Effect of Exercise Training on Anthropometric Measurements and Biomarkers in the Young Adult PCOS Population: A Comprehensive Review of Literature

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ABSTRACT

Objective: To find out the effectiveness of Exercise training on anthropometric measurements and biomarkers in the Young adult PCOS population.

Method: The articles were selected from various authentic platforms like Google Scholar, PubMed and ScienceDirect, from the years 2020-2025. Total articles selected were 41 from which only 15 articles were selected for the study according to the inclusion and exclusion criteria.

Results: Vigorous aerobic exercise, like HIIT, and resistance training improve body composition, insulin sensitivity, and reproductive health in women with PCOS when combined with a Mediterranean diet, they enhance weight management, reduce insulin resistance, and improve mental well-being. Exercise also positively influences fertility biomarkers, such as testosterone and SHBG levels enhancing the mental health and quality of life.

Conclusion: This article found that regular physical activity, especially vigorous exercises like HIIT and resistance training, can help manage PCOS. As it has been seen in many researches Physical activity is crucial for both metabolic and psychological health in women with PCOS which improves body composition, insulin sensitivity, and reproductive health, while also boosting mental well-being. When combined with a Mediterranean diet.

Keywords: Anthropometric measurements, Biomarkers, Exercise training, PCOS, Young adults.

INTRODUCTION

The regular flow of mucous and blood cells from the uterine lining through the vagina is what defines menstruation, which is a natural phenomenon. Specialized cells called mucous cells create mucus, a viscous, thick substance that protects many bodily regions. This marks the beginning of a woman's reproductive years. Typically, it lasts two to seven days [1]. A common health condition caused by an imbalance in reproductive hormones is polycystic ovarian syndrome, or PCOS. Hormonal imbalance causes problems for the ovaries, as part of a typical menstrual cycle, the ovaries create the egg that is released once a month. If PCOS is present, the egg might not develop normally or might not be released at ovulation as it should be. PCOS is a disorder that changes how a woman's ovaries work. Polycystic ovaries, excessive androgen production, and irregular periods are the hallmarks of PCOS [2]. Women with PCOS may experience symptoms such as sugar cravings, frequent urination, sluggish wound healing, exhaustion, blurred vision, tingling sensations, mood swings, anxiety, depression, pelvic discomfort, fever, nausea, vomiting, urine difficulties, and constipation [3].

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PCOD and PCOS differ slightly from one another. PCOS (polycystic ovarian syndrome) is a metabolic syndrome that increases the risk of infertility, miscarriage, insulin resistance, diabetes, cardiovascular diseases, and endometrial malignancies. In contrast, PCOD (Polycystic Ovarian Disease) is a milder illness that is addressed by diet and exercise and has less fertility concerns. For both, getting medical help is essential, although PCOS involves more serious health issues.[4]

According to estimates, the prevalence of PCOS in women aged 17 to 45 ranges from 5.5% to 12.6% worldwide. Similarly, depending on the diagnostic standards applied, the prevalence estimates in India range from 8.2% to 22.5%, with regional variations observed across different states. For example, the prevalence of PCOS in Andhra Pradesh, South India, found that among college girls was 9.3%, in Mumbai, Western India, was 22.5% , Bhopal was 8.2%, Lucknow, North India, was estimated to be 3.7%. These variations in prevalence highlight the growing concern around polycystic conditions in women. [5]

Considering the hormonal and metabolic disturbances associated with PCOS, the purpose of this study was to compare the activity of OS (oxidative stress) parameters in PCOS to those of women with normal body weight who do not have menstrual abnormalities. The OS characteristics were examined and contrasted with the patients' anthropometric measurements and lipid profiles.[6] Therefore, our goal was to find out how anthropometric measures like waist circumference, BMI, and waist-to-height ratio (WHtR) relate to body composition indices like BIA and sex hormone levels in women with PCOS. Anthropometric measurements included waist circumference, body mass index (BMI), waist-to-height ratio (WHtR), and body composition indices (measured by bioelectric impedance analysis [BIA]).[7]According to the World Health Organization (WHO), a body mass index (BMI) of 25 to 29.9 denotes overweight, whereas a BMI of 30 or more suggests obesity. Obesity affects 38.0% of women and 36.9% of men worldwide [8], highlighting the significance of developing reliable health indicators. A biomarker is an objectively measured and assessed biological property that serves as a predictor of abnormal or normal biological processes, as well as a response to a therapeutic intervention. Biomarkers are essential for disease diagnosis, stratification, prognosis prediction, progression, regression, or treatment outcome. Biomarkers that address this complex syndrome's non-reproductive and reproductive aspects are desperately needed. A combination of clinical and anthropometric biomarkers, or minimally invasive biomarkers, may improve the diagnosis and prognosis of women with PCOS. Addressing cardiometabolic dysregulations in PCOS population requires the use of accurate and reasonably priced screening biomarkers of insulin resistance in slim women.[9]

In keeping with this objective, the Endocrine Society Clinical Practice Guidelines on the Diagnosis and Treatment of PCOS propose physical activity and exercise as the first line of treatment to lower the risk of chronic disorders. Women with PCOS are more likely to have comorbid conditions like metabolic syndrome, cardiovascular disease, and endometrial cancer because they are more likely to have insulin resistance, obesity (particularly visceral adiposity), dyslipidaemia, and endometrial abnormalities. The PCOS Australian Alliance adult guidelines recommended at least 150 minutes per week of moderate-intensity physical activity, of which 90 minutes should be moderate-to-high intensity aerobic activity, in order to maintain health and/or help prevent chronic comorbidities by lowering body weight. This recommendation was based on a 2011 systematic review of aerobic exercise (such as walking or cycling) for women with PCOS. Anaerobic resistance training (RT) is a type of exercise that uses repeated motions against unfamiliar loads to increase muscular contraction. This type of exercise is linked to improve insulin sensitivity, faster glucose absorption, clinically reduced blood pressure over time, elevated basal metabolic rate, and enhanced functional strength because muscle contraction incorporates both mechanical and metabolic aspects. Visceral obesity, or belly fat, is a common symptom of PCOS and is linked to an increased risk of diabetes, hypertension, and metabolic syndrome. Therefore, in women with PCOS, the myogenic or muscle adaptations brought on by RT are frequently accompanied by a variety of physiological (metabolic) and functional changes that could be clinically significant. Every RT program was linked to a decrease in body fat in PCOS-afflicted women, mostly as a result of decreased abdominal adiposity. A small weight loss of 5–10% of total body weight is anticipated to result in health advantages, including better insulin sensitivity and decreased total cholesterol, therefore this finding is encouraging. Planned and structured movement intended to alleviate PCOS clinical symptoms and lower the long-term risk of comorbidities is what is meant by exercise as therapeutic therapy.[10]

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METHODOLOGY

Source of evidence searched:

- Google scholar
- PubMed
- Cochrane

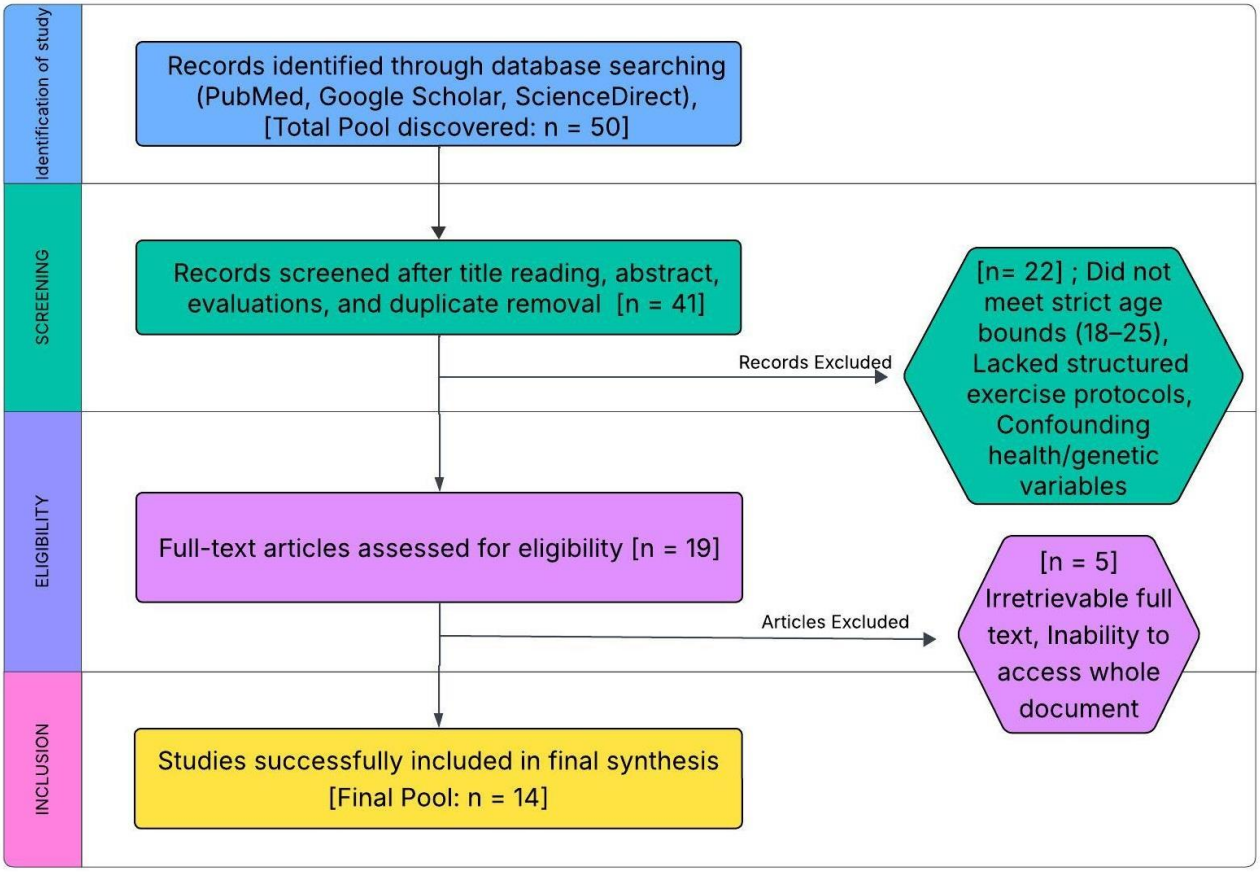
Study selection:

Inclusion criteria

- Women suffering from PCOS (based on validated criteria (e.g, Rotterdam, NIH etc)
- Young adults (18 to 25 Years)
- Articles published in English
- Articles containing exercise training protocol
- Articles measuring anthropometric indices or biomarker profile or both.
- Articles were included from 2020 to 2026

Exclusion criteria

- Articles before 2020.
- Populations outside the young adult group.
- Articles in any other language than English.
- Articles not measuring any anthropometric indices or biomarker profiles
- Impaired mental status.
- Articles not containing exercise protocol.
- Co-existing conditions that independently alter biomarkers (e.g., pregnancy, Cushing's syndrome, thyroid disorders).
- Any history of cancer/genetic disorders.



TITLE	AUTHOR	YEAR	METHOD	SAMPLE SIZE	RESULT	CONCLUSION	Outcome Measure
Lifestyle Management in Polycystic Ovary Syndrome – Beyond Diet and Physical Activity	Cowan, S., Lim, S., Alycia, C., Pirotta, S., Thomson, R., Gibson-Helm, M., Blackmore, R., Naderpoor, N., Bennett, C., Ee, C., Rao, V., Mousa, A., Alesi, S., & Moran, L.	2023	Comprehensive review of literature	NA	No specific diet composition has been definitively recommended, various dietary modifications (protein, carbohydrate, and fat quality or quantity) show comparable effects on PCOS symptoms. Vigorous aerobic exercise appears to be the most beneficial for improving body composition, cardiorespir	Lifestyle management, including diet, exercise, psychological support, and sleep interventions, is key for PCOS. Vigorous aerobic exercise improves metabolic health, while inositol supplementation shows promise. Other complementary approaches lack strong evidence.	Improved insulin resistance, body composition, cardiorespiratory fitness, and general metabolic health in PCOS by lifestyle modification; the greatest benefits were shown with intense aerobic exercise and inositol supplementation.

					atory fitness, and insulin resistance		
Effect of Pilates on Regulating Menstrual Cycle in Females with Polycystic Ovarian Syndrome	Mohamed, E.S., & Ahmed, S.A.	2022	Randomized controlled trial of Pilates exercises on menstrual regularity in women with PCOS	26	Significant reductions in pain during menstruation were observed (Wilk's Lambda = 0.117, $F(3,23) = 58.109$, $P < 0.05$). Menstrual cycles became more regular, and improvements in menstrual regulation were noted through the VMSS.	The study concluded that Pilates exercises are effective in reducing menstrual pain and in regulating menstrual cycles in women .with PCOS. These improvements contributed to enhanced overall functioning and quality of life for the participants, making Pilates a beneficial intervention for managing PCOS symptoms	The study utilized the Visual Analog Scale (VAS) to assess pain levels and the Verbal Multidimensional Scoring System (VMSS) to evaluate menstrual cycle regulation. Measurements were taken at baseline, and after the 1st, 2nd, and 3rd months of the Pilates exercise protocol, which was administered three times per week over the course of three months.
Resistance Training as Therapeutic Management in Women with PCOS: What is the Evidence?	Hutchison, S.K., & Stepto, N.K.	2023	Systematic review analyzing the effects of resistance training on women with PCOS	NA	The findings indicated that resistance training (RT) led to improvements in body composition, with reductions in waist circumference and body fat percentage, alongside increase in lean muscle mass. Hormonal improvements were observed, including lower testosterone	Resistance training appears to be a beneficial therapeutic approach for women with PCOS, offering improvements in both physical and mental health outcomes. However, the studies included in the review had small sample sizes and varied methodologies, suggesting a need for	The studies reviewed assessed various outcomes, including body composition (waist circumference, body fat percentage, lean muscle mass), hormonal levels (testosterone and insulin sensitivity), and psychosocial factors (sexual function, depression, and anxiety scores).

					levels and enhanced insulin sensitivity. Psychosocial benefits were also noted, with improvements in sexual function and reductions in symptoms of depression and anxiety.	further research with larger, more standardized trials to fully determine the long-term benefits of RT in managing PCOS.	
Exercise and Sport: Their Influences on Women's Health Across the Lifespan	Bruinvels, G., Burden, R.J., & McGregor, A.J.	2021	Review article examining the impact of exercise and sports participation on various aspects of women's health	NA	Exercise and sports improved body composition (reduced body fat, increased lean muscle mass), insulin sensitivity, and reproductive health, particularly in managing conditions like PCOS. Psychosocially, it reduced depression and anxiety while enhancing overall quality of life.	Regular exercise and sport have significant health benefits for women, improving physical, mental, and reproductive health. Personalized exercise programs are recommended to optimize outcomes across different life stages.	The studies assessed physical health (body composition, hormonal profiles, insulin sensitivity), metabolic health, and psychosocial factors (mental health, quality of life, sexual function) in women participating in exercise and sports
Health-Related Physical Fitness in Women with PCOS Versus Controls: A Systematic Review and Meta-Analysis	Costa, R.F., de Sá, J.C.F., & de Melo, A.S.	2022	Systematic review and meta-analysis comparing physical fitness levels between women with PCOS and healthy controls	NA	Women with PCOS showed significantly lower CRF compared to controls, but no significant difference in muscle strength. Some studies indicated reduced muscle endurance,	The review concluded that PCOS is associated with lower CRF, but the evidence on muscle strength and endurance is inconclusive. The authors recommend further studies to better understand	The study focused on cardiorespiratory fitness (CRF), muscle strength, and muscle endurance in women with PCOS, comparing these measures with healthy controls. It also examined factors like insulin sensitivity and hormone levels that may influence these fitness outcomes.

					particularly core endurance, in PCOS, though results were not consistent. Insulin sensitivity and hormone levels were found to affect CRF.	the relationship between PCOS and physical fitness, particularly considering moderating factors like insulin sensitivity and hormone levels.	
Lifestyle Medicine Encompassing Scientific Exercises and Right Diet: The Key To Prevent And Reverse PCOS/PCOD	J.C Balachandar , S. Irshad Ahamed , Amit Kumar Agrawal , Baani Khanna,Dilsher Khanna , M. Jayachandran1	2022	Review of lifestyle medicine approaches, focusing on exercise and diet, for PCOS prevention and reversal	NA	Lifestyle interventions combining exercise and diet have shown significant improvements in PCOS outcomes. Regular physical activity enhances insulin sensitivity and supports weight management. Dietary changes, such as reducing simple carbs and increasing anti-inflammatory foods, help regulate hormones and restore menstrual regularity. These interventions also improve lipid profiles, blood pressure, and mental health.	A combined approach of exercise and diet is effective in managing PCOS, improving metabolic and reproductive health, and reducing cardiovascular risk. Personalized interventions are recommended for better outcomes, and ongoing research is needed to confirm long-term benefits.	Key health indicators assessed in studies examining lifestyle interventions for PCOS include body mass index (BMI), insulin sensitivity, hormonal profiles (particularly androgen levels), menstrual regularity, and ovulatory function. Additionally, parameters such as lipid profiles, blood pressure, and quality of life assessments are considered to evaluate the comprehensive impact of lifestyle modifications.
Optimizing Polycystic Ovarian Disorder (PCOD) Treatment with Personalized	Most Sufia Begum,	2021	Review study	NA	Personalized lifestyle and nutrition strategies,	Personalized lifestyle and nutrition	Key outcome measures for evaluating the effectiveness of these interventions include

Lifestyle and Nutrition Strategies	Samira Areen				such as the Mediterranean diet, combined with regular physical activity, have demonstrated significant improvements in metabolic and hormonal parameters for women with PCOS. Studies show reductions in insulin resistance, better weight management, and improvements in psychological well-being.	interventions are crucial in managing PCOS. Tailored dietary plans and physical activity improve metabolic health, hormone regulation, and mental health. Using technologies like Clinical Decision Support Systems (CDSS) can enhance adherence to these strategies, emphasizing the need for individualized care in PCOS treatment.	dietary adherence (measured by food diaries and dietary recalls), metabolic parameters (such as insulin resistance and lipid profiles), hormonal levels (including serum testosterone), and psychological well-being (assessed via anxiety and depression questionnaires).
A Low Glycemic Index, Energy-Restricted Diet but Not Lactobacillus rhamnosus Supplementation Changes Fecal Short-Chain Fatty Acid and Serum Lipid Concentrations in Women with Overweight or Obesity and Polycystic Ovary Syndrome	K Łagowska, S Drzymała-Czyż	2022	Randomized controlled trial assessing the effects of a low GI diet and probiotic supplementation on metabolic parameters in PCOS	40	A 20-week low glycemic index, energy-restricted diet led to significant improvements in body weight, fat mass, fecal short-chain fatty acids (acetic and butyric acids), and serum lipid profiles (cholesterol, LDL, and triglycerides) in women with PCOS. However, Lactobacillus rhamnosus supplementation did not	Implementing a low glycemic index, energy-restricted diet resulted in significant improvements in metabolic health indicators among overweight and obese women with PCOS. However, adding Lactobacillus rhamnosus supplementation did not provide additional benefits in altering gut	The study assessed various parameters, including anthropometric measurements (body weight, BMI, fat mass), fecal short-chain fatty acids (acetic and butyric acids), serum lipid concentrations (total cholesterol, low-density lipoprotein cholesterol, triglycerides), and the abundance of specific gut bacteria (Akkermansia muciniphila, Bifidobacterium longum, and Faecalibacterium prausnitzii). These measures were evaluated at baseline and after the 20-week intervention

					show any additional benefits over the diet alone.	microbiota composition, increasing fecal short-chain fatty acid levels, or enhancing serum lipid profiles beyond the effects of the diet alone.	
Effect of a Dietary and Exercise Intervention in Women with Overweight and Obesity Undergoing Fertility Treatments: Protocol for a Randomized Controlled Trial	Kindann Fawcett, Audrey Martinez, Meghan Crimmins, Clark Sims, ElisabetBørsheim & Aline Andres	2021	Protocol outlining a study to evaluate the impact of combined dietary and exercise interventions on fertility outcomes in overweight/obese women undergoing fertility treatments	120	This randomized controlled trial aims to determine if a structured dietary and exercise program can positively influence fertility-related biomarkers and overall metabolic health in women with overweight or obesity undergoing fertility treatments.	The trial is expected to provide valuable insights into how a combined dietary and exercise intervention can improve fertility outcomes and metabolic health in women with overweight and obesity. If successful, the findings could guide future fertility treatment strategies and pre-conception care for this population.	The primary outcomes of the trial include changes in oocyte gene expression profiles and follicular fluid metabolite concentrations, assessing the molecular impact of dietary and exercise interventions on fertility. Secondary outcomes involve improvements in metabolic health, such as insulin sensitivity, blood pressure, triglyceride levels, and inflammatory markers like C-reactive protein and interleukin-6.
Lactobacillus rhamnosus Has No Beneficial Effect on Anthropometric Parameters, Carbohydrate Metabolism, and Androgen Status in Women with Polycystic Ovary Syndrome	Karolina Łagowska, Karina Kapczuk	2023	Double-blind, placebo-controlled trial evaluating the effects of Lactobacillus rhamnosus supplementation on metabolic and hormonal parameters in PCOS	NA	Both groups experienced significant reductions in weight, BMI, fat mass, and waist circumference. Notably, the diet-alone group showed significant decreases in testosterone levels and the free	In overweight and obese women with PCOS, a 20-week low glycemic index weight-reduction diet effectively improved anthropometric measures and androgen	The study evaluated the effects of a 20-week low glycemic index weight-reduction diet, with or without Lactobacillus rhamnosus supplementation, on anthropometric parameters (weight, BMI, fat mass, waist circumference), carbohydrate metabolism (oral glucose tolerance test results), and androgen status (testosterone levels, free androgen index) in women with PCOS.

					androgen index. Supplementation with Lactobacillus rhamnosus did not provide additional benefits over the diet alone in improving these parameters	status. Adding Lactobacillus rhamnosus supplementation did not offer extra advantages, suggesting that probiotic supplementation may not enhance the effects of dietary interventions in this context	
The Influence of Physical Activity, Diet, and Lifestyle of Patients on the Course of Polycystic Ovary Syndrome (PCOS) in Women	Gabriela Różańska-Smuszkiewicz, Paweł Smuszkiewicz-Różański, Weronika Kmiotek, Dagmara Ragan, Radosław Oronowicz, Paweł Staszczak, Barbara Jaworska, Joanna Długosz, Maciej Bara, Grzegorz Jama	2022	Observational study examining the impact of physical activity, diet, and overall lifestyle on PCOS progression	NA	Dietary changes, such as low glycemic and anti-inflammatory diets, improve insulin sensitivity and hormone balance. Regular physical activity enhances metabolic health and reproductive function, while behavioral interventions improve treatment adherence and mental health	Lifestyle interventions, including diet modifications, exercise, and behavioral changes, are key in managing PCOS. These strategies improve reproductive, metabolic, and psychological outcomes, offering a holistic approach to PCOS management.	The impact of physical activity, diet, and lifestyle on PCOS is assessed through reproductive outcomes (menstrual regularity, ovulation), metabolic markers (insulin sensitivity, weight), and psychological well-being (mood, quality of life).
Effectiveness of Exercise Interventions on Mental Health and Health-Related Quality of Life in Women with Polycystic Ovary Syndrome: A Systematic Review	Rhiannon K Patten, Michaela C Pascoe, Alba Moreno-Asso, Russell A Boyle, Nigel K Stepto, Alexandra G Parker	2021	Systematic review assessing the impact of various exercise interventions on mental health and quality of life in women with PCOS	Women diagnosed with PCOS	Exercise interventions showed positive effects on mental health and health-related quality of life in women with PCOS. Significant	Exercise interventions are beneficial in enhancing the mental health and quality of life for women with PCOS. However, variability in the	Various measures such as the PCOSQ (Polycystic Ovary Syndrome Questionnaire) and SF-36 (Short Form Health Survey) were used. Results indicated improvements in emotional wellbeing, physical health, and mental health, with notable reductions in depression and anxiety.

					improvements were observed in PCOS-related distress, mental health outcomes (e.g., reductions in anxiety and depression), and overall quality of life.	exercise protocols used calls for further research to determine the most effective exercise regimens and to assess long-term benefits.	
Comparison of Physical Activity Levels and Dietary Habits Between Women with Polycystic Ovarian Syndrome and Healthy Controls of Reproductive Age: A Case-Control Study	Muhammad Salman Butt, Javeria Saleem, Rubeena Zakar, Sobia Aiman, Gul Mehar Javaid Bukhari, Florian Fischer	2022	Case-control study	150	Women with PCOS exhibited significantly lower physical activity levels and poorer dietary habits compared to healthy controls. Specifically, they engaged in less moderate-to-vigorous physical activity and consumed diets higher in processed foods and lower in fruits and vegetables.	The findings suggest that women with PCOS have less favorable lifestyle behaviors, characterized by reduced physical activity and suboptimal dietary habits, which may contribute to the exacerbation of PCOS symptoms. Interventions promoting increased physical activity and healthier diets are recommended for this population.	The primary outcomes assessed were physical activity levels and dietary habits, evaluated using standardized questionnaires.
Effect of Exercise Interventions on Metabolic, Reproductive, and Mental Health in Overweight Women with Polycystic Ovary Syndrome	R. Patten	2023	A randomized clinical trial involved 24 overweight women aged 18-45 years diagnosed with PCOS. Participants were assigned to either a HIIT group (n=13)	24	Both groups showed significant VO_2peak improvements, with HIIT yielding a greater increase (23.4% vs. 14.0%, P=0.004). HIIT also significantly	HIIT was more effective than MICT in enhancing fitness, insulin sensitivity, and certain reproductive health markers in overweight	cardiorespiratory fitness (VO_2peak), insulin sensitivity, free androgen index (FAI), sex hormone-binding globulin (SHBG), mental health, and health-related quality of life (HRQoL)

			or a MICT group (n=11) for a 12-week supervised exercise program.		enhanced insulin sensitivity (49.1% improvement, P=0.014) and improved reproductive markers, including reductions in FAI (P=0.041) and increases in SHBG (P=0.026).	women with PCOS. These findings suggest HIIT as a time-efficient intervention for managing PCOS-related health issues. Further research with larger sample sizes is recommended to confirm these results.	

RESULT

The literature review emphasizes how common PCOS is in young adult women and the physical, metabolic, and hormonal effects that go along with it. Exercise and lifestyle modifications are beneficial in improving anthropometric indices and important metabolic indicators, which helps with better symptom control, according to evidence from several studies. Frequent exercise has been associated with better menstrual regularity, more balanced hormone profiles, and increased insulin sensitivity. These outcomes highlight the crucial role that organized exercise plays in a thorough approach to PCOS treatment. The quality of life and general health outcomes of this population could be greatly enhanced by putting such lifestyle-focused interventions into practice.

DISCUSSION

Despite being more common in younger populations, PCOS is still a common endocrine condition that has serious health consequences. The necessity of early screening, prompt diagnosis, and awareness campaigns was highlighted by a descriptive cross-sectional study that included 381 female medical students and found a prevalence of 46.34%. [24] Although there is no widely accepted dietary composition for PCOS, lifestyle modification—specifically, tailored food planning and organized exercise—is acknowledged as a key component of PCOS care [11]. Research suggests that dietary changes along with consistent exercise enhance menstrual regulation, insulin resistance, and hormonal balance—all of which are critical for managing symptoms and maintaining long-term health [12]. New research indicates that resistance exercise can improve metabolic indices, hormone profiles, waist circumference, and body composition without causing noticeable weight reduction. The body of research backs a holistic strategy that integrates medical treatment, lifestyle modifications, focused exercise, and psychosocial support to maximize health outcomes for women with PCOS[25].

Conflict Of Interest

No conflicts of interest are disclosed by the writers.

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