



# Evaluation of dietary behaviours and physical activity of Polish women with endometriosis

Ocena zachowań żywieniowych i aktywności fizycznej polskich kobiet cierpiących na endometriozę

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## Abstract

**Introduction and Objective.** Endometriosis (EM) is a chronic inflammatory disease for which pharmacological treatment does not always give the desired results. The importance of diet in the course of the disease is increasingly highlighted. The aim of the study was to evaluate the nutritional behaviour and physical activity of women with EM and the influence of the abovementioned factors on the specific symptoms of the disease.

**Materials and Method.** A cross-sectional study was conducted using an online questionnaire-based survey. The questionnaire was posted on social media groups related to endometriosis and diet, obtaining 230 responses. Correlations between variables were examined using Spearman's rank correlation coefficient. The significance of differences between the independent groups was tested using the Mann-Whitney U test.

**Results.** According to the survey, 64.8% of women participating in the study adhered to a diet because of EM. The most frequent changes in nutritional habits were reduction in the consumption of sugar and sweets, and resignation from fast foods. There were significant differences between the group of women adhering to a diet, and the group of women not adhering to a diet in the consumption of products such as red meat, fish, milk and dairy products, legumes, white bread, gluten-free bread, seeds and nuts, gluten-free groats, cereals, fruits, vegetables, sweetened beverages, and fruit juices. Following dietary changes, 83.9% of the women reported an improvement in at least one of the endometriosis symptoms.

**Conclusions.** The study proves that women with EM seek relief through dietary modifications, with the majority experiencing improvements in symptoms and well-being after making the changes. Further research is required to establish what kind of a diet and what type of products are the most efficient in alleviating the symptoms of endometriosis.

## Key words

diet, endometriosis, life style, nutrition, Polish women

## Streszczenie

**Wprowadzenie i cel pracy.** Endometrioza jest przewlekłą chorobą zapalną, której leczenie farmakologiczne nie zawsze przynosi pożądane rezultaty. Coraz częściej podkreśla się znaczenie diety w przebiegu tej choroby. Celem badania była ocena zachowań żywieniowych i aktywności fizycznej kobiet cierpiących na endometriozę oraz wpływu tych czynników na specyficzne objawy choroby.

**Materiał i metody.** Badanie przekrojowe przeprowadzono za pomocą ankiety internetowej. Kwestionariusz został zamieszczony w mediach społecznościowych na grupach związanych z endometriozą i dietą. Uzyskano 230 wypełnionych ankiet. Korelacje między zmiennymi badano za pomocą współczynnika korelacji rang Spearmana, a istotność różnic pomiędzy niezależnymi grupami za pomocą testu U Manna-Whitneya.

**Wyniki.** Jak wynika z przeprowadzonego badania, 64,8% respondentek stosowało dietę z powodu endometriozy. Najczęściej dokonywanymi zmianami nawyków żywieniowych było ograniczenie spożycia cukru i słodczy oraz rezygnacja z żywności typu fast food. Pomiędzy grupą kobiet stosujących dietę a grupą kobiet niestosujących diety stwierdzono istotne różnice w spożyciu takich produktów jak: czerwone mięso, ryby, mleko i produkty mleczne, rośliny strączkowe, białe pieczywo, pieczywo bezglutenowe, nasiona i orzechy, kasze bezglutenowe, płatki zbożowe, owoce, warzywa, napoje słodzone i soki owocowe. Po wprowadzeniu zmian w diecie 83,9% kobiet zgłosiło poprawę co najmniej jednego z objawów endometriozy.

**Wnioski.** Badanie dowodzi, że kobiety cierpiące na endometriozę szukają ulgi w dolegliwościach za pomocą odpowiedniego odżywiania, a większość z nich po wprowadzeniu zmian doświadcza złagodzenia objawów i poprawy samopoczucia. Konieczne są dalsze badania w celu ustalenia, jaki rodzaj diety i które produkty są najbardziej skuteczne w łagodzeniu objawów endometriozy.

## Słowa kluczowe

dieta, odżywianie, styl życia, endometrioza, Polki

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## INTRODUCTION

Endometriosis (EM) is a chronic gynaecological disease [1]. Occurrence in the endometrium – the uterine mucosa, consisting of stromal cells and glandular cells outside the uterine cavity – is typical in this condition [2]. The etiology of the disease is controversial and not fully understood. Genetic, immunological, hormonal, and environmental factors contribute to development of the disease [3]. The most common symptoms of endometriosis is painful menstruation, pelvic pain, dyspareunia and infertility. In each menstrual cycle, ectopic endometrial tissue triggers the activation of macrophages and pro-inflammatory cytokines, including tumour necrosis factor  $\alpha$  (TNF- $\alpha$ ), IL-1, IL-6, and IL-8. Repeated tissue damage with local inflammation, angiogenesis and neurogenesis, may result in painful symptoms, even causing chronic pain [4]. Conventional treatment methods often do not give satisfactory effects and women often search for relief in the diet.

The role of nutrition in endometriosis became the object of interest of scientists due to the observations that processes connected with the disease, such as inflammation, hormonal activity, menstrual cycle or metabolism of prostaglandins, may be modified by diet [5]. In recent years, many researchers have evaluated the effect of nutrition on endometriosis, focusing mainly on the risk of the disease; however, there are some studies on the role of diet on the course of the disease [6]. Supplementation with a composition including quercetin, curcumin, parthenium, nicotinamide, 5-methyltetrahydrofolate and omega-3/6 demonstrated significant reduction of pain symptoms in the EM patients in the intervention group compared to controls. Moreover, a significant reduction in serum concentrations of prostaglandin E2 and carbohydrate antigen 125 (CA-125) was observed [7]. Another study showed that dietary intervention including supplementation of vitamins (B<sub>6</sub>, A, C, E), minerals salts (Ca, Mg, Se, Zn, Fe), lactic ferments and fish oil (omega-3/6) was equally effective in reducing non-menstrual pelvic pain as hormonal suppression therapy [8]. A diet high in antioxidants resulted in an increase in plasma vitamin concentrations and antioxidant enzyme activity, and decrease in oxidative stress markers [9]. Adherence to the Mediterranean diet also led to a decrease in pain symptoms [10]. Some of the studies focused on particular dietary components, such as fatty acids, vitamins and polyphenols. Research shows the potential protective role of polyunsaturated fatty acids (PUFA) [11–14]. As reported, omega-3 can alleviate the pain associated with EM, reduce lesion size and prevent infertility [15]. However, studies in women with EM did not show the advantage of supplementing PUFA or fish oil over placebo in decreasing the symptoms [15, 16]. Vitamins may affect oxidative stress, estrogen levels and prostaglandin metabolism. Studies report that supplementation with vitamins C and E decreases the level of inflammatory markers [17], reduces oxidative stress markers and the severity of pain, dysmenorrhea and dyspareunia. [18, 19]. A recently published meta-analysis suggests that vitamins may effectively decrease the pain symptoms in EM [20]. Vitamin D mainly plays a role in regulating blood calcium concentration and modulates metabolic reactions and immune response by decreasing the production of IL-17 and IL-6, reducing expression of VEGF- $\alpha$  genes and inhibiting the NF- $\kappa$ B pathway, which

may result in a decrease in the invasion and proliferation of endometriosis lesions. [21]. However, studies by Nodler and Almassionokiani showed no statistically important difference between the vitamin D supplementation group and placebo group [16, 22]. To the contrary, in a trial by Mehdizadehkashi, vitamin D supplementation resulted in decreased pelvic pain, decreased CRP, and increased total antioxidant capacity compared to placebo [23].

Resveratrol is a very promising compound in terms of mitigating endometriosis symptoms – a polyphenol, it has anti-inflammatory, anti-neoplastic, anti-oxidative and anti-angiogenic properties, processes that are strongly connected with endometriosis pathogenesis. Studies report that resveratrol supplementation may decrease TNF- $\alpha$ , the VEGF gene and protein expression, as well as inhibiting aromatase activity, COX-2 expression and pain symptoms [24].

Due to the limited number of studies and their heterogeneity, it is not possible to prepare specific nutritional guidelines for patients with endometriosis. However, based on a systematic review, the authors suggest that a properly balanced diet in endometriosis should focus on eliminating nutritional deficiencies common in patients with EM, the most frequently observed deficiencies being magnesium, iron, B vitamins, zinc, selenium and folic acid, as well as on eliminating excess estrogen, reducing inflammation, oxidative stress and exposure to estrogen derivatives such as phytoestrogens and xenoestrogens [21].

The aim of this study was to evaluate the nutritional behaviour and physical activity of Polish women with endometriosis, and the influence of the above-mentioned factors on the specific symptoms of the disease.

## MATERIALS AND METHOD

A cross-sectional study targeting Polish women with endometriosis was conducted by an online questionnaire-based survey. All interested women over 18 years of age diagnosed with EM had an opportunity to complete the questionnaire. Based on dietary behaviour, the study participants were divided into two groups: women who modified their diet because of EM and women who did not change their diet due to the disease. The study was observational in nature and participation was voluntary and anonymous. Therefore, it did not require the approval of the Bioethics Committee. The questionnaire was designed by the study authors based on a review of the related literature, and was pre-tested by 6 respondents to ensure comprehension and feasibility. Necessary adjustments were made, and the questionnaire was administered using the Google Forms tool. A link to the survey was placed in the Facebook groups associated with endometriosis and diet. The form accepted responses from 11–15 January 2021.

The questionnaire consisted of 47 questions divided into 3 sections. The first section focused on socio-demographic information, such as age, education level, place of residence, and history of the disease: time from diagnosis, stage of disease, predominant symptoms and number of symptoms. The second section was addressed to women who modified their diet because of endometriosis, and investigated changes in dietary patterns and their impact on the disease symptoms. Respondents were questioned about the following dietary modifications: reduction or elimination of consumption

of meat, animal products, milk and dairy, dairy products with lactose, eggs, products containing gluten, sugar and sweets, fast foods, soy and soy products, legumes, vegetables, fruits; increased consumption of legumes, vegetables, fruits, wholemeal products, fish and vegetable oils, as well as about implementation of fasting. The questionnaire also included an open 'other (please specify)' option with space for respondents to provide their own answer. Participants were then asked about the implications of dietary modification on the EM symptoms and other health effects.

The last section of the survey evaluated the frequency of consumption of particular products by all women participating in the study. Respondents were queried about their intake of the following products: read meat, white meat, fish, milk and dairy products, eggs, soy and soy products, legumes, white bread, wholegrain bread, gluten free bread, seeds and nuts, groats containing gluten, gluten free groats, cereals, white rice, brown rice, potatoes, fruits, vegetables, fruit juices, sweetened beverages, coffee, tea, alcohol and water.

For the analysis of intake frequency, eight categories were defined to which scores were assigned:

- several times a day – score 1;
- once a day – score 2;
- 2–3 times a week – score 3;
- once a week – score 4;
- 2–3 times a month – score 5;
- once a month – score 6;
- less than once a month – score 7;
- never – score 8.

For the amount of water consumed, the categories were as follows:

- up to 0.5 L – score 1;
- from 0.5 L- 1 L – score 2;
- from 1 L-2 L – score 3;
- more than 2 L – score 4;
- does not drink water (prefers other beverages) – score 5.

Statistical analysis of the results was performed in the Microsoft Excel 2010 and Statistica 13.3 (Statsoft) programmes. In descriptive statistics, categorical data were presented as the number of cases (n) and percentages (%). Frequencies of food intake were expressed as median of scores categorising frequency (with interquartile range). Correlations between variables were examined using Spearman's rank correlation coefficient. The significance of differences between the independent groups was tested using the Mann-Whitney U test or Pearson's chi-squared test, as appropriate. The level of statistical significance was set at  $p < 0.05$ .

## RESULTS

The study involved a total of 230 women with endometriosis. The socio-demographic characteristics of the study group are presented in Table 1. The largest group were women aged 30–39 years; average body mass of women participating in the study was 62.6 kg ( $\pm 12.3$  kg). Most of the respondents had normal BMI (18.5–24.99 kg/m<sup>2</sup>), higher education, and lived in the cities. Information regarding the course of endometriosis among surveyed women is shown in Table 2.

When asked about the role of nutrition in the treatment of endometriosis, 57.4% of the women indicated that diet can support treatment and 26.5% answered that diet is the basis

**Table 1.** Socio-demographic characteristics of the study group

Variable	No. (n=230)	Percent (%)	Women adhering to a diet (n=149)	Percent (%)	Women not adhering to a diet (n=81)	Percent (%)
Age (years)	18–24	23	10.0	13	8.7	12.3
	25–29	66	28.7	40	26.8	32.1
	30–39	121	52.6	84	56.4	45.1
	40–49	20	8.7	12	8.1	9.9
BMI (kg/m <sup>2</sup> )	<16	1	0.4	1	0.7	0.0
	16.0–16.99	9	3.9	6	4.0	3.7
	17.0–18.49	19	8.3	15	10.1	4.9
	18.5–24.99	146	63.5	99	66.4	58.0
	25–29.9	42	18.3	22	14.8	24.7
	30–34.99	10	4.3	5	3.4	6.2
	35–39.99	2	0.9	0	0.0	2.5
	$\geq 40$	1	0.4	1	0.7	0.0
Education	Primary	1	0.4	1	0.7	0.0
	Vocational	3	1.3	3	2.0	0.0
	Secondary	47	20.4	20	13.4	33.3
	Higher	179	77.8	125	83.9	66.7
Place of residence	Village	54	23.5	30	20.1	29.6
	City up to 50,000 inhabitants	25	10.9	15	10.1	12.3
	City up to 100,000 inhabitants	26	11.3	15	10.1	13.6
	City up to 250,000 inhabitants	24	10.4	16	10.7	9.9
	City of more than 250,000 inhabitants	101	43.9	73	49.0	34.6

**Table 2.** Characteristics of the subjects in terms of the course of endometriosis

Variable	No. (n=230)	Percent (%)	Women adhering to a diet (n=149)	Percent (%)	Women not adhering to a diet (n=81)	Percent (%)	
Time from diagnosis	Less than 1 year	55	23.9	30	20.1	25	30.9
	1–3 years	84	36.5	54	36.2	30	37.0
	4–7 years	46	20.0	30	20.1	16	19.8
	7–10 years	21	9.1	17	11.4	4	4.9
	10 and more years	24	10.4	18	12.1	6	7.4
Stage of disease	I	7	3.0	5	3.4	2	2.5
	II	8	3.5	7	4.7	1	1.2
	III	35	15.2	23	15.4	12	14.8
	IV	67	29.1	51	34.2	16	19.8
	Non-specified	113	49.1	63	42.3	50	61.7
Predominant symptoms	Painful periods	198	86.1	132	88.6	66	81.5
	Heavy periods	125	54.3	83	55.7	42	51.9
	Abdominal pain not related to menstruation	157	68.3	104	69.8	53	65.4
	Dyspareunia	131	57.0	92	61.7	39	48.1
	Intestinal symptoms	170	73.9	119	79.9	51	63.0
	Infertility	93	40.4	66	44.3	27	33.3
	Others	41	17.8	31	20.8	10	12.3
No. of symptoms	1	16	7.0	10	6.7	6	7.4
	2	31	13.5	16	10.7	15	18.5
	3	40	17.4	20	13.4	20	24.7
	4	43	18.7	26	17.4	17	21.0
	5	56	24.3	42	28.2	14	17.3
	6 and more	44	19.1	35	23.5	9	11.1

of therapy. However, 13.5% did not know the role of diet in EM. Of all the study participants, 149 (64.8%) declared that they were using nutritional modifications because of endometriosis (Tab. 3). Among other changes not listed in the survey, elimination of alcohol (2.7%) and coffee or caffeine (2.7%) were mentioned. The correlation between selected variables characterizing the study participants and dietary adherence are presented in Table 4.

In the group of respondents who modified their diet, 31.5% made changes in dietary habits not earlier than 6 months before the research, 24.8% adhered to a diet from 6 months up to 1 year, 20.8% followed the diet from 1 up to 2 years, and 22.8% for more than 2 years (data not shown).

Respondents were looking for information regarding the diet in EM in different sources (Tab. 5). Among other responses not listed in the survey, 'my knowledge', 'naturopath', 'trial and error' and 'self-observation' were mentioned. For 17.4% of the women who modified their nutritional behaviours, websites and/or Facebook groups or Internet forums were the only sources of information about diet in EM.

The alleviation of endometriosis symptoms after dietary modifications was observed by 83.9% of the surveyed women (Tab. 6). After changing their nutritional habits, 40.3% of respondents observed the mitigation of one symptom and 25.5% of 2 symptoms of the disease. Moreover, 18.1% of the surveyed women reduced their drug doses while 8.7% completely discontinued them.

The study showed significant differences in nutritional habits between the group of women following a diet due to EM and those not engaged in dietary modifications (Tab. 7). Women adhering to a diet more often consumed

**Table 3.** Dietary modifications made by women with endometriosis to alleviate symptoms of the disease

Type of dietary modification	No. (n=149)	Percent (%)
Reduction of meat consumption	90	60.4
Total resignation from meat consumption	20	13.4
Total resignation from animal products consumption	3	2.0
Resignation from dairy products with lactose	62	41.6
Total resignation from milk and dairy	35	23.5
Reduction of products containing gluten	67	45.5
Total resignation from products containing gluten	29	19.5
Reduction of sugar and sweets consumptions	121	81.2
Resignation from fast foods	120	80.5
Elimination of eggs	11	7.4
Reduction of soy and soy products consumption	65	43.6
Reduction of legumes consumption (except soy)	21	14.1
Increase of legumes consumption	26	17.4
Reduction of vegetables consumption	3	2.0
Increase of vegetables consumption	106	71.1
Reduction of fruit consumption	10	6.7
Increase of fruit consumption	74	49.7
Increase of consumption of wholemeal products	61	40.9
Increase of fish consumption	80	53.7
Increase of vegetable oils consumption	92	61.7
Implementation of fasting	20	13.4
Others	20	13.4

**Table 4.** Spearman's rank correlation analysis for the relationship between selected variables characterizing the study participants and dietary adherence

Variable	Correlation coefficient (R)	p
BMI	-0.17	0.010*
Age	0.07	0.304
Time from diagnosis	0.15	0.025*
Number of symptoms	0.20	0.001*
Stage of endometriosis	-0.04	0.630

p < 0.05 was considered to be statistically significant (\*)

**Table 5.** Sources of knowledge of surveyed women about the role of diet in endometriosis

Source of knowledge	No. (n=149)	Percent (%)
Doctor's recommendation	45	30.2
Dietician	56	37.6
Facebook groups or Internet forums	98	65.8
Family or friends	11	7.4
Websites	105	70.5
Scientific articles	55	36.9
Books	42	28.2
Others	6	4.0

**Table 6.** Changes in endometriosis symptoms and other effects observed after dietary modifications

Effects of the diet	Type of change	No. (n=149)	Percent (%)
Changes linked to endometriosis	Less painful menstruation	73	49.0
	Less heavy menstruation	32	21.5
	Alleviation of abdominal pain not related to menstruation	73	49.0
	Alleviation of dyspareunia	19	12.8
	Worsening of symptoms	1	0.7
	No changes observed	23	15.4
	Others	22	14.8
Other effects of diet	Increase in frequency of excretions	54	36.2
	Decrease in frequency of excretions	10	6.7
	Improvement of hair, skin and nails condition	50	33.6
	Worsening condition of hair, skin and nails	5	3.4
	Improvement of well-being	107	71.8
	Deterioration of well-being	1	0.7
	Loss of body mass	74	49.7
	Gain in body mass	7	4.7
	No changes observed	12	8.1
	Others	11	7.4

fish, legumes, gluten-free bread, seeds and nuts, gluten-free groats, cereals, fruits, vegetables, and fruit juices. On the other hand, they less frequently consumed red meat, milk and dairy products, white bread, and sweetened beverages.

A statistically significant correlation was shown between adhering to the diet and the thermal processing method of

**Table 7.** Differences in the consumption of individual products between the group of women adhering to a diet and those not adhering to a diet. Data expressed as median of scores categorising frequency of food consumption (with interquartile range)

Product	Women adhering to a diet (n= 149)	Women not adhering to a diet (n=89)	p value
Red meat	7 (5–8)	4 (3–6)	<0.001*
White meat	3 (3–5)	3 (3–4)	0.191
Fish	4 (3–5)	5 (4–6)	<0.001*
Milk and dairy products	4 (3–7)	3 (1–4)	<0.001*
Eggs	3 (3–4)	3 (3–4)	0.304
Soy and soy products	8 (6–8)	8 (7–8)	0.064
Legumes (except soy)	4 (3–6)	6 (4–7)	<0.001*
White bread	7 (3–8)	3 (2–5)	<0.001*
Wholegrain bread	3 (2–6)	3 (2–5)	0.650
Gluten free bread	8 (4–8)	8 (8–8)	<0.001*
Seeds and nuts	3 (2–4)	4 (3–6)	<0.001*
Groats containing gluten	5 (4–8)	6 (4–7)	0.555
Gluten free groats	4 (3–6)	7 (5–8)	<0.001*
Cereals	4 (3–7)	5 (4–7)	0.010*
White rice	5 (4–7)	5 (4–6)	0.951
Brown rice	6 (5–8)	7 (5–8)	0.271
Potatoes	4 (3–5)	3 (3–5)	0.184
Fruits	2 (1–3)	3 (2–3)	<0.001*
Vegetables	1 (1–2)	2 (1–3)	<0.001*
Fruit juices	4 (3–7)	5 (3–7)	0.034*
Sweetened beverages	8 (6–8)	6 (4–8)	<0.001*
Coffee	2 (2–6)	2 (1–5)	0.149
Tea	1 (1–3)	1 (1–2)	0.288
Alcohol	6 (5–7)	6 (4–7)	0.085
Water	3 (2–3)	3 (2–3)	0.567

p-values based on Mann-Whitney U test. p < 0.05 – statistically significant (\*)

food (p=0.003, according to a Pearson's chi-squared test). Among the women who changed their dietary patterns because of EM, the most popular methods were, respectively, boiling in water (24.2%), stewing (21.5%), frying (16.8%), and baking in the dish or oven bag (15.4%). Women not adhering to a diet the most frequently chose frying (32.1%), traditional baking (23.5%), and boiling in water (21%) (Tab. 8).

Physical activity was practiced regularly by 38.7% of respondents, the most popular disciplines stated being yoga (27%), fitness (25.8%), walks (23.6%), gym (16.9%), cycling (14.6%), and jogging (11.2%). Women adhering to a diet were more frequently engaged in regular physical activity; in this group, 44.3% of women exercised regularly, contrary to only 28.4% of the women not adhering to a diet (Tab. 9). The correlation between adhering to a diet and regular physical activity was statistically significant (p=0.018, according to the Pearson's chi-squared test).

## DISCUSSION

This cross-sectional study shows that women with EM often modify their diet in order to improve their well-being. Among the study participants, 64.8% were following a diet while taking part in the survey. Changes in the nutritional habits

**Table 8.** Most popular thermal processing methods among women adhering to a diet and women not adhering to a diet.

Thermal processing method	No. (n=230)	Percent (%)	Women adhering to a diet (n=149)	Percent (%)	Women not adhering to a diet (n=81)	Percent (%)	p value
Frying	51	22.2	25	16.8	26	32.1	0.003
Baking in dish/oven bag	32	13.9	23	15.4	9	11.1	
Traditional baking	36	15.7	17	11.4	19	23.5	
Grilling	2	0.9	2	1.3	0	0.0	
Boiling	53	23.9	36	24.2	17	21.0	
Steam cooking	17	7.4	14	9.4	3	3.7	
Stewing	39	17.0	32	21.5	7	8.6	

p-value based on Pearson's chi-squared test

**Table 9.** Engagement in regular physical activity in the group of women adhering to a diet, and those not adhering to a diet

Regular physical activity	No. (n=230)	Percent (%)	Women adhering to a diet (n=149)	Percent (%)	Women not adhering to a diet (n=81)	Percent (%)	p Value
Yes	89	38.7	66	44.3	23	28.4	0.018
No	141	61.3	83	55.7	58	71.6	

p-value based on Pearson's chi-squared test

were most often made by women inhabiting big cities with more than 250,000 inhabitants, less often by village residents. This result can be connected with the availability of medical care or specialists such as dietitians. Women adhering to a diet were mostly diagnosed 7–10 years and 10 and more years before the study. Presumably, conventional treatment had not brought satisfactory results and consequently decided to try supplementary methods. Also, the number of symptoms were linked to the dietary changes – probably women for whom symptoms of the disease were more annoying, are they were more eager to try unconventional methods.

The percentage of women who modified their diet due to EM reported in this study is slightly lower than in the study by Bogusz and Górnicka [25], in which 77.3% of Polish women declared a change in dietary habits after being diagnosed with EM. In turn, comparable results to those obtained in the current study were reported among Italian women with EM (66.4%) [26]. However, lower percentages of women with EM undertaking dietary modifications due to the disease, were observed among Australian and Dutch women – 44% and 43%, respectively [27,28].

The most often implemented dietary modifications noted in the group of women adhering to a diet were reduction of sugar and sweets consumption (81,2%), resignation from fast foods (80,5%), and an increase in vegetables consumption (71.1%). After introducing changes to the diet, some relief from EM symptom was observed by 83.9% of women. Others women experienced positive changes not directly connected with endometriosis symptoms after adhering to a diet, such as increase in the frequency of excretion, and improvement in the condition of skin, hair and nails. Presumably, this occurred because of the better quality of the diet after modifications. Respondents also indicated improvement in well-being as a result of diet.

Assessment of the consumption of individual products by women with EM showed significant differences among the group who adhered to a diet, and those who did not adhere to a diet. Women in the first group were more likely to fulfil the recommendations of the Polish National Institute of Public Health – National Institute of Hygiene (NIZP-PZH) regarding

the reduction of red meat consumption up to 500 g per week, and implementing one vegetarian day during the week [29]. The fish consumption advised by NIZP-PZH is 2 portions per week to cover the EPA and DHA needs of the organism [30]. This recommendation was met by 34.3% of women adhering to a diet, and by only 7.4% of those not adhering to a diet (data not shown). Dairy consumption was significantly higher among women in the second group. The median frequency of dairy intake among these women was 2–3 times a week, while for women adhering to a diet it was once a week. NIZP-PZH recommends consumption of 2 glasses of milk per day, which may be substituted by yoghurt, buttermilk or white cheese [29]. It can be assumed that women consuming dairy several times a day meet these recommendations – according to this study it was only 5.4% in the group following a diet, contrary to 28.4% of women not following a diet (data not shown). Compared to the women not following the diet, 3 times as many women adhering to a diet never consumed white bread – 41% versus 13.6% (data not shown). They also more frequently chose gluten-free bread and groats, probably due to a reduction or resignation from gluten. Cereals were more often consumed by women adhering to a diet. According to NIZP-PZH, 3 servings of wholegrain products (90 g) should be consumed every day [29]. Seeds and nuts, a rich source of vegetable oils, were often consumed by women following a diet, and increasing the consumption of seeds and nuts was included in the 2020 guidelines of NIZP-PZH [29]. Women practicing dietary modification often met this criterion. The study also found significant differences between the groups in the consumption of fruits and vegetables, which was higher in the group adhering to a diet, and were more likely to meet the recommendations regarding consumption of a minimum 400 g of these products per day [29]. Women following a diet more often drank fruit juices. One glass of juice may replace one portion of fruits a day, but higher consumption is not recommended [31]. Women in this group less often drank sweetened drinks, probably to reduce sweets and sugar in their diet.

The most popular methods of thermal processing of food among women on a diet were boiling in the water and

steaming, methods which are more health beneficial than frying or traditional cooking, which were conversely more frequently chosen by women not undertaking any dietary modifications. According to the current study, the women who made changes in their nutritional habits cared not only about the ingredients, but also about the way of preparing food and chose the healthier options.

Changes in dietary habits, such as reduction of meat consumption, limitation of sugar and sweets, elimination of fast foods, increase in legumes, fruits, vegetables, vegetable oils, and fish consumption, are beneficial for health and in accordance with NIZP-PZH recommendations [29,31]. Modifications such as complete resignation from meat, dairy, gluten, soy, limitation of fruits and vegetables, or fasting, are not scientifically justified and may lead to nutritional deficiencies, considering long-term use of the diet and the low percentage of women consulting with a dietitian.

The main source of knowledge about nutrition for the surveyed women were websites, Internet forums and/or Facebook groups. Similar results were presented in another study on Polish women conducted by Szymańska and Dąbrowska-Galas [32]; O'Hara et al. also indicated the Internet as the main source of knowledge [33]. According to the authors of the above-mentioned study, looking for information about the disease on their own gives the women a sense of control and the decision about their health. On the other hand, the process of research is connected with a feelings of being overwhelmed, fear, and difficulties with implementing mutually exclusive recommendations [33]. Arena et. al. investigated the risk of fake news in the Internet and according to the study 76% of patients with endometriosis read fake news about the disease, including 39% of patients who found information that endometriosis can be treated exclusively by diet [34].

Most of the women adhering to a diet reported some relief from pain symptoms, and improvement in well-being. Similar results were also obtained by other researchers [25, 27, 35–37]. In the study by Armour et al., the effectiveness of diet in reducing endometriosis symptoms was rated at 6.4 ( $\pm$  2,4) on a 0–10 scale [27]. According to O'Hara et al. [34] and Vennberg Karlsson et al. [37], adhering to a diet gave the patients a sense of control over the disease and the treatment process, leading to improvement in well-being. The current study indicated that 18.1% of women limited their doses of medicaments, and 8.7% completely resigned from pharmacological treatment. A similar effect of the diet was observed by Armour et al. in which 18% of women limited their doses of drugs by at least 50% [27].

According to the current study, only 38.7% of the surveyed women exercised regularly, preferring such activities as yoga, fitness and walking. In the study by Armour et al., 42% of surveyed women used physical activity as a method of alleviating the symptoms of endometriosis [27]. Sachs et. al. indicate that women who have the disease engage in less physical activity weekly than women without the disease, which may be because of the pain symptoms accompanying endometriosis [38]. However, studies indicate that systematic physical activity may regulate the immunologic system and pro-inflammatory markers, reduce menstrual bleeding, and therefore decrease the risk of EM [39]. High physical activity increases sex hormone-binding globulin (SHBG) and reduces serum estrogen concentration. It also decreases insulin resistance and hyperinsulinaemia, which may be associated with the disease risk. Another study suggested that physical

activity can help in reducing the risk of endometriosis, but the results did not reach statistical significance [40]. The study of O'Hara et al. showed that yoga may be beneficial in reducing pain and improving the quality of life of women with EM [33] by allowing the women to control the pain through breathing and relaxation techniques. In the current study, the women who adhered to a diet significantly more often exercised regularly than women not adhering to a diet, and shows that they not only concentrated on nutrition, but also their general lifestyle.

Studies focusing on the impact of nutrition on the risk and treatment of endometriosis, however, are equivocal, due to the lack of well-designed, randomized studies on large groups of women. Based on the published research it is not possible to establish precise guidelines regarding the diet in EM. However, the studies allow the assumption that diet can alter the symptoms of the disease, and that the anti-oxidants and anti-inflammatory ingredients play the most important role. The results of the current study show that women with EM often decide to implement changes in their nutritional habits, and that the diet can be an important element supporting the treatment of the disease. This requires further research to investigate which nutritional interventions may bring the greatest benefits.

A limitation of this study is the method of recruiting study participants by making the survey available to a wide audience through the social media. There is a small risk that the questionnaire may have been completed by women who do not in fact have EM, or that the answers given were not truthful. Another limitation is the lack of validation for the questionnaire.

## CONCLUSIONS

The results of the study show that women with EM search for relief in dietary modifications, and most women experience improvement of the symptoms and well-being after implementing changes. Statistically significant differences between the dietary habits of women adhering to a diet, and women not adhering to a diet, were observed with regard to the consumption of red meat, fish, milk and dairy products, legumes, white bread, gluten free bread, seeds and nuts, gluten free groats, cereals, fruits, vegetables, fruit juices and sweetened beverages. However, not all modifications implemented by the women were desirable and beneficial for health. Further research is required to establish the type of diet and type of products which could be the most efficient in alleviating the symptoms of endometriosis.

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