International Journal of Reproduction, Contraception, Obstetrics and Gynecology
Sopna SC et al. Int J Reprod Contracept Obstet Gynecol. 2023 May;12(5):1405-1413
www.ijrcog.org
pISSN 2320-1770 | eISSN 2320-1789

DOI: https://dx.doi.org/10.18203/2320-1770.ijrcog20231233

Original Research Article

Effectiveness of circuit interval training and physiotherapy health education on anthropometric measurements and quality of life among obese women with polycystic ovary syndrome- a randomised controlled trial

S. Christy Sopna[1]*, Beulah Jebakani D.[1], Jayavani R. L.[2], Sabita P.[2]

[1]Department of Obstetrics and Gynecology Physiotherapy, Mother Theresa Postgraduate and Research Institute of Health Sciences, Government of Puducherry Institution, Puducherry, India
[2]Department of Obstetrics and Gynecology, Indira Gandhi Medical College and Research Institute, Government of Puducherry, India

Received: 19 March 2023
Accepted: 11 April 2023

***Correspondence:**
S. Christy Sopna,
E-mail: christysopna123@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: The objective was to assess the effectiveness of circuit interval training and physiotherapy health education on anthropometric measurements and quality of life (QOL) among obese women with PCOS.
Methods: The study is a parallel group randomised controlled trial among 40 obese women diagnosed with PCOS based on Rotterdam criteria and conducted in obstetrics and gynaecology Physiotherapy centre, IGMC&RI, Puducherry. Allocation of participants to group A and group B done using permutated block randomization by an independent physiotherapist. Group A(n=20) received the conventional treatment and Group B (n=20) received the circuit interval training for 6 weeks.
Results: The outcome values obtained were calculated by the software SPSS 26. The power of the study is 80%. P<0.05 was considered a significant difference and 95% confidence. There was a significant improvement in the pre and post-test values of anthropometric measurements (BMI and WHR) within the experimental group. The minimal clinically important difference (MCID) of 1.03 points in BMI, 0.019 in WHR, and 0.018 in WHtR, which was higher than the MCID of the control group was observed between the groups. The results show that circuit interval training is effective in improving the anthropometric measurements and quality of life obesity was found to have a negative correlation with the quality of life, implying that increased weight reduces the quality of life in PCOS women.
Conclusions: Circuit interval training along with physiotherapy health education, has a positive impact on improving anthropometric measurements such as BMI, waist circumference, and metabolic parameters over time.

Keywords: Circuit interval training, PCOS, Physiotherapy health education

INTRODUCTION

Polycystic ovary syndrome (PCOS) is a heterogeneous endocrine disorder distinguished by the manifestation of ovarian cysts, anovulation and endocrine variations that severely impact the life of a woman. Stein and Leventhal were the first to describe polycystic ovary syndrome (PCOS) more comprehensively in 1935.[1] According to the World health organization (WHO) 116 million women (4%-12%) are affected by PCOS worldwide in 2012, and in 2020, the ratio increased to 26%.[2] Obesity is very common among PCOS women which is responsible for an increased risk of subfecundity and infertility, so obese women show poorer reproductive outcomes regardless of the mode of conception and a higher body mass index

(BMI) is associated with poorer fertility prognosis. Obesity in PCOS can lead to reproductive, gestational, metabolic and psychological complications and therefore appropriate interventions assisting in the management of obesity are imperative.[3] The psychological impact of PCOS is substantial with the incidence of depression and anxiety varying from 28% to 64% has a negative impact on women's quality of life (QOL).[4] A women is considered obese when the body mass index (BMI) is equal to or greater than 25 kg/m^2 by WHO (2000). Lifestyle modification focusing on diet and exercise is preferred as the first line of treatment for PCOS.[5] A structured exercise program consisting of circuit interval training refers to the number of carefully selected exercises arranged consecutively. The original format consists of 9 to 12 stations comprises circuit training. This number will vary according to the design of the program. The participant moves from one station to another with little (15 to 30 secs) or no rest (Sorani, 1996) focusing on the reduction of body weight increasing reproductive outcomes, reducing the risk of cardiovascular comorbidities, and improves mental health.[6] Anthropometric measurements are the non-invasive quantitative measurements of the body consisting of height, weight, body mass index (BMI), body circumferences to assess for adiposity (waist, hip, and limbs), and skinfold thickness by Centre of Disease Control and Prevention in 2014. Quality of life is the individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns (World Health Organization, 2012). Physiotherapy health education is the systematic way of educating the patients in a programmed way over the entire period of treatment may help to overcome the barriers to exercising in women with PCOS.[7] Hence, this study was conducted to find the effectiveness of circuit interval training and physiotherapy health education is essential for women with PCOS to improve their physical and psychological health leading to improved quality of life (QOL).

METHODS

Study design

This study was an experimental study with two-arm parallel group randomised controlled trial in the obstetrics and gynecology physiotherapy centre, OBG department in Indira Gandhi Medical College and Research Institute, Puducherry, India from January 2022 to January 2023 with sample size 20 in each group including 10% of attrition rate. Allocation to conventional and experimental groups done through permutated block randomization by drawing sequential sealed opaque envelopes. Allocation was performed through computer-generated permutated block randomization with a block size of 4 by an independent physiotherapist. All women provided written informed consent before participation. There was no blinding because the study included treating participants.

Variables of the study

Independent variables were circuit interval training and physiotherapy health education. Dependent variables included: i) primary outcomes such as anthropometric measurements and WHOQOL-BREF questionnaire, ii) secondary outcomes such as Beck depression inventory (BDI) II and duration and frequency of menstruation.

Participants

Women attending the outpatient department of obstetrics and gynecology department of Indira Gandhi medical college and research institute, Puducherry were recruited for the study.

Inclusion criteria

The inclusion criteria include women between the age of 18 to 35 diagnosed with PCOS based upon Rotterdam criteria as confirmed by a gynecologist, BMI of 25-35 kg/m^2, Subjects who were willing to participate in the study and able to do exercise and sufficient English or Tamil language to understand and complete the outcome tool were selected for the study.[8-11]

Exclusion criteria

Exclusion criteria included women with other causes of menstrual disturbances, pregnancy, known cardiovascular problems (cardiac arrhythmias), uncontrolled hypertension or low blood pressure, presence of neurological disease, orthopedic illness, cardiopulmonary disease, and musculoskeletal injuries. Subjects on anti-obesity medications, known psychiatric illness and inability to cooperate were excluded from the study.[8,9,11]

Study protocol

The participants were selected based on the selection criteria from the women diagnosed with PCOS by gynecologist. The purpose and nature of the study were explained to all participants through an information sheet and informed consent were obtained from them. The baseline assessment was taken by the principal investigator. Allocation to conventional and experimental groups was done through permutated block randomization by sequentially numbered closed envelopes method by an independent physiotherapist. The participants in group A received conventional treatment, 3 days a week for 6 weeks as a home exercise program and the participants in group B received interventional treatment (circuit interval training), 3 days a week for 6 weeks as a supervised exercise program. The post-interventional assessment is taken and the results are interpreted. Throughout the program, both groups were completing a PCOS exercise diary which contains a detailed description of exercises, repetition of exercises, and time spent on each session. There was one dropout in the intervention group due to some personal issue in the family. Finally, 20 women in

the control group and 19 women in the interventional group were assessed for post-intervention measurement mentioned in the consort flow chart in Figure 1.

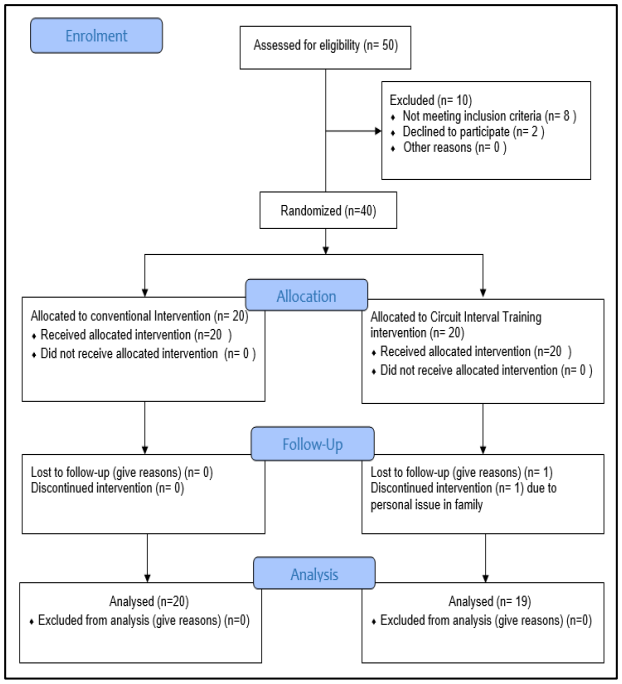

Figure 1: Consort flow chart of participants.

Intervention

Control group- group I conventional group

Routine standard physiotherapy care included aerobic exercise for 30 minutes. Breathing exercise- 5 reps/3 seconds inspiration 6 seconds expiration/1 set.

Self-stretching exercise for biceps and triceps- 5 reps/5 seconds hold/1 set and walking for 3 alternate days in a week for 6 weeks as a home exercise programme. Subjects were assessed at baseline and after 6 weeks.

Experimental group: group II interventional group circuit interval training

Circuit interval training involves warm up for 5 minutes, a set of 10 exercises for 3 reps/exercise and a cool-down exercise for 5 minutes, 10 seconds of transition between the exercise, the set of exercises repeated for 1-6 circuits for an intensity of 60-85% HR max, rate of perceived exertion (RPE) and 13-15 (Borg scale) for a duration of 30 to 40 minutes. The list of exercises, progression and health education strategies were mentioned in Appendix I.

Outcome measures

Outcome measures of the study are presented in Table 1.

Table 1: Outcome measures of the study.

Outcome measure	Variables/parameters	Instruments
Primary outcome	Anthropometric measurements measured by the principal investigator by standard WHO protocol	Body mass index (BMI) Waist to hip ratio (WHR) Waist to height ratio (WHtR)
Primary outcome	Quality of life (QOL)	WHOQOL BREF questionnaire Self-reported by the participant
Secondary outcome	Depression	Beck depression inventory (BDI) II Self-reported by the participant
Secondary outcome	Duration of menstruation Frequency of menstruation	Menstrual diary to be maintained by the participant (self-reported)

Data analysis

The outcome values obtained were calculated by the software SPSS 26. The power of the study 80%. P<0.05 was considered as a significant difference and 95% confidence. The normality testing was done through the Shapiro-Wilk test. The mean and standard deviation (SD) was calculated. Chi-square test was used to analyse the categorical variables. Paired t-test and unpaired t-test were used to analyse the data within and between the groups. A statistical power analysis was performed a priori for sample size estimation, based on BMI (kg/m^2) data from previous PCOS intervention study on effect of aerobic exercise. The resulting sample size was 20 per group including 10% of attrition rate.

RESULTS

The average age of the participants in the experimental group was 26.15±3.453 and 25.65±3.646 in the control group. In the current study, PCOS was reported more from age 20 to 25, followed by the age group 26 to 30. The average age of menarche of the participants was 11.90±1.210 in the experimental group and 11.70±0.979 in the control group. 38 (95%) of the women are married and 2 (5%) are unmarried. Education of the participants was 11 (27.5%) degree holders, 18 (45%) completed high school, and 11 (27.5%) completed higher secondary. The socioeconomic status of the participants showed 27 (67.5%) lower class, 10 (25%) lower middle class, and 3 (7.5%) upper lower class.

Table 2: Description of sample characteristics between experimental and control group.

Demographic variables	Experimental group		Control group		P value
	N	%	N	%	
Age	26.15±3.453		25.65±3.646		
20-25	11	55	12	60	t=0.445 p =0.659* NS
26-30	8	40	5	25	
31-35	1	5	3	15	
Age of menarche	11.90±1.210		11.70±0.979		t=0.575 p =0.569* NS
Hirsutism	16.05±2.23		17.15±2.907		t=-1.341 p=0.188* NS
Marital status					χ^2=0.000, Df=1 P =1.00* NS
Married	19	95	19	95	
Unmarried	1	5	1	5	
Education					
Degree	4	20	7	35	χ^2=2.218, Df=3 p =0.528* NS
High school	9	45	9	45	
Higher secondary	7	35	4	20	
Socioeconomic status					
Lower	16	80	11	55	χ^2=2.859, Df=2 p =0.239* NS
Lower middle	3	15	7	35	
Upper lower	1	5	2	10	
Dysmenorrhoea					χ^2=1.905, Df=1 p =0.168* NS
No	4	20	8	40	
Yes	16	80	12	60	
Employment					χ^2=1.12, Df=1 p =0.288* NS
Employed	4	20	7	35	
Homemaker	16	80	13	65	

χ^2- chi square test; NS - non significant; Df - difference; P- probability value

Table 3: Comparison of post-test values of anthropometric measurements between control and experimental group.

Post Test	Group	Mean	SD	't' value	P value
BMI	Experimental group	28.39	2.900	-0.009	0.993
	Control group	28.402	1.86		
WHR	Experimental group	0.79	0.037	-1.17	0.248
	Control group	0.806	0.046		
WHtR	Experimental group	0.541	0.0566	-1.23	0.225
	Control group	0.563	0.0517		

HS* highly significant; SD- standard deviation; P value- probability value

Table 4: Comparison of post-test values of WHOQOL BREF between the control group and experimental group.

WHOQOL BREF subscales	Post-test	Mean	SD	't' value	P value
Physical	Experimental group	70.47	7.41	5.58	0.000** HS
	Control group	53.25	11.33		
Psychological	Experimental group	65.63	13.107	3.30	0.001** HS
	Control group	51.95	12.73		
Social	Experimental group	65.79	22.619	2.477	0.018** HS
	Control group	51.65	11.56		
Environmental	Experimental group	59.74	9.89	0.533	0.597
	Control group	57.85	12.05		
WHOQOL BREF total	Experimental group	261.63	28.70	5.06	0.000** HS
	Control group	214.75	30.04		

HS* highly significant; SD- standard deviation; P value- probability value

28 (70%) of the participants with dysmenorrhoea, while 12 (30%) did not have dysmenorrhoea. 11 (27.5%) are employed and 29 (72.5%) are a homemaker. The experimental group's mean hirsutism score was 05±2.23, while the control group was 17.15±2.907. There was no significance in the baseline characteristics and the participants were normally distributed between the group (Table 2).

The post-test values of anthropometric measurements (BMI, WHR, WHtR) were non-significant with p>0.05 (Table 3). The mean and standard deviation of BMI in the experimental group was 28.39 and 2.900 which was higher than the mean and standard deviation of the control group. There was a minimum clinically important difference (MCID) higher in the experimental group than in the control group.

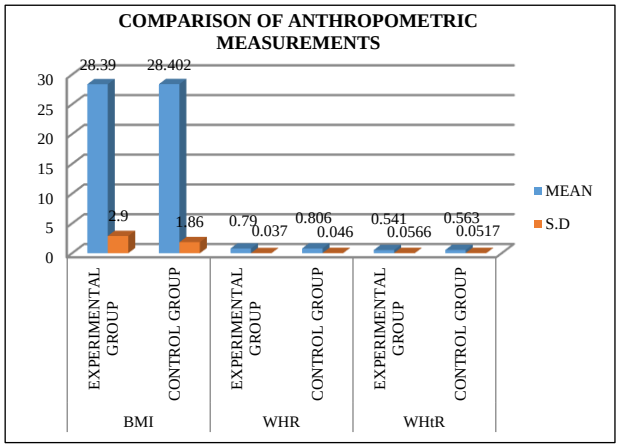

Figure 2: Comparison of anthropometric measurements between control and experimental group.

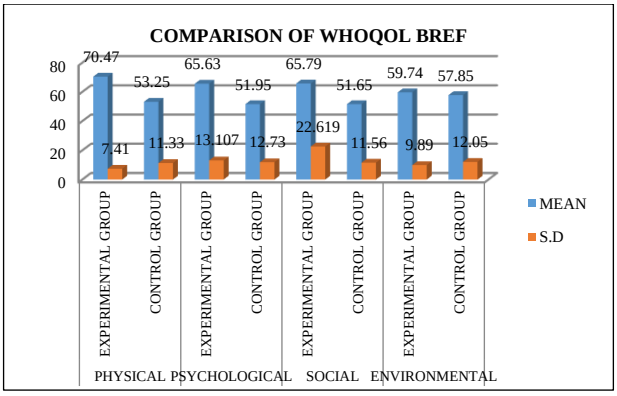

Figure 3: Post-test values of WHOQOL BREF between control and experimental group.

There was a highly significant difference in the WHOQOL BREF questionnaire with p<0.001. There was highly significant improvement in the physical, psychological and social domains of the quality of life. The mean and standard deviation of each subscale is reported in the Table 4. The Figure 3 is the graphical representation of the domains of the WHOQOL BREF in the control and experimental group.

There was a significant difference in the Beck depression inventory-II (p<0.05) between the experimental and control group with a t value -2.58. Minimal clinically important difference (MCID) shows that there was a mean difference of 1.03 in BMI, 0.01 in WHR and 0.18 in WHtR which were higher than the control group. The results of the anthropometric measurements may not be statistically significant in the current study but the MCID has shown a beneficial effect on the patient or in the clinician aspect (Table 5).

Table 5: Comparison of post-test values of secondary outcomes between control and experimental group.

Secondary outcomes	Post-test	Mean	SD	't' value	P value
BDI II	Experimental group	29.16	5.66	-2.58	0.014** HS
	Control group	34.55	7.20		
Duration of menstruation	Experimental group	3.11	1.72	1.66	0.105
	Control group	2.25	1.48		
Frequency of menstruation	Experimental group	27	13.27	0.08	0.932
	Control group	26.6	15.50		

HS* highly significant; SD- standard deviation; P value- probability value

DISCUSSION

Primary outcomes of the study

In the current study, there was a significant improvement in BMI, WHR, and WHtR between pre and post-test values of the circuit interval training exercise group, but there is no significant difference between the control and experimental groups, this may be due to the short duration of the exercise. These findings are similar to the study reported by Pawar and Mahajan. In their study, there was an improvement in the LH values but statistically significant improvement was not observed in BMI after 6 weeks of circuit interval training.[8] Studies showed significant effects when the exercises were performed for a long duration of time and lifestyle modification involving Exercise and dietary changes both have the ultimate goal of lowering body weight/BMI, when exercise is combined with dietary changes, a significant decrease in BMI is achieved. Even a 5 to 10% weight loss

in obese women with PCOS provides clinical improvement.[12] The MCID is a clinically significant minimum value which is important to measure the magnitude of improvement when there is no statistically significant value. The MCID (minimal clinically important difference) was first defined by Jaeschke et al, as 'the smallest difference in score in the domain of interest which patients perceive as beneficial'. MCID also known as Minimal important difference, the minimally important change, the minimal detectable change.[13] In the present study, the MCID was 1.03 points in BMI, 0.019 in WHR, and 0.018 in WHtR which is higher than the MCID observed in the control group. Although the anthropometric measurements don't have statistical significance, it has MCID higher than the control group which may contribute to metabolic, psychological and cardiovascular changes in the PCOS.[12] The changes in the anthropometric measurements may be due to an adaptation of skeletal muscle to exercise, and insulin sensitivity modulation by increasing triacylglycerol concentration. The improvement in insulin sensitivity is due to the efficient lipid turnover resulting in increased muscle lipid uptake, transport utilization, and oxidation. Endurance Exercise increases the capillary density, number, and mitochondrial density hyperplasia of muscle fibers, neural sensitization, motor learning, and adaptations thereby increasing exercise capacity and reducing exercise intolerance in PCOS.[14] Seo et al study reported circuit interval training being effective in reducing body weight and body mass index (BMI) in adults with overweight or obese.[6] Kumari et al in a randomized controlled trial conducted a short structured exercise program for 8 weeks and showed a significant difference in weight, BMI, waist and hip circumference, waist-height ratio (anthropometric parameters), heart rate, respiratory rate, systolic and diastolic blood pressure and VO_2 max.[15] In the present study, there was a significant improvement in the overall score of WHOQOL-BREF ($p<0.01$). The physical ($p<0.001$), psychological subdomain ($p=0.001$) and social domain ($p=0.018$) were also highly significant with no significance in the environmental domain similar to the study by Benetti-Pinto et al in a case-control study of PCOS women reported that BMI is inversely correlated with the quality of life among PCOS women mainly with the physical, psychological and environmental aspects.[16]

Secondary outcomes of the study

In the current study, a significant improvement in the depression level ($p<0.05$) after circuit interval training and physiotherapy health education is seen. There was an increased level of depression in PCOS women reported in a systematic review and meta-analysis among obese PCOS women and healthy controls revealed that higher depression scores in patients with PCOS were associated with body mass index (BMI).[17] Depression is associated with high cortisol levels and increased sympathetic nervous system activity and low serotonin in the central nervous system, these features are common in insulin resistance states also, so reduction of depression in PCOS women implies improvement in insulin resistance.[18-22] So circuit interval training is capable of reducing insulin resistance by adaptation of skeletal muscle to exercise which modulates the insulin sensitivity by increasing triacylglycerol concentration and increased lipid turnover.[8] In the current study, correlation analysis was done between the quality of life and level of depression using the Pearson correlation and the results showed a negative correlation $r=-0.043$ in the experimental group and $r=-0.419$ in the control group, implying that the level of depression decreases when there is an improvement in the quality of life and vice-versa. Menstrual duration and frequency are of reproductive outcomes assessed in the current study which showed no significant improvement ($p=0.105$) and ($p=0.932$) as the reproductive outcomes are reported significant after 12 weeks of regular exercise.[22] Long-term exercise is needed for significant improvement in the reproductive outcome. The adherence rate of the study participants exceeded 90% similar to the study, an average adherence rate of 92.7%.[6] The higher adherence rate in the current study may be due to the physiotherapy health education strategy used in the study, as reported by Sheedy et al, the health education strategy includes establishing rapport with the patients, specifying the specific change in behavior, reducing barriers to exercise, and augmenting facilitators for exercise.[7] In the current study, an exercise diary, brochure, and audio-visual aids were used to educate about PCOS Physiotherapy management. A similar study was conducted by Abobaker et al, which found that there is an improvement in knowledge and quality of life among PCOS women after the educational program.[23] Physiotherapy health education is a patient-centered health education strategy that demonstrates that physiotherapists are a capable and ready group to engage in.[7] This is the first study of its kind in which circuit interval training and physiotherapy health education as an intervention for PCOS. The adherence rate exceeded 90% and the dropout rate is lower.

The limitation of the study is the short duration and small sample size. Further research can be conducted with a larger sample size and a longer study duration. More research is needed to determine the relative contribution of lifestyle factors such as dietary intake along with circuit interval training. The effectiveness of circuit interval training on reproductive and hormonal level outcomes in PCOS patients over a longer period can be studied and studies can be done on the symptom-based physiotherapy treatment program.

CONCLUSION

This study on the effectiveness of circuit interval training and physiotherapy health education in obese women with polycystic ovary syndrome proved that 6 weeks of circuit interval training and physiotherapy health education had a minimal clinically important difference (MCID) of 1.03 points in BMI, 0.019 in WHR, and 0.018 in WHtR, which was higher than the MCID of the control group. The results show that circuit interval training is more effective in

improving the anthropometric measurements than the conventional treatment. The quality of life improved significantly, particularly in the physical and psychological and social aspects. Obesity was found to have a negative correlation with the quality of life, implying that increased weight reduces the quality of life in PCOS women. The level of depression is reduced significantly and it is negatively correlated to the quality of life. The adherence rate of the participant has exceeded 90%. The current study proves that circuit interval training along with physiotherapy health education has a positive impact on improving anthropometric measurements such as BMI, waist circumference, and metabolic parameters over time. The effects of circuit interval training in reducing cardiovascular risk factors, improving quality of life, and reducing depression in obese women with polycystic ovary syndrome will help to effectively treat polycystic ovary syndrome.

ACKNOWLEDGMENTS

Authors would like to thank all the participants of the study.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee of Indira Gandhi medical college and research institute; a government of Puducherry institution approved this study with IEC No.402/IEC-35/IGMC and RI /pp-7/2022, The trial was registered in clinical trial registry (CTRI/2022/10/046618).

REFERENCES

1. Lin AW, Kazemi M, Jarrett BY, Vanden Brink H, Hoeger KM, Spandorfer SD, et al. Dietary and physical activity behaviors in women with polycystic ovary syndrome per the new international evidence-based guideline. Nutrients. 2019;11(11):2711.
2. Nagarathna P, Rajan PR, Koneri R. A detailed study on poly cystic ovarian syndrome and it's treatment with natural products. Int J Toxicol Pharmacol Res. 2014;5(4):109-20.
3. Huber-Buchholz MM, Carey DG, Norman RJ. Restoration of reproductive potential by lifestyle modification in obese polycystic ovary syndrome: role of insulin sensitivity and luteinizing hormone. J Clin Endocrinol Metab. 1999;84(4):1470-4.
4. Bhattacharya SM, Jha A. Prevalence and risk of depressive disorders in women with polycystic ovary syndrome (PCOS). Fertil Steril. 2010;94(1):357-9.
5. Dağ ZÖ, Dilbaz B. Impact of obesity on infertility in women. J Turk German Gynecol Assoc. 2015;16(2):111.
6. Seo YG, Noh HM, Kim SY. Weight loss effects of circuit training interventions: a systematic review and meta-analysis. Obes Rev. 2019;20(11):1642-50.
7. Sheedy J, Smith B, Bauman A, Barnett A, Calderan A, Culbert J, et al. A controlled trial of behavioural education to promote exercise among physiotherapy outpatients. Aust J Physiother. 2000; 46(4):281-9.
8. Pawar S, Mahajan A. Comparison of effects of high intensity interval training and circuit training on hormonal imbalance and cardiopulmonary fitness in women with polycystic ovarian syndrome. Int J Res Soc Sci. 2019; 9(5):437-53.
9. Jiskoot G, Dietz de Loos A, Beerthuizen A, Timman R, Busschbach J, Laven J. Long-term effects of a three-component lifestyle intervention on emotional well-being in women with polycystic ovary syndrome (PCOS): a secondary analysis of a randomized controlled trial. PLoS One. 2020;15(6):e0233876.
10. Kiel IA, Lionett S, Parr EB, Jones H, Røset MA, Salvesen Ø, et al. Protocol: improving reproductive function in women with polycystic ovary syndrome with high-intensity interval training (IMPROV-IT): study protocol for a two-centre, three-armed randomised controlled trial. BMJ Open. 2020;10(2).
11. Hiam D, Patten R, Gibson-Helm M, Moreno-Asso A, McIlvenna L, Levinger I, et al. The effectiveness of high intensity intermittent training on metabolic, reproductive and mental health in women with polycystic ovary syndrome: study protocol for the iHIT-randomised controlled trial. Trials. 2019;20(1):1-9.
12. Thomson RL, Buckley JD, Noakes M, Clifton PM, Norman RJ, Brinkworth GD. The effect of a hypocaloric diet with and without exercise training on body composition, cardiometabolic risk profile, and reproductive function in overweight and obese women with polycystic ovary syndrome. J Clin Endocrinol Metabo. 2008;93(9):3373-80.
13. Jaeschke R, Singer J, Guyatt GH. Measurement of health status. Ascertaining the minimal clinically important difference. Control Clin Trials. 1989;10:407-15.
14. Shetty D, Chandrasekaran B, Singh AW, Oliverraj J. Exercise in polycystic ovarian syndrome: an evidence-based review. Saudi J Sports Med. 2017;17(3):123.
15. Kumari P, Selvam DP, Sundaram DM, Abraham DM, Palekar DT. Benefits of short structured exercise progeam in obese women with polycystic ovary syndrome. Ann Rom Soc Cell Biol. 2021;25(6):981-7.
16. Benetti-Pinto CL, Ferreira SR, Antunes A Jr, Yela DA. The influence of body weight on sexual function and quality of life in women with poly-cystic ovary syndrome. Arch Gynecol Obstet. 2015;291:451-5.
17. Barry JA, Kuczmierczyk AR, Hardiman PJ. Anxiety and depression in polycystic ovary syndrome: a systematic review and meta-analysis. Hum Reprod. 2011;26:2442-51.
18. Rasgon NL, Rao RC, Hwang S, Altshuler LL, Elman S, Zuckerbrow-Miller J, et al. Depression in women with polycystic ovary syndrome: clinical and

biochemical correlates. J Affect Disord. 2003;74(3):299-304.
19. Rahiminejad ME, Moaddab A, Rabiee S, Esna-Ashari F, Borzouei S, Hosseini SM. The relationship between clinicobiochemical markers and depression in women with polycystic ovary syndrome. Iran J Reprod Med. 2014;12(12):811-6.
20. Okamura F, Tashiro A, Utumi A, Imai T, Suchi T, Tamura D, et al. Insulin resistance in patients with depression and its changes during the clinical course of depression: minimal model analysis. Metabolism. 2000;49:1255-60.
21. Adriaanse MC, Dekker JM, Nijpels G, Heine RJ, Snoek FJ, Pouwer F. Associations between depressive symptoms and insulin resistance: the Hoorn study. Diabetologia. 2006;49:2874-7.
22. Vigorito C, Giallauria F, Palomba S, Cascella T, Manguso F, Lucci R, et al. Beneficial effects of a three-month structured exercise training program on cardiopulmonary functional capacity in young women with polycystic ovary syndrome. J Clin Endocrinol Metab. 2007;92(4):1379-84.
23. Abobaker RM, Fouad AL, U. Donato MF, Mulit GL, David MS, Samuel VM. Effect of educational program on quality of life among women with polycystic ovarian syndrome. Egypt J Nurs Health Sci. 2021;2(2):134-58.

Cite this article as: Sopna SC, Jebakani BD, Jayavani RL, Sabita P. Effectiveness of circuit interval training and physiotherapy health education on anthropometric measurements and quality of life among obese women with polycystic ovary syndrome- a randomised controlled trial. Int J Reprod Contracept Obstet Gynecol 2023;12:1405-13.

Appendix I

Circuit interval training

Exercise	Repetition
Warm up **Deep breathing exercises** **Self-stretching exercises** **Biceps, triceps stretch** **Calf and hamstring stretch**	 5 minutes 3 reps each exercise
Brisk walking	10 minutes
Circuit interval exercises	20 minutes three circuits of exercise
Squats	3 reps
Swiss ball arm crunch	3 reps
Lunges	3 reps
Swiss ball alternate arm and leg extension	3 reps
Swiss ball wall squat	3 reps
Swiss ball shoulder bridge	3 reps
Jumping jacks	3 reps
Swiss ball hamstring curl	3 reps
Abdominal crunch	3 reps
Swiss ball back extension	3 reps
Cool down **Deep breathing exercise** **Ankle toe movements**	5 minutes 5 repetitions 10 repetitions

Exercise protocol for circuit interval training

Frequency: 3 repetitions/exercise
10 seconds transition between exercises.
Set of exercises repeated for 1-6 circuits
Intensity: 60 – 85% HR max, rate of perceived exertion (RPE)-13-15 (Borg scale)
Type: Aerobic and anaerobic exercise
Duration: 30-40 minutes
Progression of circuit interval training

Weeks	Upper intensity (% HR max) 3 mins	Lower intensity (% HR max) 1 min	Duration (Minutes)	No. of circuits
1st week	70	60	30	1
2nd week	75	60	35	2
3rd week	80	60	35	2-3
4th week	80	60	40	3-4
5th week	85	65	40	3-4
6th week	85	65	40	3-6

Progression of circuit interval training

Physiotherapy health education strategy:

1. Brief health information about polycystic ovary syndrome (PCOS)- 5 mins
2. Exercise counselling – 5 mins
3. An information brochure and exercise video – 5 mins.

Special considerations for the exercise programme were given on each visit. The participants asked to report any discomfort, pain, fatigue, or weakness. Exercise programs progressed only when the signs and symptoms of PCOS were decreasing. The duration and intensity were increased or decreased depending on the subject's response.