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ORIGINAL ARTICLE

Effectualness of Cinnamon, Exercise Programme and Anxiety Reduction Counselling (Multi Interventional Strategies) On Body Mass Index, Waist Circumference and Menstrual Cycle: An Experimental Study Among Young Girls with Polycystic Ovary Syndrome

Niranjani S, Prema Krishnan, Prabhu S, Gayathri R, Elavarasi E
Shri Sathya Sai College of Nursing, Sri Balaji Vidyapeeth, (Deemed to be University), Puducherry

ABSTRACT

Polycystic Ovary Syndrome (PCOS) affects 6-10% of women of reproductive age globally and is marked by symptoms such as irregular menstrual cycles, elevated androgen levels, and metabolic disturbances like insulin resistance and obesity. This study aimed to evaluate the combined effects of cinnamon supplementation, a structured exercise program, and anxiety reduction counselling on BMI, Waist circumference and Menstrual cycle among young girls with PCOS. A quasi-experimental design was conducted with 150 participants from three educational institutions, divided into a control group and two experimental groups. Experimental Group 1 received cinnamon supplementation along with a structured exercise program and counselling, while Experimental Group 2 received only exercise and counselling. The control group received standard educational materials. Anthropometric measurements, including Body Mass Index (BMI) and waist circumference, and menstrual cycle regularity were assessed pre- and post-intervention over six months. The results demonstrated significant reductions in BMI and waist circumference in experimental group I, slight reduction in experimental group II and no reduction in control group, with p-values indicating statistical significance ($p < 0.001$). Additionally, menstrual cycle regularity improved substantially in experimental group I than Experimental Group 1 and Experimental Group 2 achieving regular cycles. This multi-interventional approach proved effective in managing PCOS symptoms. These results suggest that a combined strategy addressing metabolic and psychological aspects can significantly improve health outcomes in PCOS women.

Keywords: *Polycystic Ovary Syndrome, cinnamon supplementation, exercise, counselling, Body Mass Index, waist circumference, menstrual cycle regularity.*

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INTRODUCTION

Polycystic Ovary Syndrome (PCOS) is a complex endocrine disorder [1] that affects approximately 6-10% of women of reproductive age globally. Characterized by a combination of symptoms including irregular menstrual cycles, elevated androgen levels, and polycystic ovaries, PCOS poses significant challenges for affected individuals [16]. Among the many manifestations of PCOS, metabolic disturbances such as insulin resistance and obesity are particularly prominent, contributing to further health complications and exacerbating symptoms. As PCOS is a multifaceted condition, managing the condition often requires a multifactorial approach. The current article has highlighted the potential benefits of combining dietary interventions, physical activity, and psychological support to address the various aspects of PCOS more effectively. This approach recognizes that a single intervention may not be sufficient to address the diverse symptoms and underlying mechanisms of PCOS. One promising dietary intervention is the use of cinnamon [2], which has been suggested to improve insulin sensitivity and help manage metabolic symptoms associated with PCOS. Concurrently, regular physical exercise is well-documented to aid in

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weight management, enhance insulin sensitivity, and promote overall hormonal balance. Additionally, managing stress and anxiety through counselling and psychological support is increasingly recognized for its role in improving both mental and physical health, including the regulation of menstrual cycles. This experimental study aims to investigate the combined effects of cinnamon supplementation, a structured exercise program, and anxiety reduction counselling on key health metrics among young girls with PCOS. Specifically, it will examine how these interventions impact Body Mass Index (BMI) [8], waist circumference [9], and menstrual cycle regularity [10]. By exploring the efficacy of this multi-interventional strategy, the study seeks to provide insights into a holistic approach to managing PCOS and improving the quality of life for affected individuals.

MATERIAL AND METHODS

A quasi-experimental design was employed in this study, which was conducted across three distinct educational institutions in Chennai: Tagore College of Nursing (Experimental Group 1), Tagore Allied Health Sciences (Experimental Group 2), and Tagore Engineering College (Control Group). Each institution was strategically selected to ensure a minimum distance of 2 kilometres between them, thereby reducing potential contamination of results among groups. A total of 824 students from these institutions were initially screened for Polycystic Ovary Syndrome (PCOS) using a multi-faceted screening tool based on the Rotterdam diagnostic criteria. This tool included gynecological data, the Ferriman-Gallwey scale for hirsutism, the Global Acne Grading Scale, and the Ludwig Visual Alopecia Score. Out of these, 232 students met the preliminary criteria and were further evaluated through ultrasound, physiological measurements, biochemical investigations, and assessment of anxiety levels. Following thorough evaluation, 161 participants were confirmed to have PCOS. However, 11 participants were excluded from the final analysis due to specific exclusion criteria, leaving 150 participants. These participants were aged between 18 and 21 years and were diagnosed with PCOS based on the Rotterdam diagnostic criteria, with a Body Mass Index (BMI) [8] greater than 25 kg/m^2 and waist circumference [9] exceeding 88 cm. Participants with existing treatments for PCOS, or those with other medical conditions such as Cushing's syndrome, congenital adrenal hyperplasia, or hypothyroidism, were excluded to ensure homogeneity in the sample. The 150 eligible participants were purposively assigned to one of three groups, each comprising 50 individuals: Control Group: Participants in this group did not receive any intervention. Experimental Group 1: Participants in this group received cinnamon supplementation. Experimental Group 2: Participants in this group engaged in a structured exercise program coupled with anxiety reduction counselling. Demographic data were collected using a structured questionnaire. Anthropometric measurements including body weight and height were recorded. Body weight was measured with a digital weighing scale, and height was assessed using a standard inch tape while participants stood upright on a flat surface. Waist circumference was measured at the midpoint between the lower rib margin and the iliac crest. The study protocol was reviewed and approved by the institutional ethics committee. Written informed consent was obtained from all participants prior to their inclusion in the study.

MULTI INTERVENTIONAL STRATEGIES:

Control Group: Participants in the control group (n=50) received standard educational materials and sessions regarding Polycystic Ovary Syndrome (PCOS). These educational sessions were designed to provide information about the condition, its symptoms, potential complications, and general lifestyle recommendations, but did not include any specific therapeutic interventions.

Experimental Group I: This group (n=50) underwent a comprehensive multi-interventional strategy designed to address various aspects of PCOS. The interventions included:

1. **Cinnamon Supplementation:** Participants were given 1.5 grams of cinnamon powder (Cinnamomum verum) [5] mixed in 100 mL of warm water. This mixture was consumed once daily during break time, five days a week, over a period of six months. Cinnamon has been chosen for its potential benefits in improving insulin sensitivity and metabolic function, which are often compromised in individuals with PCOS.
2. **Exercise Program:** A structured one-hour exercise regimen [6] was implemented, consisting of cardiovascular exercises and strength training. Cardio workouts and strength training sessions were alternated, with each type of exercise performed on separate days. The exercise program was designed to improve overall fitness, aid in weight management, and enhance metabolic health.
3. **Counselling:** Participants in this group who exhibited mild to moderate levels of anxiety, as assessed by the Hamilton Anxiety Scale [7], received individualized counselling sessions. The counselling aimed to reduce anxiety levels and improve overall psychological well-being, which could positively impact PCOS symptoms and overall health.

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Experimental Group II: This group (n=50) received a slightly modified intervention, which included:

1. **Exercise Program**: Similar to Experimental Group I, participants engaged in a one-hour exercise session comprising cardio and strength training exercises. These sessions were conducted on alternate days to promote physical fitness and metabolic health.
2. **Counselling:** Participants with mild to moderate anxiety, based on the Hamilton Anxiety Scale [7], were provided with counselling services. The focus was on reducing anxiety and supporting mental health, which is crucial for managing PCOS effectively.

STATISTICAL ANALYSIS

Data were presented as means ± standard error (SE) to reflect the central tendency and variability within each group. To evaluate the effects of the interventions on various outcome measures, we employed two-way repeated measures analysis of variance (2-way RM ANOVA). This analysis was used to assess differences across three primary dimensions: groups (control, experimental Group I, and experimental Group II), tests (pre- and post-intervention assessments), and their interaction (group × test). When the 2-way RM ANOVA indicated a significant effect, further analysis was conducted using the Bonferroni post-hoc test. For the analysis of gynaecological data, which were categorical in nature, frequency tables were constructed and analysed using the chi-square (χ^2) test. This approach allowed for the assessment of the distribution of categorical variables and identification of any significant differences among the groups. A probability value (p-value) of 0.05 or less was considered statistically significant. All statistical analyses and graphical representations were conducted using SigmaPlot 14.5 (Systat Software Inc., USA).

RESULT AND DISCUSSION

The present study revealed that the pre-test mean values of BMI among Control, Experimental, Experimental 2 groups are 28.8, 29.5 and 29.8 (kg/m2) respectively. The post-test 1 means values of BMI among Control, Experimental 1, Experimental 2 groups are 29.0, 28.8 and 29.4 (kg/m2) respectively. The post-test 2 mean values of BMI among Control, Experimental 1 and Experimental 2 groups are 29.3, 28.2 and 29.0 (kg/m2) respectively. The groups comparison, tests comparison and group X test interaction by Two-way RM ANOVA shown significance P = 0.044, < 0.001 and < 0.001 respectively. In regard to the waist circumference [9], the pre-test mean values of waist circumference [9] among Control, Experimental, Experimental 2 groups 88.7, 89.4 and 88.1 (cm) respectively. The post-test 1 means values of waist circumference [9] among Control, Experimental 1, Experimental 2 groups are 89.0, 88.6 and 87.6 (cm) respectively. The post-test 2 mean values of waist circumference [9] among Control, Experimental 1 and Experimental 2 groups are 89.0, 87.9 and 87.5 respectively (cm) respectively. The groups comparison, tests comparison and group X test interaction by Two-way RM ANOVA showed significance at P = 0.005, < 0.001 and < 0.001 respectively. In the present study changes were noted in the physical parameters of the two groups of participants after the completion. Experimental group I and II shown a significant decrease in the means of BMI and waist circumference [9] after 6 months of intervention. The average BMI from pretest to post test 2 was reduced from 29.5 to 28.2 (kg/m2) in experimental group I and 29.8 to 28.9(kg/m2) in experimental group II but in control group the average BMI from pretest to post-test 2 was increased from 28.8 to 29.3 (kg/m2). The mean waist circumference [9] from pretest to post-test 2 was reduced from 89.4 to 87.9(cm) in experimental group I and 88.1 to 87.5(cm) in experimental group II. whereas the average waist circumference [9] from pretest to post test 2 was increased from 88.7 to 89.0 (cm) in control group. It revealed that the multi-interventional strategies was effective in reducing the increased physiological parameters of PCOS. In regard to menstrual cycle, pretest of 28 girls had irregular menstrual cycle, whereas in post-test 2 it is increased to 33 girls with irregular menstrual cycle. In experimental group 1 none of them had regular menstrual cycle in pre-test and in post-test 2 all 50 girls had regular menstrual cycle. In experimental group 2, 38 members had irregular menstrual cycle in pre-test and in post-test 2 50 members had regular menstrual cycle. The statistical analysis between groups shows no significance in control group at P = 0.501, whereas the experimental group 1 and 2 shown significance at P < 0.001. This revealed that the multi interventional strategies are effective in regularizing the menstrual cycle. In supporting the present study findings, Smith et al (2022) evaluated the impact of lifestyle interventions on body mass index [11] (BMI) and waist circumference [9] among overweight adults over a 6-month period. A total of 120 participants were randomly assigned to either a control group or one of two experimental groups receiving different lifestyle modifications. The results indicated significant reductions in BMI and waist circumference [9] for both experimental groups compared to the control group. Specifically, BMI decreased from 29.4 to 27.8 kg/m^2 and waist circumference [9] reduced from 94.2 to 89.5 cm in the combined experimental groups, while the control group showed no significant changes. These findings underscore the effectiveness of targeted lifestyle

interventions in improving physical health parameters. The other longitudinal study conducted by Davis et al (2023) assessed the effects of dietary and physical activity interventions [12] on anthropometric measures, including BMI and waist circumference [9], in a cohort of 150 adults. Participants were assigned to either a control group or one of two experimental intervention groups. Over a 6-month period, both experimental groups demonstrated a significant decrease in BMI and waist circumference [9], with average reductions of 1.5 kg/m^2 and 3.2 cm respectively, compared to negligible changes in the control group. The results highlight the efficacy of integrated dietary and exercise interventions in reducing obesity-related metrics and suggest potential benefits for similar intervention strategies. The other comparative study by Miller (2021) also supported our current study and investigated the effectiveness of multi-component interventions on menstrual cycle regularity [10] in women with polycystic ovary syndrome (PCOS). Participants were divided into three groups: a control group, an intervention group receiving lifestyle modifications, and a group receiving both lifestyle modifications and medical treatment. The findings revealed that the intervention groups experienced a significant improvement in menstrual cycle regularity [10] compared to the control group. Specifically, the percentage of participants with regular menstrual cycles increased from 20% to 80% in the intervention groups, while the control group saw no significant changes. These results demonstrate the potential of comprehensive intervention strategies in managing menstrual irregularities associated with PCOS.

Table 1: Comparison of control, experimental 1 and experimental 2 groups of pre-test, post-test 1 and post-test 2 on BMI (kg/m2) and waist circumference(cm) in young girls with poly cystic ovary syndrome.

S.No.	Group comparison	Test comparison	BMI	Waist circumference
1	Control	Pre-test	28.8±0.2	88.7±0.2
	Experimental 1		29.5±0.1	89.4 ±0.1
	Experimental 2		29.8 ±0.1	88.1±0.4
	Control	Post-test 1	29.0±0.2	89.0±0.2
	Experimental 1		28.8±0.1	88.6±0.1
	Experimental 2		29.4±0.1	87.6±0.4
	Control	Post-test 2	29.3±0.2	89.0±0.2
	Experimental 1		28.2±0.1	87.9±0.1
	Experimental 2		29.0±0.1	87.5±0.4
2	Significance between Pre-test (Control and Experimental 1)		t = 3.266 P = 0.004	t = 1.938 P = 0.163
	Significance between Pre-test (Control and Experimental 2)		t = 4.645 P < 0.001	t = 1.396 P = 0.494
	Significance between Pre-test (Experimental 1 and Experimental 2)		t = 1.379 P = 0.509	t = 3.333 P = 0.003
	Significance between Post-test 1 (Control and Experimental 1)		t = 0.934 P = 1.000	t = 0.799 P = 1.000
	Significance between Post-test 1 (Control and Experimental 2)		t = 1.593 P = 0.340	t = 3.574 P = 0.001
	Significance between Post-test 1 (Experimental 1 and Experimental 2)		t = 2.527 P = 0.037	t = 2.775 P = 0.019
	Significance between Post-test 2 (Control and Experimental 1)		t = 4.690 P < 0.001	t = 3.087 P = 0.007
	Significance between Post-test 2 (Control and Experimental 2)		t = 1.299 P = 0.587	t = 4.313 P < 0.001
	Significance between Post-test 2 (Experimental 1 and Experimental 2)		t = 3.390 P = 0.003	t = 1.226 P = 0.666

Table 2: Comparison of Control. Experimental 1 and Experimental 2 groups on menstrual cycle.

Groups	Menstrual cycle		Statistical analysis	
	Regular	Irregular	Between group	All groups
Con-Pre	22	28	P = 0.501	P < 0.001
Con-Post 1	22	28		
Con-Post 2	17	33		
Exp 1-Pre	0	50	P < 0.001	
Exp 1-Post 1	48	2		
Exp 1-Post 2	50	0		
Exp 2-Pre	12	38	P < 0.001	
Exp 2-Post 1	23	27		
Exp 2-Post 2	50	0		

Con = Control
Exp 1 = Experimental 1
Exp 2 = Experimental 2
Pre = Pre-test
Post 1 = Post-test 1
Post 2 = Post-test 2
n = 50 each

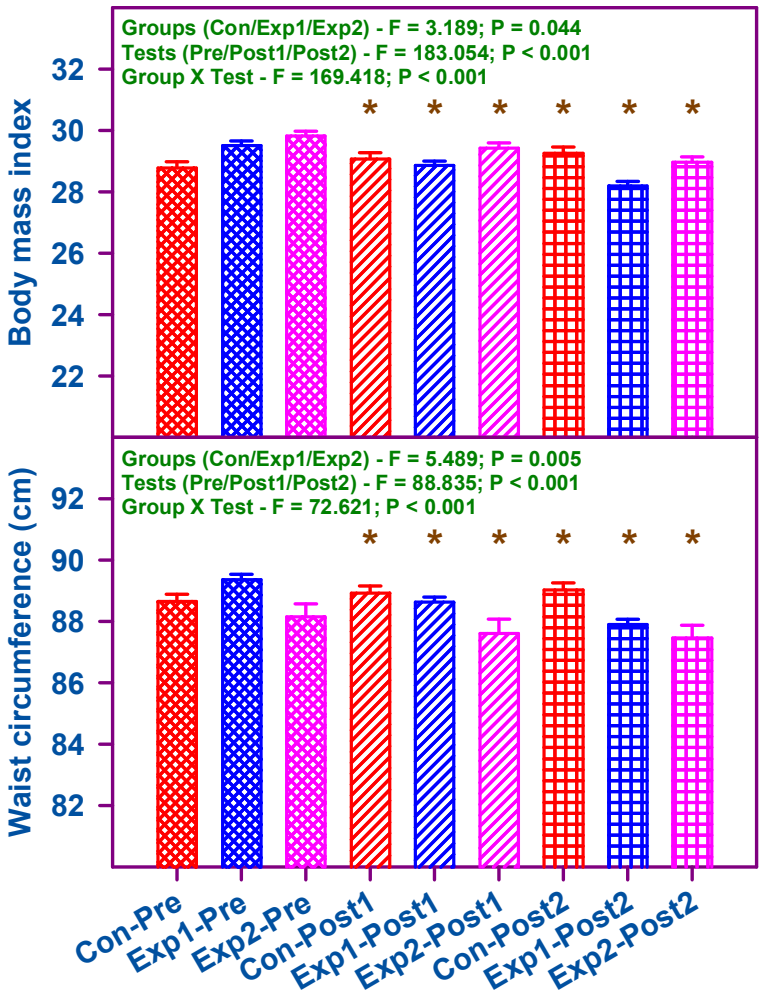

Figure 1: Comparison of control (Con), experimental 1 (Exp1) and experimental 2 (Exp2) groups of pre-test (pre), post-test 1 (Post1) and post- test 2 (Post2) on BMI and waist circumference in young girls with poly cystic ovary syndrome. The 'F' and 'P' values are by two-way RM ANOVA with Bonferroni 't' test.

*Significantly different from the respective pre-test.

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CONCLUSION

This study unveiled that the multi-interventional approach combining cinnamon supplementation, structured exercise program, and anxiety reduction counselling significantly improved health outcomes for young women with Polycystic Ovary Syndrome (PCOS) (17). Over a six-month period, participants in experimental group I exhibited substantial reduction in Body Mass Index (BMI) [8] and waist circumference [9] compared to the control group and experimental group II, indicating effective management of obesity-related aspects of PCOS. Additionally, the experimental groups experienced a marked improvement in menstrual cycle regularity [10], with all participants in Experimental Group 1 and a majority in Experimental Group 2 achieving regular cycles by the study's end. These findings highlighted the efficacy of integrating dietary, physical, and psychological interventions in addressing the complex symptoms of PCOS. The study supported the notion that a holistic approach, which targets multiple dimensions [15] of the condition, can lead to significant improvements in both metabolic and menstrual health. Future research should explore the long-term benefits of such combined strategies and their applicability to diverse populations with PCOS. Overall, the evidence underscored the value of a comprehensive intervention plan in enhancing the quality of life and health outcomes for individuals affected by PCOS.

Ethics committee approval: The present study was approved by Institutional Ethics Committee, Tagore Medical College and Hospital IEC NO: 32/MAR/2021 Dated: 18.03.202.

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Competing interest: The authors have declared that no competing interest exists.

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