

LIFESTYLE INTERVENTIONS FOR OBESE WOMEN WITH PCOS

Determining the Impact of Various Lifestyle Interventions on Development of PCOS:

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A Literature Review

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LIFESTYLE INTERVENTIONS FOR OBESE WOMEN WITH PCOS

Research Question: How can lifestyle interventions improve outcomes for women in the United States who have been diagnosed with PCOS?

Abstract

In the United States, there is an epidemic of chronic disease prevalence that is only growing. Parallel to this is the issue of Polycystic Ovarian Syndrome, an endocrine disorder which increases risk of chronic diseases such as heart disease and type two diabetes. It is one of the most prevalent disorders affecting reproductive age females and can lead to development of infertility if left untreated. The disorder can present as symptoms including hirsutism, anovulation, irregular menstrual cycles, insulin resistance, weight gain and more. There is variation between patients experiencing different symptoms that has yet to be analyzed. This analysis of the available literature pertaining to positive outcomes with PCOS focuses on interventions that have been studied, being physical activity, pharmacological treatment, and dietary interventions. Weight loss promotion is the first treatment for women who are overweight, and those who are not will usually receive hormonal birth control. These lifestyle interventions can be ineffective if not consistently used and tend to have low compliance. Hormonal birth control can aid in regulating menstrual cycles and ovulation patterns, but can also introduce previously absent metabolic disturbance. Therefore, current research does not adequately provide treatments that promote positive outcomes in women with PCOS. Interventions that focus on the individual patient holistically and account for their preferences have been shown to be higher in compliance and effectiveness.

LIFESTYLE INTERVENTIONS FOR OBESE WOMEN WITH PCOS

Table of Contents

Introduction.....	4
Methods.....	6
Figure I. <i>Article Selection Process</i>	8
Results.....	6
Table I. <i>Detailed Article Review</i>	8
Discussion.....	16
Conclusion	20

LIFESTYLE INTERVENTIONS FOR OBESE WOMEN WITH PCOS

Introduction

It is estimated that of those who choose to have children, 12.7% will seek treatment for infertility before they are able to do so (Carson & Kallen, 2021). Further, the effects of Polycystic Ovarian Syndrome (PCOS) account for 75% of the cases of infertility linked to an ovulation disorder (Carson & Kallen, 2021). PCOS is prevalent in about six to twenty percent of reproductive age females (Siddiqui et al., 2022), and infertility or trouble becoming pregnant is considered one of the classifications of ovulatory dysfunction that can contribute to a diagnosis (Belenkaia et al., 2019). PCOS presents a variety of challenges aside from infertility, including insulin resistance, hyperandrogenism, hirsutism, and irregular menstrual cycles. Adolescents with PCOS generally receive diagnoses based on insulin resistance and hyperandrogenism that later develops into increased risk for cardiovascular and metabolic disorders, menstrual disorders, acne and more. In addition, PCOS puts patients at higher risk of gestational diabetes, pregnancy related hypertensive disorders and spontaneous abortion (Homburg, 2006).

The etiology of PCOS remains unclear and has been suggested to be linked to lifestyle and genetic factors. Data suggests that PCOS tends to cluster diagnoses in families in wider concentrations than in greater scale populations (Siddiqui et al., 2022). The apparent hormonal dysfunction PCOS stems from begins with gonadotropin-releasing hormone (GnRH), which when irregular disrupts androgen synthesis as well as encouraging resistance to insulin (Siddiqui et al., 2022). Resistance to insulin stimulates ovarian theca cells, to produce excess androgens. Additionally, the GnRH fails to stimulate the hypothalamic release of luteinizing hormone and follicle stimulating hormone from the anterior pituitary gland. LH and FSH are the most significant hormones to the menstrual process, which results in oligo anovulation (irregular menstrual cycles) in women with PCOS (Siddiqui et al., 2022).

LIFESTYLE INTERVENTIONS FOR OBESE WOMEN WITH PCOS

The greater challenge at hand comes with treatment of this disorder, and isolating the variables that are direct effects of ovulatory dysfunction rather than obesity itself. Obesity naturally contributes to insulin resistance, but external insulin resistance can cause obesity. Therefore, the complications listed above as well as many of the symptoms of PCOS can manifest as a result of obesity. Conversely, symptoms including weight gain and insulin resistance can be attributed to PCOS (Siddiqui et al., 2022). A lack of definitive cause and gaps of understanding the influence of genetic contributions to this condition creates a challenge.

Current treatments for PCOS range from holistic to hormonal, changing between providers as there is not a clear path and treatment begins with symptom management. Common initial treatments include oral contraceptives and metformin coupled with lifestyle suggestions (Siddiqui et al., 2022). Oral contraceptives commonly are used to suppress menstrual irregularities and primarily prevent growth and development of new ovarian cysts (Patel, 2018). Metformin as an insulin sensitizer is often prescribed to mitigate effects of insulin resistance and encourage weight loss when coupled with diet and exercise.

The majority of the literature emphasizes the importance of lifestyle changes on increasing insulin sensitivity and long-term outcomes due to PCOS. However, there is controversy on the most effective pharmacological treatments, dietary guidelines, and exercise regimens. Additionally, large discrepancies exist in clinical guidelines treating a patient with PCOS and insulin resistance versus one who may be obese or insulin resistant without PCOS. High Intensity Interval Training (HIIT) is commonly suggested for weight loss, but is also associated with increases in cortisol (Dote-Montero et al., 2021) that may disrupt an already fragile hormone balance in women with PCOS. Dietary guidelines also vary between suggestions

LIFESTYLE INTERVENTIONS FOR OBESE WOMEN WITH PCOS

between pursuing a low-carb ketogenic, mediterranean, low-fat, or high protein diet minimizing success of mitigating symptom development through weight loss.

Various lifestyle interventions have become the cornerstone of PCOS management in America yet there is more detail needed to provide patients with necessary information. This paper will serve to identify different lifestyle interventions and analyze their possible impact on relieving the burden of PCOS on women in the United States.

Methods

To gather information, the databases PubMed and JSTOR were searched for information regarding the research question. PubMed is a vast source containing many scientific articles and studies. JSTOR is another research database, but it is not focused on any specific area. The aim of using these two databases was to acquire context and background information from JSTOR and PubMed for studies. As shown in the figure below, various inquiries were searched yielding n representing the number of results populated. Further, the articles were excluded based on year, requiring publishing date to be 2005 or later, to ensure more current and accurate information was gathered.

Beginning with the PubMed database, the first search inserted was “PCOS AND risk factors”, yielding $n=2,767$ articles populated. Of these, many were unrelated to the subject at hand and discussed risk factors for various chronic diseases. A few were considered that analyzed the increased risk of cardiovascular disease associated with PCOS. The next search was “PCOS AND severity”, resulting in $n=1,032$. These articles were more general in their connection to PCOS, but were considered to be included if they had a strong connection to dietary patterns or exercise. Additionally, hormone balances and symptoms including hirsutism and insulin resistance being included in an article’s title made it more deeply considered for inclusion. The next search was “PCOS AND hormonal birth control”, to analyze the available

LIFESTYLE INTERVENTIONS FOR OBESE WOMEN WITH PCOS

research regarding treatments of PCOS, their successes and respective risks. For this search, n=90 and many articles were solely focused on the effects of hormonal birth control, but a few made relevant connections to PCOS. Continuing looking into treatment options, the next search was “PCOS AND semaglutide” yielding 29 results. Many were unrelated to PCOS, so the search was made to exclude ‘AND’ which resulted in n=19.

JSTOR is the second database used to collect sources of information and analyze the available research. The first search input was “PCOS AND effective treatment”, yielding 380 total articles. The second search was “cure AND PCOS”, populating n=139. This search term was edited to look further into the effectiveness of specific PCOS treatments, and lead to search term three “PCOS AND hormonal birth control” providing 90 results.

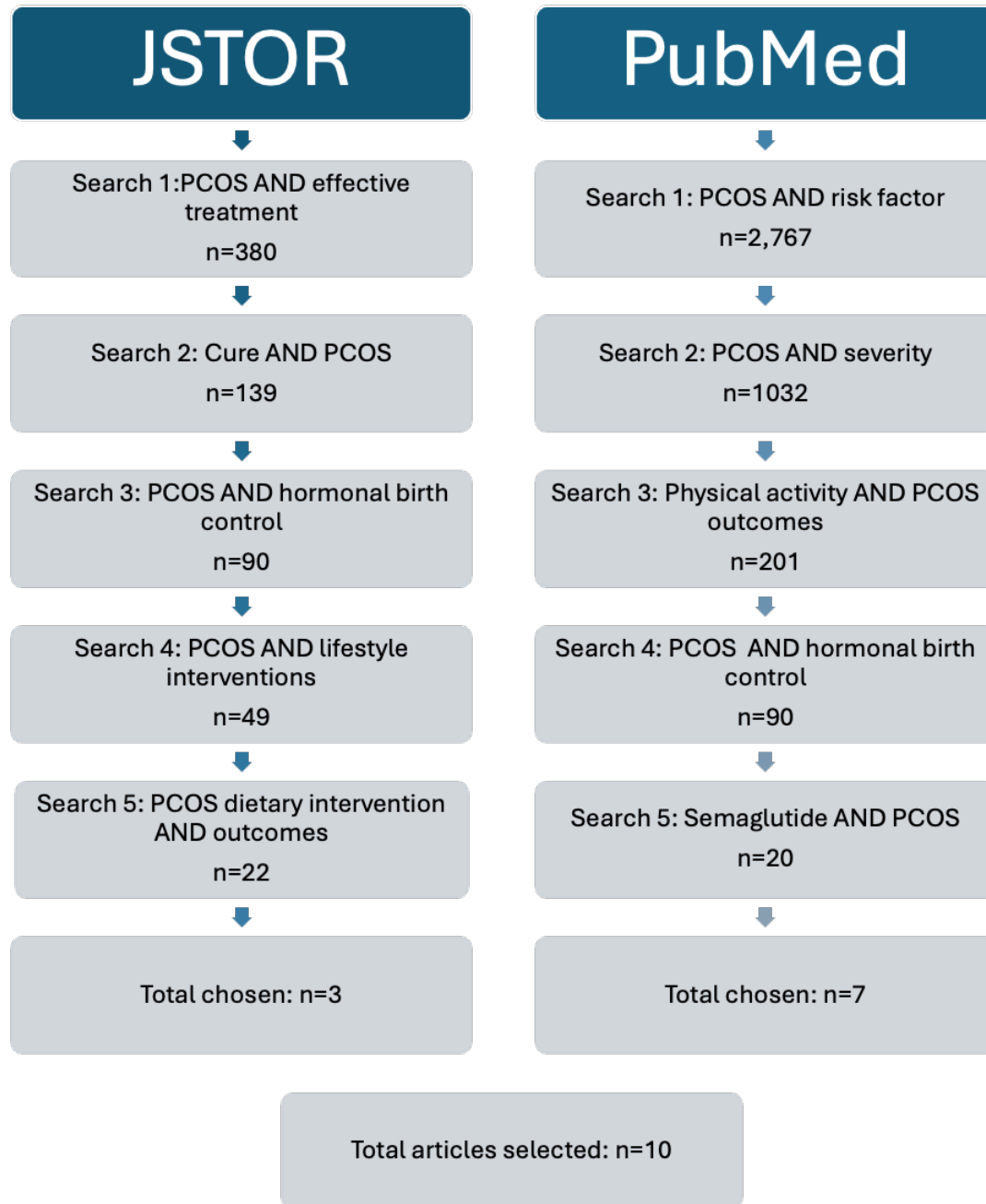
Feasible results would contain information based on contraceptive options and how they may or may not affect PCOS outcomes. Search four focused on non-pharmacological treatment seeking information relating outcomes to physical activity and dietary interventions. Search term “PCOS AND lifestyle interventions” yielded 49 results. Many discussed combined treatments of insulin sensitizing agents with diet and exercise, while not isolating specific variables for comparison in their impact. This search was further refined into five “PCOS dietary intervention AND outcomes”, and n=22 results. The populated results were further considered based on key terms in the titles, including PCOS, effects, treatment, and reproductive.

Irrelevant articles were immediately excluded upon search and others were considered for inclusion based on various factors. These included relevance to the research question, amount of topically similar material already included and year of publishing. Exclusions were also based on the research types recovered, literature reviews and meta-analyses were excluded. In addition, studies that claimed to be the first of their kind were prioritized over others. These inclusion and

LIFESTYLE INTERVENTIONS FOR OBESE WOMEN WITH PCOS

exclusion characteristics were applied consistently across consideration of each search result, and ten articles were selected for inclusion. A more concise chart displaying the article selections made is portrayed below in Figure I.

Figure I. *Article Selection Process*



LIFESTYLE INTERVENTIONS FOR OBESE WOMEN WITH PCOS

Results

Polycystic Ovarian Syndrome has steadily increased in prevalence through the years though the majority of the population is unfamiliar with its complications (Jaber, R. M. et al., 2022). Women with PCOS are at higher risk of type-two diabetes, heart disease, infertility, miscarriage and other pregnancy complications (Vencill & Williams, 2024). PCOS requires public focus to improve outcomes for millions of women in the United States. The selected sources provided information relating to ways in which to manage symptoms, as well as minimizing chronic disease risk. The literature has narrowed in on three treatment strategies that can alleviate risk and encourage positive outcomes. These three strategies include pharmacological intervention, encouragement of physical activity and dietary interventions. For further details regarding the literature reviewed, refer to Table I.

Encouragement of Physical Activity

Factors such as insulin resistance, weight gain, and others related to the overall etiology of PCOS could also be attributed to being overweight or obese. Therefore, it is difficult to distinguish between an overweight woman without PCOS and a woman with PCOS who is overweight. Because of this, exercise is considered to be one of the first interventions presented as it can improve cardiovascular and reproductive outcomes as well as overall increasing sensitivity to insulin (Almenning et al., 2015). The literature overall emphasizes the importance of being physically active, but lacks specificity. High intensity interval training (HIT) and strength training (ST) have been shown to decrease overall body fat percentage and insulin resistance (Almenning et al., 2015). In comparison to moderate intensity exercise, high intensity exercise has proven more effective in lowering insulin resistance and improving overall outcomes (Almenning et al., 2015). There is evidence that consistent general exercise improves

LIFESTYLE INTERVENTIONS FOR OBESE WOMEN WITH PCOS

reproductive outcomes, menstrual cycles and ovulation(Palomba et al., 2008). In this case, the return to normal ovulation patterns was attributed to the decrease in insulin resistance directly caused by regular physical activity. Initial treatments for PCOS generally begin with physical activity and dietary interventions, but these are problematic. The reason for this is high attrition rates in studies analyzing the effects of general lifestyle changes, due to their challenging nature. The difficulty of these behavior changes relates to patients receiving this advice as well, and it is common that they will be considered unresponsive to lifestyle treatment(Carmina & Longo, 2023). Many women are deemed “unresponsive” to lifestyle interventions and for there medications such as semaglutide and metformin can be considered for weight loss

Pharmacological Interventions

As insulin resistance is one of the major contributing factors relating to the manifestation of PCOS, pharmacological treatments of certain insulin sensitizers have been considered as treatments for PCOS. Semaglutide has proven effective in decreasing body weight and visceral fat in recent years, superseding metformin in use due to its more dramatic effects(Carmina & Longo, 2023). Overall use of semaglutide injections in obese patients with PCOS improved insulin resistance, BMI, fasting blood glucose, and improved ovulatory menstrual cycles(Jensterle et al., 2024). There is still little evidence regarding semaglutide treatment on obese patients with PCOS, but it has produced better outcomes in comparison to metformin.

In an effort to address disrupted menstrual cycles and hirsutism, hormonal contraceptives are commonly prescribed as an initial treatment strategy(Mosorin et al., 2023). These combined hormonal contraceptives (CHC) can be separated into combined vaginal contraceptives(CVC) and combined oral contraceptives(COC). Antiquated literature has suggested COCs can cause more unintended metabolic disturbances(Mosorin et al., 2023). However, more recent literature

LIFESTYLE INTERVENTIONS FOR OBESE WOMEN WITH PCOS

reports that both kinds of contraceptives cause metabolic disturbances and specifically can increase triglyceride levels, increasing risk of myocardial infarction(Mosorin et al., 2023). COCs show increases in insulin levels when fasting and two hours later, whereas CVCs only show an increase when fasting. There is little evidence that there is a substantial difference in metabolic disruptions related to CHC use including their effect on insulin resistance.

Dietary Interventions

Coupled with physical activity, dietary modification is the primary lifestyle intervention for women with PCOS. Specific dietary needs must be met while identifying how to include foods that improve patient outcomes. In analysis of factors contributing to PCOS, those with PCOS consume more fast food and coffee(Ibrahim et al., 2023). There is little evidence providing advantages of certain diets over others, yet a common focus is consumption of foods with a low-glycemic index(low-GI)(Marsh et al., 2010). Low-GI diets have been marked as a potentially beneficial dietary intervention to mitigate hyperinsulinemia often caused by carbohydrate consumption in women with PCOS. In comparison to a general health promoting diet, in those with PCOS a low-GI diet has been proven to increase insulin sensitivity by up to three times the original value(Marsh et al., 2010). Additionally, a low-GI diet can also improve menstrual regularity(Marsh et al., 2010). Generally healthy diets such as the Mediterranean diet are anti-inflammatory, which aids in symptom alleviation(Barrea et al., 2019).

LIFESTYLE INTERVENTIONS FOR OBESE WOMEN WITH PCOS

Table I. Detailed Article Review

	Author	Year	Article title and Journal	Purpose of article	Sample Info	Type of research	Research findings	Limitations
1	Marsh, K. A. Steinbeck, K. S. Atkinson, F. S. Petocz, P. Brand-Miller, J.C.	2010	Title: Effect of a low glycemic index compared with a conventional healthy diet on polycystic ovary syndrome Journal: American Journal of Clinical Nutrition	To analyze the effect of a generally healthy diet with a diet that focuses on low glycemic index foods on women with PCOS.	Women with PCOS between 18 and 40 years of age with a BMI $\leq$ 25 who are not breastfeeding or planning pregnancy were considered for the study.	Longitudinal study	Levels of luteinizing hormone and follicle stimulating hormone did not change much between groups.	Research dietitian was aware of who was assigned to what groups
2	Mosorin, M. E. Piltonen, T. Rantala, A. S. Kangasniemi, M. Korhonen, E. Bloigu, R. Tapanainen, J. S. Morin-Papunen, L.	2023	Title: Oral and Vaginal Hormonal Contraceptives Induce Similar Unfavorable Metabolic Effects in Women with PCOS: A Randomized Controlled Trial Journal: Journal of Clinical Medicine	Analyzing the effects on metabolic manifestations of PCOS through comparison of contraceptive methods.	In the group given combined oral contraceptives, there was an increase in both fasting insulin and insulin levels after 120 minutes, whereas the combined vaginal contraceptive group only had an increase in the 120 minute levels.	Randomized controlled trial	Combined oral and vaginal contraceptives both proved effective in mediating hyperandrogenism, hirsutism and anovulation, but both treated groups experienced metabolic changes.	Study sample was small, as the researchers were unable to recruit enough women who fit the guidelines. This is also one of the only available studies. Participants were all caucasian.
3	Ibrahim, A. A. Mohammed, H. S. Elsaid, N. Salim, A. A. Fathy, E. G. Hasaneen, N.		Title: Risk factors for polycystic ovary syndrome among women of reproductive age in Egypt: A case control study	An analysis of women with PCOS through data collection of history and social information as risk predictors.	The predisposing factors that manifest as risk for PCOS are not all behavioral. Socioeconomic status is strongly correlated with PCOS.	Case control study	High BMI, caffeine consumption and commonly consuming fast food were risk factors for PCOS. Prevalence of PCOS was higher in urban populations	Study used self-reported data and may not have been accurately reported.

LIFESTYLE INTERVENTIONS FOR OBESE WOMEN WITH PCOS

	M.		Journal: African Journal of Reproductive Health				compared to rural.	
4	Vencill, J. A. Williams, S. L.	2024	Title: The Psychology of PCOS: Building the Science and Breaking the Silence (Chapter 6 and 7) Journal: Journal of Sex & Marital Therapy	Explain PCOS' effect on the psyche of women as well as gaps in access to healthcare that may develop as social inequity.	Inequities in PCOS treatments available and the level of care given by different providers. Racial markers of inequality were also present.	Cross-Sectional Study	Of those with PCOS, black women are more likely to develop metabolic syndrome than their white counterparts.	The book collected data through interviews in which information was self-reported, and may contain subjective material as there can be variation of severity across a spectrum.
5	Jensterle, M. Ferjan, S. Janez, A.	2024	Title: The maintenance of long-term weight loss after semaglutide withdrawal in obese women with PCOS treated with metformin: a 2-year observational study Journal: Frontiers in Endocrinology	Examine the effectiveness of semaglutide drugs on PCOS weight loss and outcomes, as well as further treatment.	PCOS weight loss triggered by semaglutide injectors. The withdrawal period was analyzed to discover if using metformin for maintenance or other insulin sensitizers was impactful. Certain biological markers such as testosterone were compared before, during and after the semaglutide trial phase.	Observational Study	Twenty one of twenty five participants had a lower body weight than at the beginning of the study. Those who used metformin gained on average 1/3 of their weight back.	This study excluded a control group. Additionally, the sample size was small (n=25).
6	Jaber, R. M. Aripin, A. Alias, N. Omar, S. Kamal, N. R. Dwekat, O.	2022	Title: Knowledge and attitudes towards polycystic ovarian syndrome Journal: African Journal of Reproductive Health	Analyze the attitudes present of women and the prior knowledge of PCOS they have.	-What the general population knows and thinks about PCOS -General knowledge of diagnostic criteria, risk factors and complications of PCOS	Cross-Sectional Study	58% of the women sampled have minimal knowledge of PCOS.	This study was conducted on women who came to the Jordan University Hospital as patients or companions. It is possible that while waiting, participants may have hastily answered the prompts rather than truly considering them.

LIFESTYLE INTERVENTIONS FOR OBESE WOMEN WITH PCOS

7	Carmina, E. Longo, R. A.	2023	Title: Semaglutide Treatment of Excessive Body Weight in Obese PCOS Patients Unresponsive to Lifestyle Programs Journal: Journal of Clinical Medicine	Addresses the limitation of physical intervention studies with a high attrition rate through remedy of semaglutide.	Analyzing general markers of testosterone, androgens, insulin and fasting blood-glucose levels when determining the effectiveness of semaglutide injections.	Clinical Trial	Close to eighty percent of participants obtained a weight loss of at least 5% of their starting weight.	The study only used low doses of semaglutide and found that this was unresponsive in more obese women, but did not evaluate if higher dosages proved more effective.
8	Barrea, L. Arnone, A. Annunziata, G. Muscogiuri, G. Laudisio, D. Salzano, C. Pugliese, G. Colao, A. Savastano, S.	2019	Title: Adherence to the Mediterranean Diet, Dietary Patterns and Body Composition in Women with Polycystic Ovary Syndrome (PCOS) Journal: Nutrients (2019)	Compare and contrast various diets and their outcomes in patients with PCOS.	Adherence to mediterranean diet in effort of promoting healthy outcomes. Analysis of seven-day food records to compare diets of patients with PCOS.	Cross-sectional, Observational study	Compared to the control group, the PCOS group adhered less to the mediterranean diet and consumed less fiber and complex carbohydrates.	Analysis of dietary patterns over a short period (7 days) does not account for factors such as seasons, stressors, and financial situation. Proximity and availability of health promoting foods were also not considered.
9	Palomba, S. Giallauria, F. Falbo, A. Russo, T. Oppedisano, R. Tolino, A. Colao, A. Vigorito, C. Zullo, F. Orio, F.	2008	Title: Structured exercise training programme versus hypocaloric hyperproteic diet in obese polycystic ovary syndrome patients with anovulatory infertility: a 24-week pilot study Journal: Oxford Academic Journal of Human Reproduction	This study aims to compare the effects of diet and exercise when not used together as a treatment for PCOS.	The results of following a diet or structured exercise regime compared to each other through a collection of markers such as BMI, body weight, insulin resistance and free androgen index.	Randomized controlled trial	Waist circumference was significantly decreased in the SET group compared to the diet programme group. Body weight and BMI decreased more in the diet group, but saw a lesser insulin sensitizing effect.	Attrition rate for the SET group was 15% compared to 35% in the diet programme group. No cost analysis was taken into consideration of the feasibility or results of either group.

LIFESTYLE INTERVENTIONS FOR OBESE WOMEN WITH PCOS

10	Almenning, I. Rieber-Mohn, A. Lundgren, K. M. Shetelig Lovvik, T. Garnaes, K. K. Moholdt, T.	2015	Title: Effects of High Intensity Interval Training and Strength Training on Metabolic, Cardiovascular and Hormonal Outcomes in Women with Polycystic Ovary Syndrome: A Pilot Study Journal: Plos one	Analyzing the effectiveness of high intensity interval training and strength training on improving insulin sensitivity.	Health outcomes and markers when women with PCOS are advised to do different kinds of exercise.	Three-arm parallel randomized controlled trial	Insulin resistance sees stronger decreases as intensity of exercise increases. Overall body-fat percentages decreased for both treatment groups.	One limitation of the study includes a low sample size (n=31). Additionally, the sample groups were not controlled for diet. Therefore, participants may have had wildly different diets skewing the results
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LIFESTYLE INTERVENTIONS FOR OBESE WOMEN WITH PCOS

Discussion

Causes of PCOS are still not well researched and established due to interdependent symptoms that can present as results of obesity in women without PCOS. Some genetic disposition has been studied, but there has not been effective research. This is because there are no long-term studies that have been able to prove familial clustering of PCOS is due to genetic factors, rather than similar lifestyles. There are also many complications to improving outcomes since most require behavioral intervention. As discussed, the majority of the literature focuses on encouraging physical activity and dietary interventions first, also considering the use of medications to enhance metabolic effects. This is significant because PCOS has been shown to present an intrinsic level of insulin resistance even when women are not overweight, and lifestyle interventions are proven insulin sensitizers(Marsh et al., 2010).

The growing population of women with PCOS is an alarming trait paralleling the increase in chronic disease prevalence. Proper treatment is integral to optimizing positive outcomes in those affected, and as a preventative measure as well for those who may be predisposed. As discussed, initial treatments for PCOS are anti-inflammatory and insulin sensitizing lifestyle recommendations. It was found that high intensity exercise compared to moderate intensity was more effective at sensitizing insulin(Almenning et al., 2015). Strength training was found to increase the ratio of lean mass to body fat(Almenning et al., 2015). This is because skeletal muscle used in exercise is a major site for glucose disposal, and exercise aids in proper glucose disposal and sensitivity(Almenning et al., 2015). These results are significant as they enhance the need for exercise in women with PCOS, even without dietary intervention, as the two are normally coupled.

Presenting interventions in smaller steps such as starting with diet or exercise rather than

LIFESTYLE INTERVENTIONS FOR OBESE WOMEN WITH PCOS

both may be more effective in promoting long-term positive outcomes. Namely, a previous study analyzed the difference in impact of a structured exercise regimen and a dietary intervention. Here, participants were able to select which intervention fit them best, and the study overall experienced higher compliance and lower attrition rates. Diets that are lower in glycemic index tend to improve insulin sensitivity exponentially (Marsh et al., 2010). These diets are high in fiber and contain complex carbohydrates. Additional data revealed that the mediterranean diet has proven to be efficient in improving ovulatory outcomes. These results were strong even when compared to a general diet with similar macronutrient and fiber levels, suggesting that the mediterranean diet can help promote ovulation success (Marsh et al., 2010). Ultimately, research suggests any sustainable changes in diet and amount of physical activity are helpful in mitigating severity and risk of chronic disease for women with PCOS (Jensterle et al., 2024).

However, considering the fact that most studies do have high attrition rates, there must be an option considering overall health aside from behavioral interventions. A more novel and promising option has been the presence of semaglutide injections. These have been proven to have better outcomes and stronger weight loss results compared to a commonly used insulin sensitizer, metformin (Carmina & Longo, 2023). While very new and not thoroughly researched in their effects on PCOS, the results are very favorable.

In addition to metformin, common medications for PCOS include use of hormonal birth control. These can either be oral or vaginal contraceptive methods that are hormonal. These treatments are helpful in symptom relief, but can increase resistance to insulin and weight gain. These two factors only further progression of PCOS and worsen outcomes in the long-term (Mosorin et al., 2023). It has been suggested that CVCs are less metabolically disruptive than COCs, but more recent data shows they both share risk and metabolic side effects in similar

LIFESTYLE INTERVENTIONS FOR OBESE WOMEN WITH PCOS

fashions(Mosorin et al., 2023).

An important factor to consider is the cost of interventions. Women with a lower socioeconomic status are at a higher risk of developing PCOS, and may not be able to afford treatment methods. Dietary studies are generally not cost-analyzed and this could contribute to attrition rates for some women who may not be able to afford healthy foods. Similarly, lower socioeconomic status may decrease access to healthier foods and promotion of physical activity. Gyms may not be accessible for the average person, or affordable. These factors may be part of why the majority of studies in PCOS research are small sample sizes and generally shorter terms of observation. Further, studies assessing impact of semaglutide medications mostly are not considering cost either. This is an integral portion of sustainable intervention as one must be able to afford them, or they will be non-compliant.

Limitations

The central limitation to this analysis is the general lack of research in this field. One contribution to this gap is the variety in diagnostic criteria used in various studies. Some definitions of diagnoses require cysts on the ovaries being seen on an ultrasound. Others are solely based on symptom groupings such as irregular menstrual cycles, hirsutism and acne. Additionally, of the available studies, most had very small sample sizes. Behavioral change studies in PCOS have high attrition rates which tend to emphasize smaller samples and may be less representative of general populations. In this analysis, it is also important to consider that the interventions of physical activity were done without controlling for dietary patterns. It is possible that participants may have not adhered to the guidelines to maintain their normal dietary pattern. Further, most of the research available has been done on solely caucasians. This does not consider the possible impact of cultural or ethnic foods that may be an integral part of one's diet.

LIFESTYLE INTERVENTIONS FOR OBESE WOMEN WITH PCOS

The research on treatment with low-dose semaglutide shows great success in decreasing weight, but also has proven to be much less effective on women who are more obese. Further research analyzing the impacts that higher doses of semaglutide can have on more obese women with PCOS are necessary to create equitable and sustainable interventions.

An interesting finding as a result of this analysis is that hormonal birth control methods can and are proven to disrupt metabolic processes in women with PCOS, possibly worsening their symptoms. Because of this, other options must be considered for ways to restore ovulatory function and menstrual cycles without increasing chronic disease risk. Additionally, further research must analyze if the diagnosis of PCOS is enough to increase chronic disease risk regardless of weight status. Many women with PCOS are not overweight and weight loss interventions may not be effective. However, as discussed earlier, the majority of treatment options are weight loss inducing. There must be consideration for patients in normal BMI range who also have PCOS.

Most current literature regarding these interventions do not take into account the cost associated with them. Women in lower socioeconomic status may only be able to afford fast food, or may work long hours and not have time to cook. Further, social determinants of health need to take priority in identifying risk factors and outcomes for various populations, to highlight inequity and barriers to care. There is a severe lack of inclusion of non-caucasian participants in studies regarding PCOS and interventions.

The results of this analysis prove that the most effective interventions are ones that can be consistent. Regardless of kinds of exercise, diets or pharmacological interventions each aspect made an impact on the overall health outcomes of the women studied. The studies show promise in treating and more accurately identifying PCOS in the future, by being able to narrow certain

LIFESTYLE INTERVENTIONS FOR OBESE WOMEN WITH PCOS

results. While gaps in the literature can create gray areas of how behaviors may manifest as health or risk promoting, they also open an opportunity for further and new research. It has been well known that weight loss overall in those with PCOS who are obese is helpful at optimizing patient outcomes, but research can now be done to compare kinds of exercise. Additionally, these results show possibility for fertility in women with PCOS who have become infertile, but the research has just not been done on a large enough scale that findings can necessarily be applied to the general population.

Conclusion

The results found indicate positive outcomes that cannot yet be promised to those suffering from PCOS. This is due to a variety of limitations including high attrition rates and low sample sizes used. Aside from sample size, there is a lack of literature taking a representative population sample. The information found emphasizes a need for patient's opinions to be considered in their treatment options, showing they were more likely to continue. Additionally, while there are many gaps in the literature, a larger effort must be made to address the growing problem of PCOS in the United States. Not only would this improve women's health outcomes, but it would also improve chronic disease statistics. In order to improve quality of life, fertility and life expectancy, women must have complete and accurate information to address PCOS.

LIFESTYLE INTERVENTIONS FOR OBESE WOMEN WITH PCOS

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LIFESTYLE INTERVENTIONS FOR OBESE WOMEN WITH PCOS

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