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Assessment of Anthropometric correlates in different phases of menstrual cycle: An observational study

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Abstract
Background: *In female reproductive life there are structural, functional and hormonal changes which occurs repetitively responsible for the menstrual cycle. However, numerous factors like hormonal fluctuations, clinical conditions, body mass index (BMI), genetics etc. plays an important role in governing the normal physiology of menstrual cycle [2]* ***Methods:*** *Study was conducted in the Department of Physiology, TMMC and RC over a period of 1 year. A group of 40 females between the age group of 18–25 years having normal menstrual cycle were selected. Anthropometric parameters were measured in different phases of menstrual cycle among the study group. Comparison between the mean of Anthropometric parameters in different phases of menstrual cycle were done using Friedman's test while inter-group comparison was done using Wilcoxon sign-ranks test.* ***Results:*** *Increase in mean BMI was noted in Ovulatory phase and increase in mean Waist-Hip ratio was noted in Menstrual phase. However, findings did not reached the level of statistical significance.* ***Conclusion****: Anthropometric parameters, viz weight were compared between different phases of menstrual cycle. There was no significant difference in mean weight, BMI, WHR between phases of menstrual cycle. However, there was increase in mean weight in secretory phase (58.81) but it is not statically significant (P=0.105).*
Keywords: *Anthropometric correlates, Menstrual cycle*

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I. Introduction

In female reproductive life there are structural, functional and hormonal changes which occurs repetitively responsible for the menstrual cycle. The Menstrual cycle is divided into four phases namely the Menstrual phase, Proliferative phase, Ovulatory phase and Secretory phase [1] However, numerous factors like hormonal fluctuations, clinical conditions, body mass index (BMI), genetics etc. plays an important role in governing the normal physiology of menstrual cycle [2]

There are various factors involved for the prevalence of menstrual disorders such as hormonal imbalance, alcohol consumption, caffeine intake , stress, smoking, ethnicity, BMI, malnutrition etc. [3, 4, 5, 6, 7]. Of the various factors mentioned, if we talk about Body Mass Index, having a high or low BMI may leads to irregular, painful and or even absence of mensturation. [2]

The individual body fat composition can be measured using set of quantitative non-invasive techniques, which is simply called as anthropometric measurements. Here, height, weight, BMI, Waist Hip ratio, Skin fold thickness are considered to measure the body fat composition.[8] According to WHO, waist hip ratio (WHR <0.80) considered as normal weight, between 0.80-0.84 as overweight and >0.85 as obese.[9]. The body fat distribution plays a vital role in forecasting the health risks of obesity like Android (male pattern) Trunk/abdominal fat and Ganoids (female pattern) fat at Hip and thigh.[10]

II. Methodology

The study was carried out in the Clinical laboratory of Physiology department, Teerthanker mahaveer medical college and research centre, Moradabad (U.P.) from September 2017 to February 2018.

A group of 40 females between the age group of 18-25 years, willing to participate in the study and with regular menstrual cycle. (cycle duration between 21 to 35 days and menstrual phase between 2 to 6 days)[11, 12] using simple random sampling method were selected for the study. However Females with a known case of hormonal disorder, using hormonal oral contraceptive pills, history of alcohol consumption or smoking,

known case of any haematological disorder, any history of chronic systemic or gynaecological disorder were excluded from the study.

The following parameters namely Height, Weight, BMI, Waist circumference, Hip circumference, Waist Hip ratio were assessed under the different phases of menstrual cycle-

1. Menstrual phase (2^{nd} day)
2. Proliferative phase (9^{th} days after 1^{st} sample)
3. Ovulatory phase (14^{th} days after 2^{nd} sample)
4. Secretory phase (8 days after 3^{rd} sample)

Measurement of anthropometric parameters

- Height was measured in a standing position, without shoes, using stadiometer to nearest of 1 cm.[13]. Weight was measured using electronic weighing machine to the nearest of 100 gm with subjects standing without shoes and wearing light clothes.[13]
- Body mass index (BMI) was calculated in kg/m^2 using the following formula: BMI = Weight (kg) / Height ($meter^2$)
- Waist circumference was measured midway between iliac crest and the lower most margin of ribs.[14, 15, 16] with a non-stretchable measuring tape, without applying pressure on the body surface and Hip circumferences was measured around the widest portion of the participant's buttocks.[14,15,16]
- Waist-Hip Ratio (WHR) was calculated in centimetres by using following formula: WHR = WC (cm)/ HC (cm) [14,15,16]

Statistical Analysis

- The data for all the parameters were analyzed and expressed as Mean ± S.D.
- Comparison between the mean of Anthropometric parameters in different phases of menstrual cycle was done using Friedman's test**.**
- The inter-group comparison of Anthropometric parameters in menstrual cycle phases was done using Wilcoxon sign-ranks test.
- P- value of <0.05 was considered statistically significant and analysis of data was done using Statistical Package for Social Sciences (SPSS version 23)

III. Results

Table 1: Comparison of BMI between the phases of menstrual cycle (n=40)

"p" value = 0.102 (not significant)

BMI	Mean	Std. Deviation	Critical value	p-value
Menstrual phase	22.93	4.03	6.807	0.102
Proliferative phase	22.99	4.06		
Ovulatory phase	23.08	4.16		
Secretory phase	23.02	4.01		

Table 1 shows the mean BMI was compared between all the phases of menstrual cycle by using the Friedman's test. There was no significant difference in mean BMI between all the phases of menstrual cycle.

Table 2: The Inter-group comparison of mean BMI between the phases of menstrual cycle (n=40)

		Mean Difference	p-value
Menstrual phase	**Proliferative phase**	-0.06	0.113
Menstrual phase	**Ovulatory phase**	-0.15	0.095
Menstrual phase	**Secretory phase**	-0.08	0.105
Proliferative phase	**Ovulatory phase**	-0.09	0.819
Proliferative phase	**Secretory phase**	-0.03	0.127
Ovulatory phase	**Secretory phase**	0.06	0.116

"p" value: <0.05 (significance); >0.05 (not significance)

Table 2 shows the inter-group comparison of mean BMI was done by using the Wilcoxon sign-ranks test. No significant difference was found for the inter-group comparison of mean BMI between all the phases of menstrual cycle.

Table 3: Comparison of Waist-Hip ratio between the phases of menstrual cycle (n=40)

WHR	Mean	Std. Deviation	Critical value	p-value
Menstrual phase	0.87	0.05	3.038	0.230
Proliferative phase	0.86	0.06		
Ovulatory phase	0.86	0.05		
Secretory phase	0.86	0.07		

"p" value: <0.05 (significance); >0.05 (not significance)

Table 3 shows the mean Waist-Hip ratio was compared between the phases of menstrual cycle by using the Friedman's test. There was no significant difference in mean waist-hip ratio.

Table 4: The Inter-group comparison of mean Waist-Hip ratio between the phases of menstrual cycle. (n=40)

		Mean Difference	**p-value**
Menstrual phase	**Proliferative phase**	0.01	0.129
Menstrual phase	**Ovulatory phase**	0.01	0.100
Menstrual phase	**Secretory phase**	0.02	0.090
Proliferative phase	**Ovulatory phase**	0.00	0.875
Proliferative phase	**Secretory phase**	0.01	0.450
Ovulatory phase	**Secretory phase**	0.01	0.071

"p" value: <0.05 (significance); >0.05 (not significance)

Table 4 shows the inter-group comparison of mean waist-hip ratio was done by using the Wilcoxon sign-ranks test. No significant difference was found for the inter-group comparison of mean waist-hip ratio.

IV. Discussion

Hormonal fluctuations, genetics, serious medical conditions, obesity and body mass index influence the regularity and flow of regular menstrual cycle in women and it is observed that there can be absence of menstruation, irregular menstruation and painful menstruation due to low or high BMI.[17, 18] Obesity and overweight were measured by using the Body Mass Index (BMI) and Waist and hip circumference (WHR) [19]

Byrd and Thomas (1983) studied relation between weight gain in different phases of menstrual cycle, they reported fluctuations in body composition due to influence of water retention and thus weight gain in most women in secretory phase.[20]

Golub et al (1965) reported among sixty-nine females who kept daily record of their body weight prior to menstruation while 43.5% of them experienced their highest weight during the first day of menstruation. The control group was reported to experience a slight increase in weight (<500g) five days prior to the onset of menses. Similarly, a fluctuation in daily weight of 0.59 to 2.07 kg in women throughout the menstrual cycle was reported. [21]

Sylvia Kirchengast (2003) et al studied changes of the body weight and waist-to-hip ratio during menstrual cycle and 32 healthy young women is age between 19- 30 year were included. Found that body weight increased only slightly during the second cycle half and marked decrease in WHR around at the of ovulation in all subject who advertised average cycle length and a successful ovulation could be assumed.[22]

Haghighizadeh MH et al (2014) studied the relationship between menstrual cycles and body weight changes among university students in Ahvaz, Iran. Weights of all the subjects (50) were measured each morning during a complete menstrual cycle. Seventy eight percent of participants had normal weight and body weight increased only slightly during the three days before beginning of the menstruation. No statistically significant differences were found in weight during menstrual cycle. [23]

The slight gain in weight in secretory phase is due to salt and water retention caused by the oestrogen. The feeling of heaviness disappears during the menstruation phase.[24]

There was no significant difference in mean BMI between menstrual phase, proliferative phase, ovulatory phase, and secretory phase (p=0.102)

The inter-group comparison of mean BMI between menstrual cycle phases shows no significant change and no significant changes in BMI in different phases of menstrual cycle.

Mary Grace Lasquety et al (2012) studied the influence of BMI on the menstrual cycle. The lengths of the follicular and luteal phases and the day of ovulation was calculated by using luteinizing hormone (LH) tests. The 244 women categorized into overweight (BMI of 25– 29.9 kg/m^2), obese(BMI ≥ 30 kg/m^2), and normal

weight (BMI of 18.5–24.9 kg/m^2). The length of the luteal phase and menses significantly varied between the groups. The overall conclusion of this study is obesity is most common factor for shortening the luteal phase and lowers the ovulatory cycle, which highly accounted for infertility. [25]

.Ricardo et al (2015) found that WHR slightly vary between the follicular and luteal phase due to the slight accumulation of water in luteal phase, but BMI do not show any changes.[26]

Limitations

- Small sample size is one of the limitation of study. A larger sample size could have depicted more wider range of results
- Statistical validation by considering the subjects sample size greater than three in single cycle
- Anthropometric parameters such as weight, BMI, waist circumference, hip circumference and WHR must be studied in 7-8 menstrual cycles.

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