

A Network Analysis of Core Symptoms and Symptom Clusters in Cervical Cancer Patients During the Rehabilitation Period

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Abstract

Aim:To explore the network characteristics of symptom clusters in patients with cervical cancer during the rehabilitation period, identify core symptoms and provide evidence for the management of symptoms in patients.

Design: A cross-sectional survey.

Methods:Participants in the rehabilitation period were recruited from two hospitals in Nantong City between January 2020 and September 2024. The rehabilitation period was defined as at least three months after surgery or the completion of adjuvant therapy. The symptoms were measured using Functional Assessment of Cancer Therapy-Cervix, Patient Health Questionnaire-9, Generalized Anxiety Disorder-7 and Pittsburgh Sleep Quality Index. Symptom clusters along with core symptoms were identified through network analysis.

Results:A total of 522 patients were included in the research. The most common symptoms in postoperative rehabilitation patients with cervical cancer were afraid to have sex, fear of treatment side effects, concern about prognosis, lack of energy and feeling ill. Network analysis revealed that patients in the rehabilitation period of cervical cancer had 7 symptom clusters. 'Feeling ill' exhibited the highest strength centrality and was the core symptom in the entire symptom network. There were both commonalities and differences in symptom clusters among patients at different stages of the rehabilitation period.

Conclusions: Patients in the rehabilitation period exhibit multiple symptom clusters, with sex-related symptoms showing high incidence and severity. The composition of symptom clusters and core symptoms differs across rehabilitation stages. Healthcare professionals should conduct phased assessments of core symptoms and targeted interventions to improve quality of life for cervical cancer patients.

1. Introduction

Malignant tumors are a major cause of premature death globally, with nearly 20 million new cancer cases worldwide each year, approximately 24% of which occur in China^[1]. Cervical cancer, as one of the three most common gynecological malignancies, poses a serious threat to women's health worldwide. Preliminary estimates indicate that by 2100, the age-standardized incidence rate of cervical cancer in China will rise to 32.58 per 100,000 people^[2]. By 2032, the annual incidence of cervical cancer in China will reach 4.43%, ranking as the second most common female malignancy^[3].

The current treatment of cervical cancer primarily involves surgery, supplemented by radiotherapy, chemotherapy, and immunotherapy. Due to surgical removal of female reproductive organs and side effects of adjuvant treatments, patients may experience a series of long-term symptoms after treatment, including urinary retention^[4]. Changes in intimate relationships lead to changes in psychological states

such as disease-related shame^[5]; Perimenopausal symptoms are also frequent following ovariectomy^[6]. The incidence of symptoms such as fatigue and pain after radiotherapy and chemotherapy is as high as 70 ~ 80%^[7]. These symptoms may persist long after treatment completion and can adversely affect emotional well-being and sleep quality among cervical cancer survivors. These symptoms do not exist independently but often occur in clusters with certain correlations. This combination of two or more related and simultaneously occurring stable symptoms is defined as a symptom cluster^[8]. Interactions among symptoms may contribute to increased symptom burden and reduced functional status, affecting their functional status and greatly increasing the burden of symptoms.

Previous studies have primarily focused on patients undergoing active treatment, particularly radiotherapy and chemotherapy, while studies on symptoms in patients in the rehabilitation period after cervical cancer surgery and treatment are scarce, limiting the provision of specific and targeted theoretical guidance for symptom management.

Currently, both domestic and international studies on symptom clusters in patients with cervical cancer are mostly one-sided. The symptom clusters in cervical cancer patients are often determined through exploratory factor analysis to identify the number and types. However, existing studies have shown that even in homogeneous populations, the identification results of symptom clusters in cancer patients may vary due to differences in identification methods^[9, 10]. Network analysis provides a graphical representation of symptom interactions, facilitates the identification of potentially central symptoms, and offers insights into symptom patterns during rehabilitation, thus providing a new method for exploring symptom clusters.

There is a lack of research on symptom networks specifically in the rehabilitation period for cervical cancer patients. Therefore, this study aims to explore symptom clusters and core symptoms in patients in the rehabilitation period through network analysis. The findings are expected to contribute to a better understanding of symptom interactions and provide a foundation for future research on symptom management strategies.

2. Methods

2.1 Participants

Patients who underwent cervical cancer surgery at two tertiary hospitals in Nantong City and were in the rehabilitation period were recruited between January 2020 and September 2024.

Inclusion criteria: (1) aged ≥ 18 years, (2) diagnosed with cervical cancer by both pathology and clinical examination, and having completed surgical treatment, (3) in the rehabilitation period (≥ 3 months after surgery for patients who received only surgical treatment; ≥ 3 months after the completion of adjuvant treatments for patients who received postoperative adjuvant treatments such as radiotherapy and chemotherapy), (4) were conscious and able to communicate effectively.

Exclusion criteria: (1)currently receiving other treatments (such as gene therapy, immunotherapy, molecular targeted therapy), (2)terminally ill patients (expected survival time < 1 year), (3)patients with recurrence or metastasis, (4)Patients with severe comorbidities or other malignancies, (5)patients with severe psychiatric disorders, cognitive impairment, illiteracy, or other conditions affecting questionnaire completion, (6)patients with poor compliance who cannot complete the questionnaire.

2.2 Sample Size and Sampling Method

This study employed a cluster sampling method. Based on the incidence of symptom clusters in cross-sectional studies and preliminary pilot results, the most common symptom cluster was "fear of sexual activities" (incidence rate: 95%). With an allowable error (d) of approximately 0.02P, two-tailed test (1.96), and significance level of 0.05, the calculated sample size was 457 cases. Assuming a 10% attrition rate, the minimum required sample size was 508 participants.

2.3 Data Collection

Eligible participants were enrolled according to the predefined inclusion and exclusion criteria and subsequently completed the questionnaires. Patients with independent reading and writing abilities completed the questionnaire independently. For patients who had difficulty filling out the questionnaire independently or had poor eyesight, researchers provided assistance in a neutral and standardized manner while recording responses, and the questionnaire was completed within 20 minutes. After the survey, the questionnaire was checked on-site; missing or incorrect entries were verified and supplemented with the patient immediately, and questionnaires with excessive missing data were excluded. Multiple statistical approaches were employed to improve the robustness of the analyses. A total of 526 questionnaires were distributed, 4 invalid questionnaires were excluded, and 522 valid questionnaires were recovered, yielding a valid response rate of 99.2%.

2.4 Measurements

2.4.1 General and clinical data

Data collection consisted of two components: demographic information and disease-related data. Demographic variables included age, educational level, and employment status; disease stage, surgical methods, surgical approaches, treatment plans, and post-treatment duration.

2.4.2 Functional Assessment of Cancer Therapy-Cervix (FACT-Cx)

This scale consists of 42 items, scored on a 5-point Likert scale (0 ~ 4), with a total score ranging from 0 to 164. After cultural adaptation in China, Wan Chonghua, reported the Cronbach's α coefficient was > 0.800. In this study, the scale was used to assess symptom severity, so the scoring of all items was reversed from the original scale.

2.4.3 Patient Health Questionnaire-9 (PHQ-9) and Generalized Anxiety Disorder-7 (GAD-7)

The PHQ-9 assessment tool contains 9 items across two dimensions, scored from 0 ~ 3 according to the frequency of symptoms (from "never" to "nearly every day"), with a total score of 27. A score > 10 indicates a need for intervention for depressive symptoms; symptom severity was further categorized into mild, moderate, moderately severe, and severe based on scores^[11]. The GAD-7 contains 7 items assessing generalized anxiety symptoms, scored from 0 to 3 for each item, with a total score of 27. Symptom severity was categorized into mild, moderate, and severe based on scores^[12]. The above criteria for defining depression and anxiety severity have been validated to have high sensitivity and specificity.

2.4.4 Pittsburgh Sleep Quality Index (PSQI)

PSQI evaluates sleep quality over the past month across 7 aspects, including sleep quality and efficiency, sleep latency and duration, and hypnotic use. The scale includes 24 questions, but only 18 questions are used to calculate component scores. Each factor is scored on a 4-point Likert scale (0 ~ 3), with higher scores indicating poorer sleep quality^[13]. Chinese scholars conducted a localization study on diagnostic criteria during reliability and validity testing, and found that when the cut-off value was set at 7 for the Chinese population, the sensitivity and specificity were 98.3% and 90.3%, respectively. A cutoff score of 7 was adopted in the present study.

2.5 Data Analysis

Data were double-entered by two individuals using EpiData 4.6 software to establish the database. SPSS 25.0 and R 4.1.0 software were used for statistical analysis. Demographic data, clinical disease-related information, and the incidence of each symptom were described using counts (n) and percentages (%). The severity scores of symptoms and psychosocial adaptation scores were described using mean $\pm$ standard deviation ($\bar{x} \pm s$).

The symptom clusters were described and symptom cluster networks were constructed using the qgraph package in R 4.1.0. The Fruchterman-Reingold algorithm was used to place nodes with the strongest connections at the center of the network. Strength centrality was used to evaluate the relative importance of symptoms within the network; Betweenness Centrality was used to assess the connecting role of symptoms between other symptoms. These network indices were used to characterize symptom importance and connectivity within the network.

2.6 Ethical Considerations

All participants provided written informed consent prior to participation. Participants were informed of their right to withdraw from the study at any time without penalty. Patients have the right to suspend or withdraw from the study at any time and for any reason. Personal identifying information of participants

will be kept confidential, and all data were used solely for the purposes of this research to ensure that no participant information was disclosed.

3. Result

3.1General Data

The 522 included patients with cervical cancer in the rehabilitation period were aged from 30 to79 years, with a mean age of (53.66±9.00) years; 436 (83.5%) were married; 253 (48.5%) had a permanent residence in urban areas; 248 (47.5%) had a junior high school education; 298 (57.1%) had a monthly per capita household income of 2,000~4,000 yuan; 401 (76.8%) had one child; 197 (37.7%) had employee medical insurance; 95 (18.2%) were retired; 198 (37.9%) had stage ⅡA disease; 274 (52.5%) underwent total hysterectomy + bilateral adnexectomy + pelvic lymph node dissection; and 248 (47.5%) received surgery alone. Other general and clinical data are shown in Table1(a) and Table1(b).

Table1(a) General data (n=522)

Variables	N	Percentage(%)
Age (years)		
20~35	16	3.1
36~50	162	31.0
51~65	298	57.1
≥66	46	8.8
BMI/kg/m2		
≤18.5	11	2.1
18.5~23.9	241	46.2
24~27.9	194	37.1
≥28	76	14.6

Table1(a) continued

Variables	N	Percentage(%)
Marital Status		
Married	436	83.5
Others	86	16.5
Educational Level		
Primary School and Below	127	24.3
Junior High School	248	47.5
Senior High School	84	16.1
Secondary Technical School	19	3.6
College Degree and Above	44	8.5
Occupation Type		22.6
Farmer	118	24.3
Worker	127	7.1
White-collar/Institutional Cadre/Professional	37	14.9
Freelancer/Individual Operator	78	5.8
Service Staff	30	7.1
Housewife	37	18.2
Retired	95	
Monthly Per Capita Household Income (RMB)		
≤2000	76	14.6
2000~4000	298	57.1
4000~6000	119	22.8
≥6000	29	5.5
Residence		
Urban	253	48.5
Rural	269	51.5
Payment Method		
Self-payment	21	4.0
Employee Medical Insurance	197	37.7
New Rural Cooperative Medical Scheme (NCMS)	169	32.4

Urban Resident Medical Insurance	109	20.9
Others	26	5.0
Number of Children		
0	9	1.7
1	401	76.8
2	105	20.1
≥3	7	1.4

Table1(a) continued

Variables	N	Percentage(%)
Recovery of Housework/Workload		
None	139	26.6
A Little	168	32.2
Some	118	22.6
Most	83	15.9
Complete	14	2.7

Table1(b) Clinical data (n=522)

Variables	N	Percentage(%)
Surgical Method		
Total Hysterectomy	24	4.6
Total Hysterectomy + Bilateral Adnexectomy	105	20.1
Total Hysterectomy + Bilateral Adnexectomy + Pelvic Lymphadenectomy	274	52.5
Others	119	22.8
Surgical Approach		
Abdominal	311	59.6
Laparoscopic	167	32.0
Robotic Surgery	44	8.4
Postoperative Duration (months)		
3~6	58	11.1
6~12	110	21.1
12~24	178	34.1
≥24	176	33.7
Treatment Method		
Surgery Alone	248	47.5
Surgery + Chemotherapy	76	14.6
Surgery + Radiotherapy	17	3.2
Surgery + Radiotherapy + Chemotherapy	178	34.1
Surgery + Other Treatments (Immunotherapy)	3	0.6
Duration Since Treatment Completion (months)		
3~6	101	19.3
6~12	120	23.0
12~24	193	37.0
≥24	108	20.7

Table1(b) continued

Variables	N	Percentage(%)
Disease Stage		
Stage IA	198	37.9
Stage IB	164	31.4
Stage IIA	102	19.6
Stage IIB	39	7.5
Stage III~IV	19	3.6
Pathological Type		
Adenocarcinoma	61	11.7
Squamous Carcinoma	401	76.8
Adeno-squamous Carcinoma	2	0.4
Unknown	58	11.1

Note: In the surgical methods, the "Other" category included three subgroups of patients: 51 patients who underwent hysterectomy + bilateral adnexectomy, 27 patients who underwent hysterectomy + bilateral adnexectomy+pelvic lymph node dissection and 41 patients who underwent hysterectomy + bilateral adnexectomy+pelvic lymph node dissection+Bilateral Ureteral Stent Placement. Due to the small sample size of patients in the rehabilitation stage with Stage III~IV cervical cancer, the data were analyzed collectively.

3.2 Incidence and Severity of Symptoms

Symptom assessment results showed that patients with cervical cancer in the rehabilitation period had an average of 19.44 ± 6.63 symptoms, with incidence rates ranging from 1.0% to 95.4%. The top 5 symptoms in terms of incidence were afraid to have sex (95.4%), fear of treatment side effects (92.3%), concern about prognosis (90.2%), poor mental state (90.0%), and feeling ill (88.7%). The top 5 symptoms in terms of severity scores were lack of sexual interest (3.67 ± 0.58), lack of sexual attractiveness (3.63 ± 0.60), body image disturbance (3.34 ± 0.82), lack of work fulfillment (3.25 ± 0.90), and lack of entertainment (3.10 ± 0.92) (Figure S1) .

3.3 Network Analyze

3.3.1 Summary of Cluster Symptoms

A symptom cluster network diagram of patients with cervical cancer in the rehabilitation period was constructed through network analysis (Figure 1), which identified 7 symptom clusters:(1)negative emotional symptoms cluster, which included concern about dying, anxiety, feeling nervous, concern about prognosis, feeling sad, depression and loss of hope, (2)fatigue-pain symptom cluster, which

included forced to staying in bed, difficulty meeting family needs due to physical condition, lack of energy, feeling ill, and pain, (3)social support self-esteem symptom cluster, which included lack of support from friends, feeling distant from friends, lack of entertainment, lack of work fulfillment, and body image disturbance, (4)urinary system symptom cluster, which included discomfort during urination, difficulty controlling urine, and burning during urination, (5)sexual dysfunction symptom cluster, which included lack of sexual interest and lack of sexual attractiveness, (6)fear-related psychological symptoms cluster, which included afraid to have sex, bothered by treatment side effects, and fear of treatment side effects, (7)sleep symptom cluster, which included poor sleep quality and sleep badly. The results showed strong correlations between symptom clusters, and symptoms within the same cluster were closely connected, when one symptom occurred, the probability of another symptom occurring was high.

3.3.2 Core Symptoms and Bridging Symptoms

In the overall symptom network, the strength centrality of feeling ill, loss of hope, and tension are ranked in the top three. (Figure S2) Feeling ill had the highest intensity centrality and closeness centrality, as well as a relatively high betweenness centrality ($r_s=1.539$; $r_c=1.863$; $r_b=1.807$), indicating that it was the most influential symptom in the network (Table 2). The bridge strength of bothered by treatment side effects, feeling ill, and fear of treatment side effects are similarly ranked in the top three.(Figure S3)

Table2 Standardized Centrality Metrics of Symptom Cluster

Symptoms	strength centrality	closeness centrality	Betweenness centrality
A1 Concern about dying	0.968	0.668	-0.541
A2 Anxiety	-0.314	-0.406	-0.541
A3 Nervous	1.061	0.910	-0.541
A4 Concern about prognosis	0.650	0.523	-0.280
A5 Feeling nervous	0.532	0.280	-0.541
A6 Depression	0.684	0.594	0.242
A7 Loss of hope	1.107	1.056	-0.280
B1 Forced to stay in bed	0.750	0.812	-0.019
B2 Difficulty meeting family needs due to physical condition	0.537	0.556	-0.019
B3 Lack of energy	0.656	0.749	-0.541
B4 Feeling ill	1.539	1.863	1.807
B5 Pain	-1.436	-1.282	-0.541
C1 Lack of support from friends	-0.666	-0.612	-0.541
C2 Feeling distant from friends	-0.847	-0.888	-0.541
C3 Lack of entertainment	0.793	0.962	2.851
C4 Lack of work fulfillment	0.757	1.038	3.112
C5 Body image disturbance	-0.815	-0.791	0.763
D1 Discomfort during urination	0.123	0.015	-0.541
D2 Difficulty controlling urine	-0.522	-0.674	-0.541
D3 Burning during urination	0.147	0.019	-0.280
E1 Lack of sexual interest	-2.282	-2.089	-0.541
E2 Lack of sexual attractiveness	-1.615	-1.655	-0.280
F1 Afraid to have sex	-1.315	-1.234	-0.541
F2 Bothered by treatment side effects	0.754	0.979	-0.541

Table2 continued

Symptoms	strength centrality	closeness centrality	Betweenness centrality
F3 Fear of treatment side effects	0.666	0.570	-0.280
G1 Poor sleep quality	-1.009	-1.060	-0.280
G2 Sleep badly	-0.903	-0.904	-0.019

3.3.3 Network Stability and Accuracy

The correlation stability (CS) coefficient of the symptom clusters was 0.751, indicating reliable results (Figure S4). Bootstrapped difference analysis of edge weights showed that the 95% CS similarity between the Bootstrapped sample set and the original data set was high, confirming the reliability of the edge weights of the constructed network (Figure S5).

3.4 Symptom Clusters at Different Stages of Cervical Cancer Rehabilitation Period

During the rehabilitation period after cervical cancer treatment, the network structure of symptom clusters exhibits dynamic changes over time, with differing relationships and centrality among symptoms.

Analysis of the symptom and symptom cluster characteristics across three stages—early(3~6months), middle(7~12months), and late(beyond 12 months), reveals that there are five symptom clusters in the early and mid stages, and six in the late stage. The early stage consists of fatigue-negative symptom cluster , social support self-esteem symptom cluster, pelvic floor disorder symptom cluster, fear symptom cluster and sexual dysfunction symptom cluster (Figure 2).

The mid stage includes fear- negative symptom cluster , social support self-esteem-insomnia symptom cluster, fatigue-anxiety symptom cluster, urinary system symptoms cluster, and sexual dysfunction symptom cluster (Figure 3).

The late stage includes fatigue-pain symptom cluster, negative emotional symptoms cluster, social support symptom cluster, urinary system symptom cluster, sexual dysfunction symptoms cluster, and sleep symptoms cluster. (Figure 4)

"Feeling ill" was among the top three symptoms in terms of strength centrality in both the early and middle stages, and it was the most influential symptom in both two stages (early: $r_s=1.672$, $r_c=1.838$, $r_b=2.842$; mid: $r_s=1.458$, $r_c=1.592$, $r_b=2.850$), showing the highest betweenness centrality and relatively high closeness centrality(Table S1-S2). In the late stage, the top three symptoms in terms of strength centrality are "loss of hope," "feeling ill," and "depression," with "loss of hope" being the core symptom ($r_s=1.777$, $r_c=2.080$, $r_b=2.140$). (Table S3)

Strong correlations were observed between symptom clusters across all three stages, indicating that when one symptom occurred, another symptom was also highly likely to occur. Bootstrapped difference

analysis of edge weights showed high 95% CS similarity between the Bootstrapped sample set and the original data set, confirming the reliability of the edge weights of the constructed symptom cluster network.(Figure S6-S8)

4. Discussion

This study found that patients with cervical cancer during the rehabilitation period reported a mean of 19.44 ± 6.63 symptoms. In this study, symptoms with a high incidence rate among patients in the rehabilitation period after cervical cancer treatment included afraid to have sex, concern about prognosis, fear of treatment side effects, and lack of energy. The incidence of “lack of energy” reached as high as 90%, underscoring the prevalence and severity of cancer-related fatigue in patients. These findings suggest that fatigue may remain a prominent symptom beyond active treatment and continue to affect survivors during rehabilitation. Furthermore, 34.1% of the participants had undergone radiation therapy or chemotherapy, which is recognized as a critical risk factor for severe fatigue, primarily associated with inflammation induced by cancer therapies^[14]. The high prevalence of fear of sexual activity may be related to treatment-related physical and psychological changes experienced by survivors. All patients included in the study had undergone surgery, which results in physiological structure, in part, leads to fear of sexual activity. Additionally, HPV infection is the primary cause of cervical cancer. This characteristic of disease also contributes to the high incidence of fear of sexual activity. In the study, 88.1% of patients in our study were aged between 36 and 65 years, most of them served as the backbone of their families and often shoulder significant social and family responsibilities. However, the financial and psychological burdens associated with disease treatment have hindered patients from fulfilling these responsibilities adequately. Coupled with symptoms such as fatigue, vaginal shortening, and lymphedema, these factors may contribute to concerns regarding treatment-related side effects^[15]. Furthermore, concerns regarding prognosis, recurrence, and metastasis remained common after treatment completion. The high prevalence of concern about prognosis may be related to persistent uncertainty regarding disease recurrence and long-term outcomes, even though most participants had early-stage disease.

Lack of interest in sexual activity, lack of sexual attractiveness, body image disturbance, and lack of work fulfillment were the top four symptoms in terms of severity among patients in the rehabilitation period of cervical cancer. Research has found that patients with malignant tumor commonly experience problems related to sex^[16]. Pathological premature menopause caused by ovariectomy is an important reason for decreased libido^[6]. Additionally, body image concerns are common among female cancer survivors and may be associated with reduced intimacy, lower sexual interest, and challenges in social and occupational functioning.

Due to the disease and treatments, patients with cervical cancer continue to experience a series of psychological issues during rehabilitation period. Notably, the incidence and severity of sexual life-related psychological problems are both high in patients during the rehabilitation period of cervical cancer. However, due to traditional cultural influences, many patients find it difficult to discuss these

problems openly. These findings highlight the potential value of exploring individualized supportive care approaches in future studies and underscore the importance of continued attention to psychological and sexual health concerns throughout the rehabilitation period.

This study identified seven symptom clusters: negative emotional symptoms cluster, fatigue-pain symptom cluster, social support self-esteem symptom cluster, urinary system symptom cluster, sexual dysfunction symptom cluster, fear-related psychological symptoms cluster, and sleep symptom cluster.

Notably, the sexual dysfunction symptom cluster demonstrated the highest symptom burden, followed by the social support/self-esteem symptom cluster. This study listed the sexual dysfunction cluster separately, because the incidence of sexual dysfunction among cervical cancer survivors reaches 80%^[18]. Decreased sexual function after treatment is prevalent, and such symptoms are not only associated with negative emotions but also closely linked to changes in physical structure caused by treatment. Some patients experience a sudden drop in hormone levels due to ovariectomy, resulting in perimenopausal emotional and physiological symptoms that are more severe than those observed in physiological menopause, underscoring the need for clinical attention. Some patients experience a sharp decline in hormone levels due to ovariectomy during surgery, leading to more severe perimenopausal emotional and physical symptoms compared with physiological menopause, indicating the need for clinical attention.

Most participants were in the post-treatment rehabilitation phase and no longer receiving active treatment. Consequently, concerns related to social participation and psychosocial well-being may become increasingly relevant during rehabilitation. Previous research has found that patients with gynecological cancers generally receive low to moderate support across all dimensions, and cervical cancer patients are particularly experience high levels of social impairment^[19]. Furthermore, patients commonly experienced disease-related shame and disturbed self-image. Due to the private nature of the disease's etiology and affected site, many patients choose to conceal their condition, which leads to low self-esteem and voluntary social withdrawal, resulting in a severe lack of support. In the research, more than 90% of the patients engaged in moderate-to-heavy physical labor. Fatigue induced by treatment rendered them unable to perform their former job duties, thereby further hinder their achievement of self-worth. These findings highlight the need for further research on supportive care strategies targeting psychosocial concerns during rehabilitation.

This study identified "feeling ill" as the most central symptom within the overall symptom network. Feeling ill, loss of hope, and feeling nervous ranked among the top three in terms of strength centrality, suggesting that perceptions of illness may play an important role within the symptom network.

Previous studies have reported that feelings of illness are common among cancer survivors and may be associated with poorer patient-reported outcomes^[20, 21]. Self-awareness belongs to the pain symptom cluster, reflect that emotional and psychological factors are closely associated with pain manifestations, meanwhile, distress and anxiety about the disease are the core manifestations of the overall symptom

clusters. Many cervical cancer patients undergo surgery, radiotherapy, and chemotherapy, along with genital organ resection and side effects such as nausea, vomiting, and alopecia. Additionally the sense of social isolation caused by frequent follow-up visits can lead to a diminished sense of social role and an enhanced sense of patient role. Therefore, future symptom management strategies may benefit from considering psychological and social factors alongside physical symptoms.

This study compared symptom network characteristics across early (3–6 months), middle (7–12 months), and late (> 12 months) rehabilitation stages. The three stages exhibit both commonalities and stage-specific differences. Notably the sexual dysfunction symptom cluster persisted throughout the entire rehabilitation period, consistently ranking first in severity across all stages (early stage: 3.66 ± 0.54 ; middle stage: 3.66 ± 0.54 ; late stage: 3.37 ± 0.49). In patients within one year post-treatment, this cluster primarily manifested as lack of sexual attractiveness and lack of sexual interest. While in the late period, it further incorporated fear of sexual activity and disturbed self-image. Several factors may contribute to this pattern. First is the irreversible alterations in physiological structure caused by treatment. Second is the disease characteristic: HPV (Human Papillomavirus), the primary etiological factor, is linked to sexual activity. Both factors further induce persistent psychological barriers to sexual activity in patients. Additionally, the social support-related symptom cluster also persists throughout the entire rehabilitation period, with its severity consistently maintaining a high level (early stage: 2.84 ± 0.86 ; middle stage: 2.83 ± 0.87 ; late stage: 3.21 ± 0.54). These findings suggest that deficiencies in perceived social support may persist throughout the rehabilitation period, particularly from friend and social aspects. The social support symptom cluster in the early rehabilitation period includes the “inability to work”, while this characteristic is absent in the mid and late stages. This may be related to the fact that cancer survivors typically resume work gradually after an average of 6 months^[22]. This pattern may reflect gradual adaptation to occupational and social roles following treatment. However, issues such as lack of work fulfillment and lack of support persist, leading to the long-term continuation of support-related problems.

This study constructed symptom networks for population at 3–6 months, 7–12 months, and over 12 months in rehabilitation period. The results showed that the core symptom within the 3–12 month group was self-awareness of illness, while it was disappointment in the group over 12 months. Moreover, as the time since treatment completion prolonged, the core status of feeling ill declined. As the focus shifts from treatment to long-term survival and adaptation, patients' dissatisfaction with post-operative quality of life and their unmet expectations for social reintegration may be important reason for “disappointment” becoming the core symptom in the later rehabilitation period. For patients within 12 months of recovery, particularly those receiving home care within 6 months, virtual reality-based interventions may represent a promising area for future investigation in symptom management^[23]. For patients over 12 months, who have gradually resumed social reintegration, guided self-help approaches may warrant further evaluation in future studies. Differences in core symptoms across rehabilitation stages may help inform the development of stage-specific symptom management strategies.

Furthermore, this study found that concern about treatment side effects, feeling ill, and fear of treatment side effects ranked the top three in terms of bridge strength, playing a connecting role in the overall symptom network. Concern about treatment side effects may be associated with the treatment modalities received by the study population. Surgical treatment can lead to vaginal shortening and narrowing as well as premature menopause in patients, while some patients have to cope with alopecia, nausea, vomiting, and radiation cystitis or gastroenteritis because of radiotherapy and chemotherapy. These factors may contribute to psychological distress among survivors. Feeling ill is both a core symptom and a bridge symptom, playing a key role within the network. All three bridge symptoms are associated with fears and distress related to the disease, suggesting that attention should be paid to patients' psychological status with timely counseling.

4.1 Research Limitations and Recommendations for Future Studies

This study has several limitations. First, participants were recruited from only two hospitals in Nantong City, which may limit the generalizability of the findings to other populations and healthcare settings. Second, all symptom data were collected using self-reported questionnaires and may therefore be subject to recall bias and reporting bias. Third, although network analysis provides valuable insights into symptom interrelationships, the identified network structures may vary across populations and clinical contexts. Finally, rehabilitation stages were compared using different participant groups rather than through longitudinal follow-up of the same individuals. Future multicenter longitudinal studies are warranted to validate the present findings and further explore the evolution of symptom networks during cervical cancer survivorship.

5. Conclusion

This study identified a total of 7 symptom clusters in patients during the rehabilitation period of cervical cancer, and the composition of symptom clusters and core symptoms exhibited differences at different stages of the rehabilitation period. Particular attention may be warranted for sexual health concerns and psychological symptoms during rehabilitation. The identification of stage-specific core symptoms may help inform future symptom assessment and management strategies and provide a foundation for future intervention research among cervical cancer survivors.

Declarations

Registration: This study has been registered in the Chinese Clinical Trials Registry on 28 September 2023 (registration number: ChiCTR2300076277). This study was approved by the Ethics Committee of Affiliated Hospital of Nantong University (approval number: 2023-TDFY-055; approved date: 26 September 2023)

Reporting Method:The study adhered to the Strengthening the Reporting of Observational Studies in Epidemiology guidelines.

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Conflicts of Interest: The authors declare no conflicts of interest.

Impact:

☑The identification of 7 distinct symptom clusters, along with the interconnections between individual symptoms, deepens our understanding of the multifaceted challenges faced by cervical cancer survivors during rehabilitation.

☑By mapping these clusters across different recovery stages, this research enables more precise, tailored symptom assessment and management that aligns with survivors' evolving needs.

☑These results can directly inform clinical practice, helping care teams deliver personalized support that alleviates symptom distress and enhances long-term well-being for cervical cancer survivors.

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Figures

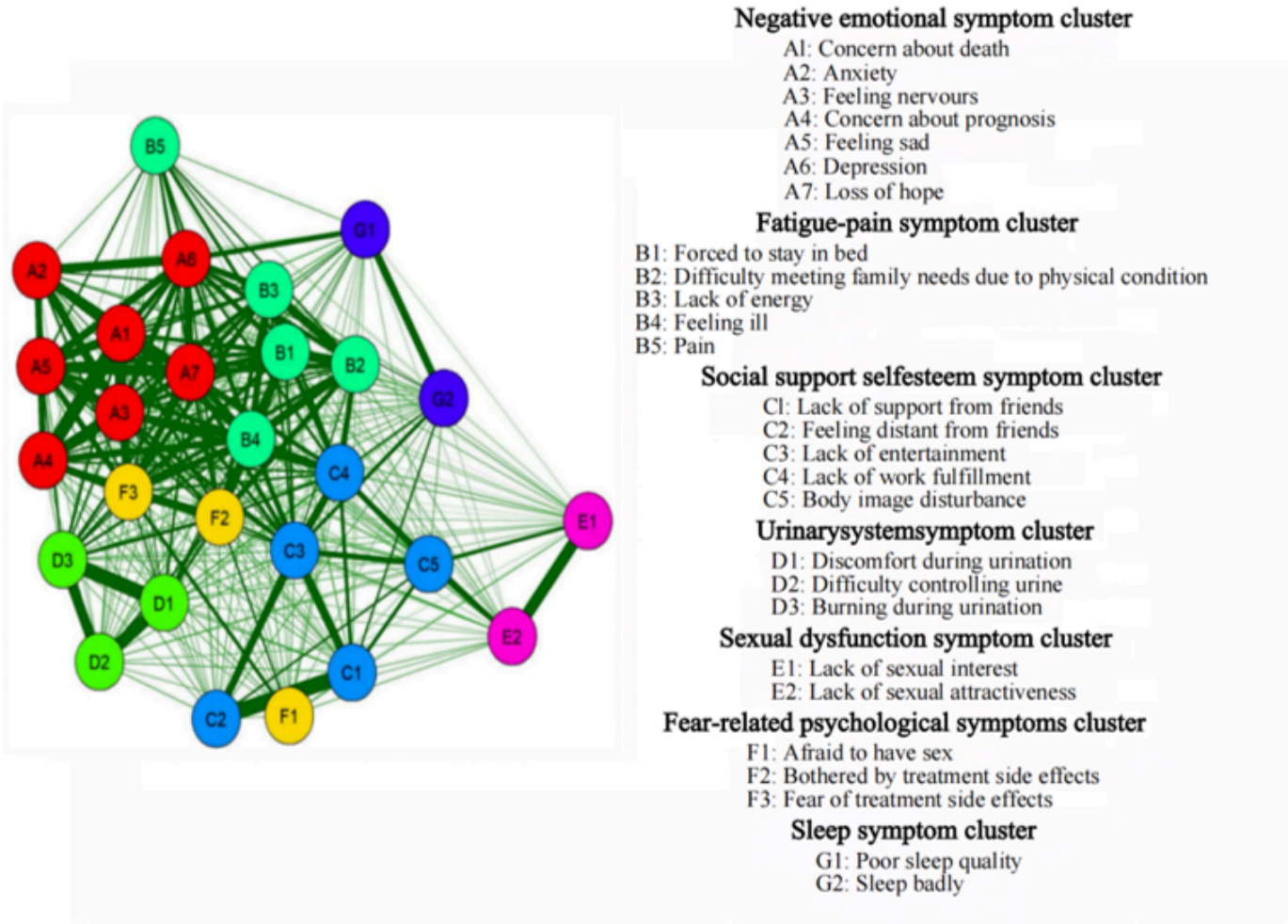


Figure 1

Symptom Network Structure of patient with Cervical Cancer during rehabilitation period

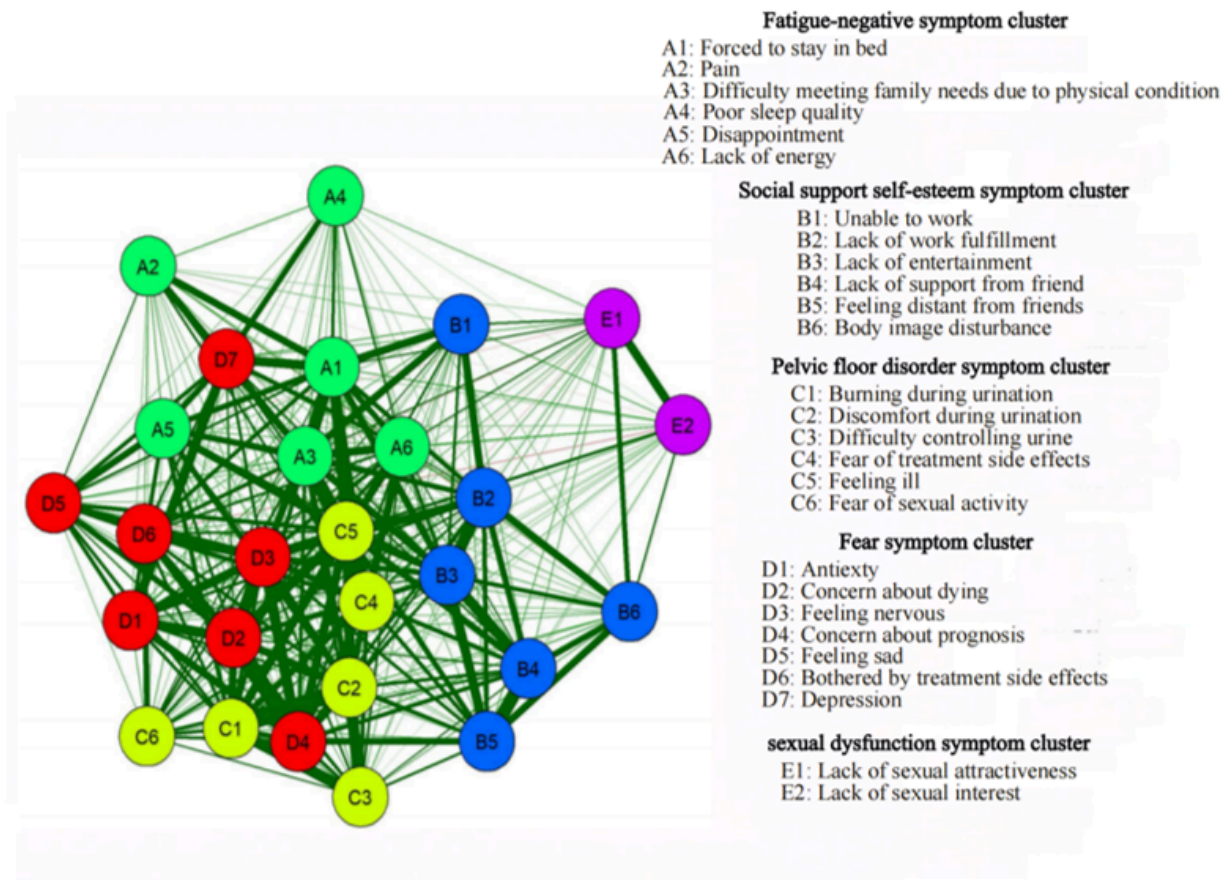
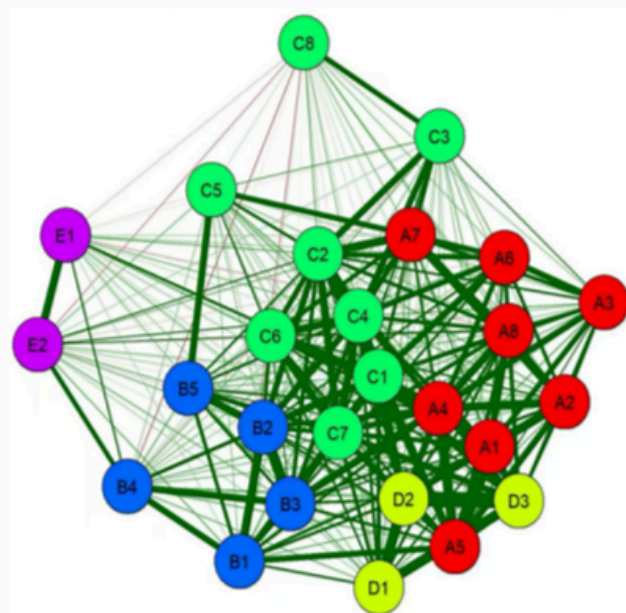


Figure 2

Symptom Network Structure in Patients During the Early Rehabilitation Period (3-6 Months)



Fear-negative symptom cluster

- A1: Concern about dying
- A2: Anxiety
- A3: Feeling sad
- A4: Feeling nervous
- A5: Concern about prognosis
- A6: Loss of hope
- A7: Depression
- A8: Fear of treatment side effects

Social support self-esteem-insomnia symptom cluster

- B1: Feeling distant from friends
- B2: Lack of entertainment
- B3: Lack of work fulfilment
- B4: Body image disturbance
- B5: Sleep badly

Fatigue-anxiety symptom cluster

- C1: Feeling ill
- C2: Forced to stay in bed
- C3: Pain
- C4: Difficulty meeting family needs due to physical condition
- C5: Poor sleep quality
- C6: Lack of energy
- C7: Fear of treatment side effects
- C8: Bothered by vaginal odor

Urinary system symptoms cluster

- D1: Difficulty controlling urine
- D2: Discomfort during urination
- D3: Burning during urination

Sexual dysfunction symptom cluster

- E1: Lack of sexual interest
- E2: Lack of sexual attractiveness

Figure 3

Symptom Network Structure in Patients During the Middle Rehabilitation Period (7-12 Months)

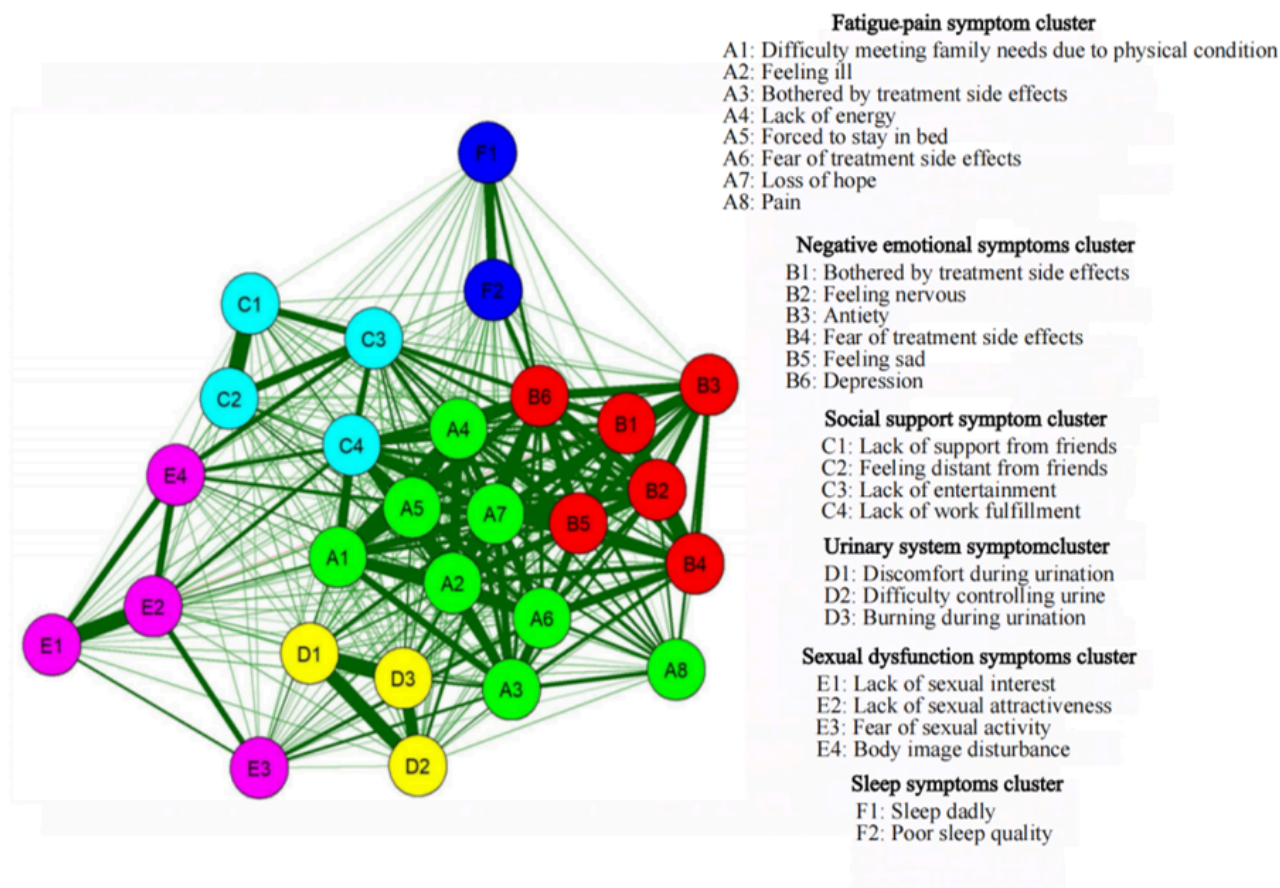


Figure 4

Symptom Network Structure in Patients During the late Rehabilitation Period (over 12 Months)

Supplementary Files

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- [AppendixA.docx](#)
- [AppendixB.docx](#)