Coping style as mediator between resilience, perceived social support, and health-related quality of life in Chinese mainland women newly diagnosed with breast cancer

Kaina Zhou (zhoukaina@xjtu.edu.cn)  
Xi’an Jiaotong University Health Science Center  https://orcid.org/0000-0002-1898-6379

Fan Ning  
Xi’an Jiaotong University

Xiao Wang  
Shaanxi Provincial Tumor Hospital

Wen Wang  
Xi’an Jiaotong University

Dongfang Han  
First Affiliated Hospital Xi’an Jiaotong University

Research Article

Keywords: breast cancer, resilience, perceived social support, coping style, health-related quality of life

DOI: https://doi.org/10.21203/rs.3.rs-220162/v1

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Abstract

Background

Breast cancer may impair health-related quality of life (HRQoL). We examined the mediating role of coping style (CS) in the relationship between resilience, perceived social support (PSS), and HRQoL in newly diagnosed breast cancer patients in the Chinese mainland.

Methods

A total of 431 patients completed a survey at two hospitals in Shaanxi Province, China, using self-report measures assessing HRQoL, resilience, PSS, and CS. A one-sample t-test analyzed differences between resilience, PSS, and CS in breast cancer patients and the corresponding norm. Multivariate linear regression analyzed the independent predictors of HRQoL. The mediating role of CS between resilience, PSS, and HRQoL were investigated using structural equation modeling (SEM).

Results

Participants had significantly lower scores for resilience and PSS and higher scores for the avoidance and resignation CSs than their corresponding norm. SEM analysis showed resilience had significant direct effects on CS ($\beta$: 0.66, 95% CI: 0.54, 0.77) and HRQoL [0.32 (0.12, 0.49)]. PSS had significant direct effects on CS [0.18 (0.06, 0.29)]. Resilience [0.32 (0.19, 0.53)] and PSS [0.09 (0.03, 0.18)] had significant indirect effects, and resilience [0.64 (0.56, 0.71)] had significant total effects on HRQoL. CS had significant direct and total effects on HRQoL [0.48 (0.30, 0.72)].

Conclusions

Newly diagnosed breast cancer patients of mainland China had lower resilience and PSS and higher negative CSs. CS appeared to mediate the influence of resilience and PSS on HRQoL. Multimodal intervention programs focusing on CS might increase the influence of resilience and PSS on HRQoL in breast cancer patients.

Background

As a major stressful life event, breast cancer diagnosis and treatment-related adverse effects could cause severe physical and psychological trauma to the patient and eventually result in damage to their health-related quality of life (HRQoL) [1, 2]. The improvement of breast cancer treatment strategies and an increased survival rate have made the psychosocial rehabilitation of patients increasingly important [3].
HRQoL is an individual’s self-perception of their physical, psychological, and social functioning [4]. It is an essential indicator for evaluating the overall therapeutic effect of cancer treatment and the overall functional rehabilitation of patients during their lifetime [4]. Diseases and various negative stressors affect the HRQoL of breast cancer patients with varying degrees, especially in the field of psychosocial functioning [4]. Commonly reported factors that influence HRQoL include anxiety, depression, and despair [5, 6]; resilience [7]; perceived social support (PSS) [8, 9]; and coping style (CS) [10]. CS is also an important mediator variable of HRQoL [11].

Among the above-mentioned psychosocial factors, resilience and PSS often reflect an individual’s ability to adapt and successfully cope with adversity [12, 13]. This changes continuously with the interactions between the individual and the environment [12, 14]. Resilience and PSS levels integrate physiological, psychological, and social functions that affect an individual’s HRQoL after suffering from stressful events [7, 13, 14]. Women with breast cancer experience different degrees of psychological trauma during the process of diagnosis, treatment, and rehabilitation [5, 6, 15]. However, previous studies have focused primarily on negative psychological responses such as anxiety and depression [5, 6], fear of progression/relapse [16, 17], decreased self-efficacy [18], poor perception of social support [9, 13], and negative coping strategies [10]. Few studies have examined the direct effects and indirect effects via CS of resilience and PSS on the physical, psychological, and social functioning of women with breast cancer. Further, studies of Chinese mainland women who have been newly diagnosed are even more limited.

**Theoretical basis**

This study is based on the Neuman Systems Model (NSM), a theoretical framework for nursing that emphasizes the interaction between people and the environment and the individual's response to stressors in the environment. The main components of this model include the stressor, the body's defense, and nursing interventions. When a stressor acts on the body, the body reacts defensively, and the purpose of a nursing intervention is to maintain and restore the balance of the body's system [19].

Each woman with breast cancer is an independent system; the disease and its treatment-related factors (stressors) will have various negative effects on the patient (system) and then cause changes in their psychological toughness (body defense). Through comprehensive consideration of the positive role of the patient's self-defense capabilities and the positive guiding effects of a patient's personal responses (i.e., CS), this study used the NSM as the theoretical basis to build an influencing factor model. Resilience and PSS were regarded as the body's defenses, CS as the personal response, and HRQoL as the patient-reported outcome (Figure 1). This model was used to examine the mediator role of CS (i.e., mediator variables) in the relationship between resilience and PSS (i.e., independent variables) and HRQoL (i.e., outcome variable). To our knowledge, only one study has used the NSM as the theoretical basis for breast cancer patient research on nausea and vomiting caused by chemotherapy [20]. It has not been reported as the theoretical basis in research examining HRQoL in breast cancer patients.
The purpose of the study is to examine the mediator role of CS in the relationship between resilience, PSS, and HRQoL in women newly diagnosed with breast cancer. There are two hypotheses: (i) resilience, PSS, and CS are independent predictors of HRQoL; and (ii) CS mediates the relationship between resilience, PSS, and HRQoL. The study's findings will provide new evidence for identifying the mediator roles of psychosocial factors in the relationship between resilience, PSS, and HRQoL and developing multimodal intervention programs to improve HRQoL in women newly diagnosed with breast cancer.

Methods

Design, participants, and sampling

We used a cross-sectional study design. Convenience sampling was used to recruit women with breast cancer who had been admitted to the Tumor Hospital of Shaanxi Province or the First Affiliated Hospital of Xi'an Jiaotong University. Inclusion criteria were women newly diagnosed with breast cancer, aged 18 years or older, and Chinese speakers. The exclusion criteria were patients with other comorbid non-breast tumors, breast diseases, or cognitive disorders (screened by a blinded psychiatrist according to the criteria of the DSM-5.). The required sample size was estimated based on the metric of 5 to 10 participants per item in a validated instrument [21] to ensure sufficient power. Considering that the largest instrument used has 36 items, the appropriate sample size should be 180 to 360 patients.

Measurements

We used four existing instruments to assess HRQoL, resilience, PSS, and CS.

Functional Assessment of Cancer Therapy–Breast version 4.0

Patients’ HRQoL was measured by the 36-item Chinese Functional Assessment of Cancer Therapy–Breast version 4.0 (FACT-Bv4.0). Each item is rated on a 5-point Likert scale (0 = not at all, 4 = very much). The items are divided into five subscales (i.e., social/family well-being [SWB], physical well-being [PWB], functional well-being [FWB], emotional well-being [EWB], and breast cancer-specific [BCS] concerns) [22]. The FACT-Bv4.0 total score (ranging from 0 to 144) is the sum of the five subscales scores, with a higher score indicating better HRQoL [23]. A validation study of the Chinese FACT-Bv4.0 resulted in higher reliability (Cronbach’s a of the five subscales ranges from 0.59 to 0.85) and satisfactory validity [23]. In this study, the Cronbach’s a for the overall scale was 0.93; for each of the five subscales, it was 0.85 (PWB), 0.91 (SWB), 0.86 (EWB), 0.89 (FWB), and 0.70 (BCS).

Connor–Davidson Resilience scale

The 25-item Chinese Connor–Davidson Resilience Scale (CD-RISC) was used to measure psychological resilience. Responses are indicated on a 5-point Likert-type scale, ranging from 0 (not true at all) to 4 (true
nearly all the time). Items are divided into three subscales—tenacity, self-reliance, and optimism. The total score ranges from 0 to 100, with a higher score reflecting higher resilience [24]. The Chinese CD-RISC also has high reliability (Cronbach's $a = 0.91$) and satisfactory validity [24]. In this study, the Cronbach's $a$ values were 0.95 (CD-RISC), 0.92 (tenacity), 0.77 (self-reliance), and 0.88 (optimism).

**Multidimensional Scale of Perceived Social Support**

The 12-item Chinese Multidimensional Scale of Perceived Social Support (MSPSS) measures perceived support from family, friends, and significant others. Items are rated on a 7-point Likert scale (1 = very strongly disagree, 7 = very strongly agree). The total score is the sum of all items, ranging from 12 to 84, with a higher score indicating higher PSS [25]. The Chinese MSPSS has been well validated in university students (Cronbach's $a = 0.92$) [26] and patients with methadone maintenance treatment (Cronbach's $a = 0.92$) [27]. In this study, the Cronbach's $a$ values were 0.93 (MSPSS), 0.91 (family support), 0.90 (friends' support), and 0.93 (significant others' support).

**Medical Coping Mode questionnaire**

The 20-item Chinese Medical Coping Mode questionnaire (MCMQ) was used to assess the CS of patients with breast cancer. It has three subscales, namely confrontation, avoidance, and resignation, with a higher subscale score indicating more confrontation, avoidance, or resignation, respectively [28]. The Chinese MCMQs have satisfactory psychometric properties (Cronbach's $a$ was 0.76) [28]. In this study, the Cronbach's $a$ for the three subscales were 0.70 (confrontation), 0.72 (avoidance), and 0.88 (resignation).

**Data collection and analysis**

Data were collected from May to October 2020. Patients were instructed to complete the questionnaires independently. If the patient had difficulties in reading or writing, a trained data collector read the items to the patient and recorded their responses.

Categorical variables were summarized using frequencies and percentages, while continuous variables were summarized using mean and standard deviation (SD). A one-sample $t$-test was utilized to compare the total score of the CD-RISC and MSPSS and the three subscales scores of the MCMQ with the corresponding normative data. A multivariate linear regression analysis was performed to identify the influence of resilience, PSS, and CS on HRQoL when controlling for socio-demographics and clinical characteristics.

Structural equation modeling (SEM) was employed using the maximum likelihood bootstrapping method [28] to examine the mediating role of CS on the relationship between resilience, PSS, and HRQoL. Standardized direct, indirect, and total effects and $R^2$ with a corresponding 95% bias-corrected confidence interval were estimated based on 1000 random samples (bootstrapping method subsample) generated by computer [29, 30]. The mediating roles were examined via three stages [31]: 1) significant direct effects of resilience and PSS (independent variable) on CS (mediators); 2) significant direct effects of
resilience and PSS on HRQoL (outcome variable); and 3) significant indirect effects of resilience and PSS and direct effects of CS on HRQoL. The model fit was examined with $c^2$ value (desired significance $P > 0.05$), adjusted goodness-of-fit index (AGFI; desired value $\geq 0.90$), and root mean square error of approximation (RMSEA; desired value $< 0.08$) [30]. The data were analyzed using SPSS 25.0 and AMOS 21.0 (IBM Corp., Armonk, NY). A value of $P < 0.05$ (two-tailed) was considered statistically significant.

**Ethical statement**

The Human Research Ethics Committee of Xi’an Jiaotong University reviewed and approved the study protocol (2019-9800). Written informed consent was obtained from each patient before administering the questionnaire survey. Furthermore, the study conforms to the standards contained in the Declaration of Helsinki, as amended.

**Results**

A total of 440 patients met the eligibility criteria, and 431 (98.0%) completed the questionnaires with no missing data; 127 (29.5%) were from the Tumor Hospital of Shaanxi Province, and 304 (70.5%) were from the First Affiliated Hospital of Xi’an Jiaotong University. Nine patients were excluded due to comorbid non-breast tumors ($n = 3$), other breast diseases ($n = 4$), and refusal to provide written informed consent ($n = 2$). Table 1 summarizes the socio-demographic, clinical characteristics, and results for the four questionnaires used in the data analysis of the sample. Table 2 shows the comparisons of resilience, social support, CS, and corresponding norms.

After controlling for the socio-demographic and clinical characteristics, resilience, PSS, and CS (i.e., confrontation, resignation) significantly influenced HRQoL, with $R^2$ of 0.64 (Model A), 0.64 (Model B), and 0.66 (Model C; $P < 0.001$; Table 3).

SEM analysis showed resilience had significant direct effects on CS ($B:0.66, 95\% CI: 0.54, 0.77$) and HRQoL [$0.32 (0.12, 0.49)$]. PSS had significant direct effects on CS [$0.18 (0.06, 0.29)$]. Resilience [$0.32 (0.19, 0.53)$] and PSS [$0.09 (0.03, 0.18)$] had significant indirect effects, and resilience [$0.64 (0.56, 0.71)$] had significant total effects on HRQoL. CS had significant direct and total effects on HRQoL [$0.48 (0.30, 0.72)$]. Resilience and PSS explained 61% variance of CS [$R^2:0.61, 95\% CI: 0.46, 0.73$], while resilience, PSS, and CS explained 61% variance of HRQoL [$0.61 (0.50, 0.69)$]. (Table 4) Figure 2 illustrates the relationship among these variables. The model fit indices were all satisfied (Figure 2).

**Discussion**

After controlling for socio-demographic and clinical characteristics, statistical analyses demonstrated that women newly diagnosed with breast cancer had poor HRQoL, which was significantly influenced by resilience, PSS, and CS (confrontation and resignation). Additionally, CS mediated the relationship between resilience, PSS, and HRQoL.
Based on the NSM, we constructed a model to examine the mediator role of CS. The SEM analysis further identified the mediating role of CS in the relationship between resilience, PSS, and HRQoL. First, in the SEM model, resilience had significant direct effects on CS and HRQoL, while PSS only had significant direct effects on CS. This partially support the first and second stages of the mediator role analysis [31]. Second, resilience and PSS had significant indirect effects, and CS had significant direct effects on HRQoL, thus supporting the third stage of the mediator role analysis [31]. The indirect effect between PSS and HRQoL further indicates that CS (especially confrontation) is the important point of delivering perceived social support to HRQoL improvement. These findings support our second hypothesis that CS mediated the relationship between resilience, PSS, and HRQoL.

The SEM findings indicate that positive CS (i.e., confrontation) would strengthen the influence of resilience and PSS on HRQoL. Accordingly, interventions for enhancing the confrontation CS should be prioritized when developing HRQoL improvement programs. Previous studies have reported the mediating role of social support between resilience and HRQoL [32]. However, to the best of our knowledge, no previous studies have reported the mediating role of CS in the relationship between resilience, PSS, and HRQoL in similar samples of breast cancer patients [33-35]. Therefore, our findings provide new evidence for identifying the mediator roles of psychosocial factors in the relationship between resilience, PSS, and HRQoL and developing multimodal intervention programs that consider CS to improve the positive influences of resilience and PSS on HRQoL in women newly diagnosed with breast cancer.

The results with regard to poor HRQoL showed that functional well-being had the lowest score among the five subscales. This demonstrates that newly diagnosed women with breast cancer had the most prominent decrease in functional health. The emotional, social/family, and physical well-being subscales were also affected negatively during the disease course. The findings were consistent with prior research [7] that indicated breast cancer patients had difficulties with physical, psychological, and social functioning.

Although the breast cancer-specific subscales for additional concerns had the highest scores among the five subscales, which is consistent with our previous studies [36, 37], more attention should be devoted to the lower health domain scores in physical, social/family, emotional, and functional well-being that might be the result of concerns about potential future surgery and adjuvant therapy in clinical care for newly diagnosed patients.

The patients had lower resilience and PSS and higher negative CSs (i.e., avoidance and resignation) than that of the corresponding norm. These findings were consistent with previous studies [8-10, 15, 33]. Closer inspection of the CD-RISC, MSPSS, and MCMQ subscales suggests that some patients were tenacious, perceived strong family support, and selected confrontation as their CS while dealing with the disease. Strong family support may be beneficial to improve the patient's resilience. Considering the significance of family networks in China, it is necessary to further focus on enhancing family resilience for the patients in breast cancer care [38, 39]. However, patients with lower optimism and higher negative CS (i.e., avoidance and resignation) scores are a concerning group. The aforementioned findings suggest
that psychosocial interventions should focus on improving poor resilience and changing the negative CSs of women newly diagnosed with breast cancer [40, 41].

The finding that resilience, PSS, and CS (i.e., confrontation and resignation) had significant influences on HRQoL is consistent with previous research [42-44] and partially supports our first hypothesis that psychosocial factors are independent predictors of HRQoL. However, the avoidance CS did not significantly influence HRQoL. This may be because newly diagnosed patients chose the confrontation CS to deal with their health problems, as the confrontation CS score is closer to that of the norm. Although it has been reported that negative CSs are negatively associated with HRQoL [45], the insignificant impacts of avoidance in women with newly diagnosed breast cancer in this study needs further examination.

This study has some limitations. First, the self-reported data of HRQoL, resilience, PSS, and CS lack objectivity. Information on related behaviors and physical health changes are recommended in future work. Second, the relationships among the above variables were possibly inflated due to response bias. Third, this cross-sectional study design could not support causal relationships among variables. Thus, their relationship trajectories during the long-term rehabilitation process should be further explored in longitudinal studies. Finally, the study was conducted in Xi’an, thus limiting the generalization of the findings to all women newly diagnosed with breast cancer. A multicenter design is recommended to enhance generalizability.

**Conclusion**

The patients in our study had relatively poor HRQoL, lower resilience and PSS, and higher avoidance and resignation CSs. Resilience and CS had significant direct effects on HRQoL, and CS mediates the influence of resilience and PSS on HRQoL. A multimodal intervention program focusing on CS needs to be developed to improve the positive influence of resilience and PSS on HRQoL in breast cancer patients.

**Abbreviations**

PSS - Perceived Social Support

AGFI - Adjusted Goodness-of-Fit Index

BCS - Breast Cancer-Specific

CD-RISC - Connor–Davidson Resilience Scale

CS - Coping Style

EWB - Emotional Well-Being

FACT-Bv4.0 - Functional Assessment of Cancer Therapy–Breast version 4.0
FWB - Functional Well-Being
HRQoL - Health-Related Quality of Life
MCMQ - Medical Coping Mode questionnaire
MSPSS - Multidimensional Scale of Perceived Social Support
NSM - Neuman Systems Model
PWB - Physical Well-Being
RMSEA - Root Mean Square Error of Approximation
SD - Standard Deviation
SEM - Structural Equation Modeling
SWB - Social Well-Being

Declarations

Ethics approval and consent to participate: The Human Research Ethics Committee of Xi’an Jiaotong University reviewed and approved the study protocol (2019-9800). Furthermore, the study conforms to the standards contained in the Declaration of Helsinki, as amended.

Consent to participate: Written informed consent was obtained from each patient before administering the questionnaire survey.

Consent for publication: Not applicable.

Availability of data and materials: The datasets used and/or analyzed during this study are available from the corresponding author on reasonable request.

Competing interests: The authors declare that they have no competing interests.

Funding: The study was supported by China Postdoctoral Science Foundation (No. 2018M643678). The funding body had no role in the design of the study and collection, analysis, and interpretation of data or in writing the manuscript.

Author Contributions: KZ designed the study. FN, XW, WW, and DH collected the data. KZ analyzed and interpreted the data and prepared the manuscript draft. KZ revised the manuscript. All authors read and approved the final manuscript.

Acknowledgments: We thank the China Postdoctoral Science Foundation (No. 2018M643678) for their funding support.
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Tables

Table 1. Participants’ socio-demographics, clinical characteristics, and summary results for the four questionnaires (N = 431)
|                        | n (%) |
|------------------------|-------|
| **Socio-Demographics** |       |
| Age (years; mean ± SD; range: 27–77) | 48.26 ± 10.40 |
| Education Level        |       |
| Primary & Below        | 90 (20.9) |
| Secondary              | 278 (64.5) |
| Tertiary               | 63 (14.6) |
| Marital status         |       |
| Married                | 425 (98.6) |
| Other Marital Status   | 6 (1.4) |
| Has Children           |       |
| Yes                    | 416 (96.5) |
| No                     | 15 (3.5) |
| Employment Status      |       |
| Unemployed             | 170 (39.4) |
| Retired                | 54 (12.5) |
| Employed               | 207 (48.1) |
| Average monthly income over the past 12 months (Chinese Yuan) | |
| <3000                  | 170 (39.4) |
| 3000–6000              | 194 (45.0) |
| 6001–9000              | 52 (12.1) |
| >9000                  | 15 (3.5) |
| Place of Residence     |       |
| Urban                  | 207 (48.0) |
| Rural                  | 224 (52.0) |
| Chronic Disease (disease course > 6 months) | |
| Yes                    | 28 (6.5) |
| No                     | 403 (93.5) |
| **Clinical Characteristics** |  |
| Illness Stage       |       |
|--------------------|-------|
| 0–I                | 134 (31.1) |
| II                 | 203 (47.1) |
| III                | 66 (15.3)  |
| IV                 | 28 (6.5)   |

| Metastasis          |       |
|---------------------|-------|
| No Metastasis       | 285 (66.1) |
| Axillary            | 119 (27.6) |
| Other Metastasis    | 27 (6.3)  |

| Surgical Style      |       |
|---------------------|-------|
| No Surgery          | 146 (33.9) |
| Modified Radical Mastectomy | 203 (47.1) |
| Simple Mastectomy   | 60 (13.9)  |
| Breast Conservation | 23 (5.3)   |

| Adjuvant Therapy    |       |
|---------------------|-------|
| Conventional Chemotherapy | 381 (88.4) |
| Neoadjuvant Chemotherapy | 26 (6.0)  |
| Radio Therapy       | 151 (35.0) |
| Endocrine Therapy   | 231 (53.6) |
| Targeted Therapy    | 47 (10.9)  |

**HRQoL**\(^b\) (mean ± SD)

| Well-Being           |       |
|----------------------|-------|
| Physical Well-Being  | 17.75 ± 4.91 |
| Social/Family Well-Being | 17.66 ± 5.95 |
| Emotional Well-Being | 14.29 ± 4.48 |
| Functional Well-Being| 13.24 ± 5.04 |
| Breast-Cancer-Specific | 24.81 ± 3.97 |

Subscales for additional concerns

**FACT-Bv4.0**\(^c\) Total Score: 87.74 ± 18.69

**Resilience** (mean ± SD)
|                       |        |
|-----------------------|--------|
| Tenacity              | 27.51 ± 8.19 |
| Self-Reliance         | 16.84 ± 4.42 |
| Optimism              | 10.37 ± 3.06 |
| **CD-RISC**<sup>d</sup> Total Score | 54.72 ± 14.71 |

**Perceived Social Support**<sup>b</sup> (mean ± SD)

|                          |        |
|--------------------------|--------|
| Family support           | 24.16 ± 3.24 |
| Friends’ support         | 20.76 ± 4.00 |
| Significant others’ support | 20.52 ± 4.17 |
| **MSPSS**<sup>e</sup> total score | 65.45 ± 9.40 |

**Coping Style** (mean ± SD)

|                        |        |
|------------------------|--------|
| Confrontation          | 19.87 ± 3.73 |
| Avoidance              | 16.70 ± 1.90 |
| Resignation            | 9.57 ± 2.87 |

<sup>a</sup> SD: standard deviation

<sup>b</sup> Health-related quality of life

<sup>c</sup> Functional Assessment of Cancer Therapy–Breast version 4.0

<sup>d</sup> Connor–Davidson Resilience scale

<sup>e</sup> Multidimensional Scale of Perceived Social Support

**Table 2.** Comparisons of resilience, social support, coping styles, and corresponding norms (<sup>N</sup> = 431)
|                          | Score Mean ± SD | Norm Mean ± SD | MD<sup>a</sup> | 95% CI<sup>b</sup> | P     |
|--------------------------|-----------------|----------------|---------------|-------------------|-------|
| **Resilience**<sup>e</sup> |                 |                |               |                   |       |
| CD-RISC<sup>c</sup> Total Score | 54.72 ± 14.71   | 65.4 ± 13.9    | -10.68        | -12.59, -8.77     | <0.001|
| **Perceived Social Support**<sup>f</sup> |             |                |               |                   |       |
| MSPSS<sup>d</sup> total score | 65.45 ± 9.40    | 68.91 ± 11.99  | -3.46         | -4.68, -2.24      | <0.001|
| **Coping Style**<sup>g</sup> |                 |                |               |                   |       |
| Confrontation             | 19.87 ± 3.73    | 19.48 ± 3.81   | 0.39          | -0.10, 0.87       | 0.12  |
| Avoidance                 | 16.70 ± 1.90    | 14.44 ± 2.97   | 2.25          | 2.01, 2.50        | <0.001|
| Resignation               | 9.57 ± 2.87     | 8.81 ± 3.17    | 0.76          | 0.39, 1.13        | <0.001|

<sup>a</sup> Mean difference

<sup>b</sup> Confidence interval

<sup>c</sup> Connor–Davidson Resilience scale

<sup>d</sup> Multidimensional Scale of Perceived Social Support

<sup>e</sup> Adapted from: Ren Y, Zhou Y, Ma C, et al (2014) Influence of psychological resilience on job satisfaction of nurses. Chin Nurs Res 28(1C):293-294.

<sup>f</sup> Adapted from: Wang Y, Liu C (2019) The mediating effects of social support and coping style between nurses’ personality characteristics and mental health. Chin J Nurs Educ 16(7):536-540.

<sup>g</sup> Adapted from: Shen X, Jiang Q (2009) Report on application of Chinese version of MCMQ in 701 patients. Chin J Behav Med Sci 9(1):18-20.

**Table 3.** Independent predictors of health-related quality of life (N = 431)
| Independent Variables                          | $B$ (95% CI) $^d$ | $P$   |
|-----------------------------------------------|-------------------|-------|
| **Model A$^a$**                               |                   |       |
| Resilience                                    | 0.75 (0.59, 0.92) | <0.001|
| Perceived Social Support                      | 0.29 (0.06, 0.51) | 0.014 |
| Coping Style (Confrontation)                  | 0.60 (0.01, 1.19) | 0.046 |
| **Model B$^b$**                               |                   |       |
| Resilience                                    | 0.81 (0.66, 0.97) | <0.001|
| Perceived Social Support                      | 0.28 (0.05, 0.51) | 0.016 |
| Coping Style (Avoidance)                      | 0.82 (-0.07, 1.71)| 0.070 |
| **Model C$^c$**                               |                   |       |
| Resilience                                    | 0.64 (0.47, 0.81) | <0.001|
| Perceived Social Support                      | 0.22 (0.002, 0.45)| 0.048 |
| Coping Style (Resignation)                    | -1.68 (-2.48, -0.89)| <0.001|

A multivariate linear regression analysis was performed after controlling for the following dummy variables: education level (ref. primary and below), marital status (ref. married), has children (ref. yes), employment status (ref. unemployed), average monthly income over the past 12 months (Chinese Yuan) (ref. <3000), place of residence (ref. urban), chronic disease (ref. yes), illness stage (ref. 0–I), metastasis (ref. no metastasis), surgical style (ref. no surgery), adjuvant therapy (ref. conventional chemotherapy), and continuous characteristics (age).

$^a R = 0.80, R^2 = 0.64, F = 14.33, P < 0.001.$

$^b R = 0.80, R^2 = 0.64, F = 14.25, P < 0.001.$

$^c R = 0.81, R^2 = 0.66, F = 15.76, P < 0.001.$

$^d$ confidence interval.

**Table 4** Standardized mediator effect of coping style and standardized direct, indirect, and total effect of resilience and perceived social support on health-related quality of life (HRQoL) ($N = 431$)
| Standardized effect       | Mediator (coping style) |  $P$  | HRQoL     |  $P$  |
|--------------------------|------------------------|------|-----------|------|
| **Resilience**           |                        |      |           |      |
| Direct (95% CI)          | 0.66 (0.54, 0.77)      | 0.002| 0.32 (0.12, 0.49) | 0.03 |
| Indirect (95% CI)        | -                      |      | 0.32 (0.19, 0.53) | 0.002|
| Total (95% CI)           | 0.66 (0.54, 0.77)      | 0.002| 0.64 (0.56, 0.71) | 0.002|
| **Perceived social support** |                      |      |           |      |
| Direct (95% CI)          | 0.18 (0.06, 0.29)      | 0.012| 0.03 (-0.08, 0.13) | 0.64 |
| Indirect (95% CI)        | -                      |      | 0.09 (0.03, 0.18) | 0.01 |
| Total (95% CI)           | 0.18 (0.06, 0.29)      | 0.012| 0.12 (0.02, 0.20) | 0.06 |
| **Coping style**         |                        |      |           |      |
| Direct (95% CI)          | -                      |      | 0.48 (0.30, 0.72) | 0.003|
| Indirect (95% CI)        | -                      |      | -         |      |
| Total (95% CI)           | -                      |      | 0.48 (0.30, 0.72) | 0.003|

95% CI: 95% confidence interval.