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Original Article

Intervention model under the Omaha system framework can effectively improve the sleep quality and negative emotion of patients with mid to late-stage lung cancer and is a protective factor for quality of life

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Abstract: This study aims to evaluate the effects of Omaha System framework interventions on quality of life, emotional well-being, and sleep quality in 507 mid to late-stage lung cancer patients. Retrospectively, we compared data of 294 patients receiving conventional care (conventional group) with 213 patients undergoing Omaha System interventions (intervention group) from January 2019 to January 2023. Key indicators included quality of life (FACT-L), anxiety (SAS), depression (SDS), sleep quality (PSQI), hope (HHS), and dignity (PDI). Post-intervention, the intervention group showed a significant increase in FACT-L scores (P<0.001), indicating enhanced quality of life. There was a notable reduction in PSQI scores (P<0.001), suggesting improved sleep quality. Additionally, their anxiety and depression levels significantly decreased, as evidenced by lower SAS (P<0.001) and SDS scores (P<0.001). Logistic regression revealed that care nursing intervention scheme (P=0.007), age (P=0.008), marital status (P=0.002), per capita monthly household income (P=0.004), SAS after intervention (P=0.002), and PSQI after intervention (P=0.002) had a positive influence on quality of life. In conclusion, the Omaha System interventions markedly improved the quality of life, emotional state, and sleep in lung cancer patients.

Keywords: Omaha system framework, intervention model, lung cancer, quality of life, sleep quality, negative emotion, risk factors

Introduction

Lung cancer (LC), a prevalent cancer that affects people worldwide, is responsible for a significant number of cancer-related deaths [1]. In 2020, LC accounted for 11.4% of new cancer cases worldwide, with a mortality rate of 18.0% [2]. In China, there were about 820,000 new cases of LC and 710,000 related deaths in 2020, ranking first among all cancers [3]. It is expected that by 2025, the number of LC patients in China will reach 1 million [4]. More than three-fourths of patients are in advanced stages at the time of diagnosis due to the lack of obvious early symptoms [5]. The five-year survival rate of LC patients in European countries ranges from 11% to 15%, while the five-year survival rate in developed cities in China is still less than 13.75% [6, 7].

In recent years, due to advancements in both economic and medical fields, as well as the widespread adoption of comprehensive treatment approaches, the survival rates of LC patients have shown significant improvement. Recent advances in treatment have led to an increasing number of patients surviving with advanced lung cancer, presenting new and formidable challenges to tumor care [8, 9]. In addition to suffering from symptoms associated with LC, such as pain, chemotherapy reactions, and sleep difficulties, LC patients also endure a

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range of psychological and emotional distress, including anxiety, depression, despair, a sense of burden, and concerns about their families. These factors compromise both their physical and mental health, as well as their dignity and quality of life (QoL) [10, 11]. Prior research has revealed that LC patients have a high demand for continuous care after operation, mainly involving environmental support, self-health management knowledge and skills, health improvement, and psychological support [12]. The Omaha system is a simplified and user-friendly nursing procedure system that encompasses various aspects of care for LC patients. It provides a systematic, continuous, and comprehensive approach to evaluating and monitoring the patients' health issues, as well as implementing interventions to address their medical and nursing needs, thereby improving their QoL [13, 14].

This study is the first to apply the Omaha system to patients with intermediate and advanced LC in order to investigate its effects on sleep quality, negative emotions, and QoL. The positive outcome of the Omaha system is expected to provide a more humanized and personalized service for the comprehensive care of LC patients.

Methods and data

Ethical statement

This study was approved by the Medical Ethics Committee of The Second Affiliated Hospital of Xi'an Jiaotong University.

Sample source

A total of 764 patients with mid to late-stage LC treated at The Second Affiliated Hospital of Xi'an Jiaotong University from January 2019 to January 2023 were retrospectively analysed.

Inclusion and exclusion criteria

Inclusion criteria: (1) patients who were diagnosed with stage III-IV LC through pathological examination; (2) patients who were 18 years old or older; (3) patients with complete case records; (4) patients who received either control or Omaha System-based interventions, followed by outcomes evaluation; (5) patients whose outcome evaluations included QoL, anxiety levels, depression levels, sleep quality, level of hope, and dignity.

Exclusion criteria: (1) patients who had taken anti-anxiety or anti-depression drugs orally within 3 months; (2) patients comorbid with other malignant tumours; (3) patients comorbid with other chronic diseases that affect their sleep quality or QoL; (4) patients with an expected survival time of less than 6 months.

Sample screening

A total of 764 patients were initially screened based on the inclusion and exclusion criteria. After the screening process, 507 patients were found to meet the specified requirements and were included in the study. According to different nursing schemes, 294 patients who received conventional care were grouped into a conventional group, and 213 patients who received the Omaha System-based interventions were assigned to an intervention group. The routine care scheme was implemented in The Second Affiliated Hospital of Xi'an Jiaotong University from January 2019 to January 2021, and 294 patients received conventional care. From February 2021 to January 2023, the medical and nursing work of our department was modified to an intervention model based on Omaha System, so 213 patients received the new nursing model.

Care schemes

Conventional group: All patients received dietary guidance during chemotherapy, medication guidance following the doctor's advice, diet care, health education, knowledge about adverse reactions, preventive measures during chemotherapy, as well as conventional psychological and social support.

Intervention group: 1) Nursing team structure: Led by 2 senior nurses, the team comprised 5 nurses, including researchers. 2) Problem classification system: Care problem evaluation was designed collaboratively by an associate clinical professor from the oncology department, the head nurse of the internal medicine department, and a researcher. The evaluation included 38 questions based on the Omaha problem classification system and patient data. Each patient was assessed using the Omaha system-based scales for behaviour, cognition, and

conditions. A score ≤3 points indicated care problems. 3) Problem intervention system: Tailored intervention measures based on specific problems were conducted. Nurses selected 75 intervention targets, such as behaviour correction and emotion management. 4) Effect evaluation and family continuous care: Comprehensive evaluation of care problems and postoperative chemotherapy education were provided before patient discharge. A post-discharge care plan was tailored to patient and family needs before discharge. Sleep interventions included cognitive behavioural therapy and recommendations by the American Academy of Sleep Medicine for chronic insomnia. Specific measures included relaxation training and sleep hygiene practices. 5) Follow-up and continuous assessment: Follow-ups were carried out at 3 days, 1 week, 2 weeks, 1 month, and 3 months post-discharge to understand ongoing care problems. Based on changes in patient conditions, continuous updates were recorded following the initial assessment performed within 24 hours of hospital admission using Omaha theory system [13].

Measures to ensure quality of different care models

The following quality control measures were implemented to ensure the outcome of the different care models. 1) For the implementation of interventions, we planned each intervention in detail, including health education activities, sleep interventions, exercise, and dietary guidance. The goals and methods of each intervention were carefully designed and adapted to the specific needs of the patient. To ensure the quality of interventions, specialized trainings were provided to nurses so that they could gain a thorough understanding and proper implement each intervention. Standard operating procedures were developed to ensure consistency and effectiveness of the interventions. 2) The implementation of the interventions was regularly monitored and evaluated. Details of the intervention implementation, including frequency, duration, and patient feedback, were recorded. The patient data were analysed to assess the specific impact of different interventions on patients' health status and QoL.

Data collection

In our study, patients' general data and functional scores were collected from the electronic medical records and outpatient review records. The general data included: sex, age, place of residence, education level, marital status, religious belief, work situation, per capita monthly household income, disease stage, pathological type, and disease duration. The functional scores encompassed several assessments: Functional Assessment of Cancer Therapy-Lung cancer (FACT-L) [15], Pittsburgh Sleep Quality Index (PSQI) [16], Self-Rating Anxiety Scale (SAS) [17], Self-Rating Depression Scale (SDS) [18], Herth Hope Scale (HHS) [19], and Patient Dignity Inventory (PDI) [20].

Functional score

FACT-L is a scale developed by University of Chicago Medical Center in the United States. The scale was translated into Chinese by Wan Chonghua et al. to form the Chinese version of FACT-L, including five dimensions: physiological status, social/family status, emotional status, functional status, and LC specificity module. Among them, the first four dimensions are collectively called the cancer commonality module (Functional Assessment of Cancer Therapy-General (FACT-G)), with a total of 36 items. The scale adopts the 0-4 point-based scoring method, with the total score ranging from 0 to 144 points. A higher score indicates better QoL.

PSQI is developed by the research team from the University of Pittsburgh, aiming at measuring the sleep quality and obstacles of individuals. The scale covers 7 dimensions: sleep duration, sleep delay, sleep efficiency, sleep disorders, drug use, daily dysfunction, and overall sleep quality. PSQI consists of 19 items, and each item is weighted on a 0-3 scale. The global PSQI score is then calculated by totalling the 7 dimensions, providing an overall score ranging from 0 to 21, where lower scores denote a healthier sleep quality.

HHS is a scale designed to evaluate individual's hope level and future expectation. It covers three dimensions: goal setting, planning, and motivation, and consists of 12 items in total. The score ranges from 12 to 48 points, and a higher score indicates a higher hope level.

PDI is developed specifically to assess the intrinsic dignity of seriously ill or terminally ill patients. The scale focuses on 3 core dimensions: meaning of life, social role, and self-cognition. There are 25 items in PDI, and a 5-point

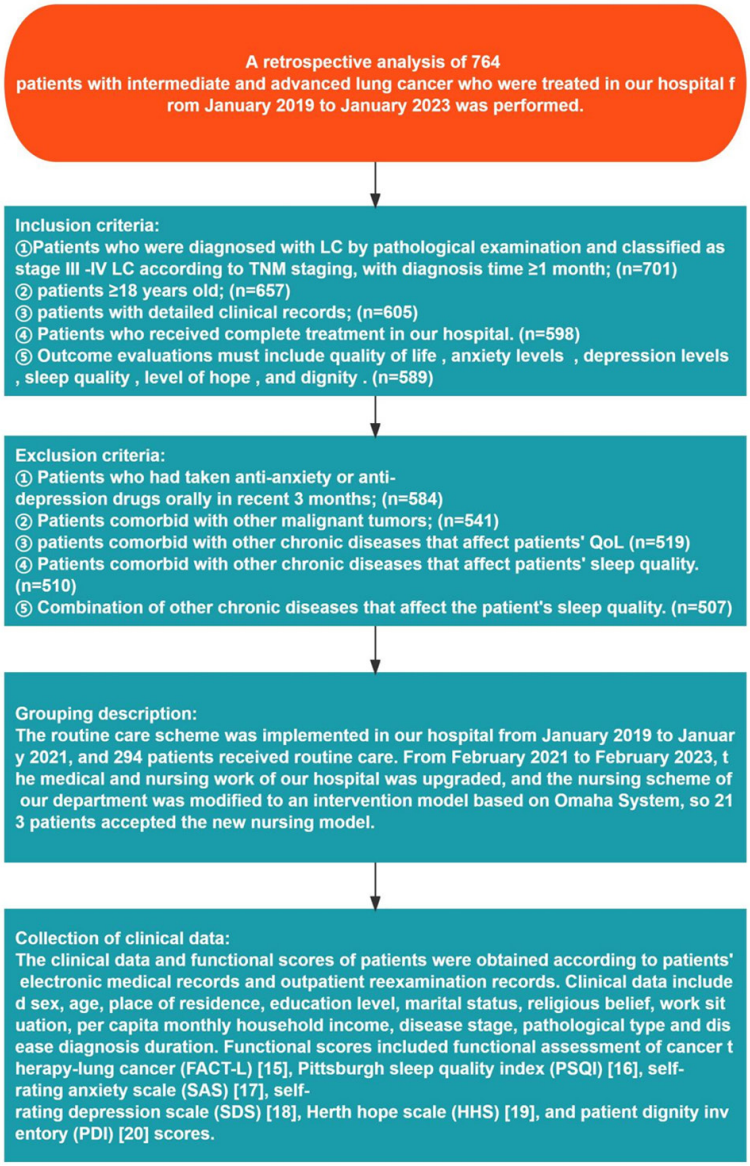

Figure 1. Sample screening flow.

scoring method is adopted. The score ranges from 25 to 125 points, with a higher score indicating stronger sense of intrinsic dignity.

SAS and SDS are commonly used assessment tools in the field of mental health to measure the anxiety and depression levels of individuals, respectively. Both scales adopt a 4-point scoring method, with a score range of 20-80 points. A higher SAS/SDS score implies more serious anxiety/depression.

Outcome measures

The clinical data of the two groups were compared. The changes in FACT-L, PSQI, HHS, and PDI scores before and after care intervention were compared. According to the change in QoL after care intervention, patients whose FACT-L score improved by over 50% were assigned to a significant improvement group, and patients whose score improved by 50% or less in an insignificant improvement group. Logistics regression was carried out to analyse the risk factors affecting the patients' QoL (**Figure 1**).

Statistical analyses

SPSS 20.0 software was adopted for data processing. The Shapiro-Wilk test was used for normality test, and normally distributed measurement data were described as mean ± standard deviation ($\bar{X}\pm s$). Their comparison between groups was conducted by the independent-samples t test, and the intra-group comparison was by paired samples t test. Counting data were compared by the χ^2 test. In our analysis, logistic regression was used to analyse the relationship between risk factors and the QoL in the included patients. This method calculated the odds of a particular outcome (QoL impact) based on predictor variables (risk factors). The logistic model generates probabilities between 0 and 1, with coefficients indicating the influence of each predictor. Maximum Likelihood Estimation was employed for parameter estimation. The results were interpreted as the likelihood of changes in QoL in response to different clinical and functional variables. The prediction efficacy of factors on QoL was evaluated by the receive operating characteristic (ROC) curve. $P<0.05$ suggests a significant difference.

Results

Clinical data

The clinical data of the conventional and intervention groups were compared, and no signifi-

Table 1. Baseline data

Factors	Conventional group (n=294)	Intervention group (n=213)	X^2	P
Gender				
Male	163	103	2.486	0.115
Female	131	110		
Age (years)				
≥65	159	99	2.857	0.091
<65	135	114		
Place of residence				
Urban area	188	117	4.189	0.041
Rural area	106	96		
Education level				
≥ high school	205	163	2.868	0.09
< high school	89	50		
Marital status				
Married	223	167	0.454	0.501
Others	71	46		
Religious belief				
Yes	89	60	0.263	0.608
No	205	153		
Current working situation				
On-the-job	163	103	2.486	0.115
Others	131	110		
Per capita monthly household income (Yuan)				
≥3000	188	146	1.162	0.281
<3000	106	67		
Payment method of medical expenses				
Medical insurance	273	202	0.818	0.366
Self-pay	21	11		
Disease staging				
Stage III	163	135	3.212	0.073
Stage IV	131	78		
Histological types of diseases				
Squamous carcinoma	156	117	0.173	0.677
Adenocarcinoma	138	96		
Disease diagnosis duration (year)				
≥1	159	110	0.295	0.587
<1	135	103		

cant differences were found in terms of sex, age, place of residence, education level, marital status, religious belief, work situation, per capita monthly household income, disease stage, pathological type and disease diagnosis duration (P>0.05, **Table 1**).

Comparison of anxiety and depression scores

The negative emotions of the two groups before and after care intervention were compared. Before care, no notable differences were found between the conventional group and intervention group in SDS and SAS scores (P>0.05, **Figure 2**). However, after care, the SDS and SAS scores of both groups decreased significantly (P<0.0001, **Figure 2**). Furthermore, after care, the intervention group got significantly lower SDS and SAS scores compared to the conventional group (P<0.0001, **Figure 2**).

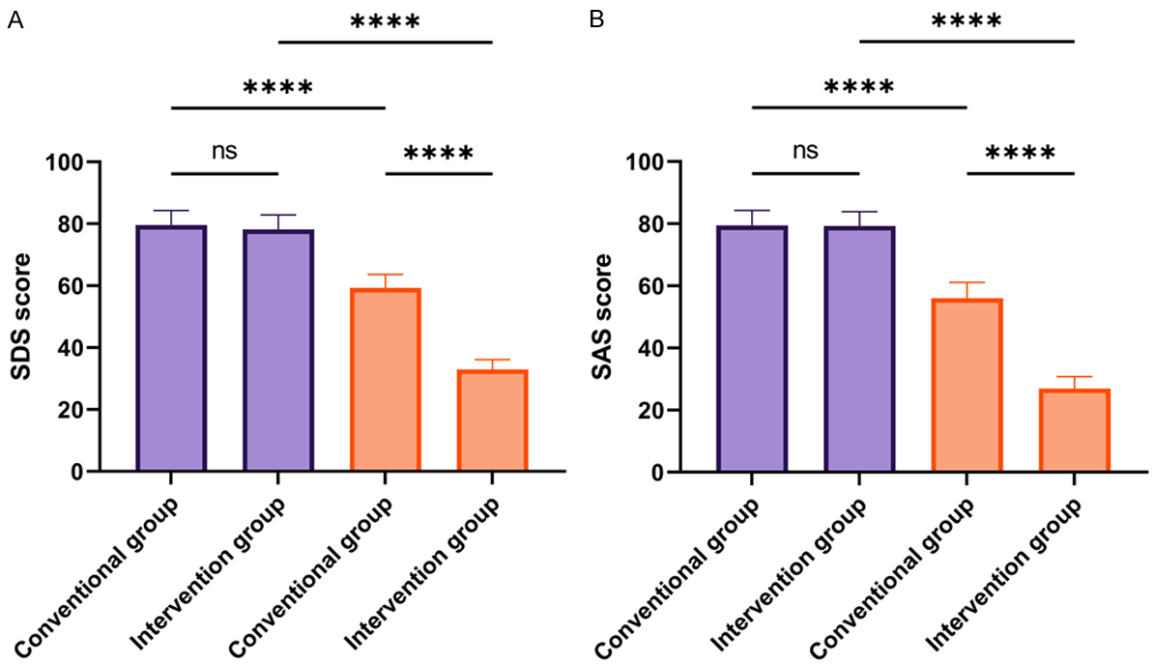

Figure 2. Changes in patients' negative emotion scores before and after intervention. A: Comparison of SDS score between conventional and intervention groups before and after intervention; B: Comparison of SAS score between conventional and intervention groups before and after intervention. Notes: SAS: Self-rating anxiety scale; SDS: Self-rating anxiety scale; nsP>0.05; ****P<0.0001.

Comparison of QoL and sleep quality

The QoL and sleep quality in the two groups were compared before and after care intervention. Before care, no notable differences were identified between the conventional and intervention groups in FACT-L and PSQI scores (P>0.05, **Figure 3**). However, after care, the FACT-L scores of the two groups increased significantly (P<0.0001, **Figure 3**), and the PSQI scores decreased notably (P<0.0001, **Figure 3**). Furthermore, after intervention, the intervention group exhibited notably higher FACT-L scores and notably lower PSQI scores than the conventional group (P<0.0001, **Figure 3**).

Comparison of the levels of hope and dignity

The levels of hope and dignity in the two groups were compared before and after care intervention. Before care, the conventional and intervention groups did not differ significantly in HHS and PDI scores (P>0.05, **Figure 4**), whereas after care, the HHS scores of both groups increased notably (P<0.0001, **Figure 4**), and PDI scores of them decreased notably (P< 0.0001, **Figure 4**). Moreover, after care intervention, the intervention group demonstrated significantly higher HHS scores and lower PDI scores than the conventional group (P<0.0001, **Figure 4**).

Analysis of risk factors affecting patients' QoL

Based on the FACT-L scores after care intervention, patients were categorized into two groups. Patients whose score improved by >50% were assigned to a group with significant improvement in QoL (n=234), and patients whose score improved by ≤50% to a group without significant improvement in QoL (n=273). Then clinical data of the two groups were analysed. According to univariate analysis, age younger than 65 years old, being married, an average monthly family income ≥3000 yuan, disease staging, disease duration <1 year, and care intervention scheme were significant general factors affecting the QoL (P<0.01, **Table 2**). Also, functional scores including lower SDS, SAS and PSQI scores were also identified as significant factors affecting the improvement of QoL (P<0.01, **Table 2**). Each factor was then assigned (**Table 3**), and the cut-off value was used as the basis to group the patients. According to multivariate logistic regression analysis, care nursing intervention scheme, age, marital status, per capita

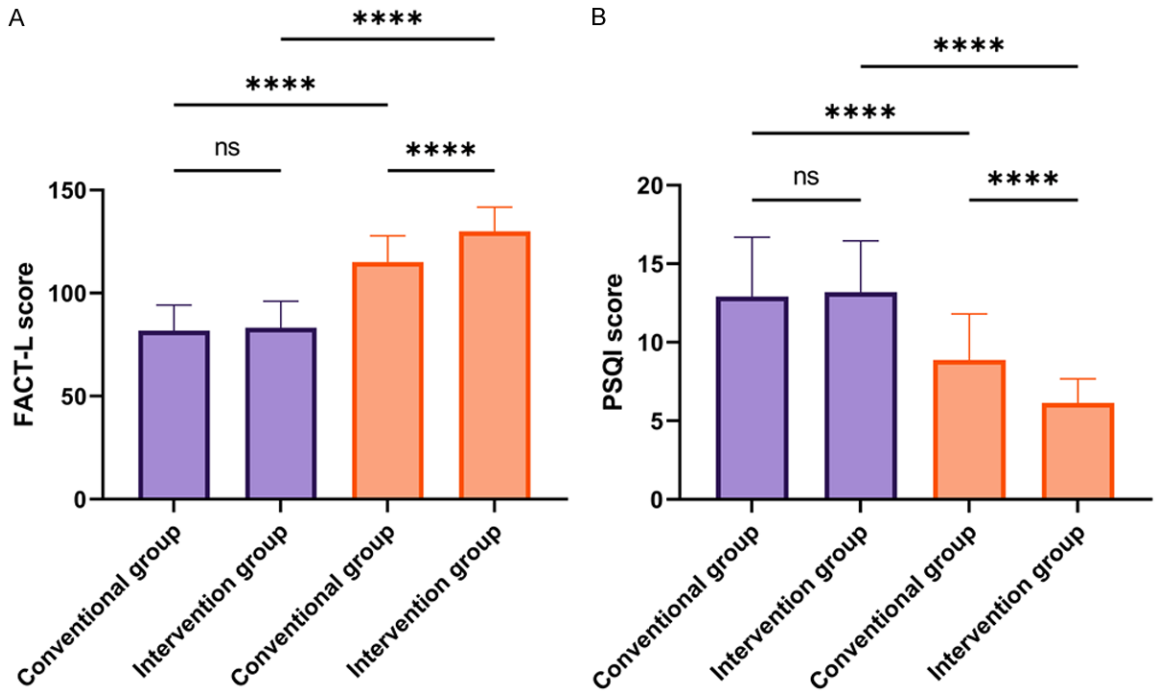

Figure 3. Changes in quality of life and sleep quality scores of patients before and after intervention. A: Comparison of FACT-L scores between conventional and intervention groups before and after intervention; B: Comparison of PSQI scores between conventional and intervention groups before and after intervention. Notes: FACT-L: Functional assessment of cancer therapy-lung cancer; PSQI: Pittsburgh sleep quality index; nsP>0.05; ****P<0.0001.

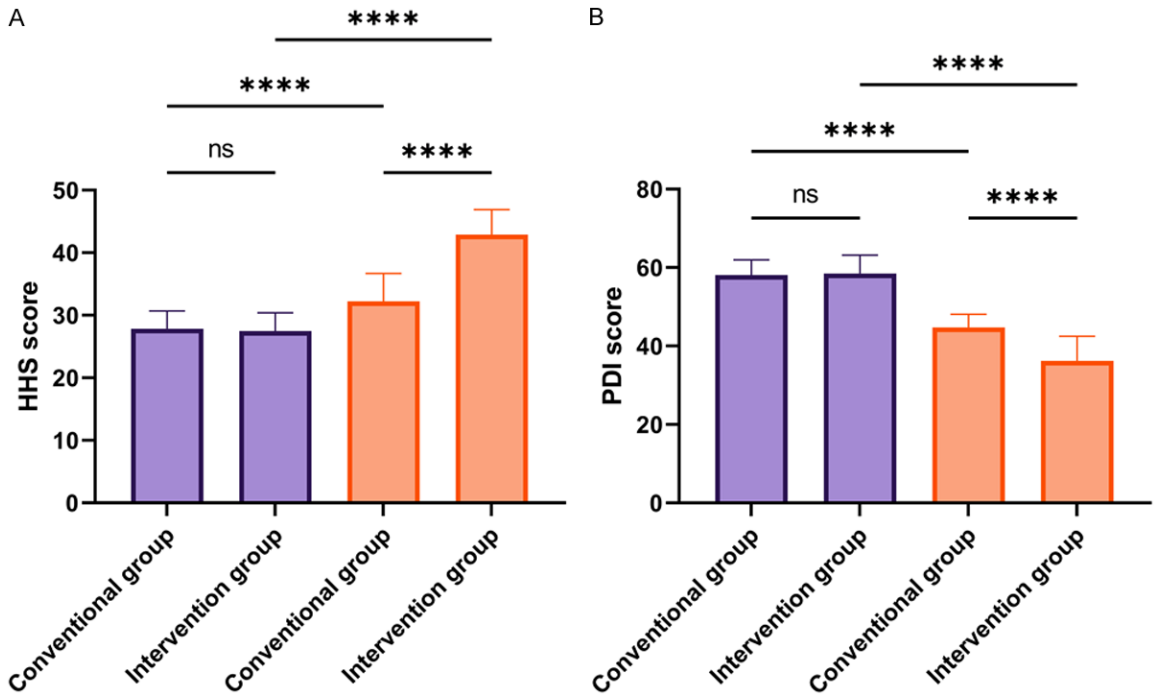

Figure 4. Changes in patients' hope and dignity levels before and after intervention. A: Comparison of HHS score between conventional and intervention groups before and after intervention; B: Comparison of PDI score between conventional and intervention groups before and after intervention. Notes: HHS: Herth hope scale; PDI: Patient dignity inventory; nsP>0.05; ****P<0.0001.

Table 2. Analysis of factors affecting patients' quality of life

Factors	Group with significant improvement (n=234)	Group without significant improvement (n=273)	X^2	P
Gender				
Male	126	140	0.332	0.564
Female	108	133		
Age (years)				
≥65	82	176	43.655	<0.001
<65	152	97		
Place of residence				
Urban area	138	167	0.614	0.253
Rural area	96	106		
Education level				
≥ high school	163	205	1.869	0.172
< high school	71	68		
Marital status				
Married	213	177	48.688	<0.001
Others	21	96		
Religious belief				
Yes	71	78	0.190	0.663
No	163	195		
Current working situation				
On-the-job	117	149	1.059	0.303
Others	117	124		
Per capita monthly household income (Yuan)				
≥3000	188	146	40.446	<0.001
<3000	46	127		
Payment method of medical expenses				
Medical insurance	223	252	1.907	0.167
Self-pay	11	21		
Disease staging				
Stage III	170	128	34.516	<0.001
Stage IV	64	145		
Histological types of diseases				
Squamous carcinoma	133	140	1.565	0.211
Adenocarcinoma	101	133		
Disease diagnosis duration (year)				
≥1	82	187	56.623	<0.001
<1	152	86		
Care intervention scheme				
Conventional group	106	188	28.721	<0.001
Intervention group	128	85		
SDS after intervention	45.03±13.41	51±13.29	2.667	0.008
SAS after intervention	39.71±15.35	47.35±14.15	3.094	0.002
PSQI after intervention	6.68±1.77	8.61±3.19	4.364	<0.001
HHS after intervention	37.59±7.01	35.95±6.55	1.448	0.149
PDI after intervention	40.30±6.56	41.89±6.17	1.495	0.137

Notes: SAS: Self-rating anxiety scale; SDS: Self-rating depression scale; PSQI: Pittsburgh sleep quality index; HHS: Herth hope scale; PDI: Patient dignity inventory.

Table 3. Assignment

Factors	Assignment
Age (years)	≥65=1, <65=0
Marital status	Married =0, others =1
Per capita monthly household income (Yuan)	≥3000=0, <3000=1
Disease staging	Stage III =0, stage IV =1
Disease diagnosis duration (year)	≥1=1, <1=0
Care intervention scheme	Conventional group =1, intervention group =0
SDS after intervention	≥52.5=1, <52.5=0
SAS after intervention	≥30.5=1, <30.5=0
PSQI after intervention	≥7.5=1, <7.5=0
Improvement of quality of life	Group with significant improvement =0, group without significant improvement =1

Notes: SAS: Self-rating anxiety scale; SDS: Self-rating depression scale; PSQI: Pittsburgh sleep quality index.

Table 4. Logistics regression analysis of risk factors affecting patients' quality of life

Factors	β value	Standard error	Chi square value	*P* value	OR value	95% CI	
						Lower limit	Upper limit
Nursing intervention scheme	1.208	0.447	7.318	0.007	3.348	1.395	8.037
Age	1.187	0.444	7.131	0.008	3.277	1.371	7.831
Marital status	1.824	0.581	9.861	0.002	6.196	1.985	19.344
Per capita monthly household income	1.370	0.478	8.216	0.004	3.937	1.542	10.049
Disease staging	-0.408	0.510	0.641	0.423	0.665	0.245	1.806
Disease diagnosis duration	-0.312	0.453	0.476	0.490	0.732	0.301	1.777
SDS after intervention	-0.289	0.758	0.145	0.703	0.749	0.169	3.311
SAS after intervention	1.462	0.468	9.770	0.002	4.314	1.725	10.789
PSQI after intervention	1.419	0.461	9.493	0.002	4.134	1.676	10.198

Notes: SAS: Self-rating anxiety scale; SDS: Self-rating depression scale; PSQI: Pittsburgh sleep quality index.

monthly household income, SAS after intervention, and PSQI after intervention were independent factors affecting patients' QoL (**Table 4**, P<0.01).

Efficacy of risk factors in evaluating patients' QoL

Finally, the efficacy of risk factors in predicting patients' QoL was analysed. The results demonstrated that the area under the curve (AUC) of each individual factor for evaluating patients' QoL did not exceed 0.7 (**Figure 5A**). The AUC of the factors combined was 0.8 (**Figure 5B**; **Table 5**).

Discussion

In this study, the intervention model based on Omaha system was found to be effective in improving the sleep quality and reducing the negative emotions of patients with mid to late-stage LC. Moreover, the intervention model was identified as a protective factor for QoL. These results highlight the important role of the Omaha system-based intervention model in improving the patients' QoL.

The treatment process of mid to late-stage LC involves not only chemotherapy, molecular targeted therapy, immunotherapy, anticancer drug therapy, and nutritional therapy, but also care measures to prolong the survival time, improve QoL, alleviate pain, and prevent complications [21, 22]. However, traditional care methods have limitations including the lack of continuous and personalized care support after discharge, insufficient intervention addressing sleep quality, exercise, and mental health, and the possible lack of systematic and structured care practices, which compromise the rehabilitation and QoL of patients [23].

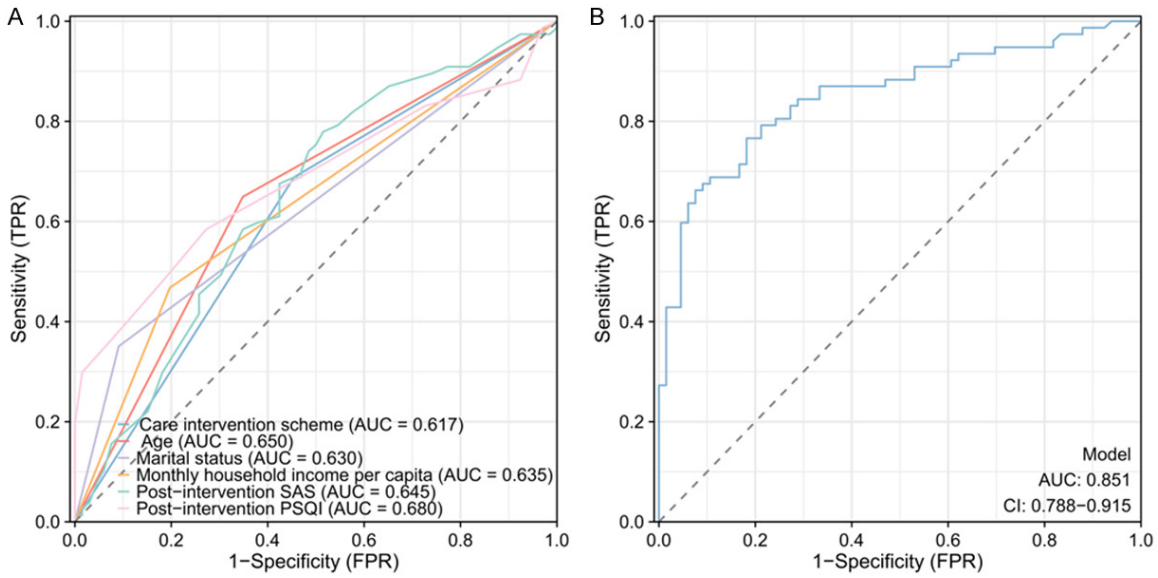

Figure 5. AUC of risk factors for predicting patients' quality of life. A: AUC of individual factors for predicting patients' quality of life; B: AUC of combined factors for evaluating patients' quality of life. Note: AUC: area under the curve; SAS: Self-rating Anxiety Scale; PSQI: Pittsburgh sleep quality index.

Table 5. ROC parameters for predicting quality of life using individual or combined factors

Predictor variable	AUC	95% CI	Cut-off value	Sensitivity	Specificity	Youden index
Joint prediction	0.851	0.788-0.915	0.70363	66.23%	92.42%	58.66%
Care intervention scheme	0.617	0.537-0.697	0.5	68.83%	54.55%	23.38%
Age	0.65	0.571-0.729	0.5	64.94%	65.15%	30.09%
Marital status	0.63	0.566-0.694	0.5	35.07%	90.91%	25.97%
Per capita monthly household income	0.635	0.561-0.709	0.5	46.75%	80.30%	27.06%
SAS after intervention	0.645	0.554-0.737	30.5	77.92%	48.49%	26.41%
PSQI after intervention	0.68	0.593-0.767	7.5	58.44%	72.73%	31.17%

Notes: AUC: area under the curve; SAS: Self-rating anxiety scale; PSQI: Pittsburgh sleep quality index; ROC: receiver operating characteristic.

In contrast, Omaha system, as an internationally recognized practice system of nursing care classification, provides clear guidance and structure for care intervention. Under the guidance of Omaha system, nurses can comprehensively observe and evaluate patients' various needs, so as to formulate accurate and personalized care measures [24]. Furthermore, the utilization of platforms like social media (WeChat) groups, combined with the implementation of the Omaha system, can enhance the compliance and self-management efficiency of LC patients during the chemotherapy process. This approach enables patients to receive continuous and effective support within their family and community. By using these platforms and systems, patients can access ongoing guidance, education, and resources, which can contribute to the improvement of their conditions, QoL, and the alleviation of psychological stress [25]. Zhao et al. [26] found that the continuous care procedure based on Omaha system played a crucial role in providing guidance framework, standardizing nursing activities and continuously evaluating the effect, which effectively improved the nutritional status of patients. In addition, Wei et al. [27] revealed that the comprehensive care management model for type 2 diabetes mellitus based on Omaha system significantly improved the blood glucose control, QoL, and diabetes knowledge level of newly diagnosed patients with type 2

diabetes mellitus. However, there is a lack of relevant research on whether the system has a positive effect in patients with mid to late-stage LC.

Anxiety and depression are common psychological disorders in LC patients. The diagnosis and treatment of LC may cause or aggravate the symptoms of anxiety and depression [28]. Anxiety commonly arises from uncertainties, including concerns about side effects of treatment, and disease progression, while depression can be caused by chronic pain, physical decline, and reduced QoL [29, 30]. These negative psychological states may disrupt patients' daily life and social function and also reduce their treatment compliance and life satisfaction. Prior research by Yu et al. [31] revealed that psychological intervention combined with health education effectively alleviated patients' anxiety and depression. Wu et al. [32] found a significant alleviation in anxiety and depression after dialogue based on high-quality care. In this study, the intervention based on Omaha system significantly improved the anxiety and depression scores of patients, especially in the intervention group. This is because the intervention based on Omaha system provides patients with personalized care schemes, including psychological support and health education, to help them better understand and cope with the disease.

Sleep quality is a crucial factor impacting the QoL of LC patients. Many LC patients may suffer from sleep disorders, such as insomnia, nocturnal awakening, and early awakening, which are possibly linked to pain, dyspnoea, and side effects of treatment [33]. Poor sleep quality may further aggravate the fatigue and negative emotions of patients, and lower the effect of treatment and the daily function of patients [34]. In this study, the intervention group exhibited significant improvement in sleep quality scores. This is because Omaha system-based interventions covered sleep health education and behavioural interventions, which help improve the patients' sleep habits and environment, thereby improving their sleep quality. Hu et al. [35] revealed that fine nursing combined with dietary intervention contributed to pain reduction, regulation of agitation, reduction of complications, and improvement of nutrition and sleep quality, which is consistent with our research. In this study, the intervention group showed significantly improved hope and dignity scores. The intervention based on the Omaha system has been demonstrated to enhance patients' sense of self-efficacy and coping ability through the provision of personalized support and education. By tailoring interventions to meet individual needs, the Omaha system empowers patients to take an active role in their own care, which in turn improves their levels of hope and dignity.

QoL is one of the crucial indices to evaluate the disease condition and therapeutic effect of LC patients [11]. The diagnosis and treatment of LC may compromise the physical and psychological health of patients, lowering their QoL [36]. A good QoL may help patients maintain a positive attitude and better cope with the disease and treatment, which helps to improve the effect of treatment and prognosis. Therefore, it is a crucial nursing goal to improve the QoL of LC patients [37]. In this study, the QoL score of the intervention group increased significantly and was notably higher than that of the conventional group. The finding implies a significant effect of Omaha system-based intervention model on improving the QoL of patients with mid to late-stage LC. In order to deeply understand the possible factors impacting the improvement of QoL, this study further analysed the factors affecting the QoL after intervention. Through logistic regression analysis, the risk factors affecting the QoL were discussed, and intervention scheme, age, marital status, per capita monthly household income, SAS after intervention, and PSQI after intervention were found to be independent influencing factors. The result that intervention scheme is a significant factor indicates that the Omaha system-based intervention model can improve patients' improve the QoL by targeting the mental health, sleep quality, and social support through comprehensive and personalized care. Age, marital status and per capita monthly household income can indeed be associated with patients' physical and psychological adaptability, which in turn affects the QoL. The decreased anxiety and sleep scores reflect that intervention may help improve patients' mental health and sleep quality, thus improving the QoL. Hu et al. [9] conducted multivariate logistic regression analysis and found living alone, anxiety, and old age were risk factors, which are consistent with our

results. The identification and analysis of these risk factors not only contribute to an in-depth understanding of factors affecting the QoL of LC patients, but also provide useful implications for the design of targeted nursing interventions, which may help further improve the QoL and therapeutic effect of patients with LC.

This study assessed the efficacy of identified risk factors in predicting patients' QoL. The AUC of each individual risk factor in predicting patients' QoL did not exceed 0.7, but the AUC of the factors combined increased to 0.8, demonstrating an obvious advantage. It is indicated that the joint evaluation can provide a more comprehensive and accurate QoL prediction model. In particular, the AUC of joint prediction was 0.851, with relatively high sensitivity and specificity. Namely, compared to using a single risk factor, the joint assessment of combined factors can provide a broader and more accurate prediction, which helps to identify patients who may benefit more from intervention.

This study has some limitations, such as small sample size, single-centre design, lack of long-term follow-up, and potential confounding factors. Therefore, future research should consider employing a multi-centre and larger sample size design, prolonging follow-up to evaluate the long-term effect, conducting comprehensive analysis of confounding factors, and formulating intervention implementation guidelines to ensure the quality of interventions, and using different measurement tools and evaluation methods to improve the accuracy of results.

To sum up, the intervention model under the Omaha system framework has demonstrated significant improvements in QoL, negative emotions, and sleep quality in patients with mid to late-stage LC. By implementing a comprehensive evaluation and personalized care intervention, it provides support for LC patients at psychological, physiological, and social levels.

Disclosure of conflict of interest

None.

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