International Journal of Reproduction, Contraception, Obstetrics and Gynecology
Mehrotra R et al. Int J Reprod Contracept Obstet Gynecol. 2023 Jul;12(7):2070-2076
www.ijrcog.org
pISSN 2320-1770 | eISSN 2320-1789

DOI: https://dx.doi.org/10.18203/2320-1770.ijrcog20231912

Original Research Article

Impact of lifestyle modifications on morbidities associated with polycystic ovarian syndrome

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Received: 25 May 2023
Accepted: 09 June 2023

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ABSTRACT

Background: The study aimed to systematically review the efficacy of long-term (6 to 9 months) lifestyle modifications in the form of dietary modifications, weight loss interventions, and psychosocial and behavioural changes.
Methods: This observational study was done on 110 women with PCOS-like features for one year. Personal and menstrual history was recorded. General and systemic examination was done. Routine investigations of blood and urine were done. The level of hormones was evaluated. USG of the lower abdomen and pelvis was also done. The data were recorded and analysed statistically.
Results: Significant difference was observed in all parameters before and after lifestyle and behavioral modifications.
Conclusions: Lifestyle interventions may improve weight and BMI in women with PCOS. Women who underwent lifestyle modifications significantly improved menstrual and reproductive function. We considered adopting a healthy lifestyle with a low-calorie diet and physical exercise that will generate weight loss.

Keywords: PCOS, Life style modification

INTRODUCTION

PCOS is the most prevalent endocrine condition affecting women of reproductive age, affecting 5-10% of women globally. This common condition appears to be a complex genetic feature that is inherited. It is characterized by clinical or biochemical hyperandrogenism (HA), chronic anovulation, and polycystic ovaries. It is commonly linked to insulin resistance (IR) and obesity. Due to its high prevalence and probable reproductive, metabolic, and cardiovascular effects, PCOS draws substantial attention. It is the leading cause of hyperandrogenism (HA), hirsutism, and anovulatory infertility. Stein and Leventhal described the link between amenorrhea, bilateral polycystic ovaries, and obesity for the first time in 1935. It is likely polygenic and/or multifactorial.[1] Hirsutism and anovulation may be caused by anomalies in one of the endocrinologically active compartments, which include the ovaries, adrenal gland, peripheral fat, hypothalamus, and pituitary. The ovarian compartment is the most consistent source of androgens in people with PCOS. Dysregulation of the androgen-forming enzyme CYP17 in both the adrenal glands and ovaries may be one of the primary pathogenetic pathways behind hirsutism in PCOS. LH stimulates the ovarian stroma, theca, and granulosa, contributing to ovarian hirsutism. Total and free testosterone levels correlate directly with luteinising hormone levels, and the ovaries are particularly responsive to gonadotropic stimulation, probably due to CYP17 dysregulation and treatment with a gonadotropin-releasing hormone (GnRH).[2] PCOS is commonly related to insulin resistance, hyperandrogenaemia, chronic inflammation, and oxidative stress (OS), even though the pathogenesis process is poorly understood.[3-5] When the oxidative status is measured by circulatory methods such as malondialdehyde (MOA), superoxide dismutase, and glutathione peroxidase, numerous studies have shown that

the OS level in individuals with PCOS is significantly elevated compared to the normal range.[6] Approximately 25% of subcutaneous fat cells were expanded, potentially showing lipolytic catecholamine resistance. In women with PCOS, the activity of adipose tissue lipoprotein lipase (LPL), which reflects the transport of fatty acids or monoacylglycerol, is unchanged or decreased, respectively. After correcting for BMI, blood adiponectin levels were lower in women with PCOS than in controls, indicating abnormal release of specific adipokines from adipose tissue. Thus, we aimed to systematically review the efficacy of long-term (6 to 9 months) lifestyle modifications in the form of dietary modifications, weight loss interventions and psychosocial and behavioural changes.

METHODS

This observational study was conducted at the Department of Obstetrics and Gynaecology, Moti Lal Nehru Medical College, Prayagraj, affiliated with King George's Medical University, Lucknow. After taking approval from the institutional ethics committee, patient enrolment was done after taking informed consent; 110 women with PCOS-like features and aged 18-45 years were enrolled in the study. On the contrary, women below 18 years and above 45 years, with any other chronic metabolic disease, immunocompromised patients, and unwilling patients were excluded from the study. Personal history regarding diet, any addiction to tobacco, alcohol, drug abuse, sleep pattern, and sedentary habits were recorded. Menstrual history regarding the first day of the last menstrual period, previous menstrual cycle, regularity, amount, and duration of cycles were recorded. A general examination included weight, height, body mass index, pallor, icterus, edema, pulse rate, blood pressure, thyroid and breast examination, and presence of hair growth and pigmentation on the body. Further, a systemic examination of the central nervous, cardiovascular, and respiratory systems was also done. Routine investigations of blood and urine were done. Level of serum LH, FSH, prolactin, androgen and DHEA/S, FBS, fasting insulin and TSH were evaluated. The ARCHITECT assay was used to determine the presence of LH, FSH, and Prolactin in human serum and plasma using Chemiluminescent Microparticle Immunoassay (CMIA) technology with flexible assay protocols. Along with the above-mentioned examinations, USG of the lower abdomen and pelvis was also performed among the enrolled women. The data were recorded and analysed statistically.

Statistical analysis

The SPSS (Version 25.0) program was used for statistical analysis. Descriptive statistics were presented as mean, standard deviation, frequency and ratios. Categorical data were analysed using the chi-square test, and continuous data were analysed using the student t-test. Significance was evaluated at a p-value <0.05.

RESULTS

Among all the enrolled women (n=110), the majority of the women were aged 23-27 years (54.55%), followed by 18-22 years (37.27%). Most women were unmarried (78.18%) and nulliparous (93.64%). Also, most of them belonged to the lower class (54.55%) and urban areas (54.55%) (Table 1).

Table 1: Socio-demographic status of enrolled patients.

Socio-demographics		Number	Percentage
Age	18-22	41	37.27
	23-27	60	54.55
	28-32	9	8.18
Marital status	Married	24	21.82
	Unmarried	86	78.18
Parity	Nullipara (P 0+0) (unmarried + married)	103	93.64
	Parity (P1+0) (married)	7	6.36
Socioeconomic status	Lower	60	54.55
	Middle	42	38.18
	Higher	8	7.27
Geographical status	Rural	47	45.46
	Urban	60	54.55

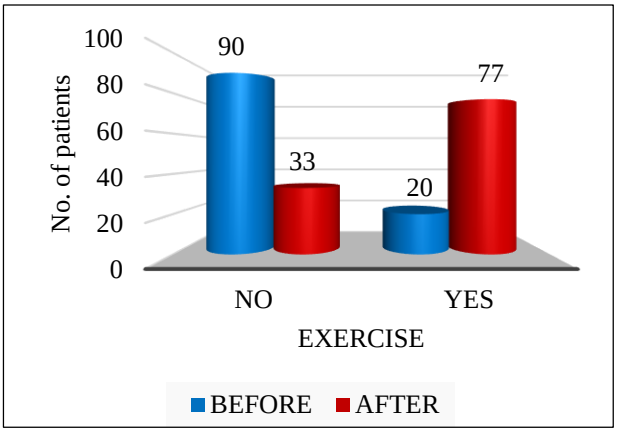

Figure 1: Habit of exercise before and after lifestyle modification in enrolled patients.

Before lifestyle and psychosocial modifications, most of the patients (80.91%) had a sedentary lifestyle, while after modifications, most of the population started having an active lifestyle (70.00%), (p<0.0001*). Before lifestyle modifications, the majority of the patients were not consistent with exercise (81.82%), but after modifications, 70.00% became active and consistent with exercise, (p<0.0001*) (Figure 1).

The majority of them were not able to have a balanced diet (93.64%), while after modifications, most of them

(61.82%) started to have a balanced diet (Table 2). Before lifestyle modifications, the mean BMI, waist circumference and waist-hip ratio were (24.56±2.08, 90.96±5.60 and 0.89±0.04), respectively. After modifications, there was a significant decrease in all the measurements (23.61±2.11, 87.05±5.37 and 0.86±0.04) (Figure 2).

Table 2: Characteristics of enrolled patients before and after lifestyle modification (n=110).

Parameters		Before (N=110)		After (N=110)		P-Value
		N	%	N	%	
Lifestyle	Active	21	19.09	77	70.00	X=57.70
	Sedentary	89	80.91	33	30.00	p<0.0001*
Exercise	No	90	81.82	33	30.00	X=59.91
	Yes	20	18.18	77	70.00	p<0.0001*
Diet	No	103	93.64	42	38.18	X=75.28
	Yes	7	6.36	68	61.82	p<0.0001*
Menstrual cycle regularity	Irregular	93	84.55	24	21.82	X=9.323
	Regular	17	15.45	86	78.18	P<0.0001*
Hirsutism	No	84	76.36	87	79.09	X=0.2363
	Yes	26	23.64	23	20.91	p=0.6269
PCOS morphology on USG	No	15	13.64	66	60.00	X=50.82
	Yes	95	86.36	44	40.00	p<0.0001*

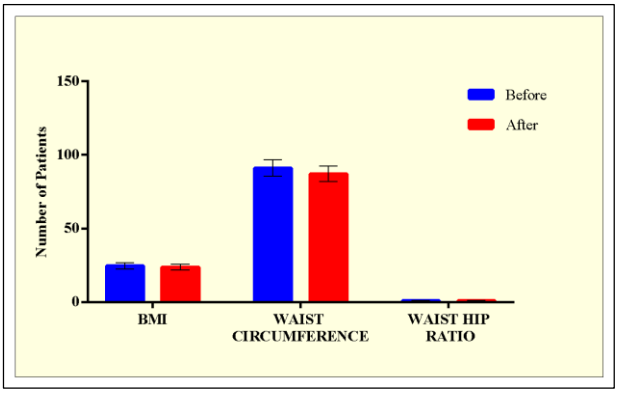

Figure 2: BMI, waist circumference and waist hip ratio duration of menstrual cycle before and after lifestyle modifications of enrolled patients.

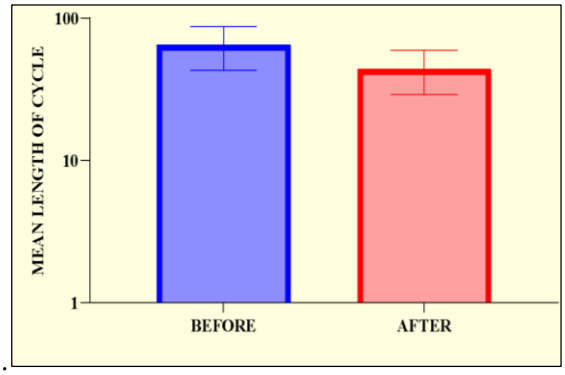

Figure 3: Duration of menstrual cycle before and after lifestyle modifications of enrolled patients

The mean age at menarche was recorded as 14.01±1.01 years. Before lifestyle modifications, most women (84.55%) had irregular menstrual cycles. After modifications, the number of patients with irregular menstrual cycles significantly decreased (21.82%). Few patients had irregular menstrual cycles, and the mean duration of irregular cycles was 21.72±11.26. The mean duration of the menstrual cycle before modification was (65.14±22.22), which gets substantially shortened after lifestyle modifications and was found to be (44.15±15.03) (Figure 3).

Before lifestyle modifications, 26 women had hirsutism, while after modifications, hirsutism was noted 23 women, and this difference was not significant as one hair cycle ranges from 6 months to 1 year. This study was not able to conclude the effect of hirsutism. Further, long follow-up studies are needed to make it conclusive. Haematological parameters and level of hormones (LH, serum FSH, LH/FSH, serum prolactin, serum testosterone, SFI and FPG/SGI) showed significant differences after lifestyle modifications (Table 3).

The mean serum Thyroid-stimulating hormone was (3.03±1.40) in enrolled patients, and 19 patients (17.27%) had Hypothyroidism. Polycystic ovaries are defined as the presence of 12 or more follicles arranged in the periphery of each ovary measuring 2-9 mm in diameter or ovarian volume of >10cc in at least one ovary and echogenic stroma.

In our study, before lifestyle and psychosocial modifications, most patients had polycystic ovarian syndrome (PCOS) morphology on USG (86.36%). After modifications, only 40.00% of them showed PCOS [p<0.0001*] (Table 1).

Table 3: Haemoglobin and hormones level in enrolled patients before and after lifestyle modification (n=110).

Parameters	Before (N=110)	After (N=110)	P-value
Hemoglobin	10.99±1.19	11.29±0.77	t=2.220, p=0.0275*
Serum LH (IU/L)	12.82±3.96	9.91±2.77	t=6.315, p<0.0001*
Serum FSH (IU/L)	6.07±1.89	5.55±1.60	t=2.202, p=0.0287*
LH/FSH	2.17±0.46	1.82±0.35	t=6.351, p<0.0001*
Serum prolactin (ng/mL)	19.58±17.66	13.67±8.69	t=3.149, p=0.0019*
Serum testosterone (pg/ml)	100.39±13.15	93.77±9.53	t=4.275, p=0.0002*
SFI (serum fasting insulin)	20.43±12.55	13.55±6.16	t=5.161, p<0.0001*
FPG (fasting plasma glucose)/SGI	10.99±1.19	6.30±1.35	t=8.710, p<0.0001*

DISCUSSION

The present study represents all the female patients [n=110]; the majority of the patients were in the age group of 23-27 years [60 (54.55%)] and 18-22 years [41 (37.27%)]. According to Rotterdam criteria, the prevalence of PCOS was 22.5%, while according to androgen excess society standards, it was 10.7%. According to Rotterdam criteria, 71.8 per cent of PCOS cases were non-obese. The most common phenotype, representing 52.6% of patients, was mild PCOS.[7] In the present study, among all the patients, most of them were [86 (78.18%)] unmarried and [24 (21.82%)] were married. In this study, most of the PCOS patients were married. It was found that PCOS cases had higher rates of miscarriage, more pregnancies, and more children overall.[8]

In our study, among all the patients, only 7 had parity 1 (P 1+0), while the rest of the women were nullipara [103(93.64%)]. Calculating the incidence of (PET) preeclamptic toxemia based on the number of patients (54.5, 12.5, 11, and 2.5%, respectively) revealed even more significant disparities across polycystic ovarian PCO, anovulatory patients in whom PCO was excluded (A-NPCO), control primiparae, and regular control patients.[9] The difference between the incidence of PET in PCO, A-NPCO, control primiparae and normal control patients was even more pronounced when calculated based on the number of patients. Overproduction of steroid hormones, especially androgens, was suggested as the main factor for the appearance of PET in PCO patients. In our study, among all the patients, the majority came from lower class [60 (54.55%)], and the rest were middle class [42 (38.18%)] and higher class [8 (7.27%)]. These findings have important public health implications given the prevalence of PCOS, its major health and financial burden, the rising rates of weight gain among young women, and the benefits of losing weight that is well-established.[10] In the present study, among all the patients, the majority belong to urban areas [60 (54.55%)], and 47 (45.46%) belong to rural areas. According to Roya et al, most were from rural areas. There were 83 controls from the metropolitan area, 28 potential PCOS cases, 17 known cases, and 83 likely PCOS cases. In the rural area, there were 73 controls, ten known cases of PCOS, and 17 potential cases. There were 45 probable cases altogether. Common PCOS were 27 compared to 153 controls. Three hundred forty-eight of the patients were not included for various reasons. Potential issues were 27.29±7.14, authorities were 29.67±6.88, and both urban and rural areas had PCOS cases with p-value of 0.001.[11] This study represents before lifestyle modifications, most of the patients [89 (80.91%)] had a sedentary lifestyle, while after lifestyle modifications, most of the population started having an active lifestyle [77 (70.00%)]. Statistically, a significant difference [p<0.0001*] was observed before and after lifestyle modifications. According to Joshi et al, fat girls with PCOS were hairy and hypertensive compared to females with PCOS who were not obese. They had significantly higher mean insulin and two hours per week post 75g glucose levels. This country's first urban community-based study diagnosed PCOS and phenotypic in young and adolescent females. According to this study, PCOS is a condition that develops throughout adolescence. Screening could offer a chance to encourage healthy lifestyles and implement early interventions to stop future morbidities in this population.[7]

In This study, before modification, the majority of the patients were not consistent with exercise (35-45 minutes of yoga or aerobic exercises or brisk walking) [90 (81.82%)]. Still, after modifications, most of them [77 (70.00%)] became active and consistent with practice, and a significant difference [p<0.0001*] was observed before and after modification in exercise. According to Abdolahian et al, exercise interventions were linked to significant changes in menstrual cycles (Pooled SMD = 1.16; 95% CI, 0.72 to 1.61), Ferriman-Gallwey (F.G.) score (pooled SMD = 0.57; 95% CI, 0.99 to 0.15), LH (pooled SMD = 056; 95% CI, 0.98 to 0.14), Anti-Müllerian Hormone (AMH), this meta-analysis found that

some clinical, metabolic, and hormonal parameters in adolescent girls with PCOS can be improved by lifestyle therapies like diet and exercise.[12]

In our study, before behavioural and psychological modifications, most were unaware of a balanced diet [103 (93.64%)]. In contrast, after modifications, most of them [68 (61.82%)] started to have a balanced diet. This difference was statistically significant [p<0.0001*]. In this study, before modifications, the mean BMI, waist circumference and waist-hip ratio were [24.56±2.08, 90.96±5.60 and 0.89±0.04], respectively. After modifications, there was a significant decrease in all the above-mentioned measurements.[12]

In the present study, the mean age of the enrolled patients at menarche was [14.01±1.01]. Similarly, according to Tabassum et al, compared to controls, the history of irregular or delayed menstruation, the older age at menarche, and childlessness were significantly affected in PCOS cases. The women with PCOS and healthy control (HC) were comparable regarding marital status and family type. Statistically significant differences were observed between PCOS and healthy control in terms of age (P<0.020), BMI (P<0.001), educational status (P<0.001), marital status (P>0.05) and work category (P<0.001). A total of 97% of PCOS cases were below the age of 30 compared to 78% of control. Among the HC group, 39% were students and only 15% received higher education (P<0.001). A higher percentage of PCOS cases (16%) belong to greater BMI (>30) in comparison to HC (2%).[8] In the present study, most patients [93 (84.55%)] had irregular menstrual cycles before behavioural and lifestyle modification. After modifications, the number of patients with irregular menstrual cycles decreased [24 (21.82%)]. A significant difference was observed among patients before and after lifestyle modifications in the menstrual cycle [p<0.0001*]. Similarly, Thomson et al did a meta-analysis and reviewed the literature to assess exercise's effectiveness in managing and treating polycystic ovarian syndrome in overweight women. They described polycystic ovaries, menstrual dysfunction, infertility, biochemical and clinical hyperandrogenism, a higher prevalence of cardiometabolic risk factors, and psychiatric conditions as characteristics of polycystic ovarian syndrome (PCOS). Twenty-four weeks of dieting or aerobic exercise improved menstrual irregularities and ovulation in overweight women with PCOS, with no observed differences in quantity or cycle length between treatments.[13]

In the present study, few patients had irregular menstrual cycles, and the mean duration of irregular cycles was [21.72±11.26]. In the present study before modifications, the mean duration of the menstrual cycle was [65.14±22.22], shortened after modifications and found to be [44.15±15.03]. Statistically, a significant difference [p<0.0001*] was observed among patients. Similarly, according to Kulshreshtha et al, forty-eight PCOS patients were followed for an average of 1.9 years post-oral contraceptive (OC). Thirty-six (75%) achieved regular cycles over one year with other non-hormonal options like spironolactone and metformin. Seven patients required no treatment. Patients who continued to have irregular cycles had a longer pre-oral contraceptive cycle length ($p < 0.01$) and a more significant duration of menstrual irregularity ($p < 0.02$). However, age, BMI and hormones were similar in the two groups.[14]

In the present study, before modifications, [26 (23.64%)] had hirsutism, while after modifications, only a slight reduction in hirsutism [23 (20.91%)] and this difference was significant as one hair cycle ranges from 6 months to 1 year. This study was not able to conclude the effect of Hirsutism. Further, long follow-up studies were needed to make it conclusive. Similarly, according to Moran et al, for secondary outcomes, lifestyle interventions were superior to minimal treatment in terms of endpoint values for total testosterone (mean difference (MD) -0.27 nmol/L, 95% confidence interval (CI) -0.46 to -0.09, P = 0.004), hirsutism by the Ferriman-Gallwey score (MD -1.19, 95% CI -2.35 to -0.03, P = 0.04), weight (MD -3.47 kg, 95% CI -4.94 to -2.00, P < 0.0001), waist circumference (MD -1.95 cm, 95% CI -3.34 to -0.57, P = 0.006), waist to hip ratio (MD -0.04, 95% CI -0.07 to -0.00, P = 0.02), fasting insulin (MD -2.02 µU/mL, 95% CI -3.28 to -0.77, P = 0.002) and oral glucose tolerance test insulin (standardized mean difference -1.32, 95% CI -1.73 to -0.92, P<0.0001) and per cent weight change (MD -7.00%, 95% CI -10.1 to -3.90, P<0.0001).[15] According to DeUgarte et al, the definition of hirsutism largely rests on women's complaints rather than their total mFG (modified Ferriman-Gallwey) score.[16] Different studies have found hirsutism rates ranging from 17% to 100% in PCOS patients.[17,18] In a meta-analysis comprising 16 research and 5647 PCOS cases, the mFG scoring system determined the hirsutism ratio to be 57%.[19] Coskun et al, determined that the frequency of hirsutism in our PCOS group was 86.0% (37/43) compared to 18.0% (15/75) in the control group (p 0.001). The ratio of hirsutism in their study's PCOS group was greater than that found in a previous study.[20] In the present study, the mean value of haemoglobin was [10.99±1.19] before and after modification; the mean value of haemoglobin increased to [11.29±0.77], and the increase may be due to change in dietary habits. At the same time, there was a decrease in the mean values of serum LH, FSH, LH/FSH, prolactin, testosterone, SFI and FPG/SGI after modifications. A significant difference was observed in the blood parameters. Likewise, according to Yang et al, (PRL), prolactin levels were significantly lower in PCOS patients than in controls over all age groups (p <0.05). In the PCOS patients, serum PRL was significantly and positively correlated with FPG, serum TSH and serum FT4, and significantly and negatively correlated with LH, LH/FSH, TC, TG, LDL-C, AST, ALT, γ-GGT, FT3, and FT3/FT4 (p<0.05 or 0.01). After adjusting for age and BMI, serum PRL was positively correlated with FPG, TSH, and FT4 and negatively correlated with LH and LH/FSH.[21] The present study represents the mean serum Thyroid-stimulating hormone was [3.03±1.40] in enrolled

patients, and hypothyroidism is present in 19 (17.27%) patients. In the present study, before modification, the majority of patients had polycystic ovarian syndrome (PCOS) on USG [95 (86.36%)]. After modification, most patients had normal findings on USG [66 (60.00%)]. Statistically, a significant difference was observed. Sinha et al revealed a significantly higher prevalence of autoimmune thyroiditis, detected in 18 patients (22.5% vs 1.25% of control) as evidenced by raised anti-TPO antibody levels (28.037±9.138 and 25.72±8.27 respectively; $P = 0.035$). PCOS patients had higher mean TSH levels than the control group (4.547±2.66 and 2.67±3.11, respectively; P value < 0.05).[22]

CONCLUSION

Based on the findings of this study, we can extrapolate that the current conservative treatment emphasizes sustainable weight loss through exercise in our study. Modifying additional lifestyle factors, including alcohol consumption, dietary intake, psychosocial stressors, and smoking, is also crucial in treating PCOS. However, further to enhance the accuracy of the present findings and bypass the confounders, it is recommended that a resilient, multicentric study with high descriptive sample size. Lifestyle interventions may improve weight and BMI in women with PCOS. The main finding of this study is that the patients who underwent lifestyle modifications displayed significant improvement in menstrual and reproductive function compared to the control group. It is considered that adopting a healthy lifestyle, composed of a low-calorie diet, and psychosocial, behavioral changes are suggested for women with PCOS.

ACKNOWLEDGMENTS

Authors would like to thank Department of Obstetrics and Gynaecology, MLN Medical College, Prayagraj, Uttar Pradesh, India, for their support and guidance.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

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Cite this article as: Mehrotra R, Chaudhary R, Saxena S. Impact of lifestyle modifications on morbidities associated with polycystic ovarian syndrome. Int J Reprod Contracept Obstet Gynecol 2023;12:2070-6.