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Menstrual pattern and anthropometric characteristics of women with primary and secondary infertility in comparison with age-matched controls

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Abstract:

BACKGROUND: The incidence of infertility has increased significantly due to lifestyle changes and the presence of diverse environmental stress. Body mass index (BMI) and waist circumference (WC) are two common anthropometric measures of obesity. Factors such as differences in race, sex, and age influence BMI, and recent studies have reported limitations in the use of BMI to determine obesity. Body fat distribution has a more valid criterion for determining obesity than BMI. Our aim was to compare the menstrual pattern and anthropometric parameters of women with primary and secondary infertility with those of age-matched controls and to assess the correlation between the anthropometric variables and fertility types.

MATERIALS AND METHODS: A cross-sectional study was conducted in which the anthropometric measurements and menstrual history over the last 3 months of cases of primary and secondary infertility were compared with the age-matched control group.

RESULTS: Women with primary and secondary infertility tend to be overweight or obese. The menstrual pattern of women with infertility was not statistically different as compared to the control groups. There were significant differences in weight, BMI, hip circumference, WC, and neck circumference (NC) of women with primary infertility with those of age-matched controls. A statistically significant difference was noted in NC between the primary and secondary infertility groups.

CONCLUSION: The results obtained show that women with infertility tend to be overweight/obese. Due to the limited sample size, the relationship between menstrual pattern and anthropometric characteristics such as waist-to-hip ratio (WHR), waist-to-height ratio (WHtR), and frame size (FRS) and infertility could not be established.

Keywords:

Anthropometric characteristics, frame size, menstrual pattern, primary infertility, secondary infertility

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Introduction

Infertility is a very critical issue for couples of childbearing age all around the world. The incidence of infertility has increased significantly due to lifestyle changes and the presence of diverse environmental stress.[1] Available data suggest that at least 50 million couples around the world experience infertility, which is defined as a failure to achieve a clinical pregnancy after at least 12 months of unprotected coitus.[2] Primary infertility and secondary infertility are the subtypes of infertility. Primary infertility is described as a condition of being unable to get pregnant as opposed to secondary infertility, which is described as the inability to conceive after a previous successful attempt. Even though infertility is not a disease, it can lead to diverse emotional and psychological consequences including frustration, depression, anxiety, hopelessness, guilt, and feelings of worthlessness in life.[3,4]

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Body mass index (BMI) and waist circumference (WC) are two common anthropometric measures of obesity in clinical and public health practice.[5] In recent studies, it has been found that the use of BMI has been restricted to determine obesity and weight problems. BMI is independent of body size and cannot determine the type of obesity and body fat distribution. Many factors influence BMI such as differences in race, sex, and age, and it is not an appropriate index to determine obesity. Body fat distribution is a more valid criterion for determining obesity than BMI.[6] It is known that as the waist-to-hip ratio (WHR) and BMI increase, there is a higher risk of suffering from diseases ranging from hypertension to diabetes, cancer, depression, and fertility problems.[7] Waist-to-height ratio (WHtR) has been found to be a simple, rapid, and more sensitive screening tool when compared to BMI.[8] Measures of frame size (FRS) have been proven to be significantly and positively correlate with fat-freemass, body fatness, bone mass, and body weight at all ages. Wrist circumference (WrC) is one of the most reliable measurements to assess body FRS through the Grant index (height in cm/WrC in cm).[9] Neck circumference (NC) has recently been used to identify overweight and obesity and is observed to correlate with age, weight, WC, hip circumference, WHR, and BMI.

There is a dearth of studies that explore differences between anthropometric characteristics, especially FRS and NC, which objectively measure the body composition of women with infertility compared with other women without the condition.[10,11] Hence, this study has been undertaken to compare menstrual pattern and anthropometric parameters of women with primary and secondary infertility with those of age-matched controls. Infertility is a pivotal issue for couples of childbearing age. It has been shown to have negative influences on their families and society. Although the implications of infertility have been profound, there is a dearth of comprehensive literature establishing various risk factors of primary and secondary infertility, apart from the conventional parameters. Cong *et al*.[1] studied the prevalence and risk factors of both primary infertility and secondary infertility in China. They found that the prevalence of infertility was lowest in the group of women with moderate menstrual flow. They also correlated infertility with underweight and overweight population and found that the prevalence of infertility in underweight women was nearly 1.5 times that of women with moderate BMI. They also found that there was a positive correlation between the incidence of infertility and age on the higher side for both the primary and secondary infertility groups. It was also seen that with the increased number of pregnancies, the chances of infertility decreased. They established a significant association between the incidence of infertility in women and their BMI, menstrual flow, state of exercise, and number of pregnancies. Mirazei *et al*.[2] studied the prevalence of infertility in women aged between 20 and 49 years in Yazd, Iran. Both extremities in BMI are associated with menstrual disorders. Heavy menstrual bleeding has been reported among women with a higher BMI.[6] They found a significant correlation between the incidence of primary and secondary infertility and parameters such as age, education level, BMI, and WC. Poddar *et al*.[3] studied the psychological profile such as attachment styles and defensive maneuvers of women with infertility as compared to fertile women in a comparative study. They concluded that infertile women have higher discomfort as compared to fertile women in forming attachments. They also found the prevalence of immature defenses such as narcissism in infertile women. They thus elaborated on the psychological dimensions of the prevalence of infertility.

Tarleton *et al*.[4] used anthropometric measurements in predicting health disparities among people of various ethnicities in a study conducted in Los Angeles, in an attempt to introduce WC and WHtR as important indicators of visceral adiposity, alongside BMI, which has the shortcoming of not accurately measuring the fat distribution in the body. Their study established WC and WHtR as effective as BMI in predictions for the risk and prevalence of cardiovascular diseases and other comorbidities such as diabetes mellitus. Casadei *et al*.[5] defined the correct techniques of measurement of anthropometric values. They also described the shortcomings of anthropometric measurements, one of which is errors in measurements due to difficulty in locating the bony landmarks, which can, however, be overcome by the use of calibrated tools. They also described anthropometric measurements as an important tool in assessing the status of physical fitness. Ashtray-Larky *et al*.[8] studied to establish WHtR as a better indicator of fat mass during weight loss. They found strong correlations of WHtR to fat mass during weight loss. Their study established WHtR as an effective tool in studying fat mass, as compared to other indices such as BMI. Öztürk *et al*.[9] while studying WrC and FRS percentiles recommended the use of body circumferences including WrC in the clinical evaluation of the metabolic state of the body and as an effective index of fat distribution in the body. Hingorojo *et al*.[10] compared BMI, NC, and WC as markers of obesity. In their study, they found strong correlations of NC with BMI and WC like their predecessors. Moran *et al*.[11] identified various cardiometabolic significance and risks associated with polycystic ovarian disease (PCOS). They attributed PCOS to an increased risk of insulin resistance and thus other cardiometabolic symptoms. They also correlated PCOS and obesity and thus stressed effective screening and prevention of cardiometabolic symptoms in women

with PCOS. This study was undertaken to compare the menstrual pattern and anthropometric parameters of women with primary and secondary infertility with those of age-matched controls.

Materials and Methods

Study design and settings

This was a cross-sectional study conducted for 6 months in the Outpatient Department of Obstetrics and Gynecology, AIIMS, Mangalagiri. The study population included women with primary and secondary infertility attending the Outpatient Department of Obstetrics and Gynecology at AIIMS, Mangalagiri.

The objectives of the study were as follows:

- To compare the menstrual pattern of women with primary and secondary infertility with that of age-matched controls.
- To compare the anthropometric parameters such as height, weight, BMI, WC, hip circumference, NC, WrC, FRS (height in cm/WrC in cm), WHR, and WHtR of women with primary and secondary infertility with those of age-matched controls.
- To determine the correlation, if any, between the anthropometric variables and fertility types.

The participant information including age, demographic details, type of infertility, and the following parameters was recorded in a study pro forma:

- ***Menstrual pattern***: Menstrual cycle regularity, duration, amount, and flow will be recorded for the last three months for the subjects and controls. These will be provided by the participants.
- ***Anthropometric data***: These will be obtained for both the cases and controls as follows:
- ***Height:*** It is measured with a height meter with participants asked to stand barefoot on the platform of the scale looking straight ahead while the horizontal bar attached to the height meter is adjusted to touch the vertex of the head.
- ***Weight:*** It is measured on a weighing scale with the participant in light clothing, barefooted, and standing in an erect posture looking straight ahead.
- ***WC*****:** It is measured with an anthropometric tape with the participants in light clothing in a standing position, abdomen relaxed, arms by the sides, and feet together. WC is measured at the level of the natural waist in the horizontal plane, which is the narrowed part of the torso as seen from the anterior aspect, at the end of normal expiration, with the tape parallel to the floor around the waist, and recorded to the nearest 0.1 cm.
- ***Hip circumference*****:** It is measured using the anthropometric tape with the participant in light clothing in a standing position with feet erect together and weight evenly distributed on both feet. The tape is placed around at the maximum extension of the buttocks with the tape parallel to the floor, held snug but not tight, and measurement was recorded to the nearest 0.1 cm.
- ***NC*****:** It is measured in a plane as horizontal as possible, at a point just below the larynx (thyroid cartilage) and perpendicular to the long axis of the neck (the tape line in front of the neck at the same height as the tape line in the back of the neck). Measurement is done with the participant looking straight ahead, with shoulders down, but not hunched with care taken not to involve the shoulder/neck muscles in the measurement.
- ***WrC:*** It is measured with the participant in a seated position using a tension-gated tape measure positioned over the Lister tubercle of the distal radius and over the distal ulna. The Lister tubercle, a dorsal tubercle of the radius, is palpated at the dorsal aspect of the radius, about 1 cm proximal to the radiocarpal joint space.

- ***Other anthropometric parameters:***
  - BMI was calculated as per the World Health Organization (WHO) guidelines as follows:

$$\text{BMI} = \frac{\text{Weight in kilograms } (\text{kg/m2})}{\text{square of height in meters}}$$

  - WHR was calculated by dividing the WC (in cm) by the hip circumference (in cm).
  - WHtR was calculated by dividing the WC (in cm) by the height (in cm).
  - FRS was (height in cm/WrC in cm) calculated based on the measured parameters.

Study participant and sampling

Women aged 20–40 years with primary and secondary infertility consenting to participate in the study were recruited. 60 subjects (30 subjects of primary infertility and 30 subjects of secondary infertility) and 60 controls (30 controls of age-matched fertile women for primary infertility and 30 controls for secondary infertility) were included. Considering the age-matched control group, for a subject with specific age, three women of the same age were approached; that is, if a subject was 30 years of age, three fertile women of 30 years of age who gave their consent to participate in the study were approached. One of those three was randomly picked as the age-matched control for the study. This was done to recruit 60 age-matched fertile women as controls (30 each for primary and secondary infertility). A consecutive convenience sampling technique was used to recruit subjects for this study till the desired sample size was achieved. Flow chart showing brief description of methodology of the study is given below.

Participants who consented to the study

↓

Subjects: women with primary infertility (*n*=30). Controls: age-matched controls (*n*=30)	Subjects: women with secondary infertility (*n*=30). Controls: age-matched controls (*n*=30)
1. Assessment of menstrual pattern	
2. Assessment of anthropometric measurements	
a. Height, weight, BMI	
b. WC	
c. Hip circumference	
d. NC	
e. WrC	
f. WHR	
g. WHtR	
h. FRS: height in cm/WrC in cm	

Women aged 20–40 years with primary infertility (inability to conceive after one year of regular unprotected coitus) and women aged 20–40 years with secondary infertility (inability to conceive with unprotected coitus after a previous successful attempt) were included in the study.

Women with primary and secondary infertility with significant comorbidities such as diabetes and hypertension were excluded from the study.

Data collection tool and technique

The data were entered in a study pro forma and then transferred to an Excel sheet. The data analysis was carried out using Statistical Package for the Social Sciences (SPSS) version 23 software with the alpha level set at 0.05. The data were analyzed using the descriptive statistics of mean and standard deviation. Inferential statistics was used to assess the difference between anthropometric characteristics and menstrual cycles of women with primary and secondary infertility and control groups.

Ethical consideration

Ethical clearance: Ethical clearance was sought from the Institute Ethics Committee (IEC) before the commencement of the study. Informed consent was obtained from all the subjects for participating in the study and for publication before commencement.

Results

Demographic details of subjects and controls of primary infertility

The majority of the participants in both groups were 25–30 years of age. 60% of the primary infertility cases and 33% of controls were graduates and above. Two-thirds of the participants in both groups were homemaker. 30% of primary infertility patients and 10% of controls belonged to the upper socioeconomic class. A majority (77%) of the participants in both groups belonged to the Hindu religion. One-fourth of the participants in primary infertility had comorbidities, and hypothyroidism was the major comorbidity.

Comparison between the average menstrual cycle length of the primary infertility cases and control group [Table 1]

The comparison of the menstrual history of the study group is shown in Table 1. The mean cycle length and flow duration of primary infertility cases were 43.5 days and 4.5 days, respectively, which were not statistically different from controls (37.4 days and 4.3 days).

Comparison between the anthropometric measurements of primary infertility cases and control group [Table 2]

Table 2 shows the comparison of anthropometric parameters of primary infertility cases and controls. The mean (standard deviation (SD)) height of the primary infertility patients and controls was 151.9 (5.5) and 150.8 (5.0), respectively. The mean (SD) weight and BMI were higher in primary infertility cases [64.8 (11.2); 28.3 (5.8)] than in the control group [56.03 (8.1); 24.656 (3.6)] with a statistically significant *P* value (0.001). The mean WC, hip circumference, and NC were statistically different between primary infertility cases and controls with *P* values of 0.043, 0.032, and 0.005, respectively. The WrC of primary infertility patients and controls was almost similar. The WHR, WHtR, and FRS were not statistically different between primary infertility cases and controls.

Demographic details of secondary infertility cases and age-matched controls

37% of secondary infertility cases and 47% of the controls belonged to 25–30 years. 53% of the secondary infertility cases and 20% of controls were graduates and above in the education category. 56% of secondary infertility cases and two-thirds of controls were homemaker. 27% of secondary infertility cases and 13% of control belonged to the upper socioeconomic class. More than 70% of the participants in both groups were Hindu by religion. 47% of participants in secondary infertility had comorbidities, and PCOS (20%) and hypothyroidism (17%) were the major comorbidities.

Table 1: Comparison of menstrual history between primary infertility patients and controls

Parameter	Primary infertility cases (*n*=30) Mean+SD	Controls (*n*=30) Mean+SD	*P*
Length of the cycle (days)	43.5±20.5	37.4±17.5	0.221
Duration of flow (days)	4.5±1.9	4.3±1.4	0.766

Table 2: Comparison of anthropometric parameters between primary infertility cases and controls

Parameter	Primary infertility cases (*n*=30) Mean+SD	Control (*n*=30) Mean+SD	*P*
Height (CM)	151.90±5.511	150.83±5.004	0.436
Weight (Kg)	64.83±11.204	56.03±8.147	0.001
BMI	28.288±5.8119	24.656±3.625	0.005
Waist circumference (CM)	90.67±7.725	85.37±11.690	0.043
Hip circumference (CM)	103.10±10.460	97.63±8.672	0.032
Wrist circumference (CM)	17.80±1.472	17.13±1.432	0.081
Neck circumference (CM)	35.50±2.113	33.93±2.067	0.005
Waist-to-hip ratio	0.883±0.0685	0.875±0.0979	0.713
Waist-to-height ratio	0.598±0.0585	0.566±0.0801	0.088

Comparison between the average menstrual cycle length of cases with secondary infertility and control group [Table 3]

The comparison of the menstrual history of the study group is shown in Table 3. The mean cycle length and flow duration of cases with secondary infertility cases were not statistically different from controls.

Table 3: Comparison of menstrual history between secondary infertility patients and controls

Parameter	Secondary infertility cases (*n*=30) Mean+SD	Controls (*n*=30) Mean+SD	*P*
Length of the cycle (days)	43.4±28.6	38.5±16.6	0.419
Duration of flow (days)	5.3±3.1	4.6±1.7	0.308

Comparison between the anthropometric measurements of secondary infertility cases and control group [Table 4]

Table 4 shows the comparison of anthropometric parameters between secondary infertility cases and controls. The mean (SD) height of the secondary infertility cases and controls was 152.1 (5.5) and 154.0 (4.2), respectively. The mean (SD) weight and BMI of secondary infertility cases were 69.7 (16.4) and (6.9), which were not statistically higher than the control. The mean WC, hip circumference, and NC of secondary infertility cases and controls were 91.3 cm, 109.2 cm, and 33.8 cm and 95.0 cm, 111.1 cm, and 36.9 cm, respectively. The WrC of secondary infertility cases and controls was almost similar. There was no significant difference in anthropometric characteristics between secondary infertility cases and controls except for the NC (*P* value 0.009). The waist-to-hip circumference ratio, WHtR, and FRS were not statistically different between secondary infertility cases and controls.

Comparison of anthropometric parameters between primary infertility and secondary infertility cases [Table 5]

A comparison of anthropometric parameters between the primary infertility and secondary infertility groups is shown in Table 5. Anthropometric parameters were not statistically different between the primary infertility and secondary infertility groups except for the NC (*P* value = 0.02).

Discussion

Obesity is a significant contributor to a variety of the underlying etiologies associated with infertility. It has been attributed to various reproductive sequelae including anovulation, subfertility and infertility, and poor reproductive outcomes.[11,12] This study was conducted to compare the menstrual pattern and anthropometric characteristics of women with primary and secondary infertility to those of the age-matched control group. In the case of primary infertility, the mean BMI of the subjects was 28.3, which according to the WHO classification of BMI for Asians falls into the obese class 1 category. The mean BMI of the age-matched controls group for primary infertility was 24.6, which according to the WHO classification of BMI for Asians falls into the overweight category. In case of secondary infertility, the mean BMI of the subjects and the controls was around 30, which according to the WHO classification of BMI for Asians falls in the obesity class 2 category.

There was a statistically significant difference in weight in women with primary infertility from the control group. While the mean weight of the women with primary infertility was 64.83 ± 11.204, that of the control group was 56.03 ± 8.147 with a *P* value of 0.001. This implies that increased body weight is an essential risk factor for primary infertility. There was a significant difference in NC of both groups. In the case of primary infertility, the mean NC of the cases was 35.50 ± 2.113, while that of controls was 33.93 ± 2.067 and a *P* value was 0.005. This is consistent with a previous study that established NC as a useful screening tool for increased fat mass in the body.[9]

Apart from these, other anthropometric parameters such as WHtR, wrist circumference-to-height ratio, and WHR were also measured and calculated; however, no significant associations were found. This study also found a significant difference between the mean NC of women with primary infertility and secondary infertility.

Table 4: Comparison of anthropometric parameters between secondary infertility cases and controls

Parameter	Secondary infertility cases (*n*=30) Mean+SD	Controls (*n*=30) Mean+SD	*P*
Height (CM)	152.10±5.821	154.03±4.156	0.144
Weight (Kg)	69.70±16.377	71.37±10.367	0.639
BMI	30.15±6.95025	30.1492±4.7043	1.000
Waist circumference (CM)	91.27±13.305	95.00±9.945	0.223
Hip circumference (CM)	109.17±14.921	111.10±8.318	0.538
Wrist circumference (CM)	18.57±4.337	18.07±1.818	0.563
Neck circumference (CM)	33.80±5.542	36.90±2.905	0.009
Waist-to-hip ratio	0.8385±0.08378	0.8558±0.07456	0.400
Waist-to-height ratio	0.6005±0.0880	0.6176±0.0696	0.409
Frame size	8.4615±1.2667	8.607±0.8736	0.607

Table 5: Comparison of anthropometric parameters between primary infertility and secondary infertility cases

Parameter	Primary infertility cases (*n*=30) Mean+SD	Secondary infertility cases (*n*=30) Mean+SD	*P*
Height (CM)	151.90±5.511	152.10±5.821	0.892
Weight (Kg)	64.83±11.204	69.70±16.377	0.184
BMI	28.288±5.8119	30.15±6.95025	0.832
Hip circumference (CM)	103.10±10.460	109.17±14.921	0.363
Wrist circumference (CM)	17.80±1.472	18.57±4.337	0.122
Neck circumference (CM)	35.50±2.113	33.80±5.542	0.028
Waist-to-hip ratio	0.883±0.0685	0.8385±0.08378	0.895
Waist-to-height ratio	0.598±0.0585	0.6005±0.0880	0.630
Frame size	8.5967±0.8565	8.4615±1.2667	0.265

It was found that women with primary infertility have larger neck sizes as compared to those with secondary infertility. This study also tried to determine the correlation between menstrual patterns (cycle length and flow duration) of women with infertility. However, no significant association was found between the menstrual pattern and primary or secondary infertility, unlike previous studies, which have found significant differences between obesity, menstrual irregularities, and infertility.[8-10]

Ojaowo *et al*.[13] found significant correlations between menstrual period and anthropometric characteristics of women with secondary infertility. They attributed it to obesity, which was the main etiology behind many underlying comorbidities, which include PCOS and infertility. This study too aimed at establishing such a relationship between menstrual parameters, anthropometry, and infertility. However, apart from certain anthropometric parameters, other measurements did not yield similar results. This may be attributed to the smaller sample size in our study.

Studies with larger sample sizes need to be undertaken to establish a significant correlation between anthropometric characteristics, which objectively measure body composition and the prevalence of primary and secondary infertility.

Limitations and recommendation

Due to the limited sample size, which was the main limitation of our study, the relationship between menstrual pattern and infertility could not be established. Further studies including a larger sample size need to be undertaken to establish a significant correlation between menstrual pattern and anthropometric characteristics, which objectively measure body composition with that of primary/secondary infertility.

Conclusions

It is concluded from this study that women with infertility tend to be overweight or obese. It may be implied that increased weight or obesity might have an effect on the female reproductive system, thereby leading to infertility.

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Conflicts of interest

There are no conflicts of interest.

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