Patient Preference and Adherence

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ORIGINAL RESEARCH

Does All Social Support Work? Examining the Mechanisms of Patient-Reported Symptom Interference after Esophagectomy Affecting Life Satisfaction

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Purpose: We intended to explore the chain mediation role of resilience and different sources of social support on the relationship between symptom interference and life satisfaction from the patient-reported perspective.

Patients and Methods: Two hundred and twenty-six patients after esophagectomy were investigated using four validated scales to estimate the symptom interference, resilience, different sources of social support, and life satisfaction. The chain mediation analysis was conducted using SPSS PROCESS Macro Model 6.

Results: Mediation analysis showed that symptom interference indirectly influenced life satisfaction through two significant mediating pathways: (i) resilience ($B = -0.138$, 95% CI: −0.194 to −0.091); (ii) the chain mediators involving in resilience and family support ($B = -0.049$, 95% CI: −0.073 to −0.026). Surprisingly, the mediating pathway of family support was not significant.

Conclusion: Interventions for resilience and family support could mitigate the adverse effects of symptom interference in patients after esophagectomy, improving life satisfaction. Of these, resilience may be more critical in terms of the utilization of social resources than family support.

Keywords: life satisfaction, oesophageal cancer, social support, resilience, symptom interference

Introduction

Under the most recent Global Cancer Statistics Report, oesophageal cancer ranked 7th in the global incidence of malignant tumors and 6th in overall mortality. More than 60% of the disease burden occurred in China.[1] Between 2020 and 2030, the disease burden caused by oesophageal cancer will continue to increase in China, with the number of new cases projected to rise from 324,422 to 435,958, and the number of deaths from 301,135 to 416,509.[2] Esophagectomy is currently the primary treatment for local and locally advanced disease. The procedure is technically demanding and carries a risk of severe complications. Presently, there are many different esophagectomy techniques, and in recent years, there has been a shift toward minimally invasive surgery and robotic-assisted thoracoscopic esophagectomy.[3] However, tumor resection, although usually effective in removing the objective diseased tissue, did not always enhance the patient's postoperative quality of life (QOL). In contrast, their early QOL generally deteriorated significantly in patients after esophagectomy.[4] Patients after esophagectomy are a group with unique symptom experiences. The trauma of esophagectomy afflicted patients with multiple physical symptoms, such as dysphagia, loss of appetite, gastrointestinal reflux, and weight loss, as well as complex psychological changes, such as fear, hopelessness, and stigma. In addition, role transition disorders and refusal to participate in social activities were also ubiquitous.[5] The damage to physical and psychological resources caused by esophagectomy required a long time for recovery, which could significantly interfere with the ability of patients to perform daily activities and reduce the QOL.[6]

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Life satisfaction (LS), ordinarily considered a synonym or interrelated construct of QOL, was defined as a personal subjective appraisal of actual life in the light of expected life objectives and was one of the markers of postoperative recovery in oesophageal cancer patients.[7] Patient-reported symptom interference with daily life represented a composite score in the domains of physical functioning, psychological health, or social functioning,[8] the level of which may directly influence on how patients after esophagectomy rated their life satisfaction. Virtually, there was a discrepancy between the level of symptom interference as judged by medical staff and subjectively by patients.[9] Correspondingly, levels of LS as assessed by both sides may also be distinct.[10] The patient-reported outcomes instrument, which provided a quantifiable LS score without interpretation of medical staff, has been shown to help quantify patients' symptoms and enhance communication between patients and healthcare professionals.[4] Consequently, from the perspective of patient-reported outcomes, this study delved into how symptom interference influenced LS in patients after esophagectomy to help them manage and cope with symptom interference during postoperative rehabilitation.

The Conservation of Resources Theory (COR) argued that the maintenance and construction of resources provide a realistic path for seeking life satisfaction. In contrast, the loss and absence of resources are barriers. Hobfoll defined resources in a goal-oriented way (eg life satisfaction), pointing out that resources were any conditions (eg resilience, social support) that could assist individuals in achieving their goals.[11] According to the COR, resilience was recognized as a pivotal internal resource of an individual, referring to the dynamic process of adapting smoothly in front of adversity, trauma, threats, or significant stressors,[12] which could mediate between stressors and stress coping outcomes.[13] In the context of cancer, resilience may serve as an internal conditioning factor to mediate the relationship between symptom interference and LS.[14] Resilience was generally considered a predictor of psychological health outcomes in cancer patients and was strongly associated with LS.[15] Furthermore, empirical findings in patients with brain tumors had shown that symptom interference was negatively correlated with resilience and QOL.[16] Accordingly, we hypothesized that resilience may mediate between symptom interference and LS in patients after esophagectomy.

Social support was a significant component of an individual's external resources in COR.[11] Perceived social support refers to the subjective feeling and evaluation of the degree of external support from individuals.[17] Many studies have confirmed the positive correlation between social support and LS in adult cancer patients.[18] According to the buffering model of stress, interaction between stress and social support could buffer the adverse effects of stress.[13] Namely, if the resources of social support for patients after esophagectomy were insufficient or absent, the negative impact of symptom interference would be exacerbated. Nevertheless, social support was a multidimensional concept, and different sources of support had different effects on stress levels.[19] Previous research had noted that family support can significantly and negatively predict stress levels, while friends and other support not.[20] Compared with Western societies, the social support structure of cancer patients in the context of traditional Chinese Confucian culture was mainly kinship, and family support was the dominating source of LS.[21] However, whether different sources of social support could buffer the adverse effects of symptom interference on LS was still unknown. With this, we assumed that different sources of social support could mediate the relationship between symptom interference and LS in patients after esophagectomy.

To our knowledge, empirical studies in breast cancer groups found that resilience could positively predict perceived social support.[22] The level of perceived social support was closely related to patients' subjective feelings.[23] It follows that if patients after esophagectomy have a low level of resilience, they may not feel or utilize the social support that actually existed to cope with symptom interference. Thus, we presumed that resilience and social support may have a chain mediation between symptom interference and LS in patients after esophagectomy.

Based on the COR, our study aimed to examine the psychological mechanisms underlying the association between symptom interference and LS in patients after esophagectomy. We proposed the following hypotheses and presented the hypothesized model in Figure 1.

i. Symptom interference can directly influence LS;
ii. Resilience and different sources of social support may mediate the relationship between symptom interference and LS;
iii. Resilience and different sources of social support probably played a chain mediation role between symptom interference and LS.

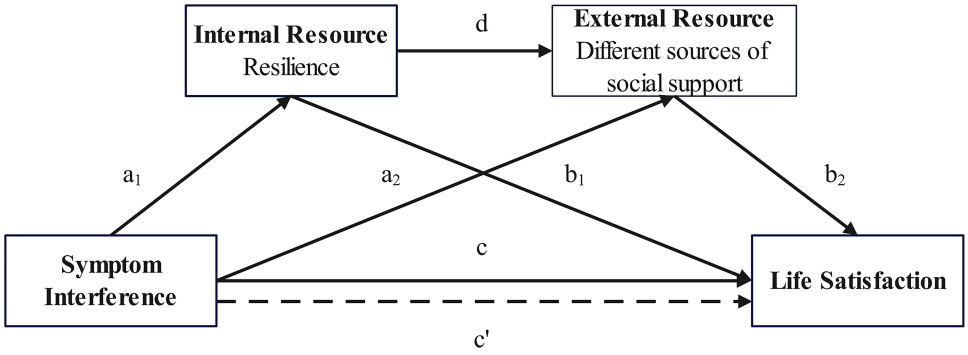

Figure 1 The hypothesized model of resilience and different sources of social support in the relationship between symptom interference and life satisfaction. a_1: path coefficient of symptom interference to internal resource. b_1: path coefficient of internal resource to life satisfaction. a_2: path coefficient of symptom interference to external resource. b_2: path coefficient of external resource to life satisfaction. d: path coefficient of internal resource to external resource. c': direct effect of symptom interference on life satisfaction. c: total effect of symptom interference on life satisfaction.

Materials and Methods

Study Design and Participants

This cross-sectional design was conducted in the thoracic surgical wards at two general hospitals in Anhui Province, Hefei City, China, between May 2021 and August 2022. Convenience sampling was used to select patients who had undergone esophagectomy and were hospitalized (<7 days after esophagectomy). This research program was approved by the Ethics Committee of Anhui Medical University (20190266), and adhered to the latest version of the Declaration of Helsinki. The inclusion criteria contained: (i) Esophageal cancer diagnosed by histology; (ii) Had undergone surgical treatment and were hospitalized; (iii) Age ≥ 18 years old; (iv) Able to communicate in Chinese; (v) Clear state of consciousness. The exclusion criteria contained: (i) Exhibit significant cognitive impairment; (ii) Combined with other life-threatening severe diseases or cancers; (iii) Unable to cooperate with the investigation; (iv) Engaging in other psychological intervention or treatment. The G. power 3.1 program performed the sample size calculation. When the moderate effect size was set to 0.3, the two-tailed test with a significance level of 0.05 and power of 0.95, we required 134 sample size.[24] Considering the 20% dropout, 168 sample size was ultimately requisite for our study.

Procedure

Two well-trained nurses in the hospital ward examined the electronic medical record system and conducted brief communication for the study with patients who met the inclusion criteria. Ahead of the questionnaire, the researcher informed all participants of the objective and procedures of the survey and how the results would be reported anonymously. Each questionnaire took 15–20 minutes to complete integrally. Of 308 eligible participants, 251 signed the informed consent and fulfilled the paper-based questionnaire independently in the wards. Ultimately, we recovered 226 available questionnaires, of which 25 were eliminated due to incomplete information.

Measures

Demographic and Medical-Related Characteristics

Demographic characteristics were examined through the following items: age, gender, marital status, education status, employment status, residential status, family's earnings per month, and expense category. Medical-related characteristics were investigated using four items, including the number of hospitalizations due to oesophageal cancer, surgical method, tumor location, and combined chronic disease. These data were collected from electronic medical records.

Independent Variable

The validated M.D. Anderson Symptom Inventory for Gastrointestinal Cancer (MDASI-GI) contains twenty-four items. Specifically, the symptom subscale containing eighteen items (thirteen core + five retained GI-specific items) can evaluate symptom severity. In comparison, the six interference items can assess the interference in the life of symptoms.

For this research, only the interference measure was taken into account. The degree rating of the six interference items is represented by numbers from 0 (did not interfere) to 10 (interfered completely). For six interference items, the Cronbach's coefficient was 0.85 when validated and 0.86 in our study.[25]

Mediators

The validated Chinese version of the Connor-Davidson Resilience Scale (CD-RISC) was used to assess the resilience of the patients after esophagectomy, containing twenty-five items, three dimensions of tenacity, strength, and optimism. A five-point Likert scale ranging from 1 (not at all true) to 5 (true nearly all the time) was applied to rate every item, with the total points changing from 0 to 100. Higher points indicate a greater level of resilience. The Cronbach's coefficient of the Chinese version was 0.91 when Chineseized and 0.94 in our study.[26]

The perceived social support scale (PSSS), developed by Zimet and translated by Jiang, was applied to evaluate the participants' degree of perception of external support. PSSS contains twelve items, three subscales of family support, friends support, and significant others. A seven-point Likert scale was used to rate every item ranging from 1 (strongly disagree) to 7 (strongly agree), with the total points changing from 12 to 84, representing the general perceived level of social support. The Cronbach's coefficient was 0.88 when developed and 0.94 in our study.[27]

Dependent Variable

The validated Chinese version of the Satisfaction with Life Scale (SWLS), containing five items, was used to evaluate the life satisfaction of the patients after esophagectomy. A seven-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree) was applied to rate every item, with the total points changing from 5 to 35. Higher points indicate greater life satisfaction. The Cronbach's coefficient of the Chinese version was 0.78 when Chineseized and 0.92 in our study.[28]

Statistical Analysis

IBM SPSS version 24.0 statistical software was used in our study to perform all the analyses. Counting data was shown using the number of cases and percentages. Measurement data conforming to normal distribution were presented through mean ± standard deviation. The Student's *t*-test and one-way ANOVA were applied to compare the total life satisfaction scores between participants with different demographic and medical characteristics. Pearson correlation analysis examined the association between symptom interference, social support, resilience, and life satisfaction.

The chain mediation analysis was conducted using the SPSS Process Model 6 developed by Hayes (2013) and the Bootstrap sampling method for mediation effects testing.[29] In this model, symptom interference may increase LS by enhancing resilience and different sources of social support. As previous studies have suggested that resilience could positively predict perceived social support,[22] we considered a chain mediation effect in which symptom interference may increase LS through higher resilience and perceived greater social support. Hence, except for the total effect (c) and direct effect (c') of symptom interference on LS, three indirect effects were contained: (i) symptom interference→resilience→LS(a_1b_1), (ii) symptom interference→different sources of social support→LS(a_2b_2), and (iii) PSS→resilience→different sources of social support→distress(a_1db_2). Demographic and medical variables significantly correlated with life satisfaction in single factor analysis were considered controlled variables in the model. Common method bias was tested using the Harman one-way test. All significance tests were two-tailed, and $P < 0.05$ was statistically significant.[30]

Results

Testing for Common Method Bias

This study utilized the patient-reported approach to collect data, so we needed to test common method bias. Conducted using Harman's single-factor test, there were a total of 9 exploratory factor eigenvalues larger than 1, and the maximum factor variance explanation was 36.73%, which was less than the suggested threshold of 50%, indicating that no serious common method bias existed in our study.[31]

Participant Characteristics and Associations with Life Satisfaction

Briefly, the average age of 226 patients after esophagectomy was (68.7±8.58) years. Most were male (n = 164, 72.60%) and married (n = 212, 93.80%). Over half of them were farmer (n = 140, 61.90%) and had primary school education or none (n = 139, 61.50%) and family's earnings per month less than 3000 CNY (n = 124, 54.90%, approximately 417.23 USD). For medical-related characteristics, most participants were admitted to the hospital once (n = 202, 89.40%) and did not undergo open esophagectomy (n = 198, 87.60%). Middle thoracic oesophageal cancer was the most common (n = 121, 53.50%), and more than half of the patients had the absence of coexisting chronic diseases (n = 126, 55.80%). Other participants' characteristics are listed in Table 1.

Single factor analysis showed that there were significant differences in the points of life satisfaction with gender (t = 2.11, $P = 0.036$), marital status (t = 2.94, $P = 0.004$), education status (F = 3.58, $P = 0.023$), employment status (F = 5.55, $P = 0.004$) and family's earning per month (F = 9.12, $P < 0.001$) (See Figure 2).

Table 1 Demographic and Medical-Related Characteristics of Participants (n = 226)

Variables	Frequency (%)
Age (year)	
< 65	63 (27.90)
65–75	104 (46.00)
≥ 75	59 (26.10)
Gender	
Male	164 (72.60)
Female	62 (27.40)
Marital status	
Single	14 (6.20)
Married	212 (93.80)
Education status	
Primary or none	139 (61.50)
Secondary	53 (23.50)
Tertiary or above	34 (15.00)
Employment status	
Retired	44 (19.50)
Worker	42 (18.60)
Farmer	140 (61.90)
Residential status	
Rural	139 (61.50)
County	53 (23.50)
Urban	34 (15.00)
Family's earning per month (¥, CNY)	
< 3000	124 (54.90)
3000–4999	69 (30.50)
≥5000	33 (14.60)
Expense category	
Public expense	98 (43.40)
Medical insurance	115 (50.90)
Self-paying	12 (5.30)
Number of hospitalizations due to EC	
1 time	202 (89.40)
2 or more times	24 (10.60)
Surgical method	
Thoraco-laparoscopic	198 (87.60)
Open esophagectomy	28 (12.40)

(*Continued*)

Table 1 (Continued).

Variables	Frequency (%)
Tumor location	
Upper	38 (16.80)
Middle	121 (53.50)
Lower	67 (29.60)
Combined chronic disease	
No	126 (55.80)
Yes	100 (44.20)

Abbreviations: CNY, China Yuan; EC, esophageal cancer; Thoraco-laparoscopic, thoracoscopic and laparoscopic combined esophageal cancer radical surgery.

Descriptive Statistics and Correlation Analyses of Study Variables

Descriptive statistical analyses, presenting as means, standard deviations (SD), and correlations, are shown in Table 2. Bivariate correlations revealed that symptom interference was significantly negatively correlated with resilience (r = −0.500, $P < 0.001$), PSSS in the domain 1 of "Family support" (r = −0.141, $P < 0.050$), and life satisfaction (r = −0.391, $P < 0.001$). Moreover, resilience was significantly positively correlated with three domains of PSSS (r = 0.489, 0.444, 0.451, $P < 0.001$) and life satisfaction (r = 0.679, $P < 0.001$). Finally, three domains of PSSS were significantly positively

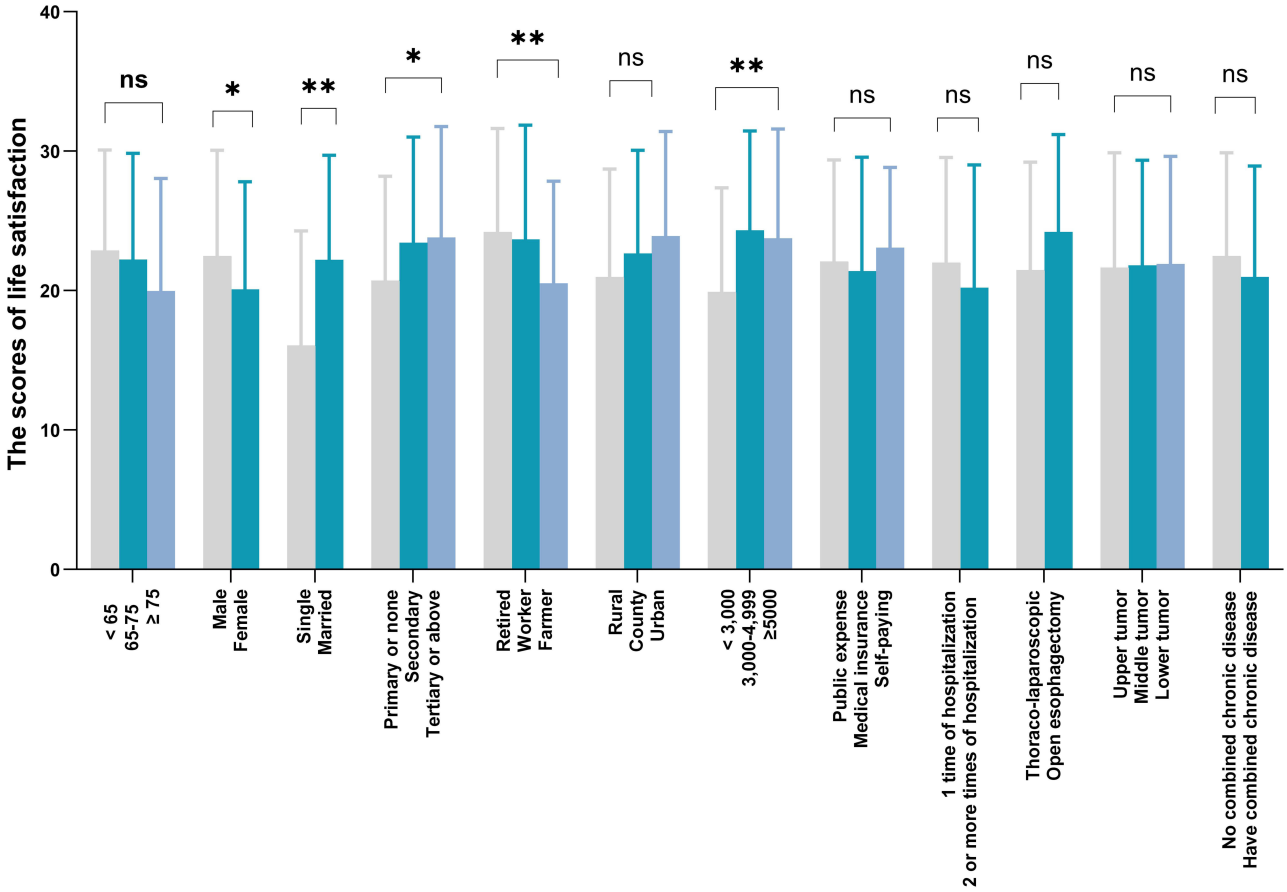

Figure 2 The associations between participant characteristics and life satisfaction. Thoraco-laparoscopic, thoracoscopic and laparoscopic combined esophageal cancer radical surgery. Error bars represent standard deviation. *P value < 0.05; **P value < 0.01; ns, P value >0.05.

Table 2 Descriptive Statistics and Correlations of Study Variables (n = 226)

Variables	*M (SD)*	Range	1	2	3	4	5	6
1MDASI - GI_6	21.24 (14.32)	0–56	1					
2 CD - RISC	64.12 (17.50)	14–92	−0.500**	1				
PSSS								
3 Domain 1	23.98 (3.80)	8–28	−0.141*	0.489**	1			
4 Domain 2	16.68 (5.95)	4–28	−0.011	0.444**	0.368**	1		
5 Domain 3	19.81 (4.48)	8–28	−0.037	0.451**	0.388**	0.672**	1	
6 SWLS	21.82 (7.68)	14–92	−0.391**	0.679**	0.569**	0.483**	0.469**	1

Notes: *P value < 0.05; **P value < 0.01.
Abbreviations: CD - RISC, Connor - Davidson Resilience Scale; MDASI - GI_6, the 6-item symptom interference domain from M.D. Anderson Symptom Inventory for Gastrointestinal Cancer (MDASI - GI); M, mean; PSSS, perceived social support scale (Domain 1: family support; Domain 2: friends support; Domain 3: significant other); SD, standard deviation; SWLS, the satisfaction with life scale.

correlated with life satisfaction (r = 0.569, 0.483, 0.469, $P < 0.001$). The significant correlations among the study variables partly favored our hypotheses initially.

Testing the Chain Mediation Model

Since symptom interference was only significantly negatively correlated with PSSS in domain 1 of "Family support", we regarded "Family support" as a separate mediator variable. Collinearity diagnostics indicated that the Variance Inflation Factor (VIF) for symptom interference, resilience, and family support were 1.358, 1.748, and 1.338, respectively, suggesting that multicollinearity may not affect our tests.

Based on the study hypothesis, the chain mediation effect analysis was conducted using Model 6 in SPSS macro program PROCESS developed by Hayes (2013), with gender, marital status, education status, family's earnings per month, and employment status as control variables. The results based on regression analysis are presented in Table 3. Symptom interference was negatively correlated with resilience ($a_1 = -0.133$, $P < 0.001$), which positively correlated with life satisfaction in turn ($b_1 = 1.032$, $P < 0.001$). Furthermore, the direct effect of symptom interference on life satisfaction was significant ($c' = -0.069$, $P < 0.050$). Therefore, Hypothesis 1 and Hypothesis 2 were verified. Notably, symptom interference was not significantly positively correlated with family support ($a_2 = 0.046$, $P > 0.050$) but significantly positively correlated with life satisfaction in turn ($b_2 = 0.491$, $P < 0.001$). Besides, resilience was significantly positively correlated with family support ($d = 0.748$, $P < 0.001$), constructing a chain mediation effect, which validated our Hypothesis 3. The chain mediation model formed is shown in Figure 3.

Table 3 Regression-Based Results in the Serial Mediation Analysis (n = 226)

Criterion	Predictors	*R*	R^2	*F*	*B*	t	95% *CI*
CD - RISC		0.642	0.412	25.598**			
	MDASI - GI_6				−0.133	−8.590**	(−0.164,-0.103)
PSSS Domain 1		0.583	0.340	16.109**			
	MDASI - GI_6				0.046	1.807	(−0.004, 0.098)
	CD - RISC				0.748	7.697**	(0.556, 0.940)
SWLS		0.741	0.549	33.097*			
	MDASI - GI_6				−0.069	−1.971*	(−0.138, 0.000)
	CD - RISC				1.032	7.024**	(0.743, 1.322)
	PSSS Domain 1				0.491	5.425**	(0.313, 0.670)

Notes: Gender, marital status, education status, family's earning per month and employment status as control variables. B, unstandardized values. *P value < 0.05; **P value < 0.01.
Abbreviations: CD - RISC, Connor - Davidson Resilience Scale; CI, confidence interval; MDASI - GI_6, the 6-item symptom interference domain from M.D. Anderson Symptom Inventory for Gastrointestinal Cancer (MDASI - GI); PSSS, perceived social support scale (Domain 1: family support; Domain 2: friends support; Domain 3: significant other); SD; standard deviation; SWLS, the satisfaction with life scale.

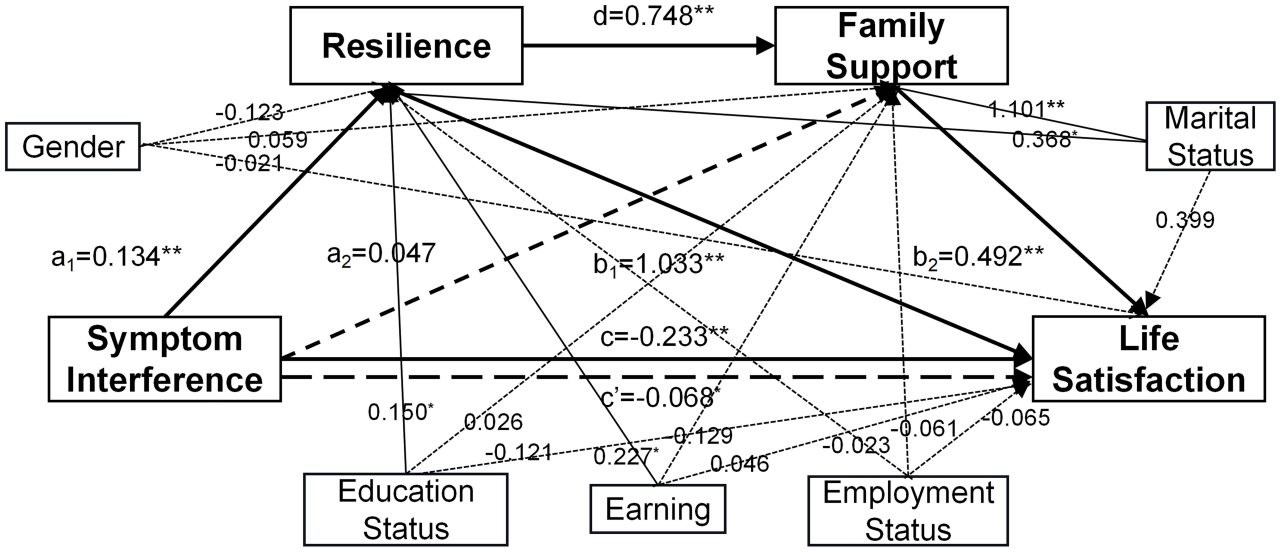

Figure 3 The chain mediation model of resilience and family support in the relationship between symptom interference and life satisfaction. Effects were reported as unstandardized values. Gender, marital status, education status, family's earning per month and employment status were employed as control variables. *P value < 0.05; **P value < 0.01.

Bootstrap Test of Mediation Effect

The mediation effect was further tested using the Bootstrap sampling method with 5000 repetitions. The results are presented in Table 4. The total indirect effect of symptom interference through resilience and "family support" on life satisfaction was significant (B = −0.164, 95% CI: −0.223 to −0.107). Specifically, symptom interference indirectly influenced life satisfaction via two significant mediation approaches: (i) resilience (B = −0.138, 95% CI: −0.194 to −0.091), accounting for 59.21% of the total effect. (ii) the chain mediators about resilience and "family support" (B = −0.049, 95% CI: −0.073 to −0.026), which took up 21.12% of the total effect.

In our study, the "family support" mediation pathway was insignificant. The total mediating effect was 71.29%. Moreover, the direct effect of symptom interference on life satisfaction remained statistically significant. Therefore, resilience and "family support" worked as a partial mediation role in the relationship between symptom interference and life satisfaction. This mediation model accounted for 54.96% of the variance in life satisfaction among patients after esophagectomy (F = 33.097, P < 0.001).

Table 4 Symptom Interference and Life Satisfaction in the Mediation Effect Analysis (n = 226)

Effect	*B*	*SE*	Bootstrapping 95% CI
Total effect	−0.233	0.038	(−0.309,-0.157)
Direct effect	−0.069	0.035	(−0.138, 0.000)
Indirect effect			
Total	−0.164	0.030	(−0.223,-0.107)
MDASI - GI_6→CD - RISC→SWLS	−0.138	0.026	(−0.194,-0.091)
MDASI - GI_6→PSSS Domain 1→SWLS	0.023	0.013	(−0.005, 0.053)
MDASI - GI_6→CD -RISC→Domain 1→SWLS	−0.049	0.011	(−0.073,-0.026)

Notes: Based on 5000 bootstrap samples; Total, direct, and indirect effects of symptom interference on life satisfaction through resilience and family support. B, unstandardized values.

Abbreviations: CD - RISC, Connor-Davidson Resilience Scale; CI, confidence interval; MDASI - GI_6, the 6-item symptom interference domain from M.D. Anderson Symptom Inventory for Gastrointestinal Cancer (MDASI - GI); PSSS, perceived social support scale (Domain 1: family support); SE, standard error; SWLS, the satisfaction with life scale.

Discussion

Based on COR, we constructed a framework for the relationship among symptom interference, resilience, family support, and life satisfaction in Chinese patients after esophagectomy. The pivotal finding discovered in our study was that resilience as an internal resource could mediate the relationship between symptom interference and life satisfaction. Moreover, only with the help of resilience can family support as an external resource further contribute to life satisfaction.

In this study, symptom interference was negatively correlated with life satisfaction. The direct effect of symptom interference on life satisfaction took up 29.56% of the total effect, supporting Hypothesis 1 and consistent with previous findings.[32] Low levels of symptom interference represented better physical functioning as well as better psychological health in patients after esophagectomy, which could optimize their perception of life state, strengthen the benignant evaluation of the quality of life, and made them more optimistic and satisfied with their internal and external environments, thus contributing to increase life satisfaction.[33]

Consistent with Hypothesis 2, we found a partial mediating role for resilience alone, which may reveal the underlying mechanism for how symptom interference indirectly influenced life satisfaction in patients after esophagectomy. The principle of the acquisition paradox in COR can reasonably explain the result,[11] namely, resource loss scenarios could amplify the value of resource gain, which was particularly substantial when resource loss was severe. The adverse effects of esophagectomy seriously jeopardized the original resources, such as reduced muscle mass, deterioration of nutritional status, and increased negative emotions, bringing unprecedented challenges to the unknown postoperative new life.[5,34] In this context, the presence or enhancement of resilience was particularly essential because it could help patients cope with and adapt to different stressors (eg symptom interference) to maintain a positive evaluation of their lives. It follows that timely assessment of resilience in patients after esophagectomy was critical, especially in resources severely impaired. Importantly, this finding also aligned with the theoretical framework of resilience.[13] A recent study noted that a consistent viewpoint about resilience was an interventional and regulable dynamic course.[35] Systematic reviews of resilience interventions in cancer patients substantiated the effectiveness in strengthening resilience and other psychological health outcomes. However, they presented a small to moderate effect that was less significant than anticipated.[36] Quantitative literature analyses suggested that primarily favorable effects of resilience were obtained by interventions based on positive psychology, support-expression group therapy, or mindfulness, but the individual effect sizes varied considerably.[37] It seemed necessary to continue trials of resilience interventions in our study populations. Unfortunately, we have not seen such experimental research in the oesophageal cancer population.

Another novel finding was that the indirect effect of family support alone was insignificant in the ultimate model. In contrast, the chain mediation effect of resilience and family support reached a significant level, confirming Hypothesis 3. In other words, family support alone did not affect life satisfaction, and only relying on inherent resilience could promote life satisfaction. The resource input principle in COR could explain the chain mediation effect:[11] people have to invest resources to repair lost resources and access other resources. Resources in different contexts can influence each other through internal resources. When the symptoms of patients after esophagectomy seriously interfere with their daily lives, it is essential to increase the investment of internal and external resources (resilience and family support) to reduce the adverse effects caused by symptom interference. Resilience positively predicted family support, indicating that higher levels of resilience were correlated with greater optimism and hopefulness and the ability to positively perceive or utilize support from their families, thus increasing resources for coping with stress.[38] Consistent with the results of Zhou's research on breast cancer patients, the solid psychological defense would lead to positive personal reactions and feelings to obtain better patient-reported results.[39] Based on the results of chain mediation analysis, family support may become the second intervention target variable for patients after esophagectomy. Support from family members can assist cancer patients in overcoming negative psychological distress, such as fear, and building up confidence in postoperative rehabilitation.[40] In accordance with the symptom interference of patients after esophagectomy, adding family support to intervention programs that enhance resilience may be a key area for future research.

In our study, family support alone neither mediated nor moderated the relationship between symptom interference and life satisfaction, which was inconsistent with previous findings.[39,41] Patients after esophagectomy had changes in social

networks and deliberately reduced or refused to participate in social interactions.[5] Lower social functioning reduced their utilization of social support and awareness of the disease,[42] which may partly explain the lack of correlation between social support and symptom interference. Unlike in Western countries, family support was the primary force influencing the sound in body and mind of Chinese patients after esophagectomy during postoperative rehabilitation.[19] However, most oesophageal cancer patients were overprotected by their families. They were not allowed to do housework or any other work during postoperative rehabilitation. This counterproductive protective attitude severely inhibited the sense of independence and confidence in rehabilitation, hindering role adaptation and transformation.[43] Indeed, the support provided was not guaranteed to help the patients, as the support should meet the patients' intrinsic needs first.[44] For these reasons, the buffering effect of social support alone on symptom interference in patients after esophagectomy was not significant. These findings indicated that resilience may be more critical in terms of the utilization of social resources.

In addition, we ascertained several factors that may influence the life satisfaction of patients after esophagectomy, including gender, marital status, education status, employment status, and family's earnings per month. An unanticipated finding was that patients with the highest family's earnings per month did not have the highest levels of life satisfaction. It might be fascinating to deeply probe the connection between financial income and life satisfaction.

Our cross-sectional design still had some limitations. First, participants in our study were conveniently selected from two hospitals, and the sampling selection method may restrict the generalization of the results. New research could apply the randomized sampling designs. Second, cross-sectional data analysis cannot make conclusive statements about causality between 4 variables. Using cross-lagged panels or experimental designs could be attempted to tease out the causal relationships further. Finally, only family support made it into the final mediation model in our study, but this did not mean that other sources of social support had no effect on patients after esophagectomy.

Conclusion

This study identified the potential mechanisms by which patient-reported symptom interference of patients after esophagectomy affecting life satisfaction. Symptom interference possibly affected life satisfaction through resilience solely or through the chain mediation effect of resilience and family support, whereas family support alone failed to mitigate the adverse impact of symptom interference on life satisfaction. Giving that resilience may be more critical in terms of the utilization of social resources than family support, priority should be given to enhancing resilience to resist the adverse effects of symptom interference for patients after esophagectomy. Previous studies have developed many resilience intervention programs for other types of cancer populations. Therefore, oncology nurses can explore the effectiveness of tailored resilience intervention programs in improving life satisfaction, guided by evidence-based methods and considering the symptom interference of patients after esophagectomy. Furthermore, the role of family support cannot be ignored. Oncology nurses could integrate family support into intervention programs for resilience, uniting patient's internal and external resources to enhance life satisfaction.

Ethics Statement

Our study was supported by the Ethics Committee of Anhui Medical University (Approval Number: 20190266).

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Disclosure

The authors declare that there are no known competing financial interests or personal relationships that could influence the work reported in this manuscript.

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