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Original Article

Overweight and menstrual disorders in girls aged 12-15 years

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Abstract

Background Several studies have noted a strong association between fat distribution and menstrual disorders. Many studies have evaluated the association between nutritional status and menstrual disorders, but the results remain inconclusive.

Objective To assess for possible associations between overweight and menstrual disorders in girls aged 12-15 years.

Methods A cross-sectional study was conducted in girls aged 12-15 years who had undergone menarche. Nutritional status was classified based on the Centers for Disease Control and Prevention curve for body mass index (BMI) as overweight (P85-P95) and normal weight (P3-<P85); those underweight (<P3) were excluded. We recorded the subjects' BMI, waist circumference (WC), waist circumference-to-height ratio (WtHR), menstrual pain (using the visual analog scale), menstrual cycle length, menstrual period duration, and bleeding volume (estimated by the daily number of menstrual pads used) and compared these variables between normal weight and overweight subjects.

Results Of 73 subjects, 32.9% were overweight and 67.1% had normal weight. There were significant associations between overweight and menstrual disorders (prevalence ratio, PR=1.304; P=0.027), irregular menstrual cycle (PR=4.696; P<0.001), abnormal menstrual period duration (PR=2.45; P<0.001), and excessive bleeding volume (PR=9.528; P<0.001). No significant association was found between overweight and menstrual pain (P=0.227). BMI, WC, and WtHR were significantly higher in girls with irregularity and abnormal duration of menstrual cycles, but not in girls with excessive menstrual pain.

Conclusion Overweight is significantly associated with menstrual disorders, irregular menstrual cycle, abnormal menstrual period duration, and abnormal volume of menstrual loss, but not with menstrual pain. **[Paediatr Indones. 2023;63:499-505; DOI: https://doi.org/10.14238/pi63.6.2023.499-505**].

Keywords: *nutritional status; menstrual disorder*

Obesity in children is one of the most serious public health challenges of modern times. Recent reports state that the incidence of childhood obesity has increased tenfold since 1975 and affects 41 million children under the age of 5 years.[1,2] Children with obesity are at risk for poor physical, emotional, and social health.[1,3] Obesity in childhood carries a high risk of obesity in adulthood. There are considerable economic costs associated with obesity because of increased health care spending.[1,4]

Overweight and obesity in children are defined as body mass index (BMI) between the 85th to 95th percentile (P85-P95) and BMI >95th percentile (>P95) for age and sex, respectively. BMI is generally recommended as the best indicator of overweight and obesity in children and adolescents in clinical practice.[5]

To date, the problem of obesity in children in Indonesia has not received sufficient attention due to a larger focus on the problem of undernutrition. Obesity in children can affect all ages, but is more

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common in older children or those approaching puberty.[6]

One of the phases of human development is adolescence, the period between childhood and adulthood, in which puberty occurs. The first menstruation, or menarche, is one of the signs of puberty in adolescent girls.[7] Menstrual disorders are a common complaint among adolescent girls. An Australian study showed that about 25% of girls experienced menstrual disorders that significantly affected life activities, resulting in children being unable to attend school. Menstrual disorders may take the form of irregular menstrual cycles, heavy menstrual bleeding (menorrhagia), or pain (dysmenorrhea). Serious complications are usually rare, and the menstrual cycle improves with age.[8]

Some studies have found that body weight can affect a woman's menstrual cycle. Obese women were noted to have irregular menstrual cycles with an increased incidence of both oligomenorrhea and amenorrhea.9 Several studies have also shown that centralized distribution of body fat has a stronger association with menstrual disorders and a more adverse hormonal profile than peripheral distribution of body fat.[7,9,10] Obesity is associated with decreased levels of sex hormone-binding globulin (SHBG), which controls the bioavailability of estradiol and testosterone.[11] Fat tissue is also directly involved in the production and metabolism of steroids; it influences the production of androgens and estrogens.[11] One of the main factors causing menstrual disorders is the hormone estrogen. Increased estrogen levels may indirectly cause an increase in androgen hormones. Increased androgen hormones interfere with follicle development, preventing follicle maturation.[12]

Although much research has been done on the relationships between nutritional status and menstrual disorders, the results remain inconclusive. Thus, we aimed to assess for possible associations between overweight and menstrual disorders such as dysmenorrhea, irregular cycle length, abnormal menstrual period duration, or abnormal volume of menstrual blood loss.

Methods

This cross-sectional, analytic study was done to assess for associations between nutritional status and menstrual disorders in girls aged 12-15 years who had experienced menarche. The minimum sample size was 48 subjects. Subjects were students attending PAB I Klumpang Junior High School, Hamparan Perak District, Deli Serdang Regency, North Sumatera, selected by purposive sampling. We sought participant assent and parent consent before including students in our study. Underweight girls were excluded from the study.

We recorded subjects' body weight (BW), body height (BH), and waist circumference (WC). Their nutritional status was determined based on BMI (kg/m2) using the CDC BMI-for-age chart for girls.[9] BMI was calculated by dividing weight in kilograms by the square of height in meters. Waist-to-height ratio (WtHR) was calculated by dividing WC by BH. Data regarding age at menarche and history of menstrual disorders were collected through questionnaires. Subjects were classified according to nutritional status as overweight (BMI-for-age P85 to P95) and normal weight (BMI-for-age P3 to <P85).

Menstrual pain (dysmenorrhea) was categorized using the visual analog scale (VAS) and was considered to be abnormal if VAS was >4. Menstrual cycle length was calculated from the first day of a menstrual period until the first day of the next period and defined as irregular if there was polymenorrhea (cycle length <21 days) or oligomenorrhea (cycle length >35 days). The duration of a menstrual period was calculated from the first day to the last day of the period and categorized as normal (3-7 days) or abnormal (<3 days or >7 days). Bleeding volume was estimated by the number of menstrual pads used in a day using a standard 26 cm pad without gel and categorized as normal if the subject used 2-4 pads a day or abnormal if the subject needed only 1 pad a day or >5 pads a day. Menstrual disorder was defined as the presence of any one or more of the following: menstrual pain, irregular cycle length, abnormal period duration, and abnormal bleeding volume.

Data were recorded, collected, and processed using *SPSS 24* software (*IBM*, Armonk, New York). Subject characteristics, including nutritional status, menstrual disorders, age at menarche, menstrual pain, menstrual cycle length, duration of menstrual period, and menstrual bleeding volume were displayed as frequency and percentage. Other characteristics of

subjects such as BMI, WC, and WtHR were displayed as means and standard deviations (SD). The Chi-square test was used to analyze for possible associations between nutritional status and menstrual disorders. To analyze for differences between BMI, WC, and WtHR with regards to the various menstrual disorders, we used unpaired T-test for normally-distributed data and Mann-Whitney test for non-normally distributed data. A P value of <0.05 was considered to be statistically significant. This study was approved by the Health Research Ethics Committee, Medical Faculty of Universitas Sumatera Utara.

Results

We initially screened 160 girls who attended PAB I Klumpang Junior High School and were willing to take part in the study. Seventy-three girls met the inclusion criteria. Subject characteristics are presented in **Table 1**.

Thirty-three (45.2%) subjects had irregular cycle length and the same number of subjects had abnormal menstrual period duration. Abnormal menstrual bleeding volume was found in 17 (23.3%) and abnormal menstrual pain was experienced by 34 (46.6%) subjects. Subjects' menstrual characteristics are presented in **Table 2**.

Table 3 shows the analysis of the association between nutritional status and various menstrual disorders. We found significant associations between overweight and any menstrual disorder, irregular menstrual cycle, menstrual period duration, and menstrual bleeding volume. There was no significant association between overweight and menstrual pain.

Subjects with menstrual disorders, irregular cycle length, abnormal period duration, or abnormal menstrual bleeding volume had significantly higher BMI, WC, and WtHR. No such difference was observed in subjects with menstrual pain (**Table 4**).

Discussion

Menstruation is a phenomenon that marks the beginning and end of reproductive age and is considered an indicator of women's health. Therefore, adolescent menstrual patterns should be understood in terms of potential influencing factors, such as age, activity, and BMI.[13] Determination of BMI uses body height and weight, but does not take into account factors such as body shape, muscle content, and body fat. Body fat content can affect the menstrual cycle by influencing hormonal changes.[14]

This study was conducted in 73 junior high school children aged 12-15 years to assess for associations between nutritional status and menstrual disorders. Our subjects were categorized as either overweight (32.9%) or normal weight (67.1%). A previous study similarly reported that 33.9% of their adolescent subjects were overweight.[15]

In our study, the mean age of menarche was 11.9 (SD 0.9) years. A study stated that 67.3% of girls experienced menarche between the ages of 11 and 13 years.[16] Another study also noted that two-thirds of girls experienced menarche at 11-<14 years

Table 1. Subject characteristics

Characteristics	(N=73)
Mean body weight (SD), kg	49.4 (10.5)
Mean body height (SD), cm	152.6 (5.5)
Mean BMI (SD), kg/cm2	21.1 (4.2)
Mean WC (SD), cm	70.9 (10.3)
Mean WtHR (SD)	0.5 (0.1)
Nutritional status, n (%)	
Overweight	24 (32.9)
Normal weight	49 (67.1)
Mean age at menarche (SD), years	11.9 (0.9)
Menstrual disorder(s), n (%)	
Yes	59 (80.8)
No	14 (19.2)

Table 2. Menstrual characteristics of subjects

Menstrual characteristics	(N=73)
Menstrual cycle regularity, n (%)	
Irregular	33 (45.2)
Regular	40 (54.8)
Duration of menstruation, n (%)	
Abnormal	33 (45.2)
Normal	40 (54.8)
Blood volume, n (%)	
Abnormal	17 (23.3)
Normal	56 (76.7)
Menstrual pain, n (%)	
Abnormal	34 (46.6)
Normal	39 (53.4)

Table 3. Analysis of the association between nutritional status and menstrual disorders

Nutritional status, n	Any menstrual disorder		PR (95%CI)	P value*
	Yes (n=59)	No (n=14)		
Overweight	23	1	1.304 (1.081 to 1.574)	0.027
Normoweight	36	13		
	Menstrual pain			
	Abnormal (n=34)	Normal (n=39)		
Overweight	9	15	0.735 (0.410 to 1.319)	0.277#
Normoweight	25	24		
	Menstrual cycle			
	Irregular (n=33)	Regular (n=40)		
Overweight	23	1	4.696 (2.684 to 8.214)	<0.001#
Normoweight	10	39		
	Duration of menstrual period			
	Abnormal (n=33)	Normal (n=40)		
Overweight	18	6	2.450 (1.515 to 3.962)	<0.001#
Normoweight	15	34		
	Menstrual bleeding volume			
	Abnormal (n=17)	Normal (n=56)		
Overweight	14	10	9.528 (3.025 to 30.011)	<0.001#
Normoweight	3	46		

*Fischer's exact test

Table 4. Differences in BMI, WC, and WtHR in subjects with menstrual disorders, menstrual pain, menstrual cycle irregularity, abnormal menstrual period duration, and abnormal menstrual bleeding volume

Variables	Median BMI (range), kg/m^2	P value	Mean WC (SD), cm	P value	Median WHtR	P value
Any menstrual disorder		0.014[a]		<0.001[b]		0.007[a]
Yes (n=59)	20.2 (16.4-33.2)		72.4 (10.6)		0.5 (0.4-0.7)	
No (n=14)	18.5 (16.4-24.2)		64.3 (5.5)		0.4 (0.4-0.5)	
Menstrual pain		0.890[a]		0.569[a]		0.674[a]
Abnormal (n=34)	19.6 (16.5-33.2)		70 (53-96)		0.5 (0.4-0.7)	
Normal (n=39)	20 (16.4-3.5)		68 (55-99)		0.5 (0.4-0.6)	
Menstrual cycle		<0.001[a]		<0.001[b]		<0.001[a]
Irregular (n=33)	24.1 (17.1-33.2)		78.7 (9.7)		0.5 (0.4-0.7)	
Regular (n=40)	17.9 (16.4-24.2)		64.7 (5.6)		0.4 (0.4-0.5)	
Duration of period		0.020[a]		0.022[a]		0.014[a]
Abnormal (n=33)	22.5 (16.4-32.6)		71 (59-99)		0.5 (0.4-0.7)	
Normal (n=40)	18.9 (16.4-33.2)		65.5 (53-96)		0.4 (0.4-0.6)	
Bleeding volume		<0.001[a]		<0.001[b]		<0.001[a]
Abnormal (n=17)	24.1 (17.1-33.2)		81.5 (10.3)		0.5 (0.4-0.7)	
Normal (n=56)	19.1 (16.4-30.5)		67.6 (10.3)		0.4 (0.4-0.6)	

[a]Fischer's exact test; [b]Chi-square test

of age.[15] Several studies have shown that a high BMI is associated with early puberty,[17] however, we did not assess for a relationship between BMI and age at menarche.

A previous study reported that menstrual disorders in the form of late menarche, irregular menstruation, and dysmenorrhea, occur in 75% of adolescent girls. Dysmenorrhea is the most frequently reported menstrual disorder.[18] In our study, menstrual disorders occurred in 80.8% of students, with abnormal menstrual pain being the most common (46.6%). Our definition of dysmenorrhea was moderate to severe pain, namely, VAS >4, which was considered to interfere with daily activities. A study reported that the most common pain intensity in dysmenorrhea was moderate (50.4%); 45.1% of subjects used analgesics to reduce pain.[19] Another study noted that 26% of girls missed school because of dysmenorrhea. The students found it difficult to complete school assignments because of the pain level.[20]

Menstrual cycles are often irregular at menarche, but in the three years after menarche onset, 60-80% of girls' cycles average 21-35 days.[21] In our study, irregular menstrual cycles were defined as cycle periods <21 days or >35 days, occurring in 45.2% of subjects. A study reported that irregular menstrual cycles occurred in 25.1% of girls, with cycle length of <21 days in 10.5%, 36-45 days in 6.1%, and >45 days in 6.1%.[22]

In our study, abnormal menstrual period duration was seen in 45.2% of subjects and abnormal bleeding volume in 23.3%. Menstrual period duration was considered abnormal if it was <3 days or >7 days. Abnormal menstrual bleeding volume was defined as requiring replacement of either only 1 or >5 pads a day. Our numbers were lower than a previous study which found abnormal period duration and abnormal bleeding volume in 64.5% of and 42% of girls, respectively.[23]

Overall, only 19.2% of our subjects did not experience any menstrual disorder. This finding was in accordance with previous studies which found menstrual disorders in 87.9% of participants[24] and 91.9% of female students.[25] Two other studies have reported the prevalence of menstrual disorders in adolescent girls to be 76.9% and 80.7%, respectively.[26,27]

We also analyzed the associations between various anthropometric indicators and menstrual disorders. Overweight was significantly associated with menstrual disorders (P=0.027). The BMI, WC, and WHtR values were significantly higher in subjects with various menstrual disorders, except for menstrual pain, a finding in line with that of a previous study.[28] In addition, a study showed that menstrual disorders were significantly more common in participants with overweight than in those with normal weight.[24] Another study also showed that women with menstrual disorders had higher BMI and WC than women without disorders.[25]

We found significant associations between overweight and irregular menstrual cycle, abnormal menstrual period duration, and abnormal menstrual bleeding volume. We also found that BMI, WC, and WtHR values were significantly higher in subjects with irregular cycle length, abnormal duration of menstruation, and abnormal blood volume. Kumalasari also showed a significant relationship between BMI and the menstrual cycle. Adolescents with good nutritional status tended to have regular menstrual cycles.[29] Additionally, a previous study showed that abnormal blood volume and irregular cycle length were significantly exacerbated by obesity (BMI>24.9).[25] Those with BMI >30 kg/m^2 or WC >88 cm had twice the risk of having an irregular menstrual cycle length.[10] A study also showed a significant association between irregular menstrual period duration with BMI, WC, and WtHR.[28] Furthermore, another study found significant associations between overweight BMI and cycle length irregularity, irregular period duration, and abnormal bleeding volume.[15]

There are several known mechanisms by which fatty tissue affects ovulation and the menstrual cycle. Adipose tissue converts androgens to estrogens. Body weight affects estrogen metabolism; higher estrogen metabolism is more common in overweight women. On the other hand, underweight women have a decreased ability to attach estrogen to globulins that cause estrogen to become inactive, so free estradiol levels increase in serum. Adipose tissue produces adipokines, which can directly reduce ovarian function by altering the signaling of the hypothalamic-pituitary-ovarian axis, thereby causing menstrual disturbances.[30-32]

A strength of this study was that in addition to assessing for possible associations between nutritional

status and menstrual disorders, we also assessed for the differences in various anthropometric measurements (BMI, WC, and WtHR) between subjects with and without menstrual disorders. In addition, although this study was conducted during the pandemic, the sample size was greater than the minimum required due to the enthusiasm of the students to participate. A limitation of our study was that the determination of menstrual disorders were based on the subjective reporting by the subjects through the questionnaire, a method prone to bias. In addition, although the number of subjects exceeded the minimum required sample size, we were unable to exercise random selection of subjects due to technical issues related to the pandemic. We also did not assess laboratory parameters such as serum cholesterol levels. A number of studies have reported that fat levels affect menstruation.[10,25,28] Further research is needed to assess the relationship between nutritional status and menstrual disorders in adolescents based on laboratory criteria such as cholesterol levels, as a comparison against anthropometric criteria.

In conclusion, there is a significant association between overweight and irregular cycle length, abnormal menstrual period duration, and abnormal menstrual bleeding volume. Overweight is not significantly associated with menstrual pain. Subjects with menstrual disorders other than menstrual pain have higher BMI, WC, and WtHR values.

Conflict of interest

None declared.

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References

1. NCD Risk Factor Collaboration (NCD-RisC). Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128.9 million children, adolescents and adults. Lancet. 2017;390:2627-42. DOI: https://doi.org/10.1016/S0140-6736(17)32129-3.
2. Wijga AH, Scholtens S, Bemelmans WJE, de Jongste JC, Kerkhof M, Schipper M, *et al.* Comorbidities of obesity in school children: a cross-sectional study in the PIAMA birth cohort. BMC Public Health. 2010;10:184. DOI: https://doi.org/10.1186/1471-2458-10-184.
3. Pizzi MA, Vroman K. Childhood obesity: effects on children's participation, mental health, and psychosocial development. Occup Ther Health Care.2013;27:99-112. DOI: https://doi.org/10.3109/07380577.2013.784839.
4. Hruby A, Hu FB. The epidemiology of obesity: a big picture. Pharmacoeconomics. 2015;33:673-89. DOI: https://doi.org/10.1007/s40273-014-0243-x.
5. Pandita A, Sharma D, Pandita D, Pawar S, Tariq M, Kaul A. Childhood obesity: prevention is better than cure. Diabetes Metab Syndr Obes. 2016; 9:83-9. DOI: https://doi.org/10.2147/DMSO.S90783.
6. Antono SD. Perbedaan prestasi belajar antara siswa obesitas dan tidak obesitas pada siswa sekolah dasar di kota Kediri. J Ilmu Kesehatan. 2017;5:84-90. DOI: https://doi.org/10.32831/jik.v5i2.138.
7. Dya NM, Adiningsih S. Hubungan antara status gizi dengan siklus menstruasi pada siswa MAN 1 Lamongan. Amerta Nutr. 2019:310-4. DOI: https://doi.org/10.20473/amnt.v3i4.2019.310-314.
8. Williams CE, Creighton SM. Menstrual disorders in adolescents: review of current practice. Horm Res Paediatr. 2012;78:135-43. DOI: https://doi.org/10.1159/000342822.
9. Lasquety MG, Rodriguez D, Fehring RJ. The influence of BMI levels on phases of the menstrual cycle and presumed ovulation. Linacre Q. 2012;79:451-9. DOI: https://doi.org/10.1179/002436312804827082.
10. Wei S, Schmidt MD, Dwyer T, Norman RJ, Venn AJ. Obesity and menstrual irregularity: associations with SHBG, testosterone, and insulin. Obesity. 2009;17:1070-6. DOI: https://doi.org/10.1038/oby.2008.641.
11. Yeung EH, Zhang C, Albert PS, Mumford SL, Ye A, Perkins NJ, *et al.* Adiposity and sex hormones across the menstrual cycle: The BioCycle study. Int J Obes (Lond). 2013;37:237-43. DOI: https://doi.org/10.1038/ijo.2012.9.
12. Sawitri DPH, Wibawa A, Tianing NW, Primayanti IDA. The correlation between body mass index and menstrual cycle disorder in medical students of Udayana University. Bali Anatomy J. 2020;3:19-23. DOI: https://doi.org/10.36675/baj.v3i1.39.
13. Singh M, Rajoura OP, Honnakamble RA. Menstrual patterns and problems in association with body mass index among

adolescent school girls. J Family Med Prim Care. 2019;8:2855-8. DOI: https://doi.org/10.4103/jfmpc.jfmpc_474_19.

14. Ganesh R, Ilona L, Fadil R. Relationship between body mass index with menstrual cycle in senior high school students. Althea Med J. 2015;2:555-60. DOI: https://doi.org/10.15850/amj.v2n4.640.
15. Dars S, Sayed K, Yousufzai Z. Relationship of menstrual irregularities to BMI and nutritional status in adolescent girls. Pak J Med Sci. 2014;30:141-4. DOI: https://doi.org/10.12669/pjms.301.3949.
16. Committee on Adolescent Health Care. Menstruation in girls and adolescents: using the menstrual cycle as a vital sign. Committee Opinion. 2015;651. [cited 2022 January 12]. Available from https://www.acog.org/clinical/clinical-guidance/committee-opinion/articles/2015/12/menstruation-in-girls-and-adolescents-using-the-menstrual-cycle-as-a-vital-sign.
17. Susilo DH. Hubungan obesitas dengan gangguan siklus menstruasi. Oksitosin: J Ilmiah Kebidanan. 2015;2:49-55. [cited 2021 March 28]. Available from https://journal.ibrahimy.ac.id/index.php/oksitosin/article/view/423.
18. Yucel G, Kendirci M, Gul U. Menstrual characteristics and related problems in 9-18-year- old Turkish school girls. J Pediatr Adol Gynecol. 2018;31:350-5. DOI: https://doi.org/10.1016/j.jpag.2018.03.002.
19. Agarwal A, Venkat A. Questionnaire study on menstrual disorder in adolescent girls in Singapore. J Pediatr Adolesc Gynecol. 2009;22:365-71. DOI: https://doi.org/10.1016/j.jpag.2009.02.005.
20. Parker MA, Sneddon AE, Arbon P. The menstrual disorder of teenagers (MDOT) study: determining typical menstrual patterns and menstrual disturbance in a large population-based study of Australian teenagers. BJOG. 2010;117:185-92. DOI: https://doi.org/10.1111/j.1471-0528.2009.02407.x.
21. Chan SS, Yiu KW, Yuen PM, Sahota DS, Chung TK. Menstrual problems and health-seeking behaviour in Hong Kong Chinese girls. Hong Kong Med J. 2009;15:18-23. PMID: 19197092.
22. Tayebi N, Yazdanpanahi Z, Yektatalab S, Pourahmad S, Akbarzadeh M. The relationship between body mass index (BMI) and menstrual disorder at different ages of menarche and sex hormones. J Natl Med Assoc. 2017;1-8. DOI: https://doi.org/10.1016/j.jnma.2017.10.007.
23. Milla SY, Mudayatiningsih S, Dewi N. Hubungan obesitas dengan gangguan menstruasi pada remaja putri di kelurahan Tlogomas. Nursing News. 2018;3:72-82. DOI: https://doi.org/10.33366/nn.v3i1.754.
24. Amgain K, Neupane S. Effect of BMI and food habits on menstrual characteristics among adolescent girls. Europasian J Med Sci. 2019;1:53-61. DOI: https://doi.org/10.46405/ejms.v1i1.35.
25. Taheri R, Ardekani FM, Shahraki HR, Esfahani NH, Hajjahmadi S. Nutritional status and anthropometric indices in relation to menstrual disorder: a cross-sectional study. J Nutr Metab. 2020:5980685. DOI: https://doi.org/10.1155/2020/5980685.
26. Kulshrestha S, Durrani AM. Prevalence of menstrual disorder and their association with physical activity in adolescent girls of Aligarh City. Int J Health Sci Res. 2019;9:384-93.
27. Karout N, Hawai SM, Altuwaijri S. Prevalence and pattern of menstrual disorder among Lebanese nursing students. East Mediterr Health J. 2012;18:346-52. DOI: https://doi.org/10.26719/2012.18.4.346.
28. Kafaei-Atrian M, Mohebbi-Dehnavi Z, Sayadi L, Asghari-Jafarabadi M, Karimian-Taheri Z, Afshar M. The relationship between the duration of menstrual bleeding and obesity-related anthropometric indices in students. J Edu Health Promot. 2019;8:81. DOI: https://doi.org/10.4103/jehp.jehp_24_18.
29. Kumalasari MLF. Correlation between body mass index with menstrual cycle on female adolescent. Proceedings of International Conference on Sustainable Health Promotion; 2018 Oct 9-11; Sidoarjo, Jawa Timur. Surabaya: Faculty of Psychology and Health, UIN Sunan Ampel; 2018. p.100-3. [cited 2021 March 28]. Available from https://proceedings.uinsby.ac.id/index.php/ICOSHPRO/article/view/22.
30. Rad M, Sabzevary MT, Dehnavi ZM. Association between menstrual disorder and obesity-related anthropometric indices in female high school students: a cross-sectional study. Int J School Health. 2018;5:e65716. DOI: https://doi.org/10.5812/intjsh.65716.
31. Al-Kashif MML. Interrelation between menstrual problems and body mass index among undergraduate female students: cross sectional study. Asian J Sci Res. 2020;13:164-9. DOI: https://doi.org/10.3923/ajsr.2020.164.169.
32. Karanth S, Liya SR. Prevalence and risk factors for dysmenorrhoea among nursing student and its impact on their quality of life. Int J Reprod Contracept Obstet Gynecol. 2018;7:2661-7. DOI: https://doi.org/10.18203/2320-1770.ijrcog20182483.