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RESEARCH ARTICLE

Correlation of Anthropometry and Nutritional Assessment with Menstrual Cycle Patterns

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ABSTRACT

Aim: The objective of this study was to create awareness about the significance of the various anthropometric measurements and nutritional status on menstrual cycle and to evaluate and scrutinize the association between various anthropometric measurements like body mass index (BMI), mid-upper arm circumference (MUAC), waist–hip ratio, triceps skin-fold thickness with menstrual cycle patterns.

Materials and methods: Three hundred adult females belonging to age group between 18 years and 24 years studying in Ramaiah Health Institutions were included. The questionnaire was forward to the subject and relevant details elicited. Anthropometric assessment and thorough general physical examination (GPE) were done and categorized into various groups as per the standards proposed by the World Health Organization (WHO).

Results: Out of the 300 subjects, 61.3% belonged to total normal weight, 22.9% underweight and 15.8% overweight. 83.7% belonged to the upper class and 16.3% upper middle class. The mean age of menarche was 12.77 years. The prevalence of irregular menstrual cycle was 35.7%. The prevalence of pubertal menorrhagia was 23.7%. Total 22% had high waist circumference and 2.9% high waist to hip ratio. According to the mid upper arm circumference, 3.7% were malnourished and 31.3% over-nourished Amongst those with a normal BMI, 62.8% had normal menstrual cycle length and amongst them, 37.2% had a longer menstrual cycle. 74.3% had dysmenorrhea. 60.3% of the women had abnormal BMI in which 8.7% were underweight and 51.6% overweight. 74.3% had dysmenorrhea. Less than 36% had an irregular menstrual cycle.

Conclusion: Women have to maintain normal BMI and engage in regular physical activity to regulate their menstrual cycle which is a determinant of women's health. Findings of the present study have greater value for irregular menstruation.

Clinical significance: Most of the parameters analyzed were statistically significant and have derived the implications that both *nutrition* and *anthropometry* play an important role in regulating the menstrual cycle patterns.

Keywords: Anthropometry, BMI, Cross sectional study, Irregular menstruation, Nutrition.

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INTRODUCTION

Menstrual cycle is a sign of women's health. In recent years, there is an escalation of menstrual disorders in both developing and developed countries. Various variables may influence the length and regularity of menstrual cycles. Studies have shown that menstrual cycle abnormalities may be associated with stress, physical exercise, body weight, and endocrine disturbances.[1] Obesity has been an issue amongst adults and is increasingly growing amongst the youth. Obesity in childhood and early adult life increases the risk of irregular menstrual bleeding during the reproductive years,[2] as well as the risk of subsequent anovulatory infertility.[3]

Several cross-sectional studies indicate 30–47% of overweight and obese women have irregular menstruation.[4,5] These menstrual irregularities in obese women correlate with an increasing BMI.[6] Women who are underweight or too lean because of injudicious dieting or excessive athletic activity experience disruption of their reproductive ability. It is now well documented that moderate weight loss in the range of 10–15% of normal weight for height, unassociated with anorexia nervosa where weight loss is in the range of 30% below ideal weight results in amenorrhea.[7]

Anthropometric measurements in the youth have a significant relation with menstrual irregularities, conditions causing infertility, adult adiposity,[8] and other comorbid conditions,[9] which may be curbed in the present state itself. Correlating both the menstrual abnormalities and anthropometry we get a rough estimate about the hormonal status of the women.

Studies have been done on the correlation between anthropometric measurements and menstrual irregularities, but not in significant numbers to cause a shift in health

trends. Nutritional assessment in the female population and its relation to menstrual pattern abnormalities lead to our current predicament and are the cause of the present study. This study aimed to create awareness about the significance of the various anthropometric measurements and nutritional status on menstrual cycle and to evaluate and scrutinize the association between various anthropometric measurements like BMI, MUAC, waist–hip ratio, triceps skin-fold thickness with menstrual cycle patterns.

MATERIALS AND METHODS

This is a prospective cross-sectional study conducted among early adult females attending the colleges of Ramaiah University, Bengaluru, Karnataka, India, belonging to age group between 18 year and 24 years studying professional courses of MBBS, BPT, Nursing, BDS and pharmacy. This study was approved by the institutional ethics committee. Those with organic diseases were excluded from the study. Taking the study carried out by Deshpande et al.[1] as a statistical reference, it was proposed to include 290 girls, which would provide nearly 30 girls in the less than 18 BMI, 90 in the over 25 BMI and rest in the normal BMI levels. In this study, 300 women were surveyed

The study instrument used was predesigned, pretested, semistructured questionnaire, properly calibrated digital weighing scale, properly calibrated height scale, properly calibrated measuring tape, properly calibrated Vernier caliper with high precision.

The project was done under written informed consent from the subjects. The questionnaire was forward to the subject containing their personal details, menstrual history, related family history, dietary history, last hormonal assay history, and any medication history. The details were elicited through interview technique. On examination, the subject was checked for other signs like hirsutism, galactorrhea, acanthosis nigricans, acne, dry and coarse skin.

Anthropometric assessment: Weight was measured in kilograms to the next highest number to decrease any bias. Height was measured in centimeters to the next highest 0.5 cm. MUAC and waist and hip circumferences were measured in centimeters. Waist-hip ratio and triceps skin-fold thickness were measured according to the procedure described by Jelliffe et al.[10] BMI was also recorded. BMI calculated as a ratio of weight (kg)/(height in meters).[2] Acute markers of nutrition like weight for age and weight for height was also calculated and done using properly calibrated standard instruments which were kept uniform for all the subjects to avoid any calibration or instrumental errors. All the anthropometric measurements were categorized into various groups as per the standards proposed by the WHO.

Three hundred questionnaires were completed, and data from these were entered in microsoft excel and analyzed using statistical package for the social sciences (SPSS) version 22. All the quantitative variables like age were expressed in terms of mean and standard deviation. All the qualitative variables like personal details, menstrual history, related family history, dietary history, last hormonal assay history, and any medication history, etc. were expressed in terms of proportion. A Chi-square test of significance was employed to find out if there was any association between various factors. A p value of less than 0.05 was considered as statistically significant.

RESULTS

The study was conducted from 30th April to 30th June 2016. A total of 300 women in the age group of 18 to 24 were recruited for the study.

Part 1: Sociodemographic Profile

The first part of the questionnaire dealt with the basic details of the participants like age, place of residence, education, religion, diet, and socioeconomic class.

Mean age of the study participants was 21.05 years with a highest of 23.3% at 21 years and lowest of 9.7% at 24 years. Nearly 39.7% were localities and 60.3% were hostilities; 28.7% were studying MBBS, 16.7% BDS, 24% BPT, 11% nursing and 19.7% pharmacy; 63.7% were Hindus, 18.3% were Muslims, and 18% were Christians. About 39.7% were vegetarians and 60.3% nonvegetarians. The consumption of nonvegetarian per week varied and 50.3% consumed nonvegetarian lees than once a week, 24% once a week, and 14% twice a week, 3.7% thrice a week, 0.7% four times a week and 0.3% five times a week. A total of 20.7% had junk food for three times a week, 27.7% for four times a week, 18.3% for 5 times a week, 29% for six times a week and 4.3% for seven times a week. 83.7% belong to the upper class, and 16.3% belong to the upper middle class using the modified Kuppuswamy's classification.

Part 2: Menstrual History

- *Pubertal history:* Mean age of menarche was 12.77 years pubertal menorrhagia at menstruation was present in 23.7%.
- *Analysis of the previous six menstrual cycles:* Cycle length was highly variable. 0.7% of women had 2-day cycles. About 66.7% of women had 3–5 days cycles, and 31.3% of women had a cycle for more than seven days. About 65.3% of women had regular menstrual cycles. Flow duration varied from 2 to 9 days. Pads used though subjective is an indirect indicator of blood loss. A total of 20% women used three pads, 29% women used four pads, 17.7% women used 5 pads, 29% women used

six pads and 4.3% of the women used seven pads per day during their menstrual cycle. About 20.7% passed clots during their menstrual cycle; 25.7% of women had pain during their menstrual cycle. Out of these women, 51.7% had very negligible pain, 38% had mild pain, 8% had moderate pain, and 2.3% had very severe pain. Among the women with pain, the duration of pain varied. 49% had pain for 1 day, 39% had pain for two days, 11.3% had pain for three days and 0.7% had pain for 4 days. Abdominal pain was noticed in 64.7%, back pain in 42.7% and thigh pain in 52.3%. 50.3% of the women had the symptom of fatigue; 48.7% noticed breast tenderness; 27.3% had a feeling of nausea during their menstrual cycle and in them, 19% of women had episodes of vomiting, and 72.7% did not feel nauseous during their menstrual cycle. Mood changes were observed in 21%, cold intolerance in 27.3%, concentration problems in 13.7%; hoarse voice change in 5%, laziness in 7%, bowel and bladder problems 44%, acne in 21.9% and dry skin in 20.3%.

Part 3: Analysis of Family History

The family history of obesity, polycystic ovary syndrome (PCOD), diabetes, and cancer was seen in 17%, 12.3%, 23.7% and 7.7% of the cases respectively.

Part 4: Analysis of Anthropometry

Table 1 shows the percentage distribution of the subjects according to their BMI in kg/m^2. Nearly 39.7% had normal BMI and 2.3 % had BMI greater than 40.

Table 2 shows the percentage distribution of subjects according to their various anthropometric determinants. By waist circumference 22%, by waist–hip ratio 2.9%, by mid arm circumference 31.3%, by triceps skinfold thickness 35.3% were found to be high risk respectively.

Part 5: Analyzing Associations

The next part of the study was to elicit the association between the anthropometry, nutritional status, and menstrual cycle patterns.

Table 1: Percentage distribution of the subjects according to their BMI in kg/m^2

BMI	*Percentile distribution*
< 18.5	8.7
18.5–23.99	39.7
24–30	30.3
31–5	10.7
35–40	8.3
> 40	2.3

Taking waist–hip ratio and triceps skinfold thickness as a sensitive indicator for anthropometry and using BMI as the indicator for nutritional status of the subject and correlating it with indices like cycle length, duration of flow, regularity of the cycle, pads used and history of passage of clots to get a more significant understanding of the association of the two. About 98.2% subjects whose waist–hip ratio was below the normal gave a history of the passage of clots during menstruation. The "*p*" value was 0.57, statistically not significant (Table 3).

Amongst the category with a normal waist to hip ratio, 65.1% had regular menstruation while 34.9% had irregular menstruation. While amongst the category with a high-risk waist to hip ratio, 62.5% had irregular menstruation and 37.5% had regular menstruation. The "*p*" value was 0.0239, statistically significant for a positive association.

Amongst the subjects with a normal BMI, 62.8% had a normal menstrual cycle length; while amongst them 37.2% had a longer menstrual cycle. Amongst subjects with lesser BMI, 26.1% had longer menstruation and with a higher BMI, 30.1% had longer menstrual cycles. The "*p*" value was 0.0369, statistically significant for a positive association.

Amongst the category of the subjects with a normal Triceps skinfold thickness, 83% had regularization of their menstrual cycle and 17% had irregular menstruation while amongst the category with high-risk values for triceps skinfold thickness 45.9% had irregular menstruation and 54.1% had normal menstruation. The *p* value was 0.001, statistically significant for a positive association.

Table 2: Percentages distribution of the subjects according to various anthropometric determinants

Anthropometric determinant	*Observation*	*Percentage distribution*
Waist circumference:		
≤ 80.10 cm.	Low risk	54.3
80.11 cm–89 cm.	Moderate risk	23.7
≥ 89.1 cm.	High risk	22
Waist-hip ratio:		
0.80 or ≤	Low risk	92
0.81–0.85	Moderate risk	5
≥ 0.85	High risk	2.9
Mid upper arm circumference:		
≤ 21 cm.	Severe malnutrition	3.7
22–32 cm.	Normal	65
≥ 32 cm.	Obese	31.3
Triceps skin-fold thickness:		
≤ 1.2 cm.	Acute adult Under-nutrition	0
1.3–4 cm.	Normal	64.7
≥ 4 cm.	Obese	35.3

Table 3: Association of waist–hip ratio and triceps skinfold thickness with the regularity of menstruation

		Regularity of menstruation			
Association		*Regular*	*Notregular*	*Percentage within regularity*	*p value*
Waist-hip ratio	≤0.8	168	90	92.1	0.0239
	0.81–0.89	8	6	5	
	>0.89	3	5	2.9	
Triceps sikn fold thickness	Normal	88	18	35.3	0.001
	High risk	105	89	64.7	

Table 4: Association of BMI with various menstrual parameters

		BMI				
Association		*<18.5*	*18.5–23.99*	*≥24*	*Percentage*	*p value*
Cycle length	3–5 days	17	76	109	67.3	0.0369
	> 5 days	6	45	47	32.7	
Passage of clots	Clots not passed	16	94	128	79.3	0.0326
	Clots passed	7	27	28	20.7	
Number of pads used	< 5	12	78	110	66.7	0.0176
	> 5	11	43	46	33.3	
Number of days of flow	< 5 days	22	101	149	90.7	0.002
	> 5 days	1	20	7	9.3	
Regularity of menstruation	Menstruation was regular	5	49	53	35.7	0.0186
	Menstruation was not regular	18	72	103	64.3	

The 83.5% of the subjects with a normal BMI had a normal flow while 16.5 % had increased days of flow. In undernourished subjects, 4.3% had increased days of flow, and in over-nourished subjects, 4.5% had increased days of flow. The *p* value was 0.002, statistically significant for a positive association.

The number of pads becomes significant here as it is an indirect determinant of the amount of blood flow per day. 64.5% subjects with a normal BMI used less than five pads per day while in undernourished subjects 47.8% used a higher number of pads than normal. The *p* value was 0.0176, statistically significant for a positive association.

About 78.3% of undernourished subjects had irregular menstruation and 66% of the over nourished subjects also had irregular menstruation. The *p* value was 0.0186, statistically significant for a positive association (Table 4).

Amongst the over nourished subjects, 45.2% give a history of the passage of clots and among the undernourished 11.3% give a history of the passage of clots. The *p* value was 0.0326, statistically significant for a positive association.

DISCUSSION

The present study attempted to understand the correlation of anthropometry and nutritional assessment with menstrual cycle patterns amongst the women pursuing various courses like medical, dental, nursing, pharmacy, physiotherapy under the umbrella of a single educational foundation. Although the cross-sectional study was employed, more diligence was used for the control of various types of bias. Before collecting the data, an excellent rapport was established with the subject. While collecting information and conducting the examination, privacy was maintained. Subjects were assured that their research data would be kept confidential and that the information shared will be used only for research purposes. Hence, this study is unlikely to have any information bias.

Further to minimize the recall bias, appropriate clues were provided in terms of Hindu calendar or important national or religious events. Properly calibrated indian standard institute (ISI) approved standard equipments were used to eliminate all the anthropometry errors. By doing so, we eliminated any possible measurement bias. While measuring the height and weight, the next highest number was considered for a decimal. This was done to avoid any decimal error or bias.

Out of the 300 subjects studied, 61.3% of the subjects belonged to normal weight distribution, 22.9% were underweight and 15.8% were overweight. This is similar to the study done in India by Deshpande et al., where a maximum of 59% of girls presented with normal BMI, while 31.5% of girls had BMI of more than 25 and 9.5% girls were found to be underweight with BMI less than 18.[1]

In the courses studied, there was a variation of 28.7% and is of the medical course which being the highest and least being 11% from nursing and with three other courses

being included like physiotherapy with 24% involvement, dental with a 16.7% involvement and pharmacy with 19.7% involvement in the survey. No religious bias was done, and involvement of all three religions was equally considered and given equal involvement. To avoid any location bias, place of residence was also considered with 39.7% being localities and 60.3% being hostilities.

Socioeconomic class differentiation was also considered. The socioeconomic classification was done and found that 83.7% belong to the upper class and 16.3% belonged to the upper middle class, using the modified Kuppuswamy's classification for assessment.

The mean age of menarche was 12.77 years with standard deviation of 1.487 years. This study is almost similar with a study conducted to determine the prevalence and pattern of menstrual symptoms among 352 nursing students in Beirut, Lebanon, which reported the age of menarche as 14 years for 23.3% and the mean menarche age as 13.2 years.[11]

In this study, the prevalence of irregular menstrual cycle was 35.7% and regular menstrual cycle was 65.3%. The prevalence of pubertal menorrhagia was 23.7%. High-risk subjects with regard to waist circumference were 22%.

In this study, the prevalence of high-risk subjects with regard to waist to hip ratio was 2.9%. This prevalence is a good indicator. The probable reason for this positive finding is that the subjects considered belonged to courses like medical and paramedical fields, and so the awareness amongst them about the relation of waist–hip ratio and good menstrual patterns was much higher than in the normal general population and the amount of physical activity involved in the everyday college life was also considerably higher than a sedentary lifestyle.

According to the MUAC, 3.7% of the subjects were noted to be severely malnourished and 31.3% were over-nourished. According to the triceps skinfold thickness measurements, 35.3% of the subjects were noted to be on the over nourished side. In this study 78.3% of under-nourished subjects had irregular menstruation, 66% of the over nourished subjects also had irregular menstruation. This association proves that both the extremities of nourishment have problems regarding the regularity of menstruation. About 60.7% of the total subjects studied constituted hostilities and hence the change in the food habits due to overeating of junk foods and decreased eating of proper nutritious food could have also led to the chances of irregular menstruation.

Amongst the category with a normal waist–hip ratio, 65.1% had regular menstruation while 34.9% had irregular menstruation. While amongst the high-risk category of waist–hip ratio, 62.5% had irregular menstruation and 37.5% had regular menstruation. This is in correlation with the study done by Castillo–Martinez et al.[12] from an outpatient obesity clinic to measure the relationship between menstrual cycle length disorders and degree of obesity. Waist-to-hip ratio was measured, and comorbidities were assessed in each patient. The risks for amenorrhea and oligomenorrhea were increased two fold by each unit increase of obesity grade.

Amongst the subjects with a normal BMI, 62.8% had normal menstrual cycle length and while amongst them 37.2% had a longer menstrual cycle. Amongst subjects with lesser BMI, 26.1% had longer menstruation and amongst subjects, with a higher BMI, 30.1% had longer menstrual cycles. 83.5% of the subjects with a normal BMI had a normal flow while 16.5 % had increased days of flow. In under nourished subjects, 4.3% had increased days of flow and in over nourished subjects, 4.5% had increased days of flow. This is in correlation with the study done to assess the correlation between body mass index and menstrual profile among nursing students of Ain Shams University by Samir et al.[13] The study concluded that there was a positive correlation between BMI and menstrual profile in relation to duration, length and amount. Also, a positive correlation was seen between the BMI of the students and their premenstrual problems.

Ganesh et al.[14] did a study to know the relationship between BMI with menstrual cycle in Senior High School in Sumedang. There was no relationship between BMI and menstrual interval and menstrual amount. However there was a relationship between BMI and menstrual period.

A total of 64.5% subjects with a normal BMI used less than five pads per day while in undernourished subjects 47.8% used a higher number of pads than normal. Total 78.3% of undernourished subjects had irregular menstruation, 66% of the over nourished subjects also had irregular menstruation Amongst the over-nourished subjects 45.2% give a history of the passage of clots and among the undernourished 11.3% give a history of the passage of clots. This is in correlation to a study done by Binu Thapa et al.[15] on the adolescent girls of Nepal and concluded that almost half of the adolescents had abnormal BMI. Common menstrual problems were dysmenorrhea and irregular menstrual cycle.

In this study, 74.3% had dysmenorrhea, out of which 78.7% had mild dysmenorrheal, which contradicts with the study by Deshpande et al.[1] where out of total 200 girls, 46% girls presented with dysmenorrheal.[1] The probable reasons for the above-seen contradiction are the heterogeneity in the study population considered regarding age and courses in our study. The heterogeneity in the courses increased the number of years spent studying. As a result, the subjects may be of a higher age category than subjects considered for the comparing study.

The mean age of the subjects considered was 21.05 years with a standard deviation of 1.95 and hence with an increase in age, there is a simultaneous increase in the chances of presenting with dysmenorrhea.

The BMI is significantly associated with the irregular menstrual cycle, polymenorrhea, increased fatigue, and severity of dysmenorrhea. This is in similar to the study done by Mohite et al.[16] in India where there was a statistical association between the nutritional status of adolescent girls according to BMI and hypomenor rhea.

The *p* value was less than 0.05 in the cases of associations between the following: (a) Waist–hip ratio and the regularity of menstruation, (b) Triceps skinfold thickness and the regularity of menstruation, (c) BMI and cycle length of each menstruation, (d) BMI and the regularity of menstruation, (e) BMI and number of pads used per day during menstruation; (f) BMI and number of days of flow during a menstrual cycle, and (g) BMI and history of the passage of clots. It thus provides a statistically significant proof that anthropometry and BMI play a very important role in regulating the menstrual cycle.

The subjects who were observed with menstrual problems were counseled and referred to tertiary care hospital to seek further guidance from the obstetrics and gynecology or endocrinology departments who would further investigate them and provide appropriate treatment.

CONCLUSION

Anthropometry and BMI play a very important role in regulating the menstrual cycle. So, women have to take a balanced diet to maintain the normal BMI and engage in regular physical activity to regulate their menstrual cycle which is a determinant of women's health. Findings of the present study have greater value for irregular menstruation. However, it was satisfactory to note that appropriate and clean methods were used in practicing and maintaining menstrual hygiene. There is a need to provide appropriate awareness to women in terms of extended lectures. This will make them more aware about the factors influencing the menstrual cycle patterns and importance to maintain menstrual health and hygiene, as the extremities of the BMI are more susceptible for menstrual cycle abnormalities, polycystic ovarian syndrome, breast cancer, ovarian cancer, reproductive tract infection and also systemic diseases like diabetes. All the factors put together will help them have better reproductive health.

CLINICAL SIGNIFICANCE

The main objective of this study was to find a correlation between the anthropometry, nutritional status, and menstrual cycle patterns. Through the survey, a strong relationship was proved between the above-mentioned parameters. Most of these parameters being statistically significant and have been compared to the previous studies and have derived the implications that both nutrition and anthropometry play an important role in regulating the menstrual cycle patterns. By controlling these parameters, we were able to decrease the abnormalities associated with menstruation as depicted in this study where the percentage of subjects who had a normal BMI value and normal anthropometric measurements, the abnormalities related to menstruation were less noted as amongst the other values for BMI and anthropometry.

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