INTERNATIONAL JOURNAL OF BIOASSAYS
ISSN: 2278-778X
CODEN: IJBNHY
ORIGINAL RESEARCH ARTICLE
OPEN ACCESS

Relationship of menstrual disorders with nutritional status of college girls from Bankura District, West Bengal, India.

Malay Kumar Patsa[1,2], Dibya Pal[1], Srimanta Sen[1], Mousumi Ganguly[1], Nirmalya Kumar Sinha[2,3,4], Dulal Chandra Das[5], Sumendev Chakrabortty[6], Monalisa Das[7,8]

[1]Department of Nutrition, Bankura Sammilani College, Bankura, West Bengal, India.
[2]Kankabati Rishi Arabinda Rural Development and Social Welfare Institute, Kankabati, Mataldanga, Pashim Medinipur, West Bengal, India.
[3]Department of Nutrition, Raja Narendralal Khan Women's College, Midnapore, West Bengal, India.
[4]Core Member, Agricure Biotech Research Society, Midnapore, West Bengal, India
[5]K. D. College of Commerce and General Studies, Midnapore, West Bengal, India.
[6]Midnapore Medical College, Midnapore, West Bengal, India.
[7]Dept. of Nutrition & Dietetics, Vidyasagar Institute of Health, Midnapore, West Bengal, India
[8]Dept. of Nutrition, Vidyasagar Institute of Health, Midnapore, West Bengal, India

Received: January 05, 2016; **Revised:** February 12, 2016; **Accepted**: March 21, 2016

Abstract: Menstrual disorders are the most common complaints of the women. This often leads to anxiety, depression and other such psychological problems. The present study was conducted to find out the association of nutritional status with menstrual pattern and menstrual disorders of college girls. This study was employed on ninety-seven female college students (18- 22 years) of Bankura district. A pre-tested, semi-structured questionnaire was used to collect socioeconomic data and information regarding menstrual pattern and disorders. Anthropometric parameters including body mass index (BMI), body fat percentage (PBF), body adiposity index (BAI) was determined and mid-thigh circumference (MTC) was measured of each girls. From this study it was found that the Age at menarche (AAM) of college girls was 12.76±1.32 which was inversely related to the socioeconomic status and some anthropometric parameters like BMI, PBF, BAI, MTC etc. Monthly per capita income (MPCI) was an important determinant of weight (F=4.374; P=0.015), BMI (F=3.414; P=0.037), PBF (F=3.600; P=0.031) among the college girls. Pearson Product Moment Correlation showed that AAM, maternal education, number of sibling, number of family members, MPCI was associated with some anthropometric parameters viz. BMI, MTC, PBF, BAI. Linear Regression analysis showed that among the five factors (viz. AAM, maternal education, number of sibling, number of family members, MPCI) the maternal education and MPCI was the main determining factor for BMI. The prevalence of PMS, dysmenorrhoea and leucorrhoea was 67.01%, 73.20% and 85.57% in this study population. It can be concluded that AAM was inversely related to the anthropometric parameters (BMI, PBF, BAI, MTC) and more than two third of the college students was suffering from different menstrual disorders. U-shaped relationship between BMI and dysmenorrhea clearly focused the influence of body fat on dysmenorrhoea.

Key words: Menstrual pattern, menstrual disorders, college girls, socioeconomic status, nutritional status, anthropometric indices.

Introduction

Menstruation is a normal physiological process and considered a sign of sexual maturation during the adolescence and fertility age of women [1]. Menstrual cycle is the periodic and cyclic shedding of progestational endometrium accompanied by loss of blood [2]. Menstruation may be associated with various symptoms occurring before or during the menstrual flow [3]. The pattern and extent of bleeding during menses and associated symptoms vary among different women [4].

Menstrual disorders are very common especially in late adolescence [5]. It has a substantial impact on female reproductive ability, mental health and ability to perform physical activities [6]. The list of menstrual disorders may range from amenorrhea, irregular cycles and abnormal flow to dysmenorrhoea and premenstrual symptoms (PMS) [7]. This often leads to anxiety, depression and other such psychological problems among the adolescents [8]. The other common gynaecological disorders are leucorrhoea and unusual uterine bleeding which are associated with bodily complaints of weakness, tiredness, exhaustion, multiple aches, and multiple somatic complaints [9,10]. Problems with menstrual pattern may affect nearly seventy-five per cent girls, and are the major cause of recurrent short term absenteeism in female college students [5].

In this background, the present study is a little attempt to evaluate the relationship of the nutritional status on the menstrual pattern and menstrual disorders among college students of Bankura district. The study is absolutely important for its analogy to a significant number of global populations and will focus the health outcome of female.

***Corresponding Author:**
Dr. Malay Kumar Patsa,
Head of the Department,
Department of Nutrition,
Bankura Sammilani College, Bankura,
West Bengal, India.

Materials and Methods

Study are and human participants

The present study was conducted among the college students of 18- 22 years residing at Bankura District. This district is situated between 22° 38' N and 23° 38' N latitude and between 86° 36' E and 87° 46' E longitude. It is one of the seven districts of Burdwan Division in the Indian state of West Bengal. According to the 2011 census, Bankura district has a population of 3,596,292. Bankura has a sex ratio of 954 females for every 1000 males and a literacy rate of 70.95%.

Ethical concerns

The present study was conducted by a registered doctor and it was approved by the Institutional Research Ethics Committee. The researcher explained the study to the potential participants prior to the study. The anonymity of the participants was kept reserved.

Inclusion and exclusion criteria

The study was carried out among ninety-seven randomly selected college girl students during September, 2015 to December, 2015. Students from all the socioeconomic classes were included in this study. The inclusion criteria were (1) the college students residing at Bankura District and (2) age range of the subjects were between 18 and 22 years. Young adult females with a past history of chronic illnesses (i.e. brain disorder, hormonal disorders, polycystic ovarian syndrome etc.) were excluded from this study.

Socio-economic status

The socioeconomic status is assessed by modified Kuppuswami's socioeconomic status scale [11]. This original scale [12] is based on a composite score considering the education and occupation of the head of the family along with monthly income of the family. To bring the income subscale up to date, the scale is revised on the basis of All India Average Consumer Price Index for Industrial Worker [13]. The information regarding monthly income of the family and number of family members was collected from the participants. Monthly per capita income (MPCI) was calculated by dividing the monthly income of the family by the number of family members and it was recorded in Rupees. It was categorized into three groups viz. < Rs.3000, Rs. 3001- 6000 and > Rs. 6000.

Anthropometric Measurements

All anthropometric measurements were made by using the standard techniques [14]. Body weight was measured by a weighing scale (Doctor Beliram and Sons, New Delhi, India) and reading was recorded to the nearest 0.5 kg. Height was measured by Martin's anthropometer and reading was recorded to the nearest 0.1 cm. Mid upper arm circumference (MUAC), neck circumference (NC), waist circumference (WC), hip circumference (HC) and mid-thigh circumference (MTC) were measured with a rigid measuring tape and recorded to the nearest 0.1 cm. The subjects stood erect with abdomen relaxed, the arms at the side and feet together and breathing normally. MUAC was measured at the midline between acromion and olecranon processes of left upper arm [15]. The NC was measured just above the cricoid cartilage [16]. WC was measured at the natural waistline which was approximate midpoint between the lower margin of the last palpable rib and the top of the iliac crest [17, 18]. HC was measured at the widest portion of the buttocks [17, 18]. MTC was measured at the midway between the inguinal crease and the proximal border of the border of the patella, perpendicular to the long axis.

Body mass index (BMI), waist-to-hip ratio (WHR), Waist-to-height ratio (WHtR), Conicity Index (Cindex), Body fat percentage (PBF), Body adiposity index (BAI) and were computed using the following standard equations [19-23]:

BMI (kg/m^2) = Weight (kg) / height^2 (m^2) [19]
WHR = Waist circumference (cm)/hip circumference (cm) [19]
WHtR= Waist circumference (cm)/height (cm) [20]
Cindex = Waist Circumference (m) / [0.109 X √{Body weight (kg) / Height (m)}] [21]
PBF= (1.20 × BMI) + (0.23 × Age) − (10.8 × sex) − 5.4 where sex is 1 for males and 0 for females. [22]
BAI = Hip circumference (cm) / (Height (m) X √Height (m)) – 18 [23]

According to guideline of World Health Organization, the cut-off points for assessing nutritional status by using BMI are Underweight: BMI < 18.5; Normal: BMI =18.5 – 24.9; Overweight: BMI ≥ 25.0 [24]. In case of female the cut-off point for MUAC is <22.0 cm [25]. The cutoff point of WC for female is 88 cm and that of WHR is ≥0.85 [19]. The Cindex value less than 1.18 indicates normal range [21].

Menstrual pattern and disorder

The data was collected by personal interviews on a pre-tested, semi-structured questionnaire. The participants were then asked about the characteristics of their menstruation: age at menarche (AAM), gynaecological age (GA), the cycle length, duration of menses and amount of blood loss as reflected by the number of sanitary pads changed per day during menstruation [26-28]. The information regarding menstrual disorders such as dysmenorrhea, pre-menstrual syndrome (PMS) and leucorrhoea were collected [26, 29].

Statistical analysis

Data processing and statistical analysis were done using the SPSS for Windows statistical software package (SPSS Inc., Chicago, IL, USA 2001). Data

is expressed as means and standard deviations, and group comparison was done using one-way ANOVA. Product moment correlation coefficient (r) between different anthropometric parameters and different demographic parameters were determined. To estimate the relationships among variables, linear regression analysis performed for continuous dependent variables and odd ratio, relative risk was performed for categorical variables. The p value <0.05 is considered statistically significant.

Results

In this study the mean age of the college girls was 19.54±1.23 years (95% CI: 19.30 – 19.79) (Table 1). AAM was 12.76±1.32 years (95% CI: 12.50-13.03 years). AAM was inversely related to the socioeconomic status and some anthropometric parameters like BMI, PBF, BAI, MTC etc. The present study indicated that MPCI was an important determinant of weight (F=4.374; P=0.015), BMI (F=3.414; P=0.037), PBF (F=3.600; P=0.031) among the college girls (Table 2). Pearson Product Moment Correlation was presented in the table 3. It showed that AAM, maternal education, number of sibling, number of family members, MPCI was associated with some anthropometric parameters viz. BMI, MTC, PBF, BAI. Linear Regression analysis showed that among the five factors (viz. AAM, maternal education, number of sibling, number of family members, MPCI) the maternal education and MPCI was the main determining factor for BMI. Table 5 indicated that castes of the girls, number of family members, parent's education was related to AAM. The prevalence of PMS, dysmenorrhoea and leucorrhoea was 67.01%, 73.20% and 85.57% in this study population (Table 6). The symptoms of PMS and the pattern of gynaecological morbidity in relation to nutritional status were presented in Fig 1 and Fig 2 respectively.

Discussion

Age at menarche

In the present study the age at menarche of the college girls were 12.76±1.32 years (95% CI: 12.50-13.03 years). In the previous studies conducted at different countries reported that the AAM is lower among the girls of Mexico [30], France [31] and higher among the girls of Brazil [32], Korea [33], Uganda [34], Ethiopia, [35], Malaysia [36], Kuwait [37], Jordan [38], Nigeria [39], Bangladesh [40], China [41] and Indonesia [42] (Fig. 3). Delayed menarche was associated with an increased risk of diabetic nephropathy and retinopathy [43] while early onset of menarche has been shown to be associated with breast cancer and ischemic heart disease [36] and risky sexual behavior induced sexually transmitted diseases, unwanted pregnancy and its illegal hazardous termination as well as adolescent motherhood [44].

In the present study, college girls from urban areas attained menarche (12.41±1.14 years) earlier than those from rural areas (12.91±1.37 years) (P<0.05) though no statistical significance was observed (t=1.744; P>0.05). But some other studies showed a significant rural urban variation [36]. Students from small-sized families attained menarche earlier than those from larger families (F=4.106; P<0.05), similar result was found in Malaysian girls [36].

We found that the girls reached the puberty at early, medium and late period were 30.93%, 52.58% and 16.49% respectively. It was noticed that the prevalence of PMS, dysmenorrhoea and leucorrhoea were U-shaped relationship with the menarcheal age i.e. higher among the early and late menarche and lower among the medium.

Menstrual pattern and disorders

The present study showed that 8.25% of the girls had abnormal cycle length. But among the university students of Egypt it was reported 16.7% [26]. The college girls having cycle duration more than four days were 51.55%. In our study the menstrual cycle length more than thirty-five days was observed among 6.19% participants. This finding is less than the previous study in central India (13.73%) [3] and Gujjar girls (9.9%) [45]. 19.59% of these girls had abnormal menstrual flow (fluid and clotted). The colour of the menstrual discharge was red (57.73 %), blackish (37.11%) and pale red (5.15%).

The prevalence of dysmenorrhoea among the college girls was 73.20%. This was lower than the previous studies conducted in Saudi (92%) [46] Nigeria (76%) [47], but higher than the studies carried out in Lebanon (63.1%) [48] Ethiopia (72%) [8]. We found that the prevalence of dysmenorrhoea (OR: 3.048) and leucorrhoea (OR: 2.889) were associated with abnormal menstrual cycle.

Socioeconomic status

The participants of the study were divided into three categories according to their socioeconomic status lower middle class (32.99%), upper middle class (37.11%) and upper class (29.90%). The BMI of these three categories were 19.86±2.61, 10.78±3.41 and 21.20±3.29 kg/m^2 respectively (F=1.994; P>0.05). The neck circumference showed a significant increasing trend with the higher economic status (F=3.267; P<0.05). Other anthropometric parameters did not show such relationship with socioeconomic status (P>0.05). No significant relationship was observed between dysmenorrhoea (χ^2=3.085; P>0.05), PMS (χ^2=09.59; P>0.05) and leucorrhoea (χ^2=2.149; P>0.05) with the socioeconomic status. It suggested that the college students were aware about their health and menstrual hygiene

irrespective of their socioeconomic status and they can avail the similar health care facilities.

Nutritional status

From anthropometric assessment, it was found that 31.96% cases were underweight and 8.25% were overweight according to BMI. Among these underweight, normal weight and overweight girls the prevalence of dysmenorrhoea was 80.65%, 68.97% and 75.00% respectively. The odd ratio represented that both the underweight and overweight girls had 1.875 times and 1.35 times more prone to dysmenorrhoea. U-shaped relationship between BMI and dysmenorrheal was revealed from this study. The similar result was found in the study conducted in Australia [49]. The odd ratio suggested that PBF more than 35% had 2.308 times more prone to dysmenorrhoea with a relative risk of 1.187. The study also found that the undernourished girls with MUAC <22 cm had 1.322 times greater risk of dysmenorrhoea. Body fat is an important predictor of dysmenorrhoea. It regulates the activity of steroid hormones and thus the endocrine control of menstruation [49]. Body fat is necessary to maintain normal ovulatory cycles but too much and too little fat being associated with the disruption of their reproductive health [50, 51].

The prevalence of PMS was 67.01% among the college girls. It was less than the prevalence found among university students of Ethiopia [52], Iran [53], Thailand [54] and Nigeria [55] which was 99.6%, 98.2%, 98% and 85.5%, respectively. However, it was higher than the prevalence found among university students of Saudi Arabia [56], college students of Japan [57] which was 35.6% and 43.3%, respectively.

The obesity marker indices of this study viz. PBF >35%, WC >88cm, WHR >0.85, WHtR >0.50 and Cindex >1.18 found that the PMS had greater risk of 3.153, 1.535, 1.587, 1.350 and 1.741 times respectively while the risk of PMS in case of undernourished girls having MUAC <22 cm was 2.681 time.

Conclusion

Detailed investigation reflects more than two third of the college students suffering from different menstrual disorders. AAM was inversely related to the socioeconomic status and some anthropometric parameters like BMI, PBF, BAI, MTC etc. U-shaped relationship between BMI and dysmenorrhea clearly focused the body fat influence the dysmenorrhea. Such study will be implemented in a large scale in the public health program to understand the several attributing factors of menstrual disorder in varied geographical, socio-demographic and economic profiles.

Table 1: Socio-demographic and anthropometric parameters of college students

Parameters	Mean ± sd	95% CI
Age (years)	19.54±1.23	19.30 – 19.79
Age at menarche (years)	12.76±1.32	12.50 – 13.03
Birth order	1.48±0.66	1.35 – 1.62
No of sibling	2.19±0.81	2.02 – 2.35
Family members	4.96±2.04	4.55 – 5.37
Family income	21360.82±15848.20	18166.71 – 24554.94
Per capita income	4709.53±3694.84	3964.86 – 5454.21
Weight (kg)	48.96±7.86	47.38 – 50.55
Height (cm)	155.63±5.60	154.51 – 156.76
Body mass index (kg/m²)	20.23±3.17	19.59 – 20.87
Neck circumference (cm)	30.03±1.63	29.70 – 30.36
Mid upper arm circumference (cm)	24.42±4.20	23.57 – 25.26
Waist circumference (cm)	72.40±10.38	70.30 – 74.49
Hip circumference (cm)	90.55±6.79	89.18 – 91.92
Mid-thigh circumference (cm)	51.05±4.95	50.05 – 52.05
Waist-to-hip ratio	0.80±0.08	0.78 – 0.81
Waist-to-height ratio	0.47±0.07	0.45 – 0.48
Body fat percentage	28.77±3.80	28.00 – 29.54
Conicity index	1.19±0.12	1.16 – 1.21
Body adiposity index	28.72±4.05	27.91 – 29.54

Table 2: Impact of per capita income on the anthropometric parameters of college students

Anthropometric parameters	Monthly per capita income (Rupees)			ANOVA
	< 3000.00 N=35	3001.00–6000.00 N=33	> 6000.00 N=29	
Weight (kg)	47.17±5.79	47.82±7.83	52.43±9.10	F=4.374; P=0.015
Height (cm)	154.58±5.02	156.16±5.29	156.31±6.52	F=0.979; P>0.05
Body mass index (kg/m²)	19.78±2.65	19.60±3.04	21.48±3.59	F=3.414; P=0.037
Neck circumference (cm)	29.73±1.04	29.81±1.77	30.64±1.91	F=3.050; P=0.052
Mid upper arm circumference (cm)	23.83±2.38	24.40±6.30	25.14±2.72	F=0.773; P>0.05
Waist circumference (cm)	72.34±9.56	70.45±8.96	74.69±12.53	F=1.295; P>0.05
Hip circumference (cm)	89.49±5.78	89.15±6.36	93.41±7.70	F=3.915; P=0.023
Waist-to-hip ratio	0.81±0.08	0.79±0.07	0.80±0.09	F=0.454; P>0.05
Mid-thigh circumference (cm)	50.65±4.16	50.14±4.90	52.61±5.71	F=2.125; P>0.05
Waist-to-height ratio	0.47±0.06	0.45±0.06	0.48±0.08	F=1.170; P>0.05
Body fat percentage	28.21±3.13	28.01±3.78	30.31±4.23	F=3.600; P=0.031
Conicity index	1.20±0.12	1.17±0.10	1.18±0.12	F=0.608; P>0.05
Body adiposity index	28.65±3.65	27.75±3.66	29.93±4.70	F=2.294; P>0.05
Age at menarche (years)	13.01±1.30	12.81±1.39	12.41±1.22	F=1.672; P>0.05

Table 3: Correlation between socio-demographic factors and anthropometric parameters of the college students

Anthropometric parameters	Age (year)	AAM (year)	GA (year)	Father's education (year)	Mother's education (year)	Birth order	No of sibling	No. of Family members	Family income	MPCI	SES
Weight (kg)	0.052	-0.179	0.180	-0.037	0.236*	-0.139	-0.260**	-0.211*	0.206*	0.369***	0.131
Height (cm)	0.140	0.153	-0.008	-0.020	-0.142	0.081	-0.028	0.058	0.151	0.043	0.063
BMI (kg/m^2)	-0.014	-0.244*	0.179	-0.029	0.302**	-0.171	-0.247*	-0.230*	0.149	0.359***	0.105
NC (cm)	0.017	-0.144	0.129	-0.010	0.230*	-0.122	-0.238*	-0.286**	0.137	0.325***	0.119
MUAC (cm)	0.052	-0.107	0.124	-0.066	0.132	-0.018	-0.028	-0.096	0.078	0.149	-0.009
WC (cm)	-0.054	-0.152	0.073	-0.092	0.234*	-0.053	-0.265**	-0.262**	0.041	0.251*	-0.043
HC (cm)	0.008	-0.217*	0.173	0.002	0.302**	-0.151	-0.313**	-0.231*	0.158	0.351***	0.111
WHR	-0.081	-0.046	-0.030	-0.124	0.108	0.037	-0.130	-0.209*	-0.080	0.075	-0.147
MTC (cm)	-0.037	-0.238*	0.159	-0.060	0.210*	-0.139	-0.224*	-0.207*	0.072	0.240*	0.056
WHtR	-0.086	-0.187	0.075	-0.086	0.255*	-0.070	-0.242*	-0.259*	0.008	0.232*	-0.055
PBF	0.060	-0.231*	0.224*	-0.028	0.287**	-0.161	-0.236*	-0.238*	0.153	0.361***	0.110
Cindex	-0.097	-0.048	-0.043	-0.097	0.127	0.046	-0.179	-0.211*	-0.096	0.061	-0.159
BAI	-0.077	-0.275**	0.151	0.014	0.344***	-0.173	-0.251*	-0.231*	0.052	0.282**	0.061

Significance level at *P<0.05; **P<0.01; ***P<0.001

Table 4: Linear regression showing the effect of socio-demographic factors (independent variables) on BMI (dependent variables) of the college students

	B	SE	β	t	Sig.	R	R^2	Adjusted R^2	F	Sig.
(Constant)	22.076	3.543		6.231	.000	0.463	0.215	0.171	4.973	0.001
AAM (year)	-.308	.233	-.128	-1.318	.191					
Mother's education (year)	.228	.113	.196	2.013	.047					
No of sibling	-.287	.400	-.073	-.718	.474					
Family members	-.150	.152	-.097	-.985	.327					
MPCI	.000	.000	.234	2.249	.027					

Table 5. Impact of demographic factors on the age at menarche among the college students

	N	AAM (year)	ANOVA/ t test
Type of locality			
Rural	68	12.91±1.37	t=1.744; P>0.05
Urban	29	12.41±1.14	
Caste			
General	68	12.55±1.36	F=3.246; P<0.05
SC	8	12.74±0.95	
ST	4	12.76±0.67	
OBC	17	13.63±1.10	
No. of family member			
3	14	12.08±1.16	F=4.106; P<0.05
4	39	12.60±1.18	
>4	44	13.12±1.39	
No of sibling			
1	14	11.99±1.06	F=2.956; P=0.057
2	59	12.87±1.38	
≥3	24	12.95±1.19	
Mother's Education			
Primary School	6	14.12±1.32	F=2.963; P<0.05
Middle School	10	12.91±1.40	
High School	41	12.46±1.28	
HS	20	13.14±1.19	
UG/PG	20	12.52±1.23	
Father's Education			
Illiterate	2	12.86±1.24	F=2.410; P<0.05
Primary School	2	14.31±1.48	
Middle School	2	15.70±0.14	
High School	16	12.67±1.53	
HS	20	12.68±1.17	
UG/PG	45	12.67±1.24	
Profession/Hons	10	12.56±1.11	
Father's occupation			
Clerical/Shop owner/Farmer	56	12.98±1.43	t=1.919; P=0.058
Service	41	12.46±1.11	
Monthly per capita income			
<3000	35	13.01±1.30	F=1.672; P>0.05
3001 – 6000	33	12.81±1.39	
>6001	29	12.41±1.22	
Socio economic status			
Lower middle class	32	12.96±1.38	F=2.104; P>0.05
Upper middle class	36	12.92±1.36	
Upper class	29	12.35±1.14	

Table 6: Menstrual pattern and disorders among the college students

Menstrual pattern and disorders	Percent
Cycle length (days)	
14 – 20	2.06
21 – 28	54.64
29 – 35	37.11
>35	6.19
Cycle duration (days)	
<2	1.03
2 – 4	47.42
5 – 7	51.55
Peak (days)	
1	10.31
2	85.57
3	4.12
Nature of the menstrual flow	
Fluid	80.41
Fluid and clot	19.59
Colour of the menstrual flow	
Red	57.73
Blackish	37.11
Pale red	5.15
Amount of menstrual bleed	
Normal	82.47
Increased	10.31
Decreased	7.22
Premenstrual syndrome	67.01
Dysmenorrhoea	73.20
Leucorrhoea	85.57

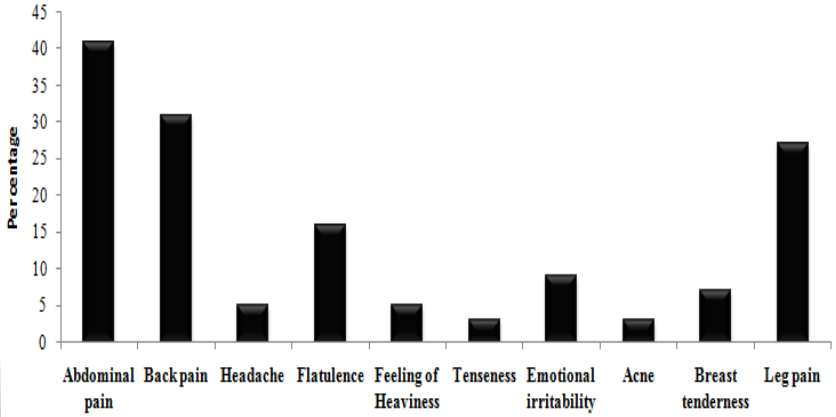

Figure 1: Prevalence of different symptoms of premenstrual syndrome among the college students

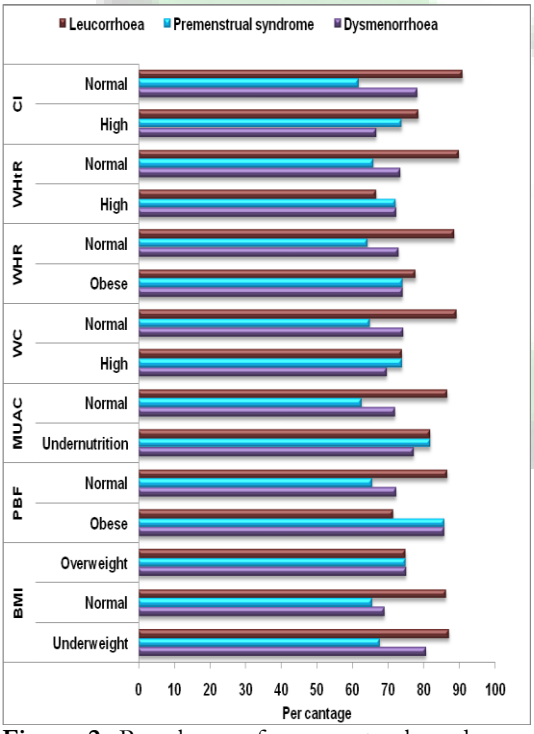

Figure 2: Prevalence of premenstrual syndrome, dysmenorrhoea and leucorrhoea in relation to nutritional status of the college students

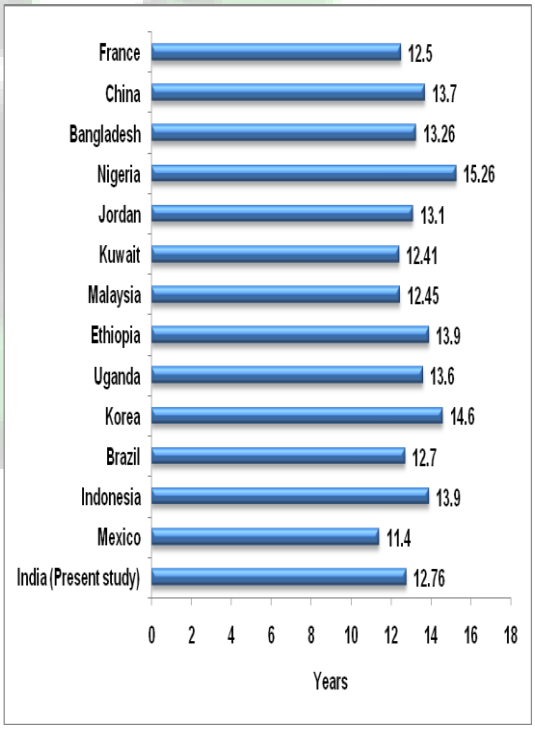

Figure 3: Age at menarche in different countries

References

1. Bayat PD, Ghanbari A, Khazaei M, Ghorbani R, Amiri S: Age at Menarche and Related Factors in Girls of Urban Areas of Markazi (Central) Province of Iran. Int. J. Morphol. 30.1(2012): 15-18.

2. Rajsinh VM, Vaishali RM: Correlates of the menstrual problems among rural college students of Satara district. Al Ameen J Med Sc. 6.3(2013): 213-218.

3. Dambhare GD, Wagh SV, Dudhe YJ: Age at Menarche and Menstrual Cycle Pattern among School Adolescent Girls in Central India. Global Journal of Health Science. 4.1(2012): 105-111.

4. Singh AJ: Place of Menstruation in the Reproductive Lives of Women of Rural North India. Indian Journal of Community Medicine. 31.1(2006): 10-14.

5. Ziv A, Boulet JR, Slap GB: Utilization of physician offices by adolescents in the United States. Pediatrics. 104(1999): 35-42.

6. Kaur S, Jairus R, Samuel G: An exploratory study to assess reproductive morbidities and treatment seeking behaviour among married women in a selected community, Ludhiana, Punjab. Nursing and Midwifery Research Journal. 9.3(2013): 91-88.

7. Campbell M, McGrath P: Use of medication by the adolescents for the management of menstrual discomfort. Arch Pediatr Adolesc Med. 151. 9(1997): 905-912.

8. Zegeye DT, Megabiaw B, Mulu A: Age at menarche and the menstrual pattern of secondary school adolescents in northwest Ethiopia; BMC Women's Health. 9(2009): 29.

9. Tewiri PV, Neelam, Kulkiro MK: A study of lukol in leucorrhoea, pelvic inflammatory diseases and dysfunctional uterine bleeding. Anc Sci Life. 21.2(2001):139-149.

10. Kulkarni RN, Durge PM: A study of leucorrhoea in reproductive age group women of Nagpur City. Indian J Public Health. 49.4(2005): 238-239.

11. Oberai SS: Updating Income Ranges for Kuppuswamy's Socio-Economic Status Scale for the Year 2014, Indian Journal of Public Health. 59.2(2015): 156-157.

12. Kuppuswamy B. Manual of Socioeconomic Status (Urban). 1st ed. Delhi: Manasayan; 1981. p.66-72.

13. Sharma R, Saini NK: A Critical Appraisal of Kuppuswamy's Socioeconomic Status Scale in the Present Scenario. J Family Med Prim Care. 3(2014): 3-4.

14. Lohman, TG, Roche, AF, Martorell, R: Anthropometric Standardization Reference Manual. Human Kinetics Books, Chicago, 1988.

15. Nichols S, Dalrymple N, and Francis M: Use of Anthropometry in Monitoring the Nutritional and Health Status of Persons Living with HIV/AIDS. In: V. R. Preedy, Ed. Handbook of Anthropometry: Physical Measures of Human Form in Health and Disease. New York: Springer; 2012.

16. Polymeris A, Papapetrou PD, and Katsoulis G: An Average Body Circumference Can Be a Substitute for Body Mass Index in Women. Advances in Medicine. 2014. 1-6.

17. WHO. WHO STEP wise approach to surveillance (STEPS). Geneva, World Health Organization, 2008.

18. WHO. Waist Circumference and Waist–Hip Ratio: Report of a WHO Expert Consultation. Geneva, World Health Organ. 2008.

19. Park K 2005. Park's Textbook of Preventive and Social Medicine. 18th Edition. Bhanot, Jabalpur: M/s Banarsidas, pp. 317-318.

20. Peng Y, Li W, Wang Y, Bo J, Chen H: The Cut-Off Point and Boundary Values of Waist-to-Height Ratio as an Indicator for Cardiovascular Risk Factors in Chinese Adults from the PURE Study. PLoS ONE 10(12): e0144539.

21. Flora MS, Mascie-Taylor CGN, Rahman M: Conicity index of adult Bangladeshi population and their socio-demographic characteristics. Ibrahim Med Coll J, 3.1(2009): 1-8.

22. Deurenberg P, Weststrate JA, Seidell JC: Body mass index as a measure of body fatness: age- and sex-specific prediction formulas. Br J Nutr. 65.2(1991): 105-114.

23. Bergman RN, Stefanovski D, Buchanan TA, *et al.,*: A better index of body adiposity. Obesity. 19.5(2011):1083–1089.

24. WHO: Physical status: the use and interpretation of anthropometry. Technical Report Series no. 854, Geneva: WHO, (1995).

25. James WPT, Mascie-Taylor CGN, Norgan NG, Bristrian, BR, Shetty, Ferro-Luzzi A: The value of arm circumference measurements in assessing chronic energy deficiency in Third World adults. Eur. J. Clin. Nutr. 48(1994): 883-894.

26. Nooh AM: Menstrual disorders among Zagazig University Students, Zagazig, Egypt. Middle East Fertility Society Journal 20(2015): 198–203.

27. Begum J, Hossain AM, Nazneen SA: Menstrual Pattern and Common Menstrual Disorders among Students in Dinajpur Medical College. Dinajpur Med Col J. 2 .2(2009): 37-43.

28. Amaza DS, Sambo N, Zirahei JV, Dalori MB, Japhet H and Toyin H: Menstrual Pattern among Female Medical Students in University of

Maiduguri, Nigeria. British Journal of Medicine & Medical Research. 2.3(2012): 327-337.

29. Das DC, Sinha NK, Patsa MK, Das M: Investigation of herbals for the treatment of leucorrhoea from south West Bengal, India. International Journal of Bioassays. 4.11(2015): 4555-4559.

30. Marván ML, Catillo-López RL, Alcalá-Herrera V, Del Callejo D: The decreasing age at menarche in Mexico.J Pediatr Adolesc Gynecol. (2016) pii: S1083-3188(16)00181-9.

31. Lalys L, Pineau JC: Age at menarche in a group of French schoolgirls. Pediatr Int. 56.4(2014): 601-614.

32. Gomes MB, Negrato CA, Calliari LE: Brazilian Type 1 Diabetes Study Group. Early age at menarche: a risk factor for overweight or obesity in patients with type 1 diabetes living in urban areas? Diabetes Res Clin Pract. 107.1(2015): 23-30.

33. Baek TH, Lim NK, Kim MJ, Lee J, Ryu S, Chang Y, Choi Y, Park HY: Age at menarche and its association with dysglycemia in Korean middle-aged women. Menopause. 22.5(2015): 542-548.

34. Odongkara Mpora B, Piloya T, Awor S, Ngwiri T, Laigong P, Mworozi EA, Hochberg Z: Age at menarche in relation to nutritional status and critical life events among rural and urban secondary school girls in post-conflict northern Uganda. BMC Womens Health. 14(2014): 66.

35. Ayele E, Berhan Y: Age at menarche among in-school adolescents in Sawla Town, South Ethiopia. Ethiop J Health Sci. 23.3(2013):189-200.

36. Hossain MG, Wee AS, Ashaie M, Kamarul T. Adult anthropometric measures and socio-demographic factors influencing age at menarche of university students in Malaysia. J Biosoc Sci. 45.5(2013): 705-717.

37. Al-Awadhi N, Al-Kandari N, Al-Hasan T, Almurjan D, Ali S, Al-Taiar A: Age at menarche and its relationship to body mass index among adolescent girls in Kuwait. BMC Public Health. 13(2013):29.

38. Bata MS: Age at menarche, menstrual patterns, and menstrual characteristics in Jordanian adolescent girls. Int J Gynaecol Obstet. 119.3(2012) :281-183.

39. Tunau KA, Adamu AN, Hassan MA, Ahmed Y, Ekele BA: Age at menarche among school girls in Sokoto, Northern Nigeria. Ann Afr Med. 11.2(2012): 103-107.

40. Hossain MG, Islam S, Aik S, Zaman TK, Lestrel PE: Age at menarche of university students in Bangladesh: secular trends and association with adult anthropometric measures and socio-demographic factors.J Biosoc Sci. 42.5(2010): 677-687.

41. Graham MJ, Larsen U, Xu X: Secular trend in age at menarche in China: a case study of two rural counties in Anhui Province. J Biosoc Sci. 31.2(1999): 257-267.

42. Sohn K. Biological standards of living: age at menarche vs height. Ann Hum Biol. (2016):1-7.

43. Harjutsalo V, Maric-Bilkan C, Forsblom C, Groop PH; FinnDiane Study Group. Age at menarche and the risk of diabetic microvascular complications in patients with type 1 diabetes. Diabetologia. 59.3(2016): 472-480.

44. Gumanga SK, Kwame-Aryee RA. Menstrual characteristics in some adolescent girls in Accra, Ghana. Ghana Med J. 46.1(2016): 3-7.

45. Dhingra R, Kumar A: Knowledge and Practices Related to Menstruation among Tribal (Gujjar) Adolescent Girls. Ethno-med. 3.1(2009): 43-48.

46. Hasanein N, Mohamed Diab S: Menstrual Disorders and Hygienic Self Care Practices among Adolescent Girls in Preparatory year at Al-Jouf University. IOSR Journal of Nursing and Health Science. 4.3(2015).

47. Olowokere EA, *et al.,:* Menstrual disorders: The implications on health and academic activities of female undergraduates in a federal university in Nigeria. Journal of Nursing Education and Practice. 4.5(2014).

48. Karout N, *et al.,:* Prevalence and pattern of menstrual disorders among Lebanese nursing students. EMHJ. 18.4(2012).

49. Ju H, Jones M, Mishra GD: A U-Shaped Relationship between Body Mass Index and Dysmenorrhea: A Longitudinal Study. PLoS ONE. 10.7 (2015): e0134187.

50. Frisch RE: The right weight: body fat, menarche and ovulation. Bailliere's Clinical Obstetrics and Gynaecology. 4.3(1990): 419–439.

51. Frisch RE, McArthur JW: Menstrual cycles: fatness as a determinant of minimum weight for height necessary for their maintenance or onset. Science (New York, NY). 185.4155(1974):949–951.

52. Tenkir A, Fisseha N, Ayele B: Premenstrual syndrome: prevalence and effect on academic and social performance of students in Jimma Uniersity, Ethiopia. Ethiop J Health Dev. 17.3(2003):181-188.

53. Nourjah P: Premenstrual syndrome among Teacher Training University students in Iran. J Obstet Gynecol India. 58.1(2008): 49-52.

54. Thu M, Diaz EO, Kapaw S: Premenstrual syndrome among female university students in Thailand. AU J T. 9.3(2006):158- 162.

55. Antai AB, Udezi *et al.,:* Premenstrual syndrome: prevalence in students of the University of Calabar,

Nigeria. African Journal of Biomedical Research. 7(2004): 45 -50.

56. Balaha MH, Amr MM, Moghannum MA, Muhaidab NA: The phenomenology of premenstrual syndrome in female medical students: a cross sectional study. Pan African Medical Journal. (2010) 1-14.

57. Fujiwara T, Nakata R: Young Japanese college students with dysmenorrhea have high frequency of irregular menstruation and premenstrual symptoms. The Open Medical Informatics Journal. 1(2007): 8-11.

Cite this article as:
Malay Kumar Patsa, Dibya Pal, Srimanta Sen, Mousumi Ganguly, Nirmalya Kumar Sinha, Dulal Chandra Das, Sumendev Chakrabortty, Monalisa Das. Relationship of menstrual disorders with nutritional status of college girls from Bankura District, West Bengal, India. *International Journal of Bioassays* 5.4 (2016): 4515-4523.

Source of support: Nil
Conflict of interest: None Declared