



Original Research

# Relationship between nutritional status and health-related quality of life in patients receiving chemotherapy after radical ovarian cancer surgery: a cross-sectional study

Nan Qin<sup>1</sup>, Di Sun<sup>2</sup>, Xu Zhang<sup>3</sup>, Guichun Jiang<sup>4,\*</sup>

<sup>1</sup>Department of Gynecology, Cancer Hospital of China Medical University, Liaoning Cancer Hospital and Institute, 110042 Shenyang, Liaoning, China

<sup>2</sup>School of Nursing, Liaoning University of Traditional Chinese Medicine, 110000 Shenyang, Liaoning, China

<sup>3</sup>School of Nursing, China Medical University, 110000 Shenyang, Liaoning, China

<sup>4</sup>Department of Nursing, Cancer Hospital of China Medical University, Liaoning Cancer Hospital and Institute, 110042 Shenyang, Liaoning, China

\*Correspondence: [lnzlhulibu@163.com](mailto:lnzlhulibu@163.com) (Guichun Jiang)

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## Abstract

**Objective:** To investigate the nutritional status and health-related quality of life (HRQoL) of postoperative chemotherapy patients with ovarian cancer and to discuss the relationship between these patients' nutritional status and HRQoL. **Methods:** 201 postoperative chemotherapy patients with ovarian cancer were enrolled. All of them were assessed with a general information questionnaire, the Patient Generated-Subjective Global Assessment (PG-SGA), and the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire-C30 (EORTC QLQ-C30). We compared the nutritional status and HRQoL among patients with different demographics and disease characteristics, as well as analyzed the correlations between nutritional status and HRQoL. **Results:** The mean quantitative evaluation of PG-SGA in patients receiving postoperative chemotherapy for ovarian cancer was  $7.82 \pm 4.58$ . Almost all of the study subjects in this investigation were moderately or severely malnourished and required nutritional support. We established a multivariate linear regression equation and found that the total PG-SGA score is an important predictor of HRQoL in postoperative chemotherapy patients with ovarian cancer. **Conclusions:** Medical staff can improve the HRQoL of this patient population by improving their nutritional status, thereby enhancing their clinical outcome.

**Keywords:** Ovarian cancer; Quality of life; Nutritional status

## 1. Introduction

Ovarian cancer is the most severe gynecological malignancy. Among the female reproductive system cancers in China, the incidence rate of ovarian cancer is second only to cervical cancer and endometrial cancer, ranking third, but the mortality rate is highest [1]. In 2020, more than 300,000 new cases of ovarian cancer are expected worldwide, with more than 190,000 deaths [2]. According to the 2015 China Cancer Statistics, there are 52,100 new cases of ovarian cancer and 22,500 deaths each year in China [3]. Ovarian cancer has occult characteristics and lacks typical clinical symptoms, as well as early diagnosis methods. More than 70% of patients are already in the advanced stage at the time of diagnosis. The 2017 National Comprehensive Cancer Network (NCCN) Clinical Practice Guidelines in Ovarian Cancer suggest that in the treatment of ovarian cancer, ovarian tumor cytoreductive surgery combined with adjuvant chemotherapy should be considered first. Chemotherapy not only can effectively prolong the survival of patients with ovarian cancer but can also improve their clinical outcomes [4].

However, while killing tumor cells, chemotherapy itself can also kill normal cells and cause serious adverse reactions [5]. The adverse reactions caused by chemotherapy,

such as nausea, vomiting and loss of appetite, often coexist in the form of “symptoms”, which plague ovarian cancer patients who are undergoing chemotherapy, and many patients even have decreased tolerance to chemotherapy and are forced to stop treatment. On the other hand, malnutrition often occurs in cancer patients receiving chemotherapy. The main reason is that malignant tumors can consume the body's nutrients and lead to malnutrition in tumor patients, and the toxic side effects of chemotherapy drugs can further aggravate malnutrition. Malnutrition not only negatively affects the survival of cancer patients but also reduces health-related quality of life (HRQoL).

The US Food and Drug Administration (FDA) officially defines HRQoL as “a multidomain concept that represents the patient's general perception of the effect of illness and treatment on physical, psychological, and social aspects of life [6]”. The results of a large sample size by Kostka J *et al.* [7] showed that obese elderly people had worse quality of life and those with good nutritional status had better quality of life and fewer self-reported quality of life problems, therefore they concluded that nutritional status was an independent predictor of HRQoL. Nutritional status not only affects the quality of life of normal people, but also that of people with diseases. Previous study in lung cancer pa-



tients found that malnutrition is strongly associated with decreased quality of life and symptom severity, and that malnutrition may be an independent determinant of decreased quality of life and reduced physical function [8]. However, fewer studies have investigated the nutritional status and HRQoL of patients undergoing chemotherapy after radical ovarian cancer surgery. Furthermore, HRQoL is known to be a multidimensional concept that includes common symptoms, treatment side effects, functioning, and general perceptions of health and well-being. Nevertheless, few studies of ovarian cancer patients have explored in depth the relationship between nutritional status and the dimensions of HRQoL.

In this cross-sectional study, the aim was to comprehensively and systematically investigate and analyze the nutritional status and HRQoL of postoperative chemotherapy patients with ovarian cancer and to discuss the relationship between nutritional status and HRQoL among this cohort of patients.

## 2. Methods

### 2.1 Study design and participants

This descriptive cross-sectional study used a convenience sampling method and recruited postoperative patients with ovarian cancer who were receiving chemotherapy from gynecological ward of Liaoning Cancer Hospital & Institute in Shenyang, mainland China, between March 2020 and October 2020. Inclusion criteria were as follows: (1) patients with a confirmed pathological diagnosis of ovarian cancer; (2) patients older than 18 years old, with clear consciousness and the ability to read and write correctly; (3) patients with no postoperative complications after surgery, and receiving a chemotherapy scheme corresponding to the 2017 NCCN International criteria, for more than one chemotherapy treatment period; and (4) patients who provided consent and volunteered to participate in this research. The exclusion criteria included subjects who had metabolic diseases (hyperthyroidism, gout, etc.) and subjects who could not cooperate with the investigation due to emotional or cognitive problems.

### 2.2 Nutrition measurement

The Patient-generated Subjective Global Assessment (PG-SGA) is the preferred nutritional assessment tool recommended by the American Society of Parenteral Enteral Nutrition and has been specifically developed for use in cancer populations [9]. Clinical studies have revealed that the PG-SGA is an effective cancer patient-specific nutritional status assessment tool [10–12].

The PG-SGA consists of two sections: a patient-completed assessment section and a clinician-completed assessment section. The assessment content encompasses seven components, including weight, food intake, symptoms, activities and functional capacity, disease and its relation to nutritional requirements, metabolic demand and

physical examination. All components of the PG-SGA are evaluated by a digital scoring method. The global assessment includes a quantitative assessment and a qualitative assessment. PG-SGA scores between 4–8 points require intervention by requiring intervention by dietitian in conjunction with nurse or physician, while scores  $\geq 9$  imply a critical need for improved symptom management and/or nutrition intervention. The qualitative assessment adds scores from the seven aspects to obtain the PG-SGA score of nutritional status. The quantitative assessment divides the nutritional status of cancer patients into three levels: well-nourished (PG-SGA rating A), moderately malnourished or suspected of being malnourished (PG-SGA rating B), and severely malnourished (PG-SGA rating C) [13,14].

### 2.3 Health-related quality of life measurement

EORTC Quality of Life Questionnaire-C30 V3.0 (QoL-C30) comprises 30 items organized into five functional scales, nine symptom scales and a global health status scale. Each item is both scored by grade rating. Items 29 and 30 are answered according to a 7-point scale, and the other items are answered according to a 4-point scale. The raw score was obtained by adding the scores of each scale and dividing the total by the number of items. The QoL-C30 standardization score was obtained by the raw score, ranging from 0 to 100. Higher scores in the global QoL or functional scales implied better HRQoL or function; higher scores in the symptom scales/items indicated worsening of symptoms. The QLQ-C30 questionnaire has high comparability in clinical studies among different countries and regions, and its reliability, validity and sensitivity have been verified in several countries [15].

### 2.4 Data collection

Both demographic data and disease-related information were obtained from the self-report questionnaire. Demographic data included age, marital status, economic level, etc. Disease-related information included stage of cancer, chemotherapy stage, metastasis status of cancer, complications, etc. Prior to completing the questionnaire, study team members used a uniform instruction guide to introduce the purpose and meaning of the survey to study participants. All subjects who met the criteria and consented to the study were asked to complete the self-report questionnaire, the PG-SGA and the QLQ-C30 in the afternoon of that chemotherapy stage. For patients who had difficulty filling in their answers, the investigator helped patients to fill out their responses one by one. The response time was 10–15 minutes. After completing the questionnaire, each participant received a modest gift as compensation for their time. The clinician-completed assessment section of the PG-SGA was completed by clinical staff as soon as the questionnaire was received from patients.

**Table 1. Demographic and clinical characteristics of participants (N = 201).**

Characteristics	Categories	Number (%)
Age	20–44	21 (10.40)
	45–59	107 (53.20)
	≥60	73 (36.30)
Marital status	Married	182 (90.50)
	Single	8 (4.00)
	Divorced	3 (1.50)
	Widowed	8 (4.00)
Education level	Primary school	45 (22.40)
	Junior high school	84 (41.80)
	High school/secondary school	51 (25.40)
	College/Bachelor	21 (10.40)
Economic level	≤1000	50 (24.90)
	1001–3000	119 (59.20)
	3001–5000	25 (12.40)
Stage (TNM)	I	24 (11.90)
	II	30 (14.90)
	III	123 (61.20)
	IV	24 (11.90)
Metastasis status of cancer	Metastasis	153 (76.10)
	Non-metastasis	48 (23.90)
Complication	No	175 (87.00)
	Yes	26 (13.00)
Chemotherapy stages	Early period	77 (38.30)
	Middle period	64 (31.80)
	Late period	60 (29.90)

### 2.5 Statistical analysis

Statistical analyses were carried out using Statistical Package for the Social Sciences (SPSS) version 19.0 (IBM Corp., Armonk, NY, 237 USA). All analyses were two-tailed, and a  $p$ -value  $< 0.05$  was accepted as statistically significant. Demographic data and disease-related information of the participants were examined by computing frequencies, percentages. The Kolmogorov–Smirnov test was used to examine whether the assumption of normality was met and, consequently, ascertain the appropriateness of parametric analyses. Comparison between multiple groups was done using One-way ANOVA test followed by Post Hoc Test (Least Significant Difference). To test for unadjusted associations between variables, Pearson’s  $r$  correlations were used. HRQoL scores were normally distributed in regression models, and residual plots and equality of variance tests revealed no significant deviation from homoscedasticity, indicating that linear regression is appropriate. A multiple stepwise linear regression was used to examine the linear trends for PG-SGA and HRQoL.

## 3. Results

### 3.1 Study population

Study personnel delivered 205 questionnaires and received 201 valid questionnaires. The rate of receiving

valid questionnaires was 98.05%. Among the 201 post-operative patients with ovarian cancer who were receiving chemotherapy, the mean age was  $55.36 \pm 10.6$  years. A total of 119 (59.2%) patients had a medium level of monthly income (1001–3000 yuan), and 84 (41.8%) were educated to the level of junior high school. According to the chemotherapy regimen and related literature staging criteria [16], the subjects were divided into early chemotherapy stage (treatment time 1–6 weeks), middle chemotherapy stage (treatment time 7–12 weeks) and late chemotherapy stage (treatment time 13–18 weeks). 77 (38.3%) patients were in the early chemotherapy stage, 64 (31.8%) were in the middle chemotherapy stage, and 60 (29.9%) were in the late chemotherapy stage. The details are shown in Table 1.

### 3.2 Nutritional status assessment

Among the 201 patients, the average PG-SGA score was  $7.82 \pm 4.58$ . The cohort was categorized into 3 classes using the PG-SGA qualitative grading standard: PG-SGA rating A (well-nourished), PG-SGA rating B (moderately malnourished or suspected of being malnourished), and PG-SGA rating C (severely malnourished). Our study indicated that the PG-SGA rating A group comprised only 2 of the patients, who were well nourished and did not require nutritional intervention. The details are shown in Table 2.

**Table 2. Global PG-SGA assessment of ovarian patients receiving chemotherapy after radical surgery (N = 201).**

PG-SGA	Number	Proportion (%)	Mean $\pm$ SD
A	2	1.0	1.00 $\pm$ 0.00
B	119	59.2	4.79 $\pm$ 1.82
C	80	39.8	12.49 $\pm$ 3.33
Total	201	100	7.82 $\pm$ 4.58

A = well-nourished; B = moderately or suspected of being malnourished; C = severely malnourished.

### 3.3 Health-relate quality of life assessment

From the assessment of the subjects' HRQoL scores, the worst three items of the functional domain and global health status were global health status, social function, and physical function, and the worst five items of the symptom domain were economic difficulties, fatigue, insomnia, loss of appetite, and pain.

Comparing all the HRQoL scale scores of patients with different demographic characteristics, there was a statistically significant difference ( $F = 4.78, p = 0.01$ ) in the financial difficulties scale HRQoL score among different age groups. In addition, there were statistically significant differences in social function ( $F = 2.60, p = 0.04$ ), fatigue ( $F = 2.52, p = 0.04$ ), and financial difficulties ( $F = 6.92, p < 0.001$ ) scale HRQoL scores among different economic levels.

On the other hand, comparing all the HRQoL scale scores of patients with different clinical characteristics, there was a statistically significant difference ( $F = 4.87, p = 0.03$ ) in the nausea/vomiting scale score based on the metastasis status of cancer. However, there were no significant differences in any HRQoL scales among the patients who had different cancer stages ( $p > 0.05$ ).

### 3.4 Correlation between nutritional status and HRQoL

Pearson correlation analysis was used to examine correlations between nutritional status and HRQoL. Table 3 shows that a significant negative correlation ( $p < 0.01$ ) exists between PG-SGA global assessment and five function subscales, and a significant positive correlation ( $p < 0.01$ ) exists between PG-SGA global assessment and other dimensions of QLQ-C30.

### 3.5 Regression analysis of influencing factors on the HRQoL of patients with ovarian cancer receiving chemotherapy after radical surgery

To analyze the influencing factors of the HRQoL among the patients, multivariate regression linear analysis was performed. Demographic features, clinical characteristics and nutritional status assessments with statistically significant difference in the correlation analysis (e.g., age, chemotherapy stage, and PG-SGA score) were entered as independent variables. The scores of all HRQoL scales were entered as dependent variables.

On the fatigue symptom scale of the HRQoL assessment, PG-SGA score explained 24.5% of the total variation (adjusted  $R^2 = 0.245, F = 65.850, p = 0.000$ ); on the pain symptom HRQoL scale, PG-SGA score explained 32.3% of the total variation (adjusted  $R^2 = 0.323, F = 96.565, p = 0.000$ ). PG-SGA score, PG-SGA weight score and PG-SGA symptoms score were significant predictive factors of physical function of HRQoL, which explained 24.7% of the variance (adjusted  $R^2 = 0.247, F = 22.878, p = 0.000$ ). PG-SGA score and chemotherapy stage were significant predictive factors of the global health status of HRQoL, which explained 15.4% of the variance (adjusted  $R^2 = 0.154, F = 19.181, p = 0.000$ ). The data are detailed in Table 4. Taken together, these results suggest that PG-SGA score represents an important predictor of HRQoL. Hence, nutritional status was found to be an important influencing factor for a patient's HRQoL.

## 4. Discussion

With the increasing incidence of gynecological malignancies and the high mortality of ovarian cancer, ovarian cancer has become a hot topic among researchers in the medical community. Ovarian tumor cytoreductive surgery combined with adjuvant chemotherapy is the main treatment. And due to the toxic side effects of chemotherapy and the metabolic consumption characteristics of the tumor itself [17], the incidence of malnutrition in patients undergoing chemotherapy is high. In addition, the HRQoL of cancer patients is the problem needed to be improved. This study used questionnaires to evaluate the nutritional status and HRQoL of postoperative chemotherapy patients with ovarian cancer, to study the correlation between nutritional status and HRQoL and to provide a clinical basis and direction for improving the HRQoL of these patients.

### 4.1 Nutritional status of ovarian cancer patients receiving chemotherapy after radical surgery

The present study found that through the nutritional status assessment, the mean quantitative evaluation of PG-SGA in patients receiving postoperative chemotherapy for ovarian cancer was  $7.82 \pm 4.58$ . Almost all of the study subjects in this investigation were moderately or severely malnourished and required nutritional support, indicating the poor nutritional status of patients undergoing chemotherapy after ovarian cancer surgery. The incidence of malnutrition in cancer patients ranges from 40 to 80% [18]. Soeters *et al.* [19] noted that patients with cancer have an abnormal metabolism and that the rest of their energy consumption has increased, so the patients are often in malnutrition. The nutritional status during chemotherapy is the premise to ensure that patients can adhere to chemotherapy treatment [20]. A survey by Laky *et al.* [21] found that sixty-seven percent of patients with gynecological cancer were classified as malnourished and that ovarian cancer patients have significantly poorer nutritional status than other

**Table 3. Pearson analysis of HRQoL and nutrition status of ovarian patients receiving chemotherapy after radical surgery.**

Variable	PG-SGA-weight	PG-SGA-Food intake	PG-SGA symptoms	PG-SGA-Activities and function	PG-SGA-metabolic demand	PG-SGA-disease and its relation to nutritional requirement	PG-SGA-physical examination	Total-PG SGA score	Global-PG-SGA-assessment
Physical function	-0.204**	-0.334**	-0.288**	-0.492**	0.085	0.019	-0.103	-0.435**	-0.416**
Role function	-0.269**	-0.298**	-0.275**	-0.512**	0.100	-0.021	-0.088	-0.449**	-0.417**
Emotional function	-0.229**	-0.245**	-0.427**	-0.355**	0.011	0.036	-0.018	-0.460**	-0.393**
Cognitive function	-0.038	-0.046	-0.285**	-0.246**	0.077	0.075	-0.031	-0.234**	-0.189**
Social function	-0.227**	-0.254**	-0.368**	-0.421**	0.074	0.014	-0.033	-0.445**	-0.376**
Global health status	-0.076	-0.171*	-0.369**	-0.396**	0.093	0.095	-0.098	-0.365**	-0.329**
Fatigue	0.265**	0.376**	0.343**	0.486**	-0.101	0.013	0.099	0.499**	0.392**
Pain	0.394**	0.402**	0.403**	0.426**	-0.010	0.054	0.049	0.572**	0.427**
Nausea/Vomiting	0.131	0.283**	0.635**	0.204**	0.008	-0.064	0.046	0.515**	0.352**
Dyspnea	0.100	0.139*	0.110	0.281**	-0.016	0.011	0.004	0.196**	0.180*
Insomnia	0.253**	0.299**	0.307**	0.207**	-0.065	0.036	0.060	0.390**	0.306**
Appetite loss	0.273**	0.348**	0.632**	0.266**	0.025	0.017	0.086	0.607**	0.446**
Constipation	0.035	0.186**	0.383**	0.139*	0.004	0.038	0.135	0.205**	0.166*
Diarrhea	0.173*	0.251**	0.372**	0.113	-0.037	0.055	0.017	0.360**	0.235**
Financial difficulties	0.095	0.102	0.305**	0.241**	-0.142*	-0.066	-0.043	0.268**	0.194**

\* $p < 0.05$ , \*\* $p < 0.05$ .

**Table 4. Multiple linear stepwise regression of HRQoL and nutrition status of ovarian patients receiving chemotherapy after radical surgery.**

Dependent variable	Independent variable	R <sup>2</sup>	Adjusted R <sup>2</sup>	F	p	Unstandardized coefficients		t	p
						B	Std.Error		
Physical Function	Model	0.258	0.247	22.878	0.000				
	Constant					95.238	2.913	32.698	0.000
	Total PG-SGA score					-5.028	0.784	-6.411	0.000
	PG-SGA -weight					5.700	1.391	4.097	0.000
	PG-SGA -symptoms					3.876	1.053	3.682	0.000
Fatigue	Model	0.249	0.245	65.850	0.000				
	Constant					17.431	2.592	6.725	0.000
	Total PG-SGA score					2.394	0.295	8.115	0.000
Pain	Model	0.327	0.323	96.565	0.000				
	Constant					-2.097	2.418	-1.867	0.068
	Total PG-SGA score					2.705	0.275	9.827	0.000
Global health status	Model	0.162	0.154	19.181	0.000				
	Constant					83.766	4.891	17.128	0.000
	Total PG-SGA score					-1.957	0.329	-5.942	0.000
	Chemotherapy stage					-4.911	1.882	-2.610	0.000

F, ANOVA; R<sup>2</sup>, coefficient of determination; B, regression coefficient.

gynecological patients. At the same time, Chantragawee *et al.* [22] and other surveys found that malnutrition is widespread in patients with ovarian cancer, consistent with the results of our study. Moreover, the study found that the three categories of dietary intake reduction, weight loss, and subcutaneous fat consumption are the most affected on the nutritional evaluation. It can be seen that the nutritional status of postoperative chemotherapy patients with ovarian cancer is considerably worrying and requires clinical attention and evaluation and should be improved urgently.

Paula Ravasco *et al.* [23] demonstrated that dietary intervention for chemotherapy patients with malignant tumors can significantly improve their nutritional status, which is of great clinical significance for ensuring the progress of chemotherapy. On the other hand, the results of this survey showed that there are significant differences in nutritional status among patients with different chemotherapy stages and economic levels ( $p < 0.05$ ). Therefore, it is necessary to provide individualized dietary guidance and health education to patients and their families. Medical staff especially need to pay more attention to the nutritional status changes of patients within the early period of chemotherapy and solve the problem of reduced dietary intake due to chemotherapy side effects as soon as possible to effectively improve the nutritional status of them, ensuring the progress of chemotherapy.

#### 4.2 HRQoL of ovarian patients receiving chemotherapy after radical surgery

The results of this study showed that HRQoL of the patients is poor and were the same as the results of a sur-

vey by Lutgendorf *et al.* [24] on the quality of life of gynecologic oncology patients. The worst three items of the functional scales and overall health status of patients with ovarian cancer after chemotherapy were the general health status, social function, and physical function scores. A poor physical function score indicated that the patient's physical strength was reduced, and their activity capacity was decreased. The physical function score of the subjects was only  $74.36 \pm 20.36$ .

The top five symptoms of HRQoL in the 201 patients are financial difficulties, fatigue, insomnia, loss of appetite, and pain. Numerous studies have indicated that [25] 76% of patients receiving cancer chemotherapy feel tired at least a few days a month, and up to 30% of patients feel tired every day. Chemotherapy patients generally have fatigue, which is consistent with the results of our study. There are many reasons for the fatigue of cancer patients in addition to the cause of cancer itself, including the long-term mental stress of patients after anti-tumor treatment, as well as side effects of chemotherapy and radiotherapy, which can also lead to fatigue. In addition, the results of this study showed that loss of appetite and pain are widespread symptoms that patients are severely plagued by. Therefore, in clinical work, medical staff should aim to alleviate fatigue in patients receiving postoperative chemotherapy for ovarian cancer, to improve appetite and pain problems, to provide individualized health education and pain care, to relieve patients' mental stress, to guide patients to rest reasonably, and to help patients avoid common side effects during chemotherapy. In the events of anemia, eating difficulties, and malnutrition, symptomatic treatment should be given in combina-

tion with treatment to reduce these discomforts and improve the HRQoL of patients receiving postoperative chemotherapy for ovarian cancer.

In the one-way analysis of variance of the clinical characteristics of the 201 patients, there was a significant difference in the global health status of HRQoL among patients at different chemotherapy stages, and there was no significant difference in any HRQoL scales among patients when grouped by tumor stage. Likely, these differences are due to the occult nature of ovarian cancer itself, and ovarian cancer patients are usually diagnosed in the late stage. Therefore, the sample size should be further expanded, and more research institutions should be involved, such that a multicenter investigation will be performed.

#### *4.3 Correlations between nutritional status and HRQoL in the multiple linear regression analysis*

The current study found that patients with good nutritional status are superior to malnourished patients in terms of physical function, role function, emotional function and overall health. Furthermore, comparing the groups, patients with good nutritional status had fewer problems with fatigue, pain, nausea, vomiting, insomnia, and loss of appetite than did patients with severe malnutrition. PG-SGA score and the global PG-SGA assessment of the patients were negatively correlated with all the functional scales and total health status of HRQoL ( $p < 0.01$ ), indicating that the better the nutritional status is of the patients, the better the functional quality and overall health status will be. PG-SGA score of them were positively correlated with the HRQoL symptom scale ( $p < 0.01$ ), which means that the worse the nutritional status is of them, the more the symptoms will affect the HRQoL. This finding suggests that the nutritional status of patients receiving postoperative chemotherapy for ovarian cancer is closely related to their HRQoL. Further, through the establishment of multiple linear regression equations, it was found that the total PG-SGA score was the influencing factor in the two categories of fatigue and pain in the HRQoL assessment. Pain and fatigue are problems that seriously afflict patients with cancer. Fifty-nine percent of patients receiving anticancer treatment have pain [26], and more than 75% of cancer patients feel tired [27]. The HRQoL of patients with cancer is severely affected by pain and fatigue.

Therefore, in the clinical setting, improving the nutritional status of postoperative chemotherapy patients with ovarian cancer can improve the patients' physical function, role function, emotional function, etc, relieve the symptoms of fatigue and pain and effectively improve the HRQoL of these patients. Especially for ovarian cancer patients receiving chemotherapy with moderate to severe malnutrition, targeted individualized nutritional support and treatment can improve the patients' HRQoL more effectively and has more important clinical significance and value.

The present study also has some limitations. This

study is a cross-sectional study, it is not yet possible to determine the causal relationship between nutritional status and quality of life. Future large sample cohort studies are needed to further validate these findings. Moreover, we used a convenience sample of ovarian cancer patients which, by being a nonprobability sampling method, may not adequately represent the population.

## **5. Conclusions**

In summary, the nutritional status and HRQoL of ovarian patients receiving chemotherapy after radical surgery are significantly correlated. Improving the nutritional status of the patients can effectively boost their HRQoL and ensure the progress of chemotherapy. Overall, we expect clinical treatment providers to pay more attention to the nutritional evaluation and provide nutritional support for postoperative chemotherapy patients with ovarian cancer in order to improve their nutritional status and quality, thus improving the clinical outcome and survival time of these patients.

## **Author contributions**

NQ and XZ contributed to the conception and design of the study. GCJ contributed to the application for funding of 2019 study. QN managed the data cleaning, and conducted the analyses, with contributions from DS. NQ, DS, XZ and GCJ interpreted the data, drafted the article and revised it. All authors contributed to the manuscript and approved the final version.

## **Ethics approval and consent to participate**

This study was granted ethical approval by the Liaoning Cancer Hospital & Institute Ethics Committee (No. 20181002). In accordance with the Declaration of Helsinki, participants were informed of the purpose and procedures of the study prior to the start of the study, and they had the right to leave the study at any time without having to answer any questions. All participants signed an informed consent form prior to the start of the study.

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## **Conflict of interest**

The authors declare no conflict of interest.

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