

Potential Impact of Walking Activity on Emotional Health in Breast Cancer Patients: A Study on the Mediating Role of Different Dimensions of Post-Traumatic Growth (Postprint)

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Abstract

Objective Breast cancer has become the cancer with the highest incidence rate globally. Breast cancer not only causes physical suffering for patients but also creates heavy psychological pressure. Although existing studies have shown that physical activity promotes emotional health in breast cancer patients, the underlying psychological mechanisms remain to be elucidated. This study examined the relationship between walking activity and positive and negative emotions in breast cancer patients and explored the potential mediating effects of different dimensions of post-traumatic growth. Methods Through a cross-sectional questionnaire survey of breast cancer patients (n=235) in the Pengpu Xincun community of Shanghai, patients' walking activity levels, five dimensions of post-traumatic growth, and positive and negative emotional intensity were assessed. A structural equation model was used to test the parallel mediating role of different dimensions of post-traumatic growth. Results The parallel mediation model showed good fit, $\chi^2(20)=28.11$, $P=0.11$, CFI=0.99, TLI=0.98, RMSEA=0.04, PRMSEA<0.05=0.61. Walking activity promoted positive emotions in breast cancer patients by facilitating the personal strength dimension of post-traumatic growth, with an indirect effect of 0.07 (95%CI[0.02, 0.13]); walking activity reduced negative emotions by facilitating the appreciation of life dimension, with an effect of -0.13 (95%CI[-0.21,-0.05]). Conclusion Post-traumatic growth plays a mediating role in the effect of walking activity on emotional health in breast cancer patients. Given that community health service institutions undertake the long-term health management of cancer patients, physicians should emphasize walking activity as one of the intervention methods to improve patients' mental health in future community health management work. Meanwhile, it is recommended to combine exercise intervention with psychological interventions that

promote post-traumatic growth to enhance the intervention effect on patients' mental health.

Full Text

The Potential Effect of Walking Activity on Emotional Health Among Breast Cancer Survivors: The Mediating Effects of Different Dimensions of Posttraumatic Growth

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Abstract

Objective: Breast cancer has become the most prevalent cancer worldwide, imposing not only physical suffering but also substantial psychological distress on patients. Although existing research demonstrates that physical activity promotes emotional health in breast cancer survivors, the underlying psychological mechanisms remain unclear. This study examined the relationship between walking activity and both positive and negative emotions among breast cancer patients, and explored the potential mediating effects of different dimensions of posttraumatic growth (PTG).

Methods: A cross-sectional survey was conducted among breast cancer patients (n=235) from the Pengpuxincun community in Shanghai, assessing walking activity levels, five dimensions of PTG, and positive and negative emotional states. Structural equation modeling was used to test the parallel mediating effects of different PTG dimensions.

Results: The parallel mediation model demonstrated good fit: $\chi^2(20)=28.11$, $P=0.11$, CFI=0.99, TLI=0.98, RMSEA=0.04, PRMSEA<0.05=0.61. Walking activity promoted positive emotions by facilitating the personal strength dimension of PTG, with an indirect effect of 0.07 (95%CI [0.02, 0.13]). Walking activity reduced negative emotions by enhancing the appreciation of life dimension, with an effect of -0.13 (95%CI [-0.21, -0.05]).

Conclusions: PTG plays a mediating role in the effect of walking activity on emotional health among breast cancer patients. Given that community health service institutions bear responsibility for long-term health management of cancer patients, clinicians should consider walking activity as an intervention to

improve patients' psychological health in future community health management efforts. Additionally, exercise interventions should be combined with psychological interventions that promote PTG to enhance intervention effectiveness.

Keywords: physical activity; breast cancer; emotional health; post-traumatic growth; mediating effect

Introduction

According to the GLOBOCAN 2020 database, breast cancer has become the most prevalent cancer globally. In 2020, China accounted for 18.4% of new breast cancer cases and 17.1% of breast cancer-related deaths worldwide, making the prognosis of Chinese breast cancer patients crucial to the global disease burden. From diagnosis through treatment to long-term survivorship, breast cancer patients face multiple stressors, including physical symptom burden, financial pressure, interpersonal difficulties, and fear of recurrence. These stressors can lead to psychological disorders such as depression and anxiety, affecting patients' quality of life and cancer prognosis.

Numerous recent studies have shown that exercise interventions effectively alleviate emotional distress in cancer patients, providing strength and support while promoting healthy lifestyles and disease recovery. However, the underlying psychosocial mechanisms through which exercise influences emotional health in cancer patients lack empirical investigation. Elucidating these mechanisms is essential for developing targeted and effective exercise intervention models.

Posttraumatic growth (PTG) refers to positive psychological changes experienced during the process of coping with trauma-related stress. PTG encompasses five dimensions: improved relationships, new possibilities, personal strength, spiritual change, and appreciation of life. The DSM-IV has classified life-threatening diseases, including cancer, as major traumatic stressors. The diagnosis and lengthy treatment of cancer undoubtedly impose tremendous physical and psychological pressure on patients. However, some patients experience positive psychological changes through their struggle with illness. For example, some patients gradually realize their inner strength and develop confidence in facing difficulties, experience stronger relationships with family and friends, and develop greater appreciation for life's preciousness. A meta-analysis found that PTG in cancer patients positively correlates with positive emotions and quality of life, and negatively correlates with depressive symptoms, suggesting that PTG has positive implications for improving patients' physical and mental health.

Physical activity may improve emotional health by promoting patients' intimate relationships, appreciation for present life, and affirmation of self-worth. Through physical activity, patients can gradually recognize their ability to overcome various physical functional disorders after treatment, regain a sense of

bodily control, and cope with life challenges, thereby fostering positive psychological growth. A meta-analysis indicated that physical activity can promote psychological growth by influencing individuals' cognitive, emotional, and interpersonal interactions regarding traumatic events. Based on this empirical evidence, PTG may be an important underlying psychological mechanism through which physical activity promotes emotional health in cancer patients.

Given that breast cancer patients often experience fatigue, pain, and shoulder-arm functional limitations due to surgery and systemic treatments (e.g., chemotherapy, radiotherapy, targeted therapy), common professional exercise interventions (such as yoga and resistance training) may not be suitable for most patients. Therefore, this study focused on relatively flexible and simple walking activity. Using community-based breast cancer patients as participants and cross-sectional survey data, we analyzed the effect of walking activity on emotional health and explored the potential mediating effects of different PTG dimensions (see the hypothesized model in [Figure 1: see original paper]).

[Figure 1: see original paper]

Methods

1.1 Study Participants

This study used convenience sampling to conduct household surveys among breast cancer patients under community management at the Pengpuxincun Community Health Service Center in Shanghai from April to July 2019. Inclusion criteria were: (1) histologically confirmed breast cancer at pathological stages 0-4; (2) age ≥ 18 years. Exclusion criteria were: (1) severe mental illness or cognitive dysfunction; (2) insufficient language comprehension despite repeated explanations. The study was approved by the Public Health and Nursing Research Ethics Committee of Shanghai Jiao Tong University School of Medicine (Approval No.: SJUPN-201915).

A total of 256 patients were recruited, with 235 completing the questionnaire (response rate: 91.8%). Participants ranged in age from 32 to 97 years (mean=64.20, SD=10.85). Most were married (91.9%) and currently unemployed or retired (95.7%). 47.3% had high school education or higher. Tumor stages ranged from 0 to IV, with an average time since diagnosis of 9.18 years. Detailed demographic and clinical characteristics are presented in .

1.2 Measures

Walking Activity: Walking activity levels were assessed using the Chinese version of the International Physical Activity Questionnaire-Long Form (IPAQ-long)[12]. This questionnaire measures walking, moderate-intensity, and vigorous-intensity physical activity across four life domains: work, transportation, household chores, and leisure-time activities. For each domain, participants reported the total time spent in specific intensity activities during

the past 7 days. The primary independent variable was the total time spent in walking activities during the past 7 days.

Posttraumatic Growth: PTG was measured using the Posttraumatic Growth Inventory-Short Form (PTGI-SF)[13]. The scale comprises 10 items assessing the degree of psychological growth across five dimensions: relationships with others, personal strength, new possibilities, spiritual change, and appreciation of life. A 6-point Likert scale (0= “no growth” to 5= “very great growth”) was used, with higher scores indicating greater growth in each dimension.

Emotional Health: Emotional health was assessed using the 20-item Positive and Negative Affect Scale (PANAS)[14]. The scale includes two factors: positive affect (PA) and negative affect (NA), each with 10 items. The PA factor consists of 10 adjectives describing positive emotions (e.g., enthusiastic), while the NA factor includes 10 adjectives describing negative emotions (e.g., nervous). Items were rated on a 5-point scale (1= “very slightly or not at all” to 5= “extremely”), with higher scores indicating greater intensity of the corresponding emotion.

1.3 Data Analysis

SPSS 26.0 was used for descriptive statistics and correlation analysis. Correlation analysis included: (1) Pearson correlations to examine relationships among main study variables; and (2) correlations between demographic/clinical characteristics and outcome variables (positive and negative emotion scores) to identify potential covariates. Mplus 8.3 was used for structural equation modeling to test the mediating effects of the five PTG dimensions on the relationship between walking activity and emotional outcomes. Model fit was evaluated using chi-square goodness-of-fit, Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and Root Mean Square Error of Approximation (RMSEA). Mediation effects were tested using bootstrap methods, with bias-corrected 95% confidence intervals excluding zero indicating significant mediation.

Results

2.1 Descriptive Statistics and Correlation Analysis

Means, standard deviations, and correlations among study variables are presented in . Walking activity level was positively correlated with four PTG dimensions (excluding spiritual change). Due to the non-significant correlation between walking activity and spiritual change, this dimension was excluded from the mediation model following Hayes’ recommendations[15]. Although walking activity was negatively correlated with negative emotion scores and showed non-significant correlation with positive emotion scores, we could not rule out its total effect on positive emotions[15,16]; therefore, both positive and negative emotions remained as outcome variables in the mediation model. The five PTG dimensions were positively correlated with each other, while positive and negative emotions were not significantly correlated.

Covariate analysis revealed that time since diagnosis ($r=0.13$; $P<0.05$), previous surgery ($r=-0.13$; $P<0.05$), and chemotherapy ($r=-0.15$; $P<0.05$) were significantly correlated with negative emotion scores, while marital status ($r=0.16$; $P<0.05$) was significantly correlated with positive emotion scores. Therefore, these variables were controlled in the structural equation model. Although cancer stage was not significantly correlated with either positive or negative emotions in this sample, it was included as a covariate given previous literature reporting associations between cancer stage and negative emotions. Additionally, to exclude the influence of moderate and vigorous physical activity on emotional health, these variables were also controlled in the model.

2.2 Structural Equation Model

The model demonstrated good fit: $\chi^2(20)=28.11$, $p=0.11$, CFI=0.99, TLI=0.98, RMSEA=0.04, PRMSEA<0.05=0.61. As shown in , the total indirect effect of walking activity on positive emotions was significant (effect=0.17, 95%CI [0.07, 0.27]). The mediating effect through the personal strength dimension was significant (effect=0.07, 95%CI [0.02, 0.13]), while effects through interpersonal relationships, new possibilities, and appreciation of life were not significant. After controlling for the mediating effect of personal strength, the direct effect of walking activity on positive emotions was no longer significant.

As shown in , the total and direct effects of walking activity on negative emotions were not significant, but the total indirect effect was significant (effect=-0.12, 95%CI [-0.19, -0.05]). The mediating effect through appreciation of life was significant (effect=-0.13, 95%CI [-0.21, -0.05]), while effects through interpersonal relationships, personal strength, and new possibilities were not significant. After controlling for the mediating effect of appreciation of life, the direct effect of walking activity on negative emotions was no longer significant.

The final model is illustrated in [Figure 2: see original paper]. Walking activity promoted positive emotions by enhancing the personal strength dimension of PTG ($\beta=0.21$, $P<0.01$), which in turn increased positive emotions ($\beta=0.34$, $P<0.01$). Additionally, walking activity reduced negative emotions by enhancing the appreciation of life dimension ($\beta=0.35$, $P<0.01$), which in turn decreased negative emotions ($\beta=-0.37$, $P<0.01$).

[Figure 2: see original paper]

Discussion

This study examined the effects of walking activity on emotional health among breast cancer patients and the mediating role of different PTG dimensions. After controlling for the effects of moderate and vigorous physical activity, results showed that walking activity promoted positive emotions through the personal strength dimension and reduced negative emotions through the appreciation of life dimension.

The beneficial effects of physical activity on emotional health in cancer patients have been demonstrated in numerous intervention studies. However, the underlying psychosocial mechanisms remain unclear. The uncertainty following a cancer diagnosis, combined with physical symptom burden and treatment side effects, often undermines breast cancer patients' self-confidence and sense of self-worth. Walking activity may facilitate the reconstruction of self-concept and promote positive psychological growth, thereby improving emotional health. A systematic review integrating qualitative and quantitative studies found that physical activity can promote PTG among individuals who have experienced traumatic events. Compared to disease progression, which is often beyond personal control, patients can more easily achieve a sense of accomplishment, self-worth, and control over their lives through physical activity, thereby affirming their inner strength and confidence to combat disease. Our findings support this literature. In this study, walking activity was significantly positively correlated with four PTG dimensions (excluding spiritual change). The non-significant correlation with spiritual change may be attributed to cultural sensitivity, as this dimension primarily reflects changes in religious beliefs with distinct Western cultural characteristics that may not be as applicable in the Chinese context, potentially affecting measurement validity.

The parallel mediation model results support our hypotheses, demonstrating that specific PTG dimensions mediate the relationship between walking activity and emotional health. Specifically, walking activity promoted positive emotions through the personal strength dimension and reduced negative emotions through the appreciation of life dimension. Through walking activity, patients may gradually recognize their personal strength to overcome post-treatment weakness and discomfort, thereby enhancing positive emotions. Additionally, outdoor walking helps patients gradually return to normal life and shift attention from illness-related suffering to daily life, fostering gratitude and appreciation for life, which helps reduce negative emotions.

These findings suggest that the psychological mechanisms through which walking activity influences positive versus negative emotions may differ. One possible explanation is that appreciation for present life may help patients cherish what they have, alleviating feelings of despair and pessimism, but may not be sufficient to significantly enhance positive emotions. In contrast, increased personal strength may more easily inspire hope and confidence for the future, thereby better promoting positive emotions. This hypothesis warrants validation in future prospective studies.

In this study, the direct effects of walking activity on both positive and negative emotions became non-significant after controlling for mediators, suggesting that PTG plays a mediating role. However, we cannot exclude other potential mechanisms. For example, research has shown that physical activity can enhance self-esteem, social support, and exercise self-efficacy, all of which are associated with emotional health. These psychological processes may also represent potential mechanisms through which physical activity improves emotions. Fu-

ture intervention studies are needed to uncover the mechanisms through which physical activity promotes emotional health in cancer patients and to clarify relationships among different mechanisms, providing a basis for developing individualized precision interventions.

This study has several limitations. First, the cross-sectional design precludes verification of causal relationships and temporal sequence; experimental studies are needed to validate model pathways. Second, walking activity was measured through self-report, which may be subject to reporting bias. Future studies should combine subjective reports with objective measures (e.g., fitness trackers, pedometers) to improve validity. Third, the sample was drawn from a single community in Shanghai; generalizability to other regions or countries requires further investigation.

Our findings have important implications for community health management and services. As breast cancer survival rates continue to improve, community healthcare providers will increasingly bear responsibility for long-term psychological and physical health management. Current exercise intervention research for cancer patients has focused primarily on modes requiring professional equipment, facilities, and guidance, such as yoga and resistance training. However, side effects from surgery and systemic treatments, along with regular chemotherapy and radiotherapy, make participation in these professional interventions difficult for many breast cancer patients. In contrast, walking activity (e.g., strolling, brisk walking) is simpler, more flexible, requires no special professional guidance, and has no special requirements for venues or equipment, making it more suitable for cancer patients undergoing treatment or in recovery. Although walking interventions for cancer patients have emerged internationally, their underlying psychosocial mechanisms remain unclear. Our findings suggest that the personal strength and appreciation of life dimensions of PTG may be potential psychological mechanisms through which walking activity promotes emotional health. Therefore, future cancer rehabilitation guidance should consider combining exercise rehabilitation with psychological support and education targeting PTG to enhance intervention effectiveness and improve patients' emotional health.

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Innovation and Clinical Value of This Study:

Current exercise intervention research for cancer patients has primarily focused on group-based modes requiring professional equipment, facilities, and instruction. However, breast cancer patients face difficulties participating in these professional interventions due to side effects from surgery and systemic treatments, as well as regular chemotherapy and radiotherapy. In contrast, walking activity (e.g., strolling, brisk walking) is simpler and more flexible, making it more suitable for cancer patients undergoing treatment or in recovery. Although walking

interventions for cancer patients have emerged internationally, their underlying psychosocial mechanisms lack empirical investigation. This study provides empirical evidence that the personal strength, new possibilities, and appreciation of life dimensions of PTG may be potential psychosocial mechanisms through which walking activity promotes emotional health. These findings provide an important basis for clinical nursing practice in providing exercise rehabilitation guidance. Future psychological intervention research and clinical cancer rehabilitation should consider walking activity as an exercise option when patients have limited physical capacity, while combining exercise rehabilitation with psychological support and education targeting PTG to enhance intervention effectiveness.

Note: Figure translations are in progress. See original paper for figures.

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