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Original Article

Impact of social support on body image during chemotherapy in patients with breast cancer: The chain mediating role of depression and self-efficacy

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ABSTRACT

Objective: To explore the mediating roles of depression and self-efficacy in the relationship between social support and body image in patients with breast cancer during chemotherapy.
Methods: A convenience sampling method was employed to survey 647 breast cancer chemotherapy patients. The survey included validated scales assessing social support, depression, self-efficacy, and body image. The chain mediation model was established using Mplus 8.3 software.
Results: Social support was negatively correlated with depression ($P < 0.001$) and poor body image ($P < 0.001$) and positively correlated with self-efficacy ($P < 0.001$). Social support indirectly affected body image through three mediating pathways: depression ($\beta = -0.084$, $P < 0.001$), self-efficacy ($\beta = -0.060$, $P < 0.01$), and the depression-self-efficacy pathway ($\beta = -0.058$, $P < 0.001$). The indirect effect accounted for 55.96% of the total effect.
Conclusions: The results support our hypothesis. Enhancing social support, alleviating depression, and improving self-efficacy through psychological interventions are recommended to improve body image in breast cancer patients during chemotherapy.

Introduction

Breast cancer is the most common malignant tumor among women.[1] According to the latest global cancer statistics, breast cancer has the highest incidence rate among women and poses a significant threat to women's health.[2] Chemotherapy is an important adjuvant treatment for breast cancer that effectively reduces the recurrence rate and improves survival rates. However, the side effects of chemotherapy, such as hair loss, skin changes, and weight fluctuations, may damage patients' body image and self-perception, reducing their body image levels.[3] Body image refers to an individual's subjective perception of their appearance, including cognitive, attitudinal, and emotional responses.[4] Patients with breast cancer commonly face issues related to body image. Studies have shown that the prevalence of body image dissatisfaction among patients with breast cancer ranges from 31% to 87% internationally[5] and is as high as 82.86% among Chinese patients.[6] Persistent body image issues may lead to anxiety, depression, low self-esteem, and other negative emotions that affect mental health and social functioning, thereby hindering social

integration.[7] Moreover, dissatisfaction with body image is closely related to pain,[8] sleep disorders,[9] sexual dysfunction,[10] and social anxiety,[11] impacting not only social activities, but also family, work, and social relationships, significantly reducing patients' overall quality of life and sense of well-being.[12,13] In particular, young patients with breast cancer generally have lower satisfaction with their body image.[14]

Social support is a key factor that affects the mental health of patients with breast cancer during chemotherapy. The social support theory posits that social networks provide patients with breast cancer with important external resources to cope with stress, which is crucial for improving their body image during chemotherapy.[15] Studies have shown that social support is significantly positively correlated with patients' body image,[16] happiness, and quality of life.[12] A lack of social support may lead to a decrease in patients' self-confidence, affecting their social behavior, disease cognition, and coping methods. Effective social support can help alleviate the distress caused by body image disorders.[17] Conversely, insufficient social support may exacerbate the negative impact on body image, increase psychological distress, and reduce the quality of life.[17]

Depression is an important factor affecting the body image of patients with breast cancer during chemotherapy. During chemotherapy, patients with breast cancer are more susceptible to depressive symptoms and body image issues owing to the disease and treatment side effects.[18] According to the stress-generation hypothesis,[19] depressive symptoms may lead individuals to have negative thoughts, emotions, and behaviors, which can affect body image levels and adversely affect the health outcomes of patients with cancer. As depressive symptoms intensify, patients are more likely to focus excessively on changes and flaws in their bodies.[20] One longitudinal study found that changes in body image may interact with depressive symptoms.[7] Dissatisfaction with body image may exacerbate depressive symptoms, which may further affect patients' subjective evaluations of their body image, forming a negative cycle. Studies have indicated that patients with breast cancer generally have a higher risk of depression.[18] Research has shown a significant negative correlation between social support and depression levels[21] and between depressive symptoms and body image levels, indicating that depression is an important factor affecting patients' body image.[22] Social support is particularly important in this context, as it can help patients cope with psychological stress and improve their body image.

Self-efficacy is an important factor that affects the body image of patients with breast cancer during chemotherapy. High levels of self-efficacy encourage patients to adopt positive coping strategies, adapt better to bodily changes, and cooperate more effectively with medical staff, thereby enhancing body image.[23] Studies show that self-efficacy is significantly positively correlated with the body image of patients with breast cancer during chemotherapy,[24] indicating that patients with higher self-efficacy tend to have more satisfactory body image. However, the side effects of chemotherapy and the treatment cycle may weaken patients' self-efficacy, leading to increased body dissatisfaction and negative evaluations. According to the self-efficacy theory,[25] an individual's psychological development is influenced by both internal and external resources. With the positive impact of social support as an external resource, patients feel supported, which helps increase self-efficacy.[26] Higher self-efficacy can effectively buffer the impact of a lack of social support, thereby improving the body image of patients with breast cancer during chemotherapy.

Depression and self-efficacy are two key factors that affect the psychological state of patients with breast cancer during chemotherapy. There are three main perspectives in the existing literature regarding the relationship between depression and self-efficacy: depression affects self-efficacy;[19] self-efficacy affects depression;[27] and depression and self-efficacy mutually influence each other.[28] Although these findings provide important clues for understanding the roles of depression and self-efficacy in patients with cancer, research on the impact of depression on self-efficacy during chemotherapy in patients with breast cancer is relatively limited. A study of African-American women with breast cancer shows that there is a negative correlation between the degree of depression and pain management self-efficacy.[29] Social cognitive theory points out that an individual's behavior is influenced not only by the external environment (such as social support) but also by internal psychological processes (such as depression and self-efficacy).[30] Alleviating depressive symptoms through social support may affect patients' self-efficacy, thereby affecting their overall psychological state.

Previous studies have shown that social support, depression, and self-efficacy affect the body image of patients with breast cancer during chemotherapy.[16,17,22,24,31,32] Although social support has been proven to affect body image, the mechanisms by which depression and self-efficacy play a role remain unclear. Therefore, this study aimed to explore the relationship between social support, depression, self-efficacy, and body image in patients with breast cancer during chemotherapy by constructing a chain mediation model, clarifying the underlying mechanisms to improve patients' perception of body image and providing theoretical support and a decision-making basis for clinical departments to develop psychological intervention strategies for patients with breast cancer. The hypothetical model used in this study is shown in Fig. 1.

H1. Social support has a direct predictive effect on body image.

H2. Depression mediates the relationship between social support and body image in patients with breast cancer during chemotherapy.

H3. Self-efficacy mediates the relationship between social support and body image in patients with breast cancer during chemotherapy.

H4. Depression and self-efficacy have a chain-mediating effect on the relationship between social support and body image in patients with breast cancer during chemotherapy.

Methods

Study design and participants

The participants, sample sizes, and data collection methods have been thoroughly described in previous research.[33] This was a secondary analysis based on a previous multicenter cross-sectional study[33] using convenience sampling to recruit patients with breast cancer undergoing chemotherapy between October 2019 and May 2021 in four tertiary hospitals in Shanghai, Shandong, Jiangsu, and Zhejiang. Inclusion criteria were the following: (1) Patients diagnosed with stages I–III breast cancer[34]; (2) Age $\geq$ 18 years; (3) Receiving adjuvant chemotherapy; and (4) Patients are aware of their condition and voluntarily agreed to participate in this study. The exclusion criteria were as follows: (1) patients with other malignant tumors or severe diseases and (2) those with severe cognitive impairments or mental illnesses who could not cooperate. This study was approved by the Ethics Committee of Fudan University Affiliated Cancer Hospital (IRB No. 2018-12-13), and all participating patients signed informed consent forms. This study (secondary analysis) used original informed consent forms.

Initially, 900 patients with breast cancer undergoing chemotherapy were recruited, 719 of whom met the inclusion criteria and agreed to participate, with a response rate of 79.9%. Among the 719 eligible patients, 72 were excluded because of incomplete questionnaires (25 cases) or missing data (47 cases). A total of 647 valid questionnaires were returned, with an effective recovery rate of 90.0% (Fig. 2).

Measures

General information questionnaire

The data for this study were extracted from a database of previous cross-sectional studies, including basic information (age, marital status, religious beliefs, education level, lifestyle, occupation, monthly income, place of residence, and body mass index) and the side effects of chemotherapy (symptoms such as nausea, vomiting, loss of appetite, oral ulcers, and skin itching).

PROMIS Social Support Short Form

The Chinese version of the PROMIS Social Support Short Form, developed by our research team in 2019,[35] was used to assess the level of
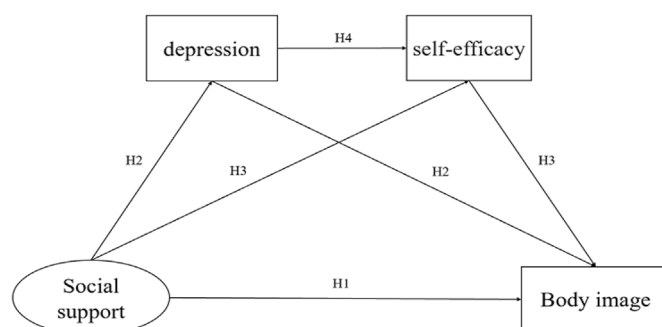

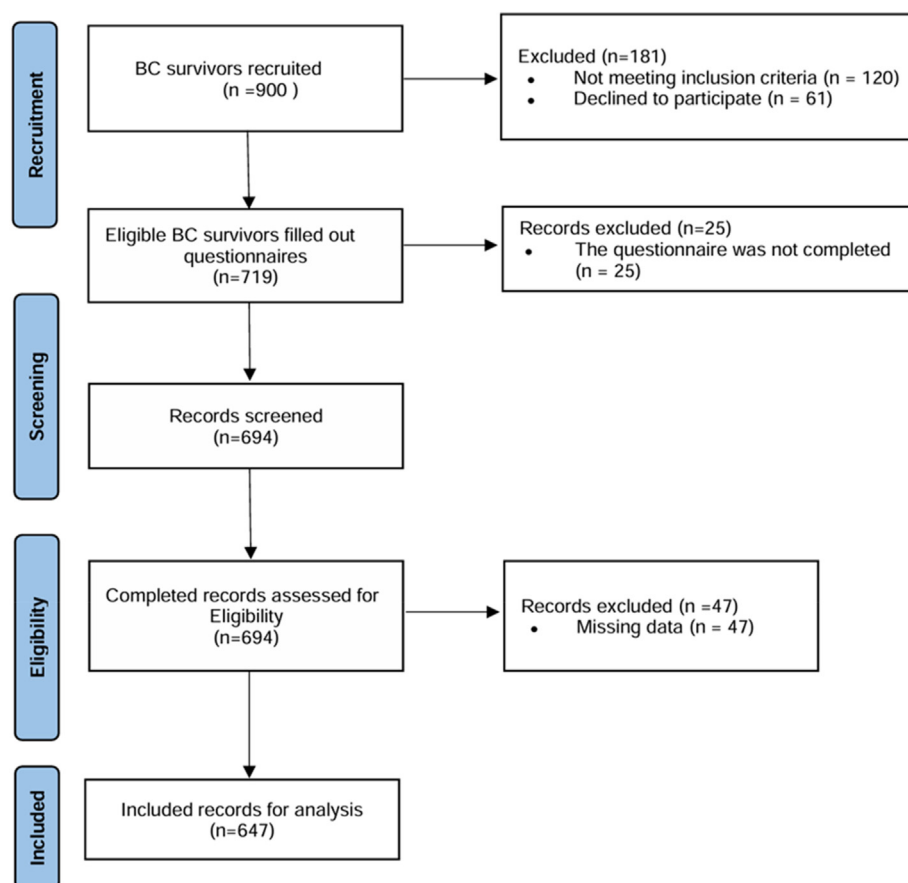**Fig. 1.** Hypothetical chain Mediation Model.

Fig. 2. Study recruitment flowchart. BC, breast cancer.

social support received over the past 7 days. The short form includes four dimensions–tangible, emotional, informational, and peer support–with 16 items. A 5-point Likert scale is used, ranging from "never" to "always," with scores assigned from 1 to 5. The total score ranged from 16 to 80. According to the PROMIS scoring manual, the raw scores were converted to standard T-scores (mean 50, standard deviation, 10) to compare social support levels between different patients. Higher scores indicated better levels of social support. The Cronbach's α coefficient for this short form ranged 0.900–0.944, and that for split-half reliability ranged 0.920–0.958, indicating good reliability.

PROMIS depression short form

The Chinese version of the PROMIS Depression Short Form, developed by our research team in 2019,[35] was used to evaluate the depressive status of patients over the past 7 days. The short form consists of 8 items, with a 5-point Likert scale ranging from "never" to "always," and a total score ranging from 8 to 40. Higher scores indicate more severe depressive symptoms. The Cronbach's α coefficient for this short form is 0.911 and that for split-half reliability is 0.925, indicating good internal consistency and structural validity.

PROMIS self-efficacy short form

The Chinese version of the PROMIS Self-Efficacy Short Form, developed by our research team in 2019,[35] was used to measure the level of patient self-efficacy in the past 7 days. It includes general self-efficacy (9 items) and disease self-efficacy (5 items), with a total of 14 items. A 5-point Likert scale was used, ranging from "not at all confident" to "very confident," with total scores ranging from 14 to 70. Higher scores indicated better self-efficacy. The overall Cronbach's α coefficient for this

short form is 0.962, with that for general self-efficacy and disease self-efficacy being 0.956 and 0.904, respectively, and the split-half reliability being 0.971.

PROMIS Body image short form

The Chinese version of the PROMIS Body Image Short Form, developed by our research team in 2019,[35] was used to measure the body image of the patients in the past 7 days. It includes attitudes (8 items) and behaviors (8 items), with a total of 16 items. A 5-point Likert scale is used, ranging from "not at all/never" to "very/always," with scores assigned from 1 to 5. The total score ranged from 16 to 80, with higher scores indicating more severe body image distress. The overall Cronbach's α coefficient for this short form is 0.938, with that for attitudes and behaviors being 0.900 and 0.923, respectively, and the split-half reliability being 0.967.

Data collection method

The investigators were recruited through a research collaboration network and received standardized training, including uniform instructions, questionnaire item explanations, and questionnaire review standards, to ensure consistency in interpreting and reviewing the questionnaire items. The research team mailed paper questionnaires to each investigator who conducted the survey during the middle stage of chemotherapy in patients with breast cancer (i.e., within 2 days after the end of the third cycle of the six-cycle chemotherapy or within 2 days after the end of the fourth cycle of the eight-cycle chemotherapy). Questionnaires were distributed and collected onsite, strictly quality-reviewed, and mailed back to the research team.[33]

Statistical analysis

Descriptive statistics were performed using the SPSS 20.0 statistical software. Categorical data were described using frequencies and percentages, and continuous data that were not normally distributed were expressed as medians (interquartile ranges) [M ($P25$, $P75$)]. Spearman's correlation analysis was used to explore correlations between variables. The Mplus 8.3 software was used to construct the chain mediation model, and the model fit was evaluated using χ^2/df, comparative fit index (CFI), Tucker–Lewis index (TLI), root mean square error of approximation (RMSEA), and SRMR indicators. If χ^2/df < 5, CFI > 0.9, TLI > 0.9, RMSEA < 0.08, and SRMR < 0.08, the model was considered to fit the data well.[36] The bias-corrected Bootstrap method was used to test the mediation effects, with 2000 resamples to verify the significance of each path in the constructed model. Results were considered statistically significant if the 95% confidence interval (CI) did not include 0 or $P < 0.05$.

Results

Common method bias test

The Harman single-factor test was used to assess the common method bias. The results showed that nine factors had eigenvalues > 1, with the first factor explaining 31.40% of the variance, which is less than the critical standard of 40%.[37] Therefore, there was no significant common method bias in the data.

General information of the study participants

A total of 647 patients with breast cancer undergoing chemotherapy were included in this study, with an average age of 48.11 ± 9.97 years. The proportion of married patients was highest (93.8%). Most participants had no religious beliefs (91.7%). The most common educational level was junior high school (31.5%) and primary school or lower (25.3%). The average monthly household income was < 3000 yuan (51.2%). The vast majority of patients lived with their families (94.3%). Occupational status was mainly unemployed or retired (64.6%). Most patients lived in rural or township areas (69.9%). Most patients (87.2%) had a body mass index < 28.0. The top three chemotherapy-related adverse reactions were nausea (60.1%), loss of appetite (57.8%), and vomiting (48.2%). The general demographic and disease-related information of the study participants is shown in Table 1.

Descriptive statistics and correlation analysis of variables

Among the 647 participants with breast cancer, 233 (36.0%) reported depressive symptoms, 419 (64.8%) had low self-efficacy, and 343 (53.0%) felt a lack of social support. Table 2 lists the main study variables. Spearman's correlation analysis results showed that the social support scores of patients with breast cancer during chemotherapy were significantly positively correlated with self-efficacy scores ($r = 0.407$, $P < 0.001$), negatively correlated with depression and body image scores ($r = -0.229, -0.239$, $P < 0.001$), negatively correlated with self-efficacy scores ($r = -0.436$, $P < 0.001$), positively correlated with body image scores ($r = 0.432$, $P < 0.001$), and negatively correlated with body image scores ($r = -0.296$, $P < 0.001$) Table 2.

Chain mediation model analysis

The Mplus 8.3 software was used to build the chain mediation model, and the results showed good model fit, with χ^2/df = 4.55 (< 5), CFI = 0.985 (> 0.950), TLI = 0.971 (> 0.950), RMSEA = 0.074 (< 0.08), and SRMR = 0.021 (< 0.08). As shown in Fig. 3, the path analysis in the model indicated that social support during chemotherapy negatively predicted depression ($\beta = -0.194$, $P < 0.001$) and body image ($\beta = -0.124$, $P < 0.05$), and positively predicted self-efficacy ($\beta = 0.357$, $P < 0.001$)

Table 1
General demographic and disease-related information ($N = 647$).

Variant	n	%
Age (years, mean ± SD)	48.11	9.97
Marital status		
Married	607	93.8
Unmarried/Widowed/Divorced	40	6.2
Religious belief		
Absent	593	91.7
Present	54	8.3
Education level		
Primary and below	164	25.3
Junior high school	204	31.5
Senior high school	133	20.6
University and above	146	22.6
Monthly per capita household income (yuan)		
≤ 3000	331	51.2
> 3000	316	48.8
Lifestyle		
Living with family	610	94.3
Living alone or otherwise	37	5.7
Occupational status		
Incumbency	229	35.4
Unemployed or retired	418	64.6
Current address		
Municipalities	195	30.1
Township or rural	452	69.9
Body mass index (kg/m²)		
< 28.0	564	87.2
≥ 28.0	83	12.8
Adverse reactions to chemotherapy (multiple choice)		
Vomiting	312	48.2
Nausea	389	60.1
Loss of appetite	374	57.8
Canker sore	171	26.4
Pruritus	229	35.4

Table 2
Descriptive statistics and correlation analysis of variables ($N = 647$).

	Median (25–75 percentile)	Social support	Depression	Self-efficacy	Body image
Social support	49.64 (44.46–58.31)	1.000			
Depression	50.64 (39.85–58.34)	−0.229[a]	1.000		
Self-efficacy	47.75 (44.04–55.18)	0.407[a]	−0.436[a]	1.000	
Body image	50.19 (43.21–55.74)	−0.239[a]	0.432[a]	−0.296[a]	1.000

[a] $P < 0.001$.

0.001); depression negatively predicted self-efficacy ($\beta = -0.379$, $P < 0.001$) and positively predicted body image ($\beta = 0.336$, $P < 0.001$); and self-efficacy negatively predicted body image ($\beta = -0.131$, $P < 0.01$).

Chain mediation effect test

Furthermore, a bias-corrected bootstrap test for mediation effects was performed with 2000 re-samples, and the 95% CI for each path did not include 0, indicating significant mediation effects. As shown in Table 3, the total effect of social support on body image was significant [$\beta = -0.361$, 95% CI (−0.484, −0.246), $P < 0.001$]; the indirect effect of social support on body image, namely the mediation effect of depression and self-efficacy, was significant [$\beta = -0.058$, 95% CI (−0.083, −0.040), $P < 0.001$]. The direct effect of social support on body image was also significant [$\beta = -0.159$, 95% CI (−0.275, −0.034), $P < 0.05$]. Thus, this model is a partial mediation model.

Discussion

The results of this study validated the initial research hypotheses, demonstrating that social support, depression, and self-efficacy are
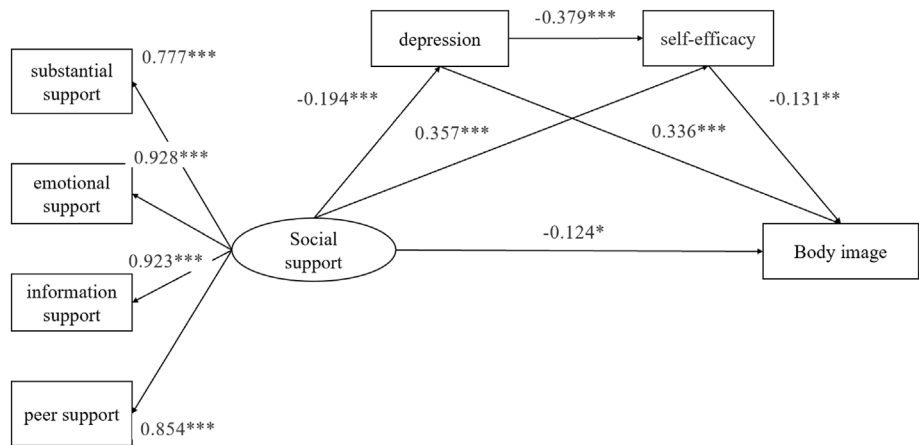
Fig. 3. Chain mediation model. *$P < 0.05$, **$P < 0.01$, ***$P < 0.001$.

Table 3
Bootstrap analysis of mediation effect significance.

Path Correlation	Effect value	SE	t	Bootstrap CI (95%)	Effect size
Total effect					
SS → BI	−0.361	0.062	−5.794[c]	(−0.484, −0.246)	
Indirect effect					
SS → DE →BI	−0.084	0.026	−3.284[c]	(−0.141, −0.040)	23.27%
SS → SE → BI	−0.060	0.023	−2.561[b]	(−0.112, −0.018)	16.62%
SS → DE → SE → BI	−0.058	0.011	−5.281[c]	(−0.083, −0.040)	16.07%
Direct effect					
SS → BI	−0.159	0.049	−2.526[a]	(−0.275, −0.034)	44.04%
Total indirect effect	−0.202	0.042	−4.865[c]	(−0.292, −0.127)	55.96%

SS, social support; BI, body image; DE, depression; SE, self-efficacy; SE, standard error; CI, confidence interval; effect size, effect value/total effect value.

[a] $P < 0.05$.
[b] $P < 0.01$.
[c] $P < 0.001$.

significantly associated with the body image perception of patients with breast cancer during chemotherapy. Mediation tests revealed significant mediating effects of depression and self-efficacy on the relationship between social support and body image in these patients, including three pathways: mediation of depression, mediation of self-efficacy, and mediation of depression and self-efficacy.

The study found that social support has a direct predictive effect on the body image of patients with breast cancer during chemotherapy, indicating that higher levels of social support are associated with better body image perception, which is consistent with previous research[38] and confirms Hypothesis 1. This may be due to the following reasons: first, social support, by providing tangible help and peer support, positively affects the psychological state and coping abilities of patients during chemotherapy;[38] second, social support offers emotional comfort and informational guidance, helping patients better understand and accept their bodily changes, which contributes to the establishment of a positive self-image;[16] moreover, in groups with high levels of social support, the release of oxytocin in the neurohypophysis increases, promoting social connections and emotional support, which helps patients establish and maintain positive social relationships and enhances their sense of social belonging.[39] In summary, social support is crucial to the psychological state of patients with breast cancer during chemotherapy and helps improve their body image. Therefore, medical staff should pay attention to its role in maintaining patients' psychological states; encourage

patients to strengthen connections with family, friends, communities, and medical teams; and enhance the social support network through emotional and practical support to improve psychological states.

Depression mediates the relationship between social support and body image in patients with breast cancer during chemotherapy, which is consistent with previous studies on the positive impact of social support on patients' psychological states[21] and the negative correlation between depression and body image in cancer patients.[7] The HNC concept model proposed by Henry et al.[22,40] emphasizes the complexity of body image issues, suggesting that their severity is influenced by physiological, psychological, and social factors. The self-reported results of this study showed that 36% of the patients had depressive symptoms, which is consistent with the finding that body image issues immediately after treatment were significantly related to depressive symptoms and unmet support needs during the same period.[32,41] Longitudinal studies[7,31] have confirmed that depression is a risk factor for poor body image. Cross-sectional studies[42] show that patients with body image issues are three times more likely to experience moderate depression. The reasons might be as follows: cross-sectional studies exclude early determinants of body image issues, however, this fully illustrates the complex bidirectional relationship between depression and body image, indicating that the association between the two is not a one-way causal relationship. In this context, medical staff should pay great attention to depressive emotions in patients with breast cancer, and assess and intervene in a timely manner. Providing social support and psychological interventions helps patients reduce depression, thereby improving their body image.

Self-efficacy also partially mediates the relationship between social support and body image. When social support levels increase, patients' self-efficacy strengthens and their psychological state improves, which is consistent with the study by Wang et al.[43] Social support provides the necessary information and resources, promotes positive coping strategies, and helps improve patients' self-efficacy.[26,44] High self-efficacy can enhance the social adaptability of patients with breast cancer during chemotherapy, helping them cope more effectively with the physical and psychological challenges of the chemotherapy process, thereby improving body image.[24] Social support encourages patients to internalize their beliefs and abilities, that is, self-efficacy, which, in turn, affects their perceptions and coping mechanisms, thus affecting their psychological state and body image. Therefore, medical staff should provide supportive mental health consultations or lectures to help patients improve their self-efficacy, establish positive self-perceptions and coping strategies, thereby improving their body image.

This study also found that depression and self-efficacy played a chain-mediating role between social support and body image in patients with breast cancer during chemotherapy. Social support is crucial for alleviating depressive symptoms and enhancing self-efficacy, which in turn promotes improvement in patients' body image perception. Studies have

shown that the enhancement of social support is closely related to the alleviation of depressive symptoms, and these two changes are closely related to the enhancement of self-efficacy, especially the impact of depression on self-efficacy, which is consistent with the results of Qian et al.[45] Manne et al.[46] also showed that by meeting patients' needs for information and support, alleviating depressive symptoms, and providing skill training and support, self-efficacy can be effectively enhanced. In patients with breast cancer, a lack of social support may lead to increased depressive symptoms,[42] which in turn reduces self-efficacy;[47] these psychological factors further affect patients' perceptions and evaluations of their own body image.[24] In addition, patients with breast cancer patients must bear family and social responsibilities during their illness, and the degree of social support directly affects their emotional state and self-efficacy, thereby affecting their body image perceptions.[44] Overall, a lack of social support affected the body image of patients with breast cancer during chemotherapy through the pathways of depression and self-efficacy. Therefore, medical staff should pay attention to the role of depression and self-efficacy in the body image levels of patients with breast cancer during chemotherapy and help patients improve their psychological state and increase body image levels by identifying, intervening, and establishing support networks.

While this study has yielded significant findings, several factors may influence the results and conclusions. Firstly, although the large sample size enhanced statistical power, it might have led to an overestimation of effect significance, thereby complicating the interpretation of the results. Future research should adopt more precise sample size calculations based on effect size and specific research objectives to enhance the practical applicability of the conclusions. Secondly, despite strict adherence to ethical guidelines and obtaining informed consent from all participants, the sensitivity surrounding body image among breast cancer patients could have induced psychological stress, potentially compromising data authenticity. To mitigate these effects, future studies should prioritize emotional support and psychological counseling, particularly for patient groups undergoing chemotherapy or facing greater psychological burdens, ensuring both their psychological well-being and data reliability. Additionally, the lack of stratified analysis in this study precluded a deeper exploration of differences between various patient groups (e.g., age, treatment stage, cultural background). Considering individual patient variations, future research should incorporate stratified analyses to investigate the dynamic interplay between social support, depression, self-efficacy, and body-mind image, providing more targeted recommendations for personalized interventions.

Limitations and future directions

The limitations of this study are as follows: (1) This is a cross-sectional survey and cannot examine the long-term changes and causal relationships between social support and body image. Owing to the inability to track changes in the variables over time, the research results can only reflect the current state. Future studies should use longitudinal designs to reveal the causal relationships and trends between these variables at different time points. (2) Although this study adopted a multicenter design, the sample may have regional biases, which may affect the wide applicability of the results. To further verify the research conclusions, future studies should use random sampling methods to improve the representativeness of the sample. (3) This study did not fully consider other factors that may affect body image, such as cultural background and personality traits. Studies have shown that these factors may moderate or mediate the relationship between social support and body image. Therefore, future studies should consider these factors comprehensively to better understand the mechanism by which social support affects body image. (4) To maintain the homogeneity of the research subjects, the original data source of this study focused on patients with breast cancer patients undergoing chemotherapy. Different treatment methods may have different impacts on patients'

body image; therefore, in future studies, we will expand the sample scope to include other treatment types to explore their impacts on the variable pathways; (5) Owing to the high number of missing values for the cancer staging variable in the original data source of this study, the variable was deleted, which is a major limitation of this study. In future, we plan to add this variable to further verify the accuracy of the study's conclusions and reduce potential biases.

Implications for clinical care

This study has important theoretical and practical significance for improving the body image of patients with breast cancer during chemotherapy and provides valuable information for developing effective intervention strategies. Understanding the psychological mechanisms of patients with breast cancer during chemotherapy is crucial for improving their body image by alleviating depressive emotions and enhancing self-efficacy. This study expands the understanding of potential factors affecting the body image of patients with breast cancer during chemotherapy and reveals effective ways to improve body image perceptions. These findings provide a valuable basis for the development of effective clinical intervention strategies. Therefore, clinical and medical staff should help patients make full use of social support resources, improve their mental health, provide interventions to enhance self-efficacy and improve their cognition of body image.

Conclusions

In summary, this study found that social support was negatively correlated with depressive emotions and body image in patients with breast cancer during chemotherapy and positively correlated with self-efficacy. Specifically, social support had a significant direct impact on body image, whereas depressive emotions and self-efficacy partially mediated the relationship between social support and body image. In addition, the chain-mediating roles of depression and self-efficacy in the relationship between social support and body image in patients with breast cancer during chemotherapy were significant. The findings of this study provide important theoretical support for an in-depth understanding of how social support affects the mental health of patients with breast cancer during chemotherapy, and provide a direction for future clinical intervention research.

CRediT author contributions statement

Xiaoyan Yu: Conceptualization, Methodology, Data curation, Formal analysis, Software, Validation, Visualization, Writing - Original draft preparation. **Qingmei Huang**: Conceptualization, Methodology, Data curation, Formal analysis, Software, Validation, Visualization, Writing - Reviewing and Editing. **Yang Yang**: Collect and verify data, Review & editing. **Ling Wang**: Collect and verify data, Review & editing. **Fulei Wu**: Collect and verify data, Review & editing. **Yuanqi Ding**: Collect and verify data, Review & editing. **Xuqian Zong**: Collect and verify data, Review & editing. **Anni Wang**: Collect and verify data, Review & editing. **Changrong Yuan**: Supervision, Methodology, Review & editing. All authors had full access to all the data in the study, and the corresponding author had final responsibility for the decision to submit for publication. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

Ethics statement

References

1. Siegel RL, Giaquinto AN, Jemal A. Cancer statistics, 2024. *CA Cancer J Clin*. 2024;74(1):12–49. https://doi.org/10.3322/caac.21820.
2. Bray F, Laversanne M, Sung H, et al. Global cancer statistics 2022: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *Ca Cancer J Clin*. 2024;74(3):229–263. https://doi.org/10.3322/caac.21834.
3. Kocan S, Aktug C, Gursoy A. "Who am I?" A qualitative meta-synthesis of Chemotherapy-induced alopecia and body image perception in breast cancer patients. *Support Care Cancer*. 2023;31(4):237. https://doi.org/10.1007/s00520-023-07704-8.
4. Cash TF. Body image: past, present, and future. *Body Image*. 2004;1(1):1–5. https://doi.org/10.1016/S1740-1445(03)00011-1.
5. Runowicz CD, Leach CR, Henry NL, et al. American cancer society/American society of clinical oncology breast cancer survivorship care guideline. *Ca Cancer J Clin*. 2016;66(1):43–73. https://doi.org/10.3322/caac.21319.
6. Ma D, Cheng K, Du H. Influencing factors of body image dissatisfaction of breast cancer patients. *Modern clinical care*. 2020;19(6):7–11. https://doi.org/10.3969/j.issn.1671-8283.2020.06.002.
7. Moreira H, Canavarro MC. A longitudinal study about the body image and psychosocial adjustment of breast cancer patients during the course of the disease. *Eur J Oncol Nurs*. 2010;14(4):263–270. https://doi.org/10.1016/j.ejon.2010.04.001.
8. Budzisz A, Jung A, Adamczyk WM, et al. Body image measured via the Fremantle Awareness Questionnaire in individuals with and without pain: a systematic review and meta-analysis. *J Pain*. 2024:104530. https://doi.org/10.1016/j.jpain.2024.104530.
9. Aquil A, El KO, El AN, et al. Body image dissatisfaction and lower self-esteem as major predictors of poor sleep quality in gynecological cancer patients after surgery: cross-sectional study. *BMC Womens Health*. 2021;21(1):229. https://doi.org/10.1186/s12905-021-01375-5.
10. Rosenberg SM, Dominici LS, Gelber S, et al. Association of breast cancer surgery with quality of life and psychosocial well-being in young breast cancer survivors. *Jama Surg*. 2020;155(11):1035–1042. https://doi.org/10.1001/jamasurg.2020.3325.
11. He C, Wu C, Yang T, et al. Trajectories and predictors of social avoidance in female patients with breast cancer. *Front Psychiatr*. 2022;13:1051737. https://doi.org/10.3389/fpsyt.2022.1051737.
12. Spatuzzi R, Vespa A, Lorenzi P, et al. Evaluation of social support, quality of life, and body image in women with breast cancer. *Breast Care*. 2016;11(1):28–32. https://doi.org/10.1159/000443493.
13. Ettridge K, Scharling-Gamba K, Miller C, Roder D, Prichard I. Body image and quality of life in women with breast cancer: appreciating the body and its functionality. *Body Image*. 2022;40:92–102. https://doi.org/10.1016/j.bodyim.2021.11.001.
14. Paterson CL, Lengacher CA, Donovan KA, Kip KE, Tofthagen CS. Body image in younger breast cancer survivors: a systematic review. *Cancer Nurs*. 2016;39(1):E39–E58. https://doi.org/10.1097/NCC.0000000000000251.
15. Hupcey JE. Clarifying the social support theory-research linkage. *J Adv Nurs*. 1998;27(6):1231–1241. https://doi.org/10.1046/j.1365-2648.1998.01231.x.
16. Doori Z, Hekmat K, Mousavi P, Latifi SM, Shahbazian H. Investigation of the relationship between perceived social support and body image in women with breast cancer. *Middle East Current Psychiatry*. 2022;29(1). https://doi.org/10.1186/s43045-021-00165-x.
17. Liu Y, Liu W, Ma Y, et al. Research on body image cognition, social support and illness perception in breast cancer patients with different surgical methods. *Front Psychol*. 2022;13:931679. https://doi.org/10.3389/fpsyg.2022.931679.
18. Javan BA, Raoofi S, Rafiei S, et al. Global depression in breast cancer patients: systematic review and meta-analysis. *PLoS One*. 2023;18(7):e0287372. https://doi.org/10.1371/journal.pone.0287372.
19. Hammen C. Stress generation in depression: reflections on origins, research, and future directions. *J Clin Psychol*. 2006;62(9):1065–1082. https://doi.org/10.1002/jclp.20293.
20. Fang SY, Chang HT, Shu BC. Objectified body consciousness, body image discomfort, and depressive symptoms among breast cancer survivors in taiwan. *Psychol Women Quart*. 2014;38(4):563–574. https://doi.org/10.1177/0361684314552652.
21. Zamanian H, Amini-Tehrani M, Jalali Z, et al. Perceived social support, coping strategies, anxiety and depression among women with breast cancer: evaluation of a mediation model. *Eur J Oncol Nurs*. 2021;50:101892. https://doi.org/10.1016/j.ejon.2020.101892.
22. Henry M, Albert JG, Frenkiel S, et al. Body image concerns in patients with head and neck cancer: a longitudinal study. *Front Psychol*. 2022;13:816587. https://doi.org/10.3389/fpsyg.2022.816587.
23. Effa CJ, Dolgoy ND, McNeely ML. Resistance exercise and art therapy on body image in breast cancer: a scoping review. *Womens Health Rep (New Rochelle)*. 2020;1(1):424–435. https://doi.org/10.1089/whr.2020.0058.
24. Arikan F, Körükçü Ö, Küçükçakal A, ˇCoşkun H. Determination of self-efficacy, body image and sexual adjustment of women with breast cancer. *Eur J Breast Health*. 2020;16(4):282–289. https://doi.org/10.5152/ejbh.2020.5188.
25. Bandura A. Self-efficacy: toward a unifying theory of behavioral change. *Psychol Rev*. 1977;84(2):191–215. https://doi.org/10.1037//0033-295x.84.2.191.
26. Huang Q, Wu F, Zhang W, Stinson J, Yang Y, Yuan C. Risk factors for low self-care self-efficacy in cancer survivors: application of latent profile analysis. *Nurs Open*. 2022;9(3):1805–1814. https://doi.org/10.1002/nop2.926.
27. Bandura A, Locke EA. Negative self-efficacy and goal effects revisited. *J Appl Psychol*. 2003;88(1):87–99. https://doi.org/10.1037/0021-9010.88.1.87.
28. Bandura A. On the functional properties of perceived self-efficacy revisited. *J Manag*. 2012;38(1):9–44. https://doi.org/10.1177/0149206311410606.
29. Vilardaga J, Fisher HM, Winger JG, et al. Pain, depressive symptoms, and self-efficacy for pain management: examination in African-American women with breast cancer. *Support Care Cancer*. 2022;30(8):6633–6640. https://doi.org/10.1007/s00520-022-07083-6.
30. Bandura A. Human agency in social cognitive theory. *Am Psychol*. 1989;44(9):1175–1184. https://doi.org/10.1037/0003-066x.44.9.1175.
31. Song L, Pang Y, Zhang J, Tang L. Body image in colorectal cancer patients: a longitudinal study. *Psychooncology*. 2021;30(8):1339–1346. https://doi.org/10.1002/pon.5688.
32. Galiano-Castillo N, Ariza-García A, Cantarero-Villanueva I, Fernández-Lao C, Díaz-Rodríguez L, Arroyo-Morales M. Depressed mood in breast cancer survivors: associations with physical activity, cancer-related fatigue, quality of life, and fitness level. *Eur J Oncol Nurs*. 2014;18(2):206–210. https://doi.org/10.1016/j.ejon.2013.10.008.
33. Huang Q, Zong X, Yuan C, et al. Risk factors for self-reported high symptom cluster burdens in patients with breast cancer undergoing chemotherapy in China: a cross-sectional study. *Health Sci Rep*. 2024;7(6):e2188. https://doi.org/10.1002/hsr2.2188.
34. The society of breast cancer China anti-cancer association, breast oncology group of the oncology branch of the Chinese medical association. Guidelines for breast cancer diagnosis and treatment by China anti-cancer association (2024 edition). *China Oncology*. 2023;33(12):1092–1186. https://doi.org/10.19401/j.cnki.1007-3639.2023.12.004.
35. Wu F. *The Development of a Phase-specific Patient-Reported Outcomes Measurement System-Breast Cancer [dissertation]*. Second Military Medical University; 2019.
36. Wang Y, Wen Z, Li W, Fang J. Methodological research and model development on structural equation models in China's mainland from 2001 to 2020. *Adv Psychol Sci*. 2022;30(8):1715–1733.
37. Podsakoff PM, MacKenzie SB, Lee JY, Podsakoff NP. Common method biases in behavioral research: a critical review of the literature and recommended remedies. *J Appl Psychol*. 2003;88(5):879–903. https://doi.org/10.1037/0021-9010.88.5.879.
38. Finck C, Barradas S, Zenger M, Hinz A. Quality of life in breast cancer patients: associations with optimism and social support. *Int J Clin Hlth Psyc*. 2018;18(1):27–34. https://doi.org/10.1016/j.ijchp.2017.11.002.
39. Riem M, Kunst LE, Kop WJ. Intranasal oxytocin and the stress-buffering effects of social support during experimentally induced pain: the role of attachment security. *J Affect Disord*. 2021;278:149–156. https://doi.org/10.1016/j.jad.2020.09.057.
40. Albert JG, Lo C, Rosberger Z, et al. Biopsychosocial markers of body image concerns in patients with head and neck cancer: a prospective longitudinal study. *Curr Oncol*. 2022;29(7):4438–4454. https://doi.org/10.3390/curroncol29070353.
41. Aguilar Cordero MJ, Mur Villar N, Neri Sanchez M, Pimentel-Ramirez ML, Garcia-Rillo A, Gomez Valverde E. Breast cancer and body image as a prognostic factor of depression: a case study in Mexico City. *Nutr Hosp*. 2014;31(1):371–379. https://doi.org/10.3305/nh.2015.31.1.7863.
42. Li M. Associations of body image with depressive symptoms and PTG among breast cancer patients: the mediating role of social support. *Front Psychol*. 2022;13:953306. https://doi.org/10.3389/fpsyg.2022.ˆ953306.
43. Wang L, Luo J, Li Y, Zhou Y, Wang W. Social support, anxiety, and depression in patients with prostate cancer: complete mediation of self-efficacy. *Support Care Cancer*. 2022;30(8):6851–6856. https://doi.org/10.1007/s00520-022-07065-8.
44. Geng Z, Ogbolu Y, Wang J, Hinds PS, Qian H, Yuan C. Gauging the effects of self-efficacy, social support, and coping style on self-management behaviors in Chinese cancer survivors. *Cancer Nurs*. 2018;41(5):E1–E10. https://doi.org/10.1097/NCC.0000000000000571.
45. Qian H, Yuan C. Factors associated with self-care self-efficacy among gastric and colorectal cancer patients. *Cancer Nurs*. 2012;35(3):E22–E31. https://doi.org/10.1097/NCC.0b013e31822d7537.
46. Manne SL, Hudson SV, Kashy DA, et al. Self-efficacy in managing post-treatment care among oral and oropharyngeal cancer survivors. *Eur J Cancer Care*. 2022;31(6):e13710. https://doi.org/10.1111/ecc.13710.
47. Gu Z, Li M, Liu L, Ban Y, Wu H. The moderating effect of self-efficacy between social constraints, social isolation, family environment, and depressive symptoms among breast cancer patients in China: a cross-sectional study. *Support Care Cancer*. 2023;31(10):594. https://doi.org/10.1007/s00520-023-08063-0.