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Eating habits among women with polycystic ovary syndrome (PCOS) on a vegetarian vs non-vegetarian diet

OLIWIA PIETRASIŃSKA[1, B–F], KLAUDIA WIŚNIEWSKA[2, A], KATARZYNA OKRĘGLICKA[2, A]
ORCID ID: 0000-0003-0500-4097 ORCID ID: 0000-0002-6215-0106

[1] Student Scientific Circle Hygiene and Prevention, Department of Social Medicine and Public Health, Medical University of Warsaw, Warsaw, Poland
[2] Department of Social Medicine and Public Health, Medical University of Warsaw, Warsaw, Poland

A – Study Design, **B** – Data Collection, **C** – Statistical Analysis, **D** – Data Interpretation, **E** – Manuscript Preparation, **F** – Literature Search, **G** – Funds Collection

Summary **Background.** Polycystic ovary syndrome (PCOS) is the most diagnosed endocrine disorder among women of reproductive age. Dietary intervention is recommended as first-line treatment of PCOS. The type of diet (vegetarian or non-vegetarian) and daily eating habits can play a key role in the treatment of this disease.
Objectives. The study aims to assess the eating habits of women suffering from PCOS following vegetarian and non-vegetarian diets.
Material and methods. The study was conducted from January to March 2022 among 233 women between the age of 19 to 57. The research tool was a website survey questionnaire with single choice and open questions on eating habits, age, weight, height, place of residence and education. The data obtained was subjected to statistical analysis using the chi-squared test. Results were considered significant at $p \leq 0.05$.
Results. Vegetarians were observed to eat more vegetables than the rest of the women. Over a quarter of these women's diets included legumes at least once a day compared to the respondents following a traditional diet ($n = 4$; 3.9%) and those not on any diet ($n = 2$; 5.3%). Both health condition and nutrition were better assessed by vegetarians. More than half of the study participants, apart from PCOS, also struggled with insulin resistance. The non-vegetarian group had a greater percentage of patients suffering from both issues.
Conclusions. Women with polycystic ovary syndrome who follow a vegetarian diet often have better eating habits than non-vegetarian. These results suggest that plant-based diets may be effective in treating PCOS. However, information on this is limited, particularly in Poland.
Key words: feeding behavior, polycystic ovary syndrome, diet, vegetarians.

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Background

Polycystic ovary syndrome (PCOS) is the most common female endocrinopathy, affecting 15% to 18% of females in childbearing age [1]. The name of the disease refers to the characteristic image of the ovaries in a gynaecological ultrasound (USG), in which there are many vesicles [2]. PCOS belongs to the group of diseases associated with hormone dysfunction by endocrine glands in the human body.

Criteria for the diagnosis of polycystic ovarian syndrome were established in 2004 by a group of experts at a conference in Rotterdam. To confirm the diagnosis of the above-mentioned disease, two of the following three criteria must be met:

- oligo-ovulation (rare ovulation) or anovulation;
- clinical and/or biochemical symptoms of hyperandrogenism. Frequent clinical manifestations of hyperandrogenism are hirsutism and acne;
- ultrasound image of polycystic ovaries, i.e. the presence of at least 12 follicles in each ovary with a diameter of 2 to 9 mm and/or an enlarged volume of the ovary (at least 10 cm^3).

Additionally, other possible causes of the problem (such as congenital adrenal hyperplasia, androgen-secreting tumours, or Cushing's syndrome) should be excluded [3].

The aetiology of polycystic ovary syndrome is not fully understood, although the mechanism for the development of the disease is known to be complex. It is influenced by genetic, endocrine, metabolic and environmental factors. The concomitance of excess body weight, unhealthy lifestyle and early maturation are risk factors for the occurrence of this disease [4]. Moreover, women with PCOS have a significantly higher risk of obesity, dyslipidaemia, impaired glucose tolerance, long-term complications, such as type 2 diabetes, endometrial cancer and cardiovascular disease, compared to the general population [5].

The assessment of the nutritional habits of patients is very important, because it was found that the type of diet, including particular groups of food products or nutrients, has an impact on the risk of disease development or progression [6]. Nutritional counselling for people with PCOS has been one of the most important methods of treatment for many years. The diet is crucial in the course of PCOS, and lifestyle change should be the first line of treatment. Maintaining a normal body weight, systematically undertaking physical activity, adhering to healthy eating patterns and avoiding smoking are crucial in the prevention and treatment of hormonal disorders [1].

Both Polish and foreign recommendations assign a key role to weight control in patients with a normal body mass index (BMI) and the reduction of excessive kilograms in the case of women with a BMI above 25 kg/m^2 [7, 8].

At the moment, no specific nutrition model has been developed that should be used in the prevention and treatment of PCOS. For years, however, experts have considered many nutritional interventions that could be helpful in treating this disease. According to the international evidence-based guide-

lines, it is known that the general principles of healthy eating should be followed for all women with PCOS following the recommendations of individual countries [9]. However, different dietary models are being considered which could benefit those affected. These are mainly: the Mediterranean diet, the low glycaemic index diet and the anti-inflammatory diet.

The solution according to the Mediterranean diet is sought mainly because it is rich in complex carbohydrates, fibre or monounsaturated fatty acids that reduce oxidative stress and inflammation in the body. Moreover, there is evidence that relying on the Mediterranean diet is inversely associated with the development of obesity, insulin resistance, type 2 diabetes and cardiovascular disease. Considering the close relationship between PCOS and obesity, chronic inflammation and insulin resistance, it seems likely that this may be one of the optimal non-pharmacological strategies for the treatment of PCOS [6, 10].

Another position in the treatment of this disease is occupied by an anti-inflammatory diet. This also includes the above-mentioned consumption of products with a low glycaemic index and glycaemic load, low content of omega-6 fatty acids and a high content of omega-3 and polyphenols. It is also characterised by a reduced amount of red and processed meat, low in sugar and saturated fatty acids [11].

In polycystic ovary syndrome, the antioxidant capacity is reduced. There is evidence that the diet should be rich in antioxidants that inhibit free radicals from damaging the body's cells [12]. For example, one study examined adult women with PCOS with excessive body weight. They complied with the rules of the Mediterranean diet, which has a low glycaemic load, is low in saturated fatty acids, moderate or high in fibre and is adjusted for the energy deficit. Such nutrition led to a moderate decrease in body weight and a significant improvement in body composition, as well as regulation of hormone concentration, glucose and menstrual cycles [13].

Although there is no preestablished optimal model of nutrition for PCOS based on the above arguments and studies, the diet should be varied, low-processed, rich in antioxidants, preferably based on products with a low and medium glycaemic index and glycaemic load.

A model of nutrition worth considering among people struggling with polycystic ovary syndrome is a vegetarian and vegan diet. This could be beneficial in the treatment process due to its anti-inflammatory properties.

By assumption, this diet contains large amounts of vegetables and fruits and is therefore rich in antioxidants. In a properly balanced, plant-based diet, the source of protein should mainly be legumes, characterised by a low glycaemic index and a high content of fibre. What is more, they contain a lot of vitamins and minerals. Moreover, the vegetarian diet excludes meat, including processed meat, which contains unfavourable saturated fatty acids and trans fatty acids [14]. A few studies indirectly confirm the positive influence of vegetarian diets on the course of PCOS [15–18]; however, there are still no specific recommendations to support this view. Therefore, it is appropriate to consider the use of a vegetarian or vegan diet for those with polycystic ovarian syndrome mainly due to the above-mentioned characteristics.

The study aims to assess the eating habits of women suffering from PCOS following vegetarian and non-vegetarian diets.

Material and methods

The combination of own questions and a self-administered version of the KomPAN® questionnaire were used to thoroughly analyse the eating habits of women suffering from PCOS, also taking into account their type of diet and lifestyle.

The KomPAN® questionnaire contains 4 sections: dietary habits (11/11 questions were analysed), food frequency consumption (33/33 questions were analysed), nutrition beliefs (0/25 questions were analysed because own statements were used), lifestyle and personal data (27/30 questions were analysed). In presented study, questions concerning the behaviour and eating habits, the frequency of meals, the subjective frequency of eating snacks, the consumption of vegetable meat and dairy substitutes, the frequency of meat consumption and stimulants used and the type and amount of physical activity were analysed [19]. Moreover, there were questions concerning anthropometric parameters (body weight and height, waist circumference), as well as questions related to socio-demographic characteristics.

The survey was carried out in Poland from January to March 2022. The questionnaire was completed by 356 individuals. Incomplete data was rejected, and finally, 233 participants aged 19–57 were enrolled in the study.

The exclusion criteria were being under 18 years of age, body mass index (BMI) below 18, anorexia, bulimia, malnutrition, severe diseases (alcoholism, severe and extensive surgery, kidney failure), cancer in the last 5 years, as well as the use of enteral and parenteral nutrition. Inclusion criteria were age and BMI over 18 and being diagnosed with PCOS. The study participants were women who voluntarily consented to take a part in the study, which was announced on social media.

Statistical analysis was carried out with the use of the Statistica 10 program. The division of participants into three groups was introduced due to the type of diet: vegetarian, non-vegetarian and non-diet (this group included people who did not follow any specific diet) and was verified using the chi-square independence test. In all analyses, a significance level of $\alpha = 0.05$ was assumed.

Results

233 women with PCOS between 19–57 years of age with a BMI of 18.0–46.4 kg/m^2 were included in the study. The exact population data of the surveyed women is presented in Table 1.

Table 1. General description of the studied population

Number of participants	*n* = 233
Age (year) (age range)	19–57
BMI (kg/m^2) (BMI range)	18.0–46.4
Smoking (%)	25.3
Age groups (%)	
18–20 years	4.3
21–40 years	85.0
41–60 years	10.7
Physical activity (%)	
Low level	39.1
Middle level	48.5
High level	12.4
Commune size (%)	
< 10,000 inhabitants	8.5
10,000–20,000 inhabitants	5.2
20,001–100,000 inhabitants	15.9
> 100,000 inhabitants	70.4
Level of education (%)	
Under middle	0.9
Middle	26.6
High	71.6
Vocational	0.9
Type of diet (%)	
Non-vegetarian	44.2
Vegetarian	39.5
No-diet	16.3

Nutritional behaviours

It was observed that women on a vegetarian diet often consume less milk or milk drinks (*n* = 56; 60.2%) than people on

a traditional diet (n = 26; 25.5%) and people who do not follow any diet (n = 4; 10.5%) ($p < 0.001$). The variable was compared with another question in the questionnaire regarding the dairy alternatives consumed (for example drinks, yogurts, vegetable spreads). Vegans and vegetarians were by far the most likely users, and 78 (83.8%) of them answered that they eat them once a week or more. All people on a vegetarian diet included such products in their diet. The data is presented in Tables 2 and 3.

The frequency of consumption of legumes was also examined. It was shown that 24 (25.8%) of the vegetarians included legumes at least once a day. This was higher than in the respondents undertaking a traditional diet (n = 4; 3.9%) and those not on any diet (n = 2; 5.3%) ($p < 0.00$. There were no significant differences between the groups in the frequency of consumption of fast food. Fast food was eaten more than once a week by 11 (29.0%) of the women who were not on any diet, 23 (24.8%) of the respondents on a vegetarian diet and 20 (19.6%) people on a traditional diet (p = 0.06). It also turned out that vegetarians consumed more vegetables than the rest of the respondents. 70 (75.3%) of them answered the question about the frequency of their vegetable consumption "several times a day". The result was quite high compared to women who did not follow any diet (n = 23; 60.5%) and those who were on a traditional diet (n = 52; 51.0%) (p = 0.005). In turn, over 50% (n = 53) of the respondents on a traditional diet stated that they do not drink any sweetened drinks such as Sprite, Coca Cola, Pepsi or Fanta, while this answer was marked by 34 (36.6%) vegetarians and 8 (21.1%) non-dieters (p = 0.038).

Nutritional knowledge and attitude to plant-based products

The next part of the survey referred to attitudes towards plant-based diets. As many as 76 (81.7%) of the vegetarians stated that plant-based meat substitutes (for example vegetable cutlets, sausages, burgers, meatballs, schnitzels, nuggets) are a wholesome alternative to meat products for them. In turn, 60 (58.8%) of the women on a traditional diet and 22 (57.9%) of the respondents not on a diet rejected this opinion ($p < 0.001$). Very similar results were obtained when it came to plant-based dairy substitutes. The data is presented in Table 4.

To test the nutritional knowledge of the study, participants were asked if they agree with the statement that the consumption of legumes, soy-beans, and its preserves has an influence on PCOS symptoms. The results related to consumption of legumes and their impact on PCOS were statistically insignificant (p = 0.07). However, the results regarding the consumption of soybean and its preserves were statistically significant. 49 (52.7%) of women on a plant-based diet, 38 (37.3%) of respondents on a traditional diet, 9 (23.7%) of people who do not follow any diet ($p < 0.001$) agreed with the sentence: "consumption of soybean and its preserves is recommended among people suffering from PCOS", which means that they answered correctly.

Physical activity, sleep habits and self-assessment of nutrition

The next part of the questionnaire dealt with the amount of sleep, physical activity and well-being. The results related to movement and sleep were statistically insignificant (p = 0.07). On the other hand, people who included meat in their diets were more likely to define their health as bad or very bad. 35 (34.4%) of the women on a traditional diet and 9 (23.7%) of those not on a diet indicated such answers. In turn, only 13 (14%) of the vegetarians described their health in this way. The rest (n = 80; 86.0%) considered their health as good (n = 66; 71%) or very good (n = 14; 15%). This variable was compared

Table 2. The type of milk

	Diet				
		Non-vegetarian (n = 102)	Vegetarian (n = 93)	No diet (n = 38)	p
What kind of milk and milk drinks do you consume most often?	I do not consume milk or milk drinks	26 (25.5%)	56 (60.2%)	4 (10.5%)	$p < 0.001$
	Fat-free milk	1 (1%)	1 (1.1%)	0 (0%)	$p < 0.005$
	Low-fat milk	52 (51%)	27 (29%)	25 (65.8%)	$p < 0.001$
	Full-fat milk	23 (22.5%)	9 (9.7%)	9 (23.7%)	$p < 0.001$

Table 3. Frequency of consumed plan – based dairy

	Diet				
		Non-vegetarian (n = 102)	Vegetarian (n = 93)	No diet (n = 38)	p
How often do you eat dairy alternatives (for example: soy and coconut yoghurts, plant-based milk, vegetable spreads)?	Never	33 (32.4%)	0 (0%)	12 (31.6%)	$p < 0.001$
	1–3 times a month	25 (24.5%)	15 (16.1%)	8 (21.1%)	$p < 0.001$
	Once a week	9 (8.8%)	11 (11.8%)	4 (10.5%)	$p < 0.001$
	A few times a week	20 (19.6%)	32 (34.4%)	10 (26.3%)	$p < 0.001$
	Once a day	8 (7.8%)	19 (20.4%)	3 (7.9%)	$p < 0.001$
	Several times a day	7 (6.9%)	16 (17.2%)	1 (2.6%)	p = 0.003

Table 4. Attitude to plant – based products

	Diet				
		Non-vegetarian (n = 102)	Vegetarian (n = 93)	No diet (n = 38)	p
Plant-based substitutes for dairy products (e.g. soy and coconut yoghurts, plant milks, vegetable spreads) are a full-fledged alternative (equivalent) to dairy products for me	Yes	55 (46.1%)	78 (83.9%)	20 (52.6%)	$p < 0.001$
	No	47 (53.9%)	15 (16.1%)	18 (47.4%)	$p < 0.001$

Table 5. Self-assessment of the nutrition

	Diet				
		Non-vegetarian (n = 102)	Vegetarian (n = 93)	No diet (n = 38)	p
How do you rate your diet?	Very Good	8 (7.8%)	16 (17.2%)	2 (5.3%)	$p < 0.001$
	Good	62 (60.8%)	64 (68.8%)	18 (47.4%)	$p < 0.001$
	Bad	26 (25.5%)	13 (14%)	18 (47.4%)	$p < 0.001$
	Very Bad	6 (5.9%)	0 (0%)	0 (0%)	$p < 0.001$

Table 6. Diagnosed diseases

	Diet				
		Non-vegetarian (n = 102)	Vegetarian (n = 93)	No diet (n = 38)	p
What disease(s) have you been diagnosed with?	Polycystic ovary syndrome	34 (33.3%)	55 (59.1%)	15 (39.5%)	$p < 0.001$
	Polycystic ovary syndrome and insulin resistance	68 (66.7%)	38 (40.9%)	23 (60.5%)	$p < 0.001$

with the next question in the questionnaire regarding the evaluation of one's diet. 80 (86%) of the vegetarians defined it as good or very good. The exact data is shown in Table 5.

Body Mass Index

Based on the data concerning the height and weight of the respondents, BMI was calculated. The results proved that women eating plant-based foods (n = 45; 48.9%) most often had the correct body weight compared to those following a traditional diet (n = 37; 36.5%) and those not following any diet (n = 6; 14.6%). Among people on a traditional model of nutrition 56 (55.1%) had a BMI over 24.9 kg/m^2, which means overweight or obese. Only 7 (19.1%) of those who were not on a diet and 24 (25.8%) of the vegetarians had a problem with excessive weight (p = 0.016).

Comorbidities

The relationship between polycystic ovarian syndrome and additional accompanying diseases was also examined. It was shown that over half of the respondents (n = 129; 55.4%), in addition to PCOS, also struggled with insulin resistance. Of the women on a traditional diet, a majority had both of the aforementioned diseases entities. The data is presented in Table 6.

Discussion

To the best of our knowledge this is the first study that is focused on this issue in Poland. For the first time, we present a Polish study evaluating the eating habits of women suffering from polycystic ovary syndrome with different models of nutrition (vegetarian and non-vegetarian). The study described in this text has shown that there are noticeable differences between the daily diet of vegetarians and non-vegetarians. Moreover, women eating more plant-based diets more often had normal body weight and less often suffered from concomitant diseases. According to an Iranian study [18], it was assumed that a vegetarian type of diet probably has a positive impact on the course of the disease. Two eating patterns were studied there – the first one was similar to a vegetarian diet, and the second one was similar to a meat diet. It was shown that a more vegetarian diet was associated with a lower risk of PCOS among the sample of Iranian women. In turn, the second diet was positively associated with a risk of PCOS.

Our study shows that the BMI of vegetarians was more often better than that of non-vegetarian women. Such a result was not obtained by in a study by Ganie et al., and there were no clear differences in body mass index between the two groups [20].

The results of our study show that more women on a non-vegetarian diet suffer from both PCOS and insulin resistance than among vegetarians. Similar conclusions were reached by Turner-McGrievy et al. Accoriding to his study 36.3% of vegans suffering from PCOS simultaneously suffered from insulin resistance, whereas among people on traditional diet there were 40.74% suffering with both diseases [17].

Moreover, the results of this study showed that vegetarians consume higher amount of legumes everyday compared to people on a non-vegetarian diet. This can be combined with the pulse-based diet found in several studies. Its characteristic feature is the consumption of a large number of legumes per day. One study used this nutrition model to improve or maintain insulin sensitivity. Additionally, it has been shown that this diet reduces the risk of developing cardiometabolic diseases in women with PCOS [10, 21]. Although there were slight differences when comparing our results to result of other authors, the overall conclusions were alike. There are still very few studies addressing dietary habits and the type of diet in PCOS. This supports the fact that analysis of this topic is very important and may determine the direction of further deliberations. In subsequent attempts, it would be worth expanding the size of the research group so that the results could be more accurate. Focusing primarily on the role of a vegetarian and vegan diet in women with diagnosed polycystic ovary syndrome could provide a new perspective concerning nutrition recommendations. Additionally, given the complexity of the problems in PCOS, it could be helpful from the point of view of a clinical dietitian working with patients.

Conclusions

In conclusion, the study showed that women diagnosed with PCOS who are on a plant-based diet are more likely to have better eating habits than those who are on a traditional diet or do not follow any diet. In addition, vegetarians are more likely to have normal BMI and are less likely to struggle with the associated disease of insulin resistance. The results confirm that a vegetarian diet can be a helpful and effective tool to improve the health and well-being of women struggling with polycystic ovarian syndrome. However, there is still too little research to explicitly state that the plant-based nutrition model is a better solution for the described disease than the traditional model.

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Address for correspondence:
Oliwia Pietrasińska, BSc
Studenckie Koło Naukowe Higieny i Profilaktyki
Zakład Medycyny Społecznej i Zdrowia Publicznego
Warszawski Uniwersytet Medyczny
ul. Oczki 3
02-007 Warszawa
Polska
Tel.: +48 668 131-950
E-mail: o.pietrasinska@gmail.com