

Evaluation of Body Fat Composition and Digit Ratio (2D:4D) in Polycystic Ovary Syndrome in Adolescents

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ABSTRACT: Polycystic ovary syndrome (PCOS) is a common endocrine disorder. It is a multi-factorial disease, of which excess androgen and android fat pattern is previously reported. The digit ratio (2D:4D) is the ratio of length of index finger to the length of ring finger which epitomize the prenatal gonadal hormone exposure. So, the present study aimed to evaluate body fat composition and digit ratio among young adolescent PCOS patients and normal individuals. It was an analytical cross-sectional study. Based on the inclusion and exclusion criteria, 48 subjects (24 in each group), that is, control and PCOS group were identified and baseline characteristics were recorded. Body fat composition was evaluated using body fat analyzer and digit ratio (2D:4D) was measured using the digital Vernier calipers. Student's t-test was used to assess differences between means. In the present study, BMI was significantly increased among the PCOS group compared to the normal ($p=0.03$). The 2D:4D digit ratio was significantly lower ($p=0.001$) among the PCOS group. Body fat ($p=0.05$) and visceral fat ($p=0.01$) were significantly higher among the PCOS group. There was negative correlation between BMI, body fat, visceral fat and digit ratio, but was not statistically significant while body fat, visceral fat and BMI showed significant positive correlation. The present study indicates that the 2D:4D digit ratio is decreased, while BMI, body fat and visceral fat are significantly increased among the PCOS group. Digit ratio and body fat can be used to evaluate the high risk PCOS adolescents and plan early interventions.

KEYWORDS: Polycystic Ovary Syndrome, Body fat, Digit ratio (2D:4D).

Introduction

Polycystic Ovary Syndrome (PCOS) is a neglected non-communicable disease.

Studies on PCOS in India reported a prevalence of 3.7% to 22.5% [1].

It affects women of all age groups including adolescents and even postmenopausal women. PCOS was diagnosed as per the Rotterdam criteria [2].

Digit ratio, represented as index finger is to ring finger (2D:4D) is considered as an important marker of the fetal growth and reproduction [3].

It is proved that male fetus with higher testosterone exposure have lesser digit ratios in comparison to females.

This marker is found to be associated with age at menarche, puberty characteristics, age at menopause, severity of premenstrual symptoms and estradiol levels in various phases of menstrual cycle [4-7].

Literature review shows contradictory reports on association between 2D:4D digit ratio and PCOS [8,9].

This may be due to the differences in the techniques used to measure the digit ratio, targeted age groups and other clinical/reproductive characteristics of the study participants.

Studies represent that as compared to other ratios, 2D:4D ratio is more acceptable form exhibiting sexual dimorphism [10].

Pathophysiology of PCOS is complicated and is regulated as various factors like genetic, intrauterine and environment [11].

Many studies have reported an excess body fat level, despite the fact that many PCOS patients have normal Body Mass Index (BMI).

BMI is proved to be clinically useful tool but it does not encompass the multifaceted biology of excess adipose distribution.

Compared to body weight, body composition plays a vital role in obesity development due to metabolic and hormonal imbalances [12].

Though, many techniques are available to measure the body fat composition, measurement using bioelectrical impedance is cost effective, non-invasive and a promising tool to evaluate body fat among PCOS.

Paucity of data exists targeting on evaluating the body fat composition and digit ratio (2D:4D) among PCOS.

With these perspectives in mind, the study aimed to evaluate the body fat composition and digit ratio (2D:4D) in PCOS in adolescents and to find out if any association exists between digit ratio and body fat composition.

Materials and Methods

This was an analytical cross-sectional study involving patients attending the Obstetrics and Gynecology Out Patient Department of our institution.

The study was conducted for two months, from June to July 2019.

Using Open epi version 3.03, taking into account power 95% and 5% α error, based on the previous study [13], considering body fat parameter, the sample size was calculated to be 48 (24 in each group).

This study was approved by Short Term Studentship-Indian Council of Medical Research (STS-ICMR) (Reference id: 2019-03914).

Institutional Ethical Committee approval was obtained before the initiation of the study and written informed consent was obtained from all the study participants.

Inclusion criteria were: newly diagnosed PCOS girls using Rotterdam criteria; in the adolescent age of 10-18 years; with at least 2 years after menarche [2].

Females with normal, regular menstrual cycles were considered as control subjects.

They were selected from our sister institutions after getting the approval.

Exclusion criteria were, age >18 years, subjects with any form of illness or on drugs.

Follicular phase was preferred for the control group and amenorrhea phase for the PCOS subjects.

Considering the inclusion, exclusion criteria subjects were divided into two groups: Group I: Control; Group II: PCOS.

Measuring Body Fat Composition

Omron KaradaScan (Model HBF-510, Japan) body fat composition analyzer was used.

It works on the principle of bioelectrical impedance (500 μ Amp at frequency 5kHz).

The subject is made to stand, bare footed so that foot electrodes are come in contact.

He is required to hold the hand grip electrodes at 90-degree angle (between his arm and body).

It has been proved that body fat measured using bioelectrical impedance is comparable to other methods like dual energy x-ray absorptiometry (DXA) and hydrostatic weighing (HW) [14].

Calculating 2D:4D Digit Ratio

Digit ratio was measured using digital vernier calipers with a resolution of 0.01mm.

Index finger and Ring finger lengths were measured on the ventral surface and ratios was obtained.

Statistical Analysis

Statistical analysis was performed after data entry using the Microsoft Excel and Open Epi Software version 3.5.3, respectively.

Student's t-test was carried out to evaluate the differences between means and correlation was assessed by Pearson's correlation. p value <0.05 was considered to be statistically significant.

Results

In our study the mean age of the control group was 18.17 \pm 0.48 years and PCOS group was 18.83 \pm 7.01 years.

Age was not significantly different (p=0.06) among the two groups.

The basal cardiovascular parameters were compared and represented in the Table 1.

Table1. Blood pressure, Heart rate, BMI and 2D:4D ratio among the two groups.

Parameters	Normal	PCOS	P value
Age (years)	18.17 \pm 0.48	18.83 \pm 7.01	0.06
SBP (mmHg)	117.62 \pm 6.41	113.92 \pm 4.02	0.02*
DBP (mmHg)	77.00 \pm 7.32	78.42 \pm 4.93	0.43
HR (beats/min)	75.92 \pm 5.22	77.21 \pm 2.77	0.29
BMI (Kg/m ²)	23.86 \pm 3.91	26.49 \pm 4.32	0.03*
2D:4D ratio	1.02 \pm 0.06	0.93 \pm 0.11	0.001*

SBP: Systolic blood pressure; DBP: Diastolic blood pressure; HR: Heart rate; BMI: Body Mass Index; 2D: Second digit; 4D: fourth digit, *-p value less than 0.05 is considered to be significant.

The systolic blood pressure (SBP) showed a significant decrease (p=0.02) among the PCOS (113.92 \pm 4.02mmHg) compared to normal (117.62 \pm 6.41mmHg) but was within the normal range.

The Diastolic Blood Pressure (DBP) did not show any significant difference (p=0.43) among

the PCOS (78.42 \pm 4.93mmHg) and the normal (77.00 \pm 7.32mmHg).

Similarly, Heart Rate (HR) also did not show any significant differences (p=0.29) among the PCOS (77.21 \pm 2.77 beats/min) and normal group (75.92 \pm 5.22 beats/min).

2D:4D digit ratio was significantly lower ($p=0.001$) among the PCOS group (0.93 ± 0.11) compared to the normal (1.02 ± 0.06) (Figure 1).

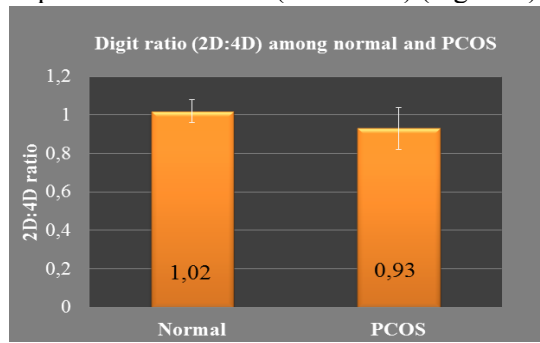


Figure 1. Digit ratio (2D:4D) among normal and PCOS group.

BMI was significantly increased ($p=0.03$) among the PCOS group ($26.49\pm4.32\text{Kg/m}^2$) compared to the normal ($23.86\pm3.91\text{Kg/m}^2$) (Figure 2).

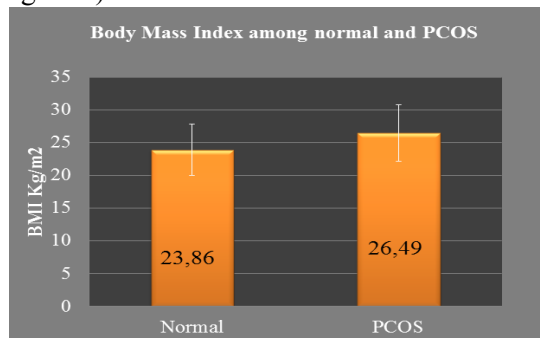


Figure 2. Body mass Index among normal and PCOS groups.

Body fat ($p=0.05$) was found to be significantly increased among the PCOS group ($32.80\pm5.24\%$) compared to normal ($30.22\pm3.56\%$) (Figure 3).

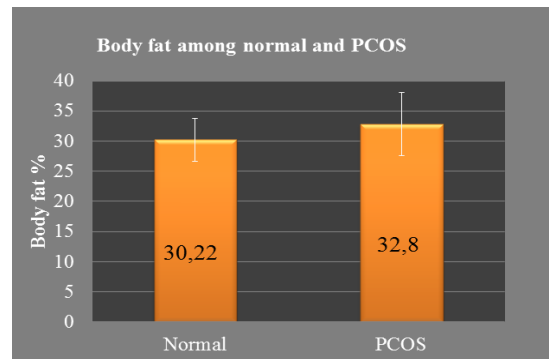


Figure 3. Body fat among normal and PCOS groups.

Similarly, visceral fat ($p=0.01$) also reported a significant increase in the PCOS ($5.74\pm3.02\%$) compared to normal ($3.58\pm1.75\%$) (Figure 4).

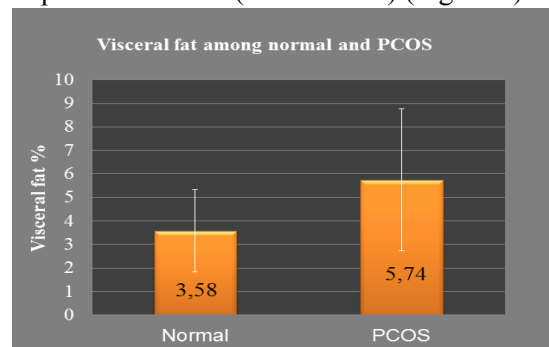


Figure 4. Visceral fat among normal and PCOS groups.

Resting metabolism showed an increase in the PCOS group (1275.5 ± 202.85) compared to the normal (1261.7 ± 140.04) but was statistically insignificant ($p=0.78$).

Subcutaneous fat in whole body ($p=0.85$); trunk ($p=0.76$); arms ($p=0.55$) and legs ($p=0.71$) did not represent any significant difference among the two groups.

Similarly, skeletal fat measured in whole body ($p=0.47$), trunk ($p=0.68$), arms ($p=0.86$) and legs ($p=0.53$) showed no significant changes among the two groups (Table 2).

Table 2. Body fat composition among the two groups.

Parameters	Normal	PCOS	P value
Body Fat (%)	30.22±3.56	32.80±5.24	0.05*
Visceral Fat (%)	3.58±1.75	5.74±3.02	0.01*
Resting metabolism	1261.7±140.04	1275.5±202.85	0.78
SC Whole body (%)	27.07±5.02	26.75±6.64	0.85
SC Trunk (%)	23.18±4.91	22.69±6.33	0.76
SC Arms (%)	44.37±5.82	43.30±6.70	0.55
SC Legs (%)	40.82±6.71	40.00±8.29	0.71
SK Whole body (%)	25.58±2.13	26.00±1.91	0.47
SK Trunk (%)	20.48±2.28	20.78±2.69	0.68
SK Arms (%)	27.27±3.90	27.49±5.32	0.86
SK Legs (%)	38.13±2.07	38.43±1.33	0.53

SC: Subcutaneous; SK: Skeletal; *-p value less than 0.05 is considered to be significant.

BMI showed significant positive moderate correlation with body fat ($r=0.65$) ($p<0.001$) and visceral fat ($r=0.76$) ($p<0.001$).

Digit ratio was found to be negatively correlated with body fat ($r=-0.19$) ($p=0.24$);

visceral fat ($r=-0.16$) ($p=0.29$) and BMI ($r=-0.17$) ($p=0.26$) but the results were statistically insignificant (Table 3).

Table3. Correlation between 2D:4D digit ratio, body fat, visceral fat and BMI.

	2D:4D ratio		Body fat		Visceral fat		BMI	
	r	p	r	p	r	p	r	p
2D:4D ratio	-	-	-0.19	0.24	-0.16	0.29	-0.17	0.26
Body fat	-0.19	0.24	-	-	0.63	<0.001	0.65	<0.001
Visceral fat	-0.16	0.29	0.63	<0.001	-	-	0.76	<0.001
BMI	-0.17	0.26	0.65	<0.001	0.76	<0.001	-	-

p value less than 0.05 is considered to be significant; r represents Pearson’s correlation.

Discussion

In the present study, 2D:4D ratio was significantly decreased among the PCOS group while BMI, body fat and visceral fat showed a significant increase.

Digit ratio didn’t report any statistically significant correlation with BMI, body fat and visceral fat. BMI was positively correlated to body fat and visceral fat.

Studies carried out, among women of variable age groups found that digit ratio is decreased among the PCOS group and this characteristic feature can be employed for early estimation [15,16].

A study has reported the association between low digit ratio and delayed menarche, indicating greater androgen exposures during fetal life [4].

In our study significant decrease was observed in the digit ratio among the PCOS group, indicating the increase androgen exposure.

In our study, visceral fat was significantly increased in PCOS group.

Studies report that PCOS women frequently present with central obesity due to masculinized body fat distribution consisting of deposition of energy in visceral adipose tissue [17].

In women with PCOS, visceral fat plays a major role in development of hyperandrogenism through insulin resistance and compensatory hyperinsulinism [18].

Similarly, BMI was increased among the PCOS group as stated in previous studies [19].

Whether obesity leads to PCOS or PCOS leads to obesity is always a debatable issue.

It is reported that body fat percentage is an indicator of inflammation due to fat accumulation [20].

In our study skeletal and subcutaneous fat distribution did not report any significant differences among the two groups.

A cohort study carried out on 132 women, reports that subcutaneous and skeletal fat were significantly increased among the PCOS group [21].

We did not find any significant difference, which may be probably due to the varied sample size, and the selected age group.

Limitations involved are: smaller sample size, hormone levels were not used for analysis and the study is of cross-sectional type due to which we cannot find the exact link or the physiological basis of decrease in the digit ratio and increased body fat.

Conclusion

Digit ratio (2D:4D) and body fat measured using bioelectric impedance are simple and powerful non-invasive tool for evaluating the high risk PCOS adolescents and thus provide a better approach for planning early lifestyle modifications in adolescents.

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Conflict of Interest

None to declare.

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