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BENEFITS OF PHYSICAL ACTIVITY ON REPRODUCTIVE HEALTH FUNCTIONS IN WOMEN POLYCYSTIC OVARY SYNDROME: SYSTEMATIC REVIEW

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Abstract

Polycystic ovary syndrome (PCOS) is a predominant endocrine disorder in women of reproductive age. The prevalence of PCOS is estimated to be around 8-13% of women of childbearing age and up to 70% of cases are undiagnosed. This systematic review aims to synthesize evidence on the impact of physical activity on reproductive health function in PCOS women. Conducted using electronic data base from journals that have been published in PubMed, Science Direct and Wiley. This study investigated physical activity interventions with intensity and volume and measured reproductive function as well as hormonal and menstrual improvements. The inclusion of physical activity alone or combined with other therapeutic interventions improved reproductive outcomes. Reproductive function of women with PCOS can be improved by physical activity. Physical activity can also reduce infertility and social and psychological stress in women.

Keyword: *Sports, Physical activity, Polycystic syndrome, Reproduction*

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1. Introduction

Polycystic ovary syndrome (PCOS) is one of the predominant endocrine disorders in women of childbearing age [1]. According to WHO, the prevalence of PCOS is estimated to be around 8-13% of women of childbearing age, and up to 70% of cases are undiagnosed. The pathophysiology of PCOS mainly relates to hormonal imbalance, chronic low-grade inflammation, insulin resistance, and hyperandrogenism which impairs folliculogenesis and increase the risk of associated diseases such as endometrial cancer and type II diabetes [2].

According to international recommendations, the three main factors for the diagnosis of PCOS are hyperandrogenism, ovarian morphology, and anovulation [2]. Four phenotypes were identified that were considered variants of PCOS based on three parameters, viz., anovulation, hyperandrogenism, and polycystic ovaries. The four phenotypes consistently range from severe (phenotype A) to non-severe (phenotype D) along the axis of metabolic and ovarian dysfunction [3]. Women with PCOS gain weight over time [4], and a high prevalence become obese, leading to

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poor IR (insulin resistance) and exacerbating PCOS [5].

The recommendations in the international evidence-based guidelines for the evaluation and treatment of polycystic ovary syndrome are based on published evidence, clinical experience, and consensus. Based on the predicted impact with the actual impact, making the evidence can be used for the assessment and management of PCOS. One of the recommended treatments based on evidence is lifestyle, diet, exercise, and behaviour to reduce body weight and insulin resistance [6].

Physical activity reduces the risk of weight gain and can improve a woman's quality of life [7]. Physical activity is an integral part of a balanced lifestyle for women with PCOS, particularly aerobic physical exercise can improve insulin sensitivity [8]. Lifestyle modification is key to managing PCOS. Diet and exercise are two key areas for successful lifestyle changes.

There is a higher prevalence of polycystic ovarian morphology (PCOM) among infertile women, yet there is little evidence to suggest that PCOM causes serious health harm [9]. Despite the health benefits of physical activity in PCOS, there has been limited focus on systematically analyzing the independent effects of exercise on female reproductive function.

This systematic review aims to synthesize the positive impact of different patterns and types of exercise on reproductive function in women of childbearing age with PCOS. This report provides information to decision-makers on the importance of physical activity to address reproductive dysfunction in PCOS women as well as pharmaceutical interventions.

2. Method

The systematic review was conducted based on the preferred reporting statement for systematic reviews and protocols for meta-analyses (PRISMA) [10] and the Cochrane guidebook for systematic reviews of interventions and protocols designed for systematic review of exercise and reproductive function in PCOS [11]. The review questions were as follow: What type and intensity of exercise affects reproductive function in women of childbearing age with PCOS.

Inclusion and exclusion criteria: Randomization-controlled trials RCTs using physical activity or exercise as the main intervention to measure causal relationships with outcome parameters of reproductive function (primary), menstrual irregularities, infertility, hirsutism, metabolic characteristics, and obesity (secondary). RCT studies with or without a comparison group that used physical activity/exercise as the main intervention along with others were selected in this study. In the selected studies, the intervention effect should include at least one reproductive function outcome parameter for post-test comparison. The age range used in this study was 13-45 years old.

Information sources and literature search: Research evidence was identified using PubMed, with the keywords PCOS, physical activity, exercise, menstrual cycle, infertility, and hyperandrogenism.

Study selection process: Using Mendeley to remove duplicate studies from identified articles. Article titles and abstracts were retrieved by one reviewer. The reliability of the screened and verified studies was enhanced by using a predefined screening formula based on eligibility criteria (level 1: screening). The full text of the screened articles was obtained to extract information on study design, participant information, sample size, intervention type and duration, follow-up period, outcome parameters, and methods used for outcome validation (level: selection). The suitability of the studies sought to be added in this systematic review was determined by identifying that the outcome measures were within the domain of interest (level 3: eligibility). All discrepancies were resolved by

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consensus with the reviewers (level 4: inclusion). A flowchart relating information about these different levels of selection was developed based on PRISMA [10].

Data items and data collection process: The extraction included information on study participants, intervention, comparison group, primary outcome, and study design. Common characteristics of these selected studies were year of publication, demographics, study duration, and study design. Characteristics of the study population, sampling technique, method, age, and comparison group were also considered in the data extraction process. Reproductive function of women with and without PCOS, including reproductive hormones, metabolic characteristics, anthropometry, and PCOS phenotypes were extracted. Physical activity levels were also considered, and data were extracted to measure the type, level, and effect of physical activity on reproductive function. **Risk of bias:** in the results of this systematic review, researchers had limited access to full articles. This was a significant limitation and considered a publication bias.

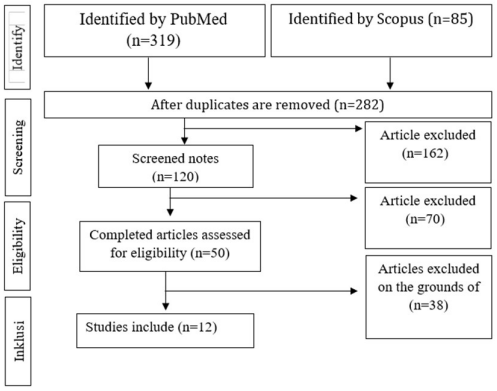

Figure 1. Data extraction and sorting

3. Results and Discussion

A total of 319 potentially eligible articles were screened through PubMed. An additional 85 studies were identified through Scopus. A total of 162 articles were excluded from further analysis as they did not meet the eligibility criteria based on their respective study design, participant information, sample size, intervention type, and study duration. Parameters and methods used for validation of results. Based on primary and secondary outcome measures, 70 full-text articles were not eligible for full assessment, and 38 studies were rejected because the primary outcomes of those studies were more concentrated on metabolic outcomes, weight loss, and quality of life in PCOS women in general and did not focus on sexual intercourse.

A further 162 articles were excluded from further analysis as they did not meet the eligibility criteria based on their respective study designs. Based on primary and secondary outcome measures, 83 full-text articles were excluded at level 3 screening. A total of 50 articles were found eligible for full-text assessment, and 38 studies were rejected as they were ineligible. **Synthesis of included studies:** these included studies were analyzed using the PICOS model and tabulated to present reproductive health outcomes of physical activity. The studies are presented in descending order based on their publication date. Overall, small sample sizes were observed (range 50-185 participants) in the included RCTs. Only one RCT [11] had a sample size >100. Most studies used aerobic and resistance training, results are summarized below:

Exercise Duration: the average duration of physical activity/exercise interventions was 15 weeks (6-24 weeks). Most interventions were planned for 16 weeks, some studies were shorter at 6 weeks [12]. Other studies used a longer duration of 24 weeks [13]. All studies reported beneficial effects of physical activity or exercise on reproductive function and menstrual frequency of PCOS women. The optimal volume, intensity, and duration of exercise cannot be fully identified, however, a minimum duration of 30 minutes at submaximal heart rate has been shown to improve reproductive function [14].

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Exercise intensity: Most studies planned aerobic exercise with submaximal heart rate. Continuous and intermittent aerobic exercise protocols as per American College of Sports Medicine (ACSM) recommendations were followed [15]. According to the international PCOS guidelines, normal weight women should engage in moderate intensity exercise for 150 minutes per week, intense exercise for 75 minutes per week or a combination of both. Obese and overweight PCOS women are advised to do 250 minutes per week of moderate-intensity exercise, 150 minutes per week of intense exercise, or a combination of both [6].

Effects of exercise on the body: continuous aerobic training and intermittent aerobic physical exercise were designed for the experimental group for 16 weeks [16]. The training program was shown to increase the level of satisfaction with body perception dimensions and modulate hormone levels in women with PCOS [17]. 30 minutes of submaximal aerobic exercise can significantly improve BMI after 3 months. The average waist circumference was reduced by 3 cm. The average weight loss was 1.71±0.19 kg after three months and 2.5±0.30 kg after six months [14].

Effect of exercise on psychological factors: aerobic exercise and resistance training reduce the risk of anxiety and depression [16]. Regular physical activity has been shown to increase motivation and optimism in women with PCOS [14]. Aerobic exercise is effective in the treatment of patients with clinical anxiety, and high-intensity exercise may be more effective than low-intensity exercise and resistance training [18]. Exercise increases neurotransmitter availability, neurotrophins and neurogenesis, reduces serum proinflammatory cytokine levels, contributes to modulation of the hypothalamic-pituitary-adrenal axis, increases plasma endocannabinoid levels; and increases positive growth factors [19].

The effect of exercise on hormones: hyperandrogenism-related can also be found with CAT and IAT activities [16]. In the study of Lopes et al, the testosterone level was significantly reduced among the experimental group [20]. The modified Ferriman Gallwey (mFG) score changed significantly (p=0.003) after three months of submaximal running training. Metabolic factors tended not to increase significantly at this level of physical activity (Tiwari et al., 2019). Anti-Mullerian hormone (AMH) was not significantly reduced in PCOS women who only undertook the exercise intervention (p=0.53).

Table 1. Benefits of physical activity on reproductive function

Author (year)	Participants and age	Intervention	Outcome measures Reproductive health
1.	36 respondents (18-40 years old)	High-intensity interval and continuous aerobic training (CAET)	Menstrual cycle length and sexual function
2.	126 respondents (18-39 years old)	Continuous (CAT) and intermittent aerobic exercise (IAT)	Sexual function
3.	50 respondents (18-40 years old)	Additional cardiopulmo ary exercise	Hyperandrogenism, menstrual disorders
4	57 respondents (18-40 years old)	Endurance, aerobic, and/or weight training depending on the subject's preference	Ovarian function, anti-Muellerian Serum hormone

The beneficial effects of physical activity in PCOS women aged 13-45 years were evaluated in this systematic

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review. This systematic review synthesized the effects of regular physical activity of varying volume and intensity on menstrual function and reproductive health in women with PCOS [21]. Lifestyle modification, including exercise and a healthy diet, has been shown to be a beneficial therapy for women with PCOS [22].

The primary and secondary outcomes of the selected RCTs vary in their endpoints [16]. Given the heterogeneous results and endpoints, this systematic review cannot fully unify the results in a homogeneous manner. The selected studies mostly addressed reproductive function [20], menstrual frequency [13], ovulation (17), and hormonal function [20].

Physical exercise can be used as an independent treatment for PCOS women to assess all phenotypic characteristics of PCOS [23]. Factors that may be responsible for obtaining the expected response from exercise include the individual's genes, age and hormonal status. Lifestyle changes, including physical activity modifications, can be recommended as an early management strategy to reduce PCOS-related comorbidities, as this decreases insulin resistance, improves metabolic and reproductive characteristics, and improves self-esteem [24].

The timing of physical activity programs varies widely, ranging from a few weeks to a year. PCOS is associated with overweight and obesity, but the exact prevalence in girls with PCOS remains unknown and varies by ethnicity. Different ethnic groups show similar benefits of physical exercise in PCOS women [25].

Inactivity has been associated with obesity, hypertension, peripheral insulin resistance, and dyslipidemia, as prevalent in PCOS patients, according to the metabolic syndrome model. Women with PCOS need to take a multidisciplinary approach, including exercise [6]. Aerobic exercise can improve glycemic control while having a beneficial impact on sexual function and quality of life. Physical activity is beneficial for the reproductive health of PCOS women as it lowers the risk of developing metabolic syndrome and associated clinical symptoms [20].

In addition to improving reproduction and self-esteem in PCOS women, physical activity has positive effects on mental health [4]. It is hypothesized that exercise is an effective way to improve the mental health of women with PCOS. The impact of lifestyle changes has proven to be staggering among PCOS women. Regular exercise improves anthropometric measurements, reproductive biochemical outcomes, and reproductive characteristics [26].

PCOS women are found to have depression and anxiety disorders, decreased psychosexual functioning and self-esteem, and are prone to eating problems due to overeating. The advice suggests modification of individual habits based on screening assessment and frequency of adverse health-related symptoms in PCOS. These interventions should focus on behavioral aspects, changing diet, incorporating exercise and physical activity into daily routines, and creating management strategies to control obesity and weight [6]. Lifestyle changes have been shown to be cost-effective and reduce the burden of disease.

The results of this systematic review show that exercise improves sexual function and menstrual frequency and balances hormonal actions in PCOS women, especially in reducing hyperandrogenism [12] and normalizing serum anti-Mullerian hormones with optimal stimulation of ovarian follicles. Improvement in reproductive function is observed for a maximum of 6 months and depends on the subjective response of participants. This may limit the effectiveness of the study results, as it only considers a few ovulation cycles. Results synthesized from longer duration RCTs may provide more robust results regarding exercise and reproductive function in PCOS women.

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Teenagers lead a more sedentary lifestyle due to technological advances. It is known that women in the childbearing age group do not engage in regular physical activity. This may be the start of PCOS development in young women. The relationship between sedentary lifestyle and the development of PCOS needs to be further investigated. Future research could further investigate the role of lifestyle modifications including regular physical exercise and dietary changes to reduce the prevalence of PCOS and related anomalies including emotional well-being, metabolic syndrome, and self-esteem among women in the reproductive age group.

4. Conclusion

Reproductive function of women with PCOS can be improved by physical activity and can also reduce infertility and the social and psychological stress experienced, practical implications and dissemination of knowledge about strategies to improve reproductive function.

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6. References

[1] Lauritsen, M. P., Svendsen, P. F., & Andersen, A. N. (2019). Diagnostic criteria for polycystic ovary syndrome. *Ugeskrift for Laeger*, *181*(15), 671–679. https://doi.org/10.1016/S1701-2163(16)32915-2.Diagnostic

[2] Christ, J. P., & Cedars, M. I. (2023). Current Guidelines for Diagnosing PCOS. *Diagnostics*, *13*(6). https://doi.org/10.3390/diagnostics13061113

[3] Singh, S., Pal, N., Shubham, S., Sarma, D. K., Verma, V., Marotta, F., & Kumar, M. (2023). Polycystic Ovary Syndrome: Etiology, Current Management, and Future Therapeutics. *Journal of Clinical Medicine*, *12*(4). https://doi.org/10.3390/jcm12041454

[4] Cowan, S., Lim, S., Alycia, C., Pirotta, S., Thomson, R., Gibson-Helm, M., Blackmore, R., Naderpoor, N., Bennett, C., Ee, C., Rao, V., Mousa, A., Alesi, S., & Moran, L. (2023). Lifestyle management in polycystic ovary syndrome – beyond diet and physical activity. *BMC Endocrine Disorders*, *23*(1), 1–33. https://doi.org/10.1186/s12902-022-01208-y

[5] Lim, S. S., Norman, R. J., Davies, M. J., & Moran, L. J. (2013). The effect of obesity on polycystic ovary syndrome: A systematic review and meta-analysis. *Obesity Reviews*, *14*(2), 95–109. https://doi.org/10.1111/j.1467-789X.2012.01053.x

[6] Teede, H. J., Misso, M. L., Costello, M. F., Dokras, A., Laven, J., Moran, L., Piltonen, T., Health, N., Public, M., Health, M., Wales, N. S., Endocrinology, R., & Centre, M. (2018). Recomendaciones de la guía internacional basada en la evidencia para la evaluación y el tratamiento del síndrome de ovario poliquístico. *Health and Human Service*, *110*(3), 364–379. https://doi.org/10.1016/j.fertnstert.2018.05.004.Recommendations

[7] Greenwood, E. A., Noel, M. W., Kao, C. N., Shinkai, K., Pasch, L. A., Cedars, M. I., & Huddleston, H. G. (2016). Vigorous exercise is associated with superior metabolic profiles in polycystic ovary syndrome independent of total exercise expenditure. *Fertility and Sterility*, *105*(2), 486–493. https://doi.org/10.1016/j.fertnstert.2015.10.020

[8] Jurczewska, J., Ostrowska, J., Chełchowska, M., Panczyk, M., Rudnicka, E., Kucharski, M., Smolarczyk, R., & Szostak-Węgierek, D. (2023). Physical

p-ISSN: 2089-6778
e-ISSN: 2549-5054

Activity, Rather Than Diet, Is Linked to Lower Insulin Resistance in PCOS Women—A Case-Control Study. *Nutrients*, *15*(9), 1–16. https://doi.org/10.3390/nu15092111

[9] Dewailly, D., Gronier, H., Poncelet, E., Robin, G., Leroy, M., Pigny, P., Duhamel, A., & Catteau-Jonard, S. (2011). Diagnosis of polycystic ovary syndrome (PCOS): Revisiting the threshold values of follicle count on ultrasound and of the serum AMH level for the definition of polycystic ovaries. *Human Reproduction*, *26*(11), 3123–3129. https://doi.org/10.1093/humrep/der297

[10] Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., Antes, G., Atkins, D., Barbour, V., Barrowman, N., Berlin, J. A., Clark, J., Clarke, M., Cook, D., D'Amico, R., Deeks, J. J., Devereaux, P. J., Dickersin, K., Egger, M., Ernst, E., Gøtzsche, P. C., … Tugwell, P. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *PLoS Medicine*, *6*(7). https://doi.org/10.1371/journal.pmed.1000097

[11] Dos Santos, I. K., de Lima Nunes, R., Soares, G. M., de Oliveira Maranhão, T. M., & Dantas, P. M. S. (2017). Exercise and reproductive function in polycystic ovary syndrome: Protocol of a systematic review. *Systematic Reviews*, *6*(1), 4–7. https://doi.org/10.1186/s13643-017-0666-5

[12] Palomba, S., Falbo, A., Giallauria, F., Russo, T., Rocca, M., Tolino, A., Zullo, F., & Orio, F. (2010). Six weeks of structured exercise training and hypocaloric diet increases the probability of ovulation after clomiphene citrate in overweight and obese patients with polycystic ovary syndrome: A randomized controlled trial. *Human Reproduction*, *25*(11), 2783–2791. https://doi.org/10.1093/humrep/deq254

[13] Orio, F., Muscogiuri, G., Giallauria, F., Savastano, S., Bottiglieri, P., Tafuri, D., Predotti, P., Colarieti, G., Colao, A., & Palomba, S. (2016). Oral contraceptives versus physical exercise on cardiovascular and metabolic risk factors in women with polycystic ovary syndrome: a randomized controlled trial. *Clinical Endocrinology*, *85*(5), 764–771. https://doi.org/10.1111/cen.13112

[14] Tiwari, N., Pasrija, S., & Jain, S. (2019). Randomised controlled trial to study the efficacy of exercise with and without metformin on women with polycystic ovary syndrome. *European Journal of Obstetrics and Gynecology and Reproductive Biology*, *234*, 149–154. https://doi.org/10.1016/j.ejogrb.2018.12.021

[15] Thompson, P. D., Arena, R., Riebe, D., & Pescatello, L. S. (2013). ACSM's new preparticipation health screening recommendations from ACSM's guidelines for exercise testing and prescription, ninth edition. *Current Sports Medicine Reports*, *12*(4), 215–217. https://doi.org/10.1249/JSR.0b013e31829a68cf

[16] Kogure, G. S., Lopes, I. P., Ribeiro, V. B., Mendes, M. C., Kodato, S., Furtado, C. L. M., Silva de Sá, M. F., Ferriani, R. A., Lara, L. A. da S., & Reis, R. M. dos. (2020). The effects of aerobic physical exercises on body image among women with polycystic ovary syndrome. *Journal of Affective Disorders*, *262*(July), 350–358.

p-ISSN: 2089-6778
e-ISSN: 2549-5054

https://doi.org/10.1016/j.jad.2019.11.025

[17] Nybacka, Å., Carlström, K., Fabri, F., Hellström, P. M., & Hirschberg, A. L. (2013). Serum antimüllerian hormone in response to dietary management and/or physical exercise in overweight/obese women with polycystic ovary syndrome: Secondary analysis of a randomized controlled trial. *Fertility and Sterility*, *100*(4), 1096–1102. https://doi.org/10.1016/j.fertnstert.2013.06.030

[18] Tonello, L., Oliveira-Silva, I., Medeiros, A. R., Donato, A. N. A., Schuch, F. B., Donath, L., & Boullosa, D. (2019). Prediction of depression scores from aerobic fitness, body fatness, physical activity, and vagal indices in non-exercising, female workers. *Frontiers in Psychiatry*, *10*(APR), 1–9. https://doi.org/10.3389/fpsyt.2019.00192

[19] Al-Qahtani, A. M., Shaikh, M. A. K., & Shaikh, I. A. (2018). Exercise as a treatment modality for depression: A narrative review. *Alexandria Journal of Medicine*, *54*(4), 429–435. https://doi.org/10.1016/j.ajme.2018.05.004

[20] Lopes, I. P., Ribeiro, V. B., Reis, R. M., Silva, R. C., Dutra de Souza, H. C., Kogure, G. S., Ferriani, R. A., & Silva Lara, L. A. da. (2018). Comparison of the Effect of Intermittent and Continuous Aerobic Physical Training on Sexual Function of Women With Polycystic Ovary Syndrome: Randomized Controlled Trial. *Journal of Sexual Medicine*, *15*(11), 1609–1619. https://doi.org/10.1016/j.jsxm.2018.09.002

[21] Moran, L. J., Pasquali, R., Teede, H. J., Hoeger, K. M., & Norman, R. J. (2009). Treatment of obesity in polycystic ovary syndrome: a position statement of the Androgen Excess and Polycystic Ovary Syndrome Society. *Fertility and Sterility*, *92*(6), 1966–1982. https://doi.org/10.1016/j.fertnstert.2008.09.018

[22] Thomson, R. L., Buckley, J. D., & Brinkworth, G. D. (2011). Exercise for the treatment and management of overweight women with polycystic ovary syndrome: A review of the literature. *Obesity Reviews*, *12*(5). https://doi.org/10.1111/j.1467-789X.2010.00758.x

[23] Harrison, C. L., Lombard, C. B., Moran, L. J., & Teede, H. J. (2011). Exercise therapy in polycystic ovary syndrome: A systematic review. *Human Reproduction Update*, *17*(2), 171–183. https://doi.org/10.1093/humupd/dmq045

[24] Jiskoot, G., Benneheij, S. H., Beerthuizen, A., De Niet, J. E., De Klerk, C., Timman, R., Busschbach, J. J., & Laven, J. S. E. (2017). A three-component cognitive behavioural lifestyle program for preconceptional weight-loss in women with polycystic ovary syndrome (PCOS): A protocol for a randomized controlled trial. *Reproductive Health*, *14*(1), 1–12. https://doi.org/10.1186/s12978-017-0295-4

[25] Kaczmarek, C., Haller, D. M., & Yaron, M. (2016). Health-Related Quality of Life in Adolescents and Young Adults with Polycystic Ovary Syndrome: A Systematic Review. *Journal of Pediatric and Adolescent Gynecology*, *29*(6), 551–557. https://doi.org/10.1016/j.jpag.2016.05.006

[26] Conte, F., Banting, L., Teede, H. J., & Stepto, N. K. (2015). Mental Health and Physical Activity in Women with Polycystic Ovary

p-ISSN: 2089-6778
e-ISSN: 2549-5054

Syndrome: A Brief Review. *Sports Medicine*, *45*(4), 497–504. https://doi.org/10.1007/s40279-014-0291-6

[27] Butt, M. S., Saleem, J., Zakar, R., Aiman, S., Khan, M. Z., & Fischer, F. (2023). Benefits of physical activity on reproductive health functions among polycystic ovarian syndrome women: a systematic review. *BMC Public Health*, *23*(1), 1–9. https://doi.org/10.1186/s12889-023-15730-8