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Effects of social support and coping styles on the dynamic evolution of anxiety and depression in nasopharyngeal carcinoma patients during radiochemotherapy and early recovery: A prospective cohort study

Ni Zhou^{1,2,3,†}, Mulan Li^{3,†}, Pinggui Gong^{1,2}, Cui He^{1,2}, Hong Peng^{1,2,*}¹ The Second School of Clinical Medicine, Southern Medical University, Guangzhou 510515, China² Department of Otolaryngology-Head and Neck Surgery, Guangdong Second Provincial General Hospital, Guangzhou 510220, China³ Department of Otolaryngology-Head and Neck Surgery, Liuzhou Worker's Hospital, Liuzhou 545007, China* **Corresponding author:** Hong Peng, doctorpenghong@163.com

† These authors contributed equally to this work as first authors.

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Abstract: Background: Radiochemotherapy and subsequent rehabilitation impose significant psychological burdens on nasopharyngeal carcinoma patients, who often experience anxiety and depression that undermine treatment compliance and quality of life. Previous studies suggest social support and coping styles can buffer psychological distress during cancer treatment; however, longitudinal research examining their dynamic impact during radiochemotherapy and rehabilitation remains scarce. **Objective:** This study explored the impact of social support and coping styles on changes in anxiety and depression among nasopharyngeal carcinoma patients undergoing radiochemotherapy and rehabilitation, providing a basis for individualized psychological interventions. **Methods:** A prospective cohort design was adopted. The Hospital Anxiety and Depression Scale (HADS), Social Support Rating Scale (SSRS), and Simplified Coping Style Questionnaire (SCSQ) were administered before radiochemotherapy (T0), mid-treatment (T1), treatment completion (T2), and one month post-treatment (T3). Tumor stage and economic burden were also recorded. Changes in anxiety, depression, social support, and coping strategies were analyzed via repeated-measures ANOVA, while linear mixed-effects models evaluated the longitudinal influence of social support and coping styles. **Results:** Among 180 patients (107 males, 73 females; mean age 51.7 ± 7.2 years), anxiety scores significantly decreased from 6.39 ± 0.94 (T0) to 4.79 ± 0.68 (T3) ($F=20.371$, $P<0.001$); depression scores similarly decreased from 6.02 ± 0.68 to 4.63 ± 0.57 ($F=18.426$, $P<0.001$). Social support and positive coping increased significantly, while negative coping decreased (all $P<0.001$). Multivariate analysis revealed social support ($B=-0.08$, $P<0.001$) and positive coping ($B=-0.12$, $P<0.001$) were associated with reduced anxiety and depression, whereas negative coping and economic burden correlated positively (all $P<0.01$). Stratified analysis confirmed patients with high social support and strong coping skills exhibited consistently lower anxiety and depression ($P<0.05$). **Conclusion:** Strengthening social support networks and promoting positive coping strategies effectively reduce anxiety and depression during radiochemotherapy and rehabilitation in nasopharyngeal carcinoma patients, enhancing treatment compliance and emotional well-being.

Keywords: pharyngeal cancer; social support; coping behaviors; anxiety; depressive symptoms

1. Introduction

Nasopharyngeal carcinoma is endemic in South China, where population-based registries report age-standardized incidences of 9–27 per 100,000—for example 27.2 per 100,000 in Sihui, Guangdong—whereas northern cities such as Harbin record <1

per 100, 000 [1,2]; patients in high-incidence areas often experience concomitant anxiety and depressive symptoms. High-incidence counties in southern China are often economically less developed; patients frequently travel long distances to tertiary centers for intensity-modulated radiotherapy (IMRT), incurring substantial out-of-pocket and indirect costs. Its occurrence is closely related to genetic susceptibility, Epstein-Barr virus (EBV) infection, and environmental factors [3]. Radiotherapy and chemotherapy are the main treatment methods, but they also bring relatively high toxic side effects and emotional burdens. Studies in nasopharyngeal-carcinoma patients demonstrate that adequate social support and adaptive coping strategies act as psychological buffers, mitigating anxiety and depression and enhancing treatment adherence and quality of life [4,5]. However, most existing research focuses on efficacy evaluation, prognostic factors, or gene and molecular levels, with relatively insufficient attention to psychosocial factors, especially lacking systematic observation of the dynamic evolution of anxiety and depression during treatment and the early recovery period [6]. A small number of cross-sectional or single-time evaluations have shown that the level of social support or coping style is associated with patients' psychological status, but there is a lack of longitudinal exploration regarding the mutual influence processes of various indicators at different time periods [7]. Some literature only focuses on a single time point or a shorter follow-up period, making it difficult to reveal how social support or coping styles evolve in parallel and affect emotional changes as radiotherapy and chemotherapy progress and treatment responses emerge [8,9]. Based on this, this study adopts a prospective cohort design to continuously monitor patients' social support and coping style scores at different stages of radiotherapy and chemotherapy as well as in the early recovery period, and uses standardized scales to evaluate anxiety and depression symptoms, aiming to clarify from a longitudinal perspective the potential regulating or buffering role of social support and coping styles in alleviating negative emotions. To further determine their specific efficacy, this study combines confounding factor adjustment and stratified analysis to explore which groups are more prone to emotional distress and which interventions can more effectively improve psychological status. The research results will provide a reference for subsequent clinical formulation of individualized social support and psychological intervention strategies, and may also offer new ideas and evidence for integrated physical and psychological treatment of nasopharyngeal carcinoma patients based on longer follow-up and multicenter verification.

2. Research methods

2.1. Research subjects and research design

This study was a prospective cohort study, covering the period from January 2023 to December 2024. It is conducted in the Department of Otorhinolaryngology-Head and Neck Surgery and the Department of Oncology at Guangdong Second Provincial General Hospital, enrolling hospitalized patients who have been newly diagnosed with nasopharyngeal carcinoma for the first time. This study has been reviewed and approved by the Medical Ethics Committee and granted the ethics approval number 2022-YUE-09. All enrolled patients signed an informed consent form after fully understanding the risks and benefits of the study.

All research subjects are newly diagnosed nasopharyngeal carcinoma patients in this hospital. The diagnosis is based on findings from fiber nasopharyngoscopy and pathological histological examination results. All patients plan to receive standardized radiotherapy and chemotherapy in this hospital and have the language and cognitive abilities to complete the scale survey. After the patients were diagnosed, the researchers introduced the purpose, significance, and process of the study to them face-to-face, and upon obtaining the patients' consent, enrolled them in the cohort.

Inclusion criteria: 1) age 18 to 75 years; 2) confirmed nasopharyngeal carcinoma by pathological examination; 3) planning to receive standardized radiotherapy and chemotherapy in this hospital; 4) able to understand and cooperate with the research process, with the ability to independently complete or complete under guidance the questionnaire assessments; 5) signed informed consent form. Exclusion criteria: 1) concurrent malignant tumors at other sites; 2) a past or current diagnosis of schizophrenia or bipolar disorder; 3) concurrent severe dysfunction of the heart, lungs, liver, or kidneys, making the patient unable to tolerate treatment or cooperate with the survey. An upper age limit of 75 years was set to balance comorbidity risks and ensure participants' capacity to complete questionnaires.

Based on the reported incidence rates of anxiety and depression symptoms in previous literature and the moderate effect size of social support on these symptoms, the researchers set the significance level $\alpha = 0.05$ and statistical power $1 - \beta = 0.80$ for estimation, concluding that at least 160 eligible patients are needed. Considering an approximately 10% potential dropout rate for follow-up, a total of 180 participants are planned to be enrolled to ensure the stability of statistical analyses.

2.2. Data collection and survey tools

Social Support referred to the objective help, subjective emotional experience, and utilization of these resources that individuals obtain in their social relationship network. It is often divided into three dimensions: subjective support, objective support, and support utilization, and it has been shown to exert a "buffering" or "protective" effect on disease-related psychological distress, which can alleviate patients' negative emotions such as anxiety and depression [10]. This study used the Social Support Rating Scale (SSRS) to quantitatively assess patients' social support. Coping Styles are the cognitive and behavioral strategies adopted by individuals when facing disease or other stressful situations, generally divided into positive coping (such as actively solving problems, seeking external support, cognitive restructuring, etc.) and negative coping (such as avoidance, denial, self-closure, etc.) [11]. This study used the Simplified Coping Style Questionnaire (SCSQ) to quantify patients' tendencies toward positive and negative coping. Based on the above theoretical framework, the results of SSRS and SCSQ can more accurately assess the level of social support and characteristics of coping styles in nasopharyngeal carcinoma patients during radiotherapy and chemotherapy as well as in the early stage of recovery, and explore their impact on the dynamic changes of anxiety and depression symptoms. The 20-item SCSQ comprises 12 positive-coping and 8 negative-coping items; it does not explicitly assess cognitive restructuring or emotional catharsis.

2.2.1. General clinical data collection

After the patients complete the enrollment signature, the researchers collect the following data through face-to-face interviews and the hospital information system: gender, age, marital status, years of education, employment status, monthly income level, tumor staging (according to the 8th edition TNM staging standard of the Union for International Cancer Control), presence or absence of distant metastasis, history of chronic diseases (including hypertension and diabetes), history of psychological disorders (including clearly diagnosed anxiety disorders or depression), as well as the radiotherapy and chemotherapy regimen (radiation dose, chemotherapeutic agent names, number of treatment cycles, and administration methods). All data are collected before the patients start radiotherapy and chemotherapy and are recorded in uniformly numbered forms.

2.2.2. Anxiety and depression scale assessment

Hospital Anxiety and Depression Scale (HADS) was used to assess patients' anxiety and depression symptoms [12]. This scale contains two subscales: Anxiety and Depression. Each subscale has 7 items, and each item is scored on a 4-point scale from 0 to 3. The score range of each subscale is 0 to 21, and a higher score indicates more severe anxiety and depression. Researchers conducted HADS assessments at the start of radiotherapy and chemotherapy (T0), at the midpoint of the total treatment course (T1), at the end of radiotherapy and chemotherapy (T2), and one month after the end of radiotherapy and chemotherapy (T3) to dynamically observe the evolution of anxiety and depression symptoms. No objective or subjective 'stress' variable was collected; psychological distress was operationalized using the HADS-Anxiety and HADS-Depression subscales.

2.2.3. Social support scale assessment

The Social Support Rating Scale (SSRS) was used to assess the level of social support. This scale includes three dimensions: objective support, subjective support, and utilization of support, with a total of 10 items. The score range is 12 to 66 points, and a higher score indicates a higher level of social support. Following the cut-offs recommended for the Social Support Rating Scale (SSRS) [13], overall social support was categorized as low (0–22), medium (23–44) and high (45–66). At the time points T0, T1, T2, and T3, the researchers guided patients to complete the questionnaire independently or read the items aloud for patients to answer orally. After scoring all items according to the scale requirements, the total score and the scores of each dimension were obtained.

2.2.4. Coping style scale assessment

The Simplified Coping Style Questionnaire (SCSQ) was used to evaluate the behavioral and psychological strategies patients adopt when facing disease and treatment pressure [14]. The scale consists of 20 items, divided into two dimensions: positive coping and negative coping. Each item is scored on a 4-point scale from 0 to 3, and the score range for each dimension is 0 to 30 points. A higher score indicates a more pronounced tendency in that dimension. To derive an overall coping tendency, we subtracted the negative-coping score from the positive-coping score, obtaining a composite coping-tendency index; this continuous index was then split at the 33rd and

67th sample percentiles into low, moderate and high groups for the stratified analyses. Researchers used the same method for assessment at T0, T1, T2, and T3. Assessments were scheduled at four timepoints: baseline (T0), mid-radiochemotherapy (T1), at completion of radiochemotherapy (T2), and 30 ± 5 days post-treatment (T3), with intervals varying by individual treatment duration.

2.2.5. Confounding factors investigation

To control for variables that might be associated with anxiety and depressive symptoms, we treated the following as covariates: pain intensity measured with an 11-point numeric rating scale (0 = no pain, 10 = worst imaginable pain); economic burden, expressed as a continuous composite score obtained by z-standardizing and averaging two indicators—the ratio of out-of-pocket treatment expenditure to total medical expenditure for the current cycle and the percentage change in monthly household income since diagnosis; severity (grade 0–4, CTCAE v5.0) of the major treatment-related toxicities nausea, vomiting and radiation dermatitis; and family-caregiver circumstances, including the presence of a primary caregiver (yes = 1 / no = 0), the caregiver's relationship to the patient and average daily caregiving hours. A variable was considered a potential confounder when previous research had linked it to both the predictors (social support or coping style) and the outcomes (anxiety or depression). All relevant data were entered into the study database and adjusted for in the subsequent statistical analyses.

2.3. Research process and quality control

2.3.1. Data collection method

All survey scales were administered in paper questionnaire form. The investigator guides patients to fill them out independently in a fixed, quiet location. For patients with visual impairments or limited literacy, the investigator reads each item aloud and accurately records the patient's verbal responses. Once a questionnaire is completed, its integrity is immediately checked. If any items are missing or incomplete, the investigator inquires on the spot and fills in the missing information. After the survey, the researchers categorize and number all questionnaires and store them in a password-locked cabinet.

2.3.2. Research quality assurance

Undertaken before participant enrollment, uniform training was provided to all investigators covering the survey process, scale-administration standards, communication skills, and data-entry procedures; a mock test was conducted upon completion of the training. After the collected paper questionnaires pass the review, two different research assistants independently enter the questionnaire contents into the encrypted electronic database. Upon completion of the data entry, a third party randomly checks 20% of the samples for comparison. A patient contact file was established, and before each follow-up, a designated research assistant makes phone calls one by one to ensure patients complete the survey at the scheduled time. The research database is backed up offline on a weekly basis by dedicated technical staff to prevent data loss. A monthly research team meeting is held to check follow-up progress, discuss difficulties encountered, and revise execution details, ensuring that the research process complies with the initial design and is continuously improved.

2.4. Statistical analysis

After two independent research assistants completed all data entry, the project leader used an automated script to check the legality and logical consistency of the values. For obviously abnormal values (e.g., exceeding the scale range), the original paper form is promptly verified. If missing items exceed one-tenth of the total items in the questionnaire, that questionnaire is excluded and the specific reason is recorded. For variables with a low proportion of missing data, a multiple imputation method was used to fill in the gaps. Low' was defined a priori as a missingness rate of < 10 % for the variable concerned. Measurement data conforming to a normal distribution were expressed as mean $\pm$ standard deviation; those not conforming to a normal distribution were expressed as median and interquartile range. Count data were expressed as case numbers and percentages. The Kolmogorov-Smirnov test was used to determine the distribution type. Since this study focuses on multi-time-point longitudinal observation, repeated measures ANOVA was used to evaluate the main effects of time and group and their interaction effects. The time $\times$ group interaction is further examined within the stratified analyses presented in the Results section. In the present analysis, group referred to the tertile classification (low, medium and high) of the baseline Social-Support Rating Scale and Simplified Coping Style Questionnaire scores. If the normal distribution or homogeneity of variance is not satisfied, the Friedman test was used instead [15]. Differences between categorical variables were assessed using the chi-square test. When a difference is statistically significant, the Bonferroni method is further employed for multiple comparison correction. A linear mixed-effects model was used to analyze the dynamic changes in anxiety and depression symptoms over time, with social support and coping styles entered as independent variables, and major clinical and demographic confounders included for adjustment, in order to evaluate the impact of social support and coping styles on the longitudinal trajectories of anxiety and depression symptoms. Specifically, the model adjusted for age, gender, tumour stage (I–IV), pain intensity, economic-burden score, toxicity grade and caregiver availability, matching the covariates presented in Tables 5 and 6. A subject-specific random intercept was specified to account for the correlation of repeated observations within individuals over time. Regression coefficients, 95% confidence intervals, and P-values were used to assess statistical significance. The primary effect size reported in this study was *Cohen's d* (standardised mean difference), calculated as $(M_1 - M_2)/SD_{\text{pooled}}$, and its magnitude was interpreted according to Cohen's guidelines. All statistical analyses were conducted in SPSS 26.0 and R 4.1.0 software. A two-sided test level of $\alpha = 0.05$ was set, and $P < 0.05$ is considered statistically significant.

3. Results

3.1. Baseline characteristics of study subjects

A total of 180 patients with nasopharyngeal carcinoma were included. Because the missingness for every study variable was below 10 %, no multiple imputation was required and all analyses were performed on complete-case data. The cohort consisted primarily of males and middle-aged patients; most were married, had a secondary-

school education, and belonged to the lower-middle economic stratum. Tumour stage III was the most common, and distant metastasis was rare. All patients received the standard radiotherapy dose, with cisplatin being the most frequently used chemotherapy drug. On average, patients reported upper-medium social support, positive coping strategies, and mild baseline anxiety and depression symptoms (**Table 1**).

Table 1. Baseline demographic and clinical characteristics of study subjects.

Variable	Statistical description
Gender, n (%)	Male 107 (59.44 %) Female 73 (40.56 %)
Age (years)	51.73 ± 7.21
Marital status, n (%)	Married 129 (71.67 %) Unmarried 38 (21.11 %) Widowed/Divorced 13 (7.22 %)
Monthly income (RMB Yuan)	3723 [3102 – 5937]
Tumour TNM stage, n (%)	Stage I 19 (10.56 %) Stage II 47 (26.11 %) Stage III 72 (40.00 %) Stage IV 42 (23.33 %)
Distant metastasis, n (%)	Yes 28 (15.56 %) No 152 (84.44 %)
Radiochemotherapy regimen	Total radiotherapy dose 68.43 ± 2.09 Gy Cisplatin 114 (63.33 %) Paclitaxel 66 (36.67 %) Chemotherapy cycles 3.04 ± 0.44
History of chronic diseases, n (%)	Yes 53 (29.44 %) No 127 (70.56 %)
History of psychological disorders, n (%)	Yes 17 (9.44 %) No 163 (90.56 %)
Baseline SSRS total score	41.62 ± 4.99
Baseline SCSQ positive coping score	18.06 ± 2.39
Baseline SCSQ negative coping score	9.41 ± 1.32
Baseline HADS-A score	6.39 ± 0.94
Baseline HADS-D score	6.02 ± 0.68

3.2. Changes in anxiety and depression over time during radiochemotherapy and early rehabilitation

Using repeated-measures analysis of variance, it was shown that patients with nasopharyngeal carcinoma experienced a marked improvement in anxiety and depression symptoms during radiochemotherapy and the early rehabilitation period (both $P < 0.001$). Further pairwise comparisons using the Bonferroni method, taking pre-treatment (T0) as the baseline, revealed that anxiety and depression scores at mid-

treatment (T1), end of treatment (T2), and early rehabilitation (T3) were all significantly lower than those at T0 (all $P < 0.05$) (**Table 2**).

Table 2. Repeated-measures ANOVA of anxiety and depression.

Time	HADS-A (Mean $\pm$ SD)	HADS-D (Mean $\pm$ SD)
T0	6.39 $\pm$ 0.94	6.02 $\pm$ 0.68
T1	5.82 $\pm$ 0.84*	5.47 $\pm$ 0.64*
T2	5.24 $\pm$ 0.73**	4.99 $\pm$ 0.68**
T3	4.79 $\pm$ 0.68***	4.63 $\pm$ 0.57***
F-value	20.371	18.426
P-value	<0.001	<0.001

Note. Values are raw means $\pm$ SD. Pairwise comparisons (T1, T2, T3 vs T0) were conducted with Bonferroni correction. * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

3.3. Changes in social support and coping styles during radiochemotherapy and early rehabilitation

A repeated-measures ANOVA found that patients' levels of social support and positive coping improved significantly as treatment progressed, while negative coping decreased significantly ($P < 0.001$ for each dimension). Further comparisons using Bonferroni correction showed statistically significant differences at each time point compared with baseline (all $P < 0.05$) (**Tables 3 and 4**).

Table 3. Repeated-measures ANOVA of social support.

Time	Social support total score	Objective support score	Subjective support score	Support utilization
T0	41.62 $\pm$ 4.99	10.16 $\pm$ 1.33	22.14 $\pm$ 3.03	9.32 $\pm$ 1.37
T1	42.90 $\pm$ 4.82*	10.67 $\pm$ 1.41*	22.94 $\pm$ 3.11*	9.59 $\pm$ 1.31*
T2	44.35 $\pm$ 4.71**	11.14 $\pm$ 1.39**	23.56 $\pm$ 3.15**	9.65 $\pm$ 1.24*
T3	45.20 $\pm$ 5.01***	11.53 $\pm$ 1.43***	24.06 $\pm$ 3.09***	9.61 $\pm$ 1.26*
F-value	12.158	8.437	9.885	7.616
P-value	<0.001	<0.001	<0.001	<0.001

Note. Values are raw means $\pm$ SD. Pairwise comparisons (T1, T2, T3 vs T0) were conducted with Bonferroni correction. * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

Table 4. Repeated-measures ANOVA of coping style.

Time	Positive coping score (SCSQ)	Negative coping score (SCSQ)
T0	18.06 $\pm$ 2.39	9.41 $\pm$ 1.32
T1	18.54 $\pm$ 2.31*	9.12 $\pm$ 1.25*
T2	19.02 $\pm$ 2.24**	8.83 $\pm$ 1.20**
T3	19.36 $\pm$ 2.41***	8.74 $\pm$ 1.25**
F-value	10.239	9.501
P-value	<0.001	<0.001

Note. Values are raw means $\pm$ SD. Pairwise comparisons (T1, T2, T3 vs T0) were conducted with Bonferroni correction. * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

3.4. The longitudinal effects of social support and coping styles on anxiety, depression

Using a linear mixed-effects model, Anxiety: symptoms declined significantly over time ($P < 0.001$). Higher social support ($B = -0.08$, 95%CI $[-0.10, -0.05]$) and positive coping ($B = -0.12$, 95%CI $[-0.15, -0.09]$) were associated with lower anxiety, whereas negative coping, economic burden, pain score and tumour stage were positively associated with anxiety (all $P < 0.01$). Depression: symptoms likewise decreased over time ($P < 0.001$). Higher social support ($B = -0.07$, 95%CI $[-0.11, -0.03]$) and positive coping ($B = -0.10$, 95%CI $[-0.14, -0.06]$) were linked to lower depression, whereas negative coping and the same clinical factors showed positive associations (all $P < 0.01$) (Tables 5 and 6).

Table 5. Linear mixed-effects analysis of the longitudinal effects of social support and coping styles on anxiety.

Variable	Regression Coefficient (B)	Standard Error (SE)	95% CI	t-value	P-value
Intercept	8.23	0.86	[6.61, 9.85]	9.57	<0.001
Time T1	-0.62	0.09	[-0.93, -0.31]	-6.889	<0.001
Time T2	-1.24	0.15	[-1.59, -0.89]	-8.267	<0.001
Time T3	-1.65	0.22	[-2.07, -1.23]	-7.436	<0.001
Social support total	-0.08	0.01	[-0.10, -0.05]	-8.146	<0.001
Positive coping score	-0.12	0.01	[-0.15, -0.09]	-12.314	<0.001
Negative coping score	0.15	0.02	[0.07, 0.23]	7.624	<0.001
Age	-0.02	0.002	[-0.03, -0.01]	-10.316	0.003
Gender (female = 1)	0.46	0.06	[0.34, 0.58]	7.667	<0.001
Tumor stage	0.35	0.05	[0.26, 0.44]	7.183	<0.001
Pain score	0.21	0.03	[0.12, 0.30]	7.316	<0.001
Economic burden level	0.58	0.08	[0.42, 0.74]	7.25	0.001

Note.Time 0 (Baseline) is the reference category and is therefore omitted from the table; B coefficients for Time T1–T3 indicate changes relative to Baseline. The model is adjusted for the confounders age, gender, tumor stage, pain score, and economic-burden level. Toxicity grade and caregiver availability were also included in the model but were not statistically significant ($P > 0.05$) and are therefore not displayed. Social-support categories follow the SSRS cut-offs; coping-style categories are based on sample tertiles. Coping-style categories are based on tertiles of the composite coping-tendency index (positive minus negative coping).

Table 6. Linear mixed-effects analysis of the longitudinal effects of social support and coping styles on depression.

Variable	Regression Coefficient (B)	Standard Error (SE)	95% CI	t-value	P-value
Intercept	7.56	0.91	[5.79, 9.33]	8.315	<0.001
Time T1	-0.51	0.07	[-0.65, -0.37]	-7.291	<0.001
Time T2	-1.12	0.16	[-1.47, -0.77]	-7.014	<0.001
Time T3	-1.43	0.19	[-1.79, -1.07]	-7.536	<0.001
Social support total	-0.07	0.01	[-0.11, -0.03]	-7.127	<0.001
Positive coping score	-0.10	0.01	[-0.14, -0.06]	-9.724	<0.001
Negative coping score	0.17	0.02	[0.12, 0.22]	8.361	<0.001
Age	-0.02	0.003	[-0.031, -0.009]	-6.516	0.004
Gender (female=1)	0.37	0.05	[0.26, 0.48]	7.346	<0.001
Tumor stage	0.31	0.04	[0.22, 0.40]	7.748	<0.001

Table 6. (Continued).

Variable	Regression Coefficient (B)	Standard Error (SE)	95% CI	t-value	P-value
Pain score	0.27	0.03	[0.18, 0.36]	7.863	<0.001
Economic burden level	0.52	0.07	[0.37, 0.66]	7.389	0.002

Note.Time 0 (Baseline) is the reference category and is therefore omitted from the table; B coefficients for Time T1–T3 indicate changes relative to Baseline. The model is adjusted for the confounders age, gender, tumor stage, pain score, and economic-burden level. Toxicity grade and caregiver availability were also included in the model but were not statistically significant ($P > 0.05$) and are therefore not displayed. Social-support categories follow the SSRS cut-offs; coping-style categories are based on sample tertiles. Coping-style categories are based on tertiles of the composite coping-tendency index (positive minus negative coping).

3.5. Stratified analysis: changes in anxiety and depression under different levels of social support or coping styles

Using repeated measures analysis of variance, it was shown that social support level, coping style, and changes in anxiety and depression symptoms had a significant interaction effect (ANXIETY: $F = 6.327$, $P = 0.002$; DEPRESSION: $F = 8.654$, $P < 0.001$). After further Bonferroni pairwise comparison corrections, during treatment and early rehabilitation, the anxiety and depression scores of patients in each social support group and coping style group were all significantly lower than baseline (all $P < 0.05$). Comparing the same time point, the anxiety scores of patients in the medium- and high-level social support groups at some time points were significantly lower than those in the low-level social support group (some $P < 0.05$), and the depression scores of patients in the medium- and high-level coping groups were significantly lower than those in the low-level coping group at all time points (all $P < 0.05$) (**Figure 1A, B**). We also tested the Anxiety $\times$ Coping-style and Depression $\times$ Social-support strata; neither time $\times$ group interaction was significant (both $P > 0.05$), so the corresponding plots are omitted.

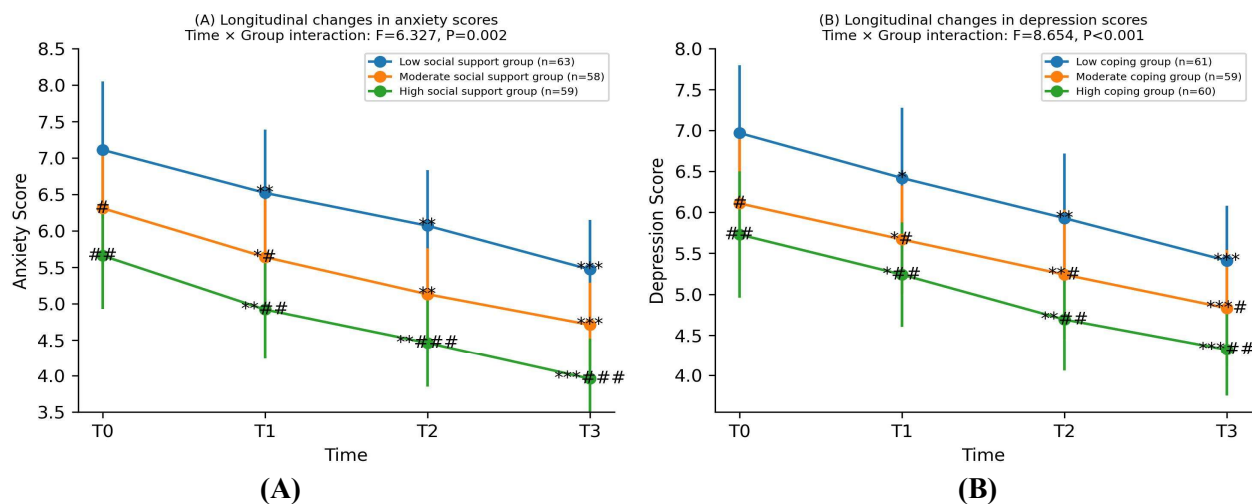


Figure 1. (A) Longitudinal comparison of anxiety scores among patients with different levels of social support; (B): Longitudinal comparison of depression scores among patients with different coping style tendencies (low, moderate, high coping-tendency tertiles). Repeated measures ANOVA time $\times$ group interaction effect: anxiety: $F = 6.327$, $P = 0.002$; depression: $F = 8.654$, $P < 0.001$. Pairwise comparisons were performed using Bonferroni correction, where “*” indicates that T1\T2\T3 in the same group were respectively compared with T0, and “#” indicates that the medium- and high-level groups at the same time point were respectively compared with the low-level group (* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$, # $P < 0.05$, ## $P < 0.01$, ### $P < 0.001$). Non-significant Anxiety $\times$ Coping and

Depression $\times$ Social-support interactions are described in the text and therefore not shown. Vertical error bars represent 95% confidence intervals.

4. Discussion

This study found that, during radiochemotherapy and the early rehabilitation period, nasopharyngeal carcinoma patients' anxiety and depression symptoms showed a continuously declining trend as treatment progressed. Their social support scores and positive coping styles significantly increased, while negative coping styles decreased over time. Linear mixed-effects analysis also identified that social support and positive coping have a protective effect against negative emotions, whereas negative coping, economic burden, and tumor stage are positively correlated with anxiety and depression symptoms. Further stratified analysis indicated that patients in the high social support or high coping ability groups had lower levels of anxiety and depression at multiple time points, and compared with baseline, the reduction in symptoms was more pronounced. This result was consistent with some domestic and international studies on psychological interventions for cancer patients, demonstrating that early intervention in social support and guidance in coping strategies could effectively alleviate patients' psychological distress and improve treatment compliance and quality of life [16]. However, this study focused on a specific population of nasopharyngeal carcinoma patients for longitudinal observation. The results also showed that economic burden and tumor stage are important factors influencing patients' psychological state, which differs from previous reports mostly targeting breast cancer or lung cancer populations. One plausible explanation is that most high-incidence counties are economically less developed; patients often travel long distances to tertiary centers for IMRT-based chemoradiotherapy, which adds transportation and accommodation expenses to already high direct medical costs, thereby intensifying family burden and side-effect management challenges [17,18]. The findings of this study extend previous understandings of the psychological changes in nasopharyngeal carcinoma patients and provide a reliable basis for formulating differentiated interventions in the future. They also offer a new direction for exploring targeted nursing intervention models under different cultural backgrounds and can be compared with multicenter trial results to enhance relevant theoretical support. In addition, we treated anxiety and depression as indicators of psychological distress and did not directly measure objective or perceived stress.

The results of this study indicated that during radiochemotherapy and the early rehabilitation period, nasopharyngeal carcinoma patients' anxiety and depression symptoms gradually alleviate as social support increases and coping styles improve. The linear mixed-effects model showed that higher social-support scores were independently associated with lower anxiety and depression, suggesting that social support buffered treatment-related psychological distress rather than objectively measured stress. Active coping strategies such as problem-solving and help-seeking were associated with greater self-efficacy, thereby alleviating feelings of helplessness and tension [19]. Higher levels of social support and positive coping reinforced each other, making it easier for patients to access medical resources or psychological assistance, further reducing the negative impact of treatment side effects on

emotions[20]. Conversely, low social support was found to induce negative coping in medical residents [21]. Negative coping has also been shown to exacerbate anxiety and depression in nasopharyngeal carcinoma patients. The simultaneous decrease in anxiety and depression suggested a close interaction between physiological and psychological mechanisms; positive coping strategies can enhance patients' tolerance of symptoms and maintain a more stable emotional state [22]. In this study, "different stages" refer to the four assessment timepoints—baseline (T0), mid-radiochemotherapy (T1), completion of radiochemotherapy (T2), and one month post-treatment (T3). We found that social support and coping styles change dynamically across these phases, indicating that psychosocial support and coping guidance should be tailored to each timepoint to optimize patient care [23]. In this study, negative coping was associated with negative emotions, indicating that clinical attention should be given to the early identification and intervention of such coping modes to prevent worsening anxiety and depression [24]. This study emphasized that strengthening the social support network and guiding positive coping can effectively reduce patients' emotional distress, and may play a key protective role under heavier economic burdens and advanced disease stages, providing new insights for subsequent clinical practice and targeted intervention research.

This study used patients from a single center as the research subjects, which may affect the generalizability of the results. Follow-up was conducted only until one month after the completion of radiochemotherapy, so it was not possible to fully capture changes in social support and coping styles during the longer-term rehabilitation process. Future studies could extend the observation period to verify the stability of these findings and explore long-term effects. Although economic burden and tumor stage were included as confounding factors, potential interfering variables such as sociocultural background and family structure were not thoroughly controlled, making it impossible to comprehensively evaluate their interaction effects on patients' psychological changes. The main scales were patient self-report forms, which may be influenced by recall bias and social desirability, potentially causing some degree of error in the social support and coping style scores. The study focused primarily on the early rehabilitation period within one month after the end of radiochemotherapy, lacking long-term follow-up, which hinders clarification of the roles of social support and coping styles in continuous recovery and long-term prognosis. Nevertheless, this study still provides strong explanatory power regarding the longitudinal evolution of anxiety and depression symptoms and the association of these symptoms with social support and coping styles, offering practical intervention references for clinical practice.

This study found that patients with higher levels of social support and positive coping experienced lower emotional distress, suggesting that clinical practices aimed at enhancing social support and promoting positive coping may help reduce patients' negative emotions. During radiochemotherapy and the early rehabilitation period, medical staff can adopt a multidisciplinary team approach to offer timely emotional support and rehabilitation guidance to patients and their families. By integrating psychological counseling, nursing interventions, and linkage to social resources, patients can be helped to cope with the dual burdens of physical symptoms and financial pressure. Stratified management based on patients' levels of social support

and coping tendencies should be implemented, with timely psychological assessment and individualized health education provided for those with higher self-paying ratios or faster disease progression, employing cognitive restructuring and emotional regulation techniques to relieve fear and pessimistic expectations. Family or community support training can further strengthen patients' daily care and communication with healthcare providers, reducing the sense of isolation caused by radiochemotherapy side effects. In the future, multicenter prospective studies could be conducted at different treatment stages and over longer rehabilitation periods to continuously observe the dynamic impact of social support and coping styles on patients' psychological and physical outcomes. By combining disease course management with precise intervention strategies, the effectiveness and feasibility of individualized nursing plans can be explored. Future randomized controlled trials across diverse economic and cultural settings could further assess the universal applicability of these intervention strategies in alleviating negative emotions and improving quality of life.

Strengths and limitations: This single-center cohort may limit generalizability, and follow-up only extended to one month post-radiochemotherapy, hindering assessment of longer-term changes in social support and coping. Although economic burden and tumor stage were adjusted for, factors such as sociocultural background and family structure were not fully controlled, potentially confounding psychological outcomes. Patient self-report measures may introduce recall bias and social desirability effects. Nevertheless, this study provides robust explanatory evidence on the longitudinal evolution of anxiety and depression and their associations with social support and coping, offering practical intervention insights for clinical practice.

5. Conclusion

This cohort study found that patients with higher levels of social support and positive coping experienced lower anxiety and depression during radiochemotherapy and the early rehabilitation period, whereas negative coping and greater economic burden were associated with more severe emotional distress. Analysis using a linear mixed-effects model indicated that social support and positive coping styles have a significant protective effect on reducing anxiety and depression, with those in high social support or high coping groups consistently showing lower emotional distress at multiple time points. Stratified analysis further confirmed that intervention needs vary at different stages; early identification and improvement of negative coping, combined with individualized health education and multidisciplinary teamwork, could effectively increase treatment adherence and improve patients' quality of life. This study provides a clear basis for the implementation of refined psychological support and graded nursing interventions in clinical settings, and it also lays a foundation for subsequent multicenter long-term follow-up and intervention research.

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