



Effectiveness of Callisthenic Exercises on BMI, Waist-Hip Ratio, Depression and Quality of Life in Class 1 Obese Young Adult Girls with Poly Cystic Ovarian Syndrome: An Experimental Study

Aishwarya Sudhakar Wayadande* and Priyanka Honklas

Department of Community Physiotherapy, PES Modern College of Physiotherapy, Shivajinagar, Pune - 411005, Maharashtra, India; aishwaryawa@gmail.com

Abstract

Polycystic Ovarian Syndrome, or PCOS, is estimated to be the most common endocrine illness affecting women of reproductive age, affecting 28% of young women. A trend toward grade 1 obesity is predicted by PCOS patients' BMI when compared to females in the same age group. Body weight exercises, known as calisthenics, involve a variety of movements that employ the body's weight as resistance. Because the movements are relatively easy to learn, pose little risk of harm, and offer a distinct exercise routine that may be more enjoyable, calisthenics may be a beneficial replacement for resistance training. To examine how callisthenic workouts affect young adult girls with PCOS's BMI, waist-hip ratio, depressive symptoms, and QOL. The study's objective was to examine the effect of callisthenic exercises on BMI, waist-hip ratio, depression, and QOL in class 1 obese young adult girls with PCOS. An Experimental study was carried out, in and around Pune city. A total of 52 patients with PCOS, and class 1 obesity were included in this study; with aged 18 to 25 were chosen using simple random sampling. The individuals underwent callisthenic exercises for 6 weeks, the pre- and post-data were measured using the waist-hip ratio, BMI, Beck Depression Inventory, and PCOS Health Related QOL. The study concluded that calisthenics helped class 1 obese young adult girls with PCOS enhance their QOL and lower their BMI, waist-hip ratio, and Beck depression score.

Keywords: Body Mass Index, Calisthenics, Depression, Polycystic Ovarian Syndrome, Quality of Life

1. Introduction

The most common endocrine disorder affecting women of reproductive age is believed to be Polycystic Ovarian Syndrome (PCOS), which affects 28% of young women. Numerous symptoms, such as hyperandrogenism and ovulatory failure, may manifest¹. Women who have PCOS are more likely to experience severe complications. One in five to six women face serious complications related to infertility and irregular menstrual cycles. The main causes include stress, obesity, and hormone fluctuations.

Females aged 18 to 44 are affected by this endocrine disease. The normal functioning of hormones plays

a crucial part in the control of the menstrual cycle and ovarian function, which maintains fertility. The performance of the ovary will be disturbed if there is a persistent hormonal imbalance in females, and this will cause a cyst to form inside the ovary's sac.

While androgen, a male hormone, is elevated above normal levels in females with PCOS².

The traditional signs and symptoms of PCOS, such as amenorrhea, oligomenorrhea, hirsutism, obesity, subfertility, and anovulation. For instance, it has been demonstrated that hirsutism significantly increases psychological stress, and infertility problems can result in anxiety, altered self-perception, and difficulty at work³.

*Author for correspondence

Research has indicated that the likelihood of developing depressive symptoms is higher in women with PCOS compared to healthy women without PCOS⁴. Obesity appears to be the main cause of decreased QOL. Furthermore, it has been shown that acne, hirsutism, and irregular periods all considerably reduce the quality of life. Interestingly, compared to about 50% of women without PCOS who are overweight or obese, between 50% and 90% of women with PCOS are insulin resistant, which leads to impaired glucose tolerance or type 2 diabetes mellitus⁵. Research has generally shown that the traits and co-morbidities associated with PCOS in women have a detrimental effect on emotional outcomes such as anxiety, depression, and quality of life⁵.

Unknown variables may be involved with PCOS. The dysregulation of female reproductive hormones is thought to be the probable reason. It is believed that Insulin Resistance (IR) and the hyperinsulinemia of IR play a significant role in the etiology of PCOS. According to reports, all of these factors contribute significantly to PCOS patients' hyperandrogenism⁶.

By elevating androgen and excessive blood insulin levels, overweight and obesity exacerbate these underlying hormonal imbalances, making the medical characteristics of PCOS in women much more pronounced. Obese people exhibit considerable skeletal muscle IR compared to lean people, who have greater body mass indices in PCOS women. Weight decrease in obese people improves or reverses IR in PCOS women's skeletal muscles⁶.

When compared to women of similar weight and Body Mass Index (BMI), those with PCOS are more abdominally fat. BMI is associated with insulin resistance and cardiovascular illness, and obesity is closely tied to hyperandrogenism⁷.

Women with PCOS, especially those with central obesity, are more likely to develop dyslipidemia, anovulation, and hyperandrogenemia, which are all metabolic and reproductive symptoms of PCOS⁸.

Obesity tends to make PCOS appear more pronounced medically. Certainly, hirsutism and irregular menstruation are more common in obese individuals than in those without obesity-related PCOS. Because of the aforementioned factors, a PCOS patient's quality of life may decline over time⁶.

The principal treatment for PCOS is weight loss. The significance of weight loss is demonstrated by the fact that even a 5% weight loss can improve response to ovulation induction and fertility treatments, as well as restore normal menstruation. The Endocrine Society's

clinical practice guidelines state that diet modification plus exercise therapy is the primary line of treatment for obesity in women and adolescents with PCOS. As for nutritional intervention, the guidelines have not yet recommended a single calorie-restricted diet. Exercise helps obese and PCOS women with their metabolic and reproductive issues, either on its own or in conjunction with calorie restriction in the diet⁵.

Losing weight may help to minimize glucose intolerance, which may help to worsen PCOS's metabolic and reproductive abnormalities. Exercise training has significantly reduced the irregularities of menstrual cycles and ovulation in roughly 50% of women with PCOS, which has a positive impact on body composition⁸.

Strength training is being promoted more and more for improving physical and mental wellness. The use of bodyweight exercises instead of free weights or resistance devices is suggested by alternative methods of strength training⁹.

Body weight exercises, often known as calisthenics, make use of the body's mass as resistance to increase strength through a range of motions. Because the movements are very simple to learn, carry a low risk of injury, and offer a distinct workout practice that may be more pleasurable, calisthenics may be a viable replacement for resistance training⁹.

The term calisthenics originally referred to a set of body weight exercises used in the United States to improve the general fitness level of female school children. The term of Greek origins comes from the words "Kalos" which means beauty and "Stenos" which means strength. In other parts of the world, for example in Australia, such a term indicates a female-only competitive sport that incorporates skills from dance and gymnastics. Over the years, this term has been generalized to a set of bodyweight skills aiming to improve health and fitness. These exercises have been used in different environments such as medical, military, and schools to improve an individual's physical features. The term calisthenics is now used to indicate a defined physical activity with similar features to gymnastics but mainly performed outdoors, in parks, using high bars, parallel bars, and rings. This discipline aims to increase strength in a variety of its expressions, such as performing the maximum number of repetitions of pull-ups or parallel bar dips with and without an external overload, for strength endurance, or to lift the maximum possible weight in the previously mentioned exercises, for maximal strength, and perform gymnastic based skills of increasing difficulty, for isometric strength¹⁰.

The goal of including calisthenics into the regimen was to improve exercise participation, provide more flexibility, and increase overall energy expenditure. This promotes weight loss and the burning of calories⁵. Research on PCOS has demonstrated that exercise and physical activity improve anthropometric measures including body mass index and abdominal body fat in addition to improving the quality of life for PCOS patients⁶.

Callisthenic exercises in young adult ladies with polycystic ovarian syndrome have seldom ever been the subject of research.

So, the current investigation was started.

2. Materials and Methods

2.1 Study Design, Setting, and Ethical Consideration

The Helsinki Declaration was adhered to by the study protocols conducted during the investigation. This study was an experimental one that was carried out in and around Pune, India. The Institutional Ethical Review Committee granted the study ethical clearance. Before the study started, written informed consent was provided by each participant. Following the instructions set forth by the Indian Council of Medical Research, all COVID-19 precautions were followed. Guidelines in the CONSORT-2010 statement were cited for improved trial reporting.

2.2 Study Participants

Patients who satisfy the inclusion and exclusion criteria were taken. Sampling of the population was done by purposive Sampling. Subjects received Callisthenic exercises for a duration of 6 weeks 3 times per week.

2.3 Inclusion Criteria

- Young adult girls diagnosed with PCOS.
- Girls who are willing to participate in a study of age 18-25 years with PCOS.
- Those having BMI score in between 30-34.99 (obesity class 1)
- Girls having waist-hip ratio >0.86.
- Beck depression inventory score 21 or above.

2.4 Exclusion Criteria

- Young adult girl with congenital or acquired injury/deformity.
- Recent abdominal surgery/any recent surgery

- Recent history of injury or accident.
- Young adult girls are already on exercise programs and on medications.

Young adult girls who are having thyroid dysfunction.

2.5 Withdrawal Criteria

- Patients not willing to disclose at an after-intervention score are obtained.
- Patients who do not maintain a follow-up of exercises for more than a week.
- Patients refusing to comply with instructions during examination and study protocol.

3. Procedure

Young adult girls diagnosed with PCOS and who are willing to participate in a study of age 18-25 years with PCOS are selected for the study. Weight and height were assessed to calculate the BMI, and those score in between 30-34.99 (obesity class 1) are included in waist and hip circumferences taken to see that the waist-hip ratio is >0.86 and the Beck depression inventory score 21 or and above are included in the study.

3.1 The Flowchart below is the Diagrammatic Representation of the Methodology Followed

ETHICAL CLEARANCE WAS TAKEN



CONSENT OF THE SUBJECTS SAMPLING



CALLISTHENIC EXERCISES



EXPLANATION OF EXERCISE PROTOCOL



PRE ASSESSMENT: BMI, WAIST-HIP RATIO, BECK DEPRESSION INVENTORY, AND PCOS HEALTH RELATED QOL



TRAINING PROGRAM FOR 6 WEEKS



POST ASSESSMENT

3.2 Outcome Measures

- Beck depression inventory:- Reliability ranged- 0.73 to 0.96 and Validity- 0.93
- Body mass index:- The formula is $BMI = \text{kg}/\text{m}^2$
- Waist-hip ratio:- Waist circumference/Hip circumference
- PCOS health-related quality of life:- Range - 0.89 ± 0.95 and Validity- 0.49 and 0.54

3.3 Intervention

- Callisthenic exercises
- Protocol- 6 weeks
- Total duration of exercises- 45minutes
- Frequency- 3 time/week
- One set of exercise consist of 10 repetitions
- For initial 3 weeks- 2 sets of all exercises with 50 seconds rest after each set of exercise.
- Progression was given by increasing 1 set of exercises after the end of the 3rd week of intervention.

4. Squats

1. Place your feet shoulder-width apart to begin.
2. Take a chair-like stance by bending your knees and pushing your hips back.
3. As low as you can, squat.
4. Push up with your legs as you come back up from the bottom of the exercise.
5. During this exercise, maintain a straight back and head.



Image 1. Squats.

5. Lunges

1. To begin, stand erect, and place your feet in a neutral posture.
2. Step your right foot in front of your body while bending your knee to the right.
3. As the left leg extends, it should almost touch the floor.
4. Bring both feet together and use the heel of the right foot to lift yourself back up to a standing position.
5. Proceed with the left leg.



Image 2. Lunges.

6. Push Ups

1. Begin on the floor with your face down.
2. With the elbows pointing toward the toes, place the hands flat on the floor, slightly wider than the shoulders.
3. With the toes on the ground, extend the legs backward.
4. To maintain a straight body, tighten your core muscles.



Image 3. Pushups.

- To elevate your body, straighten your arms and push the earth away from you.
- Lower your body until your chest nearly touches the floor while bending your arms.

7. Tricep Bench Dips

- Take a seat on the chair's edge and hold onto it with your hips. Point your fingers down at your feet. Your feet should be hip-width apart, your heels on the floor, and your legs extended. Keep your head straight and raise your chin.
- Lift your body by pressing into your palms, then move forward just far enough to allow your behind to clear the chair's edge.
- Lower yourself to a position where your elbows are bent 45 to 90 degrees.
- Return to the starting position by slowly pushing yourself up, and then repeat.



Image 4. Tricep benchdips.

8. Horizontal or Vertical Jump

- To perform a vertical jump, simply stand upright, raise your legs to your chest, and jump as high as you can.
- As previously, stand upright and leap as far as you can for horizontal leaps.

9. Plank

- Assume a push-up position, keeping your forearms flat on the floor.

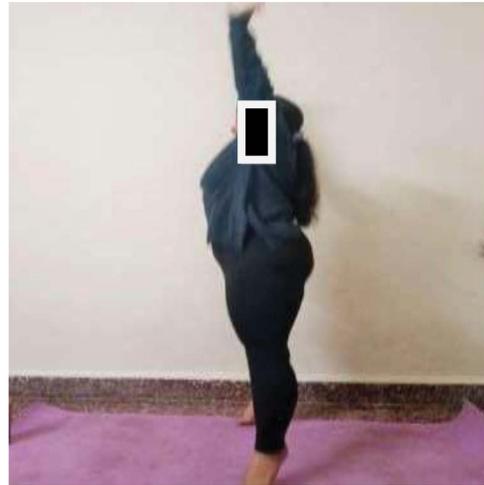


Image 5. Vertical jump.



Image 6. Plank.

- To maintain a straight body, flex the muscles around the core.
- Maintain the posture by keeping your hips from lowering.

10. Curls Up

- Begin by lying on your back with your feet flat on the ground and your knees bent 90 degrees.
- Put your hands across your chest.
- Curl your upper body toward your knees while using your core muscles.
- Take a brief break from the floor and hold the position. Elevate your upper body while maintaining a relaxed head and neck.



Image 7. Curls up.

11. Burpees

1. Place your feet shoulder-width apart to begin.
 2. Lower yourself into a squat until your palms are in contact with the ground by bending your knees.
 3. Leap down into a plank position from the bottom of the squat, landing on the balls of your feet.
 4. Leap forward from the plank position to extend your legs so that your feet touch your hands.
- With your hands raised, leap upward and land back at a standing position.

12. Statistical Analysis

The current study looked at how callisthenic exercises affected class 1 obese young adult ladies with polycystic ovarian syndrome's BMI, waist-hip ratio, depression, and quality of life.

Graph pad INSTAT was used to examine the data. 52 subjects in all took part in the investigation.

The data were analyzed using a variety of statistical methods, including the mean, Standard Deviation (SD), and test of significance. The 95% confidence interval was accounted for.

Parametric tests were used to analyze the data. The statistical tests of significance listed below were applied:

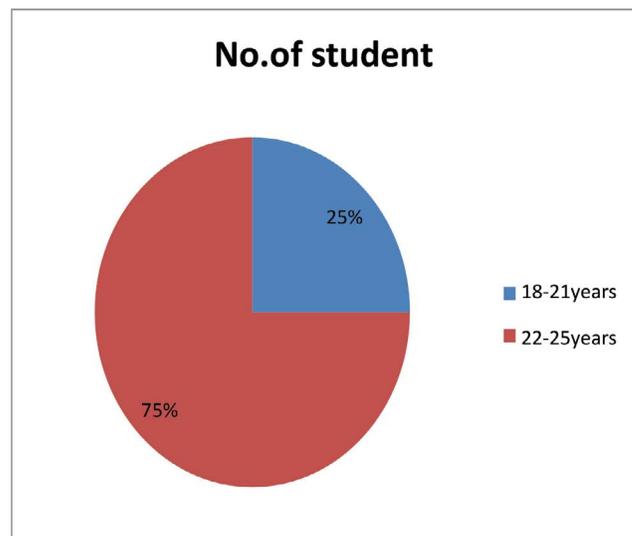
1. The Paired t test was used for intragroup examination of the data. To determine whether there was a difference between the before and post values within each group, a paired t-test was employed.
2. If the p value was less than 0.05, the results were considered statistically significant; if it was greater than 0.05, the results were considered statistically insignificant.

13. Tables and Graphs

13.1 Statistical Analysis of Descriptive Data of Study Population

Table 1. Age wise distribution of subjects in percentage

Age (In Years)	Number of Subject	Percentage %
18-21	13	25
22-25	39	75

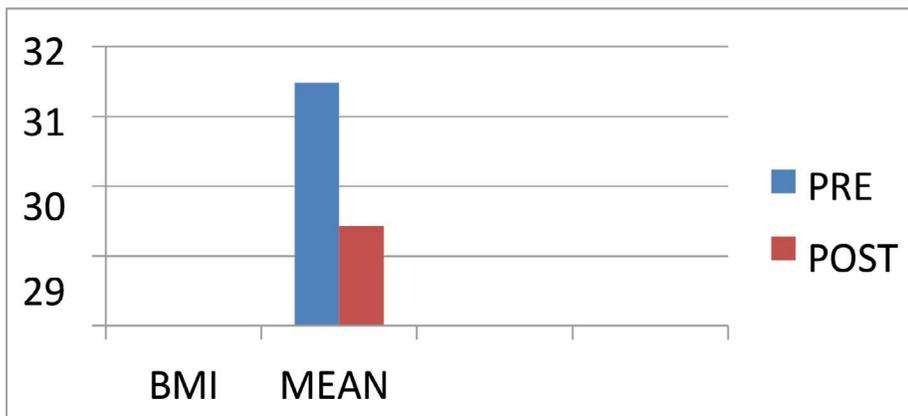


Graph 1. Age wise distribution of subjects.

13.2 Intra-Group Comparison Data Analysis

Table 2. Comparison of Pre Post Score of Bmi Scale Within Group (Calisthenics)

Parametes	Pre		Post		T-Value	P-Value	Result
	Mean	SD	Mean	SD			
Body Mass Index	31.48	1.52	29.43	1.52	22.096	<0.0001	Significant

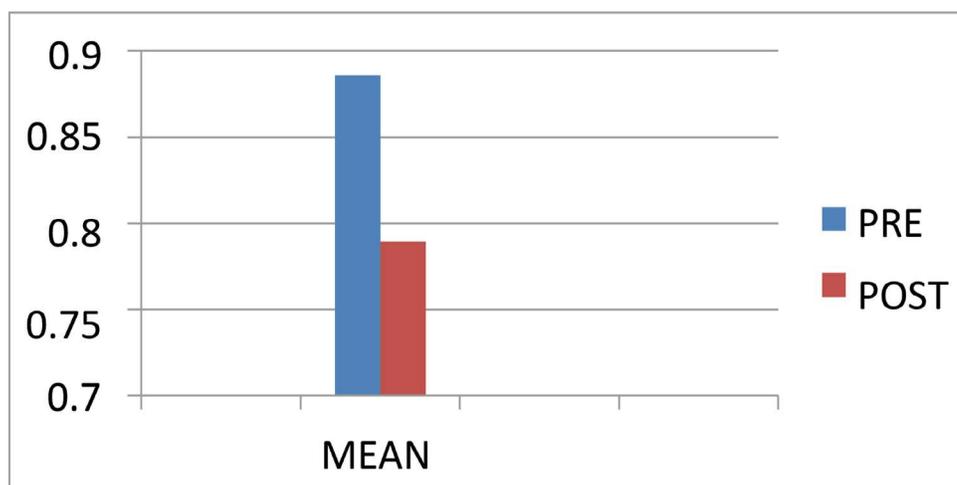


Graph 2. Comparison of Pre Post Score of BMI.

Interpretation: The pre- and post-intervention data for the BODY MASS INDEX group were evaluated using the Paired t-test. The results showed a significant difference ($p < 0.0001$) in the mean BMI score within the group before the intervention (31.48 ± 1.52) and after (29.43 ± 1.52). After six weeks, the Calisthenics workout regimen is beneficial in helping people lose weight.

Table 3. Comparison of prepost score of waist- Hipratio Scale within group (Calisthenics)

Parametes	Pre		Post		T-Value	P-Value	Result
	Mean	SD	Mean	SD			
Waist-Hip Ratio	0.8855	0.020	0.7896	0.038	20.064	<0.0001	Significant

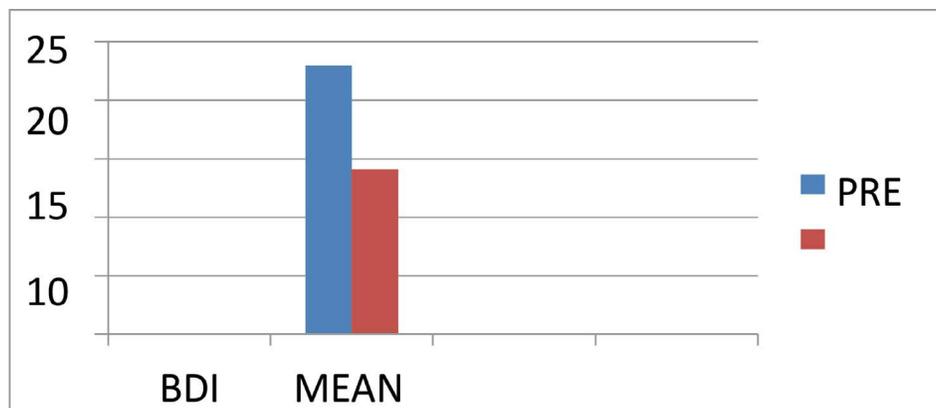


Graph 3. Comparison of prepostscore of waist- Hipratio scale within group (calisthenics).

Interpretation: Paired t-test was used to assess the pre- and post-intervention data in the group (Waist-Hip Ratio); the pre (0.8855 ± 0.020) and post (0.7896 ± 0.038) mean waist-hip ratio score within the group showed a significant difference ($p < 0.0001$). As a result, after six weeks, the Calisthenics workout regimen effectively lowers the waist-hip ratio.

Table 4. Comparison of pre post score of beck depression scale within group (Calisthenics)

Parametes	Pre		Post		T-Value	P-Value	Result
	Mean	SD	Mean	SD			
Beck Depression Scale	23.00	1.233	14.098	1.911	42.008	<0.0001	Significant

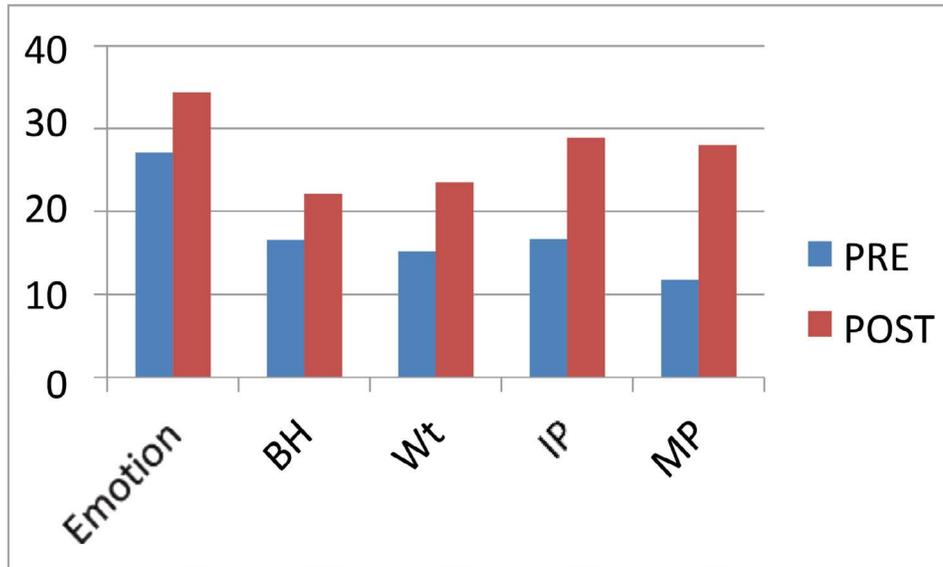


Graph 4: Comparison of pre post score of beck depression scale within group (Calisthenics).

Interpretation: The paired t-test was utilized to examine the pre and post- intervention data in the Beck Depression Scale group. The results indicated a significant difference ($p < 0.0001$) between the pre (23.00 ± 1.233) and post (14.098 ± 1.911) mean Beck depression score within the group. As a result, after six weeks, the Calisthenics exercise regimen effectively lowers the Beck depression scale.

Table 5. Comparison of pre post score of pcs health-related QOL

Parameter	Pre		Post		t -value	P-value	Result
Emotion	Mean	SD	Mean	SD	13.420	<0.0001	Significant
	27.137	6.829	34.373	6.036			
Bodyhair	16.549	3.466	22.118	3.973	22.196	<0.0001	Significant
Weight	15.176	4.160	23.471	3.781	22.829	<0.0001	Significant
Infertility Problem	16.725	3.510	28.922	4.069	20.260	<0.0001	Significant
Menstrual Problem	11.765	1.818	28.059	4.096	28.346	<0.0001	Significant



Graph 5. Comparison of pre post score of pcos health-related QOL.

Interpretation: The pre and post-intervention data in groups Emotion, Body Hair, Weight, Infertility Problem, and Menstrualproblem was analyzed using paired t-test; there was a significant difference ($p < 0.0001$) in pre (27.137 ± 6.829) and post (34.373 ± 6.036) mean Emotion, pre (16.549 ± 3.466) and post (22.118 ± 3.973) mean Body Hair, pre (15.176 ± 4.160) and post (23.471 ± 3.781) mean Weight, in pre (16.725 ± 3.510) and post (28.922 ± 4.069) mean Infertility problem, pre (11.765 ± 1.818) and post (28.059 ± 4.096) mean Menstrual problem score within groups respectively. Thus, the Calisthenics training protocol is effective in lowering the impact on emotion, body hair, weight, infertility, and menstrual problems domain at the end of 6 weeks.

14. Result

52 young adult female volunteers, with a mean age of 22.5, participated in this study. The individuals' mean BMI was 31.48 and they had PCOS along with class 1 obesity. For six weeks, each participant received training in callisthenic exercises.

A significant difference (p -value < 0.05) was seen between the pre and post-groups concerning BMI, waist-hip ratio, Beck depression scale, and PCOD health-related quality of life. Therefore, in class 1 obese young adult girls with PCOS, the callisthenic therapy regimen can be employed to enhance BMI, waist-hip ratio, Beck depression scale, and PCOD health-associated QOL.

15. Discussion

Vizza L, Smith CA, *et al.*,⁵ claim that the most effective workout technique for enhancing body composition and quality is Progressive Resistance Training (PRT).

In women with PCOS, increased insulin sensitivity and glucoregulation may, in turn, downregulate hyperandrogenemia and androgen production, perhaps mitigating irregular menstruation.

PRT's impact on body composition may help offset the causes of PCOS. Visceral fat has decreased, insulin sensitivity and glucoregulation have improved, and skeletal muscle size and quality have improved as a result of PRT in type 2 diabetes.

Long-term, regular participation in Resistance Training (RT) has other advantages as well. Frequent RT improves body composition, metabolism, and physical performance by reducing visceral fat.

Lauren K. Banting, *et al.*,¹¹ found that there are variations in the self-reported physical activity barriers, motivators, and support providers and that physical activity is related to lower melancholy in women with PCOS. Increasing physical activity may help manage PCOS and improve mental wellness. Women with PCOS who are prescribed physical activity have higher engagement rates.

Women with PCOS did identify certain particular obstacles that need to be taken into account when recommending physical activity. These included physical

limits, fear of harm, and low confidence in their abilities to continue physical activity.

A lack of confidence in continuing physical activity could be a sign that women with PCOS require more help and support in long-term and successful physical activity programs, given the importance of physical activity in the management of PCOS.

For a person, physical restrictions and injury dread can be quite debilitating. Programs and guidance may need to take this obstacle into account and devise plans to help women with PCOS feel more confident about engaging in physical activity in a way that is safe and appropriate for their physical capabilities.

There are just two studies that look at PRT's solitary effect in PCOS-affected women. According to these researches, body composition, melancholy, and anxiety are just a few of the clinically relevant outcomes that chronic PRT (10-16 weeks) has been shown to dramatically improve¹¹. Studies indicate that bodyweight-based RT with high frequency and short duration could be beneficial for enhancing body composition.

This work adopts a novel, highly scalable, and easily implementable approach to RT. It uses a callisthenic technique to help individuals incorporate short-bodyweight workouts into their everyday routines.

Together, these workouts target about 85% of skeletal muscle, require nothing in the way of equipment, and can be tailored to accommodate most fitness levels.

The therapeutic potential of this kind of exercise has not been thoroughly investigated. We aimed to assess the efficacy of resistance exercise therapy in obese young adult girls by implementing a periodic regimen in response to the phenotypic characteristics of PCOS.

In addition to improving mental health and quality of life, the PRT also addressed hyperandrogenism, and the menstrual cycle, and produced physical changes. composition that includes a lower central obesity percentage, lean muscular mass, and a lower total weight. The standard of living has also improved. According to research in the literature, a PRT program combined with calisthenics-exercises in which the body's weight serves as the main tool- promoted notable improvements in lean muscular strength and body composition in overweight and obese people. Additionally, it encouraged advancements in several health-related areas, including quality of life, anxiety, and depression.

Thus, the current study demonstrates that calisthenics workouts serve to enhance the domains of PCOS

health-related QOL (emotions, body hair, weight, infertility problem, and monthly problem) and show changes in the BMI, waist-hi ratio, and Beck depression scale.

16. Conclusion

Looking at the statistical analysis and results our study concluded that Callisthenic exercises are effective in decreasing the BMI, waist-hip ratio, depression, and Quality of life in young adult girls with PCOS at the end of 6 weeks.

17. Limitation

Only patients who have PCOS with the BMI categories in class 1 obese were included in the study.

18. Clinical Implications

The study findings are of clinical importance since they indicate an improvement in BMI, Waist-hip ratio, Beck depression, and PCOS health-related QOL.

Hence, either calisthenics or another form of progressive resisted exercises can be used to lower the BMI, waist-hip ratio, and beck depression and to improve the PCOS health-related QOL in class 1 obese young adult girls with PCOS.

19. Future Scope

Future studies need to be done with other outcome measures such as skin fold measurement, and cardiovascular endurance like a 6-minute walk test.

20. Acknowledgement

I am glad to present this project; I wish to express my sincere gratitude to all those who helped me throughout my dissertation. I want to extend my sincere gratitude towards my project guide, Dr. Priyanka Honkalas ma'am for her precious time and for providing guidance and timely suggestions that helped me carry out my thesis successfully. I would like to thank all the staff members for their advice and help throughout the dissertation writing. I sincerely thank all participants of my study for their active participation, without them this dissertation

would have not been successful. I would like to take this opportunity to thank my Parents who were there when needed to help me. I pay my sincere gratitude to all those who helped me throughout my dissertation.

21. References

- Gill H, Tiwari P, Dabadghao P. Prevalence of polycystic ovary syndrome in young women from North India: A Community-based study. *Indian Journal of Endocrinology and Metabolism*. 2012; 16(Suppl2):S389.
- Ajmal N, Khan SZ, Shaikh R. Polycystic Ovary Syndrome (PCOS) and genetic predisposition: A review article. *European Journal of Obstetrics and Gynecology and Reproductive Biology*. 2019; 3:100060.
- Angin P, Yoldemir T, Atasayan K. Quality of life among fertile PCOS patients. *Archives of gynecology and obstetrics*. 2019; 300(2):461-7.
- Cinar N, Kizilarlanoglu MC, Harmanci A, Aksoy DY, Bozdog G, Demir B, Yildiz BO. Depression, anxiety, and cardiometabolic risk in polycystic ovary syndrome. *Human Reproduction*. 2011; 26(12):3339-45.
- Vizza L, Smith CA, Swaraj S, Agho K, Cheema BS. The feasibility of progressive resistance training in women with polycystic ovary syndrome: A pilot randomized controlled trial. *BMC Sports Science, medicine and rehabilitation*. 2016; 8(1):1-2.
- Shetty D, Chandrasekaran B, Singh AW, Oliver Raj J. Exercise in polycystic ovarian syndrome: An evidence-based review. *Saudi Journal of Sports Medicine*. 2017; 17(3):123.
- Akbarzadeh M, Behbahani BM, Naderi T, Dabbaghmaneh M, Zare N. The survey of central obesity and BMI associated with different phenotypes of polycystic ovary syndrome in adolescents. *International Journal of Africa Nursing Sciences*. 2015; 3:82-5.
- Yadav S, Tarware R. Waist hip ratio: An anatomical predictive marker of risk of PCOS. *International Journal of Reproduction, Contraception, Obstetrics and Gynecology*. 2019; 8(4):1630-3.
- De Souza Santos D, De Oliveira TE, Pereira CA, Evangelista AL, Sales D, Bocalini RL, Rhea MR, Simao R, Teixeira CV. Does a calisthenics-based exercise program applied in school improve morpho-functional parameters in youth? *Journal of Exercise Physiology Online*. 2015; 18(6):52-61.
- Thomas E, Bianco A, Mancuso EP, Patti A, Tabacchi G, Paoli A, Messina G, Palma A. The effects of a calisthenics training intervention on posture, strength, and body composition. *Isokinetics and Exercise Science*. 2017; 25(3):215-22.
- Banting LK, Gibson-Helm M, Polman R, Teede HJ, Stepto NK. Physical activity and mental health in women with polycystic ovary syndrome. *BMC Women's Health*. 2014; 14(1):1-9.