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AGE AT MENARCHE: DIET AND PHYSICAL ACTIVITY

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Two thousand and seventeen girls of aged 10-14 years from schools of city of Mumbai and Pune were selected to examine association between dietary pattern and physical activity with age at menarche (AAM). These parameters were assessed through General Questionnaire and 24 hour dietary record. Physical activity index was developed as a cumulative factor of intensity*duration*frequency and tested in two experimental groups-girls who had Attained Menarche (AM) recently at the time of data collection and perimenarcheal girls (PM). The results showed that mean intakes of all nutrients were notably higher in the PM group compared to AM group. Statistically significant correlation of energy (p-value < 0.01) and fat intake (p-value < 0.05) with age of onset of menarche was found, suggesting role of energy dense and fat rich foods in impacting menarcheal age through modulation of body composition. Observations on physical activity revealed the mean physical activity index of PM group was much higher than AM group. There was statistically significant difference in the means of physical activity index with p-value 0.000 which is significant at 0.01 level.

Keywords: Age, Age at menarche, Diet, Physical activity

INTRODUCTION

Achieving menarche is a milestone in a girl's life as it signifies the beginning of reproductive capacity (Karapanou and Papadimitriou, 2010). Menarche is a transitional health outcome that influences the future health of the girl. Early onset of menarche has been reported to be a strong risk factor for breast cancer, pelvic inflammatory disease, spontaneous abortion and ischemic heart disease. In contrast, delayed menarche can influence the reproductive function and is associated with high of irregular menstrual cycles and low peak bone mass (Hossain *et al.*, 2014).

A recent multiple linear regressions study as part of the Indian Human Development Survey of 91394 ever-married women (aged 15-49 years) in India reported mean age at menarche as 13.76 years in 2005. The northern, central and western parts of India showed comparatively higher average

age at menarche compared to the states in north-east, south and east. This nationally representative survey which compared mean age at menarche at different timelines, estimated a lowering of nearly one month per decade indicative of a secular decline in age at menarche in Indian women (Pathak *et al.*, 2014).

Various genetics and environmental factors interact with each other and influence the age at menarche (Hossain *et al.*, 2014). Study done by Karapanou and Papadimitriou (2010) estimated drop in the age at menarche during most of the 20th century was about 3 months per decade which was attributed to striking improvement of socioeconomic status and general health of the populations in the Western countries. Nutrition has always been considered a major influential factor in pubertal growth period. Intake of nutrients and storage in the body during childhood can

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affect the age at menarche. The mechanism of action may involve hormones such as leptin, insulin, and growth factors such as Insulin-like Growth Factor I (IGF-I), all of which are implicated in the regulation of growth and maturation. Chronic energy undernutrition can result in delayed menarche while overnutrition (as evidenced by high BMI) has been reported to be associated with early onset of menses. Although overall nutritional status promotes menarche, several independent dietary components have also been implicated in the age at menarche. Although there is inconsistent evidence, factors such as low fibre and monounsaturated fatty acid intake, increased intake of calcium, animal protein, animal fat, have been linked to early menarche. Effect of diet on onset of menarche has been studied extensively, under nutrition and low body fat, or an altered ratio of lean mass to body fat; seem to delay the adolescent spurt and to retard the onset of menarche whereas obesity and high body fat percentage is positively correlated to early attainment of puberty (Begum, 2000).

Along with energy intake, the energy expenditure has been considered as an essential factor influencing the age at menarche. Increased participation in sports activities is linked with delayed menarche, while increased physical inactivity, such as television watching, is linked with early menarche. A cross sectional study performed in a group of Colombian university women demonstrated that age at menarche was positively associated with at least 2 hours daily physical activity (Chavarro, 2004).

A number of western studies have been conducted in the past and present times to understand the complexity of this phenomenon; however studies in India have been limited. Since menstrual health is of utmost importance in a female's reproductive career and future health, it was considered to be a worthwhile effort to conduct a study on this topic. The study was therefore undertaken with the following objectives:

- To record age of menarche in the given population.
- To study their food consumption pattern and physical activity.
- To correlate age of menarche with diet and physical activity of girls in the age group of 10-14 years.

MATERIALS AND METHODS

This was action research approved by Inter System Biomedica Ethics Committee, Kasturba Health Society, Vile

Parle (W), in which combination of the retrospective and prospective methods were used.

Selection of the Sample

School girls in the age group of 10-14 years (5th-8th standard) from various schools of two important metro cities in Maharashtra namely Mumbai and Pune were selected for the study. After obtaining formal consent from the respective school principals a preparatory talk in different sessions was given to them. In this they were introduced to physiological and anatomical changes taking place during puberty, the onset of menarche and the menstrual cycle. Based on the girls and their parental willingness to participate in the study finally 2017 subjects were enrolled for the study.

Tools of Data Collection

Screening Questionnaire

This included the date of birth as well as date of menarche if it was recently attained. Based on menarcheal date, the subjects were divided into two groups, those who had recently Attained Menarche (AM), and those who had not attained menarche and hence were Peri-Menarcheal (PM).

24 Hour Diet Record

24 hr diet record is a useful tool to gain information on the girls' dietary pattern. 24 hr diet record form was given to subjects along with directions to fill the record sheet. Also they were instructed to enter the recipes consumed in a day including their meals and tiffins along with its quantities and ingredients as far as possible. However, the amounts mentioned were based on approximation and not accurate.

Physical Activity

Physical activity of the participants with its duration and frequency was recorded. Physical activity index was developed. Subject's intensity scores were devised on the basis of calories expended per hour for that activity as given by Mudambi and Rajagopal (2007) and Oxford Food and Fitness Dictionary (2012). Accordingly the calorie expended per hour in moderate walking is 139, cycling 165, basketball 240, moderate swimming 242, moderate dancing 183, etc. Hence, intensity scores for walking were allotted as 1, cycling as 2, dancing as 3, swimming as 4, basketball as 4, etc. The intensity scores (Table 1) along with duration of physical activity and frequency together were used to calculate the physical activity index for each sample.

Table 1: Duration of the Activity along with its Frequency was with Allotted Scores

Duration		Frequency	
Time	Score	Frequency	Score
Less than 30 minutes	1	Twice/day	6
30 minutes	2	Daily	5
45 minutes	3	Alternate days	4
1 hour	4	Twice/week	3
1 ½ hour	5	Weekly	2
More than 2 hours	6	Once in 15 days	1

The formula is given as follows:

Physical Activity Index = (Intensity Factor)* (Duration)* (Frequency)

RESULTS AND DISCUSSION

Out of the total 2017 subjects, 370 (18%) had Attained Menarche (AM) in the recent period when they were recruited for this study whereas 1,647 (82%) girls had not attained their menarche (PM).

The mean age of the study population was 11.59 yrs±1.114 wherein maximum girls were of 12-13 yrs age and minimum girls were in the category of below 10 and above 14 yrs of age with only 3 girls of 8 yrs 13 girls of 9 yrs.

Mean age of AM group girls was 12.35 yr±1.009 and PM group was 11.42 yr±1.065. Age at Menarche: The mean age at menarche of the sample (n = 274) was 12.16 yrs±1.132. Almost 50% students had age of menarche between 11-12

Table 2: Age Wise Distribution of Mean Menarcheal Age

Age (years)	N	Mean ± SD
10 yr	8	10.18 yrs ± .139
11 yr	27	11.07 yrs ± .698
12 yr	108	11.61 yrs ± .872
13 yr	100	12.79 yrs ± .697
14 yr	31	13.55 yrs ± 648
Total	274	12.16 yrs ± 1.132

yr, 36.5% of students were between 12-13 yrs and 12% of the girls had age at menarche above 13 yrs of age.

From the above table it is evident that 143 out of 274 (52.18%) girls had attained their menarche before they were 12 yrs of age. This is a significant finding which substantiates the changing trend in today's Indian society so far as lowering of menarche is concerned. Out of the total population 10% of the girls had attained menarche at age 11 which is very concerning.

Age at Menarche and Nutrient Intake

In the present study information data regarding nutrient intake was collected only from 1223 subjects out of the total study population of 2017 subjects, using the 24-hr dietary record. The carbohydrate, protein, fat and total energy intake were calculated using the food value tables (ICMR, 2009). The mean intake of the above-mentioned nutrient intakes are presented in Table 3:

Table 3: Mean Nutrient Intake for Both Groups

Nutrients	AM Group		PM Group	
	N	Mean ± SD	N	Mean ± SD
Energy (kcal)	212	1215 ± 297.46	1011	1320 ± 267.78
Carbohydrates (gm)	212	167.81 ± 49.92	1011	179.51 ± 42.60
Proteins (gm)	212	36.24 ± 10.53	1011	39.49 ± 10.33
Fats (gm)	212	50.03 ± 17.63	1011	51.39 ± 13.85

As observed from the above Table 3, mean intakes of all the nutrients are notably higher in the PM group compared to AM group. Thus it appears that perimenarcheal girls were better nourished.

Analysis of the data of the present study population showed statistically significant correlation of energy (p-value < 0.01) and fat intake (p-value < 0.05) with age of onset of menarche suggesting role of energy dense and fat rich foods in impacting menarcheal age through modulation of body composition.

The mean fat intake of the study population was much higher than the RDA prescribed by the Expert Group of the Indian Council of Medical Research (2009), i.e., approximately 35-45 grams/day indicating that visible dietary fat contributed to a substantial contribution to the overall energy intake throughout the day.

Studies have shown that delayed menarche is a sign of malnutrition and as nutritional status improves, the age at

Table 4: Correlation Between Age at Menarche and Nutrient Intake

Nutrients	Pearson Correlation		
	N	Pearson Correlation Coefficient	Sig. (2-tailed)
Energy (kcal)	169	.201**	0.009
Carbohydrates (gm)	169	0.095	0.219
Proteins (gm)	169	0.091	0.241
Fats (gm)	169	.160*	0.038

menarche is lowered drastically (Abioye-Kuteyi, 1997; and Acharya, 2006).

Under nutrition subsequently leading to poor health have been considered as reason for the late onset of menarche as well, late onset of menarche can be attributed to low dietary intake of carbohydrate fats and proteins and overall poor health (John, 2008). Meyer *et al.* (1990) reported that higher dietary energy intake was associated with earlier menarche.

Some studies in the past have also shown, to the contrary, that higher intakes of carbohydrate in girls aged 6-15 y were associated with a later timing of menarche (Kissinger, 1997; and Cheng, 2010).

Protein intake has also been found to have a significant contributory effect on age at menarche. Gunther (2009) reported that a higher total protein intake in girls is associated with the early attainment of menarche. Some other researchers have suggested that greater intake of milk or milk-related nutrients such as calcium, protein, or fat have contributed to earlier menarche (Berky, 2000; and Chevalley, 2005). It has also been suggested that milk may be related to its contribution to somatic growth and other mechanisms related to reproductive maturation or it may act via a common pathway such as IGF1 pathway as IGF is involved in somatic growth and reproductive maturation (June, 2003). Studies have also reported that non vegetarians tend to attain menarche at an early age as compared to vegetarians (Bagga and Kulkarni, 2000). Our study could not generate findings which are substantiating this theory. The reason could be lack of authenticity in reporting dietary information as well as lack of repetitive attempts to collect this data by the researchers. It would therefore be worthwhile to study the dietary intake in

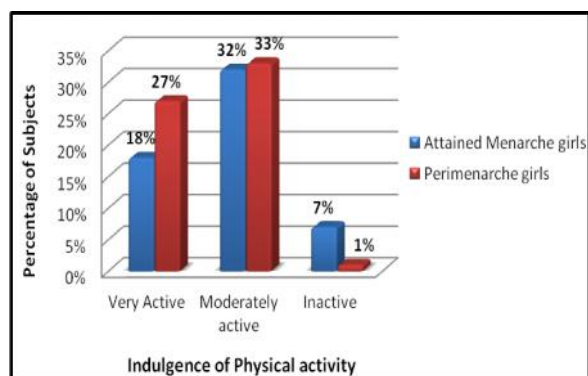
greater detail using a 3 or 7 day food record validated by a food frequency questionnaire to obtain a better insight in this aspect.

Physical Activity

When physical activity of our study population was recorded, based on the response obtained from participants from both groups it was observed that overall 8% were totally inactive. In both groups more or less equal (32-33%) girls were moderately active but percentage of very active girls in PM group was much higher (27%) than (18%) in AM group (Figure 1).

Majority of the girls were found to be indulging in multiple activities followed by walking and then dance. Number of students in other sport or physical activities was comparatively less (Figure 1).

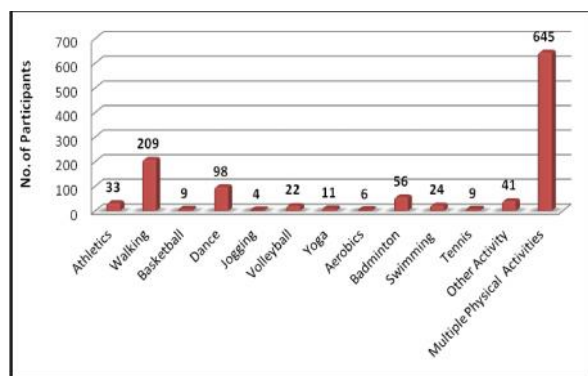
Figure 1: Indulgence in Physical Activity



Types of Physical Activities

When duration and frequency of physical activity was

Figure 2: Type of Physical Activity



tested, it was observed that duration as well as frequency was better observed in PM group compared to AM group (Figure 2).

Duration in Minutes

Physical activity index was developed for purpose of calculating total amount of activity of the study group for the whole day. This was cumulative score of intensity factor (depending on the type of activity)*duration*frequency. The means of the physical activity index of both groups were as follows (Table 5):

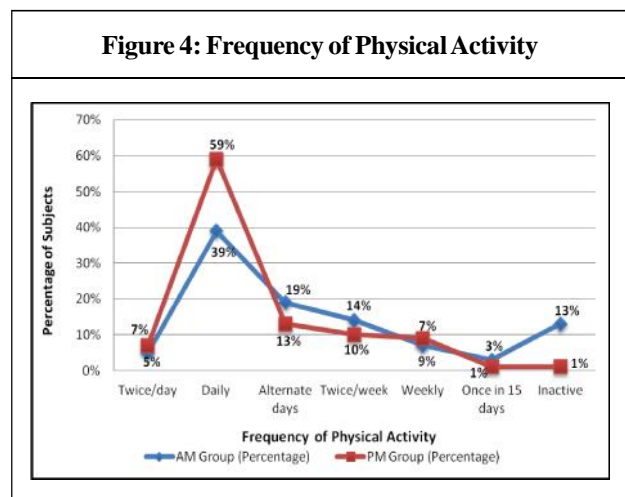
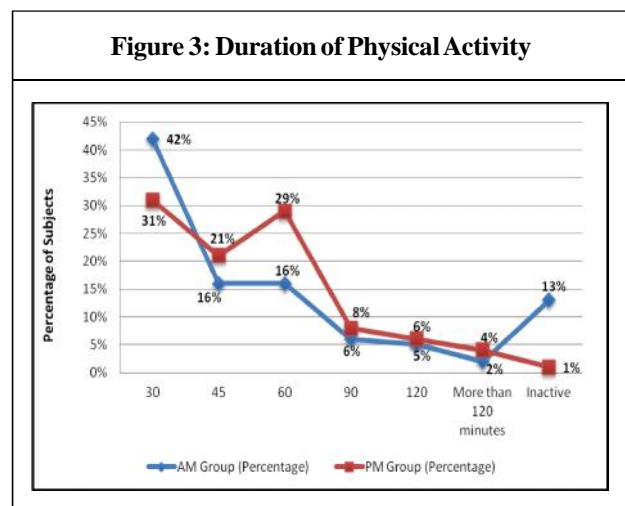


Table 5: Mean Physical Activity Index of Both Groups

Parameter Tested	AM Group		PM Group	
	N	Mean ± SD	N	Mean ± SD
Physical Activity Index	205	15.22 ± 17.32	1003	23.16 ± 22.27

As is evident from the table, mean physical activity index of PM group is much higher than AM group or to put it in different words girls indulging in more physical activity reach their menarche later. When these means of two groups were statistically tested there was statistically significant difference with p-value 0.000 which is significant at 0.01 level (Table 6).

Table 6: Correlation of Physical Activity Index of Both Groups

Parameter Tested	Levene's Test for Equality of Variances		Pearson Correlation		
	F	Sig.	t	df	Sig. (2-tailed)
Physical Activity Index	14.6	0	-4.81	1206	0

Our findings are in congruence with many studies conducted in the past in this field. A cross sectional study performed in a group of Colombian university women demonstrated that age at menarche was positively associated with the practice of at least 2 hours daily physical activity (Chavarro, 2004). The most probable explanation for delay in menarcheal age of swimmers is that the normal body fat composition of swimmers balances the negative hypothalamic effect on GnRH pulsatile exerted by intensive exercise (Karapanou and Papadimitriou, 2010). Merzenish *et al.* (1993) noted that the increased sport activity is associated with delay in the age at menarche. It may be the vigorous exercise, intense physical and mental stress which delays the menarche. Girls who indulge in moderate physical activity, averaging more than 600 kcal of energy expenditure in activity per week through participation in two or more hours per week in activities like aerobic exercise classes, swimming, jogging or tennis, are significantly more likely than less active girls to have a normal menarcheal age and less risk for breast cancer (Bernstein *et al.*, 1987).

CONCLUSION

Thus, to conclude, the present study has tried to explore various determinants of age at menarche in the Indian population specifically the school girls from Maharashtra. In our study population, positive effect of anthropometry was observed which was proved with appropriate statistical tests resulting in high statistical significance. Our findings are suggesting that girls who mature early and who are well nourished attain their menarche earlier.

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