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Bioscience Research

Print ISSN: 1811-9506 Online ISSN: 2218-3973

Journal by Innovative Scientific Information & Services Network



REVIEW ARTICLE

BIOSCIENCE RESEARCH, 2021 18(2): 1784-1793.

OPEN ACCESS

Impact of dietary management and physical activity on Polycystic Ovarian Syndrome: A Systematic Review

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PCOS is an endocrine-metabolic Disorder in our study; we compared the effectiveness of diet (DASH/Mediterranean), exercise (150min/week) on women with PCOS. In trial insertion, apposite publications were found without time limitation. To determine the effects of diet and physical activity on PCOS women, acceptable publications comprised of randomized control trials were taken. Twenty publications were eligible for inclusion criteria. Different interventions were applied on the basis of physical activity, low carbohydrate, dash diet, vitamin D, and probiotics supplementation. 18 studies were found to be positive with minimum chances of bias. Two studies were found as neutral results. 20 studies were found to be beneficial in a condition of PCOS women, and 18 studies had significant improvement in reproductive functions. Proper diet (DASH, Mediterranean) and aerobic exercise 5 times/week for 20-25min helped reduce BMI, endocrine profile and improved insulin resistance in female with PCOS.

Keywords: Dietary Management, Exercise, Polycystic Ovarian Syndrome, Polycystic Ovarian Disease

INTRODUCTION

Polycystic ovarian syndrome is multifactorial linked with other diseases, such as obesity, hypertension, cancer, resistance to insulin, cardiac issues, psychological issues, etc. (Srivastava et al. 2018). Around 18% of women of reproductive age are affected by PCOS. The exact cause of this disease is still unknown, but on ovarian ultrasound, a cyst is revealed mostly. Two of the most significant disorders linked with PCOS are hyperandrogenism (loss of hair, sebaceous formation) and insulin resistance. These two symptoms cause a significant change in the morphology of ovaries when ultrasound scanning is done. In women with PCOS, the level of pro-inflammatory cytokines and biomarkers are raised that cause severe inflammation. The presence of

obesity and inflammation contributes to insulin resistance, causing changes in the metabolic and reproductive system (Ganie et al. 2019). Due to the changes in the endocrine and metabolic systems, women with PCOS are more prone to become type 2 diabetic. As obesity worsens the symptoms of PCOS, women are recommended to lose weight, and it is the main goal in the treatment of PCOS. Some risk factors associated with PCOS are obesity, cancer, diabetes, CVD, and secondary amenorrhea (Di Guardo et al. 2019).

Some symptoms of PCOs comprise body hair growing on the chest, belly, face, and around the nipples, decreased breast size, irregular periods, male-like characteristics, enlargement of the clitoris, male-pattern baldness, acne, cysts on the

ovaries, obesity, skin tags, anxiety or depression, the voice gets more profound, dark or thick skin markings and creases around the armpits, groin, neck, and breasts, dandruff, patches of skin on the neck, arms, breasts, thighs, pelvic pain, sleep apnea, etc. PCOS itself is a dangerous disease, but it also increases the risk factors of hypertension, type 2 diabetes, cardiovascular diseases, coronary artery etc (Rodrigues et al. 2015). PCOS is common endocrine disease of women in her reproductive age; 4-12%, its prevalence while in some populations, it may be as high as 25% (Tabassum et al. 2013).

Nutritional management and moderate exercise are the key elements in losing weight and management of PCOS. The seven-day food diary is usually advised to the patients to note all the nutrients they consume for a better assessment of nutrients they have consumed. In a study, it was found that higher fat mass was linked with metabolic dysfunction. Also, the fat percentage of the body is linked to a higher level of biomarkers. When studies were carried, it was found that women stuck to unhealthy dietary habits and poor adherence to the Mediterranean diet is known to decrease PCOS symptoms. Mediterranean diet is the health-promoting dietary pattern as it is enriched in unsaturated fatty acids, low glycemic carbs, antioxidants, fibers, etc. It includes vegetables, meat, less salt, and oil (Jiskoot et al. 2020).

The short-chain fatty acids present in this diet are anti-inflammatory, reducing pro-inflammatory cytokines—dietary modification such as high protein diet, low glycemic index diet, low glycemic load diet etc. A low glycemic index diet has been shown to reduce PCOS symptoms, improve insulin resistance, and reduce the risk of CVD, ovarian cancer etc (Jiskoot et al. 2020). DASH diet is also recommended, which contains fruits, vegetables, low-fat dairy items, and low cholesterol items etc. DASH diet is usually considered a low glycemic diet. Its higher level of antioxidants and magnesium are linked to causing an increase in insulin resistance, causing obesity, type 2 diabetes, and inflammation (Jamilian et al. 2016). When studies were carried on patients with PCOS, some patients showed adverse effects on this diet. Patients with PCOS showed a decreased level of vitamin B12, a diet rich in vitamin B12 is recommended to such patients. Diet rich in minerals like zinc, iron, magnesium, selenium, omega 3 fatty acids, folic acid etc are advised.

Exercise seems to play an essential role in reducing the weight of such patients. Women with

PCOS seem to be more depressed. The level of anxiety is higher in them. Exercise helps to normalize the level of anxiety. A moderate level of exercise is recommended, not only helps maintain the weight and helps to normalize the level of pro-inflammatory markers reducing inflammation. Exercise for 25-30 min daily is advised. Planks, brisk walking, yoga, etc., helps to reduce body fats (Conte et al. 2015). Females are uncomfortable admitting they have PCOS. There is a manifestation of this problem that affects the aesthetic of women. The reason we choose this subject is because it is becoming more prevalent among females of all ages.

MATERIALS AND METHODS

Search Strategy

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) regulations are obeyed in this systematic review. By inspecting keywords in appropriate publications, search patterns were determined and discussed with an analyst for clarification. Terms and titles are explored for the highest recoveries of details.

Applied search patterns were “PCOS”, “Mediterranean Diet”, “Dietary Patterns”, “Lifestyle”, “Insulin Resistance”, “physical activity”, “Energy”, “fat”, “obesity”, “High glycemic index diet”, “Nutrition counseling”, “Polycystic ovarian syndrome”, “Anxiety”, “metabolic syndrome”, “Exercise”, carbohydrates”, “Limited Nutrition Knowledge” and “Low Starch/Low Dairy Diet”. Animal base research was rejected.

Search plan to pick out related articles include Embase, Scopus, Science Open, OpenDoar, Biomed Central, Semantic Scholar, Pubmed, and Science direct. Articles were searched from these databases in October 2020. All supportable studies are between 2015 to till 2020. Google scholar applied for supportive search studies. These studies may have been skipped from other search engines. Search patterns were applied “PCOS,” “Dietary Patterns,” “Exercise,” and “High glycemic index diet.” An evaluation was repeated for search patterns, and relevant publications and the highest number of search studies were added.

Study Selection

Authors evaluate abstracts and headings of all appropriate publications except those that were excluded. Then the authors reviewed full-text publications for more retrievals. Open access studies were 20. Authors go for the assessment of

all articles and debate on the contradictions to resolve them. After assessing full-text publications, Evaluation was repeated for included studies to verify that all acceptable articles were established for the final report.

Search Engine

The search engine was Google and yahoo. Websites are MDPI, NIH, Frontiers In, Creative Commons, Elsevier, Research gate, Orcid, and BMC.

Data Extraction

Data were extracted by the model, which was design by the authors. The model relates with the contributor, time of the study, study design, aetiology of disease, exercise, and dietary interventions. All authors checked the extracted data. Data was not extracted when results were achieved by only one study and where the litterateur was not convinced of the validity of his points, and incomplete information is provided.

Figure1: Flowchart of PRISMA

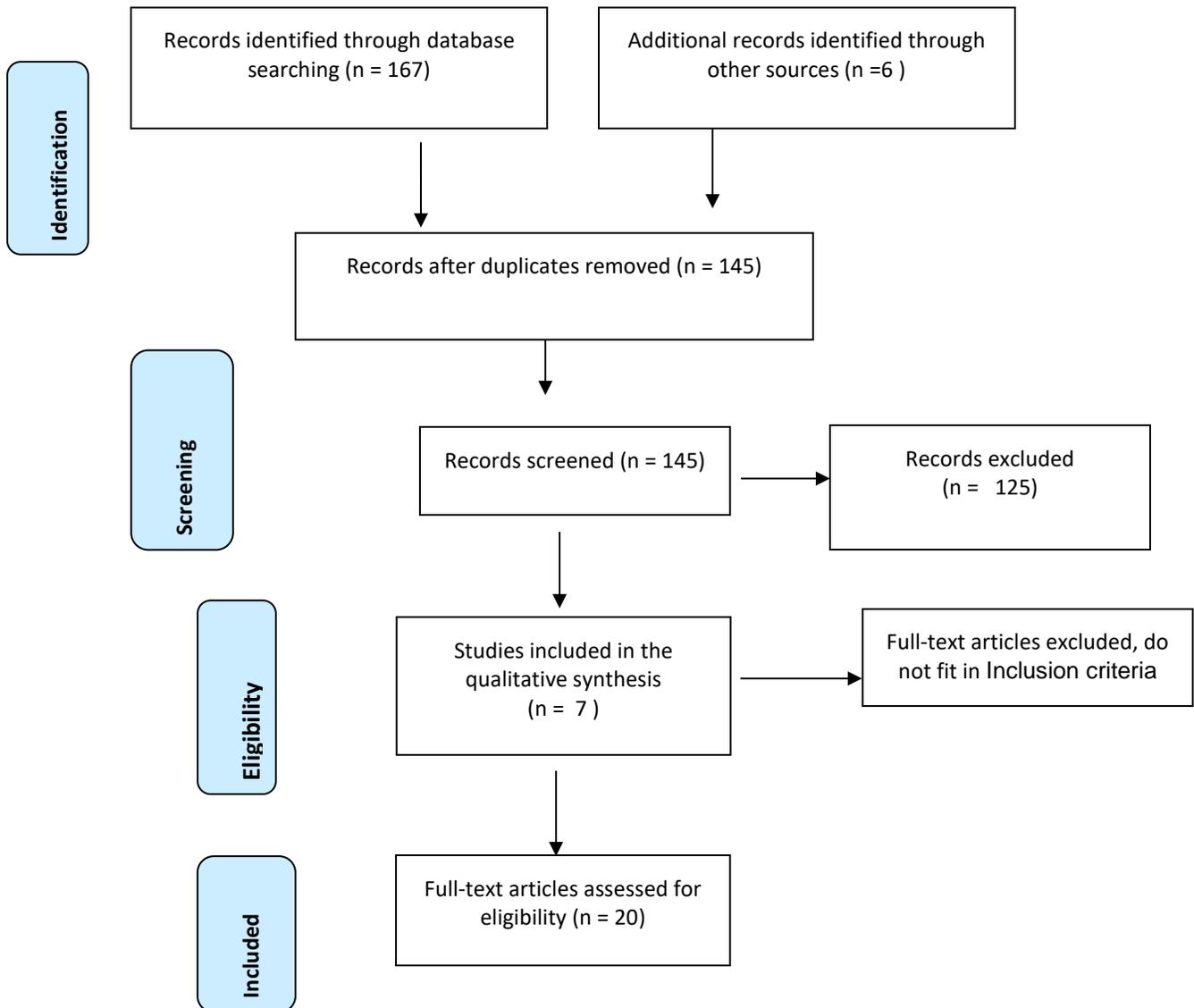


Table 1: Polycystic Ovaries syndrome and its outcomes measures

Author, Year, Location	Participants, Study Duration	Causes of PCOS	Study Design	Intervention	Outcome measure	Reference
Toscani et al., 2011, Brazil	18 women, November 2006 -July 2007	Unhealthy dietary habits	Randomized controlled trials	Lifestyle modification, Exercise, Healthy food choices	Improve endocrine profile Weight loss Intake of a well-balanced diet	24
Rahimi-Ardabili et al., 2013, Iran	80 women, March 2010- June 2010	Vitamin-D deficiency and obesity	Randomized controlled trials	Balanced diet Lifestyle modification Multivitamin	Weight reduction Improve dietary habits Provide healthy nutrients	26
Mehri Jamilian et al., 2015, Iran	60 women, July 2015- September 2015	Hormonal imbalance and obesity	Randomized controlled trial	Dietary management, physical activity	An improvement in insulin resistance Improve HS-CRP Reduce abdominal fat accumulation.	8
Thomson et al., 2012	104 women, April 2006 -February 2007	Over-weight and obesity	Randomized controlled trials	balanced diet, improve physical activity, lifestyle management	Improvement in weight reduction Increase intake of healthy nutrients	27
Eduardo Caldas Costa et al., 2018	27 women, February 2010- December 2011	Sedentary lifestyle	Randomized controlled trials	Lifestyle management, Increase physical activity, Healthy diet	More consumption of healthy food. Increase intake of fruits and vegetables Improve portion size	28
Elisabet Stener-Victorin et al., 2013	27 women, November 2005- January 2008	Physical inactivity and high fat diet	Randomized controlled trials	Less intake of high-fat food, exercise	Less fat intake improves heart health and reduces weight. Improve physical activity	29
Lisa Vizza et al., 2016	15 women, February 2014- September 2014	Physical inactive, Weight-gained	Randomized controlled trials	Dietary recommendation, Improver physical activity, exercise	Increase in metabolism. Increase weight reduction Improve food choices Lifestyle management	30
Volkan Turan et al., 2015	382 women, March 2011 -May 2014	Low metabolism, Hypertension	Randomized controlled trials	Dietary management, Improve Physical activity	Weight loss Normal blood pressure Increase in metabolism Low blood cholesterol	31

Gislaine Satyko Kogure et al., 2019	126 women, November 2014 and April 2016	Physical inactivity	Randomized controlled trials	Physical activity and lifestyle modification	Lifestyle modification Eating patterns Reduce weight Improves metabolism	32
Maryam Kazem et al., 2018	95 women, April 2011 and June 2016	Metabolic abnormalities	Randomized controlled trial	Pulse based diet	Improving cardio-metabolic disease risk factors	16
Susan Arentz et al., 2017	122 women, August 2012 and January 2014	Menstrual irregularity and hormonal imbalances	Randomized controlled trial	90 min of aerobic activity	Effective for hormonal balancing and menstrual regulation	17
Esmaeilinezhad et al., 2018	86 women, January to July 2017	Incomplete follicles maturation	Randomized controlled trial	Given pomegranate juice	Pomegranate juice improves: insulin resistance testosterone level BMI	18
Christian Trummer et al., 2019	180 women, December 2011 and July 2017	Vitamin D deficiency and increase plasma glucose	Randomized controlled trial	vitamin D supplementation	Reduced plasma glucose and insulin resistance	19
Geranne Jiskoot et al., 2020	155 women, August 2010 and March 2016	Anovulation	Randomized controlled trial	interventions including diet, exercise, and cognitive behavioural therapy	Improvements in: Depression Mood Self-Esteem	6
Fatemeh Foroozanfard et al., 2017	60 women, January 2016 to March 2016	Metabolic disorders	Randomized controlled trial	low-calorie DASH diet	Beneficial effects on: BMI Insulin Metabolism	20
Nila Ghanei et al., 2017	60 women, 12-week	Elevated Inflammation and weight gain	Randomized controlled trial	Probiotic supplementation	Lactobacillus supplementation modulates inflammation in PCOS Weight reduction	21
Jiskoot et al., 2017	210 women, September 2009 and December 2016	Hyperandrogenism, hirsutism,	Randomized controlled trial	Changing cognitions,	Improves: reproductive function	7

		infrequent or absent menstruation		changing dietary habits, encouraging and promoting physical activity, and activating social support	metabolic function Menstruation regularity	
Mohamad Irani et al., 2015	68 women, October 2013 and March 2015	An abnormal increase in TGF-1 bioavailability	Randomized controlled trial	Vitamin D Supplementation	Decreases the bioavailability of TGF-1	22
Amie Woodward et al., 2020	51 women, September 2018 and May 2021	Obesity, Insulin Resistance, Dyslipidemia, Visceral Fat, Reproductive, Cardio Metabolic Complications.	Randomized controlled trial	12-week supervised aerobic exercise program	Increased in blood lipid profile, fasting glucose aerobic fitness, oxidized LDL, testosterone and inflammatory markers.	23
Ida Almenning et al., 2015	89 women, July 2013- October 2013	Cardiovascular and Hormonal effect on PCOS	randomized controlled trials	Dietary management Lifestyle modification, exercise	Lifestyle and dietary modification: Improves food patterns and dietary habits Reduce weight Increase metabolism Balance hormones	25

Eligibility criteria for including studies in this systematic review

Inclusion criteria:

- Study design: Randomized Controlled Trials
- Types of contributors: Women with polycystic ovary syndrome (PCOS)
- Results: expected outcomes include; Insulin Resistance, physical activity, Limited Nutrition Knowledge, and a High glycemic index diet.
- Language: Articles in English languages were included.

Exclusion criteria

- Study design: non-randomized controlled trials.
 - Types of contributors: post-menopausal women and women without PCOS.
 - Topics: Hormones, eating behaviors, biomarkers, and mental health
- Language: Articles in languages (Arabic, Chinese, Hindi, and French) were excluded.

DISCUSSION

The Health-Related Quality of Life (HRQOL) and Therapeutic Lifestyle Change (TLC) modification study was carried by Maryam Kazmi in 2019, in which they took 31 women from the age group 18-35 years. Proper counseling sessions regarding change in the lifestyle, behavioural modification and exercise, etc. was carried out, without any energy restriction. TLC was introduced in which a pulse-based diet (lentils, peas, etc) along with aerobic exercise for 45 min/day- 5 times/week with proper education on PCOS was carried out. 80% of the women were overweight 76.4% got motivated to lose weight. After the study was completed, over 69% of women lost weight. Their endocrine profile was improved, and HRQOL was improved, and their score increased (Kazemi et al. 2019).

Furthermore, another study was carried by Suzen Arents. On females who were overweight and the use of herbal medicine. In this, they took 122 women from the age group 18-44 years whose BMI was greater than 24.9kg/m² or taking any estrogen medicine, anti-depressant, etc. Women were divided into two groups One with lifestyle modifications that include proper education on PCOS and exercise for 15min/week. The other group was using herbal medicines. Two medicines were made by Australian company herbimed, namely T.terrestris and tribulus forte; a study was carried for 3 months; in the end, 73% of women showed improved lifestyle change. 86%

of women made a conscious decision regarding diet. Women from both groups showed improved PCOS, insulin level, and endocrine level, lowered BMI, greater pregnancies, and increased anxiety and depression (Arentz et al.2017).

Similarly, another study was carried by Esmaeilnezhad Z, on pomegranate juice's effect on sex hormone profile and anthropometric indices. In this study, 92 women were taken and divided into three groups, 23 each group. Women were given 2L of Symbiotic Pomegranate Juice (SBJ). One group was a controlled group; they were given 2L of a placebo drink. At the end of the study, 86 females were analyzed. The primary outcome was insulin Resistance, whereas the secondary outcome was changed.LH, testosterone, Waist-Hip ratio, BMI, Fasting Blood Sugar. On the final result, it was clear that SPJ and SB change testosterone, level, increase insulin Resistance; pomegranate juice is a rich source of Antioxidant and probiotic; thus, Spj helps to improve PCOS by reducing waist-hip, insulin resistance, BMI. (Esmaeilnezhad et al.2018).

Similarly, in 2018 study was carried by Christia trummer and others. On the effect on metabolic and endocrine parameters by Vitamin D. In this study, 180 women whose 25 hydroxyl vitamin level was below 75mmol/L were selected. The effect of Vitamin D supplementation on plasma glucose was observed; patients were given cholecalciferol weekly or placebo for 24 weeks. In the end, results showed. 123 women completed the study when glucose tolerance was checked 60 min after oral tolerance was checked 60min after oral tolerance test showed less glucose level. Come out that Vitamin D has a lowering effect on plasma glucose, not on metabolic and endocrine values (Trummer et al. 2018).

Similarly, another study was carried out by Fatemah Foroozah in 2017; these 60 women were selected at age 18-40 years-showing two characters i-e delayed of menses and hirsutism, etc. Patients were recommended to take DASH diet low calories or control diet for 12 weeks. Patients were counselled on dietary and lifestyle modification and exercise. A 3-day dietary recall was also planned. Diet designed was calorie restrict as all patients were obese. The control eating plan was designed with 52-55% Carbs, 16-18% proteins and 30% of total fats. When the final analysis was done, it comes out that the DASH diet helped females in reducing weight, reduced

insulin resistance showing improvement in PCOS along with hypertension (Foroozanfard et al. 2017).

Moreover, a study was conducted by Geranne Jiskoot and others in which they found that women with PCOS have high chances of depression. They initiate three types of intervention consist of food, physical activity, and counselling. These interventions are more effective in obese women that result in better behavior and self-confidence (Jiskoot et al. 2020). Another study was conducted specifically on diet intervention by Nila Ghanei in 2017. Raised inflammation was assessed with PCOS growth. They analyzed the impact of Lactobacillus addition in the diet. They observed a decrease in inflammation in PCOS women. (Ghanei et al.2017).

It has been studied that 20% of women have a high amount of fat around organs and metabolic abnormalities. For this purpose, a study was conducted by Amie Woodward precisely on physical activity. They initiated physical activity to overcome an inactive lifestyle. After the intervention, the first outcome was the acceptance of changes in their lifestyle, and the second outcome was impacted by their levels of cholesterol and body fat (Woodward et al. 2020).

It has been seen that a 5 to 10% decrease in weight has an evident effect on different reproductive organs in PCOS. For this concern, a study was conducted by Jiskoot in 2017, in which they encouraged their participants by dietitians to weight loss. The first outcome was desired weight loss than the control group. The second outcome was improvements in women's reproductive and metabolic functions and quality of life (Jiskoot et al. 2017).

Additionally, a study was conducted by Thomson et al. 2016 in which, they found beneficial effects of physical activity in PCOS. They initiate different combinations of interventions consist of diet and physical activity. Lifestyle changes with a low caloric diet were found to remove hurdles in exercise (Thomson et al. 2016).

CONCLUSION

However, in this systematic review we compared the effectiveness of exercise diet and lifestyle modification on women with and on women with and without PCOS. Our finding showed enough evidence on the effectiveness, showing improved results in the metabolic anthropometric and evidence profile. Through this

study, we determine that exercise (aerobic) regularly for 150 minutes per week helps lower the weight-conscious decision regarding healthy eating showed a miscible reduction in the BMI.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

AUTHOR CONTRIBUTIONS

MRQ and BR (Study design and writing), SN (Writing), BR, MUN and SB (Investigations), MK,SB and KC (Proof reading and editing), SN,BR,AL,AM and MS (Final draft preparation)

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