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Original Article

Relationship between Some Anthropometric Parameters with Menarche and Dysmenorrhea among Adolescents Secondary School Girls in Kano Metropolis, Nigeria

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ABSTRACT

Dysmenorrhea (painful menstruation) is throbbing, aching cramps in the lower belly which can strike right before and during menstruation. Most adolescents experiencing dysmenorrhea have primary dysmenorrhea, i.e. without pelvic pathology. The study aimed to determine the relationship between some anthropometric parameters with menarche and dysmenorrhea among adolescent secondary school girls in Kano Metropolis. A total of 1141 secondary school girls participated in the study: 742 students from public school and 399 from private school. A convenient study was conducted on students aged 11 – 19 years old. Relevant data were collected through a self-administered questionnaire after which some anthropometric measurements, including weight, height, waist circumference, and hip, determine the relationship between body mass index, hips-to-waist ratio and percentage of circumference, triceps skin fold, thigh skin fold, supra iliac skin fold and subscapular skin fold were done. The mean age at menarche was 13.51±1.18 years, the mean menarcheal age of students from public school was 13.75±1.25 years, while the mean menarcheal age of students from private school was 13.08±0.9 years. The prevalence of dysmenorrhea was 77%, with 43% mild pain, 25% moderate pain, 7% severe pain and 2% worst pain. In conclusion, menarcheal age showed a significant positive correlation with age, total body fat, and body mass index and an inverse correlation with weight, hip circumference and waist circumference; subjects with higher body mass index, waist circumference, and percentage of body fats have a higher incidence of dysmenorrhea.

Keywords: dysmenorrhea, menarche, body mass index, percentage body fats

INTRODUCTION

Menarche, a crucial maturity indicator used to evaluate a pubertal female's developmental status, is the term for a woman's first menstrual period. (Amaza *et al*., 2012). Menarche, the first menstrual period, is only a single event in the transition to the reproductive capability that occurs at puberty; however, it is the most dramatic and therefore, more easily remembered than thelarche and puberache (Sulayman *et al*., 2013). The mean age at menarche varies from population to population and reflects various population characteristics such as nutritional status, geographic location, environmental conditions and socioeconomic status of the society (Aribo *et al.,* 2015). Typically, menarche strikes most females between the ages of eight and fourteen. (Sulayman *et al*., 2013; Yermenchanko and Dvornyk 2014; Aribo *et al*., 2015). The menarche age showed decline in western countries and the United States (Parent *et al*., 2003; Hermen, 2006; Lee *et al*., 2011) and six months every ten years in developing nations (Adesina & Peterside, 2013; Yamenchenko and Dvornyk 2014). This finding has been explained by the increase in the population's standard of living (Al-Awhadi *et al*., 2013; Eteudo *et al*., 2015). Improve living standard is linked to increased fat storage from a healthy diet, health improvement, and psychological variables that may activate the hypothalamic-pituitary-ovarian axis and cause menarche to begin (Anikwe *et al*., 2020). These factors contribute to a rise in body fat reserves and, consequently, the Leptin level that initiates menstruation (Ahrens *et al*., 2014).

Studies have shown that menarcheal age is declining in Nigeria, which is linked to improvements in the country's population's social, physical, nutritional, and economic well-being (Anikwe *et al*., 2020). The mean

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menarcheal age s recorded were 13.7years in Sokoto State, 13.9 years in River State, 13.4 years in Edo State, 13.6 years in Maiduguri, 13.08 years in Ile-Ife, 13.55 years in Kumana Cheifdom, Kaduna State and 14 years in Ibadan (Abubakar *et al*., 2011; Panti *et al*., 2011; Tanko *et al*., 2016; Tijjani *et al*., 2019). The word dysmenorrhea is derived from the Greek words, "dys" meaning difficult, "meno" meaning month, and "rrhea" meaning flow (Chauhan and Kala, 2012). Dysmenorrhea present as throbbing, aching cramps in the lower belly which can strike right before and during menstruation and can range from mild to severe pain (Nazario, 2020). Primary dysmenorrhea is not a sign of any underlying disorder but part of normal menstruation process andusually peaks between 20 and 24 years of age (Selente *et al*., 2018). Pathological disorders in the reproductive organs cause secondary dysmenorrhea, the pain tends to get worse over time and it often lasts longer than normal menstrual cramps, the pain may begin a few days before a period starts and may get worse as the period continues and may not go away after it ends (Pamplet, 2020).

According to various research dysmenorrhea disrupts, the educational and social life of women, especially young girls. Due to dysmenorrhea, absenteeism (28-48%) and perceived quality-of-life losses are prevalent among adolescent girls (Esimai and Esan, 2010; Sulayman *et al*., 2013). In the United States, dysmenorrhea is recorded to be the most signiicant cause of time lost from work and school (Esimai and Esan, 2010). In Nigeria, the prevalence of dysmenorrhea varies greatly and ranges between 42.5% in Kano State, 51 % in Enugu State and 71.8% in Kwara State among adolescent girls (Onu *et al*., 2020; Rabiu *et al*., 2019; Saka *et al.* 2018). Some studies (Docanto *et al*., 2015; Muzaffet *et al*., 2017) have reported an association between body mass index (BMI) and the severity of dysmenorrhea. Dysmenorrhea is highly prevalent in girls who eat fast food most of the time (Fujiwara, 2009; Negi *et al*., 2018).

MATERIALS AND METHOD

Materials

The materials used were weighing scale, stadio meter, skinfold calliper, measuring tape, and a questionnaire.

Research Participant

The subjects that participated in the study were adolescent girls (11-19) years, from public and private secondary schools in the Kano metropolis. Kano Metropolis consist of 8 Local Governments Areas: Dala, Fagge, Gwale, Kano Municipal, Kumbotso, Nasarawa, Tarauni and Ungogo.

Methodology

Participants (students) were adolescent school girls between eleven and nineteen years old willing to participate in the survey. The data were obtained through self-administered questionnaires and two well-trained female research assistants carried out the anthropometric measurements on participants. The anthropometric measurements were done and read twice independently, and the mean of the two measurements was taken as the actual value to reduce observation errors. The questionnaire consists of questions designed to determine menstrual disorders among adolescent girls in the Kano metropolis. Some of the information obtained on menstruation included (the number of period days, the number of pads used per day, *etc.*).

The degree of pain was measured using a numeric pain rating scale (NPRS). The NPRS consists of 11 numbers ranging from 0 for no pain to 10 for the worst pain. The participants marked the correct number that best describes their pain (0 no pain, 1-3 mild pain, 4-6 moderate pain, 7-9 severe pain, 10 worst pain) (Amita *et al*., 2008).

Sample size determination

The sample size was obtained using the formula: ($n = z^2pq/d^2$) (Naing *et al*., 2006)
Where:
n = the desired sample size per local government area
z = the standard normal deviation, usually set at 1.96 (≈ 2.0)
p = the proportion in the target population (when no estimate 50% is used; i.e. 0.5)
q = 1.0 - p
d = degree of accuracy desired, usually set at 0.04
Therefore, $n = (1.96)^2(0.5)\ (0.5)/\ (0.05)^2 = 384$
A total of 1141 respondents were used; 768 were from public schools, and 399 were from private schools.

Anthropometric Measurements

The anthropometric adiposity indices were calculated using the following anthropometric measurement as described by Lohman *et al.* (1988)

a. **Height:** standing with bare feet, vertically in midline from heel to vertex (the topmost position of the head) to the nearest 0.1cm

b. **Weight:** the subject was barefooted and lightly dressed. Weight was taken to the nearest 0.1 kg.

c. **Waist circumference (WC):** distance at the level of the narrowest point between the lower costal rib boarder and the iliac crest. It was measured perpendicular to the long axis of the trunk (cm).

d. **Hip circumference:** the distance at the level of the greatest posterior protuberance of the buttocks and perpendicular to the long axis of the trunk (cm).

e. **Skin fold:** standing in an upright position, a fold of skin was raised and subcutaneous tissue firmly between the thumb and forefingers away from the underlying muscle at the marked site 4 skin fold were measured; thigh skin fold, triceps skin fold, subscapular skin fold and supra iliac skin fold.

The following adiposity indices: body mass index (BMI), waist-to-hip ratio and percentage of body fat were derived from the above parameters using the following formulas:

Body mass index (BMI) = $\frac{Weight\ (kg)}{Height\ (m)}$

Waist-to-hip ratio (WHtR) = $\frac{Waist\ circumference(m)}{Hips\ circumference\ (m)}$

% of body fat = (0.29669 × sum of skin fold) - (0.00043 × sum of skin fold^2) + (0.02963 × age) + 1.4072

Ethical Approval

Ethical approval was obtained from the Ahmadu Bello University Committee on Use of Human Subjects for Research (ABUCUHSR) with issue number ABUCUHRS/2021/29 and also from the Kano State Education Board with reference number KSSSMB/GEN/VOL/082. Additionally, permission from the Principal of each school and consent to participate in the study from the subject parents/guardians was obtained.

Statistical Analysis

Data was expressed as mean ± standard deviation (SD). Pearson's correlation was used to examine the relationship between anthropometric measurements and menarcheal age. One-way ANOVA was used to compare the means of anthropometric parameters and dysmenorrhea. An Independent t-test was used to compare means of public and private school. Pearson's Chi square was used to determined categorized data. $p < 0.05$ was deemed statistically significant. Statistical Package to the Social Sciences (IBM SPSS *v* 26.0) for Windows was used for data analysis.

RESULTS

Descriptive statistics of the entire sample population of secondary school girls are shown in Table 1, From the table the mean age and mean ± SD menarcheal age of all the respondent are (16.19±1.59) years and (13.51±1.18) years respectively. Also from the table the minimum age at menarche of the respondent in this study is 9 years and the maximum age at menarche is 17 years.

Table 1: Descriptive statistics of the study population

Variables	Mean ± SD (n=1141)	Minimum	Maximum
Age (yrs)	16.19±1.59	11.00	19.00
Weight (kg)	45.49±6.61	27.80	75.00
Height (cm)	158.16±8.24	163.0	172.50
BMI (kg/m^2)	15.8±0.08	16.0	31.37
HC (cm)	34.09±2.62	27.00	45.00
WC (cm)	29.27±2.28	20.00	37.00
HWR	0.86±0.05	0.67	1.00
ThSF (mm)	21.01±5.24	7.10	36.80
TrSF (mm)	15.62±5.51	4.40	34.00
SSF (mm)	15.72±6	6.50	43.00
SISF (mm)	18.83±11.22	5.40	202.00
Sum of SF (mm)	70.66±18.86	31.40	128.50
Percentage BF (%)	19.79±2.04	15.64	23.51
Menarche Age (yrs)	13.51±1.18	9.00	17.00

n=1141, HC=Hip circumference, WC=Waist circumference BMI=Body Mass Index, HWR=Hips to waist ratio, ThSF=Thigh Skin fold, TrSF=Triceps Skin fold, SSF=Subscapular Skin fold, SISF=Suprailiac Skin fold, PBF=Percentage Body fats

Table 2 compares the mean age, menarcheal age and anthropometric measurement of the Kano metropolis's public and private school students. The mean age of students in public schools is significantly higher than that of students in private schools. Results from the table also show a significant difference in the menarcheal age, BOF, and BOM of the students of public and private schools. Public school students' mean anthropometric parameters are higher than those of private schools $p < 0.05$. However, there was no statistically significant difference in the anthropometric parameters except height and percentage body fats.

Table 2 Comparison of variables between public and private schools in the study population

Variables	Public Schools (n=742)	Private Schools (n=399)	T	*P*
Age (yrs)	16.9±1.32	14.86±1.14	27.240	0.000
Weight (kg)	45.60±6.5	45.29±6.81	0.779	0.436
Height (cm)	158.55±5.7	157.45±11.55	2.156	0.031
BMI (kg/m^2)	18.12±2.23	18.07±2.39	0.318	0.751
HC (cm)	34.13±2.54	34.03±2.75	0.635	0.525
WC (cm)	29.31±2.31	29.21±2.22	0.702	0.483
HWR	0.86±0.05	0.86±0.05	0.029	0.977
ThSF (mm)	20.92±5.43	21.18±4.86	-0.810	0.418
TSF (mm)	15.58±5.58	15.7±5.39	-0.335	0.738
SSSF (mm)	15.83±6.28	15.52±5.44	0.852	0.394
SISF (mm)	18.58±6.14	19.3±17.04	-0.807	0.420
SSF (mm)	70.92±19.42	70.18±17.79	0.650	0.516
PBF (%)	21.18±0.68	17.2±0.86	80.128	0.000
MA (yrs)	13.75±1.25	13.08±0.9	10.411	0.000

n=1141, mean ± SD, Independent sample t-test *=*p*<0.05 when public school was compared to private school. HC=Hip circumference, WC=Waist circumference BMI=Body Mass Index, HWR=Hips to waist ratio, ThSF=Thigh Skin fold, TrSF=Triceps Skin fold, SSF=Subscapular Skin fold, SISF=Suprailiac Skin fold, PBF=Percentage Body fats, MA= Menarche Age.

Table 3: Correlations matrix of the study population

	Age (yrs)	Weight (kg)	Height (m)	BMI (kg/m^2)	HC (cm)	WC (cm)	HWR	PBF (%)	Menarche Age
Age (yrs)	1	-0.015	0.013	0.014	0.031	-0.008	-0.048	0.666**	0.279**
Weight (kg)		1	0.346**	0.348**	0.808**	0.683**	-0.121**	0.128**	-0.089**
Height (m)			1	1.000**	0.229**	0.244**	0.036	0.056	-0.020
BMI (kg/m^2)				1	0.231**	0.245**	0.036	0.060*	-0.020
HC (cm)					1	0.709**	-0.338**	0.131**	-0.092**
WC (cm)						1	0.418**	0.124**	-0.080**
HWR							1	-0.005	0.001
PBF (%)								1	0.260**
Menarche Age (yrs)									1

n=1141, Pearson's correlation, *=p<0.05, **=p<0.01, HC=Hip circumference, WC=Waist circumference BMI=Body Mass Index, HWR=Hips to waist ratio, PBF=Percentage Body fats

Table 4: Prevalence of dysmenorrhea of the study population

Dysmenorrhea	Frequency	Percentage
No pain	260	23%
Mild pain	491	43%
Moderate pain	285	25%
Severe pain	81	7%
Worst pain	24	2%
Total dysmenorrhea	881	77%

n=1141 Frequency and percentages, Pearson's Chi-square, X^2= 80.923, p= 0.000

Table 5 presents the result of the influence of anthropometric parameters on dysmenorrhea in the study population. There is a statistically significant higher weight among the students having severe pain and worst pain group when compared to those having mild and moderate pain. Also, there is a statistically significant higher height among students in the worst pain group compared to those in mild and moderate pain groups. There is a statistically significant higher waist and hip circumference among students in severe pain and worst pain groups when compared to those in mild pain and moderate pain groups. There is a statistically significant higher percentage of body fats in students in group of worst pain compared to those in the group for mild and moderate pain.

Table 5 Dysmenorrhea and anthropometric parameters of the study population

Variables	No Pain (n=253)	Mild (n=491)	Moderate (n=285)	Severe (n=81)	Worst (n=24)	F	*P*
Weight (kg)	44.76±6.74	45.19±5.62	45.32±5.9	48.72±10.77^{abc}	50.23±8.78^{abc}	9.531	0.000
Height (m)	155.99±13.83	158.82±5.56	158.76±5.55	158.34±6.07	159.94±3.86^{abc}	5.981	0.000
BMI (kg/m^2)	15.6±0.14^{bc}	15.9±0.06	15.9±0.06	15.8±0.06	16.0±0.04	6.012	0.000
HC (cm)	33.92±2.42	33.96±2.28	33.89±2.47	35.74±4.34^{abc}	35.5±2.96^{abc}	11.355	0.000
WC (cm)	29.19±2.37	29.00±2.09	29.23±2.14	30.59±2.13^{abc}	31.31±3.86^{abc}	14.457	0.000
HWR	0.86±0.05	0.86±0.05	0.86±0.05	0.86±0.06	0.88±0.07	2.671	0.310
PBF (%)	19.78±2.10	19.68±2.00	19.77±2.03	20.17±2.11	21.01±1.60^{abc}	3.421	0.009

n=1141, , mean ± SD, one-way ANOVA, *Tukey post hoc* test, * **a=**p<0.05 when compared to no pain, and **b=**p<0.05 when compared to mild, **c=**p<0.05 when compared to moderate, and **d=**p<0.05 when compared to severe. HC=Hip circumference, WC=Waist circumference BMI=Body Mass Index, HWR=Hips to waist ratio, ThSF=Thigh Skin fold, TrSF=Triceps Skin fold, SSF=Subscapular Skin fold, SISF=Suprailiac Skin fold, PBF=Percentage Body fat

Table 6 presents the result of the influence of anthropometric parameters on dysmenorrhea of public school students of the study population. There is a statistically significant higher weight of students in group of worst pain when compared to those in severe pain group, mild group, moderate pain group and no pain group. There is statistical significant higher height of students in group of mild pain when compared to those in no pain group. There is statistical significant higher BMI of students in group of worst pain when compared to those in severe pain group, mild group, moderate pain group and no pain group. There is statistical significant higher HC of students in group of worst pain when compared to those in mild group, moderate pain group and no pain group. There is statistical significant higher WC of students in group of worst pain when compared to those in mild group, moderate pain group and no pain group. There is statistical significant higher percentage body fats of students in group of severe pain when compared to those in mild group, moderate pain group and no pain group.

Table 7 presents the result of the influence of anthropometric parameters on dysmenorrhea of

private school students of the study population. There is a statistically significant higher weight of students in the group of worst pain compared to those in the severe pain group, mild group, moderate pain group and no pain group. There is a statistically significant higher BMI among students in the severe pain group compared to those in the mild pain group, moderate pain group and no pain group. There is a statistically significant higher WC of students in the severe pain group compared to those in the mild pain group, moderate pain group and no pain group.

There is a statistically significant higher HC among students in the severe pain group compared to those in the mild pain group, moderate pain group and no pain group. There is statistically significant higher body fat among students in the severe pain group compared to those in mild, moderate, and no pain groups.

Table 6: Dysmenorrhea and anthropometric parameters of public school respondents in the study population

	No Pain (n=140)	Mild (n=378)	Moderate (n=153)	Severe (n=51)	Worst (n=20)	F	*P*
Weight (kg)	45.06±6.83	45.3±5.53	45.55±6.08	47.39±9.94	50.35±7.97^{abc}	4.488	0.001
Height (m)	1.57±0.06	1.59±0.06^{a}	1.59±0.06	1.58±0.06	1.6±0.04	2.902	0.021
BMI (Kg/m^2)	18.17±2.3	17.91±2.08	18.06±2.07	18.82±2.93^{b}	19.6±2.58^{abc}	4.499	0.001
HC (cm)	34.0±0.02	34.0±0.02	34.0±0.02	35.0±0.04^{bc}	36.0±0.03^{abc}	4.426	0.002
WC (cm)	29.0±0.02	29.0±0.02	29.0±0.02	31.0±0.02^{abc}	32.0±0.04^{abc}	11.373	0.001
HWR	0.86±0.05	0.85±0.05	0.87±0.05	0.88±0.06^{b}	0.88±0.08^{b}	5.108	0.001
PBF (%)	2.13±0.09	2.1±0.05^{a}	2.12±0.07	2.17±0.04^{abc}	2.16±0.03^{b}	14.269	0.001

n=742, mean ± SD, one-way ANOVA, *Tukey post hoc* test, *=p<0.05 **a=**p<0.05 when compared to no pain, and **b=**p<0.05 when compared to mild, **c=**p<0.05 when compared to moderate, and **d=**p<0.05 when compared to severe. HC=Hip circumference, WC=Waist circumference BMI=Body Mass Index, HWR=Hips to waist ratio, PBF=Percentage Body fats

Table 7 Dysmenorrhea and anthropometric parameters of private schools respondents in the study population

Variables	No Pain (n=95)	Mild (n=168)	Moderate (n=102)	Severe (n=20)	Worst (n=4)	F	p
Weight (kg)	44.34±6.32	44.86±5.84	45.19±5.71	50.42±11.97	49.6±14.02^{abcd}	5.541	0.000
Height (m)	154.07±2.18^{bcd}	158.26±5.51	158.96±5.53	158.13±6.54	159.50±3.32	2.789	0.026
BMI (Kg/m^2)	16.29±2.33	17.91±2.22	17.87±2.07	19.94±3.13	19.50±5.42	1.601	0.173
HC (cm)	33.86±2.44	33.77±2.4	33.84±2.48	36.6±4.57^{abc}	34.25±3.86	7.608	0.000
WC (cm)	29.02±2.29	29.12±2	29.08±2.28	30.63±2.24^{abc}	30.00±4.24	3.657	0.006
HWR	0.86±0.05	0.86±0.04	0.86±0.05	0.84±0.05	0.87±0.04	1.222	0.301
ThSF (mm)	21.05±5.66	20.6±4.74	21.02±4.13	25.08±3.56^{abc}	23.58±1.76	6.004	0.000
TrSF (mm)	15.98±5.54	15.12±5.1	15.25±4.94	19.74±5.96^{abc}	14.65±9.18	5.197	0.000
SSF (mm)	15.82±5.37	14.63±4.71	15.38±6.01	20.12±5.43^{abc}	14.95±6.03	6.975	0.000
SISF (mm)	24.27±33.06	16.62±5.19^{a}	17.98±5.9	22.89±4.38	20.43±5.49	3.646	0.006
Sum of SF (mm)	70.74±20.11	66.96±15.09	69.63±17.35	87.83±16.08^{abc}	73.6±17	9.610	0.000
PBF (%)	17.22±0.75	17.06±0.84	17.31±0.97	17.59±0.73^{c}	17.44±0.68	3.315	0.011

n=399, mean ± SD, one-way ANOVA, *Tukey post hoc* test, *=p<0.05 **a=**p<0.05 when compared to no pain, and **b=**p<0.05 when compared to mild, **c=**p<0.05 when compared to moderate, and **d=**p<0.05 when compared to severe. HC=Hip circumference, WC=Waist circumference BMI=Body Mass Index, HWR=Hips to waist ratio, ThSF=Thigh Skin fold, TrSF=Triceps Skin fold, SSF=Subscapular Skin fold, SISF=Suprailiac Skin fold, PBF=Percentage Body fats

DISCUSSION

Besides genetics, menarche is influenced by socioeconomic and environmental factors. Race, BMI, geography, nutritional habits, and exercise affect menarcheal age (Karapanou and Papadimitriou, 2010). The average age at menarche among secondary school girls is 13.51 ± 1.18 years in the present study. Similar findings were found in Nsukka 13.44 years (Nwanko *et al*., 2016), Maiduguri 13.6 years (Panti *et al*., 2011), 13.08 years in Ile – Ife (Tijani *et al*., 2019), 13.7 years in Sokoto (Abubakar *et al*., 2011) which is higher than that of Zaria 12.53±1.48 years (Sulayman *et al*., 2013), this may be due to sociocultural and environmental differences. There was a statistically significant increase in the mean menarcheal age of students in private schools compared to those in public schools; this could be explained by the better socioeconomic status of students in private schools than public school ones, and the majority of the public school students trek a long distance (reported in the questionnaire) to school every day which is stressful and may contribute to delay in menarche.

Menarcheal age showed a significant positive relationship with total body fat, and BMI and an inverse correlation with weight, HC, and WC. Frish and Revelle (1970) proposed critical body weight

and weight gain for the onset of menarche. Our result was against the critical weight hypothesis; this is similar to a study conducted by Okasha *et al*. (2009), where weight and BMI were negatively correlated with menarcheal age. It is also similar to a study conducted by Pramanik *et al*. (2015), where menarcheal age correlated negatively with weight and BMI and positively with total body fats. High waist circumference and hip circumference means there is excess fat located in the intra-abdominal region (visceral fats) (Seagle *et al*., 2013), which acts as endo-neurocrine stimulants in menarche (Frish and Ravelle, 1970).

According to this study, the prevalence of dysmenorrhea is 77% and falls within the global range of 16% to 91% (Ju *et al*., 2014; Abuhelwa *et al*., 2018). The prevalence is close to 78.9 % in India (Varghese et al., 2019) and similar to the 72% findings by Hossain *et al*. (2011). The prevalence of dysmenorrhea in this study was significantly higher compared to 42.5% in Kano State (Rabiu *et al*., 2019); this may be due to the increase in breakfast skipping (were 80% of the current study skipped breakfast). Fujawara (2003) found that young women who skip breakfast have a significantly higher degree of dysmenorrhea due to excess intake of confectionary and sweet drinks containing artificial sweeteners (Johson and Frary, 2001).

Dysmenorrhea was a significant problem in our study population, with 881 (77%) of respondents reporting various degrees of menstrual pain, 491 (43%), 285 (2%), 81 (7%), and 24 (2%) respondents suffered from mild, moderate, severe and worst pain respectively. In this current study, 9% of girls with dysmenorrhea described it as severe and worst. It is similar to the study of 10–20% severity found by (Sharma *et al*., 2014). This is lower than the figures found in earlier studies, which were 38% (Dissi and Mahmud, 2019) and 22% (Abdelmoty *et al*., 2015). The differences in the degree of pain severity may be related to cultural differences in pain perception, the absence of a universally accepted method of defining dysmenorrhea and individual variability in pain threshold. In this study, we found that being underweight may increase the risk of dysmenorrhea; however, being overweight and obese might not be associated with dysmenorrhea. The mean BMI of all the dysmenorrhea groups falls within underweight, which also explains the incidence of dysmenorrhea and underweight in these students. The findings by Cinar *et al.* (2021), Mohapatra *et al.* (2016), Khalid *et al*. (2020), and Wu *et al*. (2022) is in line with our finding regarding underweight and dysmenorrhea. Our results contradict those of Dash et al. (2016), Singh et al. (2015), and Akunna et al. (2020), who reported there was no relationship between dysmenorrhea and BMI. A study conducted by Patsa *et al*. (2016) indicates that there is a U-shaped relationship between BMI and dysmenorrhea, where both underweight and overweight are prone to dysmenorrhea. However, in another study, the frequency of dysmenorrhea in the obese group was higher than that of the underweight group (Hirata *et al*., 2002). In a study conducted by Khodakarami *et al*. (2015) and Jeevitha *et al*. (2019), the frequency of dysmenorrhea in the normal-weight group was higher than in others.

Concerning the waist and hip circumference, the severity of dysmenorrhea is seen in the group with the highest mean of hips and waist circumference. These results contradict those of Akunna et al. (2020), in which pain is seen in the group with a smaller hip-to-waist ratio. The mean percentage of body fats shows an increased severity of pain as the body fats increase. An increase in fat deposit in the body may cause an increase in prostaglandin secretion, a fat-secreting hormone that causes an increased uterine contraction. This is similar to a study conducted by Stachon (2016).

In conclusion, results of the study show earlier maturation of those in private schools when compared to those in public schools. Menarcheal age showed a positive correlation with age, total body fat, BMI and an inverse correlation with weight, HC and WC. Dysmenorrhea was a significant problem in our study population, with (77%) of respondents reporting various degrees of menstrual pain. Subjects with higher BMI, waist circumference, and body fats have a higher incidence of dysmenorrhea.

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