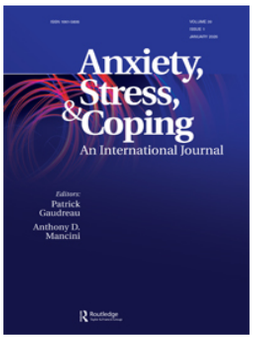

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Longitudinal effects of COVID-19 posttraumatic growth on college adjustment, depressive, and anxiety symptoms

Minglee Yong

National Institute of Education/Nanyang Technological University, Singapore, Singapore

ABSTRACT

Struggling through the stressful experience of the COVID-19 pandemic can foster posttraumatic growth (PTG), yet its lasting effects are not well understood. The study tracked 2,368 undergraduate and recently graduated students (56% female) between 18 and 30 years old (M = 21.61 years) over four online survey waves, six months apart (September 2022 to May 2024). Path analyses revealed that higher perceived PTG predicted better college adjustment and fewer depressive symptoms one year later, but only among female students. PTG had no effect on anxiety symptoms. COVID-19 stress was linearly associated with PTG, with a weakly curvilinear component. Optimism and social support contributed uniquely to perceived PTG, and social support further moderated the COVID-19 stress-PTG relation such that COVID-19 stress predicted PTG only for students with average and above average social support. These results support the predictive validity of perceived PTG and highlight the value of fostering PTG when coping with adversity, especially among women.

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Posttraumatic growth; COVID-19; optimism; social support; longitudinal; moderation

Introduction

Relatively few studies have examined long-term effects of posttraumatic growth (PTG). Most research has focused on how PTG develops following a *traumatic or stressful event* (American Psychiatric Association, 2013; Tedeschi et al., 2018), while large-scale, long-term follow-up of actual outcomes are rare. Hence, the transition from the acute phase of the pandemic (2020-2021) to the endemic phase (2022) provides an opportune time to investigate PTG and its potential outcomes (Park et al., 2023). To fully understand the effects of PTG, it is important to examine a broad range of outcomes to determine if perceived PTG represents genuine or illusory growth. Mancini (2019) suggested that these should include distress-related outcomes (e.g., symptoms of PTS, anxiety and depression) as well as indicators of adaptive functioning (e.g., life satisfaction, positive emotion, meaning in life, and feelings of belonging). As such, research has linked PTG to various physical and psychological health-related benefits, including indicators of mood, distress, and quality of life (Greenberg et al., 2021; Kyutoku et al., 2021), contributing evidence to the debate that PTG can be associated with improvement in lives.

CONTACT Minglee Yong minglee.yong@nie.edu.sg National Institute of Education/Nanyang Technological University, 1 Nanyang Walk, NIE02-03-85, Singapore 637616, Singapore

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In the context of the pandemic, COVID-19-related stress can be conceptualized as posttraumatic stress as it is precipitated by an identifiable stressful event. This conceptualization is consistent with DSM-5's definition of posttraumatic stress as "psychological distress following exposure to a traumatic or stressful event" (American Psychiatric Association, 2013, p. 265). Three studies have examined the outcomes of PTG due to COVID-19 stress, though they were based on unique samples such as nurses (Yeung et al., 2022), mothers who gave birth before and during the pandemic (Babu et al., 2022), and those with lived experience of psychiatric disorders (Lewis et al., 2022). Struggling with COVID-19 stress brought about PTG, in terms of higher job satisfaction, positive maternal-infant bonding, and psychological well-being. However, the use of cross-sectional research design and the unique samples limit the generalizability of the findings and may not provide convincing evidence of genuine positive outcomes of PTG related to COVID-19.

Predictors of PTG

Predictors of PTG include both psychological and social factors (Meyerson et al., 2011; Tedeschi et al., 2018). Cognitive mechanisms such as deliberate rumination, positive reappraisal, and acceptance facilitate cognitive processing of trauma and adoption of alternative core beliefs. Engaging in supportive discussions, sharing perspectives, and receiving validation from others can enhance meaning-making and emotional regulation in PTG. The involvement of social networks, including religious or spiritual engagement, can also help survivors develop new schemas and construct adaptive narratives that contribute to PTG.

As a psychological factor that is related to positive thinking, optimism was rarely investigated for its role in PTG during the pandemic, except Koliouli and Canellopoulos (2021). In this study, researchers found that optimism uniquely predicted PTG during the acute phase of the pandemic. According to Park et al. (2023), PTG includes both a dynamic, context-sensitive component as well as a more stable trait-like tendency to perceive positive change. This stable component of PTG may overlap with optimism which can foster PTG by promoting psychological flexibility, encouraging openness to new perspectives, and facilitating adaptive coping (Henson et al., 2021).

Social support was also linked to PTG during COVID-19 (Dominick et al., 2022; Hu et al., 2022). Evidence further suggests that social support also played a moderating role in the posttraumatic stress-PTG relationship. For instance, Fino et al. (2021) found that among healthcare workers in Italy, social support, resilience, and emotion regulation significantly moderated the association between posttraumatic stress symptoms and PTG. Workers with higher levels of psychosocial resources were more likely to experience PTG. Similarly, in a cross-sectional study in the United States, Northfield and Johnston (2022) reported that distress symptoms were more strongly associated with PTG among adults who received greater social support from parents and friends. However, the cross-sectional design of these studies limits the strength of this evidence.

Posttraumatic stress is also a predictor of PTG though the relationship is complex. A meta-analysis of 42 studies by Shakespeare-Finch and Lurie-Beck (2014) found that posttraumatic stress symptoms and PTG were related in a curvilinear way. Initially, higher posttraumatic stress symptoms were linked to greater PTG, but this relationship turned negative beyond a threshold. At low posttraumatic stress levels, individuals may not experience enough challenge to their worldview to stimulate PTG; on the other hand, extreme posttraumatic stress can overwhelm cognitive and emotional processing, hindering PTG. Moderate levels of posttraumatic stress, however, may prompt survivors to engage in deliberate rumination, re-evaluate their identity, purpose, and core beliefs, and ultimately find renewed meaning in life – making PTG more likely (Wiley & Robinson Kurpius, 2015).

Goals of the present study

As few studies have examined the actual long-term outcomes of COVID-19 related PTG, the present longitudinal study aimed to study this topic using a sample of undergraduate and recently

graduated students from Singapore. The evidence would contribute to our understanding about the longer-term predictive validity of PTG that is associated with actual positive changes. We hypothesized that PTG would predict better college adjustment as well as fewer depressive and anxiety symptoms in the long-term. Regarding predictors of PTG, we identified COVID-19 stress, optimism, and social support. Furthermore, we hypothesized that optimism and social support served moderating roles in the relationship between posttraumatic stress and PTG. Despite many COVID-19 studies assuming a linear relationship between COVID-19 stress and PTG, they could be related in a curvilinear way. Hence, we also hypothesized an inverted U-shaped component in this association.

Method

Participants

This study involved 2,368 undergraduate students aged 18–30 ($M = 21.61$ years, $SD = 1.82$ years) from a public university in Singapore, representing about 10% of the institution's undergraduate population across its various colleges and schools. Since English is the medium of instruction, all participants were proficient in English and completed the surveys in English. Excluding 17 students who did not complete the demographic section of the survey, the sample consisted of 56% females and was ethnically 85% Chinese, 3% Malay, 7% Indian, and 4% others. Students from all four academic years participated (Year 1: 580; Year 2: 682; Year 3: 585; Year 4: 504). The sample sizes for Wave 1–4 were 2,364, 1,911, 1,673, and 1,435, respectively. Over 30% reported their household income to be below $4000, 47% reported household income between $4000 and $10,000, and 22% reported their household income to be $10,000 and above. Compared to the median household income of $10,099 estimated by the Singapore Department of Statistics (2022), students probably underreported their family household income. By Wave 3 and 4, approximately 21% were no longer undergraduate students. They reported having entered the workforce, seeking employment, pursuing further studies, or engaging in other activities.

Procedure

Participants were recruited through school emails and directed to an online survey after providing informed consent for the longitudinal study. Each participant received SGD10 for completing each survey wave; after they have graduated from the university, they received SGD15. Wave 1 data collection took place from September to mid-December of 2022, when most COVID-19 restrictions were lifted, except mandatory masking on public transportation and in healthcare facilities. Singapore had shifted to a "living with endemic COVID-19" strategy (Yau et al., 2023), and educational institutions had largely resumed pre-pandemic activities while retaining expanded online learning options (Tan & Chua, 2022). Wave 2 was conducted from March to May 2023, Wave 3 from September to November 2023, and Wave 4 from March to May 2024. The study protocol was approved by the Institutional Review Board of Nanyang Technological University.

Measures

College Adjustment Scale (CAS)

The 14-item College Adjustment Scale (CAS) measures educational, relational, and psychological functioning in the college context. Undergraduate students at Wave 2 and 4 rated each item on a five-point Likert scale, indicating how accurately it described them (Very Inaccurate to Very Accurate). Sample items include "I am succeeding academically," "I don't have as much of a social life as I would like," and "I feel that I am emotionally falling apart in the university." Higher mean scores indicate better college adjustment. The CAS was administered in Waves 2 and 4, with internal consistency estimates of .88 and .89, respectively.

Patient Health Questionnaire-8 (PHQ)

The PHQ was used to assess depressive symptoms over the past few weeks, with participants rating eight symptoms on a 4-point scale (1 = Not at all, 2 = Several days, 3 = More than half the days, 4 = Nearly every day). Sample items include "Little interest or pleasure in doing things" and "Feeling tired or having little energy." Higher mean scores reflect more severe depressive symptoms. The PHQ has demonstrated good reliability and validity, and it showed internal consistency values of .86 in Wave 1 and .88 in Wave 4.

Generalized Anxiety Disorder-7 (GAD)

The GAD assesses seven anxiety symptoms and their severity, with participants rating how often they experienced these symptoms "in the past few weeks" on a 4-point scale (1 = Not at all, 2 = Several days, 3 = More than half the days, 4 = Nearly every day). Sample items include "Feeling nervous, anxious, or on edge" and "Worrying too much about different things." Higher mean scores reflect more anxiety symptoms. In this study, the scale internal consistency indices were .90 in Wave 1 and .92 in Wave 4.

Stress-Related Growth Scale – Revised (SRGS-R)

The SRG-R (Boals & Schuler, 2018; Park et al., 1996) is commonly used to assess PTG and comprises items for measuring changes in personal resources, social relationships, life philosophy, and coping skills following a stressful event, such as COVID-19 (Zhai et al., 2021). Fifteen items are rated on a seven-point bipolar scale from −3 (very negative change) to 3 (very positive change). The negative numbers help reduce positive-response bias. Adapted to the COVID-19 pandemic, each item began with "Because of the COVID-19 pandemic, … ." Sample items include "I experienced a change in how I treat others," "I experienced a change in the extent to which I feel free to make my own decisions," and "I experienced a change in my belief about how many people care about me." Scores were recoded from 1 to 7 and averaged, with higher scores indicating greater perceived positive change. The measure was administered in Waves 1 and 2, yielding internal consistency estimates of .90 and .91, respectively.

Retrospective COVID-19 Stressors Questionnaire (RC19SQ)

The RC19SQ retrospectively measures four COVID-19 stressors – social restrictions, health concerns, future uncertainty, and resource constraints – based on the four-factor COVID-19 Stressor Questionnaire (C19SQ; Yong & Suh, 2022). Participants rated their highest experienced COVID-19 stress in each domain from 2020–2022 using a nine-point scale (1 = not at all stressful to 9 = extremely stressful). Scale anchors include (1) "Not at all stressful/Did not think about the problem" to (9) "Extremely stressful/Spent a lot of time thinking about the problem." Scores were averaged across the four items, with higher means indicating greater pandemic-related stress. Wave 1 data yielded an internal consistency of .72.

Life Orientation Test – Revised (LOT)

The LOT measures dispositional optimism, defined as a generalized expectation that good things will happen. It consists of 10 items scored on a 5-point scale (0 = strongly disagree to 4 = strongly agree), with four filler items that are not scored. Sample items include "In uncertain times, I usually expect the best" and "If something can go wrong for me, it will." Higher scores reflect a more positive outlook, often linked to increased positive feelings and motivation. LOT data was collected in Wave 1, yielding an internal consistency of .76 for the six main items.

Multidimensional Scale of Perceived Social Support (MSPSS)

The MSPSS assesses perceived adequacy of social support from family, friends, and a significant other. It comprises 12 items rated on a 7-point Likert scale (1 = Very Strongly Disagree to 7 = Very

Strongly Agree), with four items measuring each support source. Sample items include "There is a special person who is around when I am in need," "My friends really try to help me," and "My family is willing to help me make decisions." Higher mean scores reflect stronger perceived support. Data was collected in the first wave, yielding an internal consistency of .91.

Covariates

Income was operationalized as the average household income per month over the last 12 months. Respondents were provided with six options: 1 = Below $2,000; 2 = $2,000 to $3,999; 3 = $4,000 to $5,999; 4 = $6,000 to $7,999; 5 = $8,000 to $9,999; and 6 = $10,000 & above. GPA scores were collected in two formats. In wave 2, participants selected from ten options - 0-0.49, 0.5-0.99, 1-1.49, 1.5-1.99, 2-2.49, 2.5-2.99, 3-3.49, 3.5-3.99, 4-4.49, and 4.5-5.0. In Wave 4, participants indicated their GPA using a 0.00–5.00 sliding scale.

Analyses

Implemented in Mplus 8.11, path analyses were used to examine the different outcomes of growth (SRGS-R), namely, college adjustment (CAQ), depressive symptoms (PHQ), and anxiety symptoms (GAD). Each model included autoregressive paths so that parameter estimates at later time points were adjusted for prior effects. GPA and household income were entered as covariates for each outcome. Figure 1 identifies the specific paths that were estimated, with full model specifications provided in Supplementary Materials. Full information maximum likelihood was used to accommodate about 17% of missing data in the dataset. Comparing participants and non-participants at subsequent waves indicated no significant differences on baseline measures. Given the large sample size and the low rate of missingness, statistical power was reasonably assured.

Model fit was evaluated using several indices – Chi square, root mean square error of approximation (RMSEA), comparative fit index (CFI), Tucker-Lewis index (TLI) and standardized root mean residual (SRMR). A model was considered to attain a good fit to the data when the chi square was nonsignificant, RMSEA $\leq$ .06, CFI or TLI $\geq$ .95, or SRMR $\leq$ .08. For college adjustment, models were estimated with maximum likelihood (ML); for depressive and anxiety symptoms, ML with robust

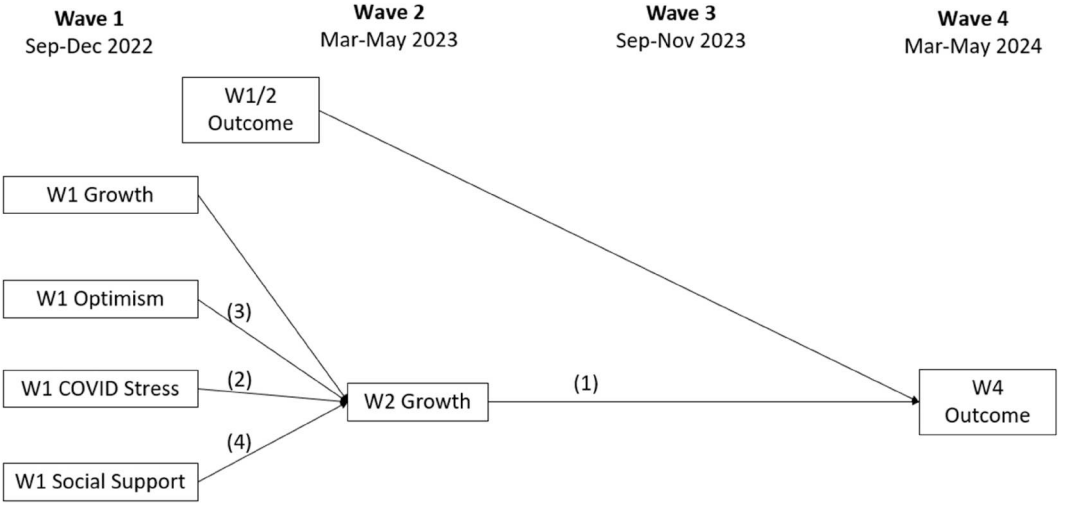

Figure 1. General specifications of longitudinal paths. Note: Outcome = College adjustment, Depressive symptoms, or Anxiety symptoms; Growth = Posttraumatic growth; COVID Stress = Retrospective COVID-19 stress; W = Wave; No data from Wave 3 was used in this study; Paths tested are labeled with numbers; Details of model specifications are provided in supplementary materials.

standard errors (MLR) was used to account for nonnormality. Model refinement was guided by modification indices and theoretical relationships among the variables. Differences in model fit were evaluated based on differences in chi-square for models estimated by ML or Satorra-Bentler scaled chi-square for models estimated by MLR.

Three sets of analyses were conducted, one per outcome (see Supplementary Materials). As preliminary analyses showed gender differences on most variables except growth and optimism, multiple-group models were run. Step 1 fit a baseline model with four gender-constrained paths, (1) growth→outcome, (2) COVID stress→growth, (3) optimism→growth, and (4) social support→growth, (Figure 1). Constraints were then freed sequentially, and changes in fit were used to select the better fitting model. For college adjustment, analyses were limited to participants who were still undergraduate students at Wave 4; graduates were excluded.

In Steps 2-3, cross-products (optimism*COVID stress and social support*COVID stress) were entered into the best-fitting base models to test whether optimism and social support moderated the association between COVID stress and posttraumatic growth. Step 4 tested a quadratic term for COVID stress curvilinear relationship. Variables in interaction terms were standardized prior to product formation. In total, 33 models were estimated. Significant interactions were probed using the Johnson-Neyman procedure (plotting moderator function or the rate of change against moderator variable). Using unstandardized path coefficients, standard errors, and covariances from the Mplus output, plots were generated using the R package "ggplot2." When the confidence intervals of the moderator function estimate excluded zero, the moderation relationship was considered significant and interpreted accordingly.

Results

Descriptives and correlations

The correlation patterns were largely consistent with expectations (Supplementary Tables 1 & 2). College adjustment was positively correlated with growth, optimism, social support, and GPA, and negatively correlated with depressive and anxiety symptoms and COVID stress. Depressive symptoms showed positive correlations with anxiety symptoms and COVID stress, and negative correlations with growth, optimism, and social support. A significant negative association between depressive symptoms and GPA was found only at Wave 1. Anxiety symptoms followed a similar pattern, being positively associated with COVID stress and negatively associated with growth, optimism, and social support. However, the negative association between anxiety and growth at wave 4 was not significant for males. Growth was positively associated with COVID stress, optimism, and social support, though the correlation with COVID stress was not significant among males. As expected, COVID stress was negatively correlated with optimism and among females only, with social support. Finally, optimism was positively associated with social support.

Gender comparisons were based on an adjusted critical alpha level of 0.00625 using Bonferroni correction for conducting *t*-tests on eight types of measures. Male students scored higher than female students on college adjustment at Wave 2 ($t(1887) = 3.90$, $d = .18$) and cumulative GPA scores at both Wave 2 ($t(1872) = 6.25$, $d = .29$) and 4 ($t(1131) = 3.81$, $d = .23$). On the other hand, females scored higher than males on depressive symptoms at Wave 1 ($t(2349) = 6.58$, $d = .27$), anxiety symptoms at Wave 1 ($t(2349) = 7.15$, $d = .30$) and 4 ($t(1423) = 3.61$, $d = .20$), COVID stress ($t(2337) = 6.44$, $d = .27$), and social support ($t(2343) = 3.25$, $d = .13$). No gender differences were found for growth and optimism.

The distributions of all measured variables exhibited skewness (−1.90–0.91) that were within the acceptable range of ±2.0. Except for Wave 4 cumulative GPA for male students (Kurtosis = 7.91), the kurtosis for all other variables ranged from −1.28 to 2.82, and was also within the acceptable range of ±7.0 (West et al., 1995). Since GPA was used only as a covariate in the models, the significant kurtosis was less likely to affect the results.

Multiple-group models with college adjustment as outcome

Only a subsample of 1,126 participants who remained students at Wave 4 and reported on their college adjustment, were included in the first set of analyses (Models 1a to 1k, Supplementary Table 3). Based on the chi square test of difference, releasing the constraints on growth→college adjustment ($\Delta\chi^2(1) = 2.96$, $p < .10$) and COVID stress→growth ($\Delta\chi^2(1) = 2.72$, $p < .10$) fit the data better. Hence, the best fitting model (Model 1c, $\chi^2(24, N = 1{,}126) = 25.904$, $p > .05$, RMSEA = .012, CFI = .999, TLI = .998, and SRMR = .017) showed evidence of gender differences along paths, COVID stress→growth and growth→college adjustment. Table 1 shows the parameter estimates. Consistent across both genders, optimism and social support at Wave 1 contributed uniquely to growth at Wave 2 though the effect of social support was small ($b = 0.036$, $SE = 0.019$, $p = 0.060$). The effect of COVID stress on growth was significant only for female students, which in turn, predicted college adjustment at Wave 4 for them, but not for male students.

Optimism was not a significant moderator for both genders (Model 1f, $\chi^2(29, N = 1{,}126) = 29.602$, $p > .05$, RMSEA = .006, CFI = 1.000, TLI = .999, and SRMR = .017). On the other hand, social support was a significant moderator for both genders (Model 1 h, $\chi^2(29, N = 1{,}126) = 30.679$, $p > .05$, RMSEA = .010, CFI = .999, TLI = .998, and SRMR = .018). To understand the nature of the moderation, a single-group model combining male and female students was tested. As shown in Figure 2, when social support was > 0.11 *SD* and above, the confidence interval of the moderator function became positive, indicating a positive predictive relationship between COVID stress and growth. On the other hand, at levels of social support ≤ 0.11 *SD*, the confidence interval included zero, suggesting a lack association between COVID stress and growth.

A small curvilinear relationship between COVID stress and growth (Model 1j, $\chi^2(29, N = 1{,}126) = 29.509$, $p > .05$, RMSEA = .006, CFI = 1.000, TLI = .999, and SRMR = .017) was found, with the cross-product, COVID stress*COVID stress negatively predicting growth which was indicative of an

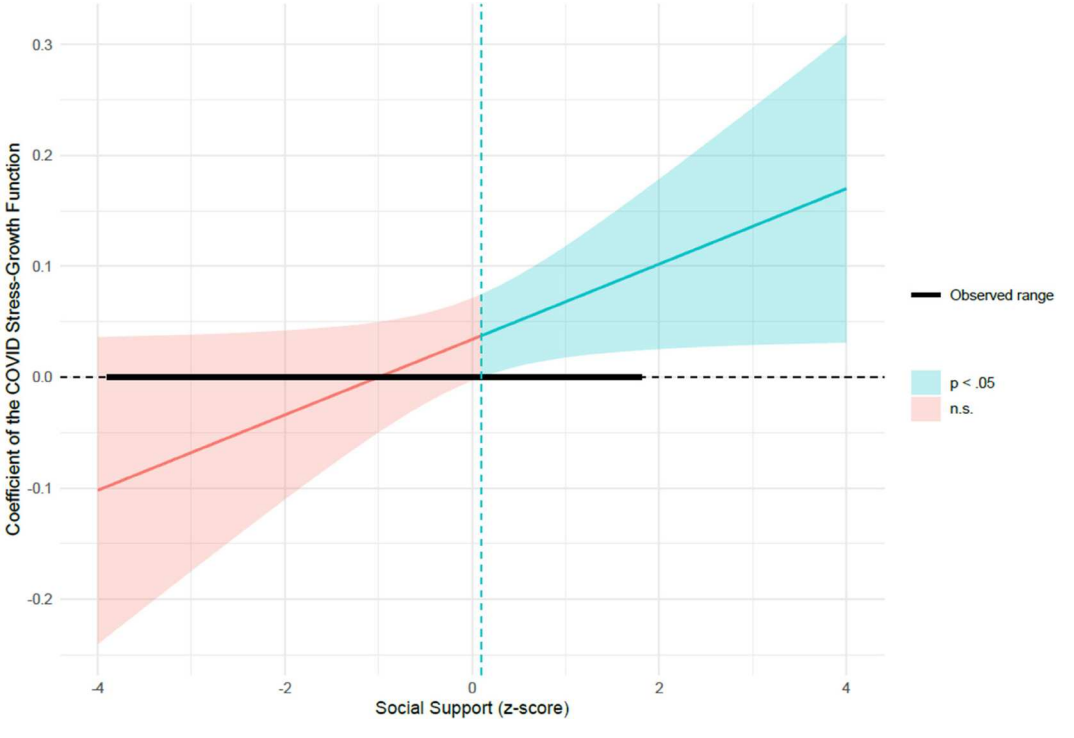

Figure 2. Johnson-Neyman plot illustrating the moderating effect of social support on the predictive association from COVID-19 stress to PTG. Note: For participants with Social Support *z*-scores > 0.11, COVID stress was positively predictive of PTG.

Table 1. Standardized parameter estimates for female and male students in multiple-group models.

Females	cv → g2 *b (SE)*	op → g2 *b (SE)*	ss → g2 *b (SE)*	cv*op → g2 *b (SE)*	cv*ss → g2 *b (SE)*	cv*cv → g2 *b (SE)*	g2 → outcome *b (SE)*
Models			Models with college adjustment as outcome				
1c	0.075(0.034)*	0.111 (0.029)**	0.051 (0.027)†				0.065 (0.030)*
1f	0.075(0.034)*	0.110 (0.029)**	0.052 (0.028)†	0.008 (0.025)			0.065 (0.030)*
1h	0.072(0.034)*	0.111 (0.028)**	0.052 (0.028)†		0.048 (0.024)*		0.065 (0.030)*
1j	0.074(0.034)*	0.111 (0.028)**	0.053 (0.028)†			−0.046 (0.026)†	0.065 (0.030)*
Models with depressive symptoms as outcome							
2b	0.030 (0.023)	0.080 (0.023)**	0.061 (0.021)**				−0.097 (0.034)**
2f	0.031 (0.023)	0.080 (0.023)**	0.064 (0.022)**	−0.005 (0.023)			−0.097 (0.034)**
2h	0.032 (0.023)	0.081 (0.023)**	0.065 (0.022)**		0.031 (0.026)		−0.097 (0.034)**
2j	0.028 (0.024)	0.081 (0.023)**	0.063 (0.022)**			−0.039 (0.025)	−0.097 (0.034)**
Models with anxiety symptoms as outcome							
3a	0.030 (0.023)	0.081 (0.023)**	0.061 (0.021)**				−0.020 (0.025)
3f	0.031 (0.023)	0.080 (0.023)**	0.063 (0.022)**	−0.005 (0.023)			−0.020 (0.025)
3h	0.032 (0.023)	0.082 (0.023)**	0.065 (0.022)**		0.031 (0.026)		−0.020 (0.025)
3j	0.028 (0.024)	0.081 (0.023)**	0.063 (0.022)**			−0.039 (0.025)	−0.020 (0.025)
Males	**cv → g2 *b (SE)***	**op → g2 *b (SE)***	**ss → g2 *b (SE)***	**cv*op → g2 *b (SE)***	**cv*ss → g2 *b (SE)***	**cv*cv → g2 *b (SE)***	**g2 → outcome *b (SE)***
Models			Models with college adjustment as outcome				
1c	−0.011 (0.040)	0.102 (0.027)**	0.055 (0.029)†				−0.015 (0.037)
1f	−0.011 (0.040)	0.105 (0.027)**	0.049 (0.027)†	0.008 (0.024)			−0.015 (0.037)
1h	−0.008 (0.040)	0.106 (0.027)**	0.050 (0.027)†		0.051 (0.026)*		−0.015 (0.037)
1j	−0.010 (0.040)	0.105 (0.027)**	0.050 (0.027)†			−0.042 (0.023)†	−0.015 (0.037)
Models with depressive symptoms as outcome							
2b	0.030 (0.023)	0.073 (0.022)**	0.065 (0.022)**				−0.011 (0.041)
2f	0.029 (0.022)	0.075 (0.022)**	0.060 (0.021)**	−0.005 (0.021)			−0.010 (0.040)
2h	0.030 (0.022)	0.076 (0.022)**	0.061 (0.021)**		0.032 (0.026)		−0.010 (0.040)
2j	0.026 (0.022)	0.076 (0.022)**	0.059 (0.022)**			−0.037 (0.024)	−0.010 (0.040)
Models with anxiety symptoms as outcome							
3a	0.029 (0.023)	0.074 (0.022)**	0.064 (0.022)**				−0.023 (0.028)
3f	0.029 (0.022)	0.075 (0.022)**	0.059 (0.021)**	−0.005 (0.021)			−0.023 (0.028)
3h	0.030 (0.022)	0.076 (0.022)**	0.061 (0.021)**		0.032 (0.026)		−0.022 (0.028)
3j	0.026 (0.022)	0.076 (0.022)**	0.059 (0.021)**			−0.037 (0.024)	−0.022 (0.028)

Note: g = Posttraumatic growth; adj = College adjustment; cv = Retrospective COVID-19 stress; op = Optimism; ss = Social support; Numerals after variable names represent waves of data collection; † $p < .10$, * $p < .05$, ** $p < .01$.

inverted U-shaped relationship ($b = -0.027$, $SE = 0.015$, $p = 0.074$). Figure 3 shows that the rate of change of growth was dependent on levels of COVID stress. When COVID stress was < −0.09 *SD*, the rate of change of growth was positive and decreasing (slope becoming gentler, like a curve) until it was no longer significant when COVID stress was ≥ −0.09 *SD*.

Multiple-group models with depressive symptoms as outcome

The best fitting model showed gender differences along the growth→depressive symptoms path (Model 2b, $\chi^2(33, N = 2{,}351) = 33.068$, $p > .05$; RMSEA = .001; CFI = 1.000; TLI = 1.000 and SRMR = .022; $\Delta MLR\chi^2(1) = 2.86$, $p < .10$). Growth negatively predicted depressive symptoms for female but not for male students. No other gender differences were found. The pattern of associations between the predictors and growth was similar to the first set of models. Optimism and social support were uniquely predictive of growth, but COVID stress was no longer predictive of growth. Moderations were tested in subsequent models with no significant results.

Multiple-group models with anxiety symptoms as outcome

Growth was not predictive of anxiety symptoms for both genders (Model 3a, $\chi^2(36, N = 2{,}351) = 27.62$, $p > .05$; RMSEA = .000; CFI = 1.000; TLI = 1.000 and SRMR = .016). Given no significant effects of the cross-product terms, there was no evidence of moderation.

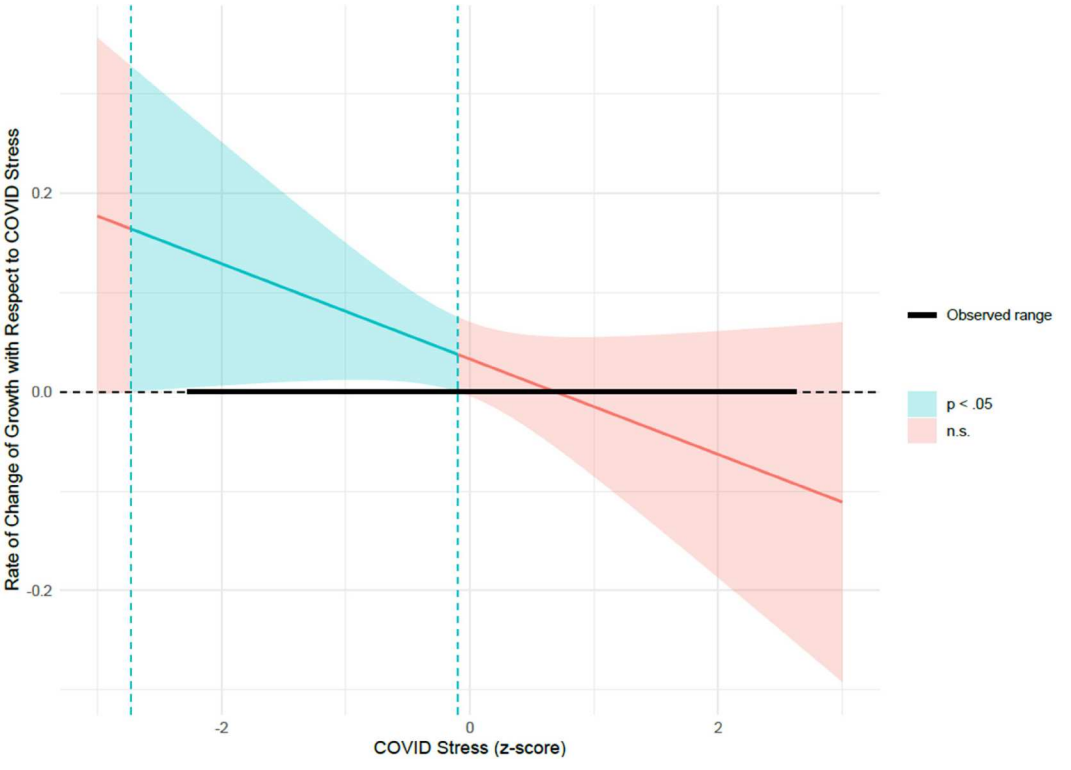

Figure 3. Johnson-Neyman plot illustrating the moderating effect of COVID-19 stress on the rate of change of growth. Note: When COVID stress *z*-score was < −0.09, COVID stess was positively predictive of growth; when the *z* score was > −0.09, COVID stress was no longer predictive of PTG.

Discussion

To address questions about the predictive validity of PTG in reflecting actual positive changes, this study examined the longitudinal outcomes of COVID-19 related PTG, in terms of college adjustment, depressive, and anxiety symptoms. These outcomes were especially pertinent to university students in emerging adulthood, a stage marked by academic, career, and interpersonal transitions that heighten their vulnerability to mental health issues (Auerbach et al., 2018). The results of this study show that outcomes predicted by PTG varied by gender and types of outcomes. Specifically, higher PTG predicted better college adjustment and fewer depressive symptoms for female but not male students. Female students who perceived positive changes in themselves in the areas of personal resources, social relationships, life philosophy, and coping skills because of the pandemic, were more likely to report better educational, relational, and psychological functioning in the university one year later. By navigating COVID-19 stressors and finding growth in the process, female students likely strengthened their adaptive coping and self-regulation skills, enabling better university functioning and fewer depressive symptoms a year later. Regarding this gender difference, improvement in social relationships as a part of PTG could have a more positive impact on female students' adjustment since females tend to rely more on social support as a coping strategy than males (O'Rourke et al., 2022). Additionally, since females are typically more susceptible to depressive symptoms (Zahn-Waxler et al., 2006), the protective effects of PTG could appear to be more pronounced for them. By boosting self-efficacy and strengthening social ties, PTG can alleviate pandemic-related loneliness and curb feelings of hopelessness, thereby reducing risk of depressive symptoms (Hyun et al., 2023). Overall, these findings support the validity of perceived PTG in predicting actual long-term functioning

outcomes among female students. On the other hand, perceived PTG was not associated with any outcomes for male students.

PTG also showed no long-term impact on anxiety symptoms, in contrast to its positive effects on female students' depressive symptoms. As depression stems from a negative view about the self, future, and world, it is contrary to experiencing positive psychological transformation of the self in PTG, including having greater sense of personal strengths, being open to new possibilities, and having renewed purpose in life. On the other hand, anxiety which centers on external threats and diminished perceived control, is less aligned with PTG's focus on the positive aspects of self. Hence, despite overlaps between depression and anxiety, their relationships with PTG were clearly differentiated among female students in this study.

The study results suggest a possible weak inverted U-shaped relationship between COVID-19 stress and PTG (Dar & Iqbal, 2020; Greenberg et al., 2021; Weber & Schulenberg, 2022). At low to average levels of COVID-19 stress, students' experience of challenges predicted PTG, with the relationship becoming weaker (gentler slope) until it was no longer significant at above average levels of COVID-19 stress. During COVID-19, university students experienced COVID-19 stress due to resource constraints, health concerns, social restrictions, and future uncertainty (Kira et al., 2020). Lower levels of COVID-19 stress were related to inconveniences and tolerable disruptions to functioning and lives; additional COVID-19 stress could be associated with health problems, missed opportunities, and deterioration of close relationships, to the extent that students' sense of identity, purpose, and meaning in life were challenged, increasing the likelihood of PTG (Dominick et al., 2022; Governale et al., 2023; Yang et al., 2023). Yet, overwhelming COVID-19 stress, such as loss of livelihood, serious health problems, and loss of loved ones could interfere with the affective–cognitive processes needed for PTG. These findings highlight the nuanced, curvilinear link between posttraumatic stress and growth.

Optimism was found to have a direct effect on PTG that is over and above the effects of other variables (Koliouli & Canellopoulos, 2021) but it did not play a moderating role in the association between COVID-19 stress and PTG. Students with an optimistic outlook, characterized by favorable expectations about pandemic outcomes, might have been more adaptable, such as finding new ways to maintain social ties, establishing new routines, embracing online learning, and cultivating new interests. Their psychological flexibility and openness to new perspectives likely helped with fostering PTG (Meyerson et al., 2011; Tedeschi et al., 2018). Hence, optimism acts as a direct resource for PTG, rather than affects or conditions the relationship between COVID-19 stress and PTG.

Consistent with COVID-19 research, social support was found to be predictive of PTG in this study (Dominick et al., 2022; Hu et al., 2022), reinforcing theories that view supportive relationships as contributing to growth (Meyerson et al., 2011; Tedeschi et al., 2018). Social support also moderated the COVID-19 stress-PTG link such that pandemic-related stress promoted PTG only among students who reported at least average social support from family, friends, or a significant other, consistent other COVID-19 studies (Fino et al., 2021; Northfield & Johnston, 2022). Those with weaker social support were less likely to experience PTG as a result of COVID-19 stress. Because physical distancing measures during the pandemic heightened feelings of loneliness, anxiety, and depression in young adults (Bu et al., 2020; Groarke et al., 2020), these results underscore the importance of social support as a vital resource for adaptive functioning during the pandemic (Zhang et al., 2021).

During this period, social support often involved exchanging coping strategies and perspectives, which could help students reframe their COVID-19 hardships and construct more hopeful personal narratives. As the pandemic was a shared global crisis, empathy and mutual understanding were amplified, increasing supportive social interactions (Stanley et al., 2021). Validation from others could increase cognitive flexibility, encouraging students to entertain multiple viewpoints and envision new possibilities. Disruption of routines and social networks may have prompted many young adults to cultivate new or previously peripheral relationships – a shift that could be transformative during the identity-exploration phase of emerging adulthood (Arnett, 2007).

Limitations and future research directions

Several limitations should be considered when interpreting the results. First, evidence of a curvilinear relationship between COVID-19 stress and PTG, as well as the moderating effect of social support were not consistently found in all the statistical models. They were prominent only in the models with college adjustment as the outcome. Additionally, the effects were also small in magnitude and might not be meaningful, on average, for an individual student. This was likely due to the stress of COVID-19 not being "traumatic" for most people in this community sample, and that most did not experience significant growth. For instance, based on the distribution of the mean scores of COVID-19 stress, only about 10% of the sample reported experiencing more than moderate to extreme levels of COVID-19 stress "to the extent that their studies, work, or relationships were definitely affected (average ratings of 7-9, out of 9)."

Second, posttraumatic stress symptoms were not directly measured in this study but were assumed from students' report of the intensity of COVID-19 stressors experienced. The estimation of this indirect path (COVID-19 stress → posttraumatic symptoms → PTG) might have been smaller than the direct link from posttraumatic stress symptoms to PTG; nevertheless, the smaller effect was detected. Third, COVID-19 stress was measured retrospectively and could be subjected to recall bias. Despite this limitation, the COVID-19 stress domains being rated were based on a validated instrument for the same population of university students (Yong & Suh, 2022). Fourth, some researchers may argue that the study was conducted after the acute phase of the pandemic, and the students were no longer experiencing COVID-19 stress. However, this could be advantageous given that passing time is a necessary condition for PTG so that certain psychological processes such as deliberate rumination can occur. Many studies of COVID-19 PTG were conducted during the acute phase of the pandemic, thus lacking the passage of time for PTG to fully emerge (e.g., Dominick et al., 2022 and Park et al., 2023).

Notwithstanding these limitations, several strengths should be highlighted. First, this longitudinal study included four waves of data collection, spaced six months apart over a period of 1.5 years. Other COVID-19 studies which investigated PTG were cross-sectional in design (e.g., Governale et al., 2023 and Yang et al., 2023). Those which used a longitudinal design had relatively short follow-up of two to six months (e.g., Dominick et al., 2022; Park et al., 2023). Hence, the results of the present study offer stronger evidence for the predictive associations involving PTG. Second, the study examined and compared three different outcomes, namely college adjustment, depressive symptoms, and anxiety symptoms, allowing for detection of differentiated effects of PTG. Third, findings of the study can be considered robust given the conservative approach in specifying the statistical models that controlled for previous levels of the outcome variables and PTG, as well as using a multiple-group approach for testing gender differences.

Future research should examine not only how PTG develops, but also its downstream effects. Hence, there is a need for extended longitudinal follow-up of individuals who have experienced adverse events and to identify conditions that foster PTG and to determine long-term positive outcomes across multiple life domains. In addition, studying gender or subgroup differences in the experience and effects of PTG may clarify the underlying mechanisms through which perceived PTG translates to tangible benefits.

Conclusions

Findings from this study provide some evidence of the non-illusory effect of PTG, which is defined as real positive changes in life, thus supporting the predictive and social validity of PTG. While it has been argued that perceived PTG may reflect positive thinking and coping (Maercker & Zoellner, 2004), it is less likely the case here since many COVID-19 stressors would have eased almost completely by the first wave of data collection in September 2022 in Singapore, when many were no longer actively coping with COVID-19 stressors. Another view is that perceived PTG could be associated

with some aspects of personality trait that is independent of the context of COVID-19. Such a personality trait could be related to dispositional optimism which was already included in the statistical models and we were able to control for this enduring influence on PTG, and yet, still document small but significant longitudinal impact of perceived PTG. Overall, the findings support PTG as a clinically relevant construct that could support improved functioning, especially for women coping with adversity.

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Formal analysis and investigation: MY
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Ethics approval for research involving human participants

The procedures used in this study were approved by the Institutional Review Board at Nanyang Technological University, Singapore (IRB-2022-591).

Information about data sharing

The data that support the findings of this study are available on request from the corresponding author, MY, or National Institute of Education/Nanyang Technological University.

Informed consent

Online, written informed consent was obtained from all participants before the start of the Wave 1 survey, implemented via Qualtrics.

ORCID

Minglee Yong http://orcid.org/0000-0002-7008-257X

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