

## The Prevalence of Dysmenorrhea and its Relationship with Body Mass Index among Female Students

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**Abstract:** Dysmenorrhea is a common gynecological problem among females. It is obvious that more than half of all females during adolescence suffer from dysmenorrhea. Many factors affecting menstrual pain such as age, weather, activity and body mass index (BMI). So, the aims of this study were to assess the prevalence of dysmenorrhea among the female students and identify the relationship between dysmenorrhea and body mass index. A descriptive correlational research design was utilized in this study. This study was conducted at the faculty of nursing, Alexandria University, Egypt. A purposive sample of (300) female students were recruited. Three tools were used for data collection. The first tool was self-administered questionnaire to collect socio-demographic data. The second tool was visual analog scale (VAS) for measuring menstrual pain intensity. The third tool was anthropometric measurements card to calculate the body mass index for each student. It is evident from the present study that 98.7% of students had dysmenorrhea and the pain characteristic was spasmodic in nature among 93.2% of them. Slightly less than one half (46.3%) of the students suffered from severe menstrual pain and 44.7% of them had moderate pain. In addition, 40.0% of the students were underweight while 10.7% were overweight and only 7.0% were obese. There was a significant increase in the menstrual pain among underweight students (56.7%) compared to normal (44.1%), overweight (34.4%) and obese students (19.0%) as  $p = 0.035^*$ . It can be concluded that there is a high prevalence of dysmenorrhea among the study subjects, which denotes that dysmenorrhea is a significant public health problem among adolescent girls. There is a significant relationship between dysmenorrhea and body mass index. It can be recommended that a health education programs regarding menstruation, proper nutrition and healthy life style must be established in the schools to give students age- appropriate information regarding these important issues.

**Key words:** Dysmenorrhea • Body Mass Index • Female Students

### INTRODUCTION

Menstruation is a natural phenomenon for females after puberty. It is a regular secretion of blood and mucous tissues from the inner lining of the uterus through the vagina [1, 2]. The first period usually begins between the ages of twelve and fifteen, which is a time period known as menarche [3, 4]. There are various types of menstrual disorders, including dysmenorrhea, menorrhagia, polymenorrhea, abnormal vaginal bleeding, amenorrhea, oligomenorrhea and irregular menstruation [5, 6]. Menstrual patterns can be affected by many factors, including age, ethnicity, family history, smoking and

physical activity [7]. In addition, inappropriate nutritional diet, obesity and reduced frequency of breakfast meals per week can also affect the frequency of these problems [8, 9].

Among the most common menstrual problems is dysmenorrhea. Dysmenorrhea is obtained from the Greek words, "dys" means difficult "meno" means the month and "rrhea" means flow [10]. Dysmenorrhea is one of the most widely recognized health problems among adolescent girls and young women, affecting 50 to 90% of the general population [11]. Dysmenorrhea refers to a cyclical lower abdominal or pelvic pain usually radiating to the back or the thighs, occurring during

menstruation. It begins a few hours before or immediately after the beginning of menstruation and continues for 12 to 72 hours, its monthly recurrence reduces women's recital level and quality of life. Dysmenorrhea leads to absence and decrease work performance in about 34-50% of women. In addition, 40% of students' absences from schools are caused by this problem [10].

**Dysmenorrhea Is Divided into Two Types:** Primary dysmenorrhea and secondary dysmenorrhea. Primary dysmenorrhea is the one, in which there is cramping pain in the lower abdomen at the onset of menstruation in the absence of any identifiable pelvic disease. Primary dysmenorrhea usually presents during adolescence within 3 years of menarche [12]. Moreover, the etiology of primary dysmenorrhea is not precisely understood, but most symptoms can be explained by the action of prostaglandin, particularly PGF2alpha which is released during endometrial sloughing. As menstruation starts on, PGF2alpha stimulates myometrial contractions, ischemia and sensitization of nerve endings. The clinical proof of this theory is fairly strong. Women with severe dysmenorrhea have higher levels of PGF2alpha in their menstrual fluid [13]. In addition, several studies have demonstrated the impressive efficacy of Nonsteroidal anti-inflammatory drugs (NSAIDs), which act through prostaglandins synthetase inhibition [14, 15]. Secondary dysmenorrhea, on the other hand, refers to painful menses resulting from an identifiable pelvic pathology such as fibroid, adenomyosis and pelvic inflammatory diseases [16].

Body mass index is a statistical measure, which compares a person's height and weight. Due to its ease of calculation, BMI is the most widely used diagnostic tool to identify obesity problems within a population. BMI is defined as the individual's body weight divided by the square of height [17]. According to WHO [18], body mass index (BMI) is divided into four categories: underweight (<18.5), normal (18.5-24.99), overweight (25-29.99) or obese ( $\geq 30$ ) [18].

Morbidity due to dysmenorrhea reflects a public health burden. It is one of the main causes of absenteeism from school and work and is responsible for significant loss of earnings and decreased quality of life. Despite its high prevalence and associated negative effects, many girls do not seek medical care for this condition [19]. There is also a high prevalence of dysmenorrhea among adolescent females in Egypt, a cross-sectional study

was conducted at Beni-Suef University revealed that (92.9%) of the students experienced dysmenorrhea [20]. A study was carried out on girls attending two nursing schools in Minia showed a high prevalence of dysmenorrhea (94.4%) [21]. Moreover, a study on four secondary schools girls in Assiut reported a prevalence of 76.1% [22]. Although some studies have demonstrated an association between BMI and the incidence and severity of dysmenorrhea, this relationship is still controversial [23, 24]. Therefore, the aims of this study were to assess the prevalence of dysmenorrhea among female students and identify the relationship between dysmenorrhea and body mass index.

**Aim of the Study:** The aims of the current study were to:  
Assess the prevalence of dysmenorrhea among the female students.

Identify the relationship between dysmenorrhea and body mass index.

**Research Questions:** What is the prevalence of dysmenorrhea among the female students?

Is there a relationship between dysmenorrhea and body mass index?

## MATERIALS AND METHODS

**Research Design:** A descriptive correlational research design was utilized in this study.

**Research Setting:** This study was conducted at the faculty of nursing, Alexandria University, Egypt.

**Study Subjects:** A purposive sample of (300) female students (approximately 75 females from each studying year) in the previous mentioned setting were recruited according to the following inclusion criteria:

- Students accepted to participate in the study.
- They had menstruation for at least 1-2 years.

### Exclusive Criteria:

- Students were diagnosed with any chronic illness or any pelvic pathology.
- Students with history of abdominal pelvic surgery.
- Students using any medications (including hormonal contraception) for at least last 2 months.

Epi info 7 program was used to estimate the sample size using the following parameters:

- Population size = 1200 within the academic year 2018-2019.
- Expected frequency 50%
- Acceptable error 5%
- Confidence coefficient 95%
- Minimal sample size 280

### Tools Used for Data Collection

**Tool I: Self-Administered Questionnaire:** It was developed by the researchers and includes the followings:

**Part I:** Socio-demographic data like age, marital status, residence.

**Part II:** Students' menstrual history as age of menarche, length of menstrual cycle, regularity, duration and amount of menstrual flow, symptoms of premenstrual syndrome and female's self care practices during menstrual pain.

**Tool II:** Visual analog scale (VAS) for measuring menstrual pain intensity. It is a self-report tool consisting of a horizontal line used for subjective estimation of menstrual pain. The students were asked to place a line perpendicular to the VAS line at the point that represented their pain intensity. It comprises 10 point numerical scale, corresponding to the degree of pain with zero representing no pain and 10 representing the worst degree of pain. In between these two opposite ends, words as mild, moderate and severe pain are assigned to each 2cm distance respectively [25].

**Tool III:** Anthropometric measurements card: BMI was calculated by weight in kg divided by the square of height in meter. The students were classified into four groups: underweight (<18.5), normal (18.5-24.99), overweight (25-29.99) or obese ( $\geq 30$ ) based on the recommendations from WHO [18].

**Tools Validity and Reliability:** The current study tools were submitted to five academic nursing experts in the obstetric nursing field to test the face and content validity of the tools. Necessary modifications were carried out according to the academic nursing experts' judgment on clarity of sentences and the appropriateness of the content. Tools reliability was tested using internal consistency test (Alpha Cronbach test). Its result was 0.80 which indicates an accepted reliability of the tools.

**Pilot Study:** A pilot study was carried out on 30 students (10% of the total sample) to test the clarity and applicability of the tools. Accordingly, needed modifications were done. The subjects who included in the pilot study were excluded from the total study sample.

**Procedure:** Official permission was obtained to perform the research after reviewing its ethical aspects by the ethical committee of faculty of Nursing. The study was carried out within the framework of permission obtained from head of the departments in the faculty.

First, the researchers divided the students into small groups according to their academic schedule. Then the researchers hold a meeting with each group during one of their free classes or between lectures to introduce themselves and briefly explained the nature and the purpose of the study. After obtaining the acceptance from the students to participate in the current study, the researchers provided an overview and clarification about the assessment tools questions to the whole class. Then, The Self - Administered Questionnaire and Visual analog scale (VAS) were distributed to each student to collect student's history and identify the level of menstrual pain. Dysmenorrhea intensity was considered as no pain (0), mild pain (1-3), moderate pain (4-6) and severe pain (7-10). The questionnaire sheet and VAS took about 15-20 minutes to be completed.

Second, BMI was calculated by the formula weight in Kg/Height<sup>2</sup> in meter and based on the BMI criteria by WHO. Weight was measured in light clothing by a digital weight scale. Height was measured from the top of the head to the ground. The students were classified into four groups: Underweight, normal, overweight and obese groups. Data were collected 2 days /week for 3 months starting from the beginning of September until the end of November 2018.

**Ethical Consideration:** Acceptance of the students to participate in the present study was obtained. All students were informed that their participation is voluntary and that the collected data would be only used for the purpose of the current study, as well as for their benefit. Students had the right to withdraw from the study at any time.

**Statistical Analysis:** Data was collected, coded, tabulated and analyzed, by using the SPSS computer program application for statistical analysis version 18. Descriptive statistics was used to calculate percentages and frequencies. Chi square ( $X^2$ ) test and Fisher Exact-test

were used to estimate the statistical significant differences between variables. A significant P-value was considered when is less than 0.05 and it was considered highly significant when P- value is less than or equal 0.01.

**RESULTS**

Table (1) illustrates the socio-demographic characteristics of the students. It can be observed that about two thirds (65.3%) of them aged between 20 - < 22 years old and the mean age was (21.65 ± 1.24) years. The majority (93.3 %) of the students were single. A sizeable proportion (71.3%) of the students was urban dwellers while the rest of them (28.7 %) were rural dwellers.

As shown in Table (2), the mean age at menarche was (12.97 ± 1.37) years. Three quarters (75%) of students had regular menstruation. Concerning interval of menstruation, it can be observed that (81.70%) of the students had 21-35 days interval between menstrual cycles. In addition, duration of menstruation ranged between 3-7 days among (94.6%) of the students. More than three quarters (78.0%) of them had moderate amount of menstrual blood loss.

Table (3) reveals that most (82.7 %) of the students suffered from premenstrual syndrome and the majority (97.6%) of them had physical symptoms. In addition, 98.7% of students had dysmenorrhea and the characteristic pain was spasmodic among 93.2% of them. Menstrual pain started with the menstrual onset and continued until the end of the first day among 98.3% of the students. About two thirds (64.5%) of the students drunk hot fluids to relieve menstrual pain.

Fig. (1) represents menstrual pain intensity among the students, it can be observed that, slightly less than one half (46.3%) of the students suffered from severe menstrual pain and 44.7% of them had moderate pain.

Table (4) shows the distribution of the students according to anthropometric measurement, it can be observed that the mean student height was 160.20 ± 15.82 and the mean weight was 62.01 ± 16.51. In addition, 40.0% of the students were underweight while 10.7% were overweight and only 7.0% were obese.

Regarding the relationship between BMI and menstrual history, Table (5) illustrates that there was a statistical significant increase in the age of menarche among underweight students (13.18 ± 1.41) comparing to overweight (12.31 ± 1.42) and obese one (12.29 ± 0.96)

(p=0.001). However, there were no significant relationship between body mass index and the menstrual regularity (p=0.730), interval (p=0.963), duration (p= 0.274) and amount (p=0.721) as presented in the same table.

There was a statistical significant increase of premenstrual syndrome among underweight students (95.8%) compared to 78.0% to normal weight, 71.9% to overweight and 52.4 % to the obese students (X<sup>2</sup> = 32.531. p <0.001\*) as shown in table (6)

As illustrated in Table (7), there was a significant increase in the menstrual pain among underweight students (56.7%) compared to normal (44.1%), overweight (34.4%) and obese students (19.0%) as p =0.035\*

Table 1: Distribution of the students according to their socio- demographic characteristics (n = 300)

Socio- demographic characteristics	No.	%
<b>Age</b>		
18 - < 20	64	21.3
20 - < 22	196	65.3
22 +	40	13.3
Min. - Max.	18.0 - 26.0	
Mean ± SD.	21.65 ± 1.24	
<b>Marital status</b>		
Single	280	93.3
Married	20	6.7
<b>Residence</b>		
Urban	214	71.3
Rural	86	28.7

Table 2: Distribution of the students according to their menstrual history: (n = 300)

Menstrual history	No.	%
<b>Age at menarche</b>		
Min. - Max.	10.0 - 17.0	
Mean ± SD.	12.97 ± 1.37	
<b>Rhythm</b>		
Regular	225	75.0
Irregular	75	25.0
<b>Interval (days)</b>		
21 - 35	245	81.7
< 21	29	9.7
> 35	26	8.7
<b>Duration (days)</b>		
< 3	2	0.7
3 - 7	284	94.6
> 7	14	4.7
<b>Amount</b>		
Scanty	34	11.3
Moderate	234	78.0
Excessive	32	10.7

Table 3: Characteristics of menstrual period pain among the students: (n = 300)

Items	No	%
Occurrence of premenstrual syndrome		
Yes	248	82.7
No	52	17.3
Premenstrual syndrome symptoms*	n=248	
Physical symptoms as abdominal cramps, fatigue, backache and headache...etc)	242	97.6
Psychological symptoms (depression, anxiety and mood swings...etc)	234	40.3
Behavioral symptoms ( school absenteeism, limited daily activities and isolation ...etc	184	76.3
Presence of menstrual pain		
Yes	296	98.7
No	4	1.3
Pain character	n=296	
Spasm	276	93.2
Throbbing	11	3.7
Stinging	9	3.1
Start of pain	n=296	
With the menstrual onset and continues until the end of first day.	291	98.3
At the end of menstruation and continues several days after	5	1.7
The menstrual pain is relieved by*	n=296	
Drinking hot fluid	191	64.5
Warm water bottle on suprapubic area	89	30.1
Taking warm shower	40	13.5
Rest and sleep	122	41.2
Analgesic or antispasmodic drug	130	43.9
Performing exercises	14	4.7

\*Multiple response questions

Table 4: Distribution of the students according to anthropometric measurements (n = 300)

Anthropometric measurements	No.	%
Student's height		
Min – Max.	62.0 - 175.0	
Mean ± SD.	160.20 ± 15.82	
Weight		
Min – Max.	43.0 – 160.0	
Mean ± SD.	62.01 ± 16.51	
Body mass index calculation (Kg/m <sup>2</sup> )		
<18.5 (underweight)	120	40.0
18.5 – 24.9 (Normal)	127	42.3
25 – 29.9 (over weight)	32	10.7
≥30 (Obese)	21	7.0
Min – Max.	16.0 – 40.0	
Mean ± SD.	21.91 ± 5.27	

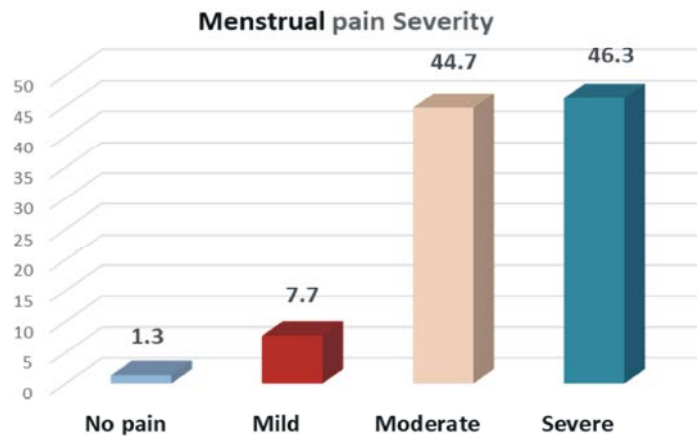


Fig. 1: Distribution of the students according to menstrual pain severity (n = 300)

Table 5: Relationship between BMI and menstrual history (n=300)

	BMI (Kg/m <sup>2</sup> )								Test of sig.	p
	<18.5 (underweight) (n=120)		18.5 - 24.9 (Normal) (n=127)		25 - 29.9 (over weight) (n=32)		≥ 30 (Obese) (n=21)			
Menstrual history	No.	%	No.	%	No.	%	No.	%		
Rhythm										
Regular	94	78.3	92	72.4	24	75.0	15	71.4	X <sup>2</sup> = 1.298	0.730
Irregular	26	21.7	35	27.6	8	25.0	6	28.6		
Age at menarche									F=5.483*	0.001*
Min. - Max.	10.0 - 17.0		11.0 - 16.0		10.0 - 16.0		11.0 - 14.0			
Mean ± SD.	13.18 ± 1.41		13.05 ± 1.30		12.31 ± 1.42		12.29 ± 0.96			
Sig. with. Underweight			0.877		0.007*		0.027*			
Sig. between cat.	p <sub>1</sub> = 0.030*, p <sub>2</sub> = 0.076, p <sub>3</sub> = 1.000									
Interval(days)									X <sup>2</sup> = 1.538	0.963
21 - 35	98	81.7	103	81.1	27	84.4	17	81.0		
< 21	12	10.0	11	8.7	3	9.4	3	14.3		
> 35	10	8.3	13	10.2	2	6.3	1	4.8		
Duration (days)									X <sup>2</sup> = 6.999	0.274
3 - 5	75	62.5	89	70.1	21	65.6	12	57.1		
5 - 7	41	34.2	35	27.6	10	31.3	6	28.6		
> 7	4	3.3	3	2.4	1	3.1	3	14.3		
Amount									X <sup>2</sup> = 3.665	0.721
Scanty	16	13.3	13	10.2	4	12.5	1	4.8		
Moderate	90	75.0	102	80.3	26	81.3	16	76.2		
Excessive	14	11.7	12	9.4	2	6.3	4	19.0		

\*Statistically significant at p ≤ 0.05

Table 6: Relationship between BMI and premenstrual syndrome (n=300)

	BMI (Kg/m <sup>2</sup> )								X <sup>2</sup>	p
	<18.5 (underweight) (n=120)		18.5 - 24.9 (Normal) (n=127)		25 - 29.9 (over weight) (n=32)		≥ 30 (Obese) (n=21)			
Premenstrual syndrome	No.	%	No.	%	No.	%	No.	%		
No	5	4.2	28	22.0	9	28.1	10	47.6	32.531	<0.001*
Yes	115	95.8	99	78.0	23	71.9	11	52.4		
Sig. with. Underweight			p<0.001*		p<0.001*		p<0.001*			
Sig. between categories	p <sub>1</sub> =0.467, p <sub>2</sub> =0.013*, p <sub>3</sub> =0.148									

p: p value for comparing between the different categories

p<sub>1</sub>: p value for comparing between Normal and Overweight

p<sub>2</sub>: p value for comparing between Normal and Obese

p<sub>3</sub>: p value for comparing between Overweight and Obese

\*: Statistically significant at p ≤ 0.05

Table 7: Relationship between BMI and a measure of pain intensity during the menstrual period (n=300)

	BMI (Kg/m <sup>2</sup> )								X <sup>2</sup>	p
	<18.5 (underweight) (n= 120)		18.5 - 24.9 (Normal) (n=127)		25 - 29.9 (over weight) (n=32)		≥ 30 (Obese) (n=21)			
Pain intensity during the menstrual period	No.	%	No.	%	No.	%	No.	%		
No pain	1	0.8	3	2.4	0	0.0	0	0.0	16.455	0.035*
Mild	6	5.0	12	9.4	3	9.4	2	9.5		
Moderate	45	37.5	56	44.1	18	56.3	15	71.4		
Severe	68	56.7	56	44.1	11	34.4	4	19.0		
Sig. with. Underweight			p= 0.153		p= 0.090		p= 0.006*			
Sig. between categories.	p <sub>1</sub> = 0.626, p <sub>2</sub> = 0.095, p <sub>3</sub> = 0.472									

\*Statistically significant at p ≤ 0.05

p: p value for comparing between the different categories

p<sub>1</sub>: p value for comparing between Normal and Overweight

p<sub>2</sub>: p value for comparing between Normal and Obese

p<sub>3</sub>: p value for comparing between Overweight and Obese

\*: Statistically significant at p ≤ 0.05

## DISCUSSION

Dysmenorrhea is a common gynecological problem among females. It is obvious that more than half of all females during adolescence suffer from dysmenorrhea, which interferes with their physical and emotional condition. It is the main cause of short-term school absenteeism and is associated with a negative effect on academic and daily activities [26, 27]. Therefore, adolescent girls should understand the patterns of menstruation and factors affecting it such as age, weight, activity and BMI. As a result, this will improve their understanding of menstrual characteristics and proper management [28]. Therefore, the aims of this study were to determine the prevalence of dysmenorrhea and its relationship with BMI among students.

In the present study, the mean age of menarche is 12.97; this result is in line with the findings of Adefuye *et al.* [29], Hossain *et al.* [30], Al-Awadhi *et al.* [31] and Ameade & Garti [32] who reported the same results. As shown in the present study, the mean BMI was  $21.91 \pm 5.27$  and there was a significant relationship between age at menarche and BMI. In other words, high age at menarche was associated with decreased BMI. This result is in line with the study of Khodakarami *et al.* [33] who reported that low age at menarche was associated with increased BMI.

As shown in the current study, most of the students had 21-35 days menstrual interval, in a study by Yamamoto *et al.* [34], most students had the menstrual interval of 25-38 days. In the study of Adefuye *et al.* [29], the mean length of the cycle was 26.9 and the range was from 14 days to 32 days. The menstrual flow from 3-7 days duration was observed among 94, 6% of the students in the present study. Similar results were obtained from the study of Hossain *et al.* [35] who mentioned that the duration of menstrual flow for 97% of students was 3-7 days. In the present study, BMI was not significantly associated with menstrual regularity, frequency, duration and amount of the blood flow. These results are congruent with the results of Khodakarami *et al.* [33].

The present study reported that most of the students 82.7% suffered from premenstrual syndrome. This findings go in line with the results of Naeimi [36] who found widespread prevalence of PMS among high school students.

There was a statistical significant increase in the prevalence of premenstrual syndrome among underweight students. However, the results of this study are congruent with the results of Kavitha and

Shanmughavadivu [37]. High prevalence of premenstrual syndrome among girls may be attributed to the lack of their preparation before the first menstruation. If the girl has learned to accept menstruation as a normal physiological function, she will adjust to these temporary discomforts. Moreover, the misconceived ideas that may have been transmitted to them by family members, friends and other people inadequately prepared to discuss the subject [38].

As shown in the present study, the prevalence of premenstrual syndrome physical symptoms like headache, backache, tiredness, nausea, breast heaviness, etc were very high when compared to the psychological symptoms like anxiety, disturbed sleep, mood swings etc. and behavioral symptoms like school absenteeism, limited daily activities and isolation. These results are in line with Margaret and Manjubala [11] who reported that physical symptoms were high (82%) when compared to the psychological symptoms (31%).

It is evident from the results of the present study that the majority of the students suffered from primary dysmenorrhea with varying degree of pain level. The majority of the students in the current study had the pain with the onset of the menstruation and continues through the first day which may reflect that this dysmenorrhea is primary in nature. The cause of the menstrual pain is thought to be the excess amount of prostaglandins released during the regular ovulation cycle, which causes contractions and pain in the uterine tissue [39].

The worldwide prevalence of dysmenorrhea varies considerably among countries, ranging between 50% and 90%. However, the results of the present study are in line with different studies in different countries. In a study of Turkish university students, the prevalence of dysmenorrhea was 87.7% [40], compared to 85.4% in Ethiopia [41], 88% in young Australians [42], 89.9% in university students in Iran [43] and 64% in a sample of Mexican university students [44].

A World Health Organization systemic review including 106 studies on dysmenorrhea illustrated that the rate of dysmenorrhea varies between 16.8 and 81%. Primary dysmenorrhea is one of the most common reasons of class absenteeism in young females [45, 46]. Furthermore, in another studies, the frequency of pain during menstruation was 82.2% among Indian secondary school adolescents [47] and 85.5% among Omani female adolescents [48]. These results indicate that dysmenorrhea is a common health problem that affects wide spectrum from females.

In the current study, there was large proportion from the students suffered from moderate and severe dysmenorrhea. These results are congruent with the results of Martinez *et al.* [49] who reported that 90% of the sample with dysmenorrhea reported moderate and sever pain. Another review article reporting that 16-90% of young females suffered from dysmenorrhea with 2-29% having pain severe enough to restrict them to bed [50].

Spasmodic pain was felt by the majority of the students in the current study which is in line with Kural *et al.* [51] who documented that 34% of their subjects had diffused lower abdominal pain and majority of them had spasmodic (68%) pain. The spasmodic pain among students may be due to uterine contractions because of increased prostaglandins production in the menstruating uterus. Non-pharmacologic pain relief measures are usually safe and inexpensive to use to decrease the negative effects resulting from dysmenorrhea. According to the results of the present study, about two thirds of the females took hot fluids to relieve menstrual pain while more than two fifth of them used analgesic or antispasmodic drug. These results are in agreement with Potur. [52] and contradicted the results of Rafique and Al-Sheikh [53] who found that the use of NSAIDs are most effective first-line treatment for dysmenorrhea.

As obvious in the present study, 40% of the students were underweight (BMI <18.5). However, these results are congruent with the results of Madhubala and Jyoti [54]. This indicates poor nutritional status of the students. The present study shows that underweight students had a significantly higher prevalence of dysmenorrhea as compared to overweight and obese ones ( $p = 0.035$ ). These results are in accordance with the results of Mohapatra *et al.* [55], but the exact pathophysiological mechanisms responsible for this association are still unclear. As certain amount of body fat is essential for normal ovulation and menstrual cycles and too little fat can result in ovulatory, menstrual and reproductive problems. However, the results of current study contradict with the findings of Snehalata [56], who found a positive relationship between dysmenorrhea and increased body mass index and illustrated that severity of PD was increased by gaining weight and increasing BMI in their subjects. A longitudinal study by Ju *et al.* [57], stated that a U-shaped association between dysmenorrhea and BMI, revealing increased prevalence in both underweight and overweight females. It further explored the association of BMI transitions over time and dysmenorrhea.

## CONCLUSIONS

Based on the findings of the present study, it can be concluded that there is a high prevalence of dysmenorrhea among the study subjects, which denotes that dysmenorrhea is a significant public health problem among adolescent girls. There is a significant relationship between dysmenorrhea and body mass index. There is a higher prevalence of severe dysmenorrhea among underweight students as compared to the obese subjects. Maintaining a healthy weight over time may be important for women to have pain-free periods.

**Recommendations:** Based on the findings of the present study, the following recommendations are suggested:

- Health education programs regarding menstruation, proper nutrition and healthy life style should be established in the schools to give students age-appropriate information regarding these important issues.
- Future studies are recommended to explore the relationship between dysmenorrhea and underweight.

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