

Dietary habits changes and quality of life in patients undergoing chemotherapy for epithelial ovarian cancer

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Abstract

Purpose The aim of this study was to evaluate dietary habit changes in patients undergoing chemotherapy for epithelial ovarian cancer.

Methods Sixty one patients undergoing chemotherapy for epithelial ovarian cancer were enrolled to the study and 44 completed. The dietary intake was evaluated by 7-day food records, and the changes in dietary intake and food-preparing methods were estimated based on a 101-item semiquantitative food frequency questionnaire. Nutritional status was checked with the use of body weight and height, waist and hip circumferences, skinfolds and subjective global assessment tool. Quality of life was measured with the use of EORTC QLQ-C30 and EORTC QLQ-OV28.

Results Despite high average body mass index (BMI) (26.7–28.0 kg/m²), malnutrition risk was observed in 43.7 and 10.7 % of patients receiving first-line and subsequent-line chemotherapy, respectively ($p<0.001$). Dietary intake and quality of life did not differ between the studied groups. A

lot of dietary habits changes were observed. Women undergoing subsequent-line chemotherapy consumed more frequently rye bread, pasta, buttermilk, vegetable, fruit, oils, nuts, and juices. Women undergoing first-line chemotherapy consumed more milk, cottage cheese, cream, eggs, fish and seafood, meat offal, salty snacks, and jam. Additionally, women undergoing subsequent-line chemotherapy more often applied cooking in water ($p<0.0001$) and baking ($p<0.05$).

Conclusions Women undergoing chemotherapy for ovarian cancer change their dietary habits in a pro healthy direction, and these changes are more expressed in patients undergoing subsequent-line chemotherapy.

Keywords Ovarian cancer · Chemotherapy · Dietary habits · Dietary intake · Quality of life

Introduction

Epithelial ovarian cancer (EOC) is the seventh most common cancer in women around the world, sixth in Europe, and fifth in Poland, accounting for about 150,000 deaths annually worldwide [1]. EOC is often referred as the “silent killer” according to its asymptomatic clinical pattern, mostly diagnosed in its advanced stages [2]. Current optimal management of advanced-stage EOC includes maximal cytoreductive surgery and a program of chemotherapy with a platinum agent (carboplatin or cisplatin) and paclitaxel [3]. Unfortunately, over 80 % of patients with advanced ovarian cancer will relapse and despite a good chance of remission from further chemotherapy, they will usually die from their disease [4].

Diet and physical activity are two lifestyle behaviors shown to significantly impact both quality of life (QoL) and survivorship in cancer patients, and from these reasons, promotion of healthy lifestyle changes in this population is imperative [5]. Patients with cancer experience a variety of symptoms

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like mucositis, taste alterations and food aversions, anorexia, nausea and vomiting, diarrhea, fatigue, pain, and dyspnea that affect their nutritional status [6]. Between 36 and 75 % of patients receiving chemotherapy report distressing changes in taste [7], what has profound effects on nutritional status, QoL, morbidity, and mortality [8, 9]. Malnutrition and weight loss are common in patients with cancer, both factors could potentially affect the response and tolerance to treatment and decrease QoL and are associated with poor survival [10, 11]. Maintaining nutritional status is now recognized as a major part of cancer care, and the oncology team should be aware of the psychological and physiological factors that interfere with food acceptance so that appropriate measures can be taken to limit the impact on the patient's well-being [7]. The aim of this study was to assess eating behavior changes and QoL in EOC patients undergoing chemotherapy.

Materials and methods

Participants

The study was performed in patients currently receiving chemotherapy for epithelial ovarian cancer at the Department of Oncology at Poznan University of Medical Sciences (Poznan, Poland). Inclusion criteria were as follows: histological diagnosis of epithelial ovarian cancer and receiving chemotherapy (radical or palliative). Exclusion criteria were as follows: nonepithelial ovarian cancers and bad performance status according to *Eastern Cooperative Oncology Group and World Health Organization Performance Status* (ECOG-WHO) ≥ 2 [12]. From 61 women who were eligible for the study, 44 completed. From 7 patients who were excluded in first-line chemotherapy group by 3, a significant deterioration of health was observed and for this reason 1 died and the conscious abandonment of research 4 women has taken. From 10 patients who were excluded in subsequent chemotherapy group by 4, a significant deterioration of health was observed and for this reason, 3 died and the conscious abandonment of research 6 women has taken. The characteristic of patients was presented in Table 1. The study was performed in accordance with the Helsinki Declaration. The subjects gave their written consent for the study.

Nutritional habits evaluation

Nutritional habits were evaluated by 7-day food records as well as by semiquantitative food frequency questionnaire (FFQ). The dietary intake was assessed by 7-day food records with a dietician checking the completion of the data (Dietetyk software, National Institute of Food and Nutrition, Warsaw, Poland). Energy value, intake of proteins, fat, carbohydrates, and selected macro and micronutrients were assessed. The

weighment method was used as the standard for estimating the nutrient intake. The results were compared to the nutritional requirements for polish population [13]. The changes in dietary intake and food-preparing methods in comparison with the state before the treatment were estimated based on a 101-item semiquantitative FFQ that was previously validated by comparison with 24-h 7-day food records. For all food and beverage items, participants were asked to report the frequency of consumption on a 6-point scale ranging from never use to more frequently.

Nutritional status

Body weight was measured in light clothing and without shoes with an accuracy of 0.10 kg, and height was measured with an accuracy of 0.5 cm (Radwag, Radom, Poland). Waist and hip circumferences were measured with an accuracy of 0.1 cm (Seca, Hamburg, Germany). Body mass index (BMI) and waist-to-hip ratio (WHR) were calculated in all subjects. Four skinfolds (biceps, triceps, subscapular, and suprailiac) were measured by a caliper with a 0.2-mm precision (Harpender company, UK) according to the Durnin and Womersley equation [14].

The subjective global assessment (SGA) tool was used to classify a patient's nutritional status as either well nourished or moderately or severely malnourished. SGA uses information obtained by clinical history (i.e., weight loss, changes in dietary intake, gastrointestinal symptoms, and functional capacity) and physical examination (i.e., loss of subcutaneous fat, muscle wasting, and edema or ascites) [15]. "SGA is simple, safe and inexpensive, which renders it an universal tool for nutritional assessment and represent a good option for assessing of nutritional status in various clinical situations [16] also in EOC patients [15, 17]."

Quality of life

QoL was assessed by EORTC QLQ-C30 questionnaire and supplementary module for ovarian cancer—EORTC QLQ-OV28 with permission of The European Organization for Research and Treatment of Cancer (EORTC) [18]. The QLQ-C30 composed of 30 questions, both multi-item scales and single-item measures, included five functional scales (physical functioning PF2, role functioning RF2, emotional functioning EF, cognitive functioning CF, and social functioning SF), three symptom scales (fatigue FA, nausea and vomiting NV, pain - PA), a global health status/QoL scale, and six single items (dyspnea DY, insomnia SL, appetite loss AP, constipation CO, diarrhea DI, financial difficulties FI). EORTC QLQ-OV28 consisted of 28 items assessing abdominal/GI symptoms, peripheral neuropathy, other

Table 1 Characteristic of the studied patients

	First-line chemotherapy <i>n</i> =16	Subsequent-line chemotherapy <i>n</i> =28	<i>p</i>
Age, in years			
Mean±SD	57.9±10.1	57.0±8.7	0.723
30–49 <i>n</i> (%)	3 (18.7)	6 (21.4)	0.778
50–69	12 (75)	21 (75.0)	
70+	1 (6.3)	1 (3.6)	
Race/ethnicity <i>n</i> (%)			
Caucasian	16 (100)	28 (100)	1.000
Stage at diagnosis			
I <i>n</i> (%)	3 (18.7)	4 (14.3)	0.104
II	0 (0)	1 (3.6)	
III	11 (68.8)	15 (64.2)	
IV	2 (12.5)	5 (17.9)	
Histology <i>n</i> (%)			
Serous	12 (75)	22 (78.6)	0.501
Other	4 (25)	6 (21.4)	
Line of chemotherapy			
1	16 (100)	0 (0.0)	<0.0001
2	0 (0)	9 (32.1)	
3	0 (0)	4 (14.3)	
4	0 (0)	4 (14.3)	
5	0 (0)	4 (14.3)	
6+	0 (0)	7 (25.0)	
Agents actually receiving			
Platinum±taxanes <i>n</i> (%)	16 (100)	17 (60.8)	<0.0001
Gemcytabine	0 (0)	2 (7.1)	
Topotecan	0 (0)	5 (17.9)	
Doxorubicin	0 (0)	2 (7.1)	
Etoposid	0 (0)	2 (7.1)	
ECOG			
0 <i>n</i> (%)	3 (18.7)	4 (14.3)	0.143
1	11 (68.7)	18 (64.3)	
2	1 (12.6)	6 (21.4)	

chemotherapy side effects, hormonal symptoms, body image, attitudes to disease/treatment, and sexuality. Questionnaires were analyzed according to The EORTC QLQ-C30 Scoring Manual [19].

Statistical analysis

Statistical analysis was performed with the use of Statistica 10.0 Software (StatSoft, Tulsa, USA). D'Agostino-Pearson omnibus test was used for normality of the data check. For comparison between the groups, if the data passed normality test, *t* Student test was used; in other cases, Mann-Whitney test was performed. Chi-square test was used for comparison of data in nominal scale. The level of significance was set at the standard level of $\alpha=0.05$.

Results

In the anthropometrical characteristic of 44 women who completed the study, no statistically significant differences were observed (Table 2). Despite average BMI (26.7–28.0 kg/m²) indicated overweight, malnutrition risk was observed in 43.7 and 10.7 % of patients receiving first-line and subsequent-line chemotherapy, respectively ($p<0.001$). Also, energy value of the diet and supply of selected nutrients in daily food rations did not differ between the studied groups (Table 3). The average value of the diet was lower than the recommended 2000 kcal [13]; however, the average percentage of fat and protein intake was above the upper limit of recommendations [13]. Additionally, low intake of calcium, magnesium, and potassium were observed as well as inadequate intake of retinol, folate, vitamin D, and vitamin B1.

Table 2 Anthropometrical measures and SGA score

Parameters		First-line chemotherapy <i>n</i> =16		Subsequent-line chemotherapy <i>n</i> =28		<i>p</i>
		Mean	SD	Mean	SD	
Weigh (kg)		67.3	10.3	72.7	14.5	0.288
Height (cm)		159.0	5.3	161.0	6.4	0.339
BMI (kg/m ²)		26.7	4.4	28.0	5.1	0.494
Circumferences	Waist (cm)	92.7	9.9	95.3	13.1	0.525
	Hip (cm)	105.0	9.4	108.0	10.4	0.373
WHR		0.89	0.54	0.88	0.56	0.406
Skinfold thickness (mm)	Triceps	20.5	3.8	20.8	4.5	0.931
	Biceps	14.5	5.1	14.9	4.8	0.741
	Subscapular	19.2	4.9	19.7	6.6	0.893
	Suprailiac	20.7	5.7	19.9	5.4	0.471
%FM		36.5	3.3	36.4	3.8	0.893
SGA	Well-nourished patients <i>n</i> (%)	9 (56.3)		25 (89.3)		<0.0001
	Patients at risk of malnutrition <i>n</i> (%)	7 (43.7)		3 (10.7)		

Table 3 Mean intake of energy and selected macro and micronutrients

	First-line chemotherapy		Subsequent-line chemotherapy		<i>p</i>
	Mean	SD	Mean	SD	
Energy (kcal)	1,439	324	1,507	338	0.715
Fat (%)	32.6	4.25	34.5	9.01	0.870
Protein (%)	17.8	2.40	18.2	3.01	0.521
Carbohydrates (%)	49.5	4.21	47.3	8.65	0.458
Cholesterol (mg)	245	93.4	271	94.9	0.428
SFA (%)	14.3	1.86	15.1	3.94	0.791
MUFA (%)	11.5	1.49	12.1	3.16	0.386
PUFA (%)	4.38	0.57	4.67	1.20	0.521
Fiber (g)	19.3	6.61	19.9	6.44	0.870
Na (mg)	1,675	386	1,859	647	0.399
K (mg)	3,016	817	3,142	690	0.414
Ca (mg)	533	252	608	251	0.274
P (mg)	1,044	277	1,150	311	0.167
Mg (mg)	262	80.3	290	76.0	0.187
Fe (mg)	10.6	2.99	10.5	3.16	0.880
Zn (mg)	8.46	1.84	9.09	2.52	0.678
Cu (mg)	1.08	0.29	1.14	0.29	0.606
Retinol (μg)	684	1,103	396	318	0.428
β-carotene (μg)	3,779	2,239	3,568	1,837	0.949
Folate (μg)	319	110	319	104	0.949
Vit D (μg)	3.73	2.84	4.05	2.81	0.481
Vit E (mg)	8.85	1.97	9.58	3.27	0.554
Vit C (mg)	103	67.5	115	53.1	0.195
Vit B ₁ (mg)	0.86	0.16	0.94	0.29	0.497
Vit B ₂ (mg)	1.26	0.42	1.29	0.31	0.521
Vit B ₆ (mg)	1.57	0.39	1.68	0.46	0.597
Vit B ₁₂ (μg)	4.33	2.42	5.48	2.78	0.122
Vit PP (mg)	14.9	2.99	15.5	4.49	0.929

Table 4 Changes in consumption of selected food products in patients undergoing chemotherapy for EOC

Products	First-line chemotherapy				Subsequent-line chemotherapy				<i>p</i>
	A+B	C	D+E	F	A+B	C	D+E	F	
Cereal products									
Wholemeal bread	33.4	46.6	6.7	13.3	34.5	38.5	11.6	15.4	0.487
White bread	0.0	21.4	42.9	35.7	0.0	29.2	45.8	25.0	0.185
Rye bread	13.4	60.0	20.0	6.6	32.0	40.0	8.0	20.0	<0.0001
Groats	26.7	26.7	33.4	13.2	33.3	37.5	16.7	12.5	0.055
Pasta	0.0	86.7	13.3	0.0	11.5	61.5	19.3	7.7	<0.0001
Rice	6.7	80.0	13.3	0.0	12.0	68.0	16.0	4.0	0.085
Milk and dairy products									
Yoghurt	40.0	33.3	20.0	6.7	50.0	30.8	11.5	7.7	0.356
Buttermilk	20.0	40.0	20.0	20.0	38.4	38.5	7.7	15.4	0.009
Milk	20.0	46.7	20.0	13.3	7.4	48.2	18.5	25.9	0.013
Cottage cheese	42.9	42.9	14.2	0.0	25.9	66.7	3.7	3.7	0.0003
Hard cheese	13.3	53.3	26.6	6.8	7.4	51.8	29.6	11.2	0.414
Cream	0.0	53.3	33.4	13.3	0.0	32.0	56.0	12.0	0.003
Vegetable									
Bulb	28.5	42.9	28.6	0.0	48.2	40.7	11.1	0.0	0.001
Root	57.1	42.9	0.0	0.0	65.4	34.6	0.0	0.0	0.246
Leafy	28.6	57.1	14.3	0.0	62.9	29.7	7.4	0.0	<0.0001
Legumes	0.0	35.7	50.0	14.3	18.6	37.0	29.6	14.8	<0.0001
Red	21.3	42.9	21.5	14.3	23.0	46.1	7.8	23.1	0.030
Green	57.2	28.6	14.2	0.0	53.8	30.8	15.4	0.0	0.912
Fruit									
Citrus	50.0	21.4	14.3	14.3	50.0	30.8	11.5	7.7	0.296
Berry	57.1	35.8	0.0	7.1	65.3	23.1	7.7	3.9	0.006
Drupe	35.8	28.6	28.5	7.1	38.5	42.3	11.5	7.7	0.022
Tropical	14.2	28.6	28.6	28.6	15.4	42.3	23.1	19.2	0.159
Pome	40.0	33.3	26.7	0.0	53.9	30.8	11.5	3.8	0.008
Meat, preserves, and eggs									
Pork	0.0	21.4	57.1	21.5	0.0	34.6	57.7	7.7	0.007
Beef	13.3	33.3	20.1	33.3	7.6	27.0	34.6	30.8	0.115
Poultry	60.0	33.3	6.7	0.0	57.6	38.5	3.9	0.0	0.547
Eggs	46.7	40.0	13.3	0.0	34.6	61.5	3.9	0.0	0.003
Fish	64.3	21.4	14.3	0.0	57.6	34.6	3.9	3.9	0.004
Offal	21.4	35.7	14.4	28.5	0.0	37.5	25.0	37.5	<0.0001
Cured meat	0.0	53.3	40.0	6.7	3.9	30.8	65.3	0.0	<0.0001
Fats									
Margarine	0.0	33.3	13.3	53.4	4.0	32.0	32.0	32.0	0.0006
Butter	14.3	35.7	35.7	14.3	7.7	46.1	38.5	7.7	0.202
Vegetable oils	28.6	64.3	7.1	0.0	38.4	61.6	0.0	0.0	0.016
Sweets and snack									
Cakes	7.1	28.6	50.0	14.3	7.7	3.8	61.6	26.9	<0.0001
Sweets	0.0	14.3	50.0	35.7	7.7	26.9	38.5	26.9	0.002
Jam	6.7	33.3	40.0	20.0	0.0	14.8	55.6	29.6	0.0004
Nuts	21.4	21.4	14.2	43.0	36.0	28.0	16.0	20.0	0.004
Salty snacks	7.1	14.3	14.3	64.3	0.0	12.0	36.0	52.0	0.0004
Beverage									
Tea	0.0	40.0	40.0	20.0	8.0	40.0	36.0	16.0	0.034

Table 4 (continued)

Products	First-line chemotherapy				Subsequent-line chemotherapy				<i>p</i>
	A+B	C	D+E	F	A+B	C	D+E	F	
Coffee	6.7	26.7	53.3	13.3	7.4	29.7	48.1	14.8	0.908
Sweetened beverages	0.0	15.4	23.1	61.5	3.7	18.5	37.0	40.8	0.007
Juice	53.4	26.6	0.0	20.0	55.6	14.8	22.2	7.4	<0.0001
Water	56.3	31.3	6.2	6.2	59.3	37.0	3.7	0.0	0.071

A, eat much more often; B, eat more often; C – not changed; D, eat more rarely; E, eat much more rarely; F, do not eat

Results from FFQ are presented in Tables 4 and 5. Women who were undergoing subsequent-line chemotherapy consumed more frequently rye bread, pasta, buttermilk, vegetables: onion, leafy, red and legumes, fruits: berries, drupe and pome, oils, nuts, and juices. In contrast, women undergoing first-line chemotherapy were characterized by a higher intake of milk, cottage cheese, cream, eggs, fish and seafood, meat offal, salty snacks, and jam. Statistically significant differences in changes regarding the use of different cooking techniques were found. Women undergoing subsequent-line chemotherapy more often applied cooking in water ($p<0.0001$) and baking ($p<0.05$).

No statistically significant differences in QLQ-C30 quality of life were observed (Table 6). Cognitive function were assessed at the highest level (76.6 ± 23.3) when the roles of functioning were at the lowest (57.7 ± 32.2). In the symptom score, the most points obtained the evaluation of fatigue (54.0 ± 23.2), while the least severe were diarrhea (9.8 ± 17.1). Evaluation of symptoms using the EORTC QLQ OV-28 showed also no statistically significant differences.

Discussion

The presented study is one of the few evaluators of quality of life, nutritional status, and dietary habit changes in the group of patients undergoing chemotherapy for ovarian cancer and

to our knowledge is the first comparing nutritional habit changes of patients undergoing first-line and subsequent-line chemotherapy.

Average BMI values in our research were similar to the study by Laky et al. [15] who observed that according to SGA, 24 % of gynecologic cancer patients were classified as malnourished but the prevalence of malnutrition was highest in ovarian (67 %) and lowest in endometrial (6 %) cancer patients. Zorlini et al. [17] showed that according to BMI, malnutrition occurred only in 3.6 % of gynecological cancer patients, while when the assessment was carried out by SGA, it raised to 24 %. In our study, the risk of malnutrition presented a total of 22.7 % patients but significantly more in the group undergoing first-line chemotherapy (43.7 %). Despite these differences, all evaluated anthropometric parameters did not differ significantly between groups. It can be assumed that BMI does not reflect adequately the gynecologic cancer patient's nutritional status and masks malnutrition [15]. According to other studies, malnutrition or malnutrition risks are observed generally in 28.9–50 % of hospitalized patients [20, 21] where a higher prevalence of malnutrition was found in medical (53 %) as compared to surgical departments (47 %) [21]. In end-stage renal disease, 93.33 % patients had mild to moderate malnutrition and 2.86 % had severe malnutrition [22]. Furthermore, it should be remembered that in the case of solid tumors, their mass can be as high as 4–5 % of the adult body weight and thereby mask the loss of weight [23].

Table 5 Changes in the use of selected food preparation methods in patients undergoing chemotherapy for ovarian cancer

Cooking technique	First-line chemotherapy				Subsequent-line chemotherapy				<i>p</i>
	A+B	C	D+E	F	A+B	C	D+E	F	
Boiling	28.7	57.1	7.10	7.10	54.2	37.5	8.30	0.00	0.0004
Steaming	28.6	42.8	14.3	14.3	34.1	41.5	9.80	14.6	0.775
Frying	0.00	35.7	64.3	0.00	4.40	17.4	73.9	4.30	0.001
Roasting	7.10	28.6	57.2	7.10	17.4	39.1	34.8	8.70	0.011
Grilling	0.00	7.10	28.6	64.3	4.40	21.7	26.1	47.8	0.002

A, use much more often; B, use more often; C, not changed; D, use more rarely; E, use much more rarely; F, do not use

Table 6 Quality of Life according to EORTC QLQ-C30 and QLQ-OV28 questionnaires

Parameter	First-line chemotherapy		Subsequent-line chemotherapy		<i>p</i>
	Mean	SD	Mean	SD	
QLQ-C30					
QL2	50.0	22.8	46.9	18.5	0.521
PF2	63.3	23.3	66.2	18.8	0.770
RF2	48.9	34.7	62.9	30.1	0.223
EF	64.2	26.2	66.0	19.3	0.939
CF	68.9	28.7	80.9	18.9	0.206
SF	60.4	26.4	68.5	20.3	0.410
FA	59.0	22.5	51.0	23.5	0.238
NV	34.4	32.5	20.4	26.3	0.128
PA	41.1	37.2	25.9	22.8	0.218
DY	28.6	43.1	16.0	21.4	0.752
SL	42.2	26.6	32.1	26.9	0.237
AP	35.5	34.4	20.9	32.2	0.108
CO	30.9	27.6	25.9	31.1	0.439
DI	4.75	12.1	12.3	18.8	0.193
FI	50.0	38.6	33.3	36.9	0.191
QLQ-OV28 Symptom scales/items					
Abdominal/GI	29.3	17.9	18.5	17.9	0.065
Peripheral neuropathy	65.6	38.2	55.1	35.8	0.268
Hormonal	37.5	36.8	33.3	34.3	0.688
Body image	32.2	32.4	40.7	29.7	0.343
Attitude to disease/treatment	75.7	25.4	73.2	20.7	0.515
Chemotherapy side effects	40.6	20.2	37.9	21.7	0.695
Other single items	50.0	24.3	37.9	23.8	0.115
Sexuality	13.9	20.6	12.0	21.7	0.542

However, Pavelka et al. [24] observed that obesity correlates positively both with faster relapse and with shorter survival of EOC patients.

In the study of Hutton et al. [25], authors have shown that the taste disorders are associated with an unpleasant taste sensation in the mouth and enhanced sensitivity to odors are found in about 86 % of persons undergoing chemotherapy. The chemotherapeutic agents most commonly associated with taste changes include carboplatin, cisplatin, cyclophosphamide, doxorubicin, 5-fluorouracil, levamisole, methotrexate, and paclitaxel [7]. Taste change translates to significantly reduce food intake, thereby lowering the energy value of the diet on average 900–1100 kcal, and constitutes a primary factor in inducing malnutrition and deteriorating the quality of life [25], reducing compliance with treatment regimens, reducing immunity, impairing ability or desire to procure food, diminishing food appreciation, changing patterns of food intake, rituals, and social activities linked to eating and drinking and emotional distress and interference with daily life [8, 9]. The energy value of the diet in the studied group of women differs from the recommended intake [13] and was lower than the estimated in other studies [25–28]. The energy

intake from protein was lower in comparison to studies by other authors [25–27, 29] however a high percentage of dietary fat similar to Hutton et al. [25] 32.6 %, Gudny Geirsdottir and Thorsdottir [26] 33 %, and Ilow et al. [27] 34.9 %. Enig et al. [29] assessed the percentage of energy derived from fat at even 45 %. In our study, high intake of antioxidants (vitamin E and vitamin C) was observed what is compatible with other studies [27–29]. We also observed low intake of magnesium and calcium what was confirmed by the study Enig et al. [29]. Low intake of magnesium appears to be particularly important because 75 % of patients were treated with platins, what is often connected with hypomagnesemia [30].

Numerous changes of dietary habits in our study were observed but what is important is the health benefits were more expressed in women undergoing subsequent-line chemotherapy. In the study by Thompson et al. [31], women after treatment of early stage breast cancer had a higher intake of fruit and vegetables and foods rich in fiber and less frequently consumed high-fat products such as fat cheeses, red meat, fast food, sweets, and fried foods. Additionally, it was observed that the longer the time since the diagnosis, the more health-promoting behavior changes were presented. Enig et al. [29]

reported in patients with various types of cancer lower intake of fat products, cheese, eggs, rye bread, or poultry and pointed that changes in nutritional habits were most expressed in patients with relapsed disease. Ilow et al. [32] compared women with breast and ovarian cancer to the healthy women and showed that cancer patients consumed more fruit and vegetables, lean dairy products, and poultry and less fat cheeses, beef, and pork but also less wholemeal bread and more white bread and more sweets. In population with prostate and breast cancer, Demark-Wahnefried et al. [33] showed that almost 69 % of the patients declared the use of low-fat diet, and 58 % declared daily physical activity. The change in dietary habits in patients after diagnosis of cancer is also confirmed by the research of Salminen et al. [34] where the main reason for the change in dietary habits was to cure cancer (52.9 %) and alleviate nausea-associated therapy (11.8 %) and recommendation of changes in diet on the part of medical staff (11.8 %). Similar changes in dietary habits in colorectal cancer patients were observed by Van Loon et al. [35] who showed that patients undergoing chemotherapy increase the intake of fish, vegetable, fruits, and whole grains and decrease the intake of red meat, whole milk, sugar, and alcohol.

The EORTC QLQ questionnaire is an integrated system for assessing the health-related QoL of cancer patients participating in international clinical trials. The use of supplementary questionnaire modules, when employed in conjunction with the QLQ-C30, can provide more detailed information relevant to evaluating the QoL in specific patient populations [19]. In the conducted study, no significant differences in QoL parameters were observed. Meraner et al. [36] showed that with the duration of chemical treatment, QoL of women with EOC is improving. At the same time, authors indicated that surgical treatment was cited as the most important factor in the deteriorating QoL of women who were in the initial stage of chemotherapy. The results confirmed also Greimel et al. [37] who observed improvement in QoL in patients with EOC with time since diagnosis. In the study of Stephenson et al. [5], there were no significant QoL differences between colorectal cancer patients treated with palliative intent or adjuvant therapy. Additionally, neither behavior was significantly associated with QoL or perceived social support. In contrast, Ravasco et al. [7] showed that although cancer stage was the major determinant of patient's QoL globally, there were some diagnoses for which the impact of nutritional deterioration combined with deficiencies in nutritional intake may be more important than the stage of the disease process. It is still actual that the interaction between nutrition and QoL is as-yet unexplored [38].

Although present cross-sectional study has retrospective character it brings a lot of useful information. Using repeated measures of diet and quality of life probably would give more precocious results, however self

estimated diet changes using modified, validated FFQ are also valuable. Dietary habits changes during chemotherapy in patients undergoing first line chemotherapy and in patients undergoing subsequent-line chemotherapy were compared. Although the subsequent-line group is heterogenous the main study objective was to indicate the changes that occur after the first chemotherapy line. Small sample size is another limitation of the study, however, comparable with other studies concerning nutritional factors in cancer population [5, 9, 11]. Obtained results do not allow to draw unambiguous conclusions and therefore more broadened studies are needed.

Conclusions

Women undergoing chemotherapy for ovarian cancer change their dietary habits in a pro healthy direction. The health benefits were more expressed in patients undergoing subsequent-line chemotherapy. There were no differences in dietary intake and quality of life between the studied groups.

Conflict of interest The authors declare no conflict of interest and state that they have full control of all primary data and that they agree to allow the journal to review their data if requested.

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