




What contributes to long-term quality of life in breast cancer patients who are undergoing surgery? Results of a multidimensional study

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Abstract

Purpose This study aims to examine the key determinants of long-term quality of life in breast cancer patients who are undergoing surgery using a multidimensional approach and taking into account preoperative and post-operative psychological characteristics such as anxiety, depression, posttraumatic growth, body image, and physical activity as well as medical parameters.

Methods The study involved 63 breast cancer patients from the Department of Surgery at the University of Szeged. Assessments occurred 1 day before surgery as well as 3 days and 18 months after surgery using the Spielberger State and Trait Anxiety Inventory (STAI), Beck's Depression Inventory (BDI), Functional Assessment of Cancer Therapy–Breast Cancer Scale (FACT-B), Posttraumatic Growth Inventory (PTGI) and Breast Impact of Treatment Scale (BITS). Data relating to physical activity, medical parameters and sociodemographic characteristics were also collected.

Results The level of depression did not change over time. State anxiety decreased 18 months after the surgery compared to before the surgery; however, there was a greater decrease immediately after the surgery and then anxiety increased again 18 months later. Trait anxiety was associated with quality of life, posttraumatic growth and body image. Posttraumatic growth and the level of depression

were found to be possible contributing factors to the increase in long-term quality of life.

Conclusions The results show that the timely detection and proper management of psychological distress and the enhancement of posttraumatic growth are of great value, as they might be important contributing factors to long-term quality of life in breast cancer patients.

Keywords Breast cancer · Psychological distress · Quality of life · Body image · Posttraumatic growth

Introduction

The traumatic nature of the diagnosis and the painful surgical procedures often lead to a series of psychological problems among cancer patients. An estimated 1.1 million women are diagnosed with breast cancer worldwide, and 410,000 die of the disease each year [1]. Meta-analyses suggest that stress-related psychosocial factors and lower health-related quality of life (QoL) are associated with poorer survival among people with breast cancer [2]. Depression and anxiety are typical responses after diagnosis and during the treatment phase, making psychological screening and intervention extremely relevant [3].

Furthermore, the level of psychological distress is usually higher before surgery at the beginning of the disease [4, 5]. According to Ho et al. [6], patients who are in treatment report higher depression and anxiety than patients who are in post-treatment, which supports the increased importance of psychological interventions not only after treatment but also in the early stage of treatment. QoL is an important outcome measure in all patients with breast cancer due to the complexity of the disease, with emotional,

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functional, physical, social and sexual factors all playing a role [3, 7–9].

Posttraumatic growth (PTG) is defined as perceived positive changes in previous levels of functioning following a traumatic life event [10, 11]. Following a diagnosis of breast cancer, many women report PTG in a variety of life domains (e.g. recognition of new possibilities in one's life, a greater sense of personal strength, and spiritual development) [12–15]. However, it is unclear whether PTG is associated with a higher level of distress or enhanced QoL among cancer survivors, as researchers have reported positive and negative associations and inconclusive results [15–22].

The often traumatic and disfiguring nature of breast cancer surgery can also lead to a series of psychological problems relating to body image, sexuality and femininity [23–25]. Body change stress refers to subjective psychological stress that accompanies women's negative and distressing feelings, emotions, thoughts and behaviours originating from and connected to breast cancer and/or breast surgeries [23]. Body change stress manifests as stress symptoms that are similar to those found in traumas, including re-experiencing (e.g. feeling upset with reminders of breast change), avoidance (e.g. attempts to limit the exposure of the body to oneself or others) and arousal symptoms (e.g. irritability) [23].

Whereas many of the symptoms that are associated with breast cancer and its treatment can last for several months or even years after treatment is complete, studies have shown that regular physical activity is beneficial in reducing and relieving cancer-related symptoms and improving QoL in cancer patients [26–29]. However, few studies have focused on the connection between QoL and PTG in relation to physical activity and body image using a longitudinal study design by observing changes in behaviour prior to and long after the operation [30–35].

Aims and research questions

Our primary goal was to gain a more complete understanding of the key determinants of long-term QoL in breast cancer patients who are undergoing surgery. Given that little empirical research has been done to investigate this question using a multidimensional approach, we surveyed a group of women who had been living with this disease for 18 months using a prospective, multidimensional study design, taking into account pre- and post-operative psychological characteristics such as anxiety, depression, post-traumatic growth, body image, and physical activity as well as medical parameters. An additional goal was for the potentially positive results of this study to serve as a clear theoretical basis for our intervention studies that we plan

to conduct with breast cancer patients who are undergoing surgery.

The following served as the research questions of the study:

1. What are the characteristic correlational patterns of the contributing factors that influence the long-term QoL of breast cancer patients?
2. Eighteen months after surgery, how do emotional factors and QoL change in breast cancer patients?

We hypothesized that an enhanced QoL would be associated with positive mood factors, greater PTG and a higher level of physical activity.

Methods

Study design and sample

All the materials that were used in this study were approved by the Regional and Institutional Human Medical Biological Research Ethics Committee. Prior to their surgery for breast cancer, the patients were assessed in the Department of Surgery at the University of Szeged. Each patient was provided with comprehensive information regarding the study and signed an informed consent form. The final sample comprised 63 female patients. The inclusion criteria were: (i) breast cancer that was confirmed by histological examination, (ii) ability to complete the necessary questionnaires, and (iii) ability to understand the objective of the study and provide informed consent. The exclusion criteria were (i) secondary breast cancer, (ii) psychiatric disorder(s) and (iii) male sex. Psychological assessments were conducted by a trained health psychologist who did not have access to medical data about the patients. The data were assessed at three time points: 1 day before surgery (T1), 3 days after surgery (T2) and 18 months after surgery (T3).

Study measures

The Spielberger State and Trait Anxiety Inventory (STAI-S; STAI-T) was administered to measure the level of anxiety before and after surgery [36]. Both the scales comprise 20 items, with responses ranging from 1 (not at all) to 4 (very much so). Total scores range from 20 to 80, with a higher number indicating a higher level of anxiety. In the STAI-S, a mean score above 50 indicates severe state anxiety. The STAI-S was administered 1 day before surgery and both 3 days and 18 months after surgery. In the STAI-T, a mean score <48 indicates no trait anxiety, a mean score of 48–52 indicates minor trait anxiety, and

a mean score >52 indicates severe trait anxiety [37]. The STAI-T was administered 1 day before surgery. The Hungarian versions of the STAI-S and STAI-T have good reliability [38].

Beck's Depression Inventory (BDI) was used to assess the severity of depressive symptoms [39]. The BDI was administered at two time points: before surgery and 18 months after surgery. All the parts include four statements that describe feelings in recent weeks. The responses range from 0 to 3. Total scores range from 0 to 84, with a higher number indicating a higher level of depression. The lowest total score was 0, whereas the highest score was 84.

Using the standard cut-off scores, a score of 0–9 indicates minimal depression; 10–18 indicates mild depression; 19–25 indicates moderate depression and >25 indicates severe depression [39, 40]. The reliability of the scale is adequate (Cronbach's $\alpha=0.86$) [41].

The FACT-Breast (FACT-B) was used to assess QoL, as it was designed specifically for breast cancer patients [42]. Patients are asked to respond to statements regarding the status of their breast as well as their emotional, functional, physical, and social well-being. Patients choose the number that corresponds with how true each statement has been for them during the past 7 days. Answers are scored using a Likert-type scale. The FACT-B was administered 1 day before and 18 months after surgery. The total FACT-B score (including all the subscales) ranges from 0 to 144, with a higher number indicating a more favourable QoL. The subscales evaluate *breast well-being* (score range 0–36), *emotional well-being* (score range 0–24), *functional well-being* (score range 0–28), *physical well-being* (score range 0–28), and *social well-being* (score range 0–28). The reliability of the FACT-B in general is high (Cronbach's $\alpha=0.9$) [42]. The Cronbach's α of the global QoL scale in this study was 0.73 before surgery and 0.79 after surgery.

We employed the Posttraumatic Growth Inventory (PTGI) 18 months after surgery, which was designed to assess positive outcomes following a struggle with highly challenging life circumstances [43]. The questionnaire comprises five subscales (*relating to others*, *new possibilities*, *personal strength*, *spiritual change*, and *appreciation of life*) and yields a total posttraumatic growth score (range 0–105). The higher the total score is, the greater the PTG is. The Hungarian version of the PTGI showed good reliability (Cronbach's $\alpha=0.898$) [43].

To measure stress from body change related to breast cancer surgery, the Breast Impact of Treatment Scale was used (total score range 0–75) 18 months after surgery [44]. The subscales evaluate *intrusive thoughts* and *level of avoidance*. The higher the total score is, the higher the level of body change stress is. The BITS was found to be a good screening tool in general and has shown high reliability in

measuring body change stress (Cronbach's $\alpha=0.91$) [44].

Sociodemographic factors and physical activity

The sociodemographic background factors included age, marital status, number of children and level of education. Physical activity was also measured, with questions addressing the type and number of hours of physical activity per week. Similar to the study by [45], we measured physical activity using open-ended questions [45].

The questions were as follows:

1. Since your diagnosis, has exercise/sport been part of your life?
2. If so, what type of exercise/sport do you do?
3. How many hours of exercise/sport do you do weekly?

We considered patients' physically active if they engaged in at least 1 h of physical activity per week. In our study, physical activity was described as specific physical activities (e.g. running, yoga). Other physical activities (e.g. gardening) were not counted as specific physical activities.

Medical parameters of patients

The medical parameters that were examined in the study were the side, size and grade of the tumour; type of neoadjuvant therapy; and type of surgery (excision/mastectomy).

Statistical analyses

The data were analysed using IBM SPSS 20.0 for Windows. Quantitative variables were described using the mean and standard deviation. Qualitative variables such as the sociodemographic characteristics were described using the percentage. To reveal the pattern of the relationships among the variables, Spearman's and Pearson's correlations were used. The differences between the variables at different time points were calculated using the paired-samples *t* test, Wilcoxon test and repeated-measures analysis of variance (rANOVA). Group comparisons were performed with the Mann–Whitney U test. Physical activity was measured as a dichotomous variable (physically active/not physically active). We also asked the patients to report their mean number of hours of physical activity per week. The FACT-B, BITS, and PTGI subscale scores were compared in different subgroups of patients, depending on the sociodemographic, psychological and medical variables. Multiple linear regression (stepwise method) was performed to identify the potential predictors of long-term QoL. The FACT-B scale (18 months after surgery) served as the dependent

variable. The independent variables that were entered into the regression analysis were physical activity, and all the psychological variables were measured in our study, which had been found to have a long-term influence on QoL in breast cancer patients undergoing surgery in previous studies [30–35]. These psychological variables were depression, state and trait anxiety, PTG and its subscales, stress relating to body change and its subscales. The results were considered statistically significant when the p value was less than 0.05.

Results

Sociodemographic and medical characteristics

The 63 breast cancer patients' mean age was 56.1 years (SD=11.92). In addition, 52.4% of them had a secondary school qualification, and most of them were married (73%). Nearly 75% of them had an excision, and the mean tumour size was 21.61 mm (SD=21). Only five of the patients received neoadjuvant treatment, and 59.7% of them were physically active (Table 1). No significant associations were found between the type of surgery and psychological factors ($p > 0.05$).

The influence of sociodemographic factors

No significant associations were found between trait and state anxiety before and after the operation and marital status ($p > 0.05$), age ($p > 0.05$), number of children ($p > 0.05$) and education level ($p > 0.05$). No significant correlations were found between the depression scales and marital status ($p > 0.05$), age ($p > 0.05$), number of children ($p > 0.05$) and education level ($p > 0.05$).

However, age was significantly correlated with the PTGI ($r = -0.275$, $p < 0.05$) and FACT-B ($r = -0.276$, $p < 0.05$) scores 18 months after the operation. Education level was significantly associated with the FACT-B [$H(2) = 8.175$, $p < 0.05$] and PTGI [$H(2) = 6.292$, $p < 0.05$] scores 18 months after the operation. Patients with a lower education level had a lower FACT-B score (89 vs. 113.8) and PTGI score (54.6 vs. 74.8) than patients with a university qualification 18 months after the operation.

Marital status was associated with the FACT-B *social well-being* factor ($U = 184.5$, $Z = -2.167$, $p = 0.03$). Married patients had a higher social well-being factor score before the operation compared to unmarried patients (30.01 vs. 20.04). The number of children was not correlated with the PTGI and FACT-B scores ($p > 0.05$).

Table 1 Sociodemographic and medical characteristics ($N = 63$)

Characteristics	
Mean age (SD)	56.1 (11.92)
Marital status N (%)	
Married	46 (73)
Not married	17 (27)
Educational level N (%)	
Primary qualification	11 (17.5)
Higher secondary qualification	33 (52.4)
University qualification	19 (30.1)
Number of children (Mean, SD)	2.03 (0.96)
Type of surgery N (%)	
Excision	47 (74.6)
Mastectomy	16 (25.4)
Grade N (%)	
I	10 (19.2)
II	26 (50)
III	16 (30.8)
Tumour size (Mean, SD)	21.61 (21)
Neoadjuvant treatment N (%)	
Yes	5 (8.1)
No	57 (91.9)
Side of tumour N (%)	
Right	29 (46)
Left	33 (52.4)
Physical activity	
Yes	37 (59.7)
No	25 (40.3)

QoL, anxiety, depression, PTG and body change stress

The mean scores on QoL, anxiety, depression, PTG and body change stress (at all three time points) are listed in Table 2. Compared to the cut-off scores, the mean scores on trait anxiety and depression indicated relatively low but stable levels of distress at all relevant time points. The BDI mean score did not change significantly over time (Table 2). State anxiety was significantly higher before the operation than 3 days after the operation (Table 2). Furthermore, state anxiety was significantly higher 18 months after the operation than 3 days after the operation (Table 2). The FACT-B mean score did not change significantly over time (Table 2). *Functional well-being* and *physical well-being* changed significantly from their level pre-surgery to their level 18 months post-surgery (Table 2). The patients reported better *functional well-being* and *physical well-being* 18 months after the operation compared to pre-operation (Table 2).

Table 2 QoL, anxiety, depression, PTG and body change stress in the study sample ($N=63$)

	Baseline mean (SD)	3 days mean (SD)	18 months mean (SD)	Baseline–18 months p value
FACT-B				
Emotional well-being	18.35 (4.33)		19.22 (4.48)	0.265 ^a
Functional well-being	17.45 (6.02)		19.31 (5.44)	0.054^a
Physical well-being	20.33 (4.62)		23.87 (4.74)	0.000^a
Social well-being	20.39 (5.67)		20.11 (5.96)	0.563 ^a
Breast well-being	23.94 (5.84)		23.96 (7.33)	0.727 ^a
FACT-B total	99.30 (19.30)		104.57 (23.66)	0.067 ^a
BDI	8.36 (7.07)		8.81 (7.23)	0.589 ^c
STAI-T	44.90 (9.76)			
STAI-S	51.46 (12.08)	39.72 (9.55)	41.52 (12.25)	0.000^b
PTGI				
Relating to others			20.26 (9.50)	
New possibilities			12.83 (7.40)	
Personal strength			12.21 (7.36)	
Spiritual change			4.27 (3.28)	
Appreciation of life			10 (4.38)	
PTGI total			59.5 (27.66)	
BITS				
Intrusive thoughts			13.52 (15.39)	
Level of avoidance			4.84 (4.83)	
BITS total			18.37 (19.84)	

Bold values indicate the significant p values between ($p = 0.00$ and $p = 0.05$)

SD standard deviation

^aWilcoxon test

^brAnova

^cPaired sample t test

Correlations between QoL and anxiety, depression, PTG and body change stress

Depression 1 day before and 18 months after surgery had a significant positive correlation with state and trait anxiety (Table 3). QoL before surgery and the subscales of QoL (except social well-being) before surgery had a significant negative correlation with depression and anxiety (Table 3). QoL 18 months after surgery and the subscales of QoL 18 months after surgery had a significant negative correlation with depression and trait anxiety (Table 3). The statistical measures indicated that PTG had a significant negative correlation with depression and trait anxiety 18 months after surgery (Table 3). A significant positive correlation was found between body change stress and both depression and trait anxiety 18 months after surgery (Table 3).

There was a significant association between QoL 18 months after surgery and PTG (Table 3). The statistical measures indicated significant positive correlations between QoL 18 months after surgery and the following PTG subscales: *relating to others*, *new possibilities*,

personal strength, and *spiritual change* (Table 3). A negative association was found between body change stress and both QoL 18 months after surgery and the QoL subscales (*emotional well-being*, *physical well-being* and *breast well-being*) 18 months after the operation (Table 3). There was no significant association between body change stress and PTG (Table 3).

Associations between physical activity and mood factors, QoL, PTG and body change stress

In our study, mean number of hours of physical activity per week was measured ($M = 3.02$, $SD = 2.19$). The results of statistical analyses showed no significant association between physical activity and psychological distress or QoL before the operation (Table 4). However, there was a significant association between physical activity and both depression and state anxiety 18 months after the operation (Table 4). Patients who engaged in physical activity had lower mean scores on depression and state anxiety 18 months after the surgery (Table 4).

Table 3 Correlation between QoL and anxiety, depression, PTG and body change stress ($N=63$)

	FACT-B								
	Emotional well-being	Functional well-being	Physical well-being	Social well-being	Breast well-being	FACT-B total	BDI	STAI-S	STAI-T
	<i>r</i>	<i>r</i>	<i>r</i>	<i>r</i>	<i>r</i>	<i>r</i>	<i>r</i>	<i>r</i>	<i>r</i>
Time point: baseline									
BDI	-0.535**	-0.679**	-0.429**	-0.236	-0.444*	-0.612**	-	0.527**	0.644**
STAI-S	-0.570**	-0.507**	-0.276	-0.166	-0.359*	-0.604**	0.527**	-	0.510**
STAI-T	-0.499**	-0.528**^p	-0.286**^a	-0.229	-0.312**^a	-0.482**	0.644**	0.510**	-
	FACT-B								
	Emotional well-being	Functional well-being	Physical well-being	Social well-being	Breast well-being	FACT-B total	BDI	STAI-S	STAI-T
Time point: 18 months									
BDI	-0.682**	-0.652**	-0.738**	-0.398**	-0.739**	-0.783**	-	0.584**	0.709**
STAI-S	-0.632**	-0.524**	-0.536**	-0.291*	-0.491**	-0.593**	0.584**	-	0.781**^a
STAI-T	-0.600**	-0.586**	-0.610**	-0.286*	-0.620**^a	-0.615**	0.709**	0.781**^a	-
PTGI									
Relating to others	0.101	0.328*	0.074	0.433**	0.051	0.255*	-0.164	-0.092	-0.130
New possibilities	0.204	0.301*	0.244	0.289*	0.225	0.311*	-0.260*	-0.238	-0.300*
Personal strength	0.273*	0.359**	0.289*	0.247	0.263*	0.388**	-0.339**	-0.250	-0.318*
Spiritual change	0.137	0.145	0.212	0.182	0.297*	0.276*	-0.215	-0.234	-0.375**
Appreciation of life	0.092	0.340**	0.118	0.213	0.106	0.226	-0.091	-0.188	-0.269*
PTGI total	0.157	0.356	0.203	0.344*	0.211	0.342**	-0.255*	-0.185	-0.288*
BITS									
Intrusive thoughts	-0.448**	-0.237	-0.388**	-0.070	-0.640**	-0.433**	0.561**	0.222	0.330*
Level of avoidance	-0.357**	-0.168	-0.315*	-0.103	-0.522**	-0.391**	0.484**	0.096	0.237
BITS total	-0.423**	-0.225	-0.381**	-0.095	-0.613**	-0.435**	0.556**	0.177	0.298*

Bold values indicate the significant p values between ($p = 0.00$ and $p = 0.05$)

r = Spearman correlation coefficient except

* $p < 0.05$, ** $p < 0.01$

^aPearson correlation coefficient

There was a significant relationship between QoL 18 months after the operation and physical activity among the breast cancer patients (Table 4). Patients who engaged in physical activity had higher scores on the FACT-B scale as well as the *functional well-being*, *physical well-being* and *breast well-being* subscales 18 months after the operation (Table 4).

There was a significant association between PTG and physical activity. Patients who engaged in physical activity had higher scores on the *new possibilities* and *personal strength* subscales (Table 4). No significant association was

found between body change stress and physical activity (Table 4).

Possible predictive factors of QoL: linear regression analysis

In the further investigation, a linear regression analysis was used to identify factors that contribute to better QoL (dependent variable). There were significant interactions with variables and QoL 18 months after the operation. The linear regression identified two main potential

Table 4 Associations between physical activity and mood factors, QoL, PTG and body change stress ($N=63$)

	Time point: baseline	Physically active ($N=37$)	Physically not active ($N=24$)	Mann–Whitney Test Z	p
		M (SD)	M (SD)		
BDI		8.80 (1.35)	9.87 (2.28)	-0.611	0.541
STAI-S		50.50 (2.58)	49.56 (2.53)	-0.765	0.444
STAI-T		41.80 (2.04)	47.93 (3.06)	-1.580	0.114
FACT-B					
Emotional well-being		18.61 (0.76)	18.93 (0.78)	-0.293	0.770
Functional well-being		18.76 (1.01)	15.50 (1.62)	-1.113	0.266
Physical well-being		19.88 (0.92)	20.81 (1.04)	-0.765	0.444
Social well-being		21.03 (0.86)	21.68 (0.92)	-0.924	0.355
Breast well-being		24.26 (1.20)	24.87 (1.41)	-0.469	0.693
FACT-B total		102.57 (3.46)	101.81 (4.13)	-1.035	0.301
Time point: 18 months					
BDI		7.15 (1.22)	12.62 (2.25)	-2.546	0.010
STAI-S		37 (1.89)	47.87 (3.73)	-2.327	0.020
FACT-B					
Emotional well-being		20.07 (0.77)	17.43 (1.40)	-1.040	0.298
Functional well-being		21.15 (0.91)	16.00 (1.37)	-2.576	0.010
Physical well-being		24.46 (0.91)	22.12 (1.32)	-2.288	0.022
Social well-being		20.73 (1.21)	16.81 (1.57)	-1.702	0.089
Breast well-being		26.46 (1.26)	21.81 (1.93)	-2.670	0.008
FACT-B total		112.8 (3.80)	94.18 (5.86)	-3.244	0.001
PTGI					
Relating to others		20.46 (1.82)	17.81 (2.25)	-0.906	0.365
New possibilities		13.88 (1.42)	9.62 (1.66)	-2.187	0.029
Personal strength		13.88 (1.61)	9.12 (1.72)	-2.367	0.018
Spiritual change		4.84 (0.65)	3.75 (0.86)	-1.735	0.083
Appreciation of life		10.53 (0.78)	9.62 (1.17)	-0.941	0.347
PTGI total		63.61 (5.16)	49.93 (6.79)	-1.818	0.069
BITS					
Intrusive thoughts		11.38 (2.71)	16 (4.62)	-1.083	0.279
Level of avoidance		4.38 (0.91)	5.43 (1.36)	-1.353	0.176
BITS total		15.76 (3.56)	21.43 (5.89)	-1.206	0.228

Bold values indicate the significant p values between ($p = 0.00$ and $p = 0.05$)

predictors. The resulting model was statistically significant ($p < 0.001$), and R^2 was 0.739. The BDI (18 months after the operation) variable ($\beta = -0.75$) and PTGI variable ($\beta = 0.22$) were identified as significant predictors of QoL 18 months after the operation (Table 5).

Discussion

The aim of this study was to identify and interpret the interrelationships among the most important factors that influence long-term QoL in breast cancer patients who are undergoing surgery and to create a clear theoretical basis

Table 5 Possible predictive factors of QoL: linear regression analysis (method=stepwise; $N=63$)

	β	B	Standard error B	t	F	R^2	Adjusted R^2
Model 1					76.643**	0.739	0.730
BDI (T3)	-0.759	-2.204	0.213	-10.356			
PTGI total	0.229	0.179	0.057	3.131			

Bold values indicate the significant p values between ($p = 0.00$ and $p = 0.05$)

** $p < 0.0$; T3 time point 3 = 18 months after the operation

for our intervention studies that we plan to conduct with breast cancer patients who are undergoing surgery.

This study showed that patients had relatively low levels of depression and trait and state anxiety as well as high QoL before the surgery. There was no change in the level of depression before the surgery and 18 months after it. In our study, state anxiety decreased from pre-surgery to 18 months post-surgery; however, there was a greater decrease immediately after surgery and then anxiety increased again 18 months later.

The major decrease in state anxiety after surgery can be explained with the immediate relief and decrease in fear after surgery. However, after the operation, many patients have to understand that their cancer treatment is far from over. Increased fear and uncertainties about cancer and its therapy can remain, which explains the increase in state anxiety 18 months after surgery. This is in line with the results of previous studies that found that breast cancer patients have higher levels of psychological distress related to their fear of cancer and its treatment [4, 46–48].

Furthermore, certain aspects of QoL changed over the 18-month period of our study. The patients reported better physical and functional well-being 18 months after the surgery. This change might be partially explained by the decrease in unpleasant physical symptoms and wound healing after surgery and upon completing adjuvant therapy. Adjuvant therapies such as chemotherapy, radiotherapy and hormonal therapy often have severe physical side effects that influence patients' physical and functional well-being [46, 49]. However, a negative relationship was also observed between QoL, depression and anxiety before surgery and 18 months after surgery. In our study, the patients who reported a higher level of psychological distress experienced lower QoL, which is consistent with previous research [6, 50, 51].

Sociodemographic factors such as age, education level and marital status also influenced QoL. As other studies have suggested, married patients reported better social well-being than patients who were living on their own and patients with a higher level of education reported better QoL [52–56].

In our study, PTG was relatively high among the breast cancer patients. Additionally, age was inversely related to the perception of positive change following cancer. As other researchers have suggested, this type of inverse relationship can be explained by younger patients' potentially experiencing cancer as being more disruptive in their daily life, given that this serious illness is less consistent with their phase of life compared to what it might be like for an older patient [16, 57, 58].

In our study, patients with lower depression, lower trait anxiety and higher QoL 18 months after the operation reported greater PTG. One explanation for these

results might be that a high level of psychological distress experienced before the surgery might have led to illusory instead of real PTG in our sample. Real PTG is a long-term constructive component of personality (perceived new possibilities and increased personal strength). However, for real PTG to appear, an emotional reassessment of the trauma (reduced level of depression and anxiety) is needed [59–61]. In our study, only illusory PTG appeared, as the level of depression did not change over time and state anxiety increased 18 months after surgery. Consistent with previous research, our study highlights that for real PTG to appear, emotional reassessment of the trauma through psychological interventions might play a facilitating role [59–61]. In our study, PTG as an illusory phenomenon served as a short-term coping strategy in reducing the distress produced by the traumatic experience of the operation. In this way, patients, therefore, are able to maintain or defend different aspects of their identity such as self-esteem, coherence and perceived control.

The patients in our sample who had difficulties in association with accepting their changed body image experienced higher levels of depression and trait anxiety 18 months after the surgery. Moreover, patients with severe body image problems experienced lower emotional and physical well-being in our research, highlighting that the trajectories of breast cancer surgery can lead to psychological problems regarding body image, sexuality and femininity. Our findings indicate that, despite the decrease in psychological distress shortly (3 days) after surgery, problems regarding body image can appear and persist 18 months after surgery. An exploration of coping styles, body image perception and social support before surgery might help to identify vulnerable women who can benefit from additional support [31, 62, 63].

In our study, an association between regular physical activity and reduced psychological distress was found 18 months after surgery. As previous research suggested, physical activity can enhance physical and functional well-being as well as PTG 18 months after treatment [64, 65]. However, given that this was an observational study, cause and effect cannot be inferred. Although more physically active patients reported greater well-being and PTG 18 months after treatment, there could be many confounders including that those who felt better were able to engage in physical activity.

Linear regression analyses showed that depression and PTG were significant predictors of QoL 18 months after surgery. That is, a lower level of depression and higher perceived PTG were associated with better QoL among the breast cancer patients. These results might have remarkable clinical relevance, as they indicate that psychological interventions following surgery should have a special focus on decreasing psychological distress and enhancing PTG.

Finally, our study had several limitations. First, the subjects were not representative of the general population in the country. Second, several factors that are potentially associated with depression, anxiety and QoL such as the type of anti-cancer treatment or religiosity were not measured in the study. Awareness of the diagnosis is a factor that is worth investigating in future research, as previous researchers found that it can reduce anxiety and depression [66]. Referring to recent literature, another important factor that affects QoL is family sharing, which has not been evaluated [67]. Finally, the identification of permanent changes in psychological suffering might require a longer period of monitoring and assessment than 18 months. Nevertheless, despite these limitations, our results support the medical relevance of patients' psychological support before and continuously after breast cancer surgery.

Conclusion

This study showed that overall QoL in breast cancer patients is a multidimensional domain that is influenced by several factors such as psychological distress, PTG, and body image. PTG and the level of depression were found to be factors that potentially contribute to an increase in long-term QoL. In our study, both state and trait anxiety influenced the psychological well-being of the breast cancer patients. Based on our results, a theoretical basis for a future intervention study with breast cancer patients who are undergoing surgery has been created. A focus on the nature of anxiety (current or permanent) and its dynamic changes during the course of an illness might help in the proper management of distress in psychological interventions. Furthermore, we aim to address the great importance of psychological intervention before and after surgery. Psychosocial assessment among breast cancer patients who are undergoing surgery should be multidimensional and simultaneously include an evaluation of long-term QoL, reduction in emotional distress and negative body image and the facilitation of PTG. The overall facilitation of these factors could have a cumulative effect on the healing process in breast cancer patients who are undergoing surgery.

Compliance with Ethical standards

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

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

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