



TO STUDY THE INFLUENCE OF PROGRESSIVE RESISTANCE TRAINING AND YOGASANA ON BODY COMPOSITION, FASTING PLASMA GLUCOSE IN PCOS (POLYCYSTIC OVARIAN SYNDROME) INDIVIDUALS.

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ABSTRACT

Background: Polycystic ovarian syndrome (PCOS) is a complex endocrine disorder affecting 8-12% of reproductive aged women, currently recognized as the leading cause of anovulatory infertility.

Aim: To study the influence of progressive resistance exercises and yoga asanas on body composition, fasting plasma glucose in polycystic ovarian syndrome Individuals.

Methodology: At baseline, recruited polycystic ovarian syndrome individuals have underwent a detailed clinical examination as per the attached proforma. A detailed anthropometric assessment including measurement of weight, height and waist circumference are done as part of the clinical assessment. Additionally a body composition analysis was performed on a body composition analyzer of Model N20. They were called in the fasting state for plasma glucose (FPG), by using a one-touch glucometer. Then the individuals were divided randomly into 2 groups: group 1 were trained with PRT and group 2 with yogasanas under supervision for 3 months then the post values of body composition and fasting plasma glucose were collected after completing the study period.

Results: The pre and post experimental mean value, t-test and p values of all the outcomes that is body composition, fasting plasma glucose shows significance (0.05) in both the groups.

Conclusion: The present study accepts alternate hypothesis and rejects null hypothesis. Hence, the study concludes that PRT and yogasana shows a significant improvement in anthropometric changes, body composition and fasting plasma glucose at 0.05 level of significance.

Keywords: Polycystic Ovary, Progressive Resistance Training, Yogasana, Body Composition, Plasma Glucose.

Introduction :

Polycystic ovarian syndrome is a complex endocrine disorder affecting 8-12% of reproductive aged women, currently recognized as the leading cause of anovulatory infertility in reproductive aged women.^{1,2,3}

Diagnosis of polycystic ovarian syndrome is done by clinical or bio-chemical hyperandrogenism, anovulatory menstrual dysfunction and polycystic ovaries on ultrasound in the absence of other causes including pituitary and adrenal dysfunction.^{4,5,6}

Insulin resistance is highly associated with reproductive and cardiometabolic (impaired glucose tolerance and metabolic syndrome) complications of the disorders.^{7,8,9}

Among the samples tested east India shows alarming levels of 25.88% women affected by polycystic ovary syndrome followed by 18.62% in north india.¹⁰

Further, 40-60% of women with polycystic ovarian syndrome are either overweight or obese with increased central adiposity and the incidence of insulin resistance is 50%.^{11,12} The pathophysiology remains unclear. The root cause of polycystic ovarian syndrome is stress and obesity.¹³

Hence, apart from pharmacological therapy, life style modification plays a major role in handling pcos. Life style modification includes altered diet composition and increased physical activity, including weight loss remains first line management to improve cardiovascular risk factors and reproductive dysfunction.^{14,15,16}

Weight loss is achieved through energy restriction. Regulation of insulin sensitivity and ovulation rates is achieved with or without modifying nutrient composition. Though specific dietary compositions leads to improvements in health outcomes among women with polycystic ovarian syndrome. Modest weight loss, weight maintenance remains a long term challenge in health sector.^{17,18,19}

Physical exercise and yoga asanas has taken a upper hand to face the long term challenges like weight regulation and regulation of physiological changes of body organ systems. Incorporating progressive resisted exercise and yoga asanas as a treatment of choice helps to regulate physical changes, reproductive function, metabolic and cardiovascular changes.^{20,21}

Physical activity enhances energy expenditure and regulates obesity to have a prolong and sustained efficacy

with exercise can be achieved with progressive resistance training.^{22,23}

Yoga is a traditional Indian culture and way of life which is purported to give the practitioner a "Healthy body and a sound mind" and is believed to alleviate stress and include relaxation, warm ups and stretching, postures, affirmation and visualization.²⁴

Yogasanas apart from regulating lifestyle has its effect on systemic changes among them regulation of endocrine system through asanas plays a major role, so it will increase the insulin sensitivity, obesity and efficacy of Progressive resistance training and yogasanas on polycystic ovarian syndrome individuals.²⁵

Need of the study:

Many of the studies have done on weight loss and ovulation cycle for shorter duration and results of the study revealed a positive change in regulation of weight and ovulation. The limitations of most of the studies indicate that the study needs to be done for longer periods and evaluation of cardiovascular risk factors and insulin resistance stands still. Moreover, the influence of various supervised exercises like progressive resisted exercises and yoga on insulin resistance and cardio vascular factors needs to be studied.

Aim:

The aim of the study is to know the influence of progressive resistance exercises and yoga asanas on body composition, fasting glucose in PCOS (Polycystic ovarian syndrome) individuals.

Objectives:

To study the effect of progressive resistance exercises (PRT) and yoga asanas on weight and body composition using N2Obody composition analyser and Fasting plasma glucose using one- touch glucometer in individuals with the PCOS.

MATERIALS:

- N2O Bodycomposition analyser
- One-touch glucometer.

Study design: This is a prospective longitudinal randomized study.

Study duration: 3 months

Study setup: The study was performed in the departments of endocrinology and physiotherapy at SVIMS, Tirupati.

Study subjects: PCOS individuals aged 18-40 years diagnosed as polycystic ovarian syndrome based on the Rotterdam criteria mentioned in the inclusion criteria are recruited into the study after taking their informed consent.

Sampling: simple randomised sampling through lottery method.

Sample size: Study is a pilot study. Individuals are

randomly selected using lottery method. 30 samples 15 PCOS individuals in group-1 and 15 PCOS individuals in group-2 as per inclusion criteria.

Inclusion criteria:

1. Patients fulfilling Rotterdam criteria for PCOS namely the presence of any two of the following :
 - a) Polycystic Ovaries on either one or both sides based on ultrasonography
 - b) Clinical hyperandrogenism as evidenced by a modified Ferriman Gallway score of 8 or more AND / OR biochemical hyperandrogenism as evidenced by a total testosterone > 0.6 ng/ml.
 - c) Oligomenorrhea (I.e < 9 menstrual cycles per year or a menstrual cycle length > 40 days) OR Amenorrhea (I.e > 3 months without periods).

AND

2. Age: 18-40 years.
3. Consent to participate in the study.

Exclusion criteria:

1. Ovarian or adrenal tumors
2. Virilization or a testosterone > 2 ng/ml
3. Suspected or documented congenital adrenal hyperplasia
4. Intake of Androgens
5. Pregnancy or lactation
6. Estrogen use
7. Untreated or inadequately treated over Hypothyroidism (TSH > 10 μ IU/L)
8. Hyperprolactinemia (prolactin > 26.72 ng/ml)
9. Diabetes mellitus as newly diagnosed by a fasting plasma glucose greater than 126 mg/dl or HbA1c greater than 6.5 % or a casual plasma glucose greater than 200 mg/dl (in the presence of osmotic symptoms and weight-loss). Further, if an oral glucose tolerance test has been done, then a 2hours post glucose value of more than or equal to 200 mg/dl will be considered as a diagnostic threshold for diabetes. In the absence of significant hyperglycemia a second abnormal result in any of the above parameters will be required to diagnose diabetes mellitus (ADA 2010).
10. PCOS individuals on antidiabetic or glucose lowering medication
11. Not consenting for the study.

METHODOLOGY:

At baseline, recruited polycystic ovarian syndrome individuals have underwent a detailed clinical examination as per the attached Performa. A detailed anthropometric assessment including measurement of weight, height and waist circumference are done as part of the clinical

assessment. Body mass index are calculated. Additionally a body composition analysis was performed using body composition analyzer of Model N20.

PCOS individuals were called in the fasting state to collect plasma glucose (FPG), by using a one- touch glucometer. Then the individuals are randomly allocated into 2 groups: and baseline values of body composition with parameters and fasting plasma glucose were collected. Group 1 were trained with progressive resistance training and group 2 were trained with yogasanas. 3 months after intervention the same parameters were collected.

Group: 1 PROTOCOL

- Lat pull down,
- Leg curl,
- Seated row,
- Leg press,
- Calf raise,
- Chest press,
- Split squat,
- Shoulder press,
- Biceps curl,
- Triceps extension and
- Abdominal curl.

All sets (except abdominal curl) were performed to avoid neuromuscular fatigue. **Intensity** 8-12 repetitions maximum, **Frequency** 2 sets, **duration-** 2 weeks. From 3rd week, all exercises except **split squats** and **shoulder press** are progressed to **3 sets**.

The home-based calisthenics exercises on non-PRT day includes:

- Lying external hip rotations ('clam shells'),
- Side leg raises,
- Push-ups on knees,
- Wall squats, oblique curls,
- Core stabilization exercises ('bird dog' and abdominal hollowing)

Performed for 3 sets x 10 repetitions each. PCOS individuals were received a different set of callisthenic home-based exercises every four weeks. PCOS individuals were asked to record the number of repetitions of each exercise performed in a log book. The records were collected weekly.

PCOS individuals in the PRT group were prescribed two supervised training sessions per week on non-consecutive days (i.e. Monday, Wednesday or Friday) for 12 weeks in department of physiotherapy, SVIMS. The PRT group were performed two home-based (unsupervised) exercise sessions consisting of lower-intensity calisthenics to

facilitate habitual movement and behaviour change. Supervised sessions were lasted for approximately 60 min, and which includes a standardized (5 min) warm-up and cool-down on exercise cycle or treadmill.

Group II: YOGASANA

All the below each asanas are done for 1min for 50 minutes in a day, five days in week. All the below asanas are done under supervision of yoga instructor in department of physiotherapy, SVIMS.

YOGA	TIME
Group lectures: <i>Lectures, in the form of cognitive restructuring based on the structural philosophy underlying yogic concepts.</i>	6 Min
• <i>Surya Namaskara</i>	10 Min
Standing asanas	
• <i>Trikonasana</i>	1 Min
• <i>Parsva- konasana</i>	1 Min
• <i>Parsvottanasana</i>	1 Min
• <i>Prasarita Padothanasana</i>	1min
Sitting Asanas	
• <i>Paschimottanasana</i>	1 Min
• <i>Baddha konasana</i>	1 Min
• <i>Malasana</i>	1 Min
• <i>Ustrasana</i>	1min
• <i>Matsyasana</i>	1min
• <i>Pavanamuktasana</i>	1min

Twisting	
• Vakrasana	1 Min
• Bharadwajasana	1 Min
• Ardhamatsyendrasana	1 Min
Prone Asanas:	
• Bhujangasana	1 Min
• Salabhasana	1 Min
• Dhanurasana	1 Min
Supine topsy turvey	
• Uttanapadasana	1min
• Naukasana	1min
• viparita Karani	1min
• Sarvangasana	1min
• Halasana	1min
Kriyas and bandhas	
• Agnisaradhautikriya	1 Min
• Nauli kriya	1 Min
• Uddiyana bandha	1 Min
Savasana	5 Min
Pranayamas	5Min

Statistical analysis:

Statistical analysis has been carried out to analyse the significant impact of the progressive resistance training and yogasanas issued to the subjects of both the group-1 and group-2 by using SPSS 16.0 version. For that the data has got entered into Microsoft excel sheet and tabulated then it has subjected to Statistical analysis.

The total sample (N=30) has randomly divided into two groups that is group-1(PRT) and Group-2(yoga); and in each group consists of 15 subjects. All the subjects completed the protocol for 3 months without any interruption.

The outcomes of this study are:

1. Body composition.
2. Fasting plasma glucose.

To compare the pre and post therapeutic effects within the groups, the simple t-test was performed. Then the paired t-test has performed between the outcomes values of group-1 and group-2.

Table: 1 pre and post mean values of weight, BMI, WC of PCOS individuals of PRT group.

Parameters	N	intervention	Mean ±SD	df	t-value	p-value
Weight (kgs)	15	pre	89.4±36.6	20	0.258	19.290
		post	86±27.0			
BMI	15	pre	31.3±12.5	5	2.656	0.490
		post	28±9.4			
WC(cms)	15	pre	104.6±29.0	8	0.655	1.600
		post	96±16.3			

Table: 2pre and post mean values of weight, BMI, WC of PCOS individuals of YOGA group.

Parameters	N	intervention	Mean ±SD	df	t-value	p-value
Weight (kgs)	15	pre	73.77±3.1	10488	1.168	0.05
		post	72.36±1.23			
BMI	15	pre	25.06±1.39	31.848	1.019	0.05
		post	24.97±1.02			
WC(cms)	15	pre	93±23.0	0.6198	1.456	0.05
		post	87±23.3			

Table 3: shows the pre and post mean values of various body composition analyser parameters of pcos individuals in PRT group1.

Parameters	N	Intervention	Mean ±SD	df	t-value	p-value
body water(%)	15	pre	42.48±8.71	14	6.87	0.05
		post	37.70±7.54			
fat free mass(gms)	15	pre	43.58±9.31	14	4.96	0.05
		post	46.37±8.67			
muscle mass(gm)	15	pre	36.53±7.90			0.05

s)		post	39.33±6.51	14	8.70	
visceral fat area (gms)	15	pre	89.10±17.82	14	4.16	0.05
		post	87.76±16.41			
arm muscle mass(gms)	15	pre	1.92±0.18	14	1.86	0.05
		post	1.64±0.32			
leg muscle mass(gms)	15	pre	7.09±1.62	14	3.86	0.05
		post	4.96±1.01			
trunk muscle mass (gms)	15	pre	19.54±5.14	14	4.21	0.05
		post	16.62±4.36			
waist hip ratio	15	pre	0.87±0.17	14	2.03	0.05
		post	0.81±0.60			
% of body Fat	15	pre	41.25±8.65	14	9.28	0.05
		post	38.16±7.91			

Table 4: pre and post mean values of various body composition analyser parameters of pcos individuals in yoga group2.

Parameter	N	intervention	Mean ±SD	df	t-value	p-value
body water (%)	15	pre	45.03±9.06	14	2.89	0.05
		post	43.96±8.92			
fat free mass (gms)	15	pre	34.01±7.14	14	3.96	0.05
		post	30.16±6.01			
muscle mass(gms)	15	pre	33.19±7.36	14	2.88	0.05
		post	31.52±6.11			
visceral fat		pre	81.52±16.32	14	5.16	0.05

area (gms)	15	post	78.16±15.73			
arm muscle mass (gms)	15	pre	1.49±0.29	14	1.96	0.05
		Post	1.30±0.27			
leg muscle mass(gms)	15	pre	5.81±1.16	14	2.86	0.05
		post	3.11±1.01			
trunk muscle mass (gms)	15	pre	15.41±3.08	14	4.31	0.05
		post	12.85±2.56			
waist hip ratio	15	pre	0.92±0.18	14	1.87	0.05
		post	0.86±0.14			
% of body fat	15	pre	38.15±7.63	14	3.79	0.05
		post	35.67±7.14			

Table: 5 pre and post mean values of fasting plasma glucose in PRT GROUP 1 and YOGA GROUP 2.

Groups	N	Intervention	Mean ±SD	df	t-value	P-value
PRT	15	Pre	117.13±23.41 (mg ms/d l)	14	7.01	0.05
		Post	110.87±22.17 (mg ms/d l)			
YOGA	15	Pre	109.20±21.61 (mg ms/d l)	14	4.25	0.05

			105.6 7+20. 43 (mg ms/d l)			
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Result:

The pre and post experimental mean value, t-test and p values of all the 2 outcomes that is body composition, fasting plasma glucose shows significance (0.05) in both the groups.

Discussion:

The aim of the present is to know the influence of progressive resistance exercises and yoga asanas on body composition, fasting glucose in PCOS (Polycystic ovarian syndrome) individuals.

As per the inclusion criteria, 30 polycystic ovarian syndrome individuals were taken for the study, they are randomly allocated into two groups. Group-1 with 15 pcos individuals underwent training of progressive resistance training exercises for 3 months and Group- 2 with 15 pcos individuals underwent training of yogasana for 3 months. Anthropometric measurements (BMI, weight, waist circumference), body composition parameters and fasting plasma glucose are the outcomes recorded from day 1 (pre-intervention) up to 3months (post-intervention) .

Pre and post intervention mean values of weight, BMI, waist circumference and body composition of group 1(from table .1 and table.3).

In the present study it has been reported that pcos individuals in group 1 with progressive resistance training exercises showed in mean value, of **weight** from 89.4 ± 36.6 (pre- intervention) to 86 ± 27.0 (post intervention), mean value of **BMI** from 31.3 ± 12.5 (pre-intervention) to 28 ± 9.4 (post intervention), mean value of **waist circumference** from 104.6 ± 29.0 (pre- intervention) to 96 ± 16.3 (post intervention) ,the values are significant $p= 0.05$.

In the present study it has been reported that pcos individuals in group 1 with progressive resistance training exercises showed in mean value of **fat free mass** from 43.58 ± 9.31 (pre intervention) to 46.37 ± 8.67 (post intervention), mean value of **muscle mass** from 36.53 ± 7.90 (pre intervention) to 39.33 ± 6.51 (post intervention) ,the values are significant $p= 0.05$.

Muscle remodeling in resistance training reflects a complex process of cell receptor interaction with different hormones and DNA - mediated production of new contractile proteins. The specific exercise response to muscular overload initially links to configuration of the exercise stimulus- intensity, frequency, volume, and sequence mode and recovery interval .^{26.1}

Resistance exercise training improves over all muscular

size, strength and power. Hormonal factors responsible for exercise induced changes in muscle size and function include changes in hepatic and exercise hepatic hormone clearance rates, differential of hormone secretions (and accompanying fluid shifts around the receptor sites.), altered receptor -site activation via neurohumoral control. In general, early phase adaptations to resistance training reflect a hormonal response that mediates neuromuscular system adaptations which enhances muscle strength .Increased muscle strength and muscle mass in obese individuals decreases the number of adiposities which in turn regulates the BMI and reduce obesity. ^{26.2}

The physiological adaptations to resistance training are increase in muscle strength, increase basal metabolism, and increase in vo2 max and improvement in body composition with regulation of body fat percentage and lean body mass. ^{26.3}

Exercise induces elevated beta- endorphins and other opioid like hormones contributes to euphoria, increased pain tolerance, exercise tolerance and altered menstrual function. ^{26.4}

It is supported by **Liza et.al** which states that there is reduction in waist circumference, significant improvement in BMI and body weight in pcos individuals with progressive resistance training exercises.²⁷

It is supported by **Gislaine satyko Koqure et.al** that resistance exercise alone can improve hyperandrogenesim reproductive function and body composition by decreasing visceral fat area , and increasing lean muscle mass , but it has no metabolic impact in women with polycystic ovarian syndrome.²⁸

It is supported by **Cristina libardi et.al** that progressive resistance training has positive effects on hormonal and physical characteristics of women with pcos.²⁹

Solomon et.al quoted that supervised PRT for 12 weeks resulted in a significant improvement in glycemic and blood pressure control, weight reduction, lipid profile and body composition of Type 2 diabetes patients.³⁰

volkann turan et.al quoted that short term regular exercise programme can lead to improvements in anthropometric, cardiovascular and metabolic parameters of non-overweight with polycystic ovarian syndrome.³¹

Pre and post intervention mean values of weight, BMI, waist circumference and body composition of group 2 (from table .2 and table.4).

The group 2 pcos individuals with yogasana showed improvement in mean value of **weight** from 73.77 ± 3.1 (pre intervention) to 72.36 ± 1.23 (post intervention), mean value of **BMI** from 25.06 ± 1.39 (pre intervention) to 24.97 ± 1.02 (post intervention), mean value of **waist circumference** from 93 ± 23.0 (pre intervention) to 87 ± 23.3 (post intervention),the values are significant $p= 0.05$.

The therapeutic strategy in the management of PCOS is to be directed at management of the patient's presenting

symptoms as well as the cause. Integrated approach to yoga therapy focuses on a holistic principle to address these issues. It believes in targeting the cause of a disorder and not just focusing on symptoms. Yoga is found to have beneficial effects on different metabolic disorders and reducing stress and anxiety that are also associated with PCOS. Although, till date there is no published literature studying efficacy of yoga directly on PCOS.³²

It is supported by **Dhara R. Doshi et.al** beneficial effect of yoga for weight reduction of obese women to improve self control.³³

Shirley Telles et. al ,quoted that A 6-day residential yoga and diet change camp which included 5hours of yoga practice and a high fiber vegetarian diet had the following effects in 47 obese persons: a decrease in the BMI, total cholesterol, high density lipoprotein (HDL), fasting serum leptin levels, waist and hip circumferences, lean mass and the body water content; while postural stability and bilateral hand grip strength increased. A decrease in fasting serum leptin levels was found which suggests of an improvement in energy balance.³⁴

It is quoted in an article by **DK.Mishra et.al**, that yoga practice has potential to control BMI and B.P without taking any medications.³⁵

It is quoted by **Ram nidhi et.al** 12 weeks of holistic yoga programme in adolescents with polycystic ovarian syndrome is significantly better than physical exercise programme in reducing anxiety symptoms and quality of life in adolescent girls with polycystic ovarian syndrome.³⁶

It is supported by **Anjali varma et.al** daily yoga for 30 mins with 4 asana, 4 pranayamas, mediation and savasana helps in weight reduction and stress management which ultimately stabilize the normal functioning of hypothalamic pituitary –ovarian axis.³⁷

Pre and post intervention mean values of fasting plasma glucose in group 1 and group 2(from table 5).

In the present study table 5 shows the statistical analysis of fasting plasma glucose in group 1 and group 2 individuals.

In **group 1** individuals it has been reported **PRT exercises** showed improvement in mean value of **fasting plasma glucose** from 117.13+23.41 (pre intervention)to 110.87+22.17(post intervention).

Possible mechanisms of how regular physical activity improves insulin action and blood glucose homeostasis in type 2 DM ,TNF- ALFA tumour necrosis factor –ALFA a hormone like substance released from active adiposities in abdominal region, which may depress insulin –regulated glucose transport.^{26,5}

It is supported by **Rebecca L. Thomson et.al** that resistance exercise improves insulin sensivity by increasing muscle mass and the number of glucose transporter proteins and aerobic exercise enhances glucose disposal through increases in skeletal muscle

capillarization and blood flow, a hexokinase and glycogen synthase activates.³⁸

In the study of **Liza et.al** quoted that an increase in skeletal muscle mass has been proposed to improve glycemic control by eliciting glucose uptake at the cellular levels in the skeletal muscles.³⁹The above studies support the group-1 of present study revealing that PRT is effective in regulating fasting plasma glucose.

In **group-2**, individuals it has been reported **yoogasana** showed in mean value of **fasting plasma glucose** from 109.20+21.61 (pre intervention) to 105.67+20.43 (post intervention).

In 2004, **Singh et.al** studied the effect of 40 days yogic exercises practiced by 24 type 2DM cases revealed the metabolic and clinical evidence of improvement in glycemic control and autonomic functions.⁴⁰

The metabolic effects of yoga have been most intensely studied for glycemic control. Evidence for improved glucose tolerance and insulin sensitivity suggests that regular asana practice may replace drug therapies in type 2 diabetics .Measureable improvements of clinical significance after yoga intervention are noted in fasting plasma glucose (FPG) and postprandial plasma glucose (PPPG).⁴¹

Balaji et al. noted that increased hepatic lipase and lipoprotein lipase at the cellular level affects the metabolism and subsequent increase in uptake of triglycerides by adipose tissues.⁴²

It is supported by **Ram Nidhi et.al** yoga was found to be more effective than conventional physical exercise in improving glucose, lipid and insulin values including Insulin resistance values in adolescent girls with polycystic ovarian syndrome independent of anthropometric changes.⁴³The above studies support the group-2 of present study revealing that yogasanas is effective in regulating fasting plasma glucose.

Conclusion:

The present study accepts alternate hypothesis and rejects null hypothesis. Hence, the study concludes that PRT and yogasana shows a significant improvement in anthropometric changes, body composition and fasting plasma glucose at 0.05 level of significance.

Limitations:

- Small sample size (N=30).
- Insulin levels would have been measured. The further study is recommended to get large sample size, to measure insulin levels, to study other protocols and other outcomes.

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