RESEARCH ARTICLE

Editorial Process: Submission:02/27/2018 Acceptance:09/02/2018

Posttraumatic Growth in Patients with Malignant Bone Tumor: Relationships with Psychological Adjustment

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Abstract

Aim: Owing to the inadequate data to support the valid instrument for assessing the positive changes among patients with malignant bone tumor, the present study was designed to provide such valid evidence through examining the psychometric properties of a Chinese version of the Posttraumatic Growth Inventory (PTGI-C) among these patients, and to evaluate the effects of posttraumatic growth on positive and negative symptoms in malignant bone tumor patients. **Methods:** Potential patients with malignant bone tumor from five tertiary hospitals were admitted to the hospital during the period from January 2013 to October 2017. At the baseline assessment (T1), all patients completed a demographic form, PTGI-C, and Positive and Negative Affect Scale (PANAS). After 4 weeks later (T2), all the patients finished PANAS and PTGI-C again, and the PTGI-C was re-administered to patients who were simple randomly selected from the total sample. **Results:** The PTGI-C exhibited moderate reliability and validity. The Cronbach's α coefficient of the total scale was 0.91. Confirmatory factor analysis supported the five-factor model and the convergent validity results obtained were distinct but correlated. The multiple linear regression analyses showed that posttraumatic growth had a significant prediction on positive affect ($F=16.445$, $p<0.001$), accounting for 69.4 % of the variance and as well as the negative affect ($F=8.707$, $p<0.001$), accounting for 48.3 % of the variance. Personal strength at T1 was positively associated with positive affect at T2, and more personal strength and spiritual change at T1 were associated with less negative affect at T2. **Conclusions:** PTGI-C has demonstrated sufficient psychometric properties which indicate that it is appropriate to measure posttraumatic growth in patients with malignant bone tumor. Relating to others, spiritual growth, personal strength and appreciate to life are important factors which contribute to predicting positive affect and negative affect.

Keywords: Posttraumatic growth- positive affect- negative affect- Chinese patients- malignant bone tumor

Asian Pac J Cancer Prev, **19 (10)**, 2831-2838

Introduction

Malignant bone tumors, including osteosarcoma and Ewing sarcoma, account for only a small percentage of cancers diagnosed (Damron et al., 2007). Due to its high malignance and highly aggressive treatment, the diagnosis and treatment of malignant bone tumor has been reckoned as a huge traumatic experience (Picci, 2007). As previous studies exclusively stated, patients almost experienced negative psychological functioning outcomes in the initial period after diagnosis of malignant bone tumor and years later (Felder-Puig et al., 1998; Rourke et al., 2007). These include various degrees of physical dysfunctions such as decreased motion of the affected joint, weight-bearing restrictions, gait impairment, muscle strength decline, which consequently affect the independent daily living of patients and further cause difficulty in their social reintegration (Tsuchiya et al., 1999; Aksnes et al., 2007; Yonemoto et al., 2012).

Despite of the well-known and extensively documented negative outcomes of malignant tumors, a growing body of empirical studies have revealed that individuals could also experience positive outcomes of the diagnosis and treatment of a life-threatening disease, for example, patients show improved psychological functioning in specific domains and a sense of increased personal strength (Zoellner and Maercker, 2006; Lelorainet al., 2010). Tedeschi and Calhoun (1996) used the concept "post-traumatic growth" (PTG) to define these positive outcomes, that is, experiences of positive changes occurs

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as a result of struggling with highly challenging life circumstances (Powell et al., 2003). Studies suggested that PTG could be summarized in the following aspects: experience of greater appreciation of life and changed priorities, greater satisfaction with self, better relationships with family and others, and positive changes in religious beliefs and spirituality (Cordova et al., 2001; Thornton, 2002; Widows et al., 2005). Positive associations between PTG and psychological adjustment, immune and quality of life have been found in previous researches (Daviset al., 1998; Zoellner and Maercker, 2006; Yonemoto et al., 2012).

While several instruments have been developed to measure the PTG, Posttraumatic Growth Inventory (PTGI) by Tedeschi and Calhoun is one of the most popular instruments based on current findings in the literature (Josephet al., 1993; Park et al.,1996; McMillen and Fisher, 1998; Powell et al., 2003). The PTGI consists of five dimensions: personal strength, new possibilities, relating to others, appreciation of life and spiritual change. To date, the PTGI has been used to assess participants gathered from survivors following a variety of traumatic events in most studies (Powell et al., 2003; Searset al., 2003; Levine et al., 2008). Similarly, statistics show that this scale has been used across several different languages and malignant tumors at various sites, such as breast, nasopharynx, gynaecological, lymphoma, colorectal, liver, stomach, bladder, brain, and lung (Cordova et al., 2001; Ho et al., 2004; Jaarsma et al., 2006; Weiss and Berger, 2006; Sanders et al., 2010).

Although the malignant bone tumors are extremely rare, nevertheless due to China's large population base, its patients account a large number in the disease cohort (Niu et al., 2015). Thus, great attention has been paid in clinical research to this seemingly negligible rate (2%–3%). Among these patients, about 40% of these cases are highly malignant (Niu et al., 2015). After the improvement of clinical diagnosis and treatment, both the survival rate and quality of life of patients with malignant bone tumor have increased, which means those patients have experienced a definite positive change (Sun et al., 2012). However, little is known about how those patients flourish and grow after the disease experience. Moreover, there has been no valid instrument for measuring the PTG among patients with malignant bone tumors specifically, limiting the interpretation of these findings to the particular group of individuals. Thus, the present study attempted to examine the psychometric characteristics of PTGI in patients with malignant bone tumor. Given the valid instrument may contribute to a better understanding of the potential positive changes among patients struggling with malignant bone tumor.

Materials and Methods

Participants and procedure

This cross-sectional and longitudinal study was performed in five large tertiary hospitals where housed five orthopaedic surgery centres in Changsha, Hunan Province, China. Eligible participants were recruited by simply random sampling from those five hospitals during the period of January 2013 to October 2017. A total of 239 participants who were diagnosed with malignant bone tumors were invited. Eligible patients met the following criteria: (1) new diagnosis of malignant bone tumors by biopsy; (2) Chinese speaker; and (3) agreement to participate. Patients with the following criteria were excluded: (1) psychiatric disorder or severe somatic disease, and (2) history of substance abuse. At the baseline, of 239 patients who met the first three inclusion criteria, 5 refused to participate after being informed of the study aim and procedure; 2 were eliminated from the study sample on the basis of the exclusion criteria, leaving 222 patients (92.9%) who participated in this study for the cross-sectional observation. After one month later of the follow-up, 158 (66.1%) had completed the questionnaires.

Data collection

After receiving ethics approval by the Ethics Committee of the Second Xiangya Hospital, Central South University and permission from the hospitals, patients were approached using a simple random sampling method. Informed consent forms were sent to the patients. Then, patients who agreed to participate were informed the purpose of the study to better understand diseases' feelings, thoughts, and beliefs following related treatment. About one week after surgery (T1), trained researchers administered structured questionnaires via face-to-face interviews to collect information on demographic and medical characteristics, posttraumatic growth, positive and negative affect from patients who provided written consent; Then, patients underwent a repeated assessment of PTG and positive and negative affect after one month later (T2).

Measures

The following data were collected according to medical record: gender, age, years of education, long-term area of residence (urban/rural), marital status, employment status, time since diagnosis and treatment details.

The Posttraumatic Growth Inventory (PTGI)

The original English version of PTGI (Powell et al., 2003) is a 21-item scale that measures the degree of reported positive change arising from the struggle with a traumatic event. The PTGI consists of five subscales: Relating to Others (7 items), New Possibilities (5 items), Personal Strength (4 items), Spiritual Change (2 items), and Appreciation of Life(3 items).Participants rate each item with response choices ranging from 0–5(0 = I did not at all experience this change; 5 = I have experienced this change to g great degree). Both the total scale and the subscales of the PTGI has satisfactory validity and reliability, with internal consistency coefficient for the total scale = .90, subscales ranged from .67 (Appreciation of Life) to .85 (Relating to Others, Spiritual Change) (Powell et al., 2003).

In this study, the Chinese version of PTGI (PTGI-C) was deprived from the original English version of PTGI through translation and back-translation. PTGI-C was administered to 27 Chinese bone tumor patients to

make sure they could understand each item. Based on pre-experiment, the Chinese version of the PTGI was produced and all the formal items were reserved.

Positive and Negative Affect Scale (PANAS)

The PANAS developed by Watson et al., (1988) was used to assess positive and negative affect. The scale consists of two 10-item mood scales: positive affect (PA) and negative affect (NA). Participants are asked to rate the extent to which they have experienced each particular emotion within a specified time period, with reference to a 5-point scale (1=very slightly or not at all, 5=extremely). A high PA score reflects a state of high energy, full concentration, and pleasurable engagement. In contrast, a high NA score indicates more distress. Previous studies have showed good reliability of the PANAS and the Chinese version of PANAS (PANAS-C) (DePaoli, n.d; Huang et al., 2003).

Statistical Analysis

All the analyses were conducted with SPSS software (Version 18.0) and AMOS (Version 17.0) (Arbuckle, 2008; Carver and Nash, 2011). According to the multiple linear regression sample content requirements, we calculated our sample size by using Kendall Rank which is 5-10 times of variables involved in the analysis. In cases where 20% or more of the items were missing in a scale, we did not calculate the scale and considered it a missing value. The Cronbach's α coefficient were calculated to evaluate the internal consistency of the PTGI-C. Besides, we used confirmatory factor analysis (CFA) to examine the goodness-of-fit of the five-factor structure proposed by Tedeschi and Calhoun (1996) in the Chinese version of the scale. The maximum-likelihood estimation method was used to test the covariance matrix to determine how well the model fitted the data. Apart from standard test, several other fit indices have also been reported, including: the Goodness of Fit Index (GFI) (Toit et al., 2001), the Comparative Fit Index (CFI) (Bentler, 1990), the Tucker-Lewis Index (TLI) (Bollen, 1989), and the Root Mean Square Error of Approximation (RMSEA) (Browne and Cudeck, 1992). We adopted a well-fitting model with the attributes of having a GFI, CFI, and TLI values of 0.90 or greater, and an RMSEA value of 0.08 or smaller (MacCallum et al., 1996; Byrne, 2016). Furthermore, χ^2 / d*f* value between 2 and 5 is generally acceptable (Hoelter, 1983). The convergent validity was examined by the average variance extraction (AVE). The AVE value should exceed 0.50 so that it is adequate for convergent validity (Jr et al., 2016). Hierarchical regression analyses were performed to examine the impact of PTG on psychological adjustment at T2 after controlling for demographic and medical variables, and baseline levels of positive and negative affect at T1. The demographic variables were entered into the first regression equation, and then medical variables into the second regression equation, positive and negative affect into the third regression equation and PTG into the fourth regression equation. Forced entry was used for all variables. Collinearity between independent variables was tested based on variance inflation factors and tolerances (Miles and Shevlin, 2000). Statistical analyses were generally performed with a 5% level of significance.

Results

Descriptive characteristics

The baseline characteristics of the 222 patients are shown in Table 1. 27 patients were lost from the original cohort mainly because of various reasons. There were 138 males (66.7%) and 84 females (33.7%) among these patients with malignant bone tumor. The ages of the patients ranged from 14 years to 65 years (M= 28.58 years, S.D.=12.792 years). Marital status included 48.64% of the patients were married or in a committed relationship and the rest of them were single or divorced. About 4.50% of the patients reported that they had only received primary education, 40.99% stated that they had completed lower general secondary education, 29.28% had finished intermediate vocational and higher general secondary education, 25.22% had gained higher vocational and university education and above. Employment status were: employed (n=104, 46.84%), unemployed (n=45, 20.28%), and students (n=73, 32.88%). Besides that, the majority of patients (99.37 %) were still under treatment with surgery or surgery and integrated therapy (chemotherapy and/or radiation therapy).

The PTGI-C score ranged from 13 to 98 (M ± SD = 60.99 ± 14.23). Patients with malignant

Table 1. Socio-demographic and Disease Characteristics of Patients Among Patients with Malignant Bone Tumor (N=222)

	Mean/N	SD/%
Gender		100.0
Female	84	33.3
Male	138	66.7
Age (years)		100.0
Education	222	100.0
Primary school	10	4.50
Lower general secondary education	91	40.99
Inter mediate vocational and higher general secondary education	65	29.28
Higher vocational and university education and above	56	25.22
Long-term area of residence	222	100.0
Rural	144	64.86
Urban	78	35.14
Marital status	222	100.0
Unmarried	114	51.35
Married	108	48.64
Employment status	222	100.0
Enterprise or government	25	11.26
Individual business households	14	6.30
Workers or farmers	65	29.28
Unemployed	118	53.15
Time since diagnosis (days)	222	100.0
Treatment	221	99.37
Surgery	98	44.34
Surgery + integrated therapy	123	55.40

Table 2. PTGI-C Reliability, Cronbach's α Coefficient

Subscales	Cronbach's α coefficient	Item
F1	0.83	7
F2	0.758	5
F3	0.786	4
F4	0.721	2
F5	0.778	3
Total scale	0.91	21

bone tumor gained the highest mean score of items on relating to others (M = 20.86) and lowest mean score of items on spiritual change (M = 3.18). The PANAS-C score ranged from 25 to 90 (M ± SD = 52.78 ± 8.48). Patients' mean score on positive affect subscale was 30.66 (SD = 5.79), while their mean score on negative affect subscale was 22.36 (SD = 6.48).

Reliability

A total of 222 valid questionnaires were collected in this study. We tested the reliability of the PTGI-C by calculating the Cronbach's α coefficient in this procedure. As shown in Table 2, the reliability results of this scale are given into it. The Cronbach's α coefficients of the five subscales are all over 0.7, as well as the total scale is as

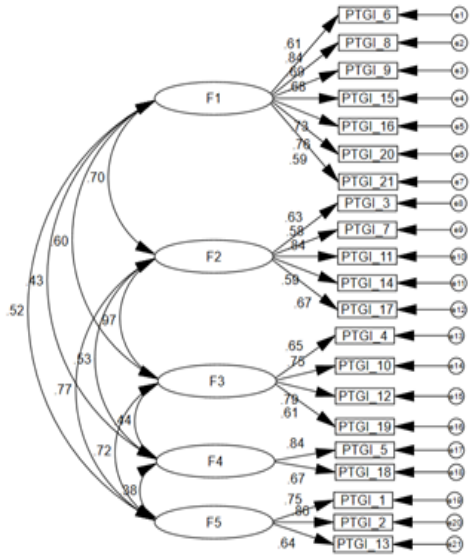

Figure 1. The Factor Model of the PTGI-C

Table 3. Matching Test Table of Confirmatory Factor Analysis Model of PTGI-C

Goodness-of-fit indices	CMIN/DF	RMR	RMSEA	GFI	AGFI	NFI	TLI	CFI
Goodness-of-fit standards	<3	<0.05	<0.08 (if <0.05-exllence; <0.08-good)	>0.90	>0.90	>0.90	>0.90	>0.90
Results	2.770	0.048	0.074	0.903	0.901	0.909	0.912	0.911

Table 4. PTGI-C validity, Convergent Validity between the Subscales and each Item

Subscale	Item	Factor Loading	Reliability	Measurement Error	Composite Reliability (C.R)	Average Variance Extraction (AVE)
	PTGI_6	0.61**	0.37	0.63		
	PTGI_8	0.84**	0.70	0.30		
	PTGI_9	0.69**	0.47	0.53		
F1	PTGI_15	0.69**	0.47	0.53	0.87	0.50
	PTGI_16	0.73**	0.53	0.47		
	PTGI_20	0.76**	0.57	0.43		
	PTGI_21	0.59**	0.35	0.65		
	PTGI_3	0.63**	0.40	0.60		
	PTGI_7	0.58**	0.34	0.66		
F2	PTGI_11	0.84**	0.70	0.30	0.80	0.50
	PTGI_14	0.59**	0.35	0.65		
	PTGI_17	0.67**	0.45	0.55		
	PTGI_4	0.65**	0.42	0.58		
F3	PTGI_10	0.75**	0.56	0.44	0.80	0.50
	PTGI_12	0.79**	0.63	0.37		
	PTGI_19	0.61**	0.37	0.63		
F4	PTGI_5	0.84**	0.70	0.30	0.73	0.58
	PTGI_18	0.67**	0.45	0.55		
	PTGI_1	0.75**	0.56	0.44		
F5	PTGI_2	0.86**	0.74	0.26	0.80	0.57
	PTGI_13	0.64**	0.41	0.59		

**, p <0.05; ***, p <0.01

Table 5. Hierarchical Regression Analysis on Positive Affect and Negative Affect Scores

	Positive affect				Negative affect			
	Model 1	Model2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
	Standard coefficient	Standard coefficient	Standard coefficient	Standard coefficient	Standard coefficient	Standard coefficient	Standard coefficient	Standard coefficient
Demographic variables								
Gender	1.241	1.212	1.655**	1.805***	-0.425	-0.428	-0.546	-0.909
Age	0.014	-0.023	-0.027	-0.018	0.023	0.039	0.028	0.022
Years of education	0.351**	0.355**	0.217	0.081	0.181	0.182	0.059	0.078
Long-term area of residence								
Urban	-1.094	-0.779	-0.516	-0.371	-0.406	-0.518	0.466	0.298
Marital status								
Married	5.212**	5.755***	5.024***	0.831	-2.357	-2.721	-2.714	-1.162
Unmarried	4.951**	5.604***	4.695**	1.286	-0.831	0.529	-1.288	-0.263
Employment status								
Enterprise or government	1.417**	0.954	1.208	2.240**	-0.733	-0.539	0.233	0.214
Individual business households	4.695***	4.426***	3.444**	3.295***	-1.384	-1.263	-0.246	-0.181
Workers or farmers	0.514	0.900	0.789	0.972	1.547	1.370	1.775**	1.307
Medical variables								
Time since diagnosis		0.167	-0.051	0.293		-0.013	0.336	0.212
Treatment after surgery								
Surgery		2.604***	2.263***	1.115		-1.475	-1.460**	-0.853
Surgery& chemotherapy		-0.012	-0.901	-0.810		-0.771	-1.265	-1.544
Positive affect at T1			0.397***	0.279***			0.026	0.063
Negative affect at T1			-0.073	-0.025			0.451***	0.402**
Posttraumatic growth inventory (PTGI)								
New possibility				0.142				-0.118
Relating to others				0.182				0.296**
Personal strength				0.523***				-0.410**
Appreciation of life				-0.126				0.293**
Spiritual change				0.213				-0.423**
F(p)	3.114**	3.171***	7.190***	16.445***	1.053	1.009	7.750***	8.707**
Adjusted R^2	0.108	0.142	0.256	0.651	0.003	0.001	0.376	0.483
ΔR^2	0.159	0.208	0.413	0.694	0.060	0.077	0.431	0.545

**, p <0.05; ***, p <0.01

high as 0.91. Regarding the reliability coefficient equal to or over 0.7 were considered to be satisfied which means the scale has good internal consistency, the findings obtained showed that PTGI-C has good internal consistency. The contents of each item in the scale are consistent and reflect the purpose of this study.

Validity

Considering this scale has already been divided into five subscales, the validity of the scale was examined with confirmatory factor analysis (CFA) by using AMOS 17.0 software. The structural equation model was conducted on the five subscales of the scale and the following results were obtained in Figure 1. The scale of the degree of fit meet all standards, which can be learned that the scale in accordance with the subscales of Figure 1 is in a very appropriate way. The results indicate that research data and theoretical dimension are fully consistent. Moreover, the factor analysis model and the data of the scale is well matched. As the matching index values was shown in Table 3, the result provided a good fit to the data with $\chi^2/df = 2.770$, GFI = 0.903, CFI = 0.911, TLI = 0.912, RMSEA = 0.074.

Considering the item plays a more important role in its dimension, we tested the factor loading of each item. The item plays a more important role in its dimension if the load of the factor is over 0.5. Secondly, the average variance extraction (AVE) was examined to show the convergent validity of the scale. Since the five dimensions contain a number of items, if the AVE of the subscale is over 0.5, it means that all items under the same dimension converge toward their own dimension and the dimension is confirmed by the validity test. Finally, the combined reliability of each dimension was examined whether it is over 0.6, while the combination is close to the concept of the reliability factor in the previous section. Scale factor loading, composite reliability, AVE results are shown in Table 4. As presented in Table 4, the value of the 21 items

are all greater than 0.5 and the values of the composite reliability of the five subscales are all greater than 0.6, as well as the AVE values are all greater than or equal to 0.5.

Regression analyses

The predictive effect of posttraumatic growth at initial assessment on psychological adjustment were examined after controlling gender, age, years of education, long-term area of residence (urban/rural), marital status, employment status, time since diagnosis and treatment details (Table 5).

Prediction of positive affect

In model 1, the demographic variables have a significant prediction on positive affect ($F = 3.114$, $p < 0.01$); they accounted for 10.8 % of the variance in positive affect at T2. In model 2, the medical variables have a significant prediction on positive affect ($F = 3.171$, $p < 0.01$); they accounted for 14.2 % of the variance in positive affect at T2. The regressions coefficient of surgery was significant ($\beta = 2.604$, $p < 0.01$). In model 3, the positive affect subscale and negative affect subscale had a significant prediction on positive affect ($F = 7.190$, $p < 0.01$), accounting for 41.3 % of variance. The baseline level of married ($\beta = 5.024$, $p = 0.006$), surgery ($\beta = 2.263$, $p = 0.006$) was positively associated with positive affect at T2. In model 4, the posttraumatic growth had a significant prediction on positive affect ($F = 16.445$, $p < 0.001$), accounting for 69.4 % of variance. The baseline level of gender ($\beta = 1.805$, $p < 0.01$), individual business households ($\beta = 3.295$, $p < 0.01$), positive affect ($\beta = 0.279$, $p < 0.001$) and personal strength ($\beta = 0.523$, $p < 0.01$) was positively associated with positive affect at T2, whereas new possibility ($\beta = 0.142$, $p = 0.208$), relating to others ($\beta = 0.182$, $p = 0.188$), appreciation of life ($\beta = -0.126$, $p = 0.226$), and spiritual change ($\beta = 0.213$, $p = 0.226$) at T1 were not associated with positive affect at T2 (Table 5).

Prediction of negative affect

In model 1, the demographic variables did not have a significant prediction on negative affect ($F = 1.053$, $p = 0.401$), accounting for 3.5 % of the variance in negative affect at T2. In model 2, the medical variables did not have a significant prediction on negative affect ($F = 1.009$, $p = 0.444$), accounting for 9.8 % of the variance in negative affect at T2. In model 3, the negative affect subscale and medical variables had a significant prediction on negative affect ($F = 7.750$, $p < 0.001$), accounting for 37.6 % of variance. The regressions coefficient of treatment after surgery was positively associated with negative affect at T2 ($\beta = 0.189$, $p < 0.05$), whereas the treatment was associated with less negative affect at T2 ($\beta = -1.460$, $p < 0.05$). In model 4, the posttraumatic growth had a significant prediction on negative affect ($F = 8.707$, $p < 0.001$), accounting for 48.3 % of variance. The regressions coefficient of relating to others ($\beta = 0.296$ $p = 0.017$) and spiritual growth ($\beta = 0.293$, $p = 0.020$) was positively associated with negative affect at T2, while personal strength ($\beta = -0.410$, $p = 0.042$) and appreciation of life ($\beta = -0.423$, $p = 0.029$) were associated with less negative affect at T2 (Table 5).

Discussion

Different from previous studies, our study was a cross-sectional and longitudinal study aiming to investigate the psychometric properties of the PTGI-C in a Chinese sampling with malignant bone tumor. The reliability and validity data in our study showed that the factor structure of the PTGI-C was comparable with the original factor structure, which indicates that it can be used in a group of malignant bone tumor patients (Tedeschi and Calhoun, 1996). The Cronbach's α coefficient for the five subscales is over 0.7 and the Cronbach's α coefficient of the total scale is up to 0.91, which means that values equal to or 0.70 were considered to be satisfied (Sanders et al., 2010). These findings are consistent with previous studies in cancer patients, which indicate that PTGI-C has good internal consistency (Jaarsma et al., 2006; Sanders et al., 2010). Furthermore, confirmatory factor analyse (CFA) was performed in this study. The factor analysis model demonstrated a good fit to the data. These findings differ from studies utilizing principal component analysis or exploratory factor analysis (Powell et al., 2003; Sears et al., 2003). While there has been considerable debate in the literature regarding the different types of factor analysis: since confirmatory factor analysis (CFA) provides for testing significance and multiple fit indices, it is more stringent for testing factor structure than principal component analysis (Henson, and Roberts, 2006). Meanwhile, the convergent validity was examined by calculating the average variance extraction and the composite reliability. These results demonstrate the degree of inter-correlations between the PTGI-C and its five subscales ranged from little if any correlation to moderate correlation, suggesting that the subscales are related but distinct. Overall, the current study verified that the PTGI has good reliability and validity in measuring the posttraumatic growth in patients with malignant bone tumor, while providing strong support to the application of PTGI in a multidimensional measure with different malignant disease populations.

The second purpose of this study was to investigate the predictive role of post traumatic growth on positive and negative affect in patients with malignant bone tumor. In order to control the effect of physical symptoms that may be attributed to the disease and medical treatment itself, we used Positive and Negative Affect Scale (PANAS) to measure the positive and negative affect. Several studies have found that post-traumatic growth moderated the effects of thoughts on positive and negative affect (Park, Chmielewski and Blank, 2010; Liu et al., 2017). In our study, personal strength significantly predicted positive affect at T2 after controlling for the influences of gender, age, marital status, years of schooling, disease stage, and baseline levels of positive and negative affect. Meanwhile, personal strength, appreciate to life, spiritual growth and relating to others significantly predicted negative affect at T2. Personal strength includes increasing self-confidence, better acceptance and expression of emotions, better appreciation of life and development of new interests. Patients with high scores for personal strength may indicate that they have enough personal ability to cope

with the current predicament and thus ease their anxiety about the disease (Wang et al., 2014). Moreover, patients who appreciate to life would naturally reduce the negative affect because it implies that these patients will make an effort to deal with the disease situation. Patients with higher spiritual growth scores are more likely to understand the life-threatening threats and initiated the mental ability to achieve a specific goal, which exactly can help them adopt more adaptive coping strategies to combat the disease thereby reduce their depression and anxiety (Danhauer et al., 2013). Additionally, the relationship with others suggests that patients received support and encouragement from their family members, friends, and other social support through higher perceiving response from others. These similar findings obtained in patients with malignant bone tumor are consistent with many studies, which indicate that patients gain more social support after controlling their negative affect (De Leeuw et al., 2000; Zhu et al., 2008).

Several limitations of the current study should be noted. Firstly, this study only utilized a sample of patients with malignant bone tumor in Hunan province, China. These samples may not represent all malignant bone tumor patients in China, which may affect the universality of our results. We tentatively suggest that future studies should assess the psychometric properties of the PTGI-C in other representative samples. Secondly, the present study nonetheless depended on self-report, an obvious limitation. Future studies should go beyond these limitations by using more objective measures, such as structured clinical interviews, peer or family ratings, and direct behavioural assessments.

In conclusion, the Chinese version of PTGI can be seen as a reliable and valid instrument to assess posttraumatic growth among malignant bone tumor patients. Relating to others, spiritual growth, personal strength and appreciate to life predict positive affect and negative affect, thus may be beneficial for their emotion problems as psychological interventions.

Conflict of interests

The authors paper reports no conflict of interest. The authors alone are responsible for the content and writing of the paper.

Acknowledgments

The research reported in this article was supported by A Clinical Study of Positive Mental Rehabilitation and Continuous Medical Service in Patients with Bone Tumor Project from Hunan Provincial Science and Technology Department in China (Grant number: 2013FJ4075).

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