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# Stress and Posttraumatic Growth Among Survivors of Breast Cancer: A Test of Curvilinear Effects

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Abstract

The purpose of the current study was to test the curvilinear associations between experiences of stress and posttraumatic growth among female breast cancer survivors. Participants ($n$ = 193; 86% Caucasian; 80% diagnosed with Stage I or II cancer) completed self-report questionnaires assessing socio-demographic and medical information, perceived general stress, cancer-specific stress, and posttraumatic growth. Two hierarchical regression models tested the associations between general and cancer-specific stress and posttraumatic growth. After controlling for the effects of age, education, and time since diagnosis, there was a significant curvilinear effect of general stress on posttraumatic growth. Moderate levels of general stress were associated with the greatest posttraumatic growth. Cancer-specific stress was not associated with posttraumatic growth. These findings suggest that stress can be adaptive in the aftermath of cancer treatments and different manifestations of stress may require individualized intervention. Future research studies are needed to better understand and contextualize these findings among other cancer populations.

**Keywords:** posttraumatic growth, stress, breast cancer, curvilinear effects

Breast cancer is the most frequently diagnosed cancer among women worldwide (Jemal et al., 2011). Early detection and effective treatments have led to an increased life expectancy for those diagnosed with the disease, with a five-year relative survival rate of approximately 90 percent in North America (Canadian Cancer Society, 2011; National Cancer Institute, 2014). While promising, these figures do not entirely reflect the number of women who live with the debilitating disease and treatment-related health outcomes that span across physical, emotional, and social life domains beyond the phase of active treatment. It is well-documented that survivors of cancer report various negative outcomes of the illness (Deimling, Bowman, Sterns, Wagner, & Kahana, 2006), yet cancer survivors also experience profound positive changes throughout the illness trajectory (see Helgeson, Reynolds, & Tomich, 2006 for a review). Specifically, between 53% to 84% of breast cancer survivors report positive changes in the aftermath of their diagnosis (Collins, Taylor, & Skokan, 1990; Sears, Stanton, & Danoff-Burg, 2003; Taylor, Lichtman, & Wood, 1984). The experience of both positive and negative challenges during cancer survivorship suggests that there may be unique experiences requiring different interventions in cancer care.

The interplay of negative and positive experiences following a cancer diagnosis is best captured by concepts such as adversarial growth, benefit finding, thriving or posttraumatic growth. There are debates among researchers and clinicians as to the distinctions among these concepts and the underlying experiences. For a comprehensive overview of the aspects involved in the aforementioned conceptual debate, the reader can refer to review papers written by Coyne and Tennen (2010), Linley and Joseph (2004), and Park and Helgeson (2006). Although these concepts are sometimes used interchangeably in spite of potential differences in the experiences, researchers are urged to specify the concept under study and avoid conceptualizing the terms as synonymous. The research in the current study focuses on posttraumatic growth.

Posttraumatic growth [PTG] (Tedeschi & Calhoun, 2004; Tedeschi, Park, & Calhoun, 1998) is

broadly defined as the positive psychological change that is triggered by highly stressful events. More specifically, it refers to a transformative positive experience from before to after the trauma, which occurs as a direct result of struggling with challenging life circumstances. The mechanism driving the growth is a process of cognitive restructuring of one's life and priorities, which could be regarded as adaptation to a new reality, that is to life after the trauma (Calhoun & Tedeschi, 2006; Janoff-Bulman, 1992). The theoretical model of PTG proposed by Tedeschi and Calhoun posits that growth can manifest in a number of ways through fostering new relationships with others, developing a new appreciation for life, finding new meanings in life, discovering personal strength, experiencing spiritual change, and the realization of new opportunities (e.g., Lelorain, Tessier, Florin, & Bonnaud-Antignac, 2012; Sabiston, McDonough, & Crocker, 2007). In most studies (see Koutrouli, Anagnostopoulos, & Potamianos, 2012 for a systematic review), these different facets of PTG are highly correlated and a more global concept of PTG has been studied.

Among cancer populations, reported prevalence rates of perceived PTG range from 53 to 90% (Petrie, Buick, Weinman, & Booth, 1999; Rieker, Edbril, & Garnick, 1985) and vary according to the type of cancer (Barskova & Oesterreich, 2009), time since diagnosis, heterogeneity and ethnicity of the sample (Helgeson et al., 2006), choice of measurement (Park & Helgeson, 2006; Sumalla, Ochoa, & Blanco, 2009), and many personal factors. For example, younger age at diagnosis, lower socioeconomic status (e.g., income and education), and belonging to a minority group (e.g., African American or Hispanic) have been consistently associated with an increased likelihood of PTG (Lechner & Antoni, 2004; Tomich & Helgeson, 2004; Weiss, 2004). Within a meta-analysis encompassing 78 cross-sectional studies, Helgeson and colleagues (2006) found associations between PTG and socio-demographic, psychological, and medical variables. Specifically, PTG was greater for females, younger individuals, and people who self-identify as being of minority status and it related to higher positive affect, optimism, religiosity, and positive reappraisal, increased stress perceptions and intrusive-avoidant thoughts, lower depression levels, and greater trauma severity (Helgeson et al., 2006). A

second meta-analysis including 38 studies with cancer and HIV-positive populations (Sawyer, Ayers, & Field, 2010) generally confirmed the findings. These reviews offer support for the tenets of the PTG model by highlighting the co-occurrence of both positive and negative health outcomes and PTG and a heightened perception of stress in survivors who also experience PTG.

According to Tedeschi and colleagues (Tedeschi & Calhoun, 2004; Tedeschi et al., 1998), the experience of PTG is highly dependent on whether a circumstance is appraised as stressful. Similarly, in the context of cancer, PTG would be dependent on the degree of stress experienced in relationship to the cancer diagnosis, cancer treatment, and/or cancer-related lifestyle changes. In studies validating the PTG model, qualitative and quantitative analyses, and reviews of the existing scholarship, researchers have suggested a potential positive association between prolonged psychological stress and increased PTG among survivors of cancer (Lelorain et al., 2012; Sabiston et al., 2007). However, the nature and directionality of this relationship is still poorly understood in this population, with some studies reporting positive (Lechner et al., 2003; Sears et al., 2003), negative (Love & Sabiston, 2011; Tomich & Helgeson, 2004) or null (Manne et al., 2004; Weiss, 2004) relationships between psychological stress and PTG. It is possible that a more complex, non-linear relationship between stress and PTG needs to be considered in the context of cancer (Helgeson et al., 2006; Lechner, Carver, Antoni, Weaver, & Phillips, 2006), as different levels of stress and related processes (i.e., coping, adjustment) may be differentially linked to experiences of PTG (Lechner et al., 2006; Taku, 2012).

To date, only a few studies have explored curvilinear associations between psychological stress and PTG. For example, Lechner et al. (2003) investigated the link between objective threat, which was measured via stages of cancer (e.g., stage 0-I = lowest threat; stage IV = highest threat), and PTG in a sample of 83 patients diagnosed with various types of cancer. The highest growth was found among individuals diagnosed with stage II cancer whereas those with stages I and IV experienced the least growth. While objective stress was correlated with perceived stress (measured via one item asking about the likelihood of dying of cancer), no curvilinear relationship was found between perceived stress

and PTG. Further, Lechner et al. (2006) found a curvilinear relationship between psychosocial outcomes (e.g., adjustment, depression, state affectivity) and PTG such that the highest adjustment was related to low and high levels of growth whereas moderate levels of growth were associated with the least adjustment. Curvilinear effects have been documented among survivors of terrorist attacks, whereby moderate symptoms of posttraumatic stress disorder were related to highest PTG (Butler et al., 2005) and in survivors of assault, where negative affective experiences were also related to highest PTG (Kleim & Ehlers, 2009). As such, a curvilinear relationship between stress and PTG may provide a more comprehensive representation of adjustment to diagnosis and throughout the cancer treatment trajectory. Furthermore, different stress manifestations have not been examined in the relationship to PTG among cancer survivors.

Cancer-specific stress encompasses fears or worry about future cancer recurrences, disease progression, and other health-related aspects associated with a cancer diagnosis (Gotay & Pagano, 2007; Kornblith et al., 2007). Among breast cancer survivors, worrying about cancer has been associated with higher distress, and mental health such as increased anxiety and depression symptoms and lower quality of life (Deimling et al., 2006). Given that up to 60% of survivors report heightened cancer worries following diagnosis and treatment (Mehnert, Berg, Henrich, & Herschbach, 2009), it seems important to investigate the role of cancer-specific stress on experiences of PTG in order to provide an accurate and comprehensive picture of this relationship.

The objective of the current study was to test the curvilinear associations between perceived general and cancer specific stress and PTG in a sample of women who have recently completed breast cancer treatment. It was hypothesized that a significant curvilinear association would be observed (i.e., an inverted U relationship) such that moderate levels of stress, both general and cancer-specific, would relate to the highest reports of PTG.

## Method

### Participants and Procedures

A convenience sample of 199 female survivors of breast cancer was recruited via physician referral and advertisements in hospitals and medical clinics in Montreal to participate in a cohort study entitled *Life After Breast Cancer: Moving On*. The current study focuses on testing the associations between stress and PTG at the first data collection. Eligibility criteria for participation in this project included a first diagnosis of breast cancer, completion of active treatment, ability to read and write in English or French, and being 18 years of age or above. Participation was voluntary and was initiated as soon as possible after the last scheduled primary/systemic treatment for breast cancer. Approval for the study was obtained from the Ethics Board of the McGill University Health Centre before study commencement.

The analytical sample of the current study includes 193 women who provided complete data. Most women (86%) in the current sample identified as Caucasian with ages between 28 to 79 years; 65% were married or in a common law; and just over half (51%) had completed undergraduate or graduate studies. The mean time since diagnosis was 10.6 months ($SD$ = 3.4) and the mean time since treatment was 3.5 months ($SD$ = 2.4). Approximately 40% of the women were diagnosed with stage I, 40% with stage II, and 20% with stage III breast cancer. The most common treatments were lumpectomy (60%), chemotherapy (65%), radiotherapy (89%), hormonal therapy (55.3%). Some women had single (28%) or double (17%) mastectomy.

### Measures

Data were collected on socio-demographic (e.g., age) and medical information (e.g., disease severity), as well as several psychological constructs captured via validated self-report measures.

Posttraumatic growth was assessed using the 21-item Posttraumatic Growth Inventory (PTGI; Tedeschi & Calhoun, 1996). The PTGI is a 21-item self-report measure assessing five separate domains

of posttraumatic growth: new possibilities ($n_{items}$ = 5, sample item: "I established a new path for my life,") relating to others ($n_{items}$ = 7, sample item, "Putting effort into my relationships,") personal strengths ($n_{items}$ = 4, sample item, "I discovered that I am stronger than I thought I was,") spiritual change ($n_{items}$ = 2, sample item, " A better understanding of spiritual matters,") and appreciation of life ($n_{items}$ = 3, sample item, "Appreciating each day.") Respondents were asked to indicate the degree to which they had experienced positive changes in their lives following the breast cancer diagnosis. The answers were rated on a 6-point Likert-type scale ranging from 0 (*not at all*) to 5 (*a very great degree*) with higher scores indicating higher growth. A total PTGI score is commonly used as a measure of PTG. Internal consistency reliability (Cronbach's α) ranged from .90 to .95 for the total scale (Brunet, McDonough, Hadd, Crocker, & Sabiston, 2010; Tedeschi & Calhoun, 1996). Two-month test-retest reliability for PTGI has been reported as $r$ = .71 (Tedeschi & Calhoun, 1996). In the current study, a total score reflecting the construct of PTG was used in analyses. Reliability assessed as internal consistency coefficient Cronbach's alpha was α = .95.

Perceived general stress was assessed via the Perceived Stress Scale (PSS; Cohen, Kamarck, & Mermelstein, 1983; Cohen & Williamson, 1988). The PSS is a 10-item self-report instrument measuring the frequency of stressful events experienced in the month prior to completing the questionnaire. Sample items include: "In the last month, how often have you felt you were unable to control the important things in your life" and "… found that you could not cope with all the things that you had to do." The items are rated on a 5-point Likert-type scale ranging from 0 (*never*) to 4 (*very often*) with higher scores indicating higher stress. The internal consistency reliability of the PSS ranged from .75 to .92 in the general population (Cohen & Williamson, 1988) and from .75 to .91 among a breast cancer sample (Golden-Kreutz et al., 2005). In the current sample, the internal consistency reliability coefficient for the total scale was α = .78.

Cancer-specific stress was assessed via the Assessment of Survivors Concerns (ACS; Gotay & Pagano, 2007). The ASC is a 6-item instrument assessing cancer-related worries. Sample items include

"I worry about my cancer coming back" and "I worry about my death." Items are rated on a 4-point Likert-type scale ranging from 1 (*not at all*) to 4 (*very much*) with higher scores indicating more worry. In the development sample of 753 cancer survivors, the internal consistency reliability coefficients ranged from $\alpha = .72$ to .92. A mean score across 5 items was used in the current analyses, while excluding the item "I worry about my child's health" since not all women in the sample reported having children. The internal consistency reliability coefficient for the five items was $\alpha = .85$.

**Data Analyses**

After computing descriptive statistics (e.g., means, standard deviations, frequencies, Pearson correlation coefficients), the linear and curvilinear associations between both perceived general stress and cancer-specific stress and PTG were tested in separate hierarchical regression models, as per guidelines developed by Aiken and West (1991). Consistent with previous findings from Helgeson et al. (2006) and based on significant correlations with PTG, women's age, education, and time since diagnosis were entered as covariates in the first step of the regression models. In step two, the mean-centered stress variables (i.e., perceived general stress and cancer-specific stress) were entered. In the final step, the quadratic terms (e.g., centered stress x centered stress) were added to the models. Significant effects on step two reflect linear effects, whereas quadratic effects (step three) illustrate curvilinear associations, specifically one bend in the regression line.

## Results

A Pearson correlation coefficient matrix, along with means, standard deviation, and ranges for all study measures are presented in Table 1. Of note, the association between general and cancer-specific stress was moderate ($r = .38$, $p < .001$), suggesting that the concepts are related yet the two scales tap different facets of stress. Lastly, PTG was related to cancer-specific stress ($r = .20$, $p = .005$), but not to general stress.

In the main analyses, the regression model predicting PTG from general stress was significant, $F(5, 187) = 6.12$, $p < .001$ (see Table 2). In step 1, age, education, and time since diagnosis accounted

for 9% of the variance in the PTG. In step 2, general stress was entered into the equation, but accounted for only a non-significant 1% in variance in PTG. This step assessed the linear effect of PSS on PTG. Step 3 assessing the curvilinear effect of PSS on PTG was significant and accounted for an additional 4% of the variance in PTG. This curvilinear effect, which is graphed in Figure 1, shows that moderate levels of general stress were associated with the highest PTG.

The final regression model predicting PTG from cancer-specific stress was significant, $F$ (5, 187) = 4.65, $p$ = .001. However, after controlling for the effects of age, education, and time since diagnosis, there was no significant linear or curvilinear effect of cancer-specific stress on PTG (see Table 2).

## Discussion

The purpose of the current study was to test the curvilinear associations between general and cancer-specific stress and posttraumatic growth (PTG) in a sample of female survivors of breast cancer. After controlling for covariates, which have been found to contribute to the experiences of growth (Helgeson et al., 2006), there was a significant curvilinear effect between general stress and PTG, but no significant relationships among cancer-related stress and PTG. The PTG levels reported in the current sample were comparable with PTG reports from other studies with similar populations (Cordova et al., 2007; Danhauer et al., 2013; Lelorain et al., 2012). These findings may suggest that different manifestations of stress should be considered differently in cancer care, and tests of the PTG model (Tedeschi & Calhoun, 2004; Tedeschi et al., 1998) should include assessments of both linear and non-linear associations between stress and challenges and PTG.

As hypothesized, general stress demonstrated a curvilinear association with PTG. The significant curvilinear effect corroborates previous findings about high levels of stress (O'Connor, Rasmussen, & Hawton, 2010) being detrimental to one's health. As shown in the current study, moderate levels of stress were related to the most positive or desirable outcomes. These findings complement previous literature, which reported on a curvilinear association between objective threat

(i.e., cancer stage, which can be conceptualized as a proxy measure of stress) and PTG (Lechner et al., 2003). This effect is also consistent with the inverted-U hypothesis (Yerkes & Dodson, 1908) which posits that curvilinear associations exist between arousal and performance whereby moderate levels of arousal predict better or optimal performance (Gould & Krane, 1992). In the current study general stress was found to relate to PTG much in the same way physiological arousal related to physical performance (Arent & Landers, 2003).

The non-significant curvilinear relationship between cancer-specific stress and PTG was contrary to hypothesis. In partial support of the PTG model (Tedeschi & Calhoun, 2004; Tedeschi et al., 1998), a small positive bivariate correlation was found between cancer-specific stress and PTG. However, in multivariate models controlling for covariates, the linear and curvilinear effect of cancer-related stress on PTG did not reach significance. It may be that the pervasive nature of cancer worries (Janz et al., 2011) is not perceived as a challenge that fosters PTG. Further, the measure used to assess cancer-specific stress in the current study focuses on only a few of the many cancer-related worries that are likely experienced among breast cancer survivors. For example, cancer stressors related to physical functioning, emotional well-being, social relationships, body image and weight, and health have been reported (Hadd, Sabiston, McDonough, & Crocker, 2010). Furthermore, these results are consistent with previous findings that global stress predicted both positive (e.g., positive affect and positivity about the illness) and negative adjustment outcomes (depression, anxiety; negative affect) among breast cancer patients while cancer-specific stress only predicted negative affective outcomes (Groarke, Curtis, & Kerin, 2013). Based on their findings, it can be inferred that perceived general stress might be of greater importance to adaptation than cancer-specific stress. Specifically, stress at moderate levels may be perceived as a challenge and could be related to adaptive outcomes, such as higher PTG. Cancer stress may be perceived as stress appraised as a threat and would likely be related to higher distress (Tedeschi & Calhoun, 2004). While it is possible that different appraisal processes occurred for

stress (challenge) compared to cancer-related stress (threat), the two measures were not specifically designed to measure different stress appraisals, and this proposition requires further research.

Notwithstanding the strengths and contributions of this study, there are certain limitations that may impact the generalizability of the results. First, given the cross-sectional design, the directionality of the effects could not be empirically established and claims about cause-and-effect could not be made. Second, this study used a convenience sample of volunteer participants, which precludes generalizability of the results. Third, PTG was assessed via a self report measure, the PTGI (Tedeschi & Calhoun, 1996), which although widely used in psycho-social oncology, it subjectively and retrospectively assesses the perceived experience of growth while also asking respondents to assess the changes they had undergone from before to after their diagnosis: this is in itself quite problematic, as it may yield unreliable reports of growth (Coyne & Tennen, 2010). Further, the suitability of assessing growth in cancer survivors via the PTGI is not well researched: the chronic type of trauma that survivors endure is arguably different from the acute types of traumas (e.g., university exams; failed romantic relationships) based on which the PTGI items were developed (Sumalla et al., 2009).

Future studies should examine PTG among other cancer populations. Studies with a longitudinal design are also needed in order to examine causal relationships between stress and PTG over time. Furthermore, future studies should continue to challenge the existing linear PTG model (Tedeschi & Calhoun, 2004) while highlighting the adaptive and maladaptive roles of stress perceptions during the post-treatment cancer trajectory. In order to better understand the interplay of PTG and stress variables, further research will benefit from exploring the effect of moderator variables, such as coping, adjustment to cancer, and various personality traits. Deciphering the nature and directionality of these relationships might provide critical insight for clinicians who deliver psychosocial services to cancer patients. For example, nurturing the experiences of PTG in patients with moderate levels of distress may facilitate faster adaptation to day-to-day reality in cancer survivors and decrease distress. It has been shown that patients, who experience high levels of stress benefit from

psychosocial interventions targeting stress and distress reduction (see Jacobsen & Jim, 2008 for a review). By reducing stress to manageable levels, such interventions could simultaneously facilitate PTG.

To conclude, the current findings suggest that among female cancer survivors, who recently completed treatment for breast cancer, the association between stress and PTG is not necessarily linear, as postulated in the PTG model (Tedeschi & Calhoun, 2004). Instead, a curvilinear association between the two variables better explained the PTG experiences. More specifically, moderate levels of general stress predicted the highest posttraumatic growth. Interventions geared towards reducing stress levels in breast cancer survivors who experience high levels of stress might indirectly facilitate growth. Intervention strategies may be needed to target stress appraisals to help breast cancer survivors appreciate stressors as challenges as opposed to threats.

**Conflict of interests**
All authors declare they have no conflict of interest.

**Human Rights and Informed Consent**
All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. Informed consent was obtained from all patients for being included in the study.

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Table 1

*Correlation Matrix Between the Study Measures*

| Variable | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1. Age | - | | | | | |
| 2. Education | -.17** | - | | | | |
| 3. Months since diagnosis | -.21** | -.06 | - | | | |
| 4. General stress | -.24** | -.06 | .07 | - | | |
| 5. Cancer-specific stress | -.12* | -.14 | .15* | .38** | - | |
| 6. Posttraumatic growth | -.20* | -.18* | .12* | -.02 | .20* | - |
| *M* | 55.11 | - | 10.64 | 15.79 | 12.85 | 62.95 |
| *SD* | 11.02 | - | 3.45 | 5.41 | 3.86 | 21.57 |
| *Range* | 28-79 | | 2-20 | 4-30 | 5-20 | 1-101 |

*$p < .05$; **$p < .003$, as per the Bonferroni correction

Table 2

*Hierarchical Multiple Regression Analyses Predicting PTG Among Female Breast Cancer Survivors*

| Step and Variable | PTG regressed on General Stress | | | | PTG regressed on Cancer-specific Stress | | | |
|---|---|---|---|---|---|---|---|---|
| | $R^2$ | $\Delta R^2$ | $\Delta F$ | β | $R^2$ | $\Delta R^2$ | $\Delta F$ | β |
| 1. Covariates | .09 | .09 | 5.98* | | .09 | .09 | 5.98* | |
| Age | | | | -.22* | | | | -.22* |
| Education | | | | -.21* | | | | -.21* |
| Time since diagnosis | | | | .06 | | | | .06 |
| 2. Stress | .10 | .01 | 1.86 | -.10 | .10 | .01 | 1.69 | .09 |
| 3. Stress X Stress | .14 | .05 | 9.79* | -.22* | .11 | .02 | 3.31 | -.13 |
| | Overall $F$ (5,187) = 6.12* | | | | Overall $F$ (5,187) = 4.61* | | | |

*Note*. PTG = Posttraumatic growth
*$p < .01$

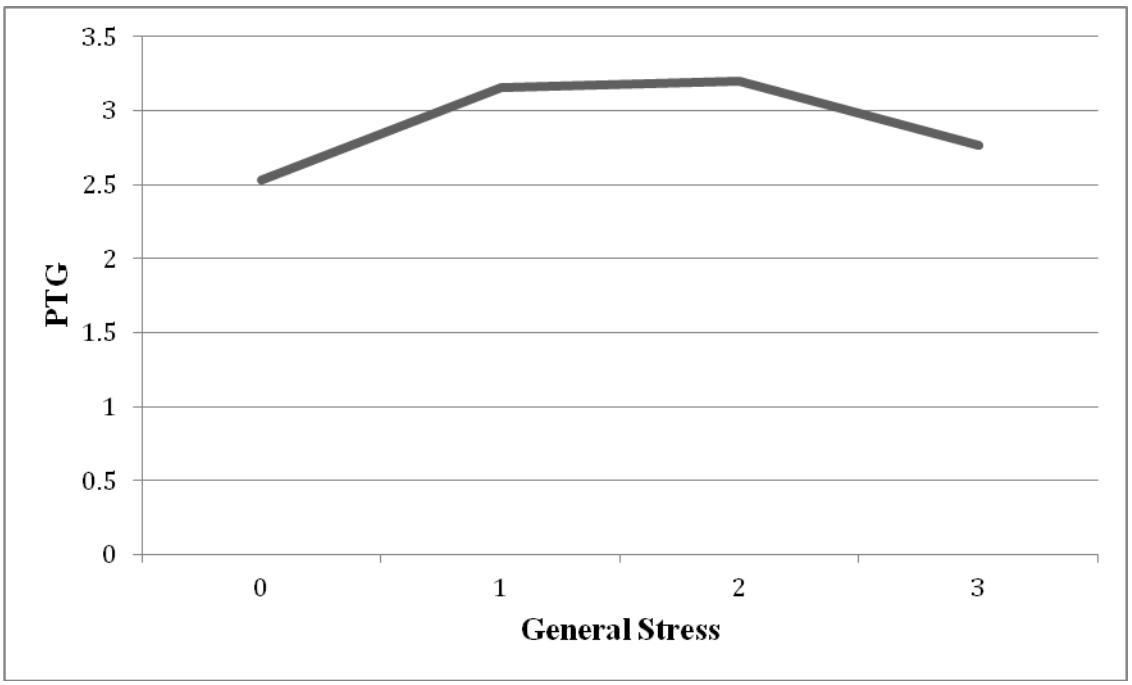
3.5
3
2.5
2
1.5
1
0.5
0
PTG
0
1
2
3
General Stress

*Figure 1.* Curvilinear relationships between PTG and General Stress
*Note.* PTG = Posttraumatic Growth