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Vitamin D and Reduced Academic Stress of Health Students

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Abstract

Stress conditions can reduce academic ability, influencing student grade point averages and encouraging negative behaviors. The objectives of this study was to discern the influence of vitamin D in the reduction of academic stress of health students. The study used a randomized controlled trial. The population was midwifery students who lived in the dormitory of Health Polytechnic of Ministry of Health, Yogyakarta, in 2017. Samples were 77 midwifery students who did not suffer from any chronic disease, nor experience academic stress. They all agreed to become study subjects. Of 39 respondents in a treatment group were administered 1 tablet of 400 mg vitamin D supplement daily, for 30 days. The control group was given placebo. Academic stress was assessed with the Depression, Anxiety, and Stress Scale 42 (DASS 42). Data were analyzed by using linear regression. The results showed that daily vitamin D supplement reduced academic stress (p-value < 0.05). One dose of 400 IU vitamin D daily for 30 days could reduce academic stress by 11.28 points. To reduce academic stress, students may consume vitamin D and expose their skin to sun rays with ultraviolet.

Keywords: academic stress, sunrays exposure, vitamin D

Introduction

Academic stress is an individual condition that one experiences related to the pursuit of knowledge and education.[1,2] Increased stress reduces academic ability that in turn influences grade point averages and encourages negative behaviors such as smoking, alcohol consumption, brawling, free sex, drug abuse, e.g., narcotics, psychotropic, and other addictive substances.[3,4] Prolonged stress can reduce the ability to adapt to stress.[5]

The prevalence of student academic stress is high. Students with moderate stress levels reach 43.3% and students with severe stress reached 31.2%.[6,7] Previous studies on gender differences in academic stress among medical students have shown that female students had higher level of academic stress compared to male students in all types of stressors.[8,9] Academic stress can be caused by numerous factors including monotony, noise, academic overload, ambiguous assignments, lack of control, harmful and critical conditions, perceived lack of appreciation, being ignored, losing opportunities, confusing rules, conflicting demands, tight academic assignment deadlines, time management, financial problems, sleeping disorders, personality tendencies, and social activity.[3,8,10] In addition, academic stress is also influenced by adverse health conditions, such as malnutrition and vitamin D deficiency.[11] Possible confounders are nutritional patterns and personality types. People with extroverted personality types (Type A) tend to be more susceptible to stress than introverted personality types (Type B).[10]

Vitamin D receptors can be found in the lower brain area, including the cortex cingulate and hippocampus, the areas involved in depression pathophysiology. Vitamin D is essential for the brain to produce serotonin hormone, which plays a key role in the mood that increases when the body is exposed to bright light, and decreases with reduced light exposure vitamin D is essential for the brain to produce serotonin hormone, which plays a key role in the mood that increases when the body is exposed to bright light, and decreases with reduced light exposure.[12,13] Several studies show a correlation between lower levels of serum 25-(OH)D, or calcifediol, to psychiatric disorders, including depression, eating disorders, and schizophrenia.[11,12]

Vitamin D deficiency has become endemic in all age

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groups all over the globe.[14] The prevalence of vitamin D insufficiency is high. Childrens' vitamin D status (aged 2.0-12.9 years) in Indonesia shows that 5.6% of children suffer from desirable (serum 25(OH)D > 75 nmol/L), 49.3% children suffered inadequacy (serum 25(OH)D 50-74 nmol/L) and 45.1% children suffered insufficiency (serum 25(OH)D 25-49 nmol/L).[15] The causative factors of vitamin D deficiency include diet (inadequate nutritional intake) and lack of sun exposure.[16] An unhealthy public lifestyle renders these basic necessities difficult to fulfill, so that vitamin D supplementation is required. 1000 international unit (IU)/day vitamin D supplements are recommended for those 19-50 years old and 5 g/day based on Reference Nutrient Intake (RNI).[17] Some study shows correlation between lower vitamin D levels and severe depression, emotional mood symptoms of premenstruation women, adult mood and cognitive disorder.[18,19] Vitamin D administration by supplement and sun ray exposure in one month show the positive effects for affective disorders.[20] Based on this background, a study to find out the influence of vitamin D supplement administration to reduce academic stress is required because the prevalence of the condition in Indonesia.[6,7] The objective of this study was to find out the influence of vitamin D in the reduction of academic stress among students of health.

Method

This study uses a randomized controlled trial (RCT) design. The population was midwifery students (all women) who lived in the dormitory of Health Polytechnic of the Ministry of Health in Yogyakarta in 2017. The sample was midwifery students living in dormitories, willing to be the subject of study and to experience academic stress (academic stress scores above 23). Subjects were excluded if suffering from a chronic illness (more than two weeks) based on a doctor's diagnosis. The study procedure began with a questionnaire pre-test to measure the state of negative emotions, including depression, anxiety and stress/tension related to academic life among students. The test examined physical and psychological conditions related to academic stress, feelings of fear, anger, and level of academic interest. Initial assessment of academic stress used the Depression Anxiety and Stress Scale 42 (DASS 42) to determine each subject's individual level. Subjects who met the criteria (experienced academic stress but did not suffer from chronic illness and were willing to be a subject of study) totaled 77 randomly-selected women for the treatment group and the control group. The treatment group was given one 400 mg tablet of vitamin D supplement daily for 30 days and asked to sunbathe twice a week (Saturday and Sunday) for approximately 60 minutes between 08:00 am and 11:00 am, with the face, arms, and legs uncovered and without using sunscreen. The control group was given 1 tablet of placebo daily for 30 days and also asked to sunbathe twice a week (Saturday and Sunday) with the same stipulations. On the 31st day, the subjects were provided posttests to measure academic stress and other confounding variables in both groups. Academic stress was assessed before and after treatment using the Depression Anxiety and Stress Scale 42 (DASS 42). For the purpose of univariate analysis, stress levels were divided into normal (stress score 0–23), mild (stress score 24–33), moderate (stress score 34–52), severe (stress score 53–73), and very severe (stress score ≥ 74). Possible confounders were nutritional patterns assessed using the Food Frequency Questionnaire (FFQ), and personality types measured by the Jenkins Activity Survey questionnaire (containing 20 question items). The highest score indicated that the subject had an extrovert personality, while the lowest score represents an introvert personality. Introvert personality type (Type B) is obtained by a score of 40–200 and extrovert (Type A) by a score of 201–380. Data were analyzed using linear regression. All p-values were t-tailed and the level of statistical significance was set to less than 0.05. Ethical approval was obtained from Ethics Committee of the Health Polytechnic of Ministry of Health Yogyakarta No: LB.01.01/KE02/XXI/489/2017. Subjects received explanations of the aims, risks, and procedures of the study and signed an informed consent as an agreement before the study was conducted. The description of recruitment flow chart is presented in Figure 1.

Results

The RCT of "vitamin D supplement and reduced academic stress" was performed with 77 midwifery students. Descriptive analysis results showed that 5.2% midwifery students suffered severe stress (stress score 53–73), 68.8% suffered moderate stress (stress score 34–52), and 26.0% suffered mild stress (stress score 24–33). After vitamin D supplement treatment and sun ray exposure, the students with severe stress decreased to 1.3%, students with moderate stress 40.3%, students with mild stress 36.4%, and normal to 22.1%.

The vitamin D administration influence on academic stress was analyzed by using a t-test. The result of normality data test showed that academic stress data were normally distributed (p-values of academic stress before and after treatment were 0.869 and 0.660, respectively). The analysis result of vitamin D administration influence to academic stress is presented in Table 1.

Table 1 shows a significant influence on the group that is given vitamin D and not on the placebo group, with regard to academic stress with p-value of 0.00 < 0.05 (95% CI: 7.33–18.64). Subject comparability

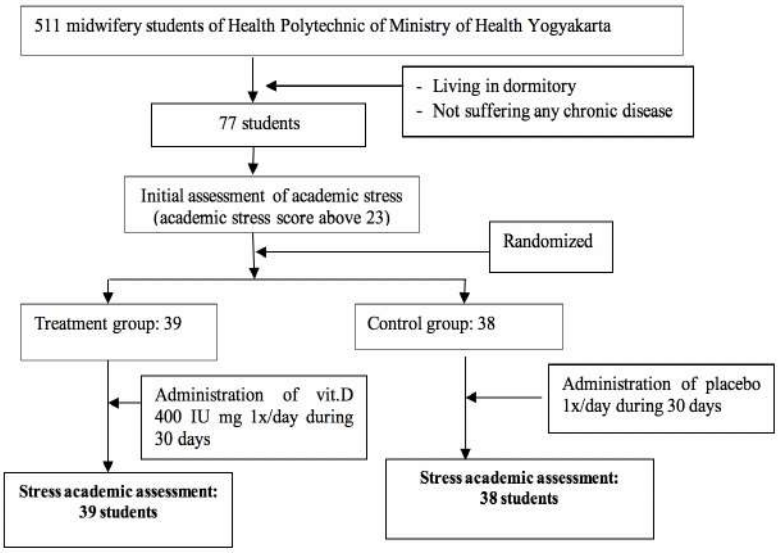

Figure 1. Diagram of Participants' Recruitment, Allocation, and Number of Participants

Table 1. The Vitamin D Supplement Administration Influence to Academic Stress

Variable	Mean		Difference	SD	p-value	95% CI
	Before	After				
Treatment	37.87	24.43	13.44	13.1	0.000	7.33–18.64
Control	37.60	37.15	0.45	11.7		

Notes: SD = Standard Deviation, CI: Confidence Interval

(vitamin D with placebo) based on personality type and food consumption are presented in Table 2.

Table 2 shows no significant differences in personality types and food consumption between the two groups. This indicates that the treatment group (vitamin D) and the placebo group are comparable (p-value > 0.05).

The effect of vitamin D on academic stress after being controlled for confounding variables the personality type, carbohydrate intake, animal diet source intake, vegetable and fruit diet source intake, vegetable intake, and dairy intake are presented in Table 3.

Table 3 shows a significant effect of vitamin D administration on academic stress after being controlled by personality type and variables—carbohydrate intake, animal diet source intake, vegetable and fruit diet source intake, vegetable intake, and dairy intake (p-value < 0.05). One dose of 400 IU of vitamin D daily for 30 days could reduce academic stress by 11.28 point.

Discussion

This study found evidence of a calming effect of vitamin D supplement administration on academic stress in health students. This is consistent with prior findings that vitamin D is of great importance for brain production of serotonin hormone, which plays a key role in the creation of mood conditions that reduce stress.[21,22] The criteria of vitamin D in this study were vitamin D3 with a 400 IU dose administered once daily times 30 days. In this case, the dose administered to the students was less than the 1000 IU/day recommended by the Ministry of Health. Pure vitamin D without combination with other minerals and vitamins, including calcium, is difficult to find, even in pharmacies and drug stores. This is a distinct problem if the pure vitamin D administration program is to be implemented for youths or the public. Vitamin D is rarely found in foods. The best source is salmon, tuna, and cod liver oil. It can also be found in small amounts in cow liver, cheese, and egg whites. Vitamin D in these foods commonly takes the form of D3 (cholecalciferol) and its metabolite 25(OH)D3.

The sun ray exposure increases the absorption of vitamin D. The sun ray exposure in this study was conducted twice a week by outdoor sunbathing between 08: 00 am to11:00 am for 60 minutes, without using an umbrella or sunblock lotion. When this study was conducted from May to June, Yogyakarta City was in the dry season, and sunlight rose around 06:00 am. This is in line with study findings on the effect of sun exposure can improve vitamin D absorption. Ultraviolet (UV) B from sun exposure at 09:00 am to 09:30 am for 30 minutes, 3 times a week for 12 weeks improves the vitamin D status. Serum 25(OH)D increase 15.9% from 15.7 ng/dL to 18.2 ng/dL.[23] The sun's UV rays are the strongest between 10:00 am and 04:00 pm to the extent possible, limit exposure to the sun during these hours.[24]

Academic stress in this study was defined as a response the students perceived from stimuli received dur-

Table 2. Subject Comparability (Vitamin D with Placebo) Based on Personality Type and Food Consumption

Variable	Category	Vitamin D		Placebo		Total		p-value
		%	n = 39	%	n = 38	%	n = 77	
Personality type	Introvert	57.1	22	56.4	22	57.9	44	1.00
	Extrovert	42.9	17	43.6	16	42.1	33	
Diet consumption	Carbohydrate intake							
	Never	0.0	0	0.0	0	0.0	0	0.439
	1–2 x/week	1.3	1	2.6	0	0.0	1	
	3–6x/week	9.1	4	10.2	3	7.9	7	
	> 1x/day	89.6	34	87.2	35	92.1	69	
	Animal source diet intake							
	Never	0.0	0	0.0	0	0.0	0	0.983
	1–2 x/week	27.3	10	25.0	11	28.9	21	
	3–6x/week	62.3	25	62.5	23	60.5	48	
	> 1x/day	10.4	4	10.0	4	10.5	8	
	Vegetable and fruit source diet intake							0.682
	Never	3.9	2	5.0	1	2.6	3	
	1–2 x/week	24.7	11	27.5	8	21.1	19	
	3–6x/week	61.0	23	57.5	24	63.2	47	
	> 1x/day	10.4	3	7.5	5	13.2	8	
	Vegetable intake							0.321
	Never	1.3	0	0.0	1	2.6	1	
	1–2 x/week	22.1	9	22.5	8	21.1	17	
	3–6x/week	57.1	25	62.5	19	50.0	44	
	> 1x/day	19.5	5	12.5	10	26.3	15	
	Dairy and fortified product							0.174
	Never	6.5	3	7.5	2	5.3	5	
	1–2 x/week	19.5	6	15.0	19	23.7	15	
	3–6x/week	27.3	8	20.0	13	34.2	21	
	> 1x/day	46.7	22	55.0	14	36.8	36	

Table 3. Multivariate Analysis of Factors that Influence Academic Stress

Variable	β	SE	p-value	95% CI	
				Lower	Upper
Constanta	−6.829				
Vitamin D administration	−11.283	2.986	0.000	−17.78	−5.87
Introvert personality type	− 0.054	0.060	0.375	−0.06	0.17
Adequate carbohydrate intake	2.019	4.239	0.635	−6.43	10.47
Adequate animal source diet intake	−2.895	2.575	0.265	−8.03	2.24
Adequate vegetable and fruit diet source intake	2.310	2.294	0.317	−2.26	6.88
Adequate vegetable intake	3.908	2.222	0.083	−0.52	8.34
Adequate dairy consumption	1.046	1.536	0.498	−2.01	4.10

Notes: β = Coefficient; SE = Standard Error; CI = Confidence Interval

ing academic life that might cause an individual balance condition disorder. Academic stress was assessed before and after by using DASS 42 questionnaire containing 60 items. The study results showed vitamin D supplements can reduce stress levels. After vitamin D supplement treatment and sun ray exposure, the student academic stress was reduced to 24.43 from 37.87. This reduction in academic stress scores was greater than in the control group without vitamin D, which was 37.6 to 37.15. The results of this study also describe the prevalence of student academic stress. The study results showed that 68.4% midwifery students suffered moderate stress. This result showed a bigger prevalence compared to previous study which found that academic stress prevalence among health students was already significant. There were 43.3% of students with moderate stress and 31.2% students with severe stress.[6,7] Female stress levels were higher compared to males for all types of stressors.[8,9]

In this study, data related to academic stress before and after treatment were compiled in the middle of the semester during the lecture period of students in class. A high rate of academic stress may be caused by many factors, including monotony, noise, too many academic assignments, ambiguous academic assignments, lack of control, harmful and critical conditions, being ignored or feeling unappreciated, lost opportunities, confusing re-

gulations, conflicting demands, academic assignment deadlines, time management issues, financial problems, sleeping disorders, and social activities.[3,8] Most stressors for students were seen related to learning activities. The Midwifery Department is a vocational institution with a learning system consisting of 40% theory and 60% practice. Very dense learning activities and many targets must be achieved. These might cause high rate academic stress among students. The study result showed that student stress was related to learning and academic activities. Stress due to basic character was difficult to change and became a factor influencing student stress conditions.

Low levels of vitamin D have been associated with severe depression, moods of premenstrual women, and adult mood and cognitive disorders.[18,19] Two RCTs measuring sun ray exposure vs. vitamin D supplementation for seasonal affective disorder show the positive effects of vitamin D, both by consuming supplements and sun ray exposure during one month.[20] To reduce academic stress, students should consume vitamin D and expose their skin to ultraviolet sun rays for limited amounts of time (note that overexposure to ultraviolet light can cause skin cancer and other bad outcomes). The Ministry of Health should make a program to promote vitamin D supplementation for students and/or teenagers.

This study is superior compared to other study because of vitamin D influence on academic stress had never been carried out in Indonesia. The limitation of this study is that the vitamin D consumption was not observed directly. However, to reduce bias, a WhatsApp group was created to remind all subjects to consume their vitamin D or placebos. Another limitation is that the sun ray exposure was done twice a week on Saturdays and Sundays for 120 minutes. This study also did not measure serum 25(OH)D levels.

Confounding is often referred to as a "mixing of effects" wherein the effects of the exposure under study on a given outcome are mixed in with the effects of an additional factor, or set of factors, resulting in a distortion of the true relationship. In a clinical trial, this can happen when the distribution of a known prognostic factor differs between groups under comparison.[25] In this study, to prevent and overcome confounding problems, some approaches had been employed, including the use of restrictions during the selection phase. In the data analysis phase, all variables suspected of being confounders had been analyzed by using multivariable analysis. The opportunity for bias to occur had also been anticipated by developing theoretical and conceptual frames from varying sources, so that all variables that might be confounders could be covered and identified properly.

Conclusion

Vitamin D administration proved to have a significant beneficial effect on academic stress. One daily 400 IU vitamin D dose for 30 days could reduce academic stress by 11.28 points. To reduce academic stress, students are adviced to consume vitamin D and expose their skin to sun rays with ultraviolet.

Recommendation

Each individual should consume vitamin D and expose their skin to sun rays with ultraviolet. The Ministry of Health should make a program to promote vitamin D supplements for students/teenagers.

Abbreviations

DASS: Depression Anxiety and Stress Scale; IU: International Unit; RNI: Reference Nutrient Intake; RCT: Randomized Controlled Trial; FFQ: Food Frequency Questionnaire; SD: Standard Deviation; SE: Standard Error; CI: Confidence Interval; UV: Ultraviolet.

Ethics Approval and Consent to Participate

Ethical approval was obtained from Ethics Committee of the Health Polytechnic of Ministry of Health Yogyakarta No: LB.01.01/KE02/XXI/489/2017. Subjects were given an explanation of the aims, risks, and procedures of the study and signed an informed consent as an agreement before the study was conducted.

Competing Interest

Author declares that there are no significant competing financial, professional, or personal interests that might have affected the performance or presentation of the work described in this manuscript.

Availability of Data and Materials

All data generated or analyzed during this study are included in this published article.

Authors' Contribution

Yuni Kusmiyati, Emy Suryani and Lucky Herawati conceptualized the study, outlined the design and supervised data analysis, as well as wrote the manuscript and collected the data; Yuni Kusmiyati and Amalia Firdausi worked out details and led the field study. All authors have read and approved the final manuscript.

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