih, D., Kardina, R.N., Nidianti, E., Rachmawati, M., Wulandari, I.I.L., Rahmawati, A.H., Hidayah, A.R.B. 2023. Circadian behavior and vitamin D status: a study on students at Faculty of Health, Universitas Nahdlatul Ulama Surabaya. *Bali Medical Journal* 12(3): 3290-3293. DOI: 10.15562/bmj.v12i3.4467

INTRODUCTION

The problem of vitamin D deficiency in Indonesia is interesting to study because the main fulfillment of vitamin D is by exposure to sunlight (ultraviolet B), which should not be difficult to obtain in Indonesia as a tropical country. This phenomenon needs attention because vitamin D has skeletal and non-skeletal effects.

Vitamin D levels are affected by sun exposure and can also be related to circadian behavior. Recent research states that circadian behavior is associated with vitamin D deficiency. Circadian behavior can be assessed from sleep quality and circadian eating patterns.[1] The circadian rhythm is a cycle of change from light to dark and back again every 24 hours that creatures on the earth's surface have adapted. The human body will function optimally during the day and will decrease at night because it is influenced by light and dark (day and night). Mechanisms in metabolic changes due to changes in eating habits can be explained through circadian rhythm disturbances (circadian rhythm disruption). The circadian rhythm system functions in synchronizing hormonal and metabolic functions, so if there is a disturbance in this system, it will disrupt hormonal and metabolic functions. Changes in sleep patterns and waking hours will reduce the production of the hormone leptin, increase the production of the hormone ghrelin, and increase insulin resistance. This can further alter the regulation of body temperature, digestion, energy metabolism and hormonal responses of individuals who eat at night rest.[2]

Silvia et al. (2019) showed a significant correlation between serum vitamin D levels and sleep latency in late adolescent girls. The study concludes that the lower of vitamin D level, the worse the individual sleep latency.[3] In another study, it was stated that there was a significant difference in serum vitamin D levels between the predominantly daytime (pDT) and predominantly nighttime (pNT) circadian eating pattern groups. Serum vitamin D levels showed high values in the pDT group. Vitamin D deficiency is common in young Minangkabau women. Therefore, the pDT circadian eating pattern is thought to be one solution in improving vitamin D

status in Minangkabau adolescent girls.[4]

Solutions for the prevention of such vitamin D deficiency require adequate evidence. Data collection and observations of various populations are still needed to strengthen the hypothesis. Therefore, this study aims to analyze the correlation between vitamin D status and circadian behavior in female students of the Faculty of Health, Universitas Nahdlatul Ulama Surabaya (UNUSA). This study is also expected to provide information about female students' vitamin D status and circadian behavior to prevent further health problems.

METHODS

Material

This quantitative research was analytically observational with a crossed sectional study approach. This research was done in 2022. The target population was students of the academic year of 2019 in the Faculty of Health UNUSA. The reachable population of this study was 105 students of the nutrition undergraduate study program, faculty of health, UNUSA. The sample size was 50 people. The sample size was calculated using the Lemeshow formula {n= [z^2. N. p. q] / [d^2 (n-1) + z^2. p. q]}. The sampling technique used was simple random sampling. The inclusion criteria for the sample selection were students of the 2019 undergraduate nutrition study program, faculty of health, UNUSA, aged 17-25 years and willing to participate in the research. Furthermore, the exclusion criteria used were being on a certain eating pattern, having skin pigmentation disorders, obesity, and suffering from liver and kidney disorders.

Data collection procedures

The data taken include circadian behavior, which mainly includes sleep quality, circadian eating patterns, and plasma vitamin D levels. Sleep quality data was collected using The Pittsburg Sleep Quality Index (PSQI) questionnaire.[5–7] Data on circadian eating patterns was taken with the 24-hour recall instrument and then calculated energy intake. The data were categorized into pDT if energy consumption when the sun had shone more than 50% of the total intake and the category of pNT if more than 50% of energy intake when there was no sunlight.[8] Sunrise and sunset times have used meteorology, climatology and geophysics agency data. Plasma vitamin D levels were obtained by taking blood samples, which were then analyzed using the fluorescence immunoassay rapid quantitative test method.

Data analysis

Data analysis was performed using the Mantel-Haenszel statistical test on the SPSS program. The significance value is set at $\alpha = 0.05$.

RESULTS

This study included 50 students in the academic year 2019 in the Faculty of Health UNUSA. The data collected to describe the characteristics of the sample

Table 1. Sample characteristics

Characteristics	Number of participants N = 50	Percentage (%)	Mean ± SD
Weight (kg)			51.01±5.78
Height (meters)			1.55±0.06
Body mass index (kg/m^2)			21.27±2.00
Nutritional status			
- Underweight	5	10.0	
- Normal	44	88.9	
- Overweight	1	2.0	
Eating Pattern			
- pDT	40	80.0	
- pNT	10	20.0	
Sleep Latency			
- ≤ 15 minutes	21	42.0	
- 16-30 minutes	18	36.0	
- 31-60 minutes	5	10.0	
- > 60 minutes	6	12.0	
Sleep Time			
- > 7 hours	8	16.0	
- < 6-7 hours	24	48.0	
- 5-6 hours	14	28.0	
- < 5 hours	4	8.0	
PSQI Score			
Sleep Quality			
- Good (score ≤ 5)	18	36.0	
- Poor (score > 5)	32	64.0	
Vitamin D Status			
- Deficiency	34	68.0	6.52±2.03
- Insufficient	16	32.0	

Table 2. Risk factor analysis

Circadian Behavior	Vitamin D Status		OR (95% CI)	p-value
	Deficiency n(%)	*Insufficiency* n(%)		
Eating Pattern				
pDT	27 (54.0)	13 (26.0)	0.890 (0.197-4.012)	0.880
pNT	7 (14.0)	3 (6.0)		
Sleep Quality				
Good	13 (26.0)	5 (10,0)	1.362 (0.385-4.817)	0.631
Poor	21 (42.0)	11 (22.0)		

included anthropometric measures (weight and height), eating patterns, sleep patterns (sleep latency, sleep duration and sleep quality scores) and vitamin D status. The results showed that most samples had normal nutritional status, and the majority of samples' eating patterns were classified as pDT. More than 60% of samples have poor sleep quality. All samples experienced vitamin D adequacy problems, both deficiency and insufficient vitamin D. Table 1 shows this study sample characteristics.

The bivariate analysis showed that the significance of the correlation between eating patterns and vitamin D status and sleep quality with vitamin D was greater than the value of α = 0.05 (Table 2). Samples with vitamin D deficiency tend to experience poor sleep quality with 1.362 times greater chance. However, the p-value indicates an insignificant correlation (p>0.05).

DISCUSSION

Most of the study sample's eating pattern was classified as pDT, meaning that energy intake was still more (>50%) when the sun shone. The sleep quality of the research sample is mostly poor because of the lack of hours of sleep, sleep latency > 30 minutes, problems experienced during sleep and an assessment of sleep quality and problems of concentration in completing work. The research sample is a student with a fairly solid activity, so the opportunity to be active at night is very large but does not change eating patterns and sleeping hours to the extreme.

This fact is in line with a study at L'Aquila University, Italy. This study with 1136 samples showed that only 5.3% of the sample experienced The Night Eating Syndrome (NES), which was characterized by recurrent episodes of night eating, excessive food intake after dinner and difficulties in sleep maintenance, in contrast to night shift workers whose activities require extreme changes in sleeping and eating patterns.[9]

Night shift workers are one of the groups that experience variations in circadian behavior. They experience changes in eating patterns, such as skipping meals more often, consuming food on time, consuming more foods with saturated fat and soft drinks with protein, fiber and eating pattern intake.[10,11] lower micronutrients (calcium, potassium, vitamin A, vitamin B1 and iron) than those who work during the day.[12]

The results showed that all research subjects experienced vitamin D adequacy problems, both deficiency and insufficient vitamin D. This requires attention because vitamin D has an important role in many aspects of health and bodywork. As a tropical country with abundant sunlight throughout the year, Indonesia can avoid vitamin D deficiency because 90% of the fulfillment of vitamin D is obtained from sunlight. However, due to lifestyles such as the use of sunscreen, closed clothing and infrequent outdoor activities, many people are less exposed to the sun.[13] The intake of vitamin D from food is very limited because there are not many foods rich in vitamin D.[14]

Vitamin D is one of the fat-soluble vitamins. Of the several forms of vitamin D, Vitamins D2 and D3 are often considered the most important. The human body cannot produce vitamin D2, while vitamin D3 can be produced by the human body. When exposed to sunlight (UV B with a wavelength of 270-300 nm), 7-dehydrocholesterol precursor compounds in the skin will be converted into cholecalciferol compounds. The 25(OH)D increase after UV B exposure was dose-dependent but not dose rate (1-20 min). A significant increase in 25(OH) D was achieved with very low doses of UV B.[15,16] A low dose of UV B in Indonesia is found in sunlight in the morning at 07.00–10.00 and in the afternoon after 15.00 – 17.00.[17]

Vitamin D deficiency is a health problem that is currently increasingly being found. A study in Semarang showed that hypovitaminosis D is very common among the working age group in Indonesia.[18] Women are one of the groups prone to vitamin D deficiency. Previous research has shown the incidence of vitamin D deficiency among pregnant women.[19,20] The health consequences of vitamin D deficiency are certainly worrying for mothers and their offspring. Therefore, it is necessary to pay attention to the adequacy of vitamin D among women of childbearing age.

Neither eating pattern nor sleep quality in this study was a risk factor for vitamin D deficiency. This was due to other factors that might influence the occurrence of vitamin D deficiency. Women's lifestyle and several other factors, such as skin pigment, location of residence, and climate, can also affect vitamin D status. However, the most important factor is sun exposure.[21] The study by Setiarsih et al. (2022) proved a significant correlation between UV B exposure status and the vitamin D status of the subjects.[19] Insufficient exposure to UV B provides a 3.948 times greater risk of experiencing insufficient vitamin D. The weakness of this study is the small sample size, so further studies need to involve a larger sample size to confirm the results of this study.

CONCLUSION

Poor sleep quality and pDT eating patterns are not risk factors for vitamin D deficiency. However, it is important to take action to improve vitamin D status so that it becomes normal and does not have any implications for health problems.

AUTHOR CONTRIBUTION

All authors contributed equally to every step of this study.

FUNDING

This research was funded by the UNUSA LPPM research grant program (research contract number: 349.87/UNUSA-LPPM/Adm-I/III/2022).

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest in this study.

ETHICAL CLEARANCE

This study has been approved by the UNUSA Health Research Ethics Committee (KEPK) approved the ethical clearance (No.155/EC/KEPK/UNUSA/2022).

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