Comparing Lifestyle-Only Interventions with Combined Medicinal and Behavioral Approaches in Managing Polycystic Ovarian Syndrome (PCOS)

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UWP 104FV: Writing in the Health Professions

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Fall Quarter 2024

Abstract

Purpose of this Review Polycystic Ovarian Syndrome (PCOS) is a prevalent reproductive endocrine disorder affecting menstruating women worldwide. Since there is no standard treatment approach for the disorder, this review examines the efficacy of various treatment methods. This research specifically examines whether combined treatments (medicinal+lifestyle or behavioral+lifestyle) are more effective than each treatment alone in managing the metabolic, reproductive, and psychological impacts of PCOS.

Summary The evidence does not exclusively favor the use of combined treatments over medicinal approaches alone. Medicinal treatments, such as metformin and hormonal birth control, demonstrate superior efficacy in addressing metabolic and reproductive issues, while behavioral interventions, particularly cognitive behavioral therapy (CBT), are more effective in managing psychological symptoms.

Keywords PCOS, obesity, calorie deficit, metformin, hormonal birth control, cognitive behavioral therapy, lifestyle intervention

Introduction

Polycystic Ovarian Syndrome (PCOS) is the most common reproductive endocrine disorder affecting menstruating women worldwide. Despite its prevalence, challenges such as misdiagnosis, delayed diagnosis, ambiguous diagnostic criteria, and unclear treatment pathways continue to hinder effective care (Hoeger et al., 2021). Table 1 shows two similar yet distinctly different diagnostic criterias that can be used to inform patient care.

Table 1. The NIH definition requires both criteria to be met in order to make a diagnosis, while Rotterdam criteria only needs two of the three to be met. Both definitions do not take into account diagnoses that may replicate the symptoms of PCOS (Source: Franks 2006).

NIH Criteria (1990)	Rotterdam Criteria (2003)
➢ Chronically irregular menstrual cycles	➢ Irregular menstrual cycles (does not need to be chronic)
➢ Clinical (facial hair) or biological (blood test) signs of increased testosterone levels	➢ Clinical (facial hair) or biological (blood test) signs of increased testosterone levels
	➢ Polycystic ovaries

These challenges reflect a larger issue: women's health remains an understudied and underfunded area of healthcare. According to Shah et al. (2021), analysis of NIH funding allocation indicates that research into women's health does not align with the significant burden of disease.

To understand PCOS, it is essential to examine its key diagnostic features and long-term effects. PCOS is diagnosed based on four key features: irregular periods, elevated testosterone levels, severe acne, and ovarian cysts. Long-term effects include reproductive complications (infertility, miscarriage), metabolic issues (obesity, insulin resistance, type II diabetes), and psychological disorders (anxiety, depression) (Hoeger et al., 2021).

However, three of these diagnostic features overlap with natural stages of life such as puberty and menopause. For example, adolescent girls may experience irregular menstrual cycles for up to 1-3 years after their first period, and menopause typically leads to natural infertility. This overlap complicates diagnosis, particularly for women under 18 or over 45, which is why these age groups are especially challenging to study.

There is more conclusive evidence published for women aged 18-45, which is the primary focus of this paper. More specifically, this research focuses on obese women within this

age group, as they are disproportionately affected by the disorder. Obesity and PCOS are interlinked, with obesity increasing the risk of PCOS, and PCOS, in turn, contributing to weight gain and obesity. According to Naderpoor et al. (2015), this exacerbates reproductive, metabolic, and psychological complications, compounding the disease's overall impact.

The compounding effects of PCOS in obese women arise because several comorbidities of PCOS and obesity overlap. To illustrate this idea, obese individuals with high body fat percentages are often insulin resistant, leading to a buildup of blood glucose which in extreme cases leads to type II diabetes. For women with PCOS, insulin resistance creates severely elevated testosterone levels. Elevated testosterone levels create irregular menstrual cycles and ultimately long-term infertility (Naderpoor et al., 2015).

Treatment options for PCOS vary, often beginning with lifestyle interventions. Patients are prescribed a caloric deficit focused on increasing their intake of fruits, vegetables, protein, and incorporating moderate daily exercise. Although a variety of lifestyle interventions can be recommended as shown in Table 2, their ambiguity and challenges in long-term sustainability may hinder its effectiveness, leading to patient frustration.

Table 2. This diagram shows the general exercise recommendations which follow the 2023 International Guidelines for all people with PCOS (Source: Colombo et al., 2023).

Type of Exercise	Recommendation	Examples
Resistance Training	2 sessions weekly, incorporating bodyweight, dumbell, or machine exercises	**Leg Exercise** → squats, lunges, wall sit, calf raises, leg extension **Arm Exercise** → bent over rows, hammer curls, shoulder press, push-ups
High Intensity Training	**For Weight Loss:** >150 min/wk **For Weight Maintenance:** 70-150 min/wk	Running, jump rope, circuit training, interval training
Low-Intensity Training	**For Weight Loss:** >150 min/wk **For Weight Maintenance:** 70-150 min/wk	Gardening, walking, biking

Research suggests that medicinal and behavioral interventions are more effective in achieving long-term weight loss and mitigating the effects of PCOS. Metformin, for instance, is a drug proven to increase insulin sensitivity and is now used to manage elevated testosterone and anti-Mullerian hormone (AMH) levels in PCOS patients, contributing to improved long-term metabolic health and fertility outcomes (Naderpoor et al., 2015). Additionally, hormonal birth control is used to regulate menstrual cycles by suppressing AMH and testosterone levels, increasing long-term fertility outcomes (Shah et al., 2021). Cognitive behavioral therapy (CBT), a relatively recent approach, addresses underlying stressors to reduce cortisol levels and foster healthier relationships with diet and exercise, potentially facilitating weight loss. This method helps reduce anxiety and depression caused by unhealthy body image, a significant long-term psychological effect of PCOS (Jiskoot et al., 2020).

This literature review will examine how different treatment methods impact the symptoms and progression of PCOS in obese women aged 18-45, where obesity is defined as a BMI of 25 kg/m^2 or higher. It will compare the combined effects of medicinal treatments (e.g. birth control, metformin) or behavioral interventions (e.g. cognitive behavioral therapy) with lifestyle changes alone (e.g. caloric restriction, regular exercise). Since managing PCOS symptoms is highly individualized, this study aims to evaluate how different treatment combinations affect symptom management and disease progression in this population.

Methods

Databases and Search Terms

PubMed and EMBASE were the primary databases used to identify relevant studies. Both databases offer broad coverage of clinical studies, making them ideal for building a comprehensive literature base. Psycinfo could have been used to examine the psychological

impacts of PCOS, however, was ultimately excluded to focus on data from broader medical databases. Cross-referencing search terms on SCOPUS minimized selection bias and ensured a well-rounded view of the available research. Initially, “adolescent” and “PCOS” were used as search terms, but these were refined after recognizing the challenge of distinguishing PCOS symptoms from normal puberty. The final search strategy focused on “obesity,” “PCOS,” and specific treatments, including “metformin” and “cognitive behavioral therapy” with “randomized controlled trial” or “meta-analysis.”

Inclusion and Exclusion Criteria

The selection process prioritized randomized controlled trials (RCTs), meta-analyses of RCTs, and systematic reviews. RCTs were given precedence since they include the highest level of evidence and are the gold standard in scientific literature. Studies were included if participants were clinically diagnosed with PCOS, had a BMI > 25 kg/m^2, and were aged 18 to 45. Preference was given to studies comparing combined medicinal or behavioral interventions with standalone treatments. Individual studies on metformin, hormonal birth control, lifestyle interventions, and cognitive behavioral therapy were also included to establish baselines. Lifestyle interventions specifically involved caloric deficits and daily exercise. Studies published within the past 20 years were included, as no significant treatments have emerged since then. Both short-term (<3 months) and long-term (~1 year) studies were selected. This yielded ten relevant studies, of which six were chosen; excluded studies did not have a clear explanation of their treatment groups and randomization process.

Critical Appraisal

The author faced difficulty conducting a comprehensive risk of bias assessment due to being the sole reviewer. Appendix A describes the risk of bias assessment, adapted from the

Joanna Briggs Institute (JBI), a validated critical appraisal tool. The original JBI tool is designed for RCTs, but the author modified its criteria to apply to both RCTs and meta-analyses of RCTs. Additionally, the author adjusted the criteria to align with their level of expertise, as they have no formal training in using these tools. This adapted method is not validated for reproducibility, but proved effective within the course's time constraints for the scope of research.

Results

Based on the critical appraisal process outlined in Appendix A, six out of the ten studies reviewed were selected to be included in this paper. All studies included lifestyle interventions as a baseline for comparison with various medicinal and behavioral interventions, except for Deshmukh et al. (2023). Table 3 presents key information on study comparisons. Outcomes reflect the multifaceted nature of PCOS, allowing for a more comprehensive assessment of treatment efficacy across a specific population.

Table 3. *Summary of Results*

	Studies					
Factors	Deshmukh et al. (2023) / *Lifestyle*	Cooney et al. (2018) / *CBT*	Jiskoot et al. (2020) / *CBT*	Naderpoor et al. (2015) / *Metformin*	Mehdinezhad et al. (2024) / *Metformin*	Shah et al. (2021) / *Birth Control*
Study Design & Method	Randomized Control Trial (RCT)	Randomized Control Trial (RCT)	Randomized Control Trial (RCT)	Systematic Review & Meta-Analysis	Systematic Review & Meta-Analysis	Randomized Control Trial (RCT)
Sample Size & Duration	n=40 total (n=21 VLCD, n=19 MCD); 8 weeks	n=15 total (n=7 CBT+LS, n=8 LS only); 16 weeks	n=183 total (1:1:1 CBT-LS, CBT-LS + SMS, CAU); 12 months	31 RCTs reviewed; 12 RCTs of interest (n=608: MET-LS, MET, LS); 3–12 months	42 RCTs reviewed; 16 single-arm RCTs of interest (MET vs. placebo, n=484); 8–48 weeks	n=94 total (n=34 OCP, n=31 Lifestyle, n=29 Combined); 16 weeks (3x)
Population	Women 18–45 yrs, BMI 30–45 kg/m², PCOS (Rotterdam), weight loss desire	Women 18–45 yrs, BMI 27–50 kg/m², PCOS (NIH), CES-D >14 (depression)	Women 18–38 yrs, BMI >25 kg/m², PCOS (Rotterdam), trying to conceive	Women 18-39 yrs, BMI >25 kg/m², PCOS (Rotterdam/NIH)	Women 18-32 yrs, BMI 21-37 kg/m², PCOS (Rotterdam)	Women 18-40 yrs, BMI 27-42 kg/m², PCOS (Rotterdam), trying to conceive
Primary Results & Findings	free androgen reduction (VLCD); weight loss (MCD/VLCD)	Heart rate & cortisol reduction (CBT+LS)	Self-esteem, body image, depression (CBT-LS & CBT-LS + SMS)	BMI, menstrual regularity, uterine fat reduction (MET-LS); improved fertility	<1500 mg/day lowered AMH over 12 weeks, improving fertility	BMI, insulin sensitivity, weight loss (Lifestyle, Combined); AMH/testosterone reduction (OCP)
Other Critical Factors	Sustainability issues in lifestyle interventions; long-term fertility outcomes not assessed	Findings align with Jiskoot et al. (2020); limited population scope	Findings align with Cooney et al. (2018); long-term fertility outcomes not assessed	No psychological outcomes; long-term fertility outcomes not assessed	Long-term fertility and metformin effects (GI issues) not measured	Live birth rates not measured; all groups showed oxyntomodulin suppression

Lifestyle Interventions

Insulin resistance occurs when glucose is not efficiently taken up by cells and accumulates in the bloodstream, which inhibits weight loss. PCOS increases the risk of developing insulin resistance, and many obese women with PCOS already face this issue. Deshmukh et al. (2023) conducted a randomized control trial on 40 women over 8 weeks, followed by an 8-week post-trial period. After randomization, the two groups were compared based on their caloric deficit interventions. One group followed an extreme caloric deficit (VLCD) of 800 kcal/day, consuming only meal replacement shakes, soups, and bars, while the second group followed a moderate caloric deficit (MCD) of 600 kcal/day based on their usual intake. The researchers measured changes in the free androgen index (testosterone levels), body weight, BMI, and waist circumference.

The VLCD group experienced a 32% reduction in free androgen index, which was statistically significant ($p<0.05$), indicating that the reduction in testosterone levels in the VLCD group is unlikely to have occurred by chance, compared to only an 8% reduction in the MCD group, which was not statistically significant ($p>0.05$). Both groups experienced weight loss which was statistically significant ($p<0.05$), and there was no significant reduction in BMI or waist circumference in the MCD group.

The researchers noted significant challenges in retaining subjects, raising concerns about the long-term sustainability of extreme caloric deficits for weight loss management. Additionally, improved fertility outcomes, a major concern for women with PCOS, were not measured in the study. These findings underscore the difficulty women with PCOS face in losing weight, as elevated testosterone contributes to insulin resistance by selectively storing fat in the abdominal area, complicating even moderate weight loss efforts.

Effect of CBT on Psychological Outcomes

Androgenal imbalances are not the only issue women with PCOS face while losing weight. High cortisol levels, a stress hormone, can also serve as a barrier to weight loss. Cooney et al. (2018) conducted a 16-week randomized clinical pilot study to evaluate whether cognitive behavioral therapy (CBT) could reduce depressive symptoms and improve stress responses. Participants were randomly assigned to either a CBT plus lifestyle intervention (CBT+LS) group or a lifestyle-only (LS) group. The LS intervention involved weekly nutrition counseling, a caloric intake of 1,500-1,800 kcal/day, and gradually increasing exercise from 50 to 175 minutes per week. The CBT group received additional 30-minute weekly sessions focused on stress management. Stress responses were assessed using the Trier Social Stress Test at baseline, 8 weeks, and 16 weeks.

Results indicated that the CBT+LS group experienced significant reductions in heart rate and cortisol levels in response to stress at both follow-up points ($p<0.05$). The LS-only group showed no significant changes ($p>0.05$). These findings suggest that CBT, when combined with lifestyle changes, improves physiological stress regulation and enhances overall well-being.

The study conducted by Jiskoot et al. (2020) supports the findings of Cooney et al. (2018), but on a much larger scale, demonstrating the effectiveness of combined CBT-LS interventions for addressing the mental and physical comorbidities of PCOS. A 12-month randomized controlled trial was conducted to assess the effectiveness of CBT combined with lifestyle interventions (LS) in managing depressive symptoms and body image among obese women with PCOS. Participants were divided into three groups: CBT-LS, CBT-LS + SMS (weekly text support), and a control group receiving care as usual (CAU). Mental health

outcomes were measured using the Beck Depression Inventory-II (BDI-II), Rosenberg Self-Esteem Scale (RSES), and Fear of Negative Appearance Evaluation Scale (FNAES).

As shown in Figure 1, the CBT-LS groups demonstrated statistically significant improvements in depression (BDI-II: $p<0.01$), self-esteem (RSES: $p<0.05$), and body image (FNAES: $p<0.01$), whereas the CAU group showed no changes. Notably, these improvements were independent of weight loss, emphasizing the unique role of CBT in addressing the psychological and emotional challenges associated with PCOS.

Effect of Metformin on Metabolic Outcomes

Metformin, a widely used drug for managing insulin resistance, has shown efficacy in improving weight management and reproductive outcomes. Naderpoor et al. (2015) conducted a systematic review and meta-analysis evaluating the effectiveness of metformin (MET) combined with lifestyle interventions (LS) on metabolic, reproductive, and psychological outcomes. The study analyzed three groups: MET-LS, MET alone, and LS alone, drawing data from twelve randomized controlled trials (RCTs) with 608 participants.

After six months, the MET-LS group experienced a 0.73 kg/m^2 reduction in BMI ($p<0.05$), reduced fat around the uterus ($p<0.05$), and improved menstrual regularity ($p<0.05$), which contributes to increased fertility. Interestingly, metformin alone yielded similar BMI reductions but did not significantly improve metabolic ($p>0.05$) or reproductive outcomes ($p>0.05$). Despite psychological outcomes being a focus of the study, no follow-up data was collected, leaving an important gap in understanding metformin's broader impact. These findings suggest that combining metformin with lifestyle changes may play a more effective role in weight management for obese individuals with PCOS.

Effect of Metformin on Reproductive Outcomes

While weight loss is the first prescribed approach, it's not the only solution for managing PCOS symptoms. Mehdinezhad et al. (2024) conducted a meta-analysis that highlights metformin's potential to reduce anti-Mullerian hormone (AMH) levels, which correlates with fewer ovarian cysts and improved fertility outcomes. The study exclusively reviewed RCTs with statistically significant results ($p<0.05$), and multiple researchers independently verified the data to avoid bias.

The analysis found that doses of <1500 mg/day over at least 12 weeks significantly reduced AMH levels. Long-term use of metformin, however, can lead to gastrointestinal issues, emphasizing that the drug should be prescribed cautiously and primarily to individuals with severe insulin resistance. While the study hypothesizes that higher doses may yield similar outcomes without additional benefits, this was not tested.

Effect of Birth Control on Metabolic and Reproductive Outcomes

Shah et al. (2021) conducted a 16-week randomized controlled trial to evaluate the effectiveness of lifestyle modification (Lifestyle), oral contraceptives (OCP), and a combination of both (Combined) in improving metabolic and reproductive outcomes. The Lifestyle group followed a 500 kcal/day deficit diet, increased physical activity, and received counseling to address unhealthy eating habits. The OCP group was prescribed a daily oral contraceptive with a 20:1 estrogen-to-progesterone ratio, while the Combined group received both interventions.

Statistically significant results ($p<0.001$) indicated the suppression of oxyntomodulin, a hormone involved in appetite regulation, in all three groups. This suppression was linked to improvements in BMI ($p<0.001$), increased insulin sensitivity ($p<0.001$), and weight loss ($p<0.001$) in the Lifestyle and Combined groups. Additionally, the OCP group showed

reductions in AMH ($p<0.001$) and testosterone ($p<0.001$) levels. However, long-term reproductive outcomes were not measured through live birth rates post-treatment, limiting conclusions about overall fertility success.

Discussion

Strengths and Limitations

The most significant limitation of this literature review is the fact that there is a sole author. Traditional systematic reviews are written by many authors to catch potential biases and later critically appraised by an unbiased party for validation purposes. The author's potential to introduce bias is unavoidable, as one may unconsciously favor certain theories and studies that more closely align with their perspective. There was an attempt by the author to mitigate this effect by consulting medical professionals to verify the claims made in this paper. Extensive peer review and risk of bias assessments were utilized to ensure appropriate study selection within the level of expertise of the author.

Furthermore, one significant limitation of the studies reviewed is the inconsistency in the definition of "consistent diet and exercise." Lifestyle interventions varied significantly across studies, ranging from extreme measures, such as the 800 kcal/day meal replacement plan in Deshmukh et al. (2023), to more moderate 500 kcal/day caloric deficits like those implemented by Shah et al. (2021). Standardizing the approach to lifestyle interventions is essential to create meaningful comparisons and to establish clear guidelines for clinical practice.

Additionally, the short durations of many studies, averaging less than six months, limited sample sizes, and high dropout rates pose challenges to drawing definitive conclusions. Longer studies with extended follow up periods are needed to assess the sustainability of weight loss,

improvements in BMI, and their effects on anti-Mullerian Hormone (AMH), testosterone levels, and insulin sensitivity.

The sustainability of extreme interventions, like those discussed in Deshmukh et al. (2023) is of great concern. Meal replacement diets of 800 kcal/day are well below the recommended daily intake for adults and are unlikely to be maintained in the long run. For lifestyle interventions to be effective, they must promote realistic and sustainable dietary and exercise habits. Future research should focus on identifying interventions that balance efficacy with sustainability, ensuring they can be incorporated as long-term lifestyle changes.

Another limitation is the exclusion of individuals with eating disorders, which highlights a critical gap in research. Obese women with PCOS may develop issues related to body image and disordered eating because of the difficulties they face losing weight due to insulin resistance. Binge eating (BED) is more prevalent within this population, which is particularly concerning. According to Krug et al. (2019), BED is characterized by episodes of consuming large quantities of food within a short time, often accompanied by feelings of loss of control. Unlike other eating disorders, BED does not involve compulsory behaviors such as excessive exercise, contributing to obesity and worsening insulin resistance. Many individuals feel extreme shame after a binge, which increases cortisol levels keeping testosterone levels abnormally elevated. Those who suffer from an eating disorder will often isolate themselves, becoming anxious and depressed, highlighting the importance of addressing psychological health in PCOS management.

Implications for Practice

Lifestyle interventions should prioritize fostering a healthy relationship with food and exercise, which is why cognitive behavior therapy (CBT) should be used as a preventative

measure rather than damage control. CBT has been shown to effectively manage disordered eating behaviors and improve overall psychological health.

Nutrition guidance should always be directed by a registered dietician who has experience in PCOS management. Overly simplistic advice, like “just eat less,” is not constructive and fails to address the hormonal and metabolic barriers to weight loss. Physicians should focus on a two-step approach, first addressing the issue medicinally with hormonal birth control or metformin. These treatments can improve insulin sensitivity while regulating testosterone and AMH levels, removing the barriers to weight loss through traditional lifestyle interventions.

Future Research

Further research should address each aspect (metabolic, psychological, reproductive) of PCOS separately. Studies focused on long-term fertility outcomes are needed, given the severity of reproductive challenges associated with PCOS. Additionally, future research should standardize treatment methods for lifestyle interventions to draw definitive conclusions about their efficacy. Longer studies with larger follow-up periods are necessary to evaluate the sustainability of weight loss, reductions in AMH and testosterone levels, and improvements in insulin sensitivity. Finally, research should examine the role of socioeconomic and cultural factors in PCOS management. Interventions that are accessible, affordable, and culturally appropriate are likely to be more effective and widely adopted, reducing the public health burden of this condition.

Conclusion

This research sheds light on the reality of endocrine disorders and the broader implications for women’s health. While lifestyle interventions are often viewed as the first course

of action, studies show they are not effective when used alone. Although testosterone levels decreased significantly, concerns about sustainability remain. Medicinal and behavioral treatments are essential to address the reproductive, metabolic, and psychological aspects of PCOS. Cognitive behavioral therapy (CBT) has been shown to reduce depression symptoms and improve stress responses. Metformin effectively reduces anti-Mullerian hormone (AMH) levels and BMI, while hormonal birth control helps suppress oxyntomodulin, lower testosterone levels, and decrease AMH levels. However, no consistent argument emerged across studies for the efficacy of combined treatment methods. The lack of comprehensive research limits our understanding of this multifaceted disorder, particularly its long-term effects on fertility.

This research aims to spark greater interest in conditions that disproportionately affect women. A standardized approach to treatment and more long-term studies are needed. The author maintains no affiliations with the publishers referenced in this literature review.

Appendix A: Risk of Bias Assessment Tool

Example of a Risk of Bias Assessment for Jiskoot et al. (2020)

The original JBI method requires individuals to comprehensively evaluate each study's statistical analysis and RCT design. The author is not trained to make these conclusions, so this information was excluded. The revised method analyzes the selection, administration of treatment, measured outcome, and participant retention of each study. A final score was calculated, with one point assigned for each question; the highest scored studies were included.

Participant Selection Bias

What kind of randomization was used to assign participants to treatment groups?

Computer-generated randomization was used to assign participants to treatment groups, but no mention about the specific tool used.

Was the process of allocating participants to treatment groups concealed?

Yes, the randomization was carried out by a research nurse that was not involved in the study. The allocation of envelopes to participants was done sequentially with identical and sealed envelopes.

Were treatment groups similar at baseline?

Yes; the specific demographic of each participant is unknown, however, the same Rotterdam criteria and exclusion of participants with certain pre-existing conditions was applied.

Intervention Administration Bias

Were participants blind to treatment assignment?

No, participants knew what group they were assigned (CBT + LS or CAU). Participants were aware of the other treatment group in the experiment because they signed an informed consent form.

Were those delivering the treatment blind to treatment assignment?

No; unknown whether the health professionals involved in administering CBT and SMS therapies knew that their patients were involved in this research study. Can assume they were aware since they were sharing confidential patient information with researchers.

Were treatment groups treated identically other than the intervention of interest?

Yes, each treatment group was tracked and measured at 3 months, 6 months, 9 months, and 12 months. The same preliminary screening and eligibility criteria was used for all participants. All participants receive weight loss and lifestyle modification guidance, just in different forms tailored to their treatment group.

Measurement of Outcome Bias

Were outcomes measured in the same way for treatment groups?

Yes, the primary outcome (various psychological improvements) were measured at 3 months, 6 months, 9 months, and 12 months for both the intervention and control group.

Participant Retention Bias

Was there follow-up to assess long-term effectiveness of treatment methods?

No, participants were not tracked to determine whether the psychological improvements were maintained after stopping cognitive behavioral therapy.

Score: 5/8

Summary: The above criteria was used to select all six studies chosen to be included. The purpose of this critical appraisal process was to evaluate the quality of each study and identify potential sources of bias that could affect the validity of the findings. This helped determine whether the study's results can be trusted and how applicable they may be to the demographic of women with PCOS being studied in this paper.

Appendix B: How AI Helped with Writing this Paper

AI Tool Name	Purpose in Research	Sample Prompts & Inputs	Modifications Made (Example)
Chat GPT	Simplify lengthy explanations into a more concise description appropriate for the target audience Critique text for logical flow of main ideas	What parts of this paragraph are redundant? Is the information discussed appropriate for the specific section (e.g. results or discussion) in accordance with the rubric? Does the provided text adequately highlight the main idea (e.g. anxiety and depression) and its implications (e.g. risk of developing an eating disorder)?	Original Work: Described each article in the results section with its target demographic (obese women aged 18-45) in great detail. AI Suggestion: This information is already discussed in the introduction. Adding it in the results section would be redundant. Revised Work: Incorporated less background information and more specific results for all sources.
Quillbot	Correct grammatical errors, make suggestions about word choice, and improve sentence structure	This AI model was used as a thesaurus. The "fluency" function was employed on the author's authentic work to identify synonyms for certain words.	Original Work: "Patients are **given** a caloric deficit focused on **increasing** their intake of fruits…" AI Suggestion: "Patients are **prescribed** a caloric deficit focused on **improving** their intake of fruits…" Revised Work: Replaced the word "given" with "prescribed." The second suggestion was not contextually appropriate.

Summary: AI was used to revise the author's authentic work for logical flow of ideas and grammatical accuracy. These suggestions were used by the author to make revisions and create the final product. AI was not used to analyze academic sources cited in this research paper. All claims made by the author are supported with evidence found directly from the sources.