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Vitamin D, and zinc intakes were related to menstrual duration In adolescent girls of senior high schools in Sukoharjo Regency

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ABSTRAK

Latar belakang: *Menstruasi adalah salah satu proses fisiologis dalam pertumbuhan dan perkembangan sistem reproduksi remaja putri yang membutuhkan asupan zat gizi yang memadai. Zinc digunakan sebagai kofaktor pada reseptor estrogen dan progestron sedangkan vitamin D belum diketahui fungsinya dalam mengatur siklus menstruasi.*
Tujuan: *Untuk menganalisis hubungan antara asupan vitamin D dan zinc dan durasi menstruasi pada remaja putri.*
Metode: *Sebanyak 154 remaja putri kelas X dan XI dari dua SMA di Kabupaten Sukoharjo, Jawa Tengah berpartisipasi dalam studi cross-sectional ini. Subjek penelitian dipilih menggunakan teknik purposive sampling dengan kriteria inklusi: usia 15-18 tahun dan tidak sedang menstruasi. Data antropometri dikumpulkan dengan pengukuran berat badan (kg) dan tinggi badan(m) sedangkan asupan vitamin D dan zinc diperoleh menggunakan kuesioner food recall 24 jam dalam 3 hari bergantian. Uji chi-square dan regresi logistik ganda digunakan untuk menganalisis variabel penelitian dengan nilai signifikansi <0,05.*
Hasil: *Semua remaja putri memiliki asupan vitamin D yang tidak adekuat dan 89% diantaranya memiliki asupan zinc yang tidak adekuat. Durasi menstruasi yang panjang terjadi pada 8,4 % remaja putri. Asupan vitamin D yang kurang (OR=4,57; 95% CI = 0,943-22,154; p=0,059) memperpanjang durasi menstruasi sedangkan dan asupan zinc yang kurang (OR=0,247; 95% CI=0,073-0,835; p=0,024) memperpendek durasi menstruasi, dibandingkan dengan asupan vitamin D dan zinc yang cukup pada remaja putri.*
Kesimpulan: *Asupan vitamin D yang kurang meningkatkan durasi menstruasi tetapi asupan zinc yang kurang justru menurunkan durasi menstruasi remaja putri SMA di Kabupaten Sukoharjo. Edukasi gizi di perlukan untuk meningkatkan asupan mikronutrien untuk mempertahankan durasi menstruasi.*

KATA KUNCI : *asupan vitamin D, asupan zinc, menstruasi, remaja putri.*

ABSTRACT

Background: *Menstruation is one of the physiological processes on growth and development of the reproductive system in adolescent girls who need adequate nutrient intake. Zinc is used as a cofactor for estrogen and progestron receptors, while vitamin D has not been known to regulate the menstrual cycle. Insufficient food intake can interfere with the duration of menstruation.*
Objectives: *To analyse the relationship between the intakes of vitamin D and zinc and the menstrual periods of the adolescent girls.*
Methods: *A total of 154 tenth- and eleventh-grade girl students from two senior high schools in Sukoharjo Regency, Central Java participated in this cross-sectional study. They were chosen using purposive-sampling technique with the following inclusion criteria: age of 15-18 years and not menstruating. The anthropometric data were collected by the measurement of Body Weight(kg) and Body Height (m) while the data of vitamin D and zinc intakes were obtained using a 24-hour-food-recall questionnaire in 3 alternating days. Chi-square test and multiple logistic regression were used to analyse the research variables with the significance value of < 0.05.*

***Results**: All adolescent girls had inadequate vitamin D intake and 89% of them had inadequate zinc intake. Long menstrual duration occurred in 8.4% of the adolescent girls. The deficient intake of vitamin D (OR = 4.57. 95% CI = 0.943-22.154; p = 0.059) lengthened the menstrual period whereas deficient zinc intake, (OR = 0.247. 95% CI = 0.073-0.835; p = 0.024) shortened it compared with adequate vitamin D and zinc intakes in adolescent girls.*

***Conclusions:** The deficient intake of vitamin D increases the menstrual duration, but the deficient intake of zinc actually lowers the menstrual period of high-school girls in Sukoharjo Regency. Nutritional education is needed to increase micro-nutrient intakes to maintain menstrual duration.*

KEYWORDS: *adolescent girls, menstruation, vitamin D intake, zinc intake.*

INTRODUCTION

Adolescence is a period of development that is very important for humans. This period is marked changes of psychological growth and body development(1). One of characterics in adolescent girls is menstruation which is a cyclical change and is the beginning of the egg-cell-formation process to readily reproduce(2).

Adolescent girls periodically have menstruation marked by the decay of the endometrium due to the absence of a mature ovum fertilized by sperms(3). Every woman in the reproductive period has a different menstrual cycle but almost 90% of them have a 25-35-day cycle. Only 10-15% of them have a 28-day cycle. Some women have irregular cycles so that their menstrual periods vary from 2 to 10 days(4).

The length of the menstrual cycle is influenced by various factors such as physical activities, stress, lifestyles, nutritional status, food intake, and physical or hormonal abnormalities(5). The physical activities of adolescents require energy beyond the need for basal metabolism(6). The amount of energy required depends on how much the muscle moves, how long and how much work are done, and the various activities of the adolescents - school activities, sports activities and others(7). The development and change including in psychology by starting the process of self-discovery sometimes cause stress to the adolescents because of the problems and the surrounding environment. Stressed-out and low-activity girls can prolong the menstrual cycles and disorders(7). Lifestyle is influence adolescent health. At this time, adolescent girls have started to try adult lifestyles and tend to be consumptive. Environments and social life influence them to have their own lifestyles, and tend to be different(8).

Nutritional status needs to be considered in the period of adolescent growth and development, because the nutritional status of adolescent girl greatly affects the occurrence of menstruation including age factor, menstrual syndrome, dysmenorrhea and the length of days of menstruation(9).

Adolescents have irregular eating habits. Unhealthy eating habits from family since childhood will continue to occur in adolescence. Poor eating without knowing the need for various nutrients results in the non-fulfilment of nutritional needs which influences health conditions of adolescent girls during menstruation(5). This period occurs hormonal changes in the body which result in changes in nutrients in the body (10). Nutrition is needed to maintain balance and meet nutritional needs due to menstruation. Pain, anxiety, emotional instability, and menstrual bleeding need to be nourished by adequate nutritional needs, carbohydrates, proteins, vitamins especially vitamin A, B6, B12, C, iron mineral, calcium, and magnesiumto maintain adequate nutrition for adolescent (11). To overcome anemia needs sufficientiron(12) and increases the body's immune system. Vitamin D and zinc are also needed to treat pain and improve the immune system due to inflammation during menstruation (13,14).

At this time the adolescent began to be served by various kinds of food which were not necessarily good for them. Adolescence is a time that requires more nutrients(15). Adolescent need optimal nutrition for growth and development. Nutrition is a process of organisms using food through digestion, absorption, transportation of nutrition storage, metabolism and

consumption of substances that used to maintain life, growth, and energy producing(16). During duration menstruation, adolescents girls are needed adequate amount of nutrition to fullfill nutritional needs and overcome menstrual disorders during menstruation(17).

The growth and development of their reproductive organs require adequate and balanced nutrition. In this condition, adolescents girls need more protein, vitamins, and minerals per unit of each energy they consume than children who have not had puberty(18). According to Smith (2016), the intakes of both macro- and micro-nutrients are needed by adolescent girls to get optimal health(19). A good nutritional intake will improve their nutritional status. Good nutritional intakes fulfil their nutritional needs. Thus, they help speed up the growth and development of the adolescents girls(20).

Vitamin D and zinc are two of the vitamins and minerals needed by the body. The intakes of vitamin D and zinc are needed to meet the nutritional needs of adolescents(21) because they are required in the management of metabolism and hormones. The need for vitamin D is very important for adolescents. Vitamin D intake is associated with the onset of pain from a symptom. Pain is associated with a lack of vitamin D intake(22). Other studies suggest that the deficiency of vitamin D causes systemic inflammation and decrease the C-reactive protein. Vitamin D is needed to assist in the developmental process, especially the bone growth in adolescents and is needed during menstruation because during menstruation the decay of the uterine wall occurs causing inflammation in the body (23). The other function of vitamin D is in the metabolism and body health. Other studies of the menstrual period and vitamin D and other health-related issues need to be conducted to add references to the menstrual period and vitamin D (24). It is clear that theintake of vitamin D and zinc are needed. Those nutrients are necessary during the menstruation assubstances that supportgrowth and development for adolescent (25) those nutrients have the same function namely binding DNA. Those are also related to other hormones in the reproductive system, especially zinc as an enzyme cofactor (26, 27, 28) helps in follicular and luteal (29) phases, maintains tissue permeability, so that cellulite tissue can function properly. Therefore, it can improve health and together with other nutrients suppresspain eventually the permeability and homeostasis can be maintained during the menstruation (30, 31, 32).

The study of Kia, Amani, and Cheragian (2015) conducted in Iran with a group of menstrual disorder showed that there is a relationship between vitamin D and the incidence of dysmenorrhea and menstrual cycles (p=0.03/0.046). The deficiency of vitamin-D intake viewed from vitamin-D serum results increased the dysmenorrhea in the respondents(33). This is also supported by the study of Rajei *et al* (2016) which stated that vitamin D is needed by women during the menstrual period to reduce the symptoms of menstrual disorders(34). Jukic *et al* (2016) in his study also stated that excessive dosing of vitamin D will affect the cycle and the length of menstruation in women(35).

Zinc is one of the minerals needed by the body that functions a lot in the compounds of the body and the metabolic processes(36). In adolescents, it functions in the process of reproductive maturity. It works with other vitamins and minerals in the management of the hormone system in the body, especially in the menstrual cycle(37). Zinc is used as a cofactor for estrogen and progestron receptors, while vitamin D has not been known to regulate the menstrual cycle. Insufficient food intake can interfere with the duration of menstruation(38).

The research by Eby (2007) stated that the intake of zinc on the subject of research was able to reduce pain during menstruation (39). This is supported also by the research from Kashefi (2013) by using a control group which found that the research subjects given zinc intake were able to reduce pain and cramp during menstruation and did not experience menstrual delays (40). The lack of reference to zinc and menstrual duration is the basis for this study.

Therefore, the objective of this study was to analyse the relationship between the intakes of vitamin D and zinc and the menstrual periods of the high-school adolescent girls in Sukoharjo Regency.

MATERIAL AND METHODS

Subjects and research procedures

A total of 154 tenth- and eleventh-grade girl students of SMAN I Kartasura and Bulu Sukoharjo Regency participated in this cross-sectional study. The sample size was determined using openepi program (41). Purposive sampling was used to select the research subjects with the following inclusion criteria: age of 15-18 years and residing in Sukoharjo Regency. The students who were sick, menstruating and taking supplements were not included in this study. The two schools used represent the urban and rural are as as well as a region with a large and small number of adolescents.

The data of identity and the length of menstruation were obtained using structured questionnaires and anthropometric data and by measuring the weight using Seca(42) digital scale and the height using microtoise. The BMI of adolescent girls was determined by using BMI by age from WHO-Antro (43). The Food-Recall Questionnaire of 3 x 24 hours was used to collect the data of vitamin D and zinc intakes.

The collected data of food intake were then processed (converted) to the amount of vitamin D and zinc intakes in a day using Nutrisoft (44) software. Adequacy of vitamin D and zinc intake for adolescent girls adjusted to the RDA (15). *Chi-square* correlation test was used to analyse the relationship between vitamin D and zinc intakes with the menstrual duration. Normal duration category if menstrual time is 3-7 days, and more 7 days is not normal duration menstruation. Data was colletion using SPSS software version 17(45) which was further analysed using multiple-logistic-regression test with the significant value of $p<0.05$. This research protocol has been approved by the Ethics Commission of Research and Education of the Public Hospital dr. Moewardi Surakarta with the ethic No: 1.199/XII/HREC/2017 dated January 3, 2018.

RESULTS

Adolescent characteristics

In this study, the analysis of the relationship between vitamin D and zinc intakes and the

Table 1. The description of the respondent characteristics

	SMAN I Kartasura		SMAN I Bulu		Total	Mean ±SD
	n	%	n	%	%	
Age (Years)	77	50	77	50	154(100)	
15	3	3.9	8	10.4	11(7.2)	
16	35	45.4	30	39.0	65(42.2)	16.52±0.75
17	30	39.0	35	45.4	65(42.2)	
18	9	11.7	4	5.2	13(8.4)	
BMI/AGE						
Normal	64	81.8	66	85.7	130(83.8)	20.16±2.29
Not normal	13	18.2	11	14.3	24(16.2)	
Vitamin-D Intake						
Adequate	17	22.1	34	44.1	51(33.1)	2.16±1.87
Inadequate	60	77.9	43	55.9	103(66.9)	
Zinc Intake						
Adequate	11	14.4	6	7.7	17(11.1)	7.61±4.35
Inadequate	63	81.6	68	88.3	137(88.9)	
Duration of Menstrual (days):						
Short (3-7)	67	87	74	96.1	141(91.6)	5.91±1.55
Long (>7)	10	13	3	3.9	13(8.4)	

Source: Primary Data 2018

menstrual-period risk was conducted on 154 high-school girls who were not menstruating. **Table 1** shows the characteristics of age, school origin, BMI for Age, vitamin D intake, zinc intake, and menstrual period. Adolescent girls have an average age of 16.52 ± 0.75 years and the highest percentage was in the age group 16 and 17 years (84.4 %). The mean BMI for Age was 20.16 ± 2.29 percentile and the BMI of the majority of girls was normal (83.8%). Approximately sixty seven percent of adolescent girls had deficient vitamin D intake while 88.9% of them had deficient zinc intake. The mean intake of vitamin D and zinc was 2.16±1.87 and 7.61±4.35 ug/day. Almost all girls had a menstrual period of 3-7 days.

The relationship between intakes of vitamin D and zinc and the duration menstruation

The relationship between vitamin D and zinc intakes, BMI/Age and age and the menstrual period was analysed using chi-square correlation test. Vitamin D and BMI/Age intakes were positively associated with menstrual period whereas the zinc intake and age were negatively associated with menstrual period (**Table 2**). The increased risk of the menstrual period was significantly apparent in girls with poor vitamin-D intake, compared with girls with adequate vitamin-D intake (OR=4.442; 95%, CI=0.952-20.77, p=0.041). On the other hand, the menstrual period decreased significantly in the adolescent girls with less zinc intake than those with the adequate intake (OR=0.277; 95%, CI = 0.070-7.39, p = 0.008).

Multiple-logistic-regression analysis was performed to further test the relationship between vitamin D and zinc intakes and the menstrual period after being controlled with age and BMI for Age (model 2). **Table 3** shows that vitamin D and zinc intakes are inversely related to the menstrual period. Vitamin D intake does not really extend 4.57 times the risk of menstrual periods compared with the adequate vitamin-D intake. The relationship was statistically significant (p=0.059). Zinc intake less significantly decreased 0.23 times the risk of menstrual periods compared with the adequate zinc intake (p=0.017).

In addition to the above variables, the two intervening variables of BMI and age have an influence to increase the risk of menstrual periods (OR = 2.428, 95%, CI = 0.632-9.322) and (OR=0.929, 95%, CI=0.280-3.086) although it is not too significant (p=0.196 and p=0.905). Vitamin D, and zinc intake, after controlled with BMI and age, only affects the menstrual periods of 16.5%, while the remaining 83.5% is influenced by other factors.

The distribution of the characteristics of the study subjects based on vitamin D intake based on their average vitamin D intake was 57.8% above the mean intake. However, on a recommended basis,

Table 2. The Relationship between of Vitamin D and Zinc intakes and the duration menstruation

Variables	Duration menstruation		Total	OR (95 % CI)	P
	Normal	Abnormal			
Vitamin-D Intake					
Adequate	63	2	65	4.44(0.95-20.77	0.04
Inadequate	78	11	89		
Zinc Intake					
Adequate	23	6	29	0.22 (0.07-7.39)	0.01
Inadequate	118	7	125		
BMI					
Normal	121	9	130	2.68(0.75-9.56)	0.11
Abnormal	20	4	24		
Age (Years)					
15-16	71	7	78	0.86(0.27-2.71)	0.81
>16-18	70	6	76		

Information: *chi-square tes*
Source: Primary Data 2018

Table 3. The relationship between the Intakes of Vitamin D and Zinc and the duration menstruation of the adolescent girls before and after controlled with BMI and Age

	OR	95% CI	P	Nagelkerke R square (%)
Model 1				
Inadequate Intake of Vitamin-D	4.39	0.92-20.96	0.06	14.4
Inadequate Intake of Zinc	0.23	0.06-0.76	0.17	
Model 2				
Inadequate Intake of Vitamin-D	4.57	0.94-22.15	0,05	
Inadequate Intake of Zinc	0.24	0.07-0.83	0,02.	16.5
Abnormal BMI	2.42	0.63-9.32	0.19	
Age > 16-18	0.92	0.28-3.08	0.90	

Information: multiple logistic regression test

all respondents did not meet the recommended vitamin-D adequacy. The frequency distribution of the zinc intake corresponding to the level of adequacy was only 11.1% while the rest consumed zinc under the sufficiency level. On the other hand, the BMI of the subjects in this study was mostly normal (83.7%).

DISCUSSION

Adolescence requires a higher intake of both macro and micro nutrients than childhood as there occurs accelerated growth and development including the reproductive organs (46,47). Adolescence requires a high intake of vitamin D (15 ug per day)(48), required for bone mineralization, the configuration and function of organs including hormone production and the management of ovulation and menstrual cycles(49-50).

The normal menstrual-cycle length is 28 days, but it may vary per month for one woman to the others (51). Menstrual variations can also occur to older and younger sisters, even twin sisters (52). In adolescence, the menstrual cycle is usually not regular. It can go forward or backward for several days because the secretion of hormone reproduction has not been stable (53). Hence, the menstrual period is between 3 to 8 days and virtually unchanged in every woman. Stress or fatigue can also cause the menstrual cycle forward or backward (54).

Adolescent girls in this study got the vitamin D intake of processed beans such as *tempe* (fermented soy beans), tofu, eggs, and fish for only 17.33% of vitamin D needs every day less than the Recommended Dietary Allowances (RDA). Therefore, it is not surprising that adolescent girls with vitamin D intake are less at risk 4.57-times longer menstrual periods. This is in accordance with the results of a study by Jukic et al (2016) which stated that the decreased intake of vitamin D in women causes irregular and longer menstrual periods (55). According with Sobaler *et al* (2017) which stated of his research that many Spanish adolescent who lack vitamins and minerals, especially vitaminD, E, and zinc (56). According line with Vinas (2011) research which states that deficiencies and prevalence of deficiencies in vitamins and minerals in Europe, especially vitamins A, C, D are quite high (57). Aside from the dietary intake, vitamin D is also synthesized from the 7-dehydrocholesterol compound that resides in the skin layer to be colecalsiferol into ultraviolet rays which then becomes calcitriol (vitamin D active compound)(58). However, this study did not measure the vitamin-D level in the serum that had not been able to determine whether the low dietary intake containing vitamin D is accompanied with the lowe level of vitamin D in the serum. The results of the research conducted in Canada by Greene-Finestone et al (2017) also reported that 15% of adolescent girls had low vitamin-D levels (59).

Zinc is one of the important minerals needed by the body. Together with several other minerals, it helps in the formation of blood haemoglobin (60), various synthesis proteins including transferring proteins as iron carriers (61), maintaining the

balance of acid-base(62), and the receptor cofactors of estrogen hormone to interact with the DNA target(63). To the authors' knowledge, there is no article that states that the intake of zinc is directly related to the menstrual period. Adequate zinc intake can prolong the release of proglastandin and increase oxygen supply in the uterus that can help to improve the disrupted menstrual cycle In addition(64), zinc also has antioxidant and anti-inflammatory effects to relieve pain during menstruation(65).

From the results of this study, adolescent girls' zinc intakes are generally less than RDA (88.9%) and the consumed foods are similar to those containing vitamin D. Furthermore, the diet of adolescent girls is irregular and the types of food are less various between lunch and dinner every day. Zinc-containing foods are animal protein sources, especially meat, liver, oysters, and eggs. Cereals and legumes are also good but their biologic value is low. Nevertheless, the results of the logistic-regression test showed that the poor intake of zinc became a protective factor against the menstrual period. It may be because only 13 girls who had abnormal menstrual periods and there is no difference of their zinc intakes. Thus, the length of the menstrual period of the adolescent girls may be influenced by the various intakes of micro minerals and vitamins(66). The effect of zinc intake from the study only slightly affected the menstrual period of the adolescent girls. This is in accordance with the research of Michos (2010) which stated that the zinc levels in the body fluctuate with other minerals in cycles and the menstrual period of women(67).

The other research conducted by Kashefi 2013 showed that the administration of zinc in certain doses was proven to reduce pain during menstruation and the subjects did not experience the menstrual delay (68).

Because the study of zinc intake and its effect on menstrual periods is very small, it is necessary to find out whether the deficient zinc intake has the big impact to the functions of organs of adolescent girls. The measurement of zinc levels in the blood is also required as the supporting data to ascertain the levels of adequacy of zinc in the body.

CONCLUSIONS AND RECOMMENDATIONS

The deficiency in vitamin D intake is risky in extending the menstrual period of the adolescent girls in two senior high schools in Sukoharjo Regency while the deficiency of the zinc intake does not affect the menstrual period. The awareness of adolescent girls related to vitamin and mineral intakes needs to be improved by means of nutritional education in school environments along with the collaboration with related stakeholders to improve reproductive health.

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