Published in final edited form as:

Psychooncology. 2018 December ; 27(12): 2754–2760. doi:10.1002/pon.4881.

Roles of Positive Psychological Outcomes in Future Health Perception and Mental Health Problems: A Report from the Childhood Cancer Survivor Study

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Abstract

Objective: Positive psychological outcomes among adolescent and young adult survivors of childhood cancer may influence long-term health status. We examined posttraumatic growth (PTG) and Life satisfaction (LS) in adolescence, and their impact on future emotional and physical health status in young adulthood.

Methods: Survivors (n=2802) from the Childhood Cancer Survivor Study were longitudinally analyzed across social, emotional, and physical factors during adolescence (12–17 years old), and PTG (PTG-Inventory) and LS (Cantril-Ladder-of-Life) during young adulthood (19–24 years old). The impact of PTG and LS on survivors' future long-term mental health, physical health, and social skills was also examined (23–28 years old) using Structural Equation Modeling.

Results: Survivors reported high levels of LS (M=7.43, range 1 to 10) and a positive impact from their cancer experience (M=48.78, range 0 to 105). Adolescent predictors of higher PTG included older age at diagnosis ($p=0.001$), experiencing more severe chronic health conditions ($p=0.01$), cancer recurrence/relapse ($p=0.01$), and being diagnosed with a non-CNS cancer ($p=0.001$). Higher perceived general health ($p=0.01$), higher social skills ($p=0.001$), and diagnosis with a non-CNS cancer ($p=0.02$) were associated with higher LS. Higher PTG during young adulthood predicted poorer perceived health ($p=0.04$) and worse emotional health ($p=0.001$) in later adulthood. Higher LS predicted better emotional health ($p=0.001$) and better perceived health ($p=0.001$).

Conclusions: While LS was found to help survivors have better perceived long-term emotional and physical health outcomes, survivors with higher PTG found both positive and negative impacts from cancer. Future therapeutic trials to improve LS should be considered.

Keywords

Positive psychological outcomes; Posttraumatic growth; life satisfaction; health perception; mental health problems; longitudinal studies; childhood cancer survivors

Cancer from childhood through adulthood can be a traumatic event with an arduous treatment¹. During remission, survivors can be challenged by diminished health and psychological distress². Despite these challenges, survivors have a generally positive life perspective³. For childhood survivors, the literature is incomplete, prompting renewed interest in how survivors remain emotionally healthy with positive life satisfaction despite, or perhaps due to, their earlier challenges^{4,5}. With 420,000+ survivors of childhood cancer in the United States⁶, benefiting from a five-year survival rate over 83%⁷, attention should focus on improving psychological outcomes.

Positive psychological outcomes after diagnosis and treatment include greater and ever-increasing life appreciation^{8,9} (higher than the general population). Some survivors report experiencing posttraumatic growth (PTG)¹⁰—a positive life change resulting from challenging circumstances¹¹.

The literature on PTG offers a new perspective, urging cancer be considered a traumatic event requiring recovery with potential transformational growth^{12,13}. Interviews of adolescent and young adult survivors reported some feeling stronger, more mature, greater purpose, and adjusted priorities^{14,15}. Buttressed by experiences, some survivors feel more capable to handle challenges.

Can cancer trauma lead survivors to positive growth? Correlational studies^{16,17,18,19} identified relationships between surviving and PTG, but not yet causality. It is not known if cancer experience from childhood is a predictor of positive life satisfaction (LS) and PTG. Adolescents and young adults are often optimistic, predisposing them to experience more PTG²⁰. Therefore, we hypothesize that future positive growth is directly associated with the experience of surviving cancer in childhood.

To understand what could predispose a child to have long-term positive outcomes from their cancer experience, the Childhood Cancer Survivor Study (CCSS) provided longitudinal measurements of survivors from childhood to early adulthood. PTG and LS are two provided indicators from early adulthood to quantify positive growth. Items reported by both survivor and parent illustrate the progression from illness in childhood to survivor in adolescence. These items include mental and physical health, social skills, illness details, perception of their own health, and demographics. The first study goal was to build a structural model combining adolescent indicators of survivors' mental, physical, and social condition along with early adulthood indicators of positive growth to identify links between early factors and late positive outcomes.

A positive perspective after childhood cancer treatment could include lower future distress, decreased cortisol secretion, increased immune function, and fewer physician appointments^{3,21}. Surviving adolescents and young adults have increased future risk for

severe chronic health conditions relative to the general population²². While cancer increases the risk of future negative outcomes²³, the experience may initiate a moderating resilience process. We hypothesized cancer experience initiated resilience processes may inhibit psychopathology (low anxiety, depression, somatization), reduce health problems, and improve future perception of health.

PTG and LS are two positive outcome markers of resilience. The CCSS measures mental, social, and physical variables in adolescence; PTG and LS in early adulthood; and mental health, health perception, and medical issues in young adulthood (age 25–30). Structural models can more clearly identify how resilience, emerging through PTG and LS, can potentially improve health outcomes while controlling for the direct effects of the disease and the child's adolescence experiences. This study's second goal was to identify factors in adolescence that predict a moderating influence of PTG and LS on long-term medical and mental health issues.

Cognitive ability developments during adolescence and young adulthood may help survivors make sense of and find meaning from their disease. Relative to older adults, the often optimism and receptiveness of adolescents and young adults may promote PTG experiences²⁴.

The purpose of this study was to estimate the prevalence and predictors of PTG and LS in long-term survivors of childhood cancer, and to examine their associations with future emotional well-being and physical health. Positive outcomes are observed over time (up to 20 years) and across different domains to identify a resilience process. Specifically, we examined longitudinal associations between behavioral and physical health status during adolescence, PTG and LS during early adulthood, and future mental and physical health in subsequent adulthood.

Methods

Population

The Childhood Cancer Survivor Study (CCSS) is a retrospective cohort with longitudinal follow-up of survivors under 21 years of age, and treated at 26 centers across the United States and Canada for leukemia, central nervous system (CNS) tumors, Hodgkin lymphoma, non-Hodgkin lymphoma, kidney tumors, neuroblastoma, sarcoma, or bone tumors. Survivors had to survive at least five years after their diagnosis date. Details of the CCSS have been reported previously²⁵.

This study examines PTG and LS in adolescence and young adulthood, limiting the sample to survivors who were 12–17 years of age at Baseline in 1994. These survivors subsequently completed the Follow-up 2 survey as young adults beginning in 2003, and the Follow-up 4 survey beginning in 2007. Of the 14,358 survivors with completed Baseline questionnaires, 3,282 were 12–17 years old (Supplemental Figure 1). Survivors who subsequently died (n=433) or reported an underlying genetic disorder (e.g. Down syndrome, Bloom syndrome, etc.; n=47) were excluded, leaving 2802 adolescent cancer survivors eligible at Baseline and

eligible to complete the remaining surveys. Of these, 1993 (69%) and 1685 (60%) completed Follow-up 2 and 4, respectively.

Measures

Baseline—The Behavior Problem Index (BPI)²⁶ was used to assess internalizing and externalizing behavior problems during adolescence ($\alpha=.93$). The survey included 28 items parent-reported items (range 1–3), originally developed for the National Health Survey, as a subset of the Child Behavior Checklist (Achenbach, 1991). Severity of chronic health conditions reported on Baseline and all subsequent surveys has been scored using the **Common Terminology Criteria for Adverse Events (CTCAE)**²⁷ version 4.3, with conditions graded on a 4-point scale (mild, moderate, severe, and life-threatening). Responses from the Baseline questionnaire were coded into organ-specific toxicities listed in the CTACE. A variable was generated for the maximum grade a survivor developed by the time of the Baseline and Follow-up 4 surveys ($\alpha=.82$). **Health perception** were parent-reported variables, which included pain as a result of cancer and/or treatment (0=No pain, 1=small, 2=medium, 3=a lot, 4=very bad/excruciating) and general health status (range 1–5, representing poor to excellent health) ($\alpha=.88$). **Cancer related variables** were abstracted and categorized into solid tumors, CNS tumors, and leukemia/lymphoma. Report of relapse originated from medical records within 5 years of primary cancer or from a validated self-report after 5 years. **Demographic variables** included age at diagnosis and Baseline, household income (<\$19,999; \$20,000–\$60,000; >\$60,000), and utilization of special education services as a proxy for cognitive problems. **Social skills variables** included five parent-reported items related to how well children got along with siblings and peers, behaving with parents, and playing/working independently (1=worse, 2=same, 3=better than other same-aged children) ($\alpha=.81$).

Follow-up 2—The Posttraumatic Growth Inventory (PTGI)¹¹ is 21 items in 5 subscales: Relating to Others, New Possibilities, Personal Strength, Spiritual Change, and Appreciation for Life. The PTGI (range 0–105) was adapted to self-assess the extent survivors were influenced by their cancer experience ($\alpha=.97$), responding to each item using a 6-point scale (0=“not at all influenced” to 5=“very much influenced”). **The Cantril Ladder of Life**²⁸ uses three self-report items to rate LS in the past, present, and future. Questions in the survey were, for example, “on which step of the ladder do you feel you personally stand at the present time?”. Ratings were made on a 10-point scale ranging from 1 (worst possible life) to 10 (best possible life) ($\alpha=.84$). This Cantril survey has been extensively used by Gallup to assess well-being around the world. Both measures have been applied to the general population and cancer survivors^{29,30}.

Follow-up 4—The Brief Symptom Inventory-18 (BSI-18) self-assessed emotional distress³¹ over the previous week, including a Global Distress Index and three subscales: depression ($\alpha=.91$) (41–81), anxiety ($\alpha=.88$) (40–81), and somatic complaints ($\alpha=.89$) (38–81). As previous PTG studies identified internalizing problems as variables³², depression and anxiety were combined into a mental health problems variable. A generated **perception of health variable** grouped somatic complaints, pain, and general health status. Variables

available at Baseline were measured in Follow-up 4 to assess chronic health conditions and perception.

Statistical Approach

We applied structural equation modeling (SEM) to identify longitudinal associations between mental health, physical health, social skills, cancer diagnosis and treatment, demographic and socioeconomic factors, and positive outcomes, i.e. PTG and LS. The first SEM model assessed predictors of PTG and LS at Follow-up 2. The Baseline predictors included seven variables (income, special education, type of cancer, recurrence/relapse, age at diagnosis and at Baseline, and medical issues), and three latent constructs (pain and perception of general health, social skills [independence and behaving well with parents, siblings, and children], and mental health [internalizing and externalizing problems]) (see Supplemental Figure 2). The second SEM model assessed outcomes of PTG and LS at Follow-up 4 (see Supplemental Figure 3) using predictors from Baseline and Follow-up 2 survey (PTG and LS), two latent constructs (health perception [pain, somatization, and perception of health] and mental health [anxiety and depression]), and one variable (chronic medical issues). To examine the unique effect of PTG and LS on health perception, mental health, and chronic health conditions, we controlled for Baseline predictors of PTG and LS, health perception, mental health, and chronic health conditions. The model was trimmed to contain only significant paths from Baseline to Follow-up 4 outcomes providing a good fit, $\chi^2(265)=1884.90$, $p=.000$; SRMR=.04; RMSEA=.05, CI=[.04 .05]; CFI=.93. A Robust Maximum Likelihood Estimator resolved skewedness of some variables. Other statistical methods, e.g. repeated measures ANOVA and correlational analyses, were performed to compare results among cancer types and survivors.

Results

All survivors in this analysis were under ten when diagnosed (median 3, range 0–9), 12–17 (median 15) at Baseline, 19–24 (median 22) at Follow-up 2, and 23–28 (median 26) at Follow-up 4 (Table 1). Participants were predominantly Caucasian (81%) and male (53%) with household income between \$20,000 and \$60,000 (70%) at Baseline. 31% attended special education programs at Baseline. Almost half had a primary diagnosis of leukemia and 12% had a relapse or second malignant neoplasm.

Baseline Evaluation

Most parents reported survivors experienced “no pain” (88%) and a “very good” or “excellent” perception of health (79%) at Baseline (Supplemental Table 1). Less than 1% reported “poor” health and 2% reported “moderate” to “severe” pain. The majority of parents also reported that children behaved well independently and were getting along well with siblings, other peers, and parents (Supplemental Table 1). Survivors had low internalizing ($M=1.40$) and externalizing ($M=1.41$) problems at Baseline, where a score of 1 indicates no parental report of problems and a score of 2 indicates occasional problems. 13% of children were identified as having severe or life-threatening chronic health condition (grade 3–4) at Baseline. For leukemia/lymphoma survivors, 9% (vs. 28% of CNS tumor

survivors) reported at least one severe or life-threatening health condition at Baseline ($p=.001$) (Supplemental Table 2).

PTG and LS

The mean-total PTGI score in this sample was 48.78 (Table 2), a consistent finding for other cancer populations^{4,30}. Overall, the survivors reported a wellbeing level on the Cantril Ladder of Life ($M=7.43$, 1–10 scale) indicating a thriving and positive view of their life situation³³. Repeated-measures ANOVA showed no difference between leukemia/lymphoma and solid cancers survivors ($p<0.001$) whereas CNS tumors survivors are significantly lower than leukemia/lymphoma ($p<0.001$) and solid cancers ($p<0.001$) survivors with medium effect sizes (see Supplemental Table 3). The level of PTG (and the different levels of satisfaction) between cancer survivors was not significant. A positive though weak association between PTG and LS was found ($r=.15$, $p<0.001$), supporting inclusion of both measures in the multivariable model (see Figure 1 and Supplemental Table 3). Older age at diagnosis ($p=0.001$), leukemia/lymphoma compared to CNS tumors ($p=0.0001$), solid cancer compared to CNS tumors ($p=0.01$), second cancer/relapse ($p=0.01$), and higher grade medical conditions ($p=0.01$) were associated with higher PTG scores with small effect sizes. Better social skills ($p=0.001$), better perception of health ($p=0.01$), solid cancer compared to CNS tumors ($p=0.01$), and leukemia/lymphoma compared to CNS tumors ($p=0.02$) were associated with higher LS with medium effect sizes.

Chronic Health Conditions and Mental Health

At Follow-up 4, 11% of leukemia/lymphoma survivors reported at least one severe chronic health conditions, compared to 27% of CNS tumor survivors ($p=.001$) (Supplemental Table 2). BSI-18 scores identified low frequency of impaired anxiety (5%), depression (7%), and somatization (6%), frequencies lower than the expected 10% threshold set based on population norms (i.e. score ≥ 63). A total of 59% of survivors reported “very good” or “excellent” health and 2% of survivors reported “poor” health (Table 1). 15% of survivors reported from “moderate” to “very severe” pain (Table 1).

Consequences of PTG and LS

Higher LS during Follow-up 2 was associated with fewer mental health problems ($p=0.001$) and more positive health perception ($p=0.001$) during Follow-up 4, with medium effect sizes. Higher PTG during Follow-up 2 was associated with more mental health problems ($p=0.001$) and poorer health perception ($p=0.04$) at Follow-up 4, though effect sizes were small. LS ($p=0.94$) and PTG ($p=0.32$) were not associated with future chronic health conditions. A summary of all the variables with the significant relationships appears on supplemental Table 4.

Discussion

Our study found that most childhood cancer survivors are doing well with low levels of psychopathology and high levels of LS. Therefore, we focused on predictors of high levels of LS in childhood cancer survivors. Our study found that better social skills during adolescence with non-CNS tumors was associated with higher LS during young adulthood,

which subsequently was associated with future positive perception of health and fewer mental health problems during adulthood. General population researchers have found that people are more content when they are around others³⁴; a result not previously confirmed among cancer survivors. Our study showed this positive relationship. We can infer that childhood cancer survivors may be happier with meaningful social interactions, improving their own understanding of themselves and their place in the larger community. More importantly, social skill improvement may not only make survivors happier, but may impact their future mental health and perceived general health.

Previous cross-sectional studies in the general population found an association between LS and low symptoms of mental health such as depression, anxiety, and hypochondriasis³⁵. LS was associated with positive perception of health and lower self-reported pain in this study, the first published longitudinal study examining this effect. Specific to childhood cancer survivors, we interpret our results to suggest that when cancer survivors are satisfied with their life, they are more inclined to see things in a positive way. Their optimism may diminish their pain perception and subjectively believe that their health is good. Finally, LS did not predict health outcomes other than perception of health and pain, suggesting LS has no effect on chronic health conditions, but instead on health perception. This study found an important role of LS in future positive outcomes. Higher LS was associated with fewer mental health problems. As mental health outcomes are rarely examined for pediatric oncology survivors in longitudinal studies, this study provides unique insight into the long-term effect of LS on survivors' mental health.

We found older age at diagnosis, recurrence/relapse, diagnosis of leukemia/lymphoma versus CNS tumor, and more severe chronic health conditions at Baseline were associated with PTG at follow-up. Older age at diagnosis has been associated with PTG in previous studies^{36,21} finding cross-sectional correlations between age at diagnosis and subsequent PTG. We examined this association longitudinally and identified a strong association between age at diagnosis and PTG.

We hypothesized that fewer chronic health conditions would predict high PTG based on published assumptions^{37,20}. Instead, worse chronic health conditions predicted PTG. This is consistent with a growing body of research suggesting a direct relationship between individuals' challenging events and reported positive outcomes.³⁸ Higher PTG was associated with future poorer health perception and more severe chronic health conditions. One possible explanation is that PTG may not reflect an absence of negative consequences or distress¹¹. To experience PTG, an individual had to face a challenging or traumatic event that would have lead him/her to experience both distress and growth²³. Therefore, when an individual reports PTG it means that he/she sees both positive impacts along with negative ones including side effects and poorer health. More research could help better understand this connection between PTG and negative outcomes.

Study Limitations

This study should be interpreted in light of several limitations. We used special education participation as a proxy for cognitive abilities. Although this is an index of cognitive limitations, it may not be as sensitive to specific cognitive skills. Future research should

focus on cognitive processing as a positive way to cope with threatening events (e.g. positive appraisal and acceptance). Our social skills variable was limited to assess social competence. This variable was created with 5 items that parents answered on their children's ability to get along with others. Future research should also look at social support and family functioning, which are important factors for PTG and LS^{11,14}.

The surveys for this large cohort study occurred over roughly 11 years, beginning with parent report of adolescents and ending with self-report as adults. As such, data collection varied with age-appropriate measures while participation varied over time. Analyzing longitudinal data from various participants could lead to concordance issues between parent and survivor reports. Future research should include focused surveys with consistent measures at different time periods to conduct comparisons over time.

Finally, we did not have an adolescent survivor measure of LS during Baseline. Ideally, this should be explored further as LS may precede development of social interactions. PTG variable was not present during baseline as well as the third time period. Future research should include the same variables for each survey to better compare over time. Due to survey timing and the long-term survivor requirement at Baseline (i.e. 5 years from diagnosis), survivors were diagnosed under the age of 10. Therefore, these results are not necessarily generalizable to survivors diagnosed as adolescents.

Clinical Implications

This study brought more insight into the long-term effects of PTG and LS for childhood cancer survivors finding that being satisfied with life could lead to fewer emotional problems and a more positive perception of their future physical health. By gaining an understanding of LS, effective interventions can be developed and mental health practitioners can be better prepared to help survivors to not only adjust and adapt to life after cancer, but also to potentially thrive in ways they otherwise may not. Mental health practitioners can develop age-specific interventions to improve LS as a way to decrease future anxiety, depression, and somatization. Several effective therapies on promoting LS have been reported such as committing acts of kindness, expressing gratitude, and re-experiencing happy life experiences³⁹. Medical staff and mental health practitioners could enable adolescents and young adult survivors to find meaning and satisfaction with their life leading to higher health perception and less pain. Additionally, providing social skills interventions could improve childhood cancer survivors' satisfaction in life. A training program teaching social skills, social problem solving, and developing close friendships in a group setting could be important for survivors to promote effective communication, cooperation, friendship, and self-control⁴⁰, and ultimately improve survivors' contentment. This study underscores the importance of raising clinicians' awareness of the possibility of perceived positive impact from their cancer experience.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

ACKNOWLEDGMENT

We thank all the investigators of the institutions that participated in the Childhood Cancer Survivor Study (CCSS). This work was supported by the National Cancer Institute (CA55727, G.T. Armstrong, Principal Investigator). Support to St. Jude Children's Research Hospital also provided by the Cancer Center Support (CORE) grant (CA21765, C. Roberts, Principal Investigator) and the American Lebanese-Syrian Associated Charities (ALSAC).

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Figure 1:

Structural regression model (second model) with all the significant standardized estimating structural paths included ($p < .05$). The first model includes only the variables from Baseline survey and Follow-up 2 survey.

For clarity, different colors were used to draw the lines. The blue lines represent relationships with PTG, the red lines relationships with LS, and the black lines relationships with other variables. The dashed lines indicate additional significant predictors when the model is analyzed without the Follow-up 4 survey.

Note: LL means Leukemia Lymphoma

Table 1

Demographic and treatment characteristics of survivors of childhood cancer survivor at Baseline (N=2,802).

	Mean	SD	Min	Max
Age	14.80	1.65	12	17
Age at Diagnosis	2.72	1.91	0	9
	N	%		
<u>Sex</u>				
Male	1, 473	53		
Female	1, 329	47		
<u>Race/Ethnicity</u>				
Non-Hispanic White	2, 263	81		
Non-Hispanic Black	159	6		
Hispanic	95	3		
Non-Hispanic Asian	51	2		
Other	234	8		
<u>Household Income in Baseline</u> *				
< \$20,000	404	15		
\$20,000 to \$60,000	1, 411	50		
Over \$60,000	837	30		
<u>Diagnosis</u>				
Leukemia	1, 270	45		
Hodgkin lymphoma	37	1		
Non-Hodgkin lymphoma	125	5		
CNS tumors	325	11		
Wilms tumor (kidney tumor)	458	16		
Neuroblastoma (extracranial solid cancer)	376	13		
Soft tissue sarcoma (soft tissue tumor)	219	7		
Bone Cancer	28	1		
<u>Treatment</u> *				
Chemotherapy, Radiation, and Surgery	818	29		
Chemotherapy & Surgery	611	22		
Chemotherapy & Radiation	344	12		
Chemotherapy	370	13		
Surgery	205	7		
Radiation & Surgery	177	6.5		
Radiation	6	0.5		
Relapse/Recurrence	354	12		

	Mean	SD	Min	Max
Recurrence of Primary Cancer	304	10.5		
Second Malignant Neoplasm	50	1.5		
<u>Special Education</u>				
Special Education	876	31		

* Percentages from among survivors who provided release of medical record inform

Table 2.

Descriptive characteristics of survivors at baseline and outcomes on subsequent follow-up.

Variables	N	Mean	SD	Min	Max
Baseline (Median age=15)					
BPI Internalizing	2763	1.40	.45	1	3
BPI Externalizing	2762	1.41	.40	1	3
Follow-up 2 (Median age =22)					
LS 5 years before	2500	6.31	2.15	1	10
LS now	2500	7.43	1.43	1	10
LS in the next 5 years	2500	8.73	1.42	1	10
PTGI Total	2513	48.78	29.08	0	105
PTGI Spirituality	2502	4.53	3.67	0	10
PTGI Appreciation of Life	2504	8.57	4.56	0	15
PTGI New Possibilities	2511	9.73	7.47	0	25
PTGI Relating to Others	2516	17.33	10.50	0	35
PTGI Personal Strengths	2508	10.32	6.01	0	20
Follow-up 4 (Median age =26)					
BSI Somatization	2660	47.06	7.60	41	81
BSI Depression	2661	46.99	8.88	40	81
BSI Anxiety	2660	45.14	8.69	38	81

Note: BPI: Behavior Problem Index, PTGI: Post Traumatic Growth Inventory, BSI: Brief Symptom Inventory