

Review

Correlates of post-traumatic stress symptoms and growth in cancer patients: a systematic review and meta-analysis

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Abstract

Objective: The aim of this study is to examine the relationships among demographic, medical, and psychosocial factors and post-traumatic stress symptoms (PTSS) and post-traumatic growth (PTG) in oncology populations.

Method: A systematic search identified $k = 116$ relevant studies published between 1990 and 2012. Meta-analyses synthesized results from studies that reported data on correlates of PTSS ($k = 26$) or PTG ($k = 48$). A meta-analysis was performed for $k = 5$ studies reporting the correlation between PTSS and PTG.

Results: Post-traumatic stress symptoms were associated with depression ($r = 0.56$), anxiety ($r = 0.65$), distress ($r = 0.62$), social support ($r = -0.33$), and physical quality of life ($r = -0.44$). PTG was associated with age ($r = -0.08$), gender ($r = -0.15$), distress ($r = -0.16$), depression ($r = -0.06$), social support ($r = 0.30$), optimism ($r = 0.27$), positive reappraisal ($r = 0.46$), spirituality ($r = 0.33$), and religious coping ($r = 0.36$). There was a small positive relationship between PTSS and PTG ($r = 0.13$).

Conclusions: Post-traumatic stress symptoms and PTG appear to be independent constructs, rather than opposite ends of a single dimension. This is reflected in a small relationship between these variables and different psychosocial correlates. PTSS were strongly associated with variables reflecting a general state of negative affect. Optimism, spirituality, and positive coping styles were associated with PTG. It remains unclear how they are associated with PTSS, given the lack of relevant studies. Longitudinal research is required to examine how psychosocial factors influence the relationship between PTSS and PTG.

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Introduction

Cancer is a life-threatening disease that can have devastating effects on patients. Globally, the incidence of cancer is increasing due to expanding and aging populations [1], and death is a probable outcome in many cases. However, continuing advances in treatment and management have led to increased survivorship rates [2]. Many patients and survivors experience distress following diagnosis and treatment for cancer, and for some, this is clinically significant [3]. For some, the diagnosis and treatment of cancer may comprise a traumatic event, with psychological consequences framed in terms of post-traumatic stress disorder (PTSD). Estimated rates of PTSD in patients and survivors range considerably from 5% to 19% [4]. An additional 5–13% of patients experience post-traumatic stress symptoms (PTSS) in the subclinical range [4].

There is evidence that the symptom structure of PTSD, as outlined in the Diagnostic and Statistical Manual of Mental Disorders—Fourth Edition (DSM-IV-TR)[5], is applicable to cancer patients and may parallel responses observed across other trauma types [6].¹ However, it has also been suggested that the experience of post-traumatic stress following cancer may be distinct. In contrast to many other traumatic events, cancer is a future-oriented and complex trauma with an internal source, such that avoidance-related symptoms may differ in function and remain difficult to define [7]. A further challenge is delineating the onset and termination of the traumatic event that can comprise aspects of diagnosis and treatment, as well as the ongoing threat of disease recurrence [7]. These differences indicate value in considering the post-traumatic reactions of cancer patients separately from other types of trauma.

Psychological adjustment to trauma is not uniformly concerned with negative outcomes, and it may be valuable to conceptualize cancer as a psychosocial transition with potential for positive and negative changes [9]. The positive psychological changes resulting from trauma are commonly described in terms of post-traumatic growth (PTG) and benefit finding [9]. Although these terms are frequently used interchangeably, differences are apparent. Benefit finding is a general process through which an individual finds positivity in an adverse event given perceived benefits [10], including those relating to positive lifestyle and behavioral changes [11]. In contrast, PTG refers mainly to more pervasive cognitive and affective changes that occur following a traumatic event that causes breakdown of assumptions about life [9–11]. These changes may occur across three broad domains [12]. Perceived changes in self may occur through more positive evaluations of competence in difficult situations, while changes in relationships can follow from emotional growth including perceived closeness to and appreciation of others. Finally, increased appreciation of life and stronger spiritual beliefs may occur [12]. There have been criticisms of the PTG construct, which may reflect socially desirable responding [13] and attempts to cope with trauma using cognitive reappraisal strategies [14]. Notwithstanding, there is growing evidence that self-reported growth among trauma survivors predicts positive behavioral changes [15]. Although the prevalence of PTG is difficult to establish, given the lack of formal classification criteria, there is growing evidence that many cancer survivors experience some form of positive psychosocial change following diagnosis. The most common type involves improved perceptions of relationships with others [16].

Given the variability in experiences of PTSS and PTG following a cancer diagnosis, it is important to identify factors that are associated with negative and positive changes in patients and survivors. Improved understanding of such factors could inform interventions to ameliorate risk factors and promote positive outcomes. A range of factors have been considered in prior research and are shown (in at least some studies) to relate to either PTSS and/or PTG in oncology populations. These variables include sociodemographic characteristics (e.g., younger age at diagnosis [17]), disease related factors (e.g., advanced stage of cancer [18–20]), cognitive or behavioral styles (e.g., positive reappraisal and problem-focused coping [21–24]), and personality factors (e.g., trait optimism [21,25–27]). Notwithstanding, the findings are generally mixed, with many studies showing no associations or contrasting effects. For example, the findings of studies reporting associations between age and severity of PTSS following a cancer diagnosis are equivocal [17,28–30]. Heterogeneity across published research is difficult to interpret. On the one hand, there are many studies characterized by small samples and seemingly discrepant findings that could be explained by sampling error alone. However, there are also

clinical characteristics (e.g., cancer type) and methodological features (e.g., sampling strategy) that vary across studies and could explain this variability.

Several prior reviews have synthesized data on the correlates of PTSS or PTG in cancer. Most [4,7,16,31,32] have focused on PTSS and include reviews combining studies of cancer with other types of trauma (e.g., combat trauma [33,34]), or focussing on specific cancers (e.g., breast cancer [16]). Other reviews [4,7,31,32] have not involved systematic search strategies and did not include all available studies. There are three prior reviews of the correlates of PTG in cancer [10,35,36]. One focused on patients with cancer and HIV/AIDS [35], while another combined studies of cancer with other trauma types [36]. The third focused on coping processes associated with PTG [10]. One meta-analysis examined the relationship between PTSS and PTG following various traumas. The majority of studies in this review involved civilian victims of conflict ($n=6685$), with few studies of people with cancer ($n=747$) [34]. Therefore, a broad and comprehensive review of the literature on the correlates of both PTSS and PTG in oncology populations is warranted.

The current review provides a synthesis of evidence on the correlates of PTSS and PTG in general oncology populations, as well as the relationship between these outcomes. Systematic search strategies and meta-analytic techniques were utilized to provide the best available estimates of associations based on available evidence. The review also evaluated the degree of variability across studies and examined factors that may account for heterogeneity.

Method

Criteria for including studies in this review

Types of studies

Eligible studies were cross-sectional and reported data on correlates of PTSS or PTG in samples of oncology patients. Longitudinal studies were eligible for inclusion where cross-sectional data (involving correlations between variables measured at a single point in time) were reported. Additional criteria for studies were as follows:

1. Considered samples of adult patients of any ethnicity or sex who had been diagnosed with cancer (including adults with active disease and survivors who were disease free);
2. Measured PTSS and/or PTG using a validated measurement tool; and
3. Measured at least one potential correlate of PTSS or PTG, using a validated measurement tool, or a demographic or medical variable that potentially correlated with PTSS or PTG.

Correlates were selected on the basis of factors commonly examined in prior reviews [10,16]. These were

age, gender, stage of disease, indices of depression, distress,² social support, physical quality of life,³ spirituality, religious coping, optimism, and positive reappraisal. Given the focus on naturalistic correlates of post-traumatic outcomes, intervention studies were excluded. Articles relating to screening or investigation of suspected cancer, or involving samples of children or adolescents, were not considered. Studies that reported on diagnoses of PTSD (rather than continuous severity scores) were not eligible. These severity scores were required, such that the continuum of PTSS could be examined. Research that measured acute trauma responses (i.e., traumatic stress symptoms within 1 month of a cancer diagnosis) was also excluded, as were those not published in English.

Search methods

A broad systematic search of Ovid MEDLINE, Ovid MEDLINE in-process, PsycINFO, CINAHL Plus, and EMBASE electronic databases was conducted for relevant literature published between January 1990 and September 2012. An expert subject librarian was consulted during the formulation of the search strategy (e.g., see Appendix A). The following key terms were used: oncology, cancer, neoplasm, posttraumatic stress, trauma reactions, post-traumatic growth, benefit finding, major depression, depression, anxiety, mood, distress, emotional distress, social support, coping, optimism, quality of life, spirituality, religiosity, and religious coping. Titles and abstracts of all citations were screened by two authors (L. S., J. B.) to determine potential eligibility. Where there was disagreement based on title and abstract, the full-text article was examined. Full-text articles for potentially eligible studies were subsequently examined by one author (L. S.) to determine inclusion. In cases where it was unclear whether the article met the inclusion criteria, a second author (J. B.) reviewed the full text before consensus was reached.

Data extraction

Data from full-text articles were extracted by one author (L. S.). Data included the following: date of publication, country of origin, size, gender breakdown, mean age of the sample, tumor stream, mean time since diagnosis, measure of PTSS and/or PTG, measure of the correlate, timing of assessment, and effect size for the relationship with correlates. Studies were classified as having a high, low, or unclear risk of bias depending on recruitment methodology. Studies utilizing random sampling from a clinic or hospital database or centrally held register that reported a response rate above 50% were classified as low risk.⁴ Those with response rates below 50% or utilizing recruitment methods that disallowed the calculation of response rates were classified as high risk. Studies lacking information to assess risk of bias were classified as 'unclear'.

The correlation coefficient r [with 95% confidence interval (CI)] was used as the effect size index. Where r was unavailable, the effect size was calculated from other statistics (e.g., t -values and Cohen's D). If the study reported a correlation that was not statistically significant but did not report the value of the point estimate, an effect size of zero was recorded. This represents a conservative approach that may underestimate the true effect size [40,41]. Where subscale scores rather than total scores were reported, a combined effect size was calculated by transforming each r into a Fischer's Z_r coefficient, averaging across coefficients, and converting back to r [42]. Where multiple measures of PTSS were used in a single study, results for measures that assessed all three symptom clusters defined by the DSM-IV-TR diagnostic criteria for PTSD were selected (e.g., PTSD Checklist—Civilian Version versus Impact of Events Scale).

Data analysis

Random effects meta-analyses were conducted to provide a weighted mean estimate of the correlation between each variable and PTSS severity and PTG levels. Such analyses were conducted where data were available from at least three studies. For each analysis, the I^2 statistic was produced to index the total variation in correlation magnitude across studies due to between-study heterogeneity versus within-study heterogeneity (i.e., sampling error) [42]. Overlapping bands of I^2 values were used to categorize heterogeneity. Values ranging 0–40% indicated minimal heterogeneity, 30–60% moderate heterogeneity, 50–90% substantial heterogeneity, and 75–100% considerable heterogeneity [43]. Forest plots were produced to examine the distribution of effects across individual studies.

Subgroup analysis

Subgroup analyses were undertaken to explore variability across factors examined in studies. Such analyses were undertaken when $k \geq 10$ studies were available for analyses. Studies were classified according to tumor stream (breast cancer versus all other streams) and the timing of assessment post-diagnosis (<12 months vs ≥ 12 months). Studies were also grouped according to the measure of PTSS employed (Impact of Events Scale versus Post-traumatic Stress Checklist—Civilian Version) and PTG (Post-Traumatic Growth Inventory versus Benefit Finding Scale). For each analysis, studies were grouped according to shared characteristics, before a weighted mean and confidence interval were calculated. Non-overlapping confidence intervals indicate significant differences.

Sensitivity analysis

Analyses were repeated for all correlates while limiting the data to studies classified as low risk of bias.

Assessment of publication bias

Funnel plots were produced to evaluate potential publication bias.

Results

Search results

Figure 1 summarizes the results of the systematic search. The database search returned 2657 entries. Deleting duplicate articles (1650) left 1007 potential articles for assessment. Following evaluation of titles and abstracts, 680 articles failed to meet inclusion criteria and were excluded. Three hundred and twenty-seven articles were subsequently selected for full-text review. Common reasons for exclusion included lack of relevance and pediatric samples. A total of 116 studies met inclusion criteria. However, 46 studies did not include sufficient statistical information and were therefore excluded. Seventy studies were included in the final analysis.

Study characteristics

A summary of studies is provided in Supplementary Tables 1 and 2, and a full reference list for the included studies is available in the Supplementary materials. Women with breast cancer represented 56% of the participants in studies of PTSS and 53% in studies of PTG. The majority of studies were

Table 1. Meta-analytic results for correlates of post-traumatic stress symptoms

Correlate	k	n	ES	95% CI for r		I ₂ %
				Lower	Upper	
Age	12	1409	-0.09	-0.17	0.01	53.42
Gender	3	259	-0.08	-0.24	0.08	42.36
Time since diagnosis	7	1081	0.02	-0.08	0.12	59.46
Depression	11	1442	0.56	0.44	0.65	86.78
Anxiety	7	1103	0.65	0.50	0.76	91.38
Distress	8	968	0.62	0.55	0.69	57.46
Social support	4	263	-0.33	-0.48	-0.17	44.81
Physical quality of life	7	980	-0.44	-0.60	-0.24	89.72

k, number of studies; n, sample size; ES, effect size.

conducted in North America, and participants were typically recruited through medical facilities during treatment.

Correlates of posttraumatic stress symptoms

Results of the meta-analyses for correlates of PTSS are presented in Table 1. Forest plots depicting the distribution of effects across analyses, and studies are presented in Figure 1 in the Supplementary material. Because of the small number of studies, meta-analyses could not be conducted for stage of disease, optimism, positive reappraisal, religious coping, and spirituality.

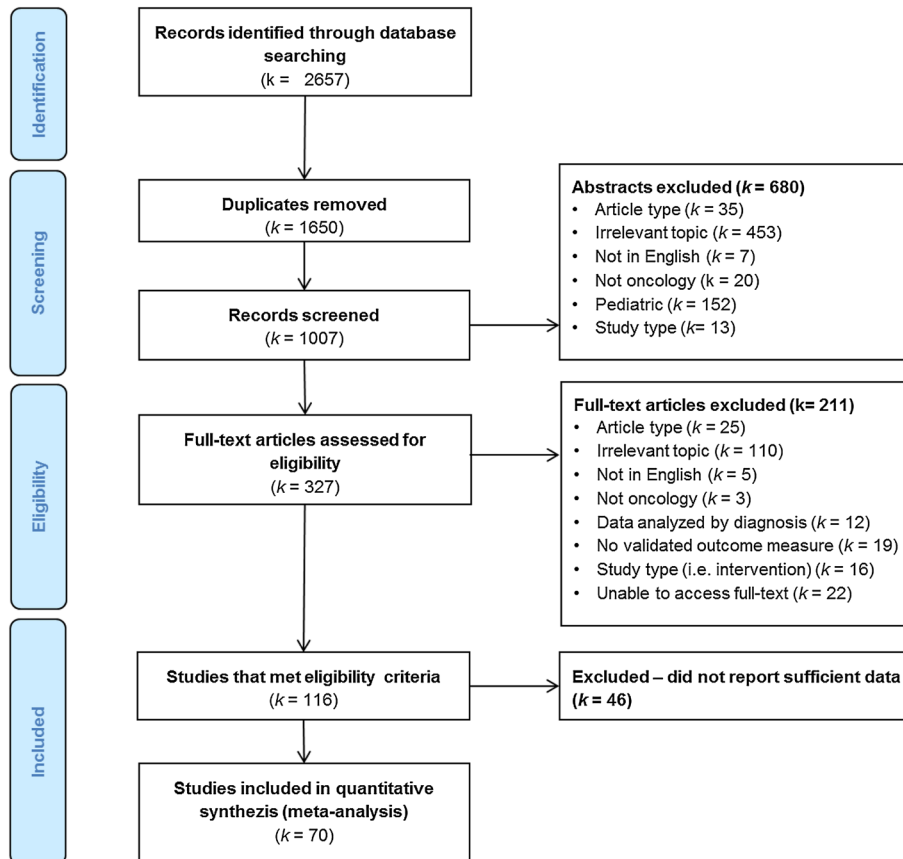


Figure 1. PRISMA flowchart of systematic search for correlates with symptoms of post-traumatic stress disorder and post-traumatic growth

Age at diagnosis

Analysis of $k=12$ studies ($n=1409$) revealed a weak negative association between age and PTSS (weighted $r=-0.09$). However, the 95% CI included zero (-0.17 to 0.01), indicating that this mean effect was not statistically significant. There were moderate levels of true heterogeneity across studies ($I^2=53.42\%$), with study-specific estimates ranging from $r=-0.29$ to 0.16 .

Gender

There was a weak negative association between gender and PTSS (weighted $r=-0.08$) as indicated by $k=3$ studies ($n=259$). Females reported higher levels than males. However, the result was not statistically significant (95% CI= -0.24 to 0.08). There were moderate levels of true heterogeneity across studies ($I^2=42.36\%$), with estimates ranging from $r=-0.24$ to 0.01 .

Time since diagnosis

Data from $k=7$ studies ($n=1081$) indicated no association between time since diagnoses and PTSS. This effect approached zero (weighted $r=0.02$) and was not statistically significant (95% CI= -0.08 to 0.12). There were moderate levels of true heterogeneity across studies ($I^2=59.46\%$), with estimates ranging from $r=-0.10$ to 0.27 .

Depression

There was a moderate positive association between depression and PTSS (weighted $r=0.56$) as indicated by $k=11$ studies ($n=1442$). The 95% CI did not include zero and was therefore statistically significant (95% CI= 0.44 – 0.65). Although there were considerable levels of true heterogeneity across studies ($I^2=86.78\%$), all reported positive relationships (ranging from $r=0.16$ to 0.79). Most effects were moderate to strong in magnitude (with only two studies reporting effects below $r=0.30$).

Anxiety

Data from $k=7$ studies ($n=1103$) suggested a strong positive relationship between anxiety and PTSS that was statistically significant (weighted $r=0.65$; 95% CI= 0.50 – 0.76). Although there was considerable heterogeneity ($I^2=91.38\%$), all studies reported positive associations that were moderate to strong (i.e., range $r=0.33$ – 0.87).

Distress

Data from $k=8$ studies ($n=968$) indicated a strong positive association between distress and PTSS that was statistically significant (weighted $r=0.62$; 95% CI= 0.55 – 0.69). Although there was a moderate level of true heterogeneity ($I^2=57.46\%$), all studies reported positive associations that were moderate to strong (range $r=0.41$ to 0.76).

Social support

There was a significant moderate and negative association between social support and PTSS (weighted $r=-0.33$; 95% CI= -0.48 to -0.17) based on $k=4$ studies ($n=263$). There were moderate levels of true heterogeneity ($I^2=44.81\%$). All studies reported negative associations that ranged from $r=-0.43$ to -0.06 .

Physical quality of life

Data from $k=7$ studies ($n=980$) revealed a moderate and negative association between physical quality of life and PTSS that was statistically significant (weighted $r=-0.44$; 95% CI= -0.60 to -0.24). Although there was a considerable level of true heterogeneity ($I^2=89.72\%$), all studies reported negative associations ranging from $r=-0.80$ to -0.07 .

Correlates of post-traumatic growth

Results of meta-analyses for correlates of PTG are presented in Table 2. Forest plots depicting the distribution of effects are presented in Figure 2 of the Supplementary material. Because of insufficient studies, analyses could not be conducted for stage of disease.

Age at diagnosis

Data from $k=19$ studies ($n=3416$) indicated a significant yet weak negative association between age and PTG (weighted $r=-0.08$; 95% CI= -0.15 to -0.02). There were moderate levels of true heterogeneity across studies ($I^2=68.56\%$), with estimates ranging from moderate and negative ($r=-0.48$) to weak and positive ($r=0.11$).

Gender

There was a weak negative association between gender and PTG (weighted $r=-0.15$), based on $k=4$ studies

Table 2. Meta-analytic results for correlates of post-traumatic growth

Correlate	k	n	ES	95% CI for r		I ₂ %
				Lower	Upper	
Age	19	3416	-0.08	-0.15	-0.02	68.56
Gender	4	345	-0.15	-0.23	-0.06	55.67
Time since diagnosis	14	3190	0.01	-0.05	0.06	49.24
Depression	19	2707	-0.06	-0.11	-0.01	37.09
Anxiety	7	1270	0.02	-0.06	0.11	52.58
Distress	10	1335	-0.16	-0.24	-0.08	46.02
Social support	15	2365	0.30	0.23	0.37	62.55
Physical quality of life	7	2270	0.02	-0.05	0.09	57.90
Optimism	7	1458	0.27	0.07	0.45	93.54
Positive reappraisal	8	981	0.46	0.37	0.53	52.27
Spirituality	7	1249	0.33	0.17	0.47	87.35
Religious coping	6	538	0.36	0.28	0.43	0.00

k, number of studies; n, sample size; ES, effect size.

($n=345$). Females experienced higher levels of PTG than males. This result was statistically significant (95% CI = -0.23 to -0.06). There were moderate levels of true heterogeneity ($I^2=55.67\%$).

Time since diagnosis

Results indicated no association between time since diagnoses and PTG, as this approached zero (weighted $r=0.01$) from $k=14$ studies ($n=3190$). This relationship was not statistically significant (95% CI = -0.05 to 0.06). There were moderate levels of true heterogeneity across studies ($I^2=49.24\%$), with estimates ranging from moderate and negative ($r=-0.28$) to moderate and positive ($r=0.24$).

Depression

Data from $k=19$ studies ($n=2707$) suggested a statistically significant weak negative association between depression and PTG (weighted $r=-0.06$; 95% CI = -0.11 to -0.01). There were minimal to moderate levels of true heterogeneity across studies ($I^2=37.09\%$) and estimates ranging from $r=-0.23$ to 0.18 .

Anxiety

The results revealed an association between anxiety and PTG that approached zero (weighted $r=0.02$) based on data from $k=7$ studies ($n=1270$). This result was not statistically significant (95% CI = -0.06 to 0.11). There were moderate levels of true heterogeneity across studies ($I^2=52.58\%$), and estimates ranged from $r=-0.18$ to 0.13 .

Distress

Data from $k=10$ studies ($n=1335$) indicated a significant weak negative association between distress and PTG (weighted $r=-0.16$; 95% CI = -0.24 to -0.08). There were moderate levels of true heterogeneity across studies ($I^2=46.02\%$). With the exception of one study reporting a positive association ($r=0.27$), all other estimates were negative, ranging from $r=-0.30$ to -0.04 .

Social support

The results revealed a statistically significant moderate and positive association between social support and PTG (weighted $r=0.30$; 95% CI = 0.23 to 0.37), based on data from $k=15$ studies ($n=2365$). Although there were moderate to substantial levels of true heterogeneity ($I^2=62.55\%$), all studies reported positive associations that ranged from $r=0.09$ to 0.50 .

Physical quality of life

There was an association between physical quality of life and PTG that approached zero and was not statistically significant

(weighted $r=0.02$; 95% CI = -0.05 to 0.09). This was based on data from $k=7$ studies ($n=2270$). Although there were moderate levels of true heterogeneity across studies ($I^2=57.90\%$), all estimates were weak and ranged from $r=-0.10$ to 0.13 .

Optimism

Data from $k=7$ studies ($n=1458$) suggested a statistically significant weak and positive association between optimism and PTG (weighted $r=0.27$; 95% CI = 0.07 to 0.45). There were considerable levels of true heterogeneity across studies ($I^2=93.54\%$) and estimates ranging from $r=0.03$ to 0.68 .

Positive reappraisal

There was a significant moderate and positive association between positive reappraisal and PTG (weighted $r=0.46$; 95% CI = 0.37 to 0.53) based on data from $k=8$ studies ($n=981$). Although there were moderate levels of true heterogeneity across studies ($I^2=52.27\%$), all estimates were positive and ranged from $r=0.27$ to 0.63 .

Spirituality

Analysis revealed a significant moderate and positive association between spirituality and PTG (weighted $r=0.33$; 95% CI = 0.17 – 0.47) based on data from $k=7$ studies ($n=1249$). Although there were substantial levels of true heterogeneity ($I^2=87.35\%$), the estimates mostly suggested positive associations $r=0.26$ – 0.70 . One exception was a study which failed to report the magnitude of a non-significant effect and was imputed as zero.

Religious coping

Data from $k=6$ studies ($n=538$) indicated a statistically significant moderate and positive association between religious coping and PTG (weighted $r=0.36$; 95% CI = 0.28 – 0.43). There was no heterogeneity across studies ($I^2=0.00\%$). Estimates suggested moderate to large associations ranging from $r=0.28$ to 0.56 .

Relationship between post-traumatic stress symptoms and post-traumatic growth

Analysis of $k=5$ studies ($n=401$) that reported on the relationship between PTSS and PTG indicated a statistically significant, albeit weak, association (mean $r=0.13$; 95% CI = 0.03 – 0.23). There was no heterogeneity across studies ($I^2=0.00\%$).

Subgroup analyses

There were sufficient data to conduct subgroup analyses for estimates of relationships involving both PTSS and PTG with correlates including age, time since diagnosis, depression, and social support. For PTSS, studies could

Table 3. Results of subgroup analyses

	Age				Time since diagnosis				Depression				Social support			
	k	Estimate	CI		k	Estimate	CI		k	Estimate	CI		k	Estimate	CI	
			LB	UB			LB	UB			LB	UB			LB	UB
Post-traumatic growth																
Timing of assessment																
Short-term	5	-0.10	-0.23	0.04	6	-0.04	-0.12	0.03	7	-0.07	-0.13	-0.00				
Long-term	8	-0.08	-0.21	0.04	6	0.04	-0.05	0.13	7	-0.04	-0.12	0.05				
Tumor stream																
Breast	6	-0.08	-0.20	0.04					6	-0.08	-0.19	0.03	5	0.28	0.15	0.4
Mixed	8	-0.15	-0.25	-0.05					9	-0.05	-0.12	0.03	7	0.35	0.26	0.44
PTG measure																
PTGI	14	-0.13	-0.21	-0.04												
BFS	5	-0.01	-0.06	0.06												
PTSS																
PTSS measure																
IES	5	-0.05	-0.15	0.05					5	0.42	0.21	0.59				
PCL-C	7	-0.12	-0.25	0.01					6	0.65	0.53	0.73				

LB, lower bound confidence interval; UB, upper bound confidence interval; short-term, <12 months post-diagnosis; long-term, ≥12 months post-diagnosis; PTGI, Post-traumatic Growth Inventory; BFS, Benefit Finding Scale; IES, Impact of Events Scale; PCL-C, PTSD Symptom Checklist—Civilian Version.

only be categorized according to the measure used to assess symptoms. For PTG, studies could be grouped meaningfully according to the timing of assessment, tumor stream, and the measure of growth utilized. The results are presented in Table 3.

There was a trend suggesting larger estimates of association between PTSS and depression in studies using the Post-traumatic Stress Symptom Checklist—Civilian Version ($k=6$; mean $r=0.65$; 95% CI=0.53–0.73) versus the Impact of Events Scale ($k=5$; mean $r=0.42$; 95% CI=0.21–0.59). The results indicated a trend toward larger estimates of association between PTG and age at diagnosis in studies using the Post-traumatic Growth Inventory ($k=14$; mean $r=-0.13$; 95% CI=-0.21 to -0.04) compared with the Benefit Finding Scale ($k=5$; mean $r=-0.01$; 95% CI=-0.06 to 0.06). However, in both instances, the 95% CIs overlapped, such that these differences were not significant. There was no evidence of meaningful differences according to timing of assessment of PTG and tumor stream.

Sensitivity analysis

Sensitivity analyses only involved studies classified as low risk of bias. Analyses of the association between PTG and gender could not be conducted as there were no studies assessed as low risk. The results are summarized in Supplementary Tables 3 and 4. Overall, results indicated similar findings between studies with a low risk of bias and all studies. Although there were some minor reductions in effect sizes, conclusions were generally robust to risk of bias.

Publication bias

Funnel plots were produced to screen for potential publication bias for analyses where there were at least $k=10$

studies. Although there are no clear guidelines on the interpretation of these plots, and the analysis was limited by the small number of studies, there was no clear evidence of bias in the published literature. These plots are presented in Figure 3 in the Supplementary material.

Discussion

This is the first systematic review and meta-analysis to evaluate the psychosocial correlates of PTSS and PTG in oncology patients. Overall, different correlates were found for these post-traumatic outcomes. Depression, anxiety, and distress were strongly and positively associated with PTSS. In contrast, anxiety was unrelated to PTG, while the relationship between depression and distress was negative and weak. Poorer physical quality of life was moderately associated with PTSS but unrelated to PTG. Gender (moderately) and age (weakly) were associated with PTG but not PTSS. Women reported more PTG than men, and younger participants reported more PTG than older participants. Optimism, positive reappraisal, spirituality, and religious coping were moderately related to PTG. However, there was insufficient data to examine relationships between these factors and PTSS. Social support was negatively related to PTSS and positively related to PTG.

Depression, anxiety, distress, and physical quality of life

Depressive symptoms, anxiety, and distress were strongly related to PTSS. While the review focused on post-traumatic symptom severity (not diagnosis), this finding is not unexpected given high rates of comorbidity among these disorders [44,45]. Results showed no relationship between physical quality of life and PTG. This is consistent with the positive psychology framework suggesting that individuals can

experience positive outcomes in the midst of distress and that adjustment is not contingent on alleviation of suffering [46]. A study of women with breast cancer found that PTG may weaken the relationship between PTSS symptoms and quality of life [47]. PTG may buffer against the effects of psychological distress on quality of life.

Optimism and adaptive coping styles

The review highlights the paucity of research on PTSS and variables relating to optimism and adaptive coping styles, including positive reappraisal, social support, religious coping, and spirituality. All of these constructs emerged as important correlates of PTG. Theoretical models posit that trauma can shatter assumptions about the self and the world, which triggers automatic ruminative activity [48,14]. For some, this rumination is experienced as PTSS [48,14]. However, for others who engage in adaptive coping styles, such as positive reappraisal, there may be deliberate rumination characterized by narrative development and the search for meaning [4,14]. Social support from family and friends may promote the construction of meaning and growth by facilitating cognitive processing of the experience [49]. PTG may also occur over time as individuals reconstruct views of themselves and the world [48,14]. Therefore, it is proposed that distress will be alleviated as PTG occurs [48,14]. The meta-analysis showed a negative weak relationship between distress and PTG. However, prospective research is needed to test this hypothesis. Social support appeared to protect against PTSS but caution is required as this finding was based on few studies.

The review highlighted the lack of research examining the relationship between spirituality and PTSS in people with cancer. In relation to PTG, spirituality and religious coping emerged as important factors. Given that spiritual changes are one facet of PTG, this result is unsurprising. Spiritual beliefs provide a framework from which traumatic events can be interpreted, thus facilitating growth and enhancing positive affect [50]. For example, previous research indicates that prayer may function as a method of cognitive processing that assists people to construct meaning following a traumatic experience, which may lead to PTG [51]. However, a traumatic event may conflict with an individual's existential beliefs [52,53]. Research has demonstrated that spiritual struggle (i.e., negative spiritual reappraisals and spiritual discontent) following a traumatic event can partially mediate the relationship between trauma and PTSS [54]. More research on the mechanisms by which spirituality and religious coping influence the development of PTG and PTSS in oncology populations is needed.

The relationship between PTSS and PTG

Results indicated a small positive association between PTSS and PTG, with only one study reporting a significant

effect [47]. These authors found that PTG moderated the relationship between PTSS and depression and quality of life, suggesting that bivariate associations are unable to capture these complex relationships. It has been suggested that growth is a cognitive adaptive process in those who experience PTSS following cancer diagnosis. Growth following trauma enables survivors to reframe their experiences and perceive potential benefits [47]. A recent meta-analysis examined the linear and curvilinear relationship between PTSS and PTG following various types of trauma, including cancer [34]. The results indicated that the relationship was best described as moderately curvilinear. This may suggest that PTSS are initially associated with an increase in PTG, but PTG decreases when PTSS becomes more severe. Overall, the authors concluded that PTSS and PTG are not opposite ends of a spectrum but rather constructs that coexist and relate in complex ways [34]. Longitudinal research is needed to elucidate the temporal course of post-traumatic reactions following a cancer diagnosis and the psychosocial factors influencing these outcomes.

Further considerations, future research, and conclusions

More studies examined the correlates of PTG ($k=48$) than PTSS ($k=26$), with participants consisting mostly of women with breast cancer. The current subgroup analyses provided no evidence of differences between samples of women with breast cancer and other cancer diagnoses for associations between PTG and social support and depression. Limitations of the data precluded more detailed comparisons across tumor types, while analysis of the impacts on PTSS could not be undertaken due to insufficient data. Accordingly, these subgroup analyses should be interpreted cautiously. Future research should examine whether other factors, including stage of disease, prognosis, and treatment phase (active versus inactive), are determinants of PTSS and/or PTG across tumor streams.

There may be different predictors of PTG and benefit finding, and this may support a theory that they are separate but related constructs [55]. For example, optimism appears to be a unique correlate of benefit finding but not PTG [55]. In the present study, subgroup analysis was undertaken to examine if the Post-traumatic Growth Inventory yielded a different effect size than the Benefit Finding Scale. However, this analysis could only be undertaken for age because of insufficient data, and the result was not significant. Additional research is required to examine the processes underlying benefit finding and PTG in cancer populations.

The current review identified high levels of between-study heterogeneity. The aim of subgroup analyses was to explain this heterogeneity but no results were significant. This may be due to difficulties categorizing studies in meaningful ways. Additional factors may also be important in explaining the heterogeneity; for instance, the timing of assessment of post-traumatic outcomes. As noted in other reviews (e.g., Rajandram *et al.* [10]), there is considerable variation across studies regarding the time at which assessments occurred. Assessments ranged from immediately to a decade post-diagnosis. Many studies did not report the time at which assessment occurred. Time since diagnosis may be an important covariate as PTSS levels generally decline following treatment completion or within 3 months post-diagnosis [4]. In comparison, PTG may increase over time as individuals process the event [11].

This review had several strengths. Clear inclusion criteria were developed, and studies were evaluated by two coders. The meta-analyses summarize findings in terms of a single, average effect size. Although the review was limited in that only published studies were included and authors were not contacted to obtain unpublished data, the funnel plots provided no evidence of publication bias.

The findings indicate that optimism and adaptive coping styles, including positive reappraisal, seeking social support, and religious coping, were associated with higher levels of PTG. However, less is known about how these factors relate to PTSS. Given the association between PTSS and quality of life of people with cancer, it is important to better elucidate the determinants of PTSS. As the reviewed studies were correlational, conclusions cannot be drawn about causality and longitudinal research is required. Finally, the limited research suggests that PTSS and PTG are distinct concepts, although both may occur in individuals who experience cancer [56]. Further research is required to examine the relationship between PTSS and PTG; whether cancer patients and survivors can experience both outcomes simultaneously; or whether PTSS precedes and/or is a catalyst for growth.

A final comment seems necessary regarding changes under DSM-5 to the criteria for PTSD, which may have implications for diagnoses following cancer. These changes mean that diagnosis and treatment of cancer may not necessarily be considered a traumatic event, unless there are other adverse and traumatic circumstances [8]. DSM-5 also requires that disturbances in functioning must not be attributed to another medical condition. Accordingly, the overall prevalence of PTSD in oncology populations may reduce because of tightened diagnostic criteria. In the future, clinically significant psychological distress in this population may be better accounted for by other diagnostic categories, such as adjustment disorder [8], rather than PTSD. Research on this issue is required.

Appendix A

Search strategy for Posttraumatic Stress: PsycINFO

1	exp neoplasms/ OR exp Oncology/	25	23 OR 25
2	Oncolog*.mp.	26	optimism/
3	Cancer*.mp.	27	Optimism.mp.
4	Neoplasm.mp.	28	26 OR 27
5	2 OR 3 OR 4	29	"quality of life"/
6	1 AND 5	30	"Quality of life".mp.
7	exp Posttraumatic Stress Disorder/	31	29 OR 30
8	Post*traumatic stress disorder.mp. OR PTSD.mp. OR Trauma reactions.mp. OR Trauma*.mp. OR Emotional trauma.mp. OR Stress.mp.	32	exp spirituality/
9	7 AND 8	33	Spirituality.mp.
10	6 AND 9	34	32 OR 33
11	exp major depression/	35	exp religiosity/
12	Depress*.mp. OR Mood.mp.	36	Religio*.mp.
13	11 OR 12	37	35 OR 36
14	anxiety/ OR anxiety disorders/	38	Religio* cop*.mp.
15	Anxiety*.mp.	39	10 AND 13
16	14 OR 15	40	10 AND 16
17	exp social support/	41	10 AND 19
18	Social support.mp.	42	10 AND 22
19	17 OR 18	43	10 AND 25
20	Coping behavior/	44	10 AND 28
21	Coping*.mp.	45	10 AND 31
22	20 OR 21	46	10 AND 34
23	exp distress/	47	10 AND 29
24	Distress.mp. OR Emotional distress.mp.	48	10 AND 38

Conflict of interest

The authors have declared no conflicts of interest.

Notes

1. The symptom structure of PTSD has undergone some revisions under DSM-5, moving to four symptom categories instead of three, and classification as a trauma-related and stress-related disorder rather than an anxiety disorder [6]. The overall prevalence of PTSD is anticipated to remain largely unchanged [7]. However, there may be some reductions in rates of diagnoses associated with cancer [8].
2. Given the overlap evident in the literature with symptoms of depression and distress, the National Comprehensive Cancer Network definition of distress was utilized, which states distress can be of a psychological, social, and/or spiritual nature that interferes with a person's ability to cope with their cancer [37].
3. Physical quality of life was selected to assess the relationship between physical functioning and PTSD symptoms and PTG.
4. Average response rates by cancer patients range from 30–42% for unpaid surveys [38] to 47–70% for paid surveys [39].

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