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# "A study of Lifestyle Modifications used for relieving dysmenorrhea in adolescent girls."

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***Abstract:***
***Introduction****-88% of the adolescent girls suffer from primary dysmenorrhea (PD) within first 2 years of menarche. Increased levels of PG's especially $PGF_{2\alpha}$ is said to be the prime reason behind PD. With rise in the adolescent obesity globally leading to early age of menarche (AOM), the young girl is subjected to the discomforts of PD earlier.*
***Material and methodology****-A cross-sectional study was conducted on 210 adolescent girls from different schools of Gwalior to find the correlation between PD and BMI. The participants' anthropometric measurements were taken and were asked to fill a questionnaire regarding the PD and the menstrual details. The pain scoring was done by NRS. The participants were divided according to the Revised IAP BMI charts.*
***Results****-Prevalence of PD was found to be 70% and higher BMI was associated with greater prevalence and severity of pain. BMI was strongly correlated with MPS (r=0.72).*
***Conclusion****-PD is disturbing and psychologically taxing for the adolescent girl and as obesity is a correctable predisposing factor for PD, weight reduction can reduce the symptoms and maintain the regularity of menstrual cycles.*
***Keywords:*** *Primary Dysmenorrhea, Body Mass Index, Mean Pain Score, Prostaglandins*

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## I. Introduction:

G. Stanley Hall, the Father of adolescence said: "Adolescence is a new birth, for the higher and more completely human traits are now born".[1] At this phase apart from a multitude of external and internal changes, roughly 88% of the girls within first 2 years of menarche suffer from Dysmenorrhea.[2] It is the most common gynecological complaint of a young adolescent female[3] creating a negative impact on quality of life which recurs every month. With India accounting for roughly $1/5^{th}$ of the world adolescent female population, it is crucial to address this sensitive issue.[4] Primary dysmenorrhea (PD) is defined as painful menstruation with cramping sensation in lower abdomen in the absence of any visible pelvic pathology that could account for it. The onset has a predictable temporal pattern beginning just before or at the start of menstruation as compared to secondary dysmenorrhea which is generally associated with intermenstrual bleeding along with an underlying pelvic pathology.[5]

An adolescent girl is subjected to the discomfort of PD at an early age as compared to her mother. The increase incidence of adolescent obesity, stress and better socioeconomic conditions are considered as major factors for the decline in age of menarche (AOM) and primary dysmenorrhea globally. Certain studies were done to ascertain the impact of obesity on PD.[6] However; they reached to a controversial result. On the other hand, some researchers found that attempts to lose weight were associated with higher PD.[7] Therefore, this was undertaken to find the relationship between PD and Body mass index (BMI).

**Aims & Objectives:** 1) To ascertain the prevalence of PD in adolescent girls of Gwalior city and to grade the pain according to a standard pain intensity scale
2) To find the correlation between PD and BMI

## II. Material and methodology:

This cross-sectional study was conducted on randomly selected 250 adolescent girls of the age group 11-15 years of different government and private schools in the city of Gwalior, Madhya Pradesh. The Institutional ethical clearance was obtained. Informed consent was taken from the parents of all the students with the help of the head of institution. Pretested, pre-structured, self-explanatory questionnaire in English as

well as in the local language was prepared and provided to each participant according to their preference. Each participant was asked to fill the questionnaire maintaining full privacy and was collected back quickly to avoid subject bias. The questionnaire comprised of 3 sections, namely anthropometric measurements, detailed menstrual history (including AOM, days of flow, length and regularity of cycles, presence of pain and accompanied symptoms) and medical history regarding past illness.Each participant's height and weight were taken using anthropometric measurement standards (CDC 2009) and BMI was calculated (body weight/height$^2$). Out of 250 participants who volunteered to participate, 12 were excluded on the basis of exclusion criteria and 28 forms were found to be incompletely filled. The study population was divided into 4 groups on the basis of the BMI, according to Revised IAP 2015 growth charts as Underweight, Normal, Overweight and Obese (Table 1).[8]

PD was defined as having even one episode of painful menstruation in the past 6 months. Pain which was preferably spasmodic in nature and located around lower abdomen, lower back and thigh or around the suprapubic region and associated with menstruation was considered as PD. Pain intensity was measured by standard Numerical Pain Rating Scale (NRS-adopted from McCaffery, Beebe et al.1989) where each participant was supposed to fill the level of pain experienced by them from a value of 0 to 10. A score of 0 was considered as no pain, 1-3 as mild (not interfering with daily activities), 4- 6 as moderate (significant interference) and 7-10 as severe pain[9] (disabling the subject with daily life activities).

**Inclusion criteria:** All apparently healthy adolescent girls who have attained menarche at least 6 months back and were willing to participate. **Exclusion criteria:** All girls who had dysmenorrhea after 2 days of start of menstruation or which starts before menstrual flow and continues several days throughout the cycle or who had continuous pain for more than the 3$^{rd}$ day or in whom the pain started 2 years after the AOM. Pain was not cramping in nature and present all over the abdomen. Participants who had pallor, nipple discharge, abnormal body hair distribution or history of diagnosed pelvic pathology and smoking. The data was collated and Statistical analysis was done using SPSS software version 18

## III. Results:

The total number of participants included in the study was 210 accounting for aresponse rate of 84%. Mean (+ SD) age and BMI were estimated as 13 + 1.94 years and 17.39 + 2.67 Kg/m$^2$ respectively in Table 1. Table 2 depicts the demographic details of the study population.

**Table 1 Classification body weight according to body mass index**

| BMI | Nutritional status |
|---|---|
| ≤ 3$^{rd}$ percentile | Underweight |
| 4$^{th}$ percentile- 22$^{nd}$ percentile | Normal |
| ≥23 adult equivalent percentile | Overweight |
| ≥25 adult equivalent percentile | Obese |

**Table 2: Demographic details of the study population**

| Characteristics | Mean + S. D |
|---|---|
| Mean age | 13±1.94 Yrs. |
| Mean height | 1.52±0.77 cms. |
| Mean weight | 39.92±6.63 Kgs. |
| Mean BMI | 17.39±3.67 Kg/m$^2$ |

Table 3 shows that the mean AOM was 12.94 + 0.74 years while the mean duration of PD was found to be 1.5 + 0.32 days.

**Table 3: Menstrual diary of the study population**

| Parameters | Mean + S. D |
|---|---|
| Mean AOM | 12.94±0.74 Yrs. |
| Mean duration of PD | 1.5±0.32 days |
| Mean length of the cycle | 28.6±3.24 days |
| Mean days of flow | 3.7±1.15 days |

Majority (52.3%) of the participants had a normal BMI while 23.8% were overweight, 7.1% obese and 16.7% underweight. Prevalence of PD in the study group was 70%, out of which 23.8% had mild, 41.5% moderate and 34.7% had severe PD as shown in Table 4. The prevalence was highest (74%) in the overweight individuals.

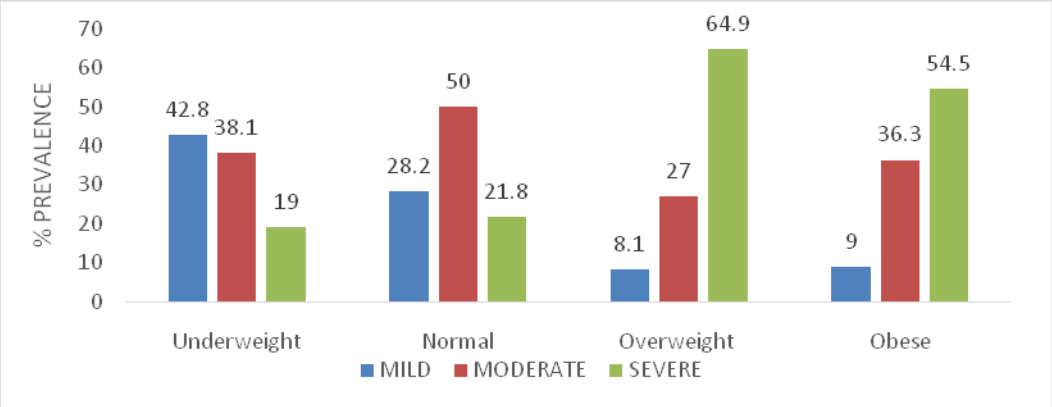
| Table 4: Prevalence of Primary Dysmenorrhea in different categories of BMI | | | | | |
|---|---|---|---|---|---|
| BMI (n) | Mean BMI (kg/m$^2$) | Prevalence of PD (n) | Mild (n) | Moderate (n) | Severe (n) |
| Underweight (35) | 11.82±0.75 | 60% (21) | 42.8% (09) | 38.1% (08) | 19.0% (04) |
| Normal (110) | 16.40±1.53 | 70.9% (78) | 28.2% (22) | 50.0% (39) | 21.8% (17) |
| Overweight (50) | 20.62±1.50 | 74% (37) | 8.1% (03) | 27.0% (10) | 64.9% (24) |
| Obese (15) | 24.98±0.90 | 73.3% (11) | 9.0% (01) | 36.3% (04) | 54.5% (06) |
| Total (210) | 17.39±3.67 | 70% (147) | 23.8% (35) | 41.5% (61) | 34.7% (51) |

PD was most prevailing in the lower age group of 10 to 13 years 75.0%, 71.9%, 70.6% respectively followed with high MPS mean score in the same age group in comparison to higher age group Table5.

| Table 5: Comparison of PD with respect to AOM | | | | | |
|---|---|---|---|---|---|
| AOM (yrs.) | PD Prevalence %(n) | Mild %(n) | Moderate %(n) | Severe %(n) | MPS Mean ±SD |
| 10 ≥ 11 (n=08) | 75.0% (06) | 20.0% (01) | 33.3% (02) | 60.0% (03) | 06.89±2.14 |
| 11 ≥ 12 (n=32) | 71.0% (23) | 33.3% (08) | 47.8% (11) | 21.7% (05) | 06.54±2.04 |
| 12 ≥ 13 (n=102) | 70.6% (72) | 19.4% (14) | 40.2% (29) | 40.2% (29) | 05.61±1.36 |
| 13 ≥14 (n=68) | 67.6% (46) | 26.0% (12) | 43.4% (20) | 30.4% (14) | 05.02±1.26 |
| Total (n=210) | 70.0% (147) | 23.8% (35) | 41.4% (61) | 34.6% (51) | 05.64±2.24 |

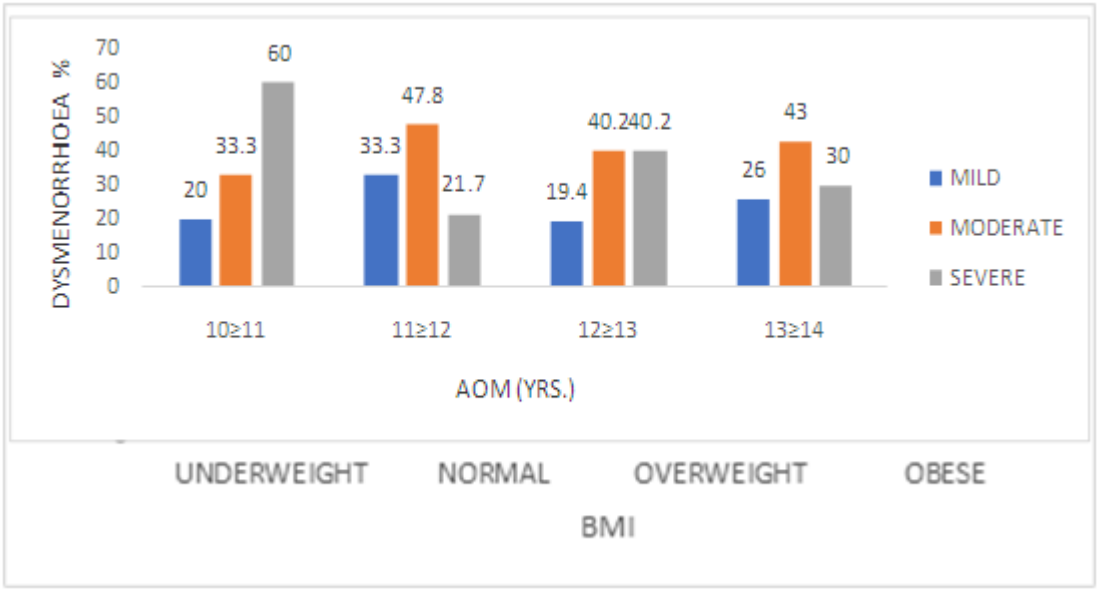
The severity of PD was highest in the overweight and lowest in the underweight participants. Most of the normal weight participants had moderate PD. The difference was found to be statistically significant, $\chi^2$ (6,147) = 28.20, p<0.001 (Figure 1)

**Figure: 1 Severity of PD in different categories of BMI**



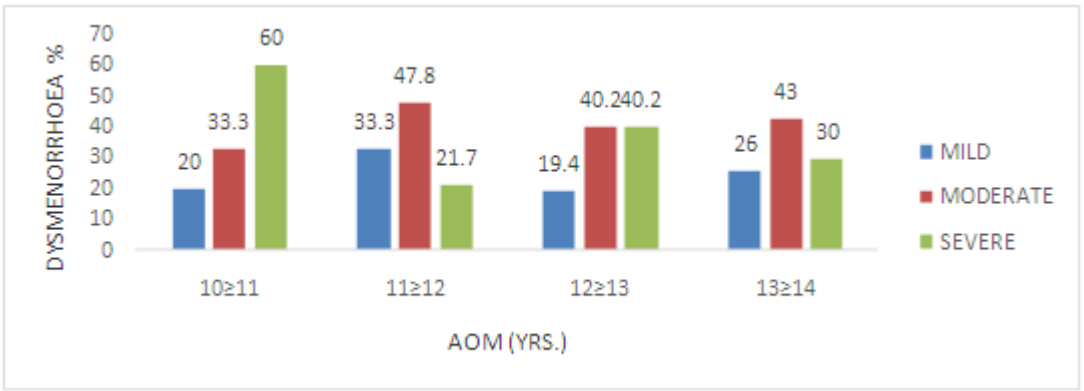

The Mean Pain Score (MPS) of the study group was estimated as 05.64±2.24. MPS of overweight and obese participants was found to be higher than underweight and normal BMI participants and difference was statistically significant, one-way ANOVA F (3,147) =15.97, p<0.001 (Figure 2).

**Fig 2: Mean Pain Score of participants in different BMI categories**




The prevalence, severity and MPS of PD was highest in girls who attained an early menarche (10≥11 yrs.) and gradually reduced as the AOM increased. The percentage of girls suffering from severe PD was higher in the participants who attained menarche earlier ((10≥11 yrs.) as depicted in Table 5 and Fig. 3. but the difference in severity was not statistically significant. $\chi^2(6,147) = 1.41$, p=0.96.

**Fig 3: Comparison of PD in participants of different AOM**




## IV. Discussion:

The prevalence of PD is highly underestimated and difficult to decipher because only a few affected seek medical treatment despite the substantial distress experienced. The reason could be that many consider pain to be a part of the menstrual cycle rather a disorder.[10]This study aimed to determine the prevalence of PD in the school going girls of Gwalior and its relationship with the BMI. The mean age and BMI of the participants was 13±1.34 yrs. and 17.39±3.67kg/m$^2$ respectively. Majority (52.3%) of the participants had a normal BMI while 23.8% were overweight, 7.1% obese and 16.7% underweight.

The percentage of overweight and obese adolescents in our study is lower than a similar study which was done on affluent schools of Gwalior which reported 35.8% and 24.6% overweight and obese respectively.[11]The prevalence of PD was relatively high (70%) in our study and related well with the corresponding values from studies across the globe, ranging from 85% in USA,[12] to 84 % in Italy.[13] Studies from India have reported the prevalence to be 87.87% across India,[14] 70.2% in South India[15]and 65% in Kadapa, a district in erstwhile Andhra Pradesh.[16]This varying prevalence of PD could be attributed to different definitions of the condition and lack of a standard method for assessing the prevalence and severity.[17] It could also be due to varying age groups on which these studies were conducted as the prevalence of PD is higher in late adolescents as compared to higher age groups.[18]

Based on our study 54.03% of the participants suffered from PD every month, 23.90% frequently (once quarterly) while 22.07% suffered rarely (twice annually). Similar results were reported by Shabnam Omidvar et al. study. [19] Majority (41.5%) of the participants described their pain as moderate in our study which is in conjunction to study conducted by Nagori N.et al.[20, 21] Nonetheless, some researchers have found majority of their study population to suffer from mild pain only.[22]

In the present study 34.7% of the participants reported severe pain. The result found is higher than previous study conducted by Harlow SD et.al. , which mentioned 7-15% subjects had severe pain? [18] The reason being, differences in pain perception and expression based on social and psychological factors.[23] The prevalence and severity of PD was higher in obese and overweight participants as compared to normal and underweight and the results were found to be statistically significant [$\chi^2$ (6,147) = 28.20, p<0.001] which is illustrated in Table 4 and Fig 1. Similar results were reported by Gurdeep kaur[24] and RupaVani et al, [25] who found that the higher BMI was associated with higher PD. In contradiction, Chauhan et al.[26] and Nazish Rafique[27] found increased prevalence of PD in underweight females. On the other hand, Khodakarami B et al[28] found the frequency and severity of PD to be higher in the normal-weight group than other subjects. Contrary to all the above studies, Hong Ju et al. found a U-shaped association where both underweight and overweight had higher PD[29] as compared to normal weight individuals while some studies have led to inconclusive results.[30, 31]

The MPS recorded in current study was 5.64±2.24 which is close to that of Heba A, AbuHelwa et al. who reported a MPS of 6.79±2.64.[32] The MPS of overweight and obese participants was higher and the difference was found to be statistically significant, F (3,147) =15.97, p<0.001 as depicted in Fig 2. Post hoc comparison by Bonferroni test indicated that the MPS of underweight (04.33±1.91) and normal (05.02±1.94) was significantly lower than overweight (07.13±1.90) and obese (07.45±2.38). However, no significant difference was found between underweight and normal as well as the overweight and obese participants. Taken together these results suggest that the severity of PD was dependent on the BMI, with higher BMI participants suffering from severe PD while the ones who were underweight or had normal BMI had lesser intensity of PD. It must be underlined here that the BMI should be high to observe the changes as the difference between underweight and normal individuals was not significant. Present study also revealed a strong significant positive correlation between MPS and BMI (r=0.72, $R^2$=0.51, SEE=2.67, p=0.0002, n=147). Similarly, Harlow and Campbell also concluded significant correlation between obesity and dysmenorrhea with more than twofold dysmenorrhea in obese patients compared with others.[33]

The above-mentioned findings can be explained by the endocrine control of menstruation which is a complex mechanism and is associated with body fat and steroid hormones.[34] PD is usually caused due to excessive release of prostaglandins (PG's) $E_2$ and $F_{2\alpha}$, especially PG $F_{2\alpha}$. The PG's induces incoordinate myometrial contractions resulting in potent vasoconstriction of uterine blood vessels[35] ultimately progressing to uterine hypoxia and ischemia as confirmed by Doppler blood flow studies. Pickles et al. first depicted 8-13 times more PG levels in the endometrial fluid of dysmenorrhoeic women and correlated with the intensity of pain.[36] Availability of arachidonic acid, COX and endometrial cellular trauma, are important factors that stimulate prostaglandin production. In uterine tissues, arachidonic acid (precursor of PG's) is usually produced from phospholipids through hydrolysis by the lysosomal enzyme phospholipase $A_2$. Progesterone exerts an important control on the stability of lysosomes; a high level of progesterone tends to stabilize lysosomes, while a declining level unstabilizes it. At the end of the luteal phase of the menstrual cycle the progesterone level declines and therefore there occurs lysosomal instability. Thus, continuing availability of increased arachidonic acid together with the intracellular destruction and trauma accompanying the onset of menstruation stimulates the production of prostaglandins. Most of the production and release of prostaglandins occurs during the first 48 hours of menstrual flow, accounting for the intense pain experienced during the first or second day of menstruation in PD.[5] In our study 42.6% reported onset of PD a day prior, 30% a few hours earlier while 27.4% along with menstruation. Parallel results were revealed by Erenel et al. on adolescent students.[37]

A certain amount of body fat, preferably the gluteo-femoral fat appears to be important to maintain normal ovulatory cycles with exaggerated fat being associated with disruption of the reproductive health. Connections between adipose tissue and reproductive endocrinology are as follows:

1) Adipocytes produce aromatase which converts androgen to estrone and estradiol: Studies have shown that endometrial thickness is influenced by adiposity through its estrogen mediated effects with increased estrogen increasing endometrial proliferation thus increasing $PGF_{2\alpha}$ concentrations.

2) Body weight influences the quality of estrogen produced, with thin females making less potent and obese females making more potent forms of estrogen.

3) Obese female has diminished sex hormone binding globulin (SHBG) thus evolving in an elevated percentage of free serum estradiol, potentially increasing the estrogenic stimulation of the endometrium and prompting proliferation of tissues that increase the PG's particularly PGF2α. All these factors led to conclude that obese females are progesterone deficient, relative to circulating estrogen levels.[38]

4) Farb et al. demonstrated that the expression of COX and other PG's were upregulated in severely obese subjects.[39]

All the above factors elicit that obese females are partly if not completely estrogen dominant which ultimately increases the PG concentration and leads to increased PD. In addition, PG's also lower the threshold for pain perception as type C pain neurons are stimulated by anaerobic metabolites generated by an ischemic endometrium. As the peripheral pain perception is increased, these dysmenorrheic females are at increased risk of other chronic painful conditions throughout the menstrual cycles[17] which severely affects the quality of life, mood and sleep**.** Other factors which may add to PD include increased vasopressin release without concomitant rise in oxytocin levels that produces dysrhythmic uterine contractions leading to uterine hypoxia and ischemia sensitivity of myometrium to rising PG's.[5]

While comparing the PD with AOM in current study, it was found that the prevalence and severity of PD was higher in participants having an early AOM ($10 \geq 11$) and lower in those having a delayed AOM which is depicted in table 5. However, the difference was not found to be statistically significant [$\chi^2(6,147) = 1.41$, p=0.96]. Also, there was an inverse correlation between AOM and MPS (r= -0.65, $R^2$=0.42, SEE=3.67, p=0.06, n=147). Similar results have been reported by Heba A, AbuHelwa et al.[32] where a higher prevalence of PD was present in participants having an early AOM.Another study found AOM<12 yrs. as a risk factor for PD (odds ratio = 1.54, 99% CI: 1.17, 2.04).[40]This can be explained by the fact that increased BMI especially the higher gluteo-femoral fat which is responsible for early AOM in adolescent girls also is a culprit in aggravating the symptoms of PD. Contradictory results were revealed by Kural et al.[41] and Margaret et al.[42] who could not find a correlationbetween AOM and PD and by Patel et al. who found a higher AOM (>14 yrs.) as a risk factor for PD.[43]

Our study delineated tiredness and fatigue (62.7%) as the most commonly associated symptom with PD while nausea and vomiting (23.0%) being the next. The associated symptoms were present either along with menstruation (57%) or a day prior to it (43%). The longer and heavier menstrual flow was associated with higher PD (OR=1.6, 95% CI=1.42-1.88). Coinciding results were found in cross sectional study done on Iranian students.[44] Adipose tissue releases adipokines which cause impaired ovarian function through altering the hypothalamo-pituitary–ovarian axis, resulting in disrupted menstruation. Previous studies suggested that menstrual irregularities are higher in both girls with low and high BMI and having menstrual irregularity has been associated with dysmenorrhea.[29, 45]

## V. Conclusion:

PD is psychologically taxing and leads to physical and emotional morbidity which ultimately disrupts the daily life of adolescent girls**.** The present study establishes a significant association between obesity and PD. Hence there is a need to acknowledge and address the issue of rising adolescent obesity in our community as it is a correctible predisposing factor for PD, given the large proportion of girls getting affected by it.

**Conflict of interest:** Nil

**Limitation:** Family history could not be incorporated as genetic and environmental factors have a role. Level of stress was not taken into consideration as it is a risk factor for PD. As data was collected through self-reported questionnaire, this can have reporting bias.

**Source of funding:** Nil

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