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Effects of Exercise on Hormones in Women with Polycystic Ovary Syndrome

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ABSTRACT

Numerous reproductive-aged women are impacted by polycystic ovary syndrome (PCOS), an endocrine-gynecology condition. While a risk factor for polycystic ovarian syndrome (PCOS) has been identified, much about the disease's origins and pathophysiology is still up in the air. We searched PubMed and ClinicalTrials.gov extensively for results pertaining to the utilisation of repurposed pharmaceuticals in order to acquire information about the causes and treatments of polycystic ovarian syndrome (PCOS) for this study. We looked at everything that could be causing polycystic ovary syndrome. In addition, the data for both the most commonly prescribed PCOS medications and those that have been repurposed are summarised in the tables. Insulin resistance, inflammation, environmental toxicants, epigenetics, oxidative stress, hyperandrogenism, stress, and nutrition were all part of the internal components that were reviewed. Altering one's way of life and making use of complementary and alternative medicine is often the first line of defence against illness for many people. There is some evidence that certain medications and supplements may be effective in treating polycystic ovarian syndrome (PCOS). These chemicals include mucolytic medicines, thiazolidinediones, sodium-glucose cotransporter-2 inhibitors, dipeptidyl peptidase-4 inhibitors, 3-hydroxy-3-methyl-3-glutaryl-coenzyme A (HMG-CoA) reductase inhibitors, and glucose-like peptide-1 receptor agonists.

Keywords- PCOS, Exercise, Hormone, Pathophysiology.

I. INTRODUCTION

Countless individuals across the globe are impacted by polycystic ovarian syndrome (PCOS), an intricate endocrine illness. Symptoms such as insulin resistance, swollen and malfunctioning ovaries, increased testosterone levels, and others are indicative of this illness. Polycystic ovarian syndrome (PCOS) with all the problems it brings is something that affects about 10% of women before menopause. Not much is known about polycystic ovary syndrome (PCOS) or its exact cause or underlying causes [1]. An elevated ratio of luteinizing hormone (LH) to follicle-stimulating hormone (FSH) and an increased frequency of

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gonadotropin-releasing hormone (GnRH) are recognised to be characteristics of polycystic ovary syndrome (PCOS). A number of internal and external factors, including insulin resistance (IR), environmental factors, hyperandrogenism (HA), heredity, and epigenetics, contribute to this disease. Additionally, it should be noted that polycystic ovary syndrome raises the risk of numerous consequences, including cardiovascular illnesses, type 2 diabetes mellitus, metabolic syndrome, anxiety, and depression[2][3].

Crucial to the reproductive and survival of the species is the female hypothalamic-pituitary-ovarian (HPO) axis, a network that is highly regulated and coordinated. Both internal and external environmental stimuli, including hormonal and neuronal signals, can activate the HPO axis and cause hormone release [4]. Because epigenetic factors influence germ cell and brain development during gestation, they have far-reaching effects on subsequent generations. A disease known as polycystic ovarian syndrome (PCOS) affects the HPO axis and causes symptoms such as high testosterone levels and infertility. Six percent to twenty percent of reproductive-age women have this disease, according to diagnostic criteria [5] [6]. Infertility, hirsutism, repeated anovulation, and hormonal imbalances are among the most common symptoms. Symptoms of persistent hyperandrogenism include abnormal oocyte maturation, early luteinisation of granulosa cells, premature cessation of activated primary follicles, excessive secretion of luteinizing hormone (LH), and impaired hypothalamic-pituitary feedback[7][8][9][10].

II. ETIOLOGY

Researchers have found numerous likely risk factors for polycystic ovarian syndrome (PCOS), including heredity[11], but the specific cause is still unknown. Polycystic ovarian syndrome (PCOS) affects 4-6% of women in the general population, but that number jumps to 20-40% when looking at female relatives [12]. A large number of women who suffer from undiagnosed polycystic ovary syndrome (PCOS) also have female relatives who suffer from the same condition. Similar to how multiple genes contribute to the onset of type 2 diabetes, recent genome-wide association studies have uncovered potential genes that contribute to the onset of polycystic ovarian syndrome (PCOS)[13]. Without a doubt, environmental and epigenetic variables, like a poor diet and insufficient physical exercise, amplify any innate genetic tendency [14].

III. PATHOPHYSIOLOGY

Primary pathologies in ovarian function, hypothalamic-pituitary axis function, and insulin secretion and activity make up the pathophysiology of polycystic ovary syndrome (PCOS). Though its exact cause is unknown, polycystic ovarian syndrome (PCOS) has been associated with insulin resistance and obesity [15]. The production of androgens by the ovaries in response to an excess of insulin can lead to anovulation. Therefore, the involvement of insulin in controlling ovarian function is not surprising. When follicular maturation arrest occurs, it indicates that something is wrong with the ovaries [16].

Elevated luteinizing hormone (LH) and gonadotropin-releasing hormone (GnRH) levels, along with low or unaltered follicular-stimulating hormone (FSH) levels, are diagnostic of polycystic ovarian syndrome (PCOS). An increase in androgen production is caused by the stimulation of the ovarian thecal cells by an increase in GnRH levels [17]. Injecting exogenous FSH or increasing endogenous FSH levels can prevent follicular growth from coming to a halt. Having a family history of polycystic ovarian syndrome (PCOS) can be a major concern for girls entering puberty, according to several research. Elevated prolactin levels are observed in around 25% of PCOS patients [18].

Normalising sex hormone-binding globulin (SHBG) levels is the end goal of therapy efforts, which involve reducing insulin and ovarian androgen synthesis. Effective management of polycystic ovarian syndrome (PCOS) symptoms can be achieved by increasing sex hormone-binding globulin (SHBG) levels [19]. Researchers have shown that compared to healthy persons, PCOS patients' cal cells produce much more testosterone, progesterone, and 17-hydroprogesterone. Changes in these cells have been observed in patients with polycystic ovarian syndrome (PCOS) who had an increased expression of the cytochrome P450 (CYP) 11A, 3-HSD2, and CYP17 genes. Polycystic ovarian syndrome (PCOS) often occurs alongside obesity, but it is not necessary for a diagnosis.

IV. EFFECTS OF EXERCISE ON HORMONES WITH PCOS

Shele *et al.*,2020 Endocrine polycystic ovarian syndrome (PCOS) is characterised by insulin resistance as one of its symptoms. Other symptoms of PCOS include increased blood testosterone levels and irregular menstrual cycles. There is still no known cause of polycystic ovarian syndrome (PCOS). When treating polycystic ovarian syndrome (PCOS) in women, the primary goal is to help them lead healthier lives and, if necessary, lose weight. In order to keep their weight down and their heart healthy, people with polycystic ovarian syndrome must exercise regularly. Research on the effects of exercise treatments on hormone levels in PCOS patients is fragmented, and this study aims to fill that gap. Here we provide the results of a meta-analysis of research that looked at PCOS women and measured their hormone levels before and after an exercise program. We excluded studies where the effect size of the exercise intervention could not be calculated. Insulin

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levels rise in women with polycystic ovarian syndrome when they are really active. Androgen levels may rise with resistance or strength training, but this theory needs more research to be confirmed. The current evidence suggests that yoga may have a favourable impact on androgens, while there is insufficient research on the subject. To fill in the gaps in our understanding of how exercise affects adipokines and anti-Müllerian hormone, more research is necessary [20].

Santos *et al*.,2020 Reproductive difficulties, metabolic dysfunction, and cardiovascular risk are common clinical manifestations of polycystic ovarian syndrome (PCOS) in reproductive-aged women. Exercise has several positive effects for women with polycystic ovary syndrome. This review set out to compile information on how various forms of physical exercise affect PCOS women's reproductive health and body composition. There were a total of 533 participants across 10 RCTs included in this meta-analysis. Aerobic and resistance training programs, whether performed independently or in tandem, were the primary subjects of the studies. Studies often had a small sample size (32 individuals on average, with a range of 15 to 124 total) and a brief period (varying from 8 to 32 weeks). Reproductive function tests, which looked at things like ovulation, menstruation, and fertility, had very inconsistent results. Aerobic exercise was found to reduce body mass index (BMI) in women with polycystic ovarian syndrome (PCOS), according to data with reasonable certainty: BMI SMD −0.35, 95% confidence interval −0.56 to −0.14, P=.001. Furthermore, we found evidence with a moderate level of assurance that exercise did not significantly affect reproductive hormones. Few studies have examined the effects of exercise on reproductive function and other crucial health outcomes in women with polycystic ovary syndrome. In order to lower her body mass index (BMI), a woman with polycystic ovarian syndrome should begin with aerobic exercise [21].

Stepto *et al*.,2019 For women who have been diagnosed with polycystic ovarian syndrome (PCOS), this opinion piece aims to evaluate the 2018 evidence-based recommendations for physical activity and exercise. The purpose of this essay is to first offer a brief overview of these standards before critically evaluating their merit. With the goal of creating all-encompassing international standards, we have come up with a number of suggestions. The suggestions were developed with the help of healthcare professionals and consumers, who were essential in shaping the goals and breadth of the proposals. Consumers and specialists in endocrinology, exercise physiology, gynaecology, nutrition, and obstetrics made formed the lifestyle guideline development group that came up with the activity suggestions. We covered five lifestyle-related clinical concerns in our two in-person encounters and extensive internet correspondence. Among these worries was the potential impact of physical activity on PCOS treatment outcomes. Two evidence-based reviews and one narrative review were used to develop the recommendations for the guidelines. The members of the guideline panel then reached a consensus and voted to finalise these suggestions. Following the procedures specified by the Appraisal of Guidelines for Research and Evaluation (AGREE) II, the development method was carried out. We used the GRADE framework to evaluate the following: the strength of the recommendations, the cost, the practicality, the acceptance, and the prospective benefits and drawbacks. Considering the existing exercise recommendations for the general public and the scant evidence for exercise as a treatment for polycystic ovary syndrome (PCOS), a unanimous recommendation was reached. Exercise therapy, which prolongs the duration of treatment with pharmaceutical medications, is recommended by both professionals and women with polycystic ovarian syndrome (PCOS) using standardised procedures. Researchers and funding agencies around the world must work together more closely to fill in the gaps in our understanding of exercise treatment for polycystic ovary syndrome (PCOS). Finding solutions that are efficient, adaptive, and long-lasting requires this step [22].

Patten *et al*.,2020 Symptoms associated with metabolism and reproduction define polycystic ovary syndrome (PCOS), a prevalent and complicated endocrine condition. Exercise prescription clearly has its limits, but exercise training on a regular basis improves clinical results for PCOS patients. In order to determine which exercise regimens are most beneficial for women suffering from Polycystic Ovary Syndrome (PCOS), this study performed a meta-analysis and thorough review. Nineteen articles were included in the meta-analysis, out of thirty-three total. Programs' lengths varied from six to twenty-six weeks. There were 777 ladies in all who participated in the meta-analysis. Compared to exercise dosage, exercise intensity is the more important factor in improving health outcomes, according to the meta-analysis. The results of the fixed effects analysis showed that high intensity exercise increased VO2peak by a moderate amount (24.2%; 90% confidence interval, 18.5-30.1) and reduced HOMA-IR and waist circumference by small amounts (−36.2%; 90% confidence interval, −55.3 to −9.0 and −4.2%, respectively). Consistent with expectations, the results showed that women whose starting values were already low benefited the most from high-intensity exercise and dietary changes, particularly in relation to VO2peak, BMI, and waist circumference. There has been a marked uptick in the use of exercise training as an adjunct to PCOS treatment plans. According to our findings, working out has several benefits, but especially high-intensity exercises that improve insulin resistance, body composition, and cardiorespiratory fitness. Based on our findings, women who have been diagnosed with polycystic ovarian syndrome (PCOS) would benefit from participating in vigorous physical activity for at

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least 120 minutes per week. Longer durations would be necessary for future research on the effects of persistent exercise [23].

Ribeiro *et al*.,2020 The goal of this research is to find out how aerobic training, whether done intermittently (IA) or continuously (CA), affects women's body composition, polycystic ovarian syndrome (PCOS), and metabolic and hormonal markers. Participants were divided into three groups for the randomised controlled experiment (RCT): training (n = 28 for CAT and n = 29 for IAT), control (n = 30) without training, and the other two groups received varying degrees of instruction. Stratified sampling was used for this purpose. Before and after a 16-week intervention (CAT, IAT, or CG)[24], metabolic and hormonal indicators, body composition, and anthropometric data were assessed. Aerobic training on the treadmill typically lasted 30–50 minutes and involved intensities of 60–90% of a person's maximal heart rate. When compared to the control group, the CA group had lower levels of weight, hip size, cholesterol, low-density lipoprotein, and testosterone (P=0.045, P =0.032, P=0.001, P =0.030, and P>0.001, respectively). As an example, the IAT group had significantly lower values for WC, hip-to-vestibule ratio (P =0.012), testosterone (P =0.019), and free androgen index (FAI) (P =0.037), among other analytical variables. Weight control (WC), total body mass (TBM), percentage of body fat (BFM), total arm mass (P ≤0.001), percentage of trunk fat (P =0.033), percentage of leg fat (P =0.021), and total gynoid mass (P =0.011) were all displayed by the CG group as increasing values. Reductions in hyperandrogenism and anthropometric indices were observed in PCOS patients who underwent training with either CAT or IAT. Nonetheless, the FAI was merely reduced with IAT training. Lipid profiles improved with CAT training alone as well [25].

Brown *et al*.,2009 Women who have polycystic ovarian syndrome (PCOS) may experience insulin resistance. Changes in the size and density of lipoprotein subtype particles are associated with insulin resistance [26]. The purpose of this study was to examine the effects of a moderate-intensity exercise program on the lipoprotein profiles of PCOS women who did not participate in the weight loss component. Two groups were randomly selected among 37 inactive women who had polycystic ovarian syndrome (PCOS). In one group, exercise intensity was gradually ramped up for 8-12 weeks, and then maintained at a moderate level for 12 weeks (for a total of 16-24 weeks, or around 228 minutes per week at 40-60% of peak oxygen consumption). None of the members of the other group altered their way of life. Low menstrual period frequency (less than eight cycles per year) and elevated androgen levels (hyperandrogenism) are diagnostic criteria for polycystic ovarian syndrome (PCOS). Before and after the intervention, fasting lipoprotein profiles were obtained. Nuclear magnetic resonance spectroscopy (NMR) was used to determine a number of characteristics, such as the average particle size, total and subclass particle concentrations of HDL, LDL, and VLDL, and computed levels of HDL cholesterol, triglycerides, and VLDL triglycerides. In order to compare the two groups' progress, researchers used Wilcoxon exact rank sum tests to look for changes in these key traits. Twelve women served as the control group, while eight women exercised as the active group. When comparing exercise- and non-exercise-dependent people, we found that the concentrations of lipoprotein parameters linked with lower insulin resistance changed significantly. Results showed that medium/small HDL (p=0.031), large VLDL (p=0.007), computed triglycerides (p=0.003), and VLDL triglycerides (p=0.003) all increased significantly. The average size of HDL (p=0.001) and the number of large HDL (p=0.002) also increased significantly [27].

Tofighi *et al*.,2010 Women with Polycystic Ovary Syndrome (POS), an endocrine condition that affects a large percentage of the population, often experience infertility due to ovarian malfunction. Aerobic exercise may help young women with polycystic ovarian syndrome (POS) problems, which is why this study set out to find out. The 30 POS women were divided into an experimental group and a control group at random [28]. Over the course of ten weeks, the experimental group engaged in targeted aerobic exercise. Throughout the course of the research, the control group did not undergo any kind of exercise program. Using anthropometric measures and fasting blood samples, the research variables were assessed before and after the workout schedule. Using the radioimmunoassay technique, the levels of LH and FSH in the plasma were examined. Insulin and testosterone levels were assessed using electrochemiluminescence (ECL). The immunoradiometric assay was used to quantify the SHBG concentration (IRMA). The results showed that the experimental group's metabolic rate (HR), fat percentage, LH level, LH/FSH ratio, SHBG, and serum insulin levels were significantly reduced (P<0.05) after beginning aerobic training. According to the results of the T-student test analysis (P<0.05), there were notable disparities in the experimental and control groups with respect to the mean levels of LH, LH/FSH proportion, SHBG, and serum insulin [29][30].

V. CONCLUSION

Every persons PCOS symptoms are different. Even when a woman has stopped having children or gone through menopause, this problem will still be there since there is no cure for it at the moment. The several pieces have not been put together to give a whole picture, even though there is strong genetic evidence. Disease diagnosis, therapy, and management are expected to undergo a sea change if the underlying causes are understood. It had evolved considerably by the time American gynaecologists Irvin F. Stein, Sr. and

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Michael L. Leventhal initially defined it formally in 1935. The prevalence of multiple variables, such as ethnicity and genetics, makes it difficult to define universal "laws" for the condition, even though diagnostic improvements have improved patient management. There have been improvements, but many studies still show that people aren't happy with their diagnoses. Several issues, including the disorder's inherent heterogeneity, conflicting diagnostic criteria and techniques, imprecise assessment of important features, and related concerns, contribute to the lack of consensus on PCOS diagnosis in teenagers. It is essential to employ a multidisciplinary approach and revise our understanding of these variances to reduce the incidence of inadequate and delayed PCOS diagnosis in women.

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