

# Factors Influencing Quality of Life in Patients with Nasopharyngeal Cancer Based on QLICP-NA (Version 2.0)

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## Research

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# Abstract

**Objective** To determine the quality of life (QoL) of patients with nasopharyngeal carcinoma (NPC) and the clinical factors that influence QoL.

**Methods** Multiple linear regression, simple and canonical correlation analyses were used to analyze the factors that affected QoL in patients with NPC.

**Results** The QoL scores were as follows: physical function domain,  $61.03 \pm 15.03$ ; mental function domain,  $60.95 \pm 15.35$ ; social function domain,  $59.17 \pm 14.16$ ; specific module domain,  $75.62 \pm 14.87$ ; and total scale score,  $66.10 \pm 97.18$ . Multiple linear regression analyses showed that family economic status and clinical stage of the disease are the factors affecting the overall QoL among NPC patients. The simple correlation analysis showed that the hemoglobin level had a positive correlation with physical function, social function, specific module domains, and the total score of the total scale. Canonical correlation analysis revealed a pair of statistically significant typical variables and the canonical correlation coefficient was 0.561 ( $P < 0.05$ ).

**Conclusion** The indicators related to the QoL among patients with NPC included family economic status, clinical stage of the disease, red blood cell count, and albumin, total bilirubin, blood urea nitrogen, creatinine, aspartate aminotransferase, and hemoglobin levels. A focus on these indicators and implementing the corresponding treatment measures had value in improving the QoL among patients with NPC.

## Introduction

Nasopharyngeal carcinoma (NPC) is endemic in southeast Asia<sup>[1]</sup>, with the highest rates observed in Guangdong province in south China<sup>[2]</sup>. For this reason, NPC is referred to as “Guangdong cancer.”<sup>[3]</sup> Due to the special anatomic areas affected by NPC, radiotherapy, chemotherapy, traditional Chinese medicine, and immunotherapy are most often used in clinical treatment;<sup>[4]</sup> however, treatment of NPC is associated with common complications, such as ulcerative reactions and oral mucosal inflammation, resulting in oral erythema and swelling, decreased saliva secretion, and other eating disorders. Severe complications often cause a depressed mood, anxiety, surrender, avoidance, low self-management ability, and a reduced quality of life (QoL) and sense of self-identity, which together lead to a decline in the overall treatment experience and/or an abandonment of treatment, which seriously affects the effect of radiotherapy.<sup>[5-8]</sup> In this study, the QLICP-NA was used to evaluate the QoL of patients with NPC, thus providing relevant references for medical workers in the selection of treatment options and improve the QoL.

## Materials And Methods

### Survey tool

The QoL instruments for cancer patients (NPC QLICP-NA [version 2.0]), which was developed by Chonghua et al. [28] was adopted. The QLICP-NA scale has 47 items. The QLICP-NA consists of a common module (Quality of Life Instruments for Cancer Patients-General Module [QLICP-NA]) that is applicable to all cancer patients and a NPC-specific module specifically designed for NPC patients. The common module is also divided into four function fields: physical; psychological; social; and common symptoms and side effects. Previous studies have verified that the generic module has good reliability, validity, and responsiveness [9–11]. The scale utilizes a five-point distance scoring method (i.e., 1, 2, 3, 4, and 5 points). The higher the forward entry score, the better the QoL; the higher the reverse entry score, the worse the QoL. For the forward item, the original score is the item score. For the reverse item, forward transformation should be performed; thus, 6 minus the original score to obtain the item score. First, the raw score of each function and the total table are calculated separately. To make the score of each function comparable, the range method was used to convert the original score into a standard score of 0 ~ 100. The Cronbach alpha coefficients of the QLICP-NA (version 2.0) physiological function module, psychological function module, social function module, NPC-specific module, and total table were 0.82, 0.81, 0.71, 0.80, and 0.90, respectively. The results of dimensional correlation analysis of items showed that the correlation between the items in each function and the scores were greater than between the scores in other functions.

## Survey objects and methods

The data of this survey were obtained from the Affiliated Hospital of Guangdong Medical University. The investigator, a physician, explained the content and purpose of the survey. After informed consent was signed, the QLICP-NA (version 2.0) was sent to and completed by the patient. The general information and clinical features of the patient were extracted from the case by the investigator. In the end, 121 subjects were collected, and the inclusion and exclusion criteria were as follows:

The inclusion criteria were as follows:

- (1) Patients clinically diagnosed with NPC by pathological examination;
- (2) Patients with primary school education or above and fundamental reading, writing, and understanding ability; and
- (3) Patients who voluntarily participate in filling in the quality of life scale.

The exclusion criteria were as follows:

- (1) Patients who are illiterate or lack the ability to read and write;
- (2) Patients who cannot clearly express their true feelings due to their vague consciousness during hospitalization; and
- (3) Severe co-existing severe diseases.

## Analysis method

SPSS 26.0 software was used for statistical analysis. Measurement data are expressed as  $x \pm s$ , while counting data are expressed as the number of cases or percentage. Multiple linear regression, and simple linear and canonical correlation analyses were used to analyze the correlation between QoL, social population index, and clinical objective index. A  $P < 0.05$  was considered statistically significant. The scores in the five domains of the scale (Y1 ~ Y5) were designated as the canonical correlation variable, U, and the clinical objective indicator variables (X1 ~ X19) were designated as the canonical correlation variable, V. The X and Y variable aggregates were analyzed for the canonical correlation analysis.

## Results

A comparison of the QoL among patients with different social and demographic factors, and clinical characteristics is shown in Table 1. A total of 121 NPC patients were investigated, including 91 males and 30 females. There were 62 patients  $> 50$  years of age and 60 patients  $< 50$  years of age. The majority of the patients were married. Seventy-six patients were workers or farmers; the remaining patients had other occupations. The family economic status was good, moderate, and poor in 12, 55, and 54 patients, respectively. Of the 121 patients, 15 had a history of smoking, 10 had a history of alcohol consumption, 36 had a primary school education, 41 had a junior high school education, 30 had a technical secondary school or senior high school education, and 14 had a junior college or above education. Seventy patients had health insurance for urban residents. Two patients had stage I NPC, 12 had stage II NPC, 45 had stage III NPC, and 56 had stage IV NPC. Twenty-two patients were treated with radiotherapy, 38 with chemotherapy, 42 with radiotherapy plus chemotherapy, and 19 received other treatments. There was no statistically significant difference between the above indices in the total score of the scale. Table 2 shows the scores for the patients' QoL in all fields and the total table.

Table 1

Comparison of QoL among patients with different sociodemographic factors and clinical characteristics

		N	Scale total score		
			X ± S	t/F	P
Sex	Male	91	66.45 ± 11.58	0.57	0.57
	Female	30	65.06 ± 11.72		
Age	< 50	60	67.37 ± 11.78	1.20	0.23
	≥ 50	62	64.85 ± 11.34		
Marriage status	Married	111	66.11 ± 11.84	0.02	0.99
	The other	10	66.05 ± 8.62		
Career	Worker/Farmer	76	64.65 ± 11.60	1.81	0.07
	Other	45	68.55 ± 11.25		
Economic status	Good	12	73.50 ± 10.13	2.98	0.06
	Medium	55	65.92 ± 12.00		
	Poor	54	64.64 ± 11.00		
Smoking history	Yes	15	65.58 ± 11.53	0.15	0.88
	No	106	66.15 ± 11.63		
Drinking history	Yes	10	67.44 ± 10.68	0.48	0.63
	No	111	65.91 ± 11.74		
Education	Primary school	36	64.44 ± 11.47	3.15	0.03
	Junior high school	41	63.37 ± 11.36		

		N	Scale total score		
			X ± S	t/F	P
	technical secondary school or senior high school	30	71.22 ± 11.03		
	junior college education or above	14	67.28 ± 11.07		
Medical form	Social insurance	70	66.69 ± 11.39	0.65	0.52
	Other	51	65.30 ± 11.90		
Clinical stage	I	2	61.34 ± 14.39	2.19	0.09
	II	12	71.71 ± 8.18		
	III	45	68.51 ± 11.64		
	IV	56	64.51 ± 10.57		
Treatment	Radiation therapy	22	65.94 ± 10.69	1.09	0.36
	Chemotherapy	38	64.96 ± 11.53		
	Radiation and chemotherapy	42	68.48 ± 12.07		
	Other	19	63.31 ± 11.49		

Table 2  
Scores of the scale

Domain	N	X ± S	The range of the score
physical function	121	61.03 ± 15.03	6.25–90.03
physiological function	121	60.95 ± 15.35	22.22–100.00
social function	121	59.17 ± 14.16	25.00-90.63
specific function	121	75.62 ± 14.87	6.82–97.73
total table	121	66.10 ± 97.18	35.47–88.37

The results of multiple linear regression analysis of the total score are shown in Table 3, with a determination coefficient of  $R^2 = 0.04$ . The factors influencing the total QoL score were family economic

situation and clinical stage. The regression coefficient of the clinical stage was negative, indicating that the QoL of patients was worse with an increase in stage. The regression coefficient of the family economic situation was positive, indicating that the QoL improved with an increase in the economic situation.

Table 3  
Stepwise regression of factors associated with QoL

<b>Factors</b>	<b><math>\beta</math></b>	<b>SE</b>	<b>t</b>	<b>P Value</b>
Constant	70.863	5.043	14.050	.000
Economic status	3.717	1.550	2.398	0.018
Clinical stage	-3.055	1.364	-2.240	0.027

Through simple correlation analysis, 15 objective indicators were selected to be correlated with the QoL of NPC patients, as shown in Table 4. The somatic functional areas were positively correlated with the albumin (Alb), total bilirubin (TB), creatinine (Cre), and hemoglobin (HGB) levels, and the red blood cell (RBC) count, which was strongly correlated with the HGB level. The mental function field was positively correlated with the alanine aminotransferase (ALT), aspartate aminotransferase (AST), and HGB levels. The social functional areas were positively correlated with the ALT and HGB levels, and the RBC count. The specific module domain was positively correlated with the RBC count and HGB level, and negatively correlated with the ALT, lactate dehydrogenase (LDH), and AST levels. The total score of the total scale was positively correlated with the Alb, Cre, and HGB levels, and the RBC count, which was strongly correlated with the HGB level.

Table 4  
Simple correlation analysis

	<b>GPH</b>	<b>GSH</b>	<b>SOD</b>	<b>SPD</b>	<b>TOT</b>
Alb(g/L)	0.282**	0.061	0.134	0.100	0.202*
GP(g/L)	0.061	-0.082	0.051	0.066	0.057
ALT(U/L)	0.103	0.223*	0.183*	-0.184*	0.099
TB(μmol/L)	0.218*	0.147	0.084	0.082	0.165
TBA(μmol/L)	0.149	0.120	0.033	0.125	0.129
ALP(U/L)	-0.158	-0.130	-0.071	0.050	-0.103
GGT(U/L)	0.060	0.138	0.088	0.064	0.126
BUN (mmol/L)	0.047	0.002	0.040	0.014	0.047
Cre (μmol/L)	0.207*	0.069	0.110	0.110	0.183*
LDH(U/L)	-0.113	0.012	0.062	-0.215*	-0.128
AST(U/L)	0.076	0.180*	0.172	-0.214*	0.053
WBC (10 <sup>9</sup> /L)	-0.007	-0.134	0.033	-0.052	-0.027
RBC (10 <sup>12</sup> /L)	0.269**	0.131	0.193*	0.222*	0.304**
HGB(g/L)	0.417**	0.179*	0.215*	0.287**	0.408**
PLT (10 <sup>9</sup> /L)	-0.028	-0.036	0.037	0.015	0.008
PHD, physical domain; PSD, psychological domain; SOD, social domain; SPD, specific domain; TOT, scale total score					
*At a p = 0.01 (two-tailed), the correlation was significant.					
**At a p = 0.05 (two-tailed), the correlation was significant.					

Canonical correlation analysis was performed on the above 15 objective indicators and the QoL of each patient. The 15 objective indicators were designated as an overall aggregate, X, and the scores of the four QoL fields and the total table were designated as an overall aggregate, Y. The canonical correlation analysis was conducted on aggregates X and Y, and the results are shown in Table 5. There were five pairs of canonical correlation variables. Only the first pair of canonical correlation variables had a P < 0.05, the correlation coefficient r was 0.561, and the Eigen value was 0.46. Table 6 shows the canonical correlation coefficient and typical load between the canonical correlation variable, V1, and the clinical objective indicators of patients with NPC, among which the typical load of Alb and the white blood cell (WBC) was larger, indicating that these two indicators had a greater impact on aggregate X. The typical

correlation coefficients (ALT and WBC count) were higher, indicating that ALT and the WBC count had a greater influence on aggregate Y. The Alb, globulin (GP), TB, ALP, BUN, and HGB levels, and the WBC, RBC, and platelet (PLT) counts were negatively correlated with the QoL of patients with NPC, indicating that the greater these indicators, the worse the QoL. The other objective indicators were positively correlated with the QoL of patients, indicating that the greater the indicators, the better the QoL of patients. It can be seen from Table 7 that the typical load of variables Y1 and Y5 was high, and the canonical correlation coefficient was also high and negative, indicating that with improvement in the QoL, the clinical objective index in aggregate X was lower.

Table 5  
Canonical correlation analysis

<b>Canonical variates</b>	<b>Canonical Correlation</b>	<b>F-statistic</b>	<b>P-value</b>
1	0.561	1.416	0.018
2	0.498	1.133	0.25
3	0.379	0.826	0.761
4	0.316	0.656	0.889
5	0.209	0.423	0.943

Table 6  
Correlation coefficient between the canonical variable, V1,  
and the clinical objective indices of patients with NPC

Original variables	New variables	V1	Loadings
A1b(g/L)	X <sub>1</sub>	-0.320	-0.584
GP(g/L)	X <sub>2</sub>	-0.264	-0.209
ALT(U/L)	X <sub>3</sub>	0.465	0.008
TB(μmol/L)	X <sub>4</sub>	-0.212	-0.356
TBA(μmol/L)	X <sub>5</sub>	0.216	0.201
ALP(U/L)	X <sub>6</sub>	-0.057	-0.033
GGT(U/L)	X <sub>7</sub>	0.073	-0.207
BUN (mmol/L)	X <sub>8</sub>	-0.015	-0.379
Cre(μmol/L)	X <sub>9</sub>	0.398	0.342
LDH(U/L)	X <sub>10</sub>	0.122	-0.007
AST(U/L)	X <sub>11</sub>	0.108	-0.524
WBC(10 <sup>9</sup> /L)	X <sub>12</sub>	-0.736	-0.79
RBC(10 <sup>12</sup> /L)	X <sub>13</sub>	-0.056	0.056
HGB(g/L)	X <sub>14</sub>	-0.443	0.065
PLT(10 <sup>9</sup> /L)	X <sub>15</sub>	-0.060	-0.245

Table 7  
Correlation coefficient between the canonical variable, U1,  
and the QoL among NPC patients

Original variables	New variables	U1	Loadings
PHD	Y <sub>1</sub>	-0.701	-0.919
PSD	Y <sub>2</sub>	0.474	-0.392
SOD	Y <sub>3</sub>	0.165	-0.417
SPD	Y <sub>4</sub>	-0.028	-0.592
TOT	Y <sub>5</sub>	-0.705	-0.843

The redundancy analysis is shown in Table 8. From the first pair of canonical variables, it can be seen that V1 explained 12.2% of the variation of the aggregate X objective index, and U1 explained 44.6% of the variation in the aggregate Y QoL score.

Table 8  
Redundancy analysis

Canonical variables	X * X	X* Y	Y * Y	Y * X
1	0.122	0.038	0.446	0.141
2	0.086	0.021	0.178	0.044
3	0.091	0.013	0.14	0.02
4	0.044	0.004	0.119	0.012
5	0.062	0.003	0.117	0.005

## Discussion

With the economic development and lifestyle changes in China, the incidence of NPC has increased year-after-year, especially in Guangdong, which poses a serious threat to population health. Radiotherapy is generally used in patients with NPC, but radiotherapy will damage the normal tissues, thus affecting the QoL of patients with NPC. In this study multiple linear regression analysis was used and the results suggested that factors affecting the overall QoL of NPC patients included family economic status and clinical stage of the disease. The better the family economic status, the higher the QoL of the patients. The QoL of patients with advanced NPC was lower than patients with early-stage NPC. This finding is consistent with the results of Henian et al. [22–24].

The results of this study showed that the life quality score in the specific module domain was higher, followed by the physical and psychological function domains, while the social function domain had the lowest score. Social function reflects the patient's interpersonal communication, social support, and social role. The social function score is the lowest, which may be because the external performance of NPC patients is apparent, which has a significant impact on their social interaction, thus leading to the lowest score. The psychological function domain mainly reflects the psychological status of patients because most of the patients are treated with radiotherapy. During radiation therapy, patients should bear the brunt of disease, and radiation physical discomfort or even pain, which will manifest in the psychological level of anxiety, depression, and other negative affective disturbances, seriously affect the patient's QoL during radiotherapy<sup>[12]</sup>, eventually leading to a lower score on the psychological function domain.

Using simple correlation analysis, it was shown that HGB had a strong and positive correlation with the physical function domain, social function domain, specific module domain, and total score of the scale. With an increase in the HGB level, the life quality score of patients increased gradually. HGB is a special

protein that transports oxygen in RBCs and is the protein that gives blood a red color. HGB is composed of globin and heme<sup>[13]</sup>. The clinical significance of the increase and decrease in HGB is similar to the clinical significance of the RBC count, a decrease of which will affect the transport function of oxygen and carbon dioxide in RBCs<sup>[14]</sup>. Hypoxic cells are present in tumors, hypoxic cells are a major cause of radiotherapy failure<sup>[15]</sup>, and oxygen is the strongest radiation sensitizer<sup>[16]</sup>. HGB is the main carrier of oxygen in the body. The concentration of HGB directly affects the oxygen content of human blood and the oxygen supply to the tumor. When the HGB concentration in the blood decreases, the blood oxygen content decreases, leading to the increase tumor tissue hypoxic cells, making the tumor resistant to radiation<sup>[17]</sup>. Bodily functions reflect the basic physiologic functions of the patient, including appetite, sleep, defecation, physical pain, and fatigue. With an increase in the HGB content, the physiological function of the patients improved gradually, leading to a gradual increase in the domain of physical function score. Specific symptoms in NPC patients include runny nose, nosebleed, dizziness, headache, and dysphagia, which may be improved with an increase in the HGB level, leading to increased motion-specific field QoL scores.

The results of typical correlation analysis showed that the objective indicators that had a significant impact on the QoL of NPC patients included Alb, TB, BUN, Cre, and AST levels, and the WBC and RBC counts. The higher the Alb, TB, and BUN levels, and the WBC count, the lower the physical domain and social domain scores. The higher the AST and Cre levels, the lower the PHD and TOT scores. WBCs are a component of the immune system. The total number of WBCs and cell classification in the blood will change during an inflammatory reaction, thus causing local tissue damage and causing a variety of complications<sup>[18]</sup> and reducing the patient's QoL. ALB is produced by the liver and has a half-life of 18 ~ 20 days. ALB reflects the nutritional status and cachexia of patients with cancer. There are different degrees of protein metabolic disorders in patients with malignant neoplasms, the underlying mechanism of which is not clear, but may be related to the plunder and consumption of large amounts of human protein by tumor cells during the growth process, and the poor appetite, dry mouth, and increased body consumption caused by radical radiotherapy<sup>[19-20]</sup>. When liver function is impaired, the ALT level is elevated, indicating that the patient may be malnourished or spread cancer cells. It is also possible that the immune system becomes hyperactive and the resistance decreases with a series of uncomfortable symptoms, which further aggravate the disease<sup>[21]</sup> is produced by the degradation of senescent RBCs in the blood, and can effectively eliminate peroxy radicals at micromolar concentrations, which has a strong antioxidant capacity and can prevent the generation of free radicals and oxidative damage<sup>[25]</sup>. Bilirubin can reduce kidney damage by inhibiting inflammatory responses and apoptosis. When the level of TB is reduced *in vivo*, the antioxidant and anti-apoptotic abilities are weakened, which can further aggravate the inflammatory response *in vivo*<sup>[26]</sup>, resulting in a decline in the QoL. Serum Cre and BUN are commonly used indicators for the evaluation of renal function<sup>[27]</sup>. Cre, as a metabolite of creatine, is excreted through the kidneys and a small amount is excreted from the renal tubules. An increase in these two indicators indicates that kidney function is impaired, thus affecting the patient's QoL.

Canonical redundancy analysis reflects the degree of variation interpretation for each canonical variable to the whole original variable group. From the above results, it can be seen that the variation degree of the first pair of canonical variables on the scores in all fields of the scale was not high, indicating that the clinical objective indicators could not fully reflect the patient's QoL, and may also be affected by other factors. Therefore, to study the QoL of NPC patients warrants comprehensive consideration of all factors.

## **Conclusion**

To sum up, among the objective clinical indicators of NPC, Alb, TB, BUN, Cre, and AST, and the RBC count reflected the patient's QoL, at least in part. Throughout the process of diagnosis and treatment of patients with clinical indicators undergoing comprehensive treatment, clinicians should pay special attention to decreased HGB, TB, ALB, and BUN levels, and WBC count and the patient's QoL. Clinicians should give more care and support to these patients, and to the specific symptoms and side effects to provide timely intervention and reduce the patients' psychological pressure, so as to improve the life QoL. In conclusion, early detection, diagnosis, and treatment of NPC patients should be achieved, and corresponding treatment measures should be implemented to improve the QoL of patients combined with the clinical objective indicators of examination.

## **Declarations**

### **Authors' contributions**

Chonghua Wan designed the study. Jiayuan Wu, Liren Hu, Zhangye Liang, and Jinlin Du performed the data collection. Yangchen Fang and Zheng Yang performed data analyses and drafted the manuscript. Zheng Yang revised the manuscript deeply. All authors contributed to interpreting the data, and have read and approved the final manuscript.

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### **Code availability**

Not applicable.

### **Conflicts of interest/Competing interests**

The authors declare that they have no competing interests.

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

The study protocol was approved by the Institutional Review Board (IRB) of the investigators' institutions and the hospital. The respondents were voluntary and provided written consent for participation.

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