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Development trajectory and predictive factors of demoralization syndrome in cervical cancer patients undergoing postoperative concurrent chemoradiotherapy

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ABSTRACT

Objective: To examine the developmental trajectories of DS and its influencing factors among cervical cancer patients undergoing postoperative CCRT.

Methods: A convenience sample of cervical cancer patients treated at a hospital in Anhui Province from June 2023 to March 2025 will be recruited. The Demoralization Scale will be administered at five time points: 3 – 7 days after surgery to three months after the final chemotherapy. Growth Mixture Modeling (GMM) will be used to identify trajectories of DS over time. The Wilcoxon rank-sum test and multiple logistics regression were used to analyze the influencing factors for the DS trajectories.

Results: Three DS trajectories were identified: Persistent Group(46.6%), Adjustment Group(45.7%) and Remission Group(7.7%). The social support, coping styles, and psychological resilience as key factors influencing DS trajectories.

Conclusions: Group heterogeneity in DS was observed in cervical cancer patients undergoing postoperative CCRT. Social support, coping styles, and psychological resilience should be considered by healthcare professionals to deliver appropriate psychosocial care.

KEYWORDS

Cervical cancer, cancer, chemotherapy, concurrent chemoradiotherapy, demoralization syndrome, longitudinal study, oncology, psycho-oncology, trajectories

1 INTRODUCTION

Cervical cancer ranks as the fourth most common cancer among women worldwide and also the fourth leading cause of cancer-related deaths in females.^[1] In recent years, both its incidence and mortality rates have shown an upward trend.^[2] The treatment modalities for cervical cancer mainly include surgery, radiotherapy, chemotherapy, and targeted therapy.^[3] Among these, concurrent chemoradiotherapy (CCRT) has achieved favorable outcomes in the adjuvant treatment of post-operative cervical cancer.^[4] However, the overlapping toxic and side effects of radiotherapy and chemotherapy tend to induce hematological toxicity, gastrointestinal reactions, vulvar and vaginal disorders, and other adverse effects, which further exacerbate the physical and psychological burden on patients.^[5]

Demoralization Syndrome(DS) is a state of psychological distress resulting from internal or external pressures^[6], including a sustained inability to cope with a stressful predicament, followed by a sense of helplessness, hopelessness, meaninglessness, subjective incompetence, and reduced self-respect. DS is frequently mistaken for depression or adjustment disorder, yet emerging evidence demonstrates that it has distinct neurobiological substrates that set it apart from depressive states.^[7] The principal differentiator between DS and a major depressive episode is the presence of subjective incompetence: individuals feel uncertain about the actions they ought to take to manage a stressful situation.^[8] DS has become a common psychological problem among cancer patients, with a prevalence of 24%–47.6%^[9, 10]. It exacerbates sleep disturbances and behavioral problems, undermines treatment adherence, and amplifies symptom burden, ultimately leading to reduced quality of life and poorer prognosis.^[11, 12] Moreover, DS is a precursor to suicidal ideation^[13]. Early detection and intervention of DS are of significant to block the suicidal ideation, promote disease recovery, and improve quality of life. At present, there are few reports on the DS level in cervical cancer patients.^[14] Moreover, the toxic reactions during postoperative CCRT may lead to the longitudinal change trajectory of DS.^[15] Identifying the type of these changes and implementing targeted interventions are conducive to individualized whole-course management.

According to the Conservation of Resources Theory (COR),^[16] psychological resilience constitutes an individual level personal resource, social support represents a condition resource at the societal level, and coping strategies function as an energy resource in the behavioral domain. When these resources are insufficient or become depleted, individuals are prone to develop DS; conversely, the supplementation or restoration of such resources—through external interventions or internal regulation—can mitigate or even reverse the onset and progression of this condition.^[16] This study will employ Growth Mixture Modeling (GMM) to identify trajectories of DS in cervical cancer patients during postoperative CCRT. It will also examine the predictive effects of psychological resilience, social support, and coping strategies. The findings aim to provide a basis for clinically identifying high-risk groups and implementing targeted psychological interventions.

2 MATERIALS AND METHODS

2.1 Design

This longitudinal descriptive study investigated the experiences of Cervical cancer patients during postoperative CCRT were recruited from Gynecology in four grade A hospitals in Anhui, China between June 2023 to March 2025. Ethical approval for this study was obtained from the Bengbu

Medical University Human Research Ethics Committee (Approval No. 2025-569), and according to the Declaration of Helsinki, all participants have provided informed consent forms.

2.2 Participants

Convenience sampling was employed. The inclusion criteria: diagnosed with cervical cancer; aged ≥ 18 years; received postoperative CCRT regimen; possessed good communication skills. Exclusion criteria: a history of mental illness; recent major life events such as accidents or bereavement. According to the research results of Kim^[17], when there are 5 measurement time points, a sample size of 200 is sufficient to achieve the accuracy of parameter estimation. Additionally, considering the actual situation of the hospital and a planned missing rate of less than 20%, a total of 240 participants were enrolled in this study.

2.3 Procedures

The patient's radiotherapy and chemotherapy cycles are basically aligned. The patient will receive approximately 6 cycles of chemotherapy (administered once weekly) and 6 weeks of radiotherapy (delivered about 5 times weekly). Notably, the overlapping phase of chemotherapy and radiotherapy imposes a substantial physical and psychological burden on the patient.^[18] 5 follow-up time points were set as follows: 3-7 days after surgery (T1), 1-3 days after the first chemotherapy (T2), 1-3 days after the fourth chemotherapy (T3), 1-3 days after the completion of all chemotherapy (T4), and 3 months after the completion of all chemotherapy (T5).

At T1, data were collected via face-to-face questionnaires, including general information, Demoralization Scale, Resilience Scale, Perceived social support scale, and Simplified Coping Style Questionnaire. If a patient was hospitalized for less than 3 days, data were collected via telephone on the day of discharge or at a mutually agreed time. One week before T2 - T4, patients were contacted by telephone to confirm their admission time; information on DS was collected face-to-face during days of chemotherapy. For patients who were transferred to other hospitals, follow-up data were collected via telephone or WeChat. For T5, data were collected via telephone or WeChat. A total of 240 patients were enrolled in this study, and 221 valid responses were finally retrieved, with an effective recovery rate of 92.1%. Of the 240 eligible participants, 240 completed the baseline; 239, 230, 228, and 221 individuals completed the assessments the first chemotherapy, fourth chemotherapy, last chemotherapy, and 3 months after the completion of all chemotherapy, respectively. Attrition rates were 0.4%, 3.8%, 0.8%, and 2.9% at each time point. Loss to follow-up was due to patient refusal to complete questionnaires, missing data, and death (Fig. 1).

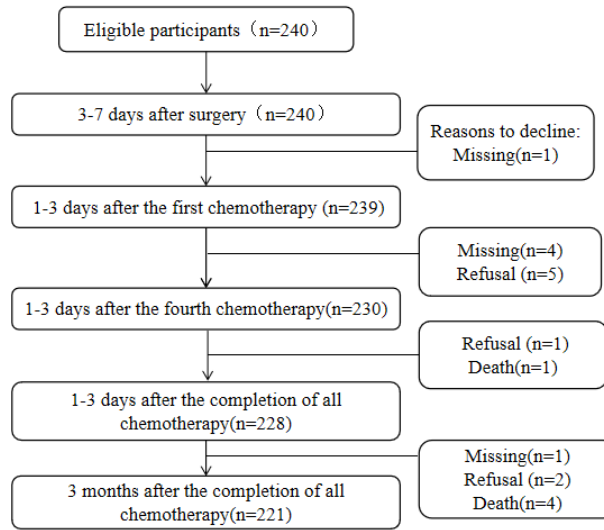


Fig 1 Sampling structure and attrition

2.4 Measures

2.4.1 Demoralization Scale, DS

Demoralization Scale was employed to assess the level of patient demoralization^[19]. The questionnaire consisted of 24 questions, each rated on a scale from 0 (strongly disagree) to 4 (strongly agree), yielding total scores from 0 to 96. A score >30 indicates the presence of demoralization. In this study, Cronbach's α for the scale ranged from 0.842 to 0.877 across the 5 time points.

2.4.2 Resilience Scale, RS-14

The Resilience Scale was developed by Wagnild et al.^[20] and sinicized by Ni et al.^[21] in China. It consists of 14 items, covering 2 dimensions: personal competence and positive cognition. A 5-point Likert scale is used for scoring, where each item is rated from 1 (completely inconsistent) to 5 (completely consistent). A higher score indicates better resilience. In this study, the Cronbach's α coefficient of the scale was 0.781

2.4.3 Perceived social support scale, PSSS

Perceived social support scale was employed to assess family support, friend support and others.^[22] The Chinese Perceived social support scale is scored on an 7-point scale ranging from 0 (none) to 7 (extremely), which comprises 14 items. The scores of 12 to 36 were considered as low support level, 37 to 60 as middle support level, 61 to 84 as high support level. In this study, Cronbach's α were 0.955 .

2.4.5 Simplified Coping Style Questionnaire, SCSQ

Simplified Coping Style Questionnaire was employed to assess the coping styles.^[23] It comprises 12 items for the positive coping scale and 8 items for the negative coping scale. The scale is assessed using a 4-point Likert scale from 0 (not taken) to 3 (often taken) for each entry. A higher score on the scale suggests a greater congruence with the coping strategies typical of the assessed dimension. In this study, the scores of positive coping and negative coping scales were 0.787 and

0.731, respectively.

2.5 Statistical analysis

Data were analyzed using SPSS 26.0 and Mplus 8.3. If missing data were found in the data, the sample would be deleted. The growth mixture model (GMM)^[24] and latent class growth model (LCGM) was employed to identify the subtypes of DS trajectories, and determine the optimal number of trajectories. Model fit indices were used to determine the optimal number of latent classes, including the Akaike information criterion (AIC), Bayesian information criterion (BIC), adjusted BIC (aBIC), entropy, Lo–Mendell–Rubin adjusted likelihood ratio test (LMR), and bootstrapped likelihood ratio test (BLRT). The lower the statistical values of AIC, BIC, and aBIC, the better the model fit; entropy exceeded 0.8, indicating a model classification accuracy above 90%; when LRT and BLRT were statistically significant ($P < 0.05$), the Nth profile model outperformed the N-1 profile model; the optimal number of classes is thus determined.

Categorical variables are presented as frequencies and percentages, and continuous variables are expressed as means and standard deviations. Wilcoxon rank–sum tests were used to compare symptom scores across the 5 time points and examine demographic differences among the identified trajectory subgroups. Furthermore, multinomial logistic regression analysis was performed to evaluate baseline predictors of each fear trajectory, with statistical significance set at $P < 0.05$.

3 RESULTS

3.1 Sample characteristics

The baseline characteristics of the study population were presented in Table 1.

Table 1 Sociodemographic and psychological variables of patients in different DS trajectories

Variables	Total Sample (n =221)	C1 (n=103)	C2 (n=101)	C3 (n=17)	Z/F	Significa nt
Age					0.099	0.952
<40	54	24	26	4		
40~50	82	37	37	8		
50~60	41	24	16	1		
>60	44	18	22	4		
Marital Status					1.603	0.449
Unmarried	200	93	93	14		
married	21	10	8	3		
Number of children					1.879	0.391
≥5	27	8	15	4		
3~4	154	75	70	9		
1~2	30	16	12	2		
0	10	4	4	2		
Average Monthly Household Income (Yuan)					3.347	0.188
<2000	22	11	7	4		
4000~	106	47	51	8		
6000~	72	37	30	5		

>600	21	8	13	0		
Education level					6.254	0.044
Less than junior high school	53	17	29	7		
Senior high school	140	73	57	10		
College or higher	28	13	15	0		
Place of residence					2.805	<0.001
Urban	102	32	56	14		
Rural	119	71	45	3		
Physical activity levels					0.411	0.814
infrequent	108	53	49	6		
occasional	74	32	32	10		
Frequent	39	18	20	1		
Health status of carers					0.065	0.968
Good	52	25	25	2		
average	74	32	33	9		
difference	95	46	43	6		
Stage of tumor						
I or II	93	44	44	5	1.397	0.497
III	27	13	12	2		
IV	101	46	45	10		
Psychological resilience		55.72±8.630	59.59±8.362	63.18±8.988	8.573	<0.001
social support		54.56±8.236	72.97±5.408	70.06±10.335	169.046	<0.001
Positive coping		30.27±4.772	30.56±4.506	30.94±4.603	0.202	0.818
Negative coping		11.07±4.590	10.49±4.328	7.29±3.853	5.321	0.006
Family resilience		58.15±7.017	61.02±5.991	61.94±5.953	6.049	0.003

3.2 Identification of DS trajectories

To precisely identify the longitudinal developmental trajectory characteristics of DS and to test the hypothesis of population heterogeneity, this study simultaneously constructed LCGM and GMM, evaluated model performance using multiple fit indices (see Table 2). From the perspective of core model fit criteria, the GMM outperformed the LCGM markedly: all information criterion indices (AIC, BIC, aBIC) were significantly lower for the GMM than for the LCGM, with differences exceeding 10 points, indicating superior model parsimony and fit accuracy of the GMM^[25]. Regarding classification accuracy, the entropy of the GMM was higher than that of the LCGM, suggesting clearer delineation of latent subgroups and more stable posterior probabilities for individual assignment.^[25] Taken together, these indices demonstrate that the GMM better captures the actual distribution of the data in this study; consequently, subsequent analyses of trajectory characteristics and subgroup influencing factors were conducted based on the optimal GMM results.

The scores of DS in cervical cancer patients at 5 time points were used as observation indicators, with time parameters set for free estimation. Latent classes were extracted sequentially, ranging from 1 to 5. When the number of extracted latent classes increased from 1 to 3, the AIC, BIC, aBIC, and Entropy all decreased accordingly. Both the LMRT and BLRT were significant ($P<0.05$). However, when the number of classes increased from 3 to 4, the LMRT was not

significant ($P>0.05$), indicating no improvement in model fit. Based on the above information, 3 classes were finally retained (see Table 2).

A trajectory plot was generated based on the DS scores of the 3 classes at the 5 time points (see Figure 1). Class 1 showed a persistently high level of DS from T1 to T5 ($I=65.074$, $S=-2.129$, $P<0.05$), and thus was named the "Persistent Group" (46.6%). Class 2 exhibited a high level of DS at T1 ($I=63.993$, $S=-4.253$, $P<0.05$), which gradually decreased to a moderate level during the follow-up period; it was therefore designated the "Adjustment Group" (45.7%). Class 3 presented a high level of DS at T1 ($I=66.882$, $S=-8.592$, $P<0.05$), but DS disappeared in patients at T4 and T5; this class was named the "Remission Group" (7.7%).

Table 2 Fit statistics with one-to-five class solutions of DS trajectories

Criterion	Parameters	AIC	BIC	aBIC	Entropy	P value		Class probability
						LMRT	BLRT	
LCGM	1	9	8282.010	8312.594	8284.072	-	-	-
	2	12	8118.511	8159.289	8121.260	0.819	0.511	0.258/0.742
	3	15	7975.506	8026.479	7978.943	0.875	0.003	0.240/0.022/0.738
	4	18	7894.666	7955.833	7898.790	0.864	0.439	0.235/0.670/0.072/0.023
	5	21	7805.805	7877.167	7810.617	0.899	0.350	0.655/0.023/0.222/0.009/0.091
GMM	1	12	7473.730	7514.508	7476.479	-	-	-
	2	15	7412.174	7463.146	7415.611	0.892	0.014	0.204/0.796
	3	18	7347.866	7409.033	7351.990	0.944	0.030	0.466/0.457/0.077
	4	21	7342.999	7414.361	7347.811	0.875	0.620	0.439/0.213/0.072/0.276
	5	24	7323.559	7405.115	7329.058	0.891	0.681	0.330/0.145/0.144/0.339/0.041

Abbreviations: aBIC, adjusted Bayesian information criterion; AIC, Akaike information criterion; BIC, Bayesian information criterion; BLRT, bootstrapped likelihood ratio test; LMR, Lo-Mendell-Rubin adjusted likelihood ratio test.

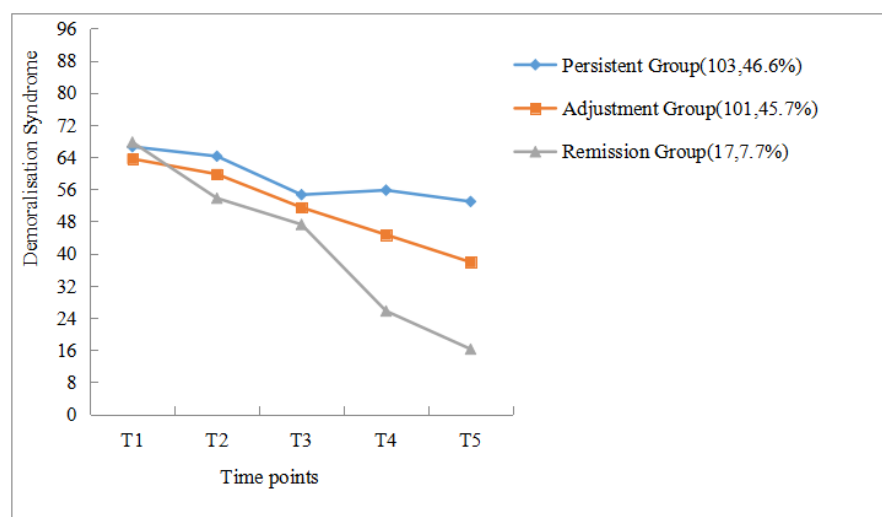


Figure 1. Trajectory of DS during postoperative CCRT in cervical cancer patients

Note: T1:Postoperative 3~7 days, T2:first chemotherapy 1~3 days, T3:fourth chemotherapy 1~3 days, T4:chemotherapy end 1~3 days,T5:chemotherapy end 3 months.

3.3 Predictors of DS trajectories

The results of one-way factor analysis showed that there were statistically significant differences in education level, place of residence, psychological resilience, social support, negative coping and family resilience among different groups ($P < 0.05$) (See Table 1).

Taking the three trajectories of DS in patients with cervical cancer as the dependent variables, and the variables with significant results in univariate analysis as the independent variables, a multinomial logistic regression analysis was performed. The model fitting was significant ($\chi^2 = 245.570$, $P < 0.001$) (see Table 3). Negative coping [odds ratio (OR): 1.162; 95% confidence interval (CI): 0.959-1.408] were identified as protective factors for C1 compared with C3. Moreover, PSSS (OR: 0.598; 95% CI: 0.492-0.726), PR (OR: 0.872; 95% CI: 0.796-0.956) were identified as risk factors for C1 compared with C2. (Table 3). Negative coping (OR: 1.232; 95% CI: 1.055-1.439) were identified as protective factors for C2 compared with C3.

Table 3 Multiple progressive logistic regression^a predicting DS trajectories

Variables (reference)	C1 vs C3					C2 vs C3				
	<i>B</i>	<i>SE</i>	<i>Wald</i>	<i>P</i>	<i>OR</i> (95% <i>CI</i>)	<i>B</i>	<i>SE</i>	<i>Wald</i> χ^2	<i>P</i>	<i>OR</i> (95% <i>CI</i>)
Intercept	41.277	7.793	28.056	<0.001	-	-4.522	4.155	1.185	0.276	-
Negative coping	0.150	0.098	2.36	0.125	1.162(0.959,1.408)	0.209	0.079	6.973	0.008	1.232(1.055,1.439)
PSSS	-0.515	0.099	27.044	<0.001	0.598(0.492,0.726)	0.092	0.048	3.583	0.058	1.096(0.997,1.205)
PR	-0.137	0.047	8.579	0.003	0.872(0.796,0.956)	-0.034	0.032	1.117	0.291	0.967(0.908,1.029)

Abbreviations: C1, Persistent Group; C2, Adjustment Group; C3, Remission Group.

4 Discussion

4.1 Trajectories of DS during postoperative CCRT in cervical cancer patients

This study identified three trajectories of DS, confirming that cervical cancer patients exhibit significant population heterogeneity during postoperative concurrent chemoradiotherapy. The Persistent Group accounted for the highest proportion (46.6%), which is consistent with the results of previous studies on psychological distress in gynecological cancer patients.^[26] Nursing teams should prioritize the Persistent Group as the key target for intervention and implement systematic psychological counseling and intervention measures to reduce their DS levels, thereby improving overall quality of life. This trajectory indicates that patients experience intense existential distress at the initiation of the first chemotherapy cycle; although the distress shows a slight decrease with increasing treatment sessions, the overall DS level remains high, reflecting a persistent risk of inadequate adaptability. The Adjustment Group constituted 45.7%, a proportion similar to that observed in patients with chronic diseases.^[27] Patients in this subgroup displayed relatively stable psychological distress; over time, they were able to gradually adapt to the disease state and achieve psychological balance for coexistence with chronic illness. The Remission Group only accounted for 7.7%, suggesting that in the absence of specialized interventions, a small number of patients still experience psychological discomfort after diagnosis but achieve spontaneous remission as treatment progresses. This phenomenon may be associated with factors such as treatment efficacy-induced psychological adaptation and enhanced social support.^[28] However, this proportion is significantly lower than that in the overall gynecological cancer patient population,^[26] which may be attributed to the longer hospitalization duration and frequent side effects of concurrent chemoradiotherapy in cervical cancer patients—these patients tend to misinterpret side effects as disease progression, thereby developing feelings of weariness and

pessimism.

4.2 Predictors of DS trajectories during Postoperative CCRT in Cervical Cancer Patients

The present study demonstrated that a higher level of negative coping was significantly associated with an increased probability of patients falling into the high-level DS group. This finding is consistent with previous investigations on patients with various types of tumors, where negative coping (e.g., emotional suppression, avoidance, and denial) has been identified as a critical risk factor for the development and maintenance of high-level negative emotional trajectories (e.g., psychological distress, anxiety) in most longitudinal studies.^[29, 30] Negative coping is characterized by avoidance, denial, and self-blame, which tend to result in the continuous accumulation of negative emotions.^[29] This not only impairs patients' emotional regulation ability but also reduces their utilization of social support, thereby exacerbating existential distress and maintaining a high level of DS.^[29] Therefore, nursing teams should conduct standardized psychological assessments in the early stage of treatment to screen for negative coping tendencies and implement targeted interventions. Such interventions are expected to transform patients' coping styles, reduce the incidence of DS, and ultimately improve their overall quality of life. Notably, some relevant studies have reported that positive coping is often associated with low-level negative emotional trajectories (e.g., fear of cancer recurrence).^[26] However, this association was not supported by the present study. A potential explanation for this discrepancy is that positive emotions and negative emotions may be relatively independent within the emotional system.^[31] Specifically, negative coping can predict the upward trajectory of negative emotions by enhancing the processing and maintenance of negative emotions. In contrast, positive emotions, due to their transient and independent nature, may not directly predict changes in negative emotions.

The results of this study indicated that the higher the level of perceived social support, the lower the risk of DS. This conclusion is consistent with the findings of multiple previous studies. A study focusing on the core symptoms of female cancer patients confirmed that social support plays a crucial bridging role in alleviating DS.^[32] Individuals with higher socioeconomic status generally have a lower prevalence of depression, and social support exerts a key mediating effect between these two factors.^[33] Emotional support was significantly associated with lower depression scores in both cross-sectional and longitudinal studies.^[34] Social support can effectively buffer the psychological and physical stress caused by diseases through multiple forms such as providing emotional comfort, information support and practical help.^[35] This further enhances patients' self-efficacy and hope, reduces the occurrence of helplessness and despair, and ultimately achieves the effect of alleviating DS in patients with cervical cancer.^[35] In clinical nursing and psychological intervention practice, focus should be placed on the construction and strengthening of patients' social support networks. Targeted intervention measures should be adopted to improve patients' perceived level of social support, thereby reducing the degree of their DS.

This study confirms that psychological resilience is a key protective factor for the trajectory of DS. Previous studies on various types of cancer patients have found a negative correlation between psychological resilience and negative emotions,^[36] and this study further clarifies the protective effect of psychological resilience in the population of cervical cancer patients receiving concurrent chemoradiotherapy after surgery. Since the site of cervical cancer is directly related to female role identity, patients with high psychological resilience can effectively cope with the psychological crisis caused by the disease through cognitive restructuring and active seeking of

partner support.^[37] Notably, this study found that there was no significant correlation between the sociodemographic characteristics and disease stages of cervical cancer patients and the DS trajectory, which is consistent with the findings of Scott et al.^[27] The reasons may account for this phenomenon that protective variables such as social support and psychological resilience have played a buffering role, reducing the potential effects of sociodemographic characteristics and disease stages on the DS trajectory.

4.3 Study limitations

The limitations of this study warrant consideration. First, given the temporal dynamism of variables such as perceived social support, coping styles, and psychological resilience, a longitudinal follow-up design is recommended in subsequent studies to more systematically explore the association mechanism between these variables and DS. Second, the samples of this study were limited to Anhui Province, China, and convenience sampling was adopted, resulting in insufficient sample representativeness and limited extrapolation of the research results. Accordingly, multi-center and large-sample studies should be conducted in future research to improve the generalizability and scientific validity of the results.

4.4 Clinical implications

Despite limitations, this study identified perceived social support, coping styles, and psychological resilience as key factors influencing DS trajectories. This study provides clinical evidence for the intervention of DS in cervical cancer patients undergoing concurrent chemoradiotherapy after surgery. It is recommended to construct a three-dimensional support network involving medical staff, family members, and fellow patients to dynamically meet the emotional and practical needs of patients. Health education and psychological counseling should be conducted to guide patients to adopt positive problem-solving strategies and reduce negative avoidance behaviors. Additionally, phased rehabilitation goals should be set according to the treatment stages to enhance patients' self-efficacy, helping them go through the treatment period smoothly and improve prognosis.

5 CONCLUSIONS

This study elucidated DS trajectory groups in cervical cancer patients undergoing concurrent chemoradiotherapy after surgery. Three distinct trajectories were identified—Persistent Group, Adjustment Group, Remission Group—demonstrating heterogeneity in DS from postoperative to chemotherapy end 3 months. Longitudinal analysis identified perceived social support, coping styles, and psychological resilience as key factors influencing DS trajectories. These factors should be considered by healthcare professionals to deliver appropriate psychosocial care. The findings further suggest potential implications for future identification of cervical cancer patients in need of targeted interventions based on their DS trajectory patterns.

AUTHOR CONTRIBUTIONS

Yanfang Zhang: Conceptualization, data curation, formal analysis, investigation, writing original draft, and writing review editing. **Xiaomei Ji, Yuanyuan Yu, Manman Hu, Li Wang, Lihua Wang:** Data curation. **LongZhao, Xiumu Yang:** investigation, methodology, and writing review and editing. **;** funding acquisition, methodology, project administration, supervision. **Xiumu Yang:** Conceptualization, funding acquisition, data curation. **Man Wu:** formal analysis, funding acquisition, methodology, supervision, writing – original draft and review editing.

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CONFLICT OF INTEREST STATEMENT

There were no financial disclosures or conflicts of interest to disclose.

DATA AVAILABILITY STATEMENT

The anonymized data that support the findings of this study were available from the author (Yangfang Zhang) upon reasonable request. The data were not publicly available due to privacy and ethical restriction.

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