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The influence of diet on polycystic ovary syndrome

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Abstract

Background: Polycystic ovary syndrome (PCOS) is a common endocrinopathy in women in reproductive age. It is estimated that it affects about 5-10% of women aged 18-44. This disease is associated with reproductive dysfunction and metabolic disorders. According to the American Society for Reproductive Medicine (ASRM) 2018 guidelines, the first line treatment for PCOS are lifestyle

adjustments, including dietary control and exercise. Hence a lot of research on the diet that is most appropriate for this group of people.

Material and methods: PubMed research base was searched using the following keywords: diet, pcos, policystic ovary syndrome in 2017-2021.

Results: The diet of women with PCOS is poorly composed, and dietary errors may affect the metabolic disorders occurring in these patients. Women with PCOS tend to have insufficient intakes of vitamin D, fiber, and vitamin B9, as well as excessive sodium intake. Mediterranean, ketogenic, low-carbohydrate, low-glycemic, low-AGE and pod-based diets positively affect this disease in various ways.

Conclusions: PCOS is a very diverse disease that affects a large number of women around the world. Changing your lifestyle, including diet and exercise, is the first line treatment. This is why creating the best diet for these patients is extremely important. Current discoveries are very promising and give hope to create a model of nutrition that will be the best for these women. Large, multicentre randomized trials are still needed to develop diets that are appropriate for different patients because the disease picture is heterogeneous.

Key words: diet, policystic ovary syndrome, bmi

Admission:

Polycystic ovary syndrome (PCOS) is a common endocrinopathy of women in childbearing age that is associated with reproductive dysfunction and metabolic disorders. It is the leading cause of anovulation-related infertility. It is estimated that it affects about 5-10% of women in reproductive age [1]. The average age of women with this condition is 18-44 years. The disease is complex and heterogeneous. Patients have numerous cysts (at least over 12) of about 8mm in size in their ovarian sacs. For this reason, 70% of women are infertile. Acne and hirsuthism caused by elevated levels of androgens often occur alongside this endocrinopathy. Moreover, there is also an insulin resistance which causes obesity and type 2 diabetes, leading to infertility. In this disease, patients may experience sleep apnea, depression or anxiety [2]. The adipose tissue of sick women differs from the healthy population. Adipocytes produce lesser amounts of adiponectin, which is an insulin sensitiser. Dyslipidemia with high TG and low HDL cholesterol is common [3]. According to the 2018 American Society for Reproductive Medicine (ASRM) guidelines, first-line treatment for PCOS is lifestyle adjustment, including dietary control and physical activity [4]. Research confirms that lifestyle changes (diet, physical activity, behavioral interventions) are extremely important in this syndrome, since they can affect BMI or the rate of free androgens in these women [5].

Material and methods:

PubMed research database was searched using the following keywords: diet, pcos, policystic ovary syndrome in: 2017-2021.

Results:

The research of M. Szczuko et al. (2017) conducted on 54 women with diagnosed according to the Rotterdam criteria, PCOS related to their diet. 54 women with diet-related PCOS according to Rotterdam criteria. With help of three types of scoring tests (Szewczyński's diet classification, Bielińska's test with Kulesza's modification and the healthy diet index), 216 menus were qualitatively assessed on the basis of -analysis of 3-day food diaries and nutritional records from the last 24-hour nutritional interview. It has been shown that most diets were incorrectly composed. Dietary errors in women with PCOS cause metabolic disorders that affect the symptoms of the disease [6].

In the studies of A. W. Lin et al. (2019) comparing the diets and physical activity of women with and without PCOS, it turned out that patients have a similar diet and amount of exercise to healthy people. Women with PCOS tend to have insufficient intakes of vitamin D, fiber, and vitamin B9, as well as excessive sodium intake. Moreover, it has been found that –current lifestyle recommendations for people with PCOS are achievable. The role of nutrition specialists was also emphasized to help women make appropriate and informed nutrition decisions [7].

Developing the optimal diet for women with PCOS is of paramount importance as it could help millions of PCOS patients. On the other hand, nutritional manipulation is one of the most frequently used treatments that affect health [8].

The Mediterranean diet (MedDiet) is characterized by plenty of vegetables, fruits, legumes, grain products (including whole grain bread), nuts and seeds, and extra virgin olive oil (the main source of fat). Additionally, low / moderate consumption of dairy products, fish, poultry and eggs is noticeable, as well as low consumption of red meat and moderate wine consumption. This diet is characterized by a low consumption of saturated fatty acids, which is about 10% of the energy supplied. However, it is rich in vitamins, unsaturated fatty acids and phenolic compounds of plant origin with antioxidant and anti-inflammatory properties. In the review by M. Mirabelli et al. (2020) it was noted that this type of nutrition may have a beneficial effect on the condition of women with PCOS, especially on the regularity of menstruation, blood pressure, glucose homeostasis, lipid profile and cardiovascular risk. Resveratrol, which is present in grape seeds, red wine, and some berries, may alleviate the hyperandrogenic symptoms of this disease [9].

L. Barrea at al. (2019) conducted a 7-day observational study on 112 PCOS-untreated women and 112 controls on the Mediterranean diet. Less diet adherence was noted in the research group as well as lower consumption of extra virgin olive oil, legumes, fish and nuts compared to healthy women. Eating pattern of patients was characterized by high consumption of simple carbohydrates, saturated fatty acids and low consumption of complex carbohydrates, fiber and unsaturated fatty acids. It correlated with more severe hyperandrogenemia, inflammation, and insulin resistance. Extra virgin olive oil contains oleocanthal, which is recognized as a powerful anti-inflammatory compound. Therefore, its long-term consumption may slow down progress of the inflammatory process, which will have a positive effect on insulin sensitivity. There is evidence that following the Mediterranean diet is inversely related to obesity, insulin resistance, risk of developing type 2 diabetes and cardiovascular disease. What makes this diet one of the best treatment options for women with PCOS [10].

The ketogenic diet is a diet in which carbohydrate intake is less than 30g per day / 5% of total energy intake, protein levels are in line with demand, and fat levels are high. During the limiting of carbohydrate consumption, insulin levels fall and glucagon levels rise to maintain normal blood glucose levels. First, glycogen stores are used, followed by β-oxidation of fatty acids. The decrease of insulin level, and therefore IGF-1, leads to the inhibition of the production of androgens. In addition, hyperglycaemia may exacerbate inflammation, and glucose has been reported to induce an inflammatory response in PCOS patients regardless of body weight.

A 12-week study by A. Paoli et al. (2020) on a low-calorie ketogenic diet in 14 women with diagnosed PCOS showed improvement in almost all anthropometric, biochemical and hormonal variables. The mean value of 3-hydroxybutyrate (the main index of ketosis) in the women studied from days 7 to 84 was 1.77 ± 0.55 mmol / L, which is normal for physiological ketosis (eg, fasting, ketogenic diet). In patients, the mean weight loss was 9.43 kg, 8.29 kg of which was adipose tissue, and the lean body mass was only slightly reduced. Insulin resistance was significantly reduced (below the HOMA-IR threshold: 2.5). There was also a significant decrease of cholesterol, triglycerides, androgens, LH and LH / FSH levels, what suggests an improvement in the hormonal status. Results of the study show that the use of a following ketogenic diet may be helpful in the treatment of PCOS [11].

LCD is a diet that reduces carbohydrate intake to <45% of total daily caloric consumption. Meta-analysis by X. Zhang et al. (2019) indicates that LCD can significantly lower both BMI and serum TC

and LDL-C levels in PCOS patients. In combination with long-term (> 4 weeks) and low-fat (<35%) use, it can lead to an increase in of FSH and SHBG levels and a decrease in of testosterone levels. As with the ketogenic diet, it has been found that this diet reduces IGF-1 levels, which may alleviate symptoms of hyperandrogenism. The loss of body weight itself, on the other hand, is associated with a reduction in the amount of adipose tissue, which leads to a decrease in the conversion of estrogens to androgens. This meta-analysis showed that LCDs can at least partially restore insulin sensitivity, which counteracts disturbances in both glucose metabolism and the reproductive system. This suggests that this diet may be a good aid in the treatment of PCOS symptoms [12].

There are reports that diets with a low glycemic index may delay the absorption of carbohydrates, improve metabolic pathways and affect insulin resistance. Hence, there are attempts to use it in patients with PCOS. A study by F. Shishehgar et al. (2019) on the effect of a low-calorie diet additionally with limited energy (500 kcal deficit) revealed its positive effects on anthropometric and metabolic traits in women with PCOS. In patients after 6 months of dieting, menstrual cycles have improved (in 80% of respondents), and the features of hyperandrogenism were less pronounced (in 32% there was a decrease in the incidence of acne). Improvement was also seen for a weight loss of 8.04% of the starting weight. Fasting insulin level also decreased, and HOMA-IR was -0.83 ± 0.33. There was a decrease in total testosterone concentration by 0.91 ± 0.33 nmol / l, FAI - −4.47 ± 1.1, and an increase in SHBG concentration of 38.98 ± 11.02 nmol / l was noted. These reports are promising in the nutrition of women with PCOS [13].

M. Szczuko et al. (2017) also studied the effects of a low glycemic index diet on 24 women with PCOS. As well increased expression of 5-LOX has been associated with obesity, atherosclerosis and insulin resistance. As a result, there is an increased synthesis of inflammatory mediators (arachidonic acid and linoleic acid derivatives). In this study, however, it was noted that the level of mediators was lower in women with PCOS than in the control group. This may be due to the fact that these mediators are used in repair responses or in the chronic inflammatory process. It has been found that in women with PCOS with low or high levels of androgens, the metabolic pathways of proinflammatory factors do not differ substantially. On the other hand, after 3 months of dieting in women with PCOS, the level of inflammatory mediators increased, which means that there was an increase in activity or activation of dormant repair processes. This suggests that a balanced diet with an appropriate amount of unsaturated fatty acids may reactivate the synthesis pathways and repair processes to a level similar to that in healthy people [14].

The Maillard reaction is a series of chemical reactions that occur between amino acids and reducing sugars when exposed to heat. Protein glycation is a post-translational modification, thanks to which we obtain temporary adducts, which after further reactions are called AGE - advanced end products of glycation. Cooking, baking, frying, grilling contribute to the high level of AGE in various food. It has been reported that this has a detrimental effect on the body. Review by V. Gill et al. (2019) reports that these compounds also affect PCOS. Women with this condition on a high AGE isocaloric diet had higher levels of serum AGE, testosterone, insulin, and oxidative stress compared to women on a low AGE diet. Thus, changes in nutrition and the way it is cooked can contribute to changes in the course of PCOS and its symptoms. In women with PCOS with insulin resistance, but without hyperglycemia, it has been noticed that as serum AGE increases, the level of RAGE also increases. The AGE-RAGE interaction influences steroidogenesis in the reproductive organs of patients with PCOS. These studies provide a new insight into the pathomechanism of this disease and are a promising target for possible dietary changes in these women [15].

The pulse-based diet consists of plants that are high in fiber, have low glycemic index, and are low in fat and high in protein. It has been reported that this diet may be associated with positive effects on metabolism, such as lowering postprandial glucose and insulin levels, lowering cholesterol, blood pressure and obesity. This action could positively affect women with PCOS. The TLC diet, on the other hand, focuses on increasing fiber intake and decreasing saturated fatty acids and cholesterol, which is designed to lower LDL-C levels and improve cardiovascular disorders. In the study by M. Kazemi et al. (2018) comparing effects of these diets (in combination with aerobic exercise, without the need for energy restriction) on women with PCOS, found that a pulse-based diet is more beneficial

in improving insulin response in OGTT. Effects on TG, LDL-C, HDL-C levels, TC / HDL-C ratio, and diastolic blood pressure may reduce the risk of cardio-metabolic and type 2 diabetes in women with PCOS. That is why lifestyle modifications are so important in this case [16].

Review K. P. Hamilton et al. (2019) reports on the valuable properties of magnesium present in the diet of women with PCOS. It has been found that supplementation with this element may lower insulin resistance. However, there is some doubt as to whether this is due to magnesium alone or by diet, so more research is needed on this topic. However, it offers a chance for a viable treatment option for this disorder through the supplementation of micronutrients [17].

However, it should be remembered that women with PCOS are more likely to suffer from depression and anxiety. The mechanism is not fully understood, but it may be influenced by metabolic changes and problems with getting pregnant. According to the research of G. Jiskoot et al. (2020) weight loss only affects self-esteem in these women, not depression and body image. Therefore, apart from nutrition, these women should also be mentally conditioned [18].

Conclusions:

PCOS is a very diverse disease that affects large number of women around the world. Changing your lifestyle, including diet and exercise is the first line treatment. So creating the best diet for these patients is extremely important. The current discoveries are very promising and give hope to create a model of nutrition that will be the best for these women. Large, multicentre randomized trials are still needed to develop diets that are appropriate for different patients because the disease picture is heterogeneous.

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