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Original Research Article

A Study of Correlation between Heart Rate Variability and Anthropometric Profile in Women with Polycystic Ovary Syndrome

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Abstract:

Background: Polycystic ovary syndrome (PCOS) is a reproductive endocrinopathy and metabolic disorder, affecting 5%-10% women of reproductive age group.

Objectives: To determine and compare anthropometric profile (BMI,WHR, Body Fat%) of PCOS women with control group and find out correlation of anthropometric parameters with autonomic modulation (evaluated by HRV) in the PCOS women.

Method: This case control study was conducted in RNT Medical College and Attached Group of Hospital, Udaipur (Rajasthan). The sample size of 160 women diagnosed with PCOS were included in this study with equal number of the control group. HRV was recorded by computerized Physiograph. Anthropometric measurements like body weight, height, waist circumference, hip circumference were assessed by using standardized instrument and body fat% was calculated by using formula.

Result: All anthropometric measurements except height were significantly (P<0.001) higher in PCOS women than healthy individuals. A significant negative correlation was observed in BMI and Body fat% with pNN50%, RMSSD and total power parameters of HRV. Whereas a significant positive correlation with LF/HF parameter.

Conclusion: Our study concluded significant correlation between anthropometric profile and heart rate variability in PCOS women.

Keywords: Polycystic ovary syndrome, Autonomic nervous system, Obese, BMI, WHR, BODY FAT% ,Heart Rate Variability.

Introduction

Polycystic ovary syndrome is a reproductive endocrinopathy and metabolic disorder, affecting 5%-10% women of reproductive age group[1]. It's manifestation includes menstrual disturbances, acne, hirsutism, obesity and infertility. Under Rotterdam criteria (2003) which have been accepted throughout the world, PCOS can be diagnosed when at least two of following three clinical features is present: hyperandrogenism (HA), oligomenorrhea/ amenorrhea or anovulation and polycystic ovary morphology[2] .

Most of the PCOS women (50%) are overweight or obese as assessed by their BMI and they have android pattern of fat distribution [3,4]. Obesity appears to exert an additive, synergistic impact on the manifestations of PCOS, independently and negatively affecting insulin sensitivity, risk of diabetes and cardiovascular profile [5,6].

PCOS also correlated with hyperlipidaemia, abdominal obesity, hypertension[7,8] which are report to be related to sympathetic hyperactivity[9,10]. Now a days, the correlation between increased sympathetic activity and PCOS has been reported, assessed by heart rate variability (HRV), most commonly used method to evaluate the modulation of autonomic nervous system[11,12].

The purpose of this study is to compare anthropometric profile (Body Mass Index, Waist Hip Ratio, BODY FAT%) of PCOS women with control group and find out correlation of anthropometric parameters with autonomic modulation (evaluated by HRV) in the PCOS women.

Material & Method

This case control study was conducted in RNT Medical College and Attached Group of Hospital, Udaipur (Rajasthan) after getting approval from IRB and IEC[NO.RNT/ACAD./IEC/2022/289 dated on 13/09/2022]. The sample size of 160 women

diagnosed with PCOS by Rotterdam criteria were included in this study with equal number of the control group. Subjects were recruited with written consent. Subjects were excluded:

(i) Patients having history of diabetes mellitus, hypertension, thyroid disorder, cardiovascular disorder, pace maker, pregnant and lactating mother.

(ii) Patients taking oral contraceptives, hypoglycemic agents, lipid lowering agent and hormonal medications within previous 10-12 weeks.

(iii) Patient taking any medication that affects ANS (adrenergic and cholinergic drugs)

(iv) Malignancy or carcinoma of female reproductive system.

Anthropometric measurements (BMI- Kg/m^2)) like height in cm and weight in kilograms were measured. Height measuring scale was used to measure height- the study participants stood in their upright position, arms by their sides and footwear removed and the weight was measured by using electronic weighing machine.

WHR is a simple measure of central obesity for this waist circumference (WC) was measured in standing position, halfway between the lower ribs and superior anterior iliac spine of the pelvis. Hip circumference (HC) was measured at level of the pubic symphysis.

BODY FAT% was calculated by using formula-

Body fat % = (1.39 x BMI) + (0.16 x AGE) – (10.34 x Gender) – 9

With gender equal to 1 for men and 0 for women (International journal of obesity and related metabolic disorders in 2002).

Heart Rate Variability (HRV) is a highly sensitive non-invasive indicator of autonomic functions. Short term HRV recording was used for this study. After, a 15 minute rest in the supine position, HRV was recorded in the 5 min lead– II ECG. In this study, variations in heart rate was analysed by time domain method and frequency domain method.

(a)Time Domain Method - One of the simplest method to perform variations in heart rate. These methods involve finding out either the heart rate at specific points in time or the intervals between successive heartbeats. In a continuous electrocardiographic (ECG) recording, each QRS complex is identified, allowing for the measurement of normal-to-normal (NN) intervals, which are the intervals between adjacent QRS complexes resulting from sinus node depolarization, or the instantaneous heart rate. Simple time–domain variables that can be calculated include the Mean RR interval, standard deviation of normal to normal interval (SDNN), root mean square of differences of successive normal to normal intervals (RMSSD) of HRV etc.

(b)Frequency Domain Method: The variations in the instantaneous heart rate can be assessed spectrally. RR tachogram is plotted using R-R intervals in the 5 minlead –II ECG. The RR tachogram is a non-periodic signal which is transformed to its frequency spectrum by using fast-fourier transformation (FFT) algorithm or autoregressive modeling (ARM). In this complex mathematical transformation, the distribution of magnitude of variations in different frequency bands corresponds to activity of different physiological systems. The entire frequency spectrum 0-0.4 Hz is divided as follows-

(i)A high frequency band (HF) 0.15-0.4 Hz- HF component has been used as an index of the vagal drive.

(ii)A low frequency band (LF) 0.04-0.15 Hz- LF component represents mainly sympathetic power.

(iii)A very low frequency band (VLF) 0-0.04 Hz- It accounts for all other heart rate changes (humoral and local factors).

Statistical Analysis: Statistical evaluation was done by using statistical software SPSS version 24. For quantitative data mean, SD were calculated and correlation coefficient for linear relationship between two variables and for statistical inference student "t" test was used for mean difference between two quantitative variables. P value <0.001 was considered as statistically significant.

Results-

Table 1: Comparison of Anthropometric Measurements in cases and controls-

Indicators	Case	Control	P – Value
Weight (kg)	57.94 ± 12.54	51.70 ± 9.82	**<0.001**
Height (cm)	158.90 ± 2.97	159.65 ± 3.19	0.03
BMI	22.91 ± 4.73	20.24 ±3.53	**<0.001**
Waist circum(inch)	30.28 ± 4.75	27.52 ±3.18	**<0.001**
Hip circum(inch)	36.93 ± 4.34	34.91 ± 3.16	**<0.001**
WHR	0.82 ±0.06	0.79 ±0.05	**<0.001**
Body fat%	26.7 ± 6.9	22.2 ± 4.8	**<0.001**

(The values are expressed as mean ± standard deviation. P<0.001 considered as highly significant).

Table no-1 presenting a composite picture of mean value of all anthropometric measurements- Height,

Weight, Body Mass Index (BMI), Waist circumference, Hip circumference, Waist Hip Ratio (WHR) and Body fat % of all cases and controls, all measurements except height are significantly ($P < 0.001$) higher in PCOS women than healthy individuals and height parameter is elevated in controls but not significantly.

Table: 2 Correlation analysis between Anthropometric Measurements and Time domainparameters of HRV in PCOS cases-

		Mean RR interval (ms)	SDNN	pNN50%	RMSSD (ms)
BMI	Pearson Correlation {r}	-0.085	-0.082	**-0.155****	**-0.124***
	P Value	0.130	0.142	0.005	0.026
WHR	Pearson Correlation {r}	-0.003	0.006	-0.090	-0.040
	P Value	0.953	0.909	0.108	0.471
BODY FAT%	Pearson Correlation {r}	-0.083	0.076	**-0.172****	**-0.134***
	P Value	0.144	0.176	0.002	0.017

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table no-2 presenting a negative correlation between BMI of PCOS patients and time domain parameters of HRV, significantly correlated with pNN50%, RMSSD and similarly Body fat % of cases was also significantly negative correlated with pNN50% and RMSSD time domain parameters of HRV. Nostatistically significant correlation of WHR was found with time domain parameters of HRV.

Table: 3 Correlation analysis between Anthropometric Measurements and frequency domain parameters of HRV in PCOS cases-

		Total power	LF (ms2)	HF (ms2)	LF (nu)	HF (nu)	LF/HF
BMI	Pearson Correlation {r}	**-0.128***	0.072	-0.087	0.012	0.009	**0.130***
	P Value	0.022	0.199	0.119	0.826	0.867	0.020
WHR	Pearson Correlation {r}	-0.010	0.098	-0.043	0.010	0.007	0.087
	P Value	0.856	0.079	0.448	0.864	0.894	0.119
Body fat %	Pearson Correlation {r}	**-0.135***	0.083	-0.100	0.014	0.010	**0.149****
	P Value	0.017	0.143	0.078	0.811	0.855	0.008

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table no-3 presentinga significant negative correlation between BMI and total power and significant positive correlation between BMI and LF/HF in PCOS cases. There was also a significant inverse correlation between Body fat% and total power parameter of HRV and positive correlation between Body fat% and LF/HF in PCOS cases. No significant correlation was found between WHR and frequency domain parameters of HRV.

High frequency band (HF) indicates vagal activity and low frequency band (LF) represents mainly sympathetic power. This LF/HF ratio is a marker of sympathovagal balance.

Discussion

In our study, when we compared the anthropometric measurements between PCOS women and non PCOS women. BMI,WHR and body fat % were found to be significantly more in women with PCOS than in women without PCOS (table-1).Similarly, Chae JS (2008) [13] studied the correlation between clinical and biochemical characteristics of PCOS among Korean women and showed more values of body mass index ($P < 0.001$) and waist-to-hip ratio ($P < 0.001$) than other group. Similarly Shah AK (2017) [14] had findings which are closely matched with our results, stating that all the anthropometric measurements except height was significantly ($P < 0.001$) higher in cases compared to controls. This has also been approved by a study conducted by Morin-Papunen LC et al (2000)[15] which found out PCOS subjects had higher mean WHR than the controls.

In our study, though, all women with PCOS were in non-obese category yet seem to have significantly higher BMI, WHR and body fat % as compared to healthy individuals. This can be attributed to higher biochemical and hormonal parameter such as affecting lipid profile, blood sugar level and cardiometabolic profile of PCOS cases. Evaluation of these parameters is of predominant in early diagnosis of PCOS and its monitoring.

Our study showed that there was sympathovagal imbalance with high sympathetic dominance in women with PCOS which indicates a reduced HRV. DeSá, Joceline Cássia Ferezini et.al.(2010) [16] also observed that PCOS was associated with alterations in the autonomic modulation of heart rate, may be due to the impact of weight gain. There was a significant negative correlation between BMI and SDNN, LF and HF, indicating a decrease in the autonomic modulation of heart rate with increasing weight. Our study has indicated negative correlation between heart rate modulation in cases with increased weight or BMI. Our study also demonstrated significant positive associations of BMI and body fat % with LF/HF of HRV in women with PCOS, highlighting alterations in the autonomic modulation of heart rate, possibly due to the influence of central obesity.

Conclusion

This study concludes that obesity especially central adiposity in women with PCOS is one of the important risk factors for the development of metabolic derangement and autonomic dysfunction and this accelerates the future possibilities of cardiovascular disorders. Since alteration in autonomic modulation is an early marker of cardiovascular dysfunction, assessment of autonomic functions should be made mandatory for all women with PCOS to prevent cardiac diseases soon. Moreover, early detection will enable an early intervention in the form of diet, exercise and lifestyle modification which decreases the central adiposity and Seventually insulin resistance and dyslipidaemia and therefore may result in improving the cardiovascular health.

Ethical Approval and Consent to Participate-

This case control study was conducted in RNT Medical College and Attached Group of Hospital, Udaipur (Rajasthan) after getting approval from IRB and IEC [NO.RNT/ACAD./IEC/2022/289 dated on 13/09/2022]. Subjects were recruited with written consent.

List of abbreviations- PCOS, ANS, HRV, LF, HF, SDNN, RMSSD, pNN50%, BMI, WHR,

Conflict of Interest: No conflict of interest.

Authors' contribution:

SC- Study design, definition of intellectual content, literature search, statistical analysis, manuscript preparation and manuscript re- view, and editing.

UC- literature search and statistical analysis.

SS- Data collection and Lab work.

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