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ORIGINAL ARTICLE

Optimism outweighs neuroticism and anxiety sensitivity to predict insomnia symptoms in women after surgery for breast cancer

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Abstract

Purpose Insomnia symptoms are common among women who have undergone surgery for breast cancer. Personality traits are also believed to have an impact on sleep. However, there are no reports to address the effects of personality traits on sleep in women with breast cancer. This study examined the separate and competing roles of neuroticism, anxiety sensitivity, and optimism in predicting post-surgery insomnia symptoms.

Methods Women with breast cancer ($n = 749$) were enrolled the week prior to surgery and required to complete a demographic questionnaire, the Chinese version of Neuroticism subscale of NEO-Five Factor Inventory (CV-N-NEO-FFI), Anxiety Sensitivity Index-3 (CV-ASI-3), and Life Orientation Test-Revised (CV-LOT-R). Four weeks post-surgery, the Chinese version of Insomnia Severity Index (CV-ISI) was administered to evaluate insomnia symptoms.

Results Neuroticism ($\beta = 0.317$, $p < 0.001$), anxiety sensitivity ($\beta = 0.220$, $p < 0.001$), and optimism ($\beta = -0.332$, $p < 0.001$) could predict post-surgery insomnia symptoms. When putting them together into one stepwise regression, optimism ($\beta = -0.215$, $p < 0.001$) became the statistically most important predictor for insomnia symptoms. Optimism suppressed the predictions of insomnia symptoms provided by neuroticism ($\beta = 0.114$, $p < 0.001$) and anxiety sensitivity ($\beta = 0.079$, $p < 0.001$).

Conclusion Neuroticism and anxiety sensitivity positively predicted insomnia, but optimism negatively predicted insomnia. In particular, optimism plays a more important role in post-surgery insomnia symptoms in women with breast cancer compared to neuroticism and anxiety sensitivity. Sleep intervention in women with breast cancer should focus on enhancing their optimism level.

Keywords Breast cancer · Neuroticism · Anxiety sensitivity · Optimism · Insomnia

Introduction

Although the survival of patients with breast cancer has significantly improved due to early diagnosis and treatment, they still suffer from different degrees of psychosomatic symptoms [1–3]. Comorbid insomnia is common in patients undergoing surgery treatment for breast cancer [2–4], and over half of patients maintain a high level of insomnia for 6 months after surgery [3]. Insomnia can lead to a number of molecular, immune, and neural abnormalities [5], which may impede the recovery of patients. Although various risk factors of insomnia have been identified in breast cancer patients such as disease stage [2, 3], type of surgery [3], pain [4], and other psychosocial factors [2, 3], the roles of personality traits on insomnia have not been fully addressed.

The predictive effects of several negative oriented personality traits on insomnia, such as neuroticism and anxiety sensitivity, have been extensively studied. Neuroticism is a heritable and stable personality trait, featured by the general predisposition to negative emotional reactions. Patients with high neuroticism may have more negative cognitive activities about illness [6], which may affect the sleep quality. Moreover, neuroticism can escalate the intensity of negative emotions [7], which often intertwines deeply with insomnia

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[8]. Overall, individuals with high neuroticism are predisposed to internalize more psychological conflicts [7–9], which leads to physiological hyper-arousal and finally insomnia. Anxiety sensitivity is another similar risk personality trait associated with insomnia. Anxiety sensitivity is a dispositional trait with excessive fear of anxiety-related sensations. Patients with high anxiety sensitivity tend to interpret more physical symptoms as threatening, and thus experience uncontrollable worry and in turn insomnia [10, 11]. Studies in populations with cardiovascular disease [12] and HIV [13] have also showed that anxiety sensitivity is consistently related to sleep disturbances. In contrast, the effects of positive oriented personality traits on sleep are not widely reported in literature.

Optimism is a quintessential, positive oriented personality trait referring to positive expectations about the future. Optimists tend to have less insomnia symptoms in their whole lifespan [14–17]. Several longitudinal studies in Chinese populations demonstrated that sleep is directly or indirectly associated with optimism [16, 17]. However, it is unclear whether optimism also has positive effects on sleep in women with breast cancer. Previous studies demonstrated that breast cancer patients with more optimism experienced less negative emotions [18] and coped with a less degree of hopelessness [19], which may all help alleviate insomnia symptoms. In addition, previous studies on the effects of positive oriented personality traits in sleep did not consider the confounding effects of negative oriented personality traits. Thus, it is still unknown whether optimism is an independent determinant of insomnia.

To evaluate the competing roles of different personality types, investigations are needed in which multiple personality traits are simultaneously examined as predictors of sleep. However, only a small number of similar types of studies exist [20]. Trait positive affect such as gratitude [21] and vigor [22] has showed a consistent association with sleep independent of trait negative affect. It is the presence of positive affect, not just the absence of negative affect that determines better sleep. This may suggest that high positive affect has a salutary effect that is distinct from that associated with low negative affect [20]. Likewise, this study aims to examine the comparative utility of positive and negative oriented personality traits to predict post-surgery insomnia symptoms in women with breast cancer and determine whether a similar relationship emerges. The inclusion of negative oriented personality traits can help rule out the possibility that positive impact of optimism on sleep is merely a reflection of the absence of negative personality dispositions.

Thus, the aim of this study was twofold. One is to see whether different personality traits, especially optimism, have the same expected effects on sleep in women with breast cancer as in other populations. Another is to examine the relative contributions provided by optimism to the prediction of post-surgery insomnia symptoms when considered other different personality traits together. We hypothesize that neuroticism and anxiety sensitivity could positively predict while optimism could negatively predict post-surgery insomnia symptoms. Then, we expect to evaluate the relative importance of optimism for sleep in women with breast cancer by assessing its comparative statistical contributions.

Methods

Subjects

In this study, women with breast cancer were all recruited from a hospital in Changsha, Hunan Province, China, from November 2013 to February 2016. The eligible criteria were the following: (1) women between the ages of 20 to 70 years old were newly diagnosed as stage I to stage III primary breast cancer; (2) women were prepared for surgery; and (3) women had the ability of literacy. Women with pregnancy, lack of education, other psychiatric disorders or physical illnesses, and history of substance abuse were excluded from this study. The disease stages were determined according to the criteria of the American Joint Committee on Cancer (AJCC). Other clinical data including types of surgery and menopausal status were obtained through medical records.

Ethics

This research has obtained ethical approval from the Ethics Committee of The Second Xiangya Hospital, Central South University. Before the start of this research, informed consent describing the purposes and process of this research was sent to eligible women and was explained to them clearly. Women who voluntarily participated in this research signed written informed consent.

Procedure

One week before surgery, the Chinese version of Neuroticism subscale of NEO-Five Factor Inventory (CV-N-NEO-FFI), Anxiety Sensitivity Index-3 (CV-ASI-3), Life Orientation Test-Revised (CV-LOT-R), and a demographic questionnaire was filled out by women under the guidance of four postgraduates. In total, 964 patients were recruited for the study, but 54 patients were excluded due to incomplete questionnaires at the first assessment. About 4 weeks after surgery, the Chinese version of the Insomnia Severity Index (CV-ISI) and Numbering Rating Scale (NRS) was sent to the 910 patients who had completed the first assessment to assess insomnia symptoms and pain intensity in the last week. Although the pain intensity felt by women with breast cancer was mild and stable [23] at this time, we still assessed pain intensity and treated it as a controlling variable to minimize its impact on

insomnia symptoms. One hundred and sixty-one patients were dropped off at the second assessment due to lack of contact, refusal to continue the study, and many other reasons or excluded from this study due to received adjuvant therapies such as chemotherapy or radiotherapy during this period. Seven hundred forty-nine women finally completed the second assessment.

Instruments

Demographic questionnaire

The demographic questionnaire collected information on age, area of residence, education level, and marital status.

Chinese version of neuroticism subscale of NEO-Five Factor Inventory

In 1985, Costa and McCrae established the original version of Big Five Personality scale: NEO-Personality-Inventory (NEO-PI), and in 1992 they introduced a simplified version of 60 items named NEO-Five-Factor Inventory (NEO-FFI). The neuroticism subscale of NEO-FFI includes 12 items and uses a 5-point Likert scoring method from 0 (strongly disagree) to 4 (strongly agree). The total score ranges from 0 to 48 points. Higher scores indicate higher levels of neuroticism. The Chinese version of neuroticism subscale had a Cronbach α from 0.77 [24] to 0.84 [25, 26] with good validity [26] in the Chinese population.

Chinese version of Anxiety Sensitivity Index-3

The Chinese version of Anxiety Sensitivity Index-3 (CV-ASI-3) was developed by Zhu et al. [27] based on the English version of Anxiety Sensitivity Index-3 (ASI-3) [28]. It was used to measure subjective fear of anxiety-related sensations [29]. The CV-ASI-3 includes 18 items and uses a 5-point Likert scale from 0 (very little) to 4 (very much). Total score ranges from 0 to 72 points. Higher total scores indicate higher levels of anxiety sensitivity. In healthy Chinese women, Cronbach's α of the total scale is 0.95, and test-retest reliability within 1 month is 0.86 [30]. In Chinese women with breast cancer, Cronbach's α of the total scale is 0.94, and test-retest reliability is 0.86 within 1 month [27].

Chinese version of Life Orientation Test-Revised

The Chinese version of Life Orientation Test-Revised (CV-LOT-R) was established [31–33] based on the English version developed by Scheier et al. in 1994 [34]. The CV-LOT-R includes 3 positive items and 3 negative items using a 5-point Likert scale from 0 (strongly disagree) to 4 (strongly agree). The total score ranges from 0 to 24 points with a higher score indicating a higher level of optimism. This scale has been validated in breast cancer patients [35, 36] in China with a Cronbach α from 0.72 to 0.75 [31, 33].

Chinese version of The Insomnia Severity Index

The Chinese version of The Insomnia Severity Index (CV-ISI) was developed by Yang [37] to evaluate the subjective feelings of insomnia. CV-ISI adopts a 5-point Likert scale from 0 (not at all) to 4 (extremely). The first three items evaluate insomnia symptoms about sleep onset latency, sleep maintenance, and early awakening problems. The last four items assess patients' satisfaction with their sleep, including influence of insomnia on daytime functioning as well as patients' own concern and distress caused by insomnia symptoms. The total score ranges from 0 to 28. Higher total scores indicate more severe insomnia. The Cronbach α of the CV-ISI was 0.91 [37] with a good validity in the Chinese population [37].

Numbering Rating Scale

Numbering Rating Scale (NRS) is the most widely used instrument to assess pain intensity. This scale divides a line with a length of 10 cm into ten equal segments. From left to right, the dots are numbered from 0 to 10. Women are instructed to select a dot to represent the feelings of pain. NRS has been well applied in breast cancer patients [23].

Statistical analysis

The SPSS 24.0 software was performed to analyze statistical data. Independent t test was used to compare demographic and clinical variables between missing subjects and subjects who completed the whole research. Dummy variables were set as followed: Living in a city was coded as 1 and living in a rural area was coded as 2. Educational levels from primary school, lower general secondary education, intermediate professional and higher general secondary education, and higher professional and university education were coded as 1 to 4, respectively. Divorced or widowed women were coded as 1 and married women were coded as 2. Being premenopausal was coded as 1 and being postmenopausal was coded as 2. Disease Stage I to III was coded as 1 to 3, respectively. Mastectomy surgery was coded as 1 and breast conserving surgery was coded as 2. Variables regarding personality traits, insomnia symptoms, and pain intensity were entered into regression equations after standardizing (z) scores. Hierarchical regression analysis was conducted to examine the predictive effect of neuroticism, anxiety sensitivity, and optimism for insomnia symptoms, separately. A stepwise regression analysis was performed to examine the unique prediction of optimism. Statistical significance was all set at $p < 0.05$.

Results

Descriptive characteristics

Among the 749 women who completed the whole research, the mean age was 48.13 ± 8.38 (standard deviation) years with a range from 27 to 70 years. About half of them (50.2%) lived in the city, and half of them (49.8%) lived in rural areas. Most (94.5%) women were married, while 5.5% were divorced or widowed. Educational levels ranged from primary school (16.3%), lower general secondary education (44.7%), intermediate vocational and higher general secondary education (21.4%), to higher vocational and university education (17.6%). About half of them (49.1%) were postmenopausal, and half (50.9%) have not yet been through menopause. 26.4% had stage III breast cancer, 62.2% had stage II, and 11.3% had stage I disease. Most of the women (97.2%) received mastectomy surgery, and only 2.8% received breast conserving surgery. The descriptive statistical data of personality traits, insomnia symptoms, and pain intensity are shown in Table 1. Cronbach's α coefficient for personality and insomnia scales were all above 0.85.

Regression analyses

Hierarchical regression analysis of neuroticism, anxiety sensitivity, and optimism predicting insomnia symptoms separately

Hierarchical regression analysis was performed to evaluate the separate predictions of personality traits for insomnia (Table 2). In the first step, demographic variables, clinical variables, and pain were statistically controlled. Then neuroticism, anxiety sensitivity, and optimism scores were entered as predictors in the second step, separately. Controlling variables significantly predicted post-surgery insomnia symptoms ($F = 16.355$, $p < 0.001$), explaining 14.1% of the variance. Neuroticism, pain, and demographic and clinical variables significantly predicted post-surgery insomnia symptoms ($F = 25.904$, $p < 0.001$), explaining 23.1% of the variance. Neuroticism was positively associated ($\beta = 0.317$, $p < 0.001$) with post-surgery insomnia symptoms and explained an extra 9.0% of variance. Anxiety sensitivity, pain, and demographic and clinical variables significantly predicted post-surgery insomnia symptoms ($F = 20.207$, $p < 0.001$), explaining 18.8% of the variance. Anxiety sensitivity was positively associated ($\beta = 0.220$, $p < 0.001$) with post-surgery insomnia symptoms and explained an extra 4.7% of variance. Optimism, pain, and demographic and clinical variables significantly predicted post-surgery insomnia symptoms ($F = 27.186$, $p < 0.001$), explaining 24.0% of the variance. Optimism was negatively associated ($\beta = -0.332$, $p < 0.001$) with post-surgery insomnia symptoms and explained an extra 9.9% of variance.

Stepwise regression analysis of neuroticism, anxiety sensitivity, and optimism predicting insomnia symptoms jointly

As can be seen from Table 3, optimism was the first to enter into the model after controlling demographic and clinical variables and pain in the stepwise regression models ($F = 27.186$, $p < 0.001$), explaining 9.9% of the variance. Neuroticism was the second to enter into the model ($F = 25.784$, $p < 0.001$), explaining an additional 0.9% of the variance. Anxiety sensitivity also offered an additional significant prediction in post-surgery insomnia symptoms ($F = 23.937$, $p < 0.001$), explaining 0.3% of the variance. Optimism became the statistically most important predictor of post-surgery insomnia symptoms (($\beta = -0.215$, $p < 0.001$), while neuroticism was a statistically more important predictor ($\beta = 0.114$, $p < 0.001$) than anxiety sensitivity ($\beta = 0.079$, $p < 0.001$). Women with more optimism tended to have less insomnia symptoms. Women with higher neuroticism and anxiety sensitivity showed more insomnia symptoms.

Discussion

This study found that neuroticism and anxiety sensitivity positively predicted insomnia, whereas optimism negatively predicted insomnia in women with breast cancer. Optimism has showed the expected protective effects on sleep in women with breast cancer. Overall, women with more optimism tended to appraise the disease as a challenge rather than a threat [18, 19] and responded to it with a greater degree of fighting spirit [19]. In addition, women with more optimism engaged in more social and recreational activities [38] and

Table 1 Descriptive statistics and Cronbach's α for all scales

Variables	Mean	SD	Minimum	Maximum	Cronbach α
Neuroticism	17.859	10.619	0.00	40.00	0.928
Anxiety sensitivity	13.462	11.522	0.00	54.00	0.944
Optimism	14.935	5.079	3.00	24.00	0.874
Insomnia	5.645	4.788	0.00	20.00	0.897
Pain	1.850	2.158	0	10.00	

Table 2 Hierarchical regression analysis of personality traits predicting insomnia symptoms

Variables	Controlling variables		Neuroticism		Anxiety sensitivity		Optimism	
	Beta	*t*	Beta	*t*	Beta	*t*		
Years of age	− 0.159	− 2.993**	− 0.084	− 1.653	− 0.152	− 2.939**	− 0.082	− 1.617
Area of residence[a]	0.033	0.790	0.000	− 0.004	0.021	0.512	0.003	0.085
Education[b]	− 0.044	− 1.055	0.011	0.274	− 0.026	− 0.636	0.013	0.325
Marital status[c]	− 0.103	− 2.987**	− 0.092	− 2.836**	− 0.110	− 3.284***	− 0.085	− 2.627**
Menopausal status[d]	0.087	1.713	0.057	1.184	0.073	1.492	0.067	1.400
Disease stage[e]	0.051	1.357	0.072	2.005*	0.057	1.554	0.062	1.738
Type of surgery[f]	− 0.101	− 2.867**	− 0.070	− 2.093*	− 0.093	− 2.728**	− 0.070	− 2.098*
Pain	0.319	9.314***	0.348	10.700***	0.330	9.911***	0.312	9.685***
Neuroticism			0.317	9.331***				
Anxiety sensitivity					0.220	6.596***		
Optimism							− 0.332	− 9.843***
F	16.355***		25.904***		20.207***		27.186***	
R^2	0.150		0.240		0.197		0.249	
Adjusted R^2	0.141		0.231		0.188		0.240	
$\triangle R^2$	0.141		0.090		0.047		0.099	

Variables regarding personality, insomnia and pain were entered into equation after standardizing into (*z*) scores

[a] Living in city was coded as 1, living in rural area was coded as 2

[b] Educational levels from primary school, lower general secondary education, intermediate vocational and higher general secondary education, higher vocational and university education were coded as 1 to 4, respectively

[c] Divorced or widowed women were coded as 1, married women were coded as 2

[d] Being premenopausal was coded as 1, being postmenopausal was coded as 2

[e] Disease Stage I to III were coded as 1 to 3, respectively

[f] Mastectomy surgery was coded as 1, breast conserving surgery was coded as 2

* $p < 0.05$

** $p < 0.01$

*** $p < 0.001$

received more social support from others [39], which may all help them sleep better [40].

Key to our findings, optimism was the statistically most important predictor of post-surgery insomnia symptoms, although optimism did not completely eliminate the predictive effects of neuroticism and anxiety sensitivity. This may suggest that positive impact of optimism on sleep is more than the absence of negative personality dispositions. This finding may be explained that more optimistic women tended to experience more positive affect which has been shown as a common denominator for better sleep [20–22]. High optimism predisposes women to high levels of positive affect which would always promote good sleep regardless of levels of negative affect [20–22]. Other possible reasons may include that optimistic women flexibly adopted various appropriate coping strategies when facing the uncertainty of breast cancer, such as problem solving, acceptance, and positive reframing [41–43]. Thus, women with more optimism are not only able to deal with the disease better, but also better deal with negative psychological experiences associated with neuroticism and anxiety sensitivity to maintain a better sleep.

Table 3 Stepwise regression analysis predicting insomnia symptoms after controlling demographic variables, clinical variables, and pain

Predictor variables	β	SE	*t*	*P*	$\triangle R^2$
Optimism	− 0.215	0.049	− 4.360	0.000	0.099
Neuroticism	0.114	0.054	2.112	0.035	0.009
Anxiety sensitivity	0.079	0.038	2.077	0.038	0.003

All variables were entered into equation after standardizing into (*z*) scores

Insomnia appears to be a problem for women with breast cancer, which overall exerts a long-term detrimental effect on survival. The accumulated evidence revealed that multiple biological alterations involved in insomnia, such as diminished immune and metabolic functions, may accelerate breast cancer progression [44]. Indeed, better objective indicators of sleep efficiency in women with advanced breast cancer have been reported to predict a longer overall survival time [45]. Approximately, a 10% increase in sleep efficiency could reduce mortality by 32% even after adjusting for medical and

psychological variables [45]. Thus, it is significant to identify the specific positive antecedents of good sleep. This study used a longitudinal design to examine the comparative roles of positive and negative oriented personality traits in sleep for the first time among women with breast cancer. Our finding suggests the priority of considering positive oriented traits (optimism) over and above negative oriented traits (neuroticism and anxiety sensitivity) in terms of sleep problems.

However, we should acknowledge there are still some limitations. First, participants in this study all come from Hunan Province, China, which limits the generalizability of our results. Second, we only assessed insomnia symptoms in the short period after surgery. Long-term follow-up studies after surgery may provide a clearer depiction of relationships between personality traits and insomnia. Third, our results are all based on self-report measures. Future research may use objective methods to measure sleep to validate our findings.

In conclusion, personality traits affect post-surgery insomnia in women with breast cancer. Neuroticism and anxiety sensitivity positively predicted insomnia, but optimism negatively predicted insomnia. More importantly, optimism provided a stronger value in identifying women at risk of developing post-surgery insomnia symptoms than neuroticism and anxiety sensitivity. Our finding suggests that enhancing optimism could be a possible new intervention for sleep problems in women with breast cancer.

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Compliance with ethical standards

This study was approved by the Ethics Committee of The Second Xiangya Hospital, Central South University in Hunan, China (reference number: 2010S177). From November 2013 to February 2016, eligible women at a hospital were informed of purposes of this research. Women who voluntarily participated in this research signed written informed consent.

Conflict of interest The authors declare that they have no conflicts of interest.

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