

Article

Study on relationship between obesity and menstrual disorders

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Abstract: Menstrual disorder is a common fact includes menstrual irregularity, amenorrhea, dysmenorrhea, menorrhagia, oligomenorrhea, polymenorrhea and other related symptoms. Realizing the fact, the present investigation was carried out to determine the prevalence of menstrual disorders among female overweight and obese students and their association with different life style factors. A descriptive cross-sectional study was carried out among 70 overweight students from Patuakhali science and Technology University, Bangladesh through self-administered structural questionnaires. The data were collected on hemoglobin level (g/dl); menstrual pattern viz. menstrual cycle length, duration and flow; lifestyle factors including junk food consumption and dietary pattern. The statistical test was carried out using SPSS V16. The hemoglobin level test ensured that 20% students were non-anemic, 44.3% were mild anemic and 35.7 % were moderate anemic and the mean hemoglobin level was 10.12g/dL. The most commonly observed menstrual disorders among students were dysmenorrhea (47.1%), irregular menstruation (11.4%), menorrhagia (1.4%) and oligomenorrhea (11%). It was observed that 1.4% had scanty flow, 65.7% had normal flow whereas 32.9% had heavy flow of blood. However, the mean flow was 31.6ml. The habit of junk food consumption was found in 88.6% of the respondents and 24.3% of the students practice dieting. Additionally, the respondents who didn't consume junk foods had regular cycle length although about 88.6% students had regular menstruation cycle and 78.2% had normal duration of flow. Most of the respondents were in moderate dietary diversity score (10.5%) because they maintain a diet chart. The hemoglobin levels ensured that 80% students were found clinically anemic. Thus the study concluded that obesity made the students susceptible to anemia.

Keywords: overweight girls; menstrual disorder; menstrual pattern; lifestyle factor; anemia

1. Introduction

Menstruation is a common physiological phenomenon in a woman that indicates her capability for origination. It is also known as the regular discharge of blood and mucosal tissue from the inner lining of the uterus through the vagina at periodically or monthly (Schuiling and Likis, 2013). Estrogen and progesterone hormones are responsible for occurring menstruation. The first period usually originates between twelve and fifteen years of age is known as menarche. Though, periods may occasionally start as young as eight years old and still be considered normal. In the developing world and lower in the developed world the average age of the first period is generally higher. The usual length of period time between the first day of one period and the first day of the

next is 21 to 45 days in young women and 21 to 31 days in adults (an average of 28 days). Bleeding usually lasts approximately 2 to 7 days. Menopause which usually occurs between 45 and 55 years of age then menstruation stops. Without significant clots, the average menstrual blood loss is about 35–50 ml. Menstrual disorders are menstrual irregularity, amenorrhea, dysmenorrhea, menorrhagia, oligomenorrhea, polymenorrhea and other related symptoms. Oligomenorrhea is defined as infrequent, irregularly timed episodes of bleeding occurring at intervals of more than 35 days. Polymenorrhoea means frequent episodes of menstruation occurring at intervals of less than 21 days (Savsani and Solanki, 2018). Menorrhagia is unaltered menstrual cycles where the quantity of menstrual loss exceeding 80 ml. Hypomenorrhea defined as regularly timed but scanty flow of bleeding which last for <2 days. Menorrhagia means regular cycles with either blood loss > 80 ml and/or flow that lasts >7 days (Harlow and Campbell, 2003). Dysmenorrhea is defined as the pain in the lower abdomen, back and thighs which occur before or during menstruation that ranges from mild, moderate or severe pain (Campbell, 1997). It continues for 12-24 hours severe enough to have emotional impact with normal activities, or require treatment. There were numerous premenstrual syndromes includes wide variety of cycle, recurrent, physical, behavioral and emotional symptoms that happen during the late luteal phase of the menstrual cycle. Premenstrual symptoms are weight gain, headache, fatigue, nervousness, irritability, mood swings (Cronje, 2002). It comes to light 7–14 days before the onset of menstruation and subsides when menstruation occurs. Bangladeshi women are perceived in menstrual problems as the second most common health problems they experience (Ziauddin, 1993). Menstrual problems affected 75% of girls. It was the major cause of recurrent short-term school absenteeism in female adolescents. The most common menstrual disorders in early adolescents were menstrual irregularity and prolonged menstrual bleeding. Due to an ovulatory cycle prolonged menstrual bleeding usually occurs early after menarche. There was a relationship between age of menarche and body mass index (BMI), with an earlier menarche linked with a higher BMI (Golden and Carlson, 2008). Commonly a menstrual flow lasts 2–7 days in 70–80% of cases, and changing three to five pads per day suggests normal flow. After menarche there was the duration between two menstrual cycles ranges from 21 to 45 days in the 1–2 years. Some types of menstrual dysfunction occur in approximately 75% of adolescent girls and may affect the life of adolescent and young adult women (Klein *et al.*, 1980). It was noted that there was a correlation between obesity and menstrual cycle.

Taboo concerning menstruation was called as menstrual taboo. Some societies consider menstruation as messy or perplexing. Eating sour foods, going out with friends, visiting religious places were imputed restrictions on adolescent girls during menstruation period (Manhas *et al.*, 2012). Besides these, taking bath, changing clothes, dietary restrictions like consumption of foods such as rice, curd, milk, potato, onion, sugarcane etc. were restricted (Singh, 2006). Many studies have been conducted earlier to address the problems related to menstrual abnormalities in young students. Yet there is limited literature and research regarding the relationship between obesity and menstrual disorders in Bangladesh. This fact from the literature encouraged to conduct the research on the relationship between obesity and menstrual disorder among the students of Kabi Begum Sufia Kamal Hall and Sheikh Fajilatunnesa Mujib Hall at Patuakhali Science and Technology University. So the aims of this study: i) to record the menstrual pattern of obese students of PSTU, and ii) to evaluate the association between obesity and menstrual pattern among PSTU students.

2. Materials and Methods

The study was conducted among overweight and obese undergraduate and graduate girls of PSTU aged 19-23 years during October-December 2017. The body mass index (BMI) of 750 students (whole population) from Kabi Begum Sufia Kamal Hall and Sheikh Fajilatunnesa Mujib Hall Patuakhali Science and Technology University (PSTU), Bangladesh, was measured in order to find out the overweight students. Thereafter, a descriptive cross-sectional study was carried out among 70 overweight students through self-administered structural questionnaires. The Hall provost was contacted before to get official permission for conducting the survey and to collect the blood sample of the respondents. A pilot survey was conducted on 10 students prior to starting the main survey. Before administering the questionnaires and collect the blood samples, the respondents were requested before their consent to conduct the study. However, the proposal had been approved by the Institutional Ethical Committee of PSTU on 15 September 2017 having reference no. PSTU/IEC/2017/05. There were four researchers and one laboratory technician on site to assist during administering the questionnaires. Data on junk food consumption was recorded from last week.

The menstruation history record regarding menstruation of last three months included age at menarche, amount of flow, duration of flow, interval of flow, menstrual disorders. Data on cycle length of each menstruation period was recorded. Those who had two or more cycle length 21-35 days were considered in regular cycle while those who had two or more cycle length <21 days or >35 days were in irregular cycle. Also, period

missed in any month out of three months were considered in irregular cycle. Data on sanitary products used in each period were converted into pad and then average number of pads was determined. Here, 2 half soaked pads & 1 changed cloth were considered as 1 full soaked pad. One packet of toilet tissues was considered as 4 pads. The amount of blood flow was calculated by multiplying total number of pads with 5. The amount of blood flow was categorized as <10 ml (scanty), 10-35 ml (normal), >35 ml (heavy) (Cole and Thomson, 1971). Dysmenorrhea and pre-menstrual syndrome were also recorded. Besides, analgesics/other medications intake during menstruation period, history of menstrual abnormalities within family member were recorded.

In twenty four hour dietary recall method, subjects were asked to recall food intake during the previous 24 hour period or preceding day. Dietary Diversity Score was classified as poor diversity (1-2 groups), moderate diversity (3-4 groups) and heavy diversity (5-7 groups). A temporary health camp was organized at Kabi Begum Sufia Kamal Hall in order to collect and analyze blood samples of each respondents. The hemoglobin level (Hb %) was estimated by Hemoglobin Test Kit (Human Company) using Colorimeter. Hemoglobin level was categorized as non-anemic (≥ 11 g/dL), mild anemic (<11-9 g/dL), moderate anemic (<9-6 g/dL) and severe anemic (<6 g/dL). The obtained data from the survey was analyzed by Microsoft Excel, SPSS (Statistical Package for Social Sciences) V16 software.

3. Results

In the present study, about 70 overweight and obese girls were selected through anthropometric measurement of all the girls. The information contained in each questionnaire was analyzed and presented in the tabular as well as graph form.

3.1. Hemoglobin level

The age of students ranged from 19-23 years. The biochemical analysis of hemoglobin level reported that about 20% girls were non-anemic and 44.3% in mild anemic which showed the peak while moderate anemic were 35.7%. The mean hemoglobin level was 10.12 g/dL (Table 1).

3.2. Life style factors

The record of the junk food consumption showed that about 88.6% of the students liked to eat junk food, out of which 12.9% consumed 1 day/week, 25.7% for 2-3 days/week and 50% consumed 4-7 days/week (Table 2). It was found that junk food consumption increased during stress (examination) in 22.9% respondents whereas only in 8.6% students, increased consumption during menstruation period. History of dieting in order to reduce weight was found in 24.3% of the respondents whereas only 2.9% were found to diet by fasting. Percentage distribution of students on the basis of their timing of dieting was found to be 21.4% at dinner and 2.9% at breakfast as well as dinner. However the timing of dieting was found to be 2.9% at breakfast as well as dinner and 21.4% at dinner (Table 2). However, low calorie junk food items consumed by respondents were singara (55.71%), samosa (35.71%), puri (14.29%), and chips (27.14%). High calorie Junk food items consumed by respondents were roll (27.1%), burger (20%), hot dog (5.7%), sandwich (18.6%), egg chop (5.7%), soft drinks (50%), chicken fry (4.3%), and ice cream (4.3%). Nonetheless, 18.57% reported consuming cereals, 7.14% pulse, 14.29% no leafy vegetables, 8.57% leafy vegetables, 2.86% milk and milk products, 7.14% meat and fish, 5.71% fruits as their dieting menu (Figure.1). The dietary diversity score was found to be poor in 2.9%, moderate in 81.4% and heavy in 15.7% out of 70 respondents (Figure 2).

3.3. Menstrual patterns

At the present study, the age of menarche was found to be <10 years in 4.3%, 11-13 years in 77.1% of the students and 14-16 years in 18.6% students. Duration of blood flow for 3-5 days was recorded in 78.6% of the cases, for 6-7 days in 18.6% of the cases while 2.9% of respondents had more than seven days of blood flow. Nonetheless, the mean duration of blood flow was calculated to be 5 days per period. In respect of regularity of menstrual cycle, the frequency of menstrual cycle was regular in 88.6% girls but it was irregular in 11.4% respondents. Thereafter it was revealed that only 1.4% of girls had scanty flow and a major number of the girls 65.7% had normal blood loss whereas heavily flow was recorded in 32.9% girls. The mean flow was found to be 31.6ml per period (Table 3).

Table 1. Anemia classification.

Hemoglobin level(g/dL)	No. of students (N=70)	Percentage (%)
Non-anemic	14	20
Mild anemic	31	44.3
Moderate anemic	25	35.7
Severe anemic	0	0.00

Table 2. Distribution of life styles factors.

Consumption of Junk food	No. of students (N=70)	Percentage (%)
Do you like to eat junk food?		
Yes	62	88.6
Does Junk food consumption increase during menstruation period?		
Yes	6	8.6
Frequency of Consumption of Junk Food (days/week)?		
0 day/week	8	11.4
1 day/week	9	12.9
2-3 days/week	18	25.7
4-7 days/week	35	50
Dieting for weight reduction		
Yes	17	24.3
Timing of dieting		
Breakfast	0	0.00
Dinner	15	21.4
Breakfast +Dinner	2	2.9
Fast to diet		
Yes	2	2.9
Dietary Diversity Scoring		
Poor dietary diversity	2	2.9
Moderate dietary diversity	57	81.4
Heavy dietary diversity	11	15.7

Table 3. Distribution of menstrual patterns.

Duration of blood flow (Days)	No. of students (N=70)	Percentage (%)
≤2 days	0	0.00
3-5 days	55	78.6
6-7 days	13	18.6
>7 days	2	2.9
Cycle length (Days)		
Regular cycle	62	88.6
Irregular cycle	8	11.4
Amount of flow (ml)		
<10 ml(scanty)	1	1.4
10-35 ml(normal)	46	65.7
>35 ml(heavy)	23	32.9
Dysmenorrhea		
Yes	37	52.9
PMS (Average)		
Yes	51	72.9
Analgesics/other medications		
Yes	15	21.4
FM have menstrual abnormalities		
Yes	28	40

Table 4. Association between lifestyle and cycle length.

Variables	Cycle length			Chi-square	p-value
	Regular	Irregular	Total		
Hemoglobin level (g/dl)					
Non-anemic	12(85.7%)	2(14.3%)	14	9.325	0.009
Mild anemic	42(87.5%)	6(12.5%)	48		
Moderate anemic	8(100%)	0(0%)	8		
Total	62(88.6%)	8(11.4%)	70		
Junk food					
Yes	54(87.1%)	8(12.9%)	62	1.165	0.280
No	8(100%)	0(0%)	8		
Total	62(88.6%)	8(11.4%)	70		
Dieting for weight reduction					
Yes	15(88.2%)	2(11.8%)	17	0.003	0.960
No	47(88.7%)	6(11.3%)	53		
Total	62(88.6%)	8(11.4%)	70		
Dietary diversity scoring					
Poor diversity	2(100%)	0(0%)	2	0.800	0.670
Moderate diversity	51(89.5%)	6(10.5%)	57		
Higher diversity	9(81.8%)	2(18.2%)	11		
Total	62(88.6%)	8(11.4%)	70		

Table 5. Association between lifestyle and dysmenorrhea.

Variables	Dysmenorrhea			Chi-square	p-value
	Yes	No	Total		
Hemoglobin level (g/dl)					
Non-anemic	0(0%)	1(100%)	1	1.635	0.442
Mild anemic	25(56.8%)	19(43.2%)	44		
Moderate anemic	12(48%)	13(52%)	25		
Total	37(52.9%)	33(47.1%)	70		
Junk food					
Yes	32(51.6%)	30(48.4%)	62	0.337	0.562
No	5(62.5%)	3(37.5%)	8		
Total	37(52.9%)	33(47.1%)	70		

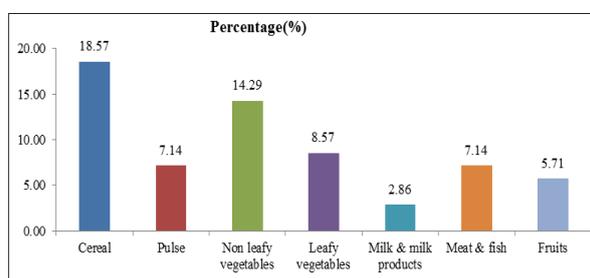


Figure 1. Dieting food items.

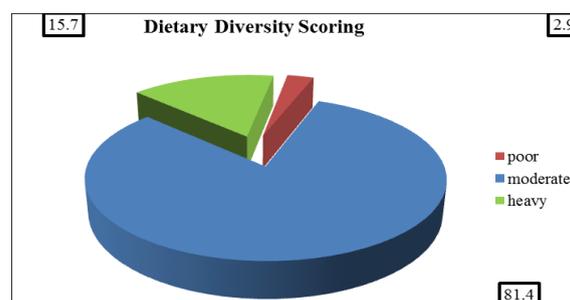


Figure 2. Dietary diversity scoring.

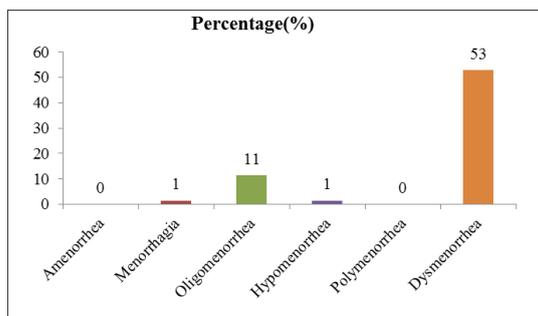


Figure 3. Menstrual disorder.

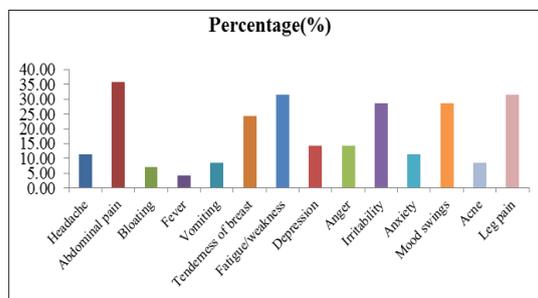


Figure 4. Premenstrual syndrome.

3.4. Menstrual practices

The sanitary products used by the students during their menstruation period were pad (48.57%), only tissue paper inside panty (2.86%), folded tissue with pad (37.14%), only cloth (4.29%), and bandage cloth with pad (7.14%). Analgesics intake was found in 21.4% of the respondents. It was found that 21.4% students followed the restriction on eating sour food, while 85.71% students followed restriction only to visit religious places during their menstruation period (Table 3). Food items liked to consume besides regular meal at premenstrual period were tea, coffee, milk, egg, fruits whereas sour food was avoided and during menstruation period were meat, fish, egg, tea, banana and milk but not sour food.

3.5. Menstrual disorders

It was observed that about 52.9% of the respondents had dysmenorrhea. Additionally, pre-menstrual syndrome was reported in 72.9% of the students. Out of 72.9% students who experienced pre-menstrual syndrome, headache was found in 11.43%, abdominal pain in 35.71%, tenderness of breast in 24.29%, anger in 14.29%, irritability in 28.57%, and leg pain in 31.43% of the respondents (Figure 4). Other menstrual disorders found in this study were in the form of menorrhagia occurred in 1% students, oligomenorrhea in 11% and one percent student had hypomenorrhea (Figure 3). The study recorded that 40% students had history of family members suffering from menstrual abnormalities (Table 3).

3.6. Association

The present study found that the regularity of the cycle length was significantly associated (Chi-square= 9.325, P=0.009) with the hemoglobin level of the respondents. However, the junk food consumption, dieting and dietary diversity scoring were not statistically associated with the cycle length (Table 4). Besides, the study also didn't find significant association between lifestyle parameters and dysmenorrhea. Nevertheless, almost all the young girls who suffered from dysmenorrhea were either mild or moderate anemic. Additionally, most of them were consumed junk food (Table 5).

4. Discussion

Adolescence is a stage of enormous physical and hormonal change for a young girl. The present study was conducted to determine the association among lifestyle factors and the menstrual pattern of the overweight and obese young girls. No significant association was found between menstrual pattern and lifestyle parameter. The age of menarche was determined by general health, genetic, socio-economic and nutritional factors. In this study, 77.1% students were found to encounter menarche between the age group of 11-13 and rest 18.6%

between 14-16 age groups. These findings correlated to the findings of Begum *et al.* (2009). Additionally, the mean age for menarche between 12-13 years old (Flug *et al.*, 1984, Herman-Giddens *et al.*, 1997 and Kavita, 2014) have been found in previous literature which was similar to our study.

Anemia was the major nutritional deficiency found in this group where 80% of the total girls were anemic. Additionally, the mean hemoglobin level (10.12 g/dL) (Table 1) was lower than the standard level of hemoglobin in female as well and study in Rajasthan, India determined mean hemoglobin level 8.5g/dL (Pathak, 2015). However, the study also found that there was a significant relation between anemia and menstrual cycle length. The majority of the students were anemic which predict that overweight and obese girls are prone to anemia. On the other hand, prevalence of heavy bleeding decreased with a higher BMI (Kristen *et al.*, 2013).

In present study, only 11.4% overweight students had irregular cycle which was congruent with the findings of Begum *et al.* (2009) that was 12.7% in young girls which indicated no difference in irregularities of cycle length between overweight girls and all young girls. But there was dissimilarity with the findings of Dars *et al.* (2014) which was 24%.

Indeed, in case of irregular cycle, no association was found with increased dietary diversity score (Table 4). Nonetheless, most of the overweight and obese respondents of the present study were found to be on the way of reducing weight by dieting. The study also revealed that the respondents who didn't consume junk food have regular cycle length and vice versa. These findings was supported by Jaget Lakkawar *et al.* (2014) but no association was found between junk food consumption and menstruation cycle (Rupavani *et al.*, 2013). Almost every girl (88.6%) was fond of junk food but the amount they consumed per day is least to count. The cycle length of the respondents who practice dieting was regular compare to others. The maximum respondents who maintain moderate dietary pattern were under regular cycle length.

The students who diet for weight reduction were mostly found to consume cereals, noodles, bread, chapatti, rice and biscuit which are mainly carbohydrate rich foods. Most of them found to consume less vegetables and fruits and avoid animal sources of food which is the best source of iron. Consequently, maximum iron deficiency anemia was found among overweight and obese girls who do diet for weight reduction.

In the present study, about 52.9% of the respondents had dysmenorrhea but 60.9% in Bangladesh (Begum *et al.*, 2009). In the study, there was no association found between dysmenorrhea & life style parameter (Table 5) which has congruence with the findings of Singh *et al.* (2008) and Parazzini *et al.* (1994). In our study, it was observed that majority of students (72.9%) were suffered from pre-menstrual syndrome which was too high compared to the findings of ACOG (1983) and Dangal (2004) that was 50%.

5. Conclusions

The study concluded that obesity made the students susceptible to anemia. However, 80% students were found to be anemic. Percentage of mild anemic students were higher compared to others and they have possibility to become moderate anemic if proper care is not taken. Consequently, it may lead to the reproductive health complications in the immediate future within these overweight and obese students, although majority of them have regular menstruation (88%) and normal duration of flow (79%) at present. Lifestyle modifications like regular physical activities, diminishing the intake of junk foods and promoting healthy eating habits should be accentuated to improve menstrual health.

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Conflict of interest

None to declare.

References

ACOG (American College of Obstetrician and Gynaecologists), 1983. Dysmenorrhoea. Technical bulletin, Washington, DC. ACOG, Vol. 63.

- Begum J, AM Hossain and SA Nazneen, 2009. Menstrual pattern and common menstrual disorders among students in Dinajpur Medical College. *Dinajpur Med. Col. J.*, 2: 37-43.
- Campbell M and P McGrath, 1997. Use of medication by adolescents for the management of menstrual discomfort. *Arch. Pediatr. Adolesc. Med.*, 151: 905-912.
- Cole SK, WZ Billewicz and AM Thomson, 1971. Sources of variation in menstrual blood loss. *An Int. J. of Obst & Gyna.*, 78: 933-939.
- Cronje WH and JWW Studd, 2002. Premenstrual syndrome and premenstrual dysphoric disorder. *Prim. Care. Clin. Off. Pract.*, 29: 1-12.
- Dangal G., 2005. Menstrual disorders in adolescents. *Int. J. Gynaec. Obst.*, 4: 52-79.
- Dars S, K Sayed and Z Yousufzai, 2014. Relationship of menstrual irregularities to BMI and nutritional status in adolescent girls. *Pak. J. Med. Sci.*, 30: 140-144.
- Flug F, PG Pelicci, F Bonetti, DM Knowles, R Dalla-Favera, 1984. Menstrual patterns in adolescent Swiss girls: a longitudinal study. *Ann. Hum. Biol.*, 11: 495-508.
- Galbete C, J Toledo, MÁ Martínez-González, JA Martínez, F Guillén-Grima and Amelia Marti, 2013. Lifestyle factors modify obesity risk linked to PPARG2 and FTO variants in an elderly population: a cross-sectional analysis in the SUN Project. *Genes Nut.*, 8: 61-67.
- Harlow SD and OMR Campbell, 2003. Epidemiology of menstrual disorders in developing countries: a systematic review. *An Int. J. of Obst. & Gyn.* 111: 6-16.
- Herman-Giddens ME, EJ Slora, RC Wasserman, CJ Bourdony, MV Bhapkar, GG Koch and CM Hasemeier, 1997. Secondary sexual characteristics and menses in young girls seen in office practice: a study from the Pediatric Research in Office Settings network. *Pediatrics*, 99: 505-512.
- Kavita SK and C Nagaraj, 2014. Dysmenorrhoea and premenstrual syndrome: frequency and effect on daily activities of adolescent girls in rural areas of Bangalore. *Int. J. of Med. Sci. and Pub. Hea.*, 3: 10-13.
- Lakkawar NJ, RL Jayavani, PN Arthi, A Padma, N Vanajakshi, 2014. A study of menstrual disorders in medical students and its correlation with biological variables. *Sch. J. Appl. Med. Sci.*, 2: 3165-3175.
- Manhas S and P Sharma, 2012. Perception about beliefs related to menstruation. A study of adolescent girls of Jammu. *Intr. Ind. Ref. Res. J.*, 33: 39-42.
- Parazzini F, L Tozzi, R Mezzopane, L Luchini, M Marchini and L Fedele, 1994. Cigarette smoking, alcohol consumption, and risk of primary dysmenorrhea. *Epidemiology*, 5: 469-472.
- Pathak S, 2015. To study the effect of dietary habits on premenstrual syndromes, menstrual disorders and practices related to menstruation among college going girls. *Int. J. of Heal. Sci.*, 2: 8-17.
- Ramlau-Hansen CH, AM Thulstrup, EA Nohr, JP Bonde, TIA Sørensen and J Olsen, 2007. Subfecundity in overweight and obese couples. *Hum. Reprod.*, 22: 1634-1637.
- Rupavani K, KS Veena, L Subitha, KVR Hemanth and A Bupathy, 2013. Menstrual abnormalities in school going girls – are they related to dietary and exercise pattern? *J. Clin. Diagnostic. Res.*, 7: 2537-2540.
- Savsani MV and RR Solanki, 2018. A study of menstrual disorders in reproductive age group and its correlation with biological variables, 4(2), pp. 1428-1437.
- Schulling KD and FE Likis, 2013. *Women's Gynecologic Health*, Jones & Bartlett Publishers.
- Singh AJ, 2006. Place of menstruation in the reproductive lives of women of rural North India. *Ind. J. Comm. Med.*, 31: 10-14.
- Singh A, D Kiran, H Singh, B Nel and P Singh, 2008. Prevalence and severity of dysmenorrhea: a problem related to menstruation, among first and second year female medical students. *Ind. J. Physiol. Pharmacol.*, 52: 389-397.
- Sutton-McDowall ML, RB Gilchrist and JG Thompson, 2010. The pivotal role of glucose metabolism in determining oocyte developmental competence. *Reproduction*, 139: 685-695.
- Ziauddin SH, 1993. *Women's Health & Illness: Perception of men & women in Rural Area of Bangladesh*. Bangladesh.