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Impact of COVID-19 on psychological wellbeing

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Abstract *Background/Objective:* This cross-sectional study aims to record post-traumatic stress (PTS) and post-traumatic growth (PTG) of the general population of China during the first wave of COVID-19 spread. *Method*: An online survey was distributed in China during February and March 2020 to record the general population's PTS (using the Post-traumatic Stress Disorder Checklist-Civilian Version, PCL-C) and PTG (using the Post-traumatic Growth Inventory, PTGI) due to COVID-19. Confirmatory Factor Analyses (CFAs) and a Two-Part Model (TPM) of regression analysis were conducted. *Results*: In total, 29,118 Chinese participants completed the survey (54.20% were in their 20s, 68% were males, and 60.30% had a university education). CFA results illustrated that bifactor models described the Chinese psychometric traits of PTS and PTG over the default models. Results of TPM suggested that female, low-educated, and middle-aged individuals were more vulnerable to PTS. Remarkably, mutual and positive correlations between the PTS and the PTG, though small in statistics, were observed through regression analyses. *Conclusions*: The current results presented new best-fit structural models, potential predictors, and valuable baseline information on the PTS and the PTG of the Chinese population in the context of COVID-19.
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Impacto del COVID-19 sobre el bienestar psicológico

Resumen *Antecedentes/Objetivo:* Este estudio transversal se realizó para registrar el estrés postraumático (EPT) y el crecimiento de estrés postraumático (CPT) de la población general de China durante la primera ola de la extensión del COVID-19. *Método:* Se realizó una encuesta en línea en China durante febrero y marzo del año 2020 para registrar EPT de la población (utilizando el Post-traumatic Stress Disorder Checklist-Civilian Version, PCL-C) y CPT (utilizando el Post-traumatic Growth Inventory, PTGI). Se llevaron a cabo Análisis Factorial Confirmatorio (AFC) y Modelo de Dos Partes (MDP) de análisis de regresión. *Resultados:* En total, 29.118 chinos completaron la encuesta (54,2% de ellos tenían 20~29 años, 68,0% eran hombres, y 60,3% tenían una Educación Universitaria). Los resultados de AFC ilustraron que los modelos de bifactoriales eran mejores para descubrir los rasgos psicométricos de EPT y CPT de los participantes chinos que los modelos predeterminados. Los resultados de MDP sugirieron que las mujeres, las personas con bajo nivel educativo y de mediana edad eran más vulnerables a EPT. Se observaron correlaciones mutuas y positivas entre EPT y CPT, aunque pequeñas. *Conclusiones:* Los resultados actuales presentaron nuevos modelos estructurales de mejor ajuste, predictores potenciales e información de referencia valiosa de EPT y CPT de la población China en el contexto de COVID-19.

The World Health Organization (World Health Organization, 2020) announced the coronavirus disease 2019 (COVID-19) outbreak as a pandemic on 11th March 2020. Infected by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2, Grifoni et al., 2020), patients with COVID-19 show a spectrum of respiratory symptoms (e.g., dry cough and dyspnoea) (L. Zhang et al., 2020). In addition to severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS), COVID-19 is already the third coronavirus pandemic from the same coronavirus family in the 21st century (Guarner, 2020; Rabaan et al., 2020). Research on SARS and MERS illustrated that people may react to these pandemics with two opposite attitudes, namely, post-traumatic stress (PTS; Cho et al., 2020; Wu et al., 2005) and post-traumatic growth (PTG; Cheng et al., 2006). However, relative to the former coronavirus pandemics, COVID-19 exhibits a higher reproductive number but a lower case-fatality rate (Petrosillo et al., 2020; Rajgor et al., 2020). Meanwhile, the impact of SARS-CoV-2 has rampantly gone beyond a public health emergency and caused global issues with the economy (Vidya & Prabheesh, 2020), youth education (Daniel, 2020), and international relations (Pevehouse, 2020). As a consequence, it is unpredictable whether individuals' post-traumatic reactions to COVID-19 could be more intricate than previous pandemics.

PTS is a plethora of aversive feelings that one may encounter after a traumatic event (Weathers et al., 1993). Post-traumatic stress disorder (PTSD) is the clinical diagnosis for people with severe PTS (Bisson, 2007). Initially, PTSD was defined in the third edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-III, 1980) for describing the clinical symptoms observed with World War II and Vietnam veterans (Marmar et al., 2015). These veterans with PTSD frequently felt anxiety, isolation, and other negative emotions due to the memories of the war (Crocq & Crocq, 2000). Later on, PTSD was identified with victims of sexual abuse (Weaver et al., 2014), earthquakes (Zhang & Ho, 2011), and other traumatic situations (Kubany et al., 2000). Currently, researchers from China (e.g., C. Wang et al., 2020), Italy (e.

g., Forte et al., 2020), Greece (e.g., Kalaitzaki, 2020), and many other countries have been monitoring the issue of PTSD in the context of COVID-19. As China is the first nation to react to the pandemic, the Chinese post-traumatic reactions may have an essential implication for the investigation (e.g., C. Wang et al., 2020).

Intriguingly, in contrast to the aforementioned 'negative' reaction—PTS, people might also obtain a 'positive' impact—PTG (Boals & Schuettler, 2011), due to the same trauma. PTG is the spiritual growth, the strengthened interpersonal relationships, and the new purpose of life gained from a traumatic event (Osei-Bonsu et al., 2012). Researchers describe PTG as a mental technique to repair broken hearts just as Chinese *Juci* or Japanese *Kintsugi* did for fixing cracked pottery (Walton, 2020). Remarkably, both of the handcraft techniques would not only restore the practical function of the pottery but also lift the aesthetic beauty of it (Walton, 2020); congruously, PTG is deemed as the nutrient to post-traumatic life and a tonic for being optimistic for the future (Jansen et al., 2011). In the case of COVID-19, researchers have predicted that it will bring PTG to people in tandem with PTS (Greenberg & Hibbert, 2020), which is supported by studies in Spain (Vazquez et al., 2021) and Turkey (Ikizer, Karanci, Gul, & Dilekler, 2021).

The predictors of PTS and PTG should be researched for each traumatic context. In the context of COVID-19, some stressors of PTS have been locked on. For example, victims of COVID-19 (Xiao et al., 2020), clinical workers (Blekas et al., 2020), and quarantined individuals (Wathelet et al., 2021) are deemed as high-risk cohorts of PTS. Specifically, clinical workers without a life partner (i.e., unmarried, divorced, and widowed) are likely to suffer more PTS than those in a marriage (d'Ettorre et al., 2021). In addition, amongst the general population, females (Liu et al., 2020) and low-educated people (L. Liang et al., 2020) may encounter more PTS than their counterparts.

Nevertheless, some research gaps remained as for the potential predictors. First, researchers have not concurred whether younger (González-Sanguino et al., 2020) or older

people (Di Tella et al., 2020) are more vulnerable to PTS due to COVID-19. Second, whether the relationship between age and PTS is linear as for COVID-19 should be questioned. Third, it was found that perceived risk (e.g., feeling unsafe), negative mood (e.g., anxiety), adverse physical reactions (e.g., insomnia), as well as PTS were locked in a vicious circle for clinical workers combating COVID-19 (Yin et al., 2021). However, whether this strong linkage can be generalized to the general population is indeterminate.

Meanwhile, the relationship between PTS and PTG is under debate. Some researchers deemed that PTS and PTG are 'two cancel-out extremes' (Frazier et al., 2001), while others proposed that they are 'two facets' of a traumatic reaction (Solomon & Dekel, 2007). Intuitively, PTS and PTG ought to be a pair of rivals; that is, feeling the PTG should prevent individuals from experiencing the PTS, and vice versa (i.e., the 'two cancel-out extremes' theory) (Frazier et al., 2001). Theoretically, PTG promotes the repair of damage caused by PTS; hence, the worse the PTS, the stronger the PTG ought to be induced (i.e., the 'two facets' theory) (Solomon & Dekel, 2007). Empirically, the observation that males gain more PTG (Zhou et al., 2020), while females suffer more PTS (Liu et al., 2020) seems to support the 'two cancel-out extremes' theory (Frazier et al., 2001). Nevertheless, positive correlations between PTS and PTG are frequently observed in the context of COVID-19 (Vazquez et al., 2021), which was consistent with the prediction of the 'two facets' theory (Solomon & Dekel, 2007). The relationship between PTS and PTG deserves more attention as it may forecast whether the ongoing impact of COVID-19 is likely to be a 'vicious circle' (X. Liang et al., 2020) or a 'phoenix renascence' (Tamiolaki & Kalaitzaki, 2020).

This study aims to evaluate the self-report PTS and PTG with the general Chinese population at the first peak of the COVID-19 spread in China. The purpose of this study is three-fold: (1) to record PTS and PTG of the general population due to COVID-19; (2) to explore the predictors of PTS and PTG, including the basic demographic information (e.g., sex and education), COVID-19 pandemic-related information (e.g., diagnosis and quarantine), psychological and physical reactions to COVID-19 (e.g., avoidance and insomnia), and on-the-spot mood (e.g., happy or sad on the testing day); (3) to examine the underlying relationship between PTS and PTG after the above predictors were controlled (i.e., hierarchical regression analyses). Referencing the previous publications, we predicted that being female (e.g., Liu et al., 2020), low-educated (e.g., L. Liang et al., 2020), quarantined (e.g., Wathelet et al., 2021), diagnosed with COVID-19 (e.g., Xiao et al., 2020), and clinical workers (e.g., Blekas et al., 2020), and having negative psychological or physical reactions to the pandemic (e.g., Yin et al., 2021) could all be stressors of PTS. More importantly, anticipating a 'phoenix renascence' (Tamiolaki & Kalaitzaki, 2020), we propose a mutual positive prediction between the PTS and the PTG.

Method

Participants

An online survey was conducted from February to March 2020 in China. During this period, the key events that

happened in China should be mentioned: (1) from the 23rd of January to the 8th of April 2020, Wuhan was officially in a lockdown for 76 days; (2) in China (covering the mainland, Hong Kong, and Macao for the current study purpose), the number of new confirmed cases and deaths due to COVID-19 peaked in February (i.e., 69,550 cases and 2,622 deaths) and were significantly reduced in March (i.e., 2,858 cases and 469 deaths); (3) during the Chinese New Year holiday (i.e., from the 24th of January to the 2nd of February), the Chinese government recommended that the general population stay at home to avoid the virus spreading, and wear masks when they had to go to public places; (4) from the 2nd of February, people were encouraged to go back to work as usual, but should wear proper personal protection.

The current sample was collected from three areas of China (viz., the mainland, Hong Kong, and Macao) by two research centers. The two online surveys used by these research centers were slightly different on the question of age. One survey required participants to provide their date of birth; in total, 25,757 questionnaires were collected, including eight participants who left their year of birth as 2020 by mistake (i.e., age ≤ 0) and one questionnaire submitted by a Chinese person living overseas. Another online survey asked the age range of participants (i.e., the '< 20', '20s', '30s', '40s', '50s', '60s', and '≥70'); in sum, 3,371 questionnaires were submitted, including one questionnaire submitted by another Chinese person living overseas. The eight questionnaires with the age issue and the two submitted by the Chinese living overseas (n = 10) were excluded from further analyses. Except for the aforementioned issues, there was no other issue (e.g., no other missing value). Then, we combined the data collected by both centers and treated participant's age as a categorical variable.

The final sample size was 29,118 (54.2% were in their '20s', 68.0% were males, and 60.3% had a university education; see Table 1). The mean age based on the available date of birth was 23.47 (SD = 7.26). All participants provided their informed consent online. Each participant had a chance to draw for a prize as a reimbursement (RMB¥10-100, winning rate = 20%). The current investigation was conducted in accordance with a protocol approved by the ethics committee of the Army Medical University.

Measures

Demographic sheet. A demographic sheet was designed by the current research team referencing previous publications of PTS and PTG in the context of COVID-19, and was presented in Chinese characters for the current participants. Collected information covered four parts, namely, basic demographic characteristics (e.g., age and sex), COVID-19 pandemic-related information (e.g., diagnosis and quarantine), psychological and physical reactions to COVID-19 (e.g., risk perception and insomnia), and on-the-spot mood (i.e., how anxious, angry, sad, fearful, and happy the participant felt on the testing day; each item was evaluated on a 5-point Likert scale, 0 = not at all to 4 = extremely strong). Since participants' responses to these on-the-spot moods were not all normally distributed, we dummy coded each on-the-spot mood (0 = not at all and 1 = slightly to extremely strong) for the following analyses. A sample of the key questions of the demographic sheet can be acquired

from the corresponding author (or by downloading supplementary documents from http://www.hulilab.com/home/viewshare/29).

PTSD Checklist-Civilian Version (PCL-C). The PCL-C is a 17-item self-report scale for examining PTSD symptoms (Weathers et al., 1993). Each item is rated on a 5-point Likert scale, ranging from 1 (*not at all*) to 5 (*extremely*). A Chinese translated version of the PCL-C was administered in the current study (Yang et al., 2007). The PCL-C total score is recommended for analyzing the overall PTSD symptoms of participants (Weathers et al., 1993). According to previous publications, Cronbach's α of the 17 PCL-C items ranged from .91 to. 97 based on both Western and Chinese participants (Li et al., 2010; L. Wang et al., 2011; Weathers et al., 1993). To date, one research gap is that the best-fit structural/

scoring model of the PCL-C *ad hoc* Chinese people in the context of COVID-19 has not been explored by previous researchers. Therefore, the model fitness of a series of available structural models of the PCL-C, such as the three-factor (Weathers et al., 1993), the second-order, and the bifactor models (Reise, 2012), was examined with the current data (see more information in supplementary documents).

Post-traumatic Growth Inventory (PTGI). The PTGI is a 21-item self-report scale for examining one's positive psychological adaptations after a traumatic event (Tedeschi & Calhoun, 1996). Each item of the PTGI is rated on a 6-point Likert scale, ranging from 0 (*I did not experience this change*) to 5 (*I experienced this change to a very great degree*). Its Chinese translated version (Ho et al., 2004) was administered in this study. Researchers have proposed the

Table 1 Demographic information for the current participants recruited during COVID-19 in China.

Demographic characteristics	Overall sample* (for logistic regression) (*N* = 29,118)	Sub-sample* (for linear regression) (*n* = 17,704)
Basic demographic information		
Sex (*n* and % for male)	19,803 (68%)	10,312 (58.2%)
Age group		
age < 20 (*n* and %)	8,249 (28.3%)	5,618 (31.7%)
age = 20 to 29 (*n* and %)	15,794 (54.2%)	8,289 (46.8%)
age = 30 to 39 (*n* and %)	2,441 (8.4%)	1,603 (9.1%)
age = 40 to 49 (*n* and %)	1,817 (6.2%)	1,512 (8.5%)
age = 50 to 59 (*n* and %)	698 (2.4%)	600 (3.4%)
age = 60 to 69 (*n* and %)	100 (0.3%)	71 (0.4%)
age ≥ 70 (*n* and %)	19 (0.1%)	11 (0.1%)
Education level:		
education ≤ junior high school	2,266 (7.8%)	1,696 (9.6%)
education = high school	8,714 (29.9%)	4,447 (25.1%)
education = college/university	17,563 (60.3%)	11,122 (62.8%)
education = post-graduate	575 (2.0%)	439 (2.5%)
Marital status (*n* and % for in a marriage)	5,103 (17.5%)	3,718 (21.0%)
COVID-19 pandemic-related information		
Participant group		
Victim of COVID-19 (*n* and %)	53 (0.2%)	32 (0.2%)
Clinical worker (*n* and %)	205 (0.7%)	162 (0.9%)
Quarantined due to COVID-19 (*n* and % for yes)	5,153 (17.7%)	3,537 (20%)
Confirmed case range:		
case number ≤ 9 (*n* and %)	17 (0.1%)	13 (0.1%)
case number = 10 to 99 (*n* and %)	7,973 (27.4%)	3,551 (20.1%)
case number = 100 to 499 (*n* and %)	7,449 (25.6%)	4,286 (24.2%)
case number = 500 to 999 (*n* and %)	10,851 (37.3%)	7,685 (43.4%)
case number = 1000 to 9999 (*n* and %)	1,676 (5.8%)	1,243 (7%)
case number ≥ 10000 (*n* and %)	1,152 (4%)	926 (5.2%)
Period of COVID-19:		
period = peak (*n* and %)	18,578 (63.8%)	12,582 (71.1%)
period = decline (*n* and %)	10,540 (36.2%)	5,122 (28.9%)

Note.

* The current study conducted the TPM (i.e., logistic-part and linear-part regressions) based on the overall sample (*N* = 29,118) and the sub-sample with mild to severe post-traumatic stress (i.e., PCL-C > 18, *n* = 17,704), respectively (see more details in the Method section). Age group: due to the small sample size of seniors, the categories of 'age = 60 to 69' and 'age ≥ 70' were combined into 'age ≥ 60' for further analyses. Confirmed case range = the range of accumulated COVID-19 confirmed case numbers in one's residential region.

PTGI total score as reflecting an individual's overall extent of post-traumatic growth. According to the previous publications, Cronbach's α of the 21 items of the PTGI was around.90 as per both Western and Chinese participants (e. g., Tedeschi & Calhoun, 1996; Tedeschi & Calhoun, 1996, N. Zhang et al., 2020). Similar to the PCL-C, the best-fit model of the PTGI for Chinese participants in terms of COVID-19 was unclear. Therefore, we examined the model fitness of the current data with available structural models of the PTGI, including the five-factor model for its full-length version (i.e., PTGI-21; Tedeschi & Calhoun, 1996) and the three-factor model for its short-length version (i.e., PTGI-13; Weiss & Berger, 2006). Meanwhile, referencing Reise (2012), the second-order model and the bifactor model were also evaluated for the PTGI (Prati & Pietrantoni, 2014) (see more details in supplementary documents).

Statistical analysis

Confirmatory factor analyses (CFAs) were conducted to evaluate the structural model fitness for PCL-C and PTGI using M*plus* 8.2 (Muthén & Muthén, 1998−2012). In this study, the WLSMV and the MLM were used for CFAs of the PCL-C (i.e., 5-point with asymmetrical distribution) and the PTGI (i.e., 6-point with non-normal distribution), respectively (Gao et al., 2020; Muthén & Muthén, 1998−2012; Sass, 2011). In addition, referencing J. Wang and Wang (2012), the best-fit model was identified according to the comparative fit index (CFI) $\geq$ .95, Tucker−Lewis Index (TLI) $\geq$ .90, standardized root mean square residual (SRMR) $\leq$ .08, and root mean square error of approximation (RMSEA) $\leq$ .08. Independent samples t-tests of sex differences on the PCL-C and the PTGI were conducted, as well as Welch's ANOVAs of age and education differences on the two scales (Levene's tests for equality of variances were significant in this study). Games-Howell tests were carried out as *post hoc* comparisons for Welch's tests. According to Afifi et al. (2007), the two-part model (TPM) was conducted for the PCL-C since its distribution was highly skewed with an inflated low-score part (i.e., a large portion of participants was almost absent of PTS; 27% had PCL-C = 17 and 12.1% had PCL-C = 18). In the TPM, a logistic regression was firstly conducted for a dummy coded PCL-C (i.e., 0 = *participants had PCL-C $\leq$ 18* vs. 1 = *participants had PCL-C > 18*). Secondly, a linear regression was conducted for the PCL-C score without the inflated part (i.e., based on only 1 = *participants had PCL-C > 18*). Meanwhile, for the sake of normality, the PCL-C score was converted (i.e., [0.30 - 1/PCL-C] $\times$ 1000) to be used in the linear regression (Keith, 2014). Moreover, referencing the previous publications, hierarchical regression was adopted for the TPM, with five steps: (1) basic demographic information; (2) COVID-19 pandemic-related information; (3) participants' psychological and physical reactions to COVID-19; (4) participants' on-the-spot mood; and (5) the PTGI score. Furthermore, Goral et al. (2020) recommended evaluating the prediction from the PCL-C to the PTGI as well. Therefore, we conducted two five-step hierarchical linear regressions for the PTGI (i.e., normally distributed) to mirror the TPM procedure of the PCL-C. Due to the word

limitation, results of the regressions for the PTGI are available by contacting the corresponding author (or by downloading supplementary documents from http://www.hulilab.com/home/viewshare/29). Apart from the CFAs, other statistical analyses of this study were processed by SPSS Version 27 (IBM Corp).

Results

Confirmatory Factor Analysis

PCL-C. The CFA results suggested that the original three-factor model of the PCL-C fit the current data quite well (CFI = .95, TLI = .94, RMSEA [90% CI] = .081 [.081, .082], and SRMR = .049), and the second-order model showed a similar result (CFI = .95, TLI = .94, RMSEA [90% CI] = .081 [.081, .082], and SRMR = .049). Nevertheless, the best-fit structural model of the PCL-C was a 17-item 3-factor bifactor model (CFI = .97, TLI = .96, RMSEA [90% CI] = .065 [.064, .066], and SRMR = .035). The standardized factor loading regression weights (*b*) of individual items to the general factor of the bifactor model ranged from .58 to .88. Cronbach's α for the three subscales of the best-fit models ranged from .85 to .86, and for the overall 17 items was .93. In the current study, the total score of PCL-C-17 was used in the further statistical analyses.

PTGI. The CFA results indicated that none of the models for the full-length version of the PTGI (i.e., PTGI-21) fitted the current data (CFI = .88, TLI = .87, RMSEA [90% CI] = .084 [.083, .085], and SRMR = .045, for the one-factor model; CFI = .89, TLI = .87, RMSEA [90% CI] = .084 [.083, .085], and SRMR = .044, for the five-factor model; and CFI = .89, TLI = .87, RMSEA [90% CI] = .084 [.083, .084], and SRMR = .045, for the three-factor model). In contrast, a 13-item 3-factor model designed by Weiss and Berger (2006) for PTGI-13 showed a good fit to the current data (CFI = .94, TLI = .93, RMSEA [90% CI] = .074 [.073, .076], and SRMR = .035). Nevertheless, Weiss and Berger (2006) reported a cross-loading issue across the 2nd and the 3rd factor of their model. Meanwhile, we identified two other issues with this model. First, Cronbach's α for the 3rd factor (i.e., 2 items) of the model was only .64. Second, Item #1 of the PTGI showed insufficient loading to this and other models that consist of Item #1 (all *b*s < .30). Thereafter, we combined the 2nd and the 3rd factors of Weiss and Berger's model into one factor and deleted Item #1. Results suggested that the final 12-item, 2-factor, bifactor model fitted the current data very well (CFI = .96, TLI = .94, RMSEA [90% CI] = .072 [.071, .074], and SRMR = .074). The standardized factor loading regression weights (*b*) of individual items to the general factor ranged from .44 to .86. Cronbach's αs for the two subscales of the best-fit model were .88 and .90, and for the overall 12 items was .94. Finally, the total score of the PTGI-12 was used in the following statistical analyses.

Sex differences

The mean of the PCL-C-17 for the overall participants was 22.58 (*SD* = 7.60). A significant sex difference on the PCL-C-17 was identified (i.e., female > male, t = 36.38, $p < .001$, Cohen's d = 0.49, 95% CI = [3.42, 3.81]).

The mean of the PTGI-12 for the overall participants was 28.59 (SD = 14.13). A significant sex difference on the PTGI-12 was observed (i.e., male > female, t = 27.06, $p < .001$, Cohen's d = 0.33, 95% CI = [4.23, 4.89]).

Age-group differences

The age-group effect on the PCL-C-17 was significant (Welch's F (5, 1080.07) = 260.25, $p < .001$). Games-Howell *post hoc* analyses revealed that the '20s' had a lower PCL-C-17 score than all other five age groups (all $ps < .001$). Meanwhile, the middle-aged groups (i.e., the '40s' and '50s') had a higher PCL-C score than youth groups (i.e., the '< 20', '20s', and '30s'; all $ps < .001$).

There was a significant age-group effect on the PTGI-12 (Welch's F (5, 1092.12) = 50.90, $p < .001$). Games-Howell *post hoc* analyses revealed that the middle-aged groups (i.e., the '40s' and '50s') had a significantly higher PTGI-12 score than two youth groups (i.e., the '< 20' and '30s'; all $ps < .001$). In addition, the '20s' had a higher PTGI-12 score than both the '< 20' and the '30s' (both $ps < .001$).

Education-level differences

The education-group effect on the PCL-C-17 was significant (Welch's F (3, 2305.80) = 196.02, $p < .001$). Games-Howell *post hoc* analyses indicated that the participants with the lowest education level (i.e., the '≤ junior high') had a higher score than all other three groups (all $ps < .001$). In addition, the 'high school' group had a lower score than the two groups with tertiary education (i.e., 'university' and 'post-graduate', both $ps < .001$). Furthermore, the 'university' group scored lower on PCL-C-17 than the 'post-graduate' group ($p < .001$).

The education-group effect on the PTGI-12 was significant (Welch's F (3, 2358.92) = 69.07, $p < .001$). Games-Howell *post hoc* analyses suggested that the 'post-graduate' group had a lower score than all other three groups (all $ps < .001$). Moreover, the 'university' group reported a lower score than the two low-educated groups (i.e., '≤ junior high' and 'high school', both $ps < .001$). Furthermore, the '≤ junior high' group scored lower on PTGI-12 than the 'high school' group ($p = .038$).

Hierarchical TPM for PCL-C

First, results of the logistic-part regression for the PCL-C-dummy are presented in Table 2. On Step 1, the Omnibus Test suggested that the demographic variables significantly predicted the PCL-C-dummy (χ^2 = 2773.44, df = 10, $p < .001$). On Step 2, the Omnibus Test showed that the prediction of the COVID-19 pandemic-related variables on PCL-C-dummy was significant (χ^2 = 371.81, df = 5, $p < .001$). On Step 3, as for the variables of Reactions to COVID-19, the Omnibus Test revealed a significant result (χ^2 = 1542.05, df = 9, $p < .001$). On Step 4, by further introducing the variables of Mood, the result of Omnibus Test was significant (χ^2 = 2197.97, df = 5, $p < .001$). On Step 5, by adding the PTGI-12 into the regression, the Omnibus Test indicated a significant result (χ^2 = 92.23, df = 1, $p < .001$). In sum, the Omnibus Test for the overall prediction of the 30 predictors

on the PCL-C-dummy was significant (χ^2 = 6977.50, df = 30, $p < .001$).

In the final logistic regression model of the PCL-C-dummy, significant demographic predictors (all $ps < .001$) were Sex (male < female, B = -0.59), Age group (each of '< 20', '30s' to '50s' > the control group '20s'; Bs range = 0.25 to 1.01), and Education ('high school' < the control group 'university', B = -0.14). Meanwhile, significant COVID-19 pandemic-related predictors were Quarantined ('Yes' > 'No', B = 0.09, $p = .014$), Confirmed case range (B = 0.12, $p < .001$), and the COVID-19 period ('peak' > 'decline', B = 0.16, $p < .001$). Furthermore, seven types of Reactions to COVID-19 (viz., Risk#1-3, Escape#1 and 3, and Physical#2 and 3; Bs range = 0.08 to 1.08, all $ps ≤ .011$) and all Mood variables were significant predictors (i.e., 'Anxious', 'Angry,' 'Sad,' 'Fearful', and 'Happy', all 'Yes' > 'No'; Bs ranged = 0.28 to 0.80, all $ps < .001$). Finally, PTGI-12 positively predicted the PCL-C-dummy (B = 0.01, $p < .001$).

Second, results of the linear-part regression for the PCL-C-converted are given in Table 3. First of all, univariate and multivariate outliers were identified (0 univariate outlier and 12 multivariate outliers) and excluded from the linear regression analyses. Meanwhile, the assumption of the multicollinearity was not violated in the current linear regression analyses (all tolerance ≥ 0.29, all variance inflation factor values, VIF ≤ 3.46) (Allen et al., 2010). On Step 1, demographic variables accounted for 5.7% of the variance in PCL-C-converted (adjusted R^2 = .06, F [10, 17693] = 106.39, $p < .001$). On Step 2, the COVID-19 pandemic-related variables explained a further 0.6% variance in PCL-C-converted (adjusted R^2 = .06, ΔR^2 = .01, ΔF [5, 17688] = 23.32, $p < .001$). On Step 3, variables of Reactions to COVID-19 demonstrated an extra 10% of the variance in PCL-C-converted (adjusted R^2 = .16, ΔR^2 = .10, ΔF [9, 17679] = 234.41, $p < .001$). On Step 4, variables of Mood accounted for an additional 7.8% variance in PCL-C-converted (adjusted R^2 = .24, ΔR^2 = .08, ΔF [5, 17674] = 364.68, $p < .001$). On Step 5, the PTGI-12 explained a further 0.9% variance in PCL-C-converted (adjusted R^2 = .25, ΔR^2 = .01, ΔF [1, 17673] = 207.91, $p < .001$). In total, the overall 30 predictors accounted for 25.0% of the variance in PCL-C-converted (R^2 = .25, adjusted R^2 = .25, F [30, 17673] = 196.29, $p < .001$, Cohen's f^2 = .33).

In the final linear regression model of the PCL-C-converted, significant demographic predictors were Sex (male < female, β = -.03, $p < .001$), Age group (each of '< 20', '40s', and '50s' > the control group '20s'; βs range = .03 to .05, $ps < .001$), Education (both of '≤ junior high' and 'high school' > the control group 'university', βs range = .02 to .08, $ps ≤ .023$; while 'post-graduate' < the control group 'univeristy', β = -.01, $p = .034$), and Marriage ('in marriage' > 'not in marriage', β = .03, $p = .010$). In addition, significant COVID-19 pandemic-related predictors were the COVID-19 Victim ('victim' > 'others', β = .02, $p = .006$), Confirmed case range (β = .05, $p < .001$), and the COVID-19 period ('peak' > 'decline', β = .02, $p = .004$). Meanwhile, as for variables of Reactions to COVID-19, there were two negative predictors (viz., Risk#1 and Risk#2, βs range = -.02 to -.03, both $ps ≤ .007$) and seven positive predictors (viz., Risk#3, Escape#1-3, and Physical#1-3, βs range = .02 to .13, $ps ≤ .009$). Furthermore, the predictions of all Mood variables were significant (all $ps < .001$), with 'Happy' as a negative predictor ('Yes' < 'No', β = -.06) and all other negative

Table 2 Logistic regression of the PCL-C-dummy based on the overall sample (*N* = 29,118).

	Hierarchical step by step				Final model			
	B	[95% CI]	Wald χ^2	*p*	B	[95% CI]	Wald χ^2	*p*
Step 1. Basic demographic information								
Sex	-1.01	[-1.07, -0.95]	1004.43	< .001	-0.59	[-0.67, -0.52]	265.52	< .001
Age < 20	0.40	[0.34, 0.46]	173.97	< .001	0.25	[0.18, 0.32]	55.57	< .001
Age = 30s	0.31	[0.19, 0.43]	25.87	< .001	0.29	[0.16, 0.42]	18.60	< .001
Age = 40s	0.94	[0.77, 1.11]	120.98	< .001	0.68	[0.49, 0.86]	52.37	< .001
Age = 50s	1.27	[1.03, 1.51]	104.69	< .001	1.01	[0.76, 1.27]	60.07	< .001
Age ≥ 60	0.05	[-0.37, 0.46]	0.05	.818	-0.01	[-0.46, 0.44]	< 0.01	.968
Edu ≤ junior high	0.18	[0.07, 0.29]	10.52	.001	0.11	[-0.01, 0.23]	2.96	.086
Edu = high school	-0.24	[-0.30, -0.18]	71.43	< .001	-0.14	[-0.20, -0.08]	19.39	< .001
Edu = post-graduate	0.15	[-0.05, 0.36]	2.18	.139	-0.03	[-0.25, 0.20]	0.05	.816
Marriage	0.08	[-0.03, 0.19]	1.92	.166	0.06	[-0.07, 0.18]	0.79	.375
Step 2. COVID-19 pandemic-related information								
Group = victim	0.19	[-0.39, 0.76]	0.40	.527	0.18	[-0.45, 0.80]	0.31	.577
Group = clinical	0.33	[-0.02, 0.69]	3.47	.062	0.16	[-0.22, 0.54]	0.70	.404
Quarantined	0.12	[0.05, 0.19]	12.14	< .001	0.09	[0.02, 0.17]	6.04	.014
Confirmed case range	0.14	[0.11, 0.17]	75.15	< .001	0.12	[0.09, 0.16]	45.98	< .001
COVID-19 period	0.31	[0.25, 0.37]	104.58	< .001	0.16	[0.10, 0.23]	23.73	< .001
Step 3. Reactions to COVID-19-dummy variables								
Risk1	0.31	[0.23, 0.39]	54.56	< .001	0.28	[0.20, 0.37]	43.06	< .001
Risk2	0.13	[0.07, 0.19]	15.96	< .001	0.08	[0.02, 0.15]	6.42	.011
Risk3	0.42	[0.36, 0.48]	196.04	< .001	0.34	[0.28, 0.40]	117.71	< .001
Escape1	0.42	[0.32, 0.51]	74.11	< .001	0.30	[0.20, 0.40]	36.01	< .001
Escape2	0.03	[-0.21, 0.27]	0.06	.812	-0.03	[-0.28, 0.22]	0.06	.802
Escape3	0.19	[0.08, 0.29]	12.66	< .001	0.17	[0.06, 0.28]	9.20	.002
Physical1	-0.07	[-0.14, 0.00]	3.87	.049	-0.03	[-0.10, 0.04]	0.58	.445
Physical2	0.67	[0.48, 0.85]	48.42	< .001	0.41	[0.21, 0.61]	16.62	< .001
Physical3	1.36	[1.23, 1.49]	430.90	< .001	1.08	[0.94, 1.21]	246.95	< .001
Step 4. On-the-spot mood-dummy variables								
Anxious	0.79	[0.72, 0.87]	408.56	< .001	0.80	[0.72, 0.88]	415.01	< .001
Angry	0.40	[0.29, 0.51]	48.84	< .001	0.42	[0.31, 0.54]	54.68	< .001
Sad	0.55	[0.45, 0.65]	112.50	< .001	0.56	[0.46, 0.66]	117.69	< .001
Fearful	0.62	[0.51, 0.74]	108.78	< .001	0.62	[0.51, 0.74]	109.17	< .001
Happy	0.32	[0.26, 0.37]	127.02	< .001	0.28	[0.23, 0.34]	99.90	< .001
Step 5. The other type of post-traumatic reaction								
PTGI-12	0.01	[0.01, 0.01]	91.75	< .001	0.01	[0.01, 0.01]	91.75	< .001

Note. PCL-C = Post-traumatic Stress Disorder Checklist-Civilian Version; PTS = post-traumatic stress. PCL-C-dummy (0 = *absent* to *almost absent of PTS* [PCL-C score ≤ 18], 1 = *mild* to *severe PTS* [PCL-C score > 18]) was the dependent variable of this regression. PTGI = Post-traumatic Growth Inventory.

Continuous independent variables: Confirmed case range = the range of accumulated COVID-19 confirmed case numbers in one's residential region (from '≤ 9' to '≥ 10000' cases); PTGI-12 = the total score of the best-fit 12-item 2-factor bifactor model of the PTGI.

Dummy coded variables: sex (0 = *female*, 1 = *male*), COVID-19 period (0 = *decline*, 1 = *peak*), and the other dummy variables (0 = *no*, 1 = *yes*). A sample of questions for Step 3 is available by contacting the corresponding author (or by downloading supplementary documents from http://www.hulilab.com/home/viewshare/29).

moods as positive predictors (i.e., 'Anxious', 'Angry', 'Sad', and 'Fearful', all 'Yes' > 'No'; βs ranged = .08 to .14). Finally, the PTGI-12 positively predicted the PCL-C-converted (β = .10, *p* < .001).

Discussion

The current cross-sectional study aims to record both the negative and positive post-traumatic reactions (i.e., PTS and PTG) toward COVID-19 with the general Chinese population (*N* = 29,118), and to explore the possible predictors as

well as the underlying relationship of these two post-traumatic reactions. Using CMA analyses, we first verified two new bifactor models for describing the psychometric properties of Chinese self-evaluations on the PTS and the PTG. Conducting *t*-tests and Welch's ANOVAs, we pinpointed the cohorts of Chinese with high-PTS [female, low-educated (i.e., '≤ junior high'), and middle-aged individuals (i.e., '40s' and '50s')] as well as those with low-PTG [female, highly-educated (i.e., 'post-graduate'), and the young and the old (i.e., '< 20' and '≥ 60')]. Finally, adopting TPM and hierarchical regression analyses, we explored the impact of participants' attitudes (e.g., avoidance) and on-the-spot moods

Table 3 Linear regression of the PCL-C-converted based on the participants with mild tosevere PTS (n = 17,704).

	Hierarchical step by step				Final model			
	B	β	p	sr^2	B	β	p	sr^2
Step 1. Basic demographic information								
Sex	-1.98	-0.10	< .001	.009	-0.56	-0.03	< .001	.001
Age < 20	1.28	0.06	< .001	.003	0.70	0.03	< .001	.001
Age = 30s	0.45	0.01	.177	< .001	0.34	0.01	.250	< .001
Age = 40s	2.59	0.08	< .001	.002	1.80	0.05	< .001	.001
Age = 50s	2.71	0.05	< .001	.002	2.06	0.04	< .001	.001
Age ≥ 60	2.33	0.02	.026	< .001	1.15	0.01	.220	< .001
Edu ≤ junior high	3.49	0.11	< .001	.010	2.47	0.08	< .001	.005
Edu = high school	0.25	0.01	.136	< .001	0.34	0.02	.023	< .001
Edu = post-graduate	-0.32	-0.01	.485	< .001	-0.87	-0.01	.034	< .001
Marriage	1.20	0.05	< .001	.001	0.72	0.03	.010	< .001
Step 2. COVID-19 pandemic-related information								
Group = victim	5.38	0.02	.001	.001	4.00	0.02	.006	< .001
Group = clinical	0.10	< 0.01	.890	< .001	-0.71	-0.01	.273	< .001
Quarantined	0.34	0.01	.049	< .001	0.19	0.01	.235	< .001
Confirmed case range	0.39	0.04	< .001	.001	0.41	0.05	< .001	.001
COVID-19 period	1.07	0.05	< .001	.002	0.45	0.02	.004	< .001
Step 3. Reactions to COVID-19-dummy variables*								
Risk1	-0.96	-0.03	< .001	.001	-1.04	-0.03	< .001	.001
Risk2	-0.28	-0.01	.091	< .001	-0.43	-0.02	.007	< .001
Risk3	2.15	0.11	< .001	.010	1.47	0.08	< .001	.005
Escape1	2.49	0.10	< .001	.009	1.81	0.07	< .001	.005
Escape2	4.67	0.06	< .001	.004	4.17	0.06	< .001	.003
Escape3	1.06	0.03	< .001	.001	1.01	0.03	< .001	.001
Physical1	0.25	0.01	.158	< .001	0.45	0.02	.009	< .001
Physical2	4.03	0.10	< .001	.008	2.86	0.07	< .001	.004
Physical3	4.73	0.18	< .001	.022	3.60	0.13	< .001	.012
Step 4. On-the-spot mood-dummy variables								
Anxious	1.47	0.08	< .001	.004	1.50	0.08	< .001	.004
Angry	2.15	0.09	< .001	.006	2.26	0.10	< .001	.007
Sad	1.63	0.08	< .001	.004	1.71	0.08	< .001	.004
Fearful	3.03	0.14	< .001	.012	3.03	0.14	< .001	.012
Happy	-0.91	-0.05	< .001	.002	-1.18	-0.06	< .001	.003
Step 5. The other type of post-traumatic reaction								
PTGI-12	0.07	0.10	< .001	.009	0.07	0.10	< .001	.009

Note. PTS = post-traumatic stress; PCL-C = Post-traumatic Stress Disorder Checklist-Civilian Version; Since the PCL-C score was highly skewed, the dependent variable of this regression was the value of PCL-C-converted (i.e., [0.30 - 1/PCL-C] × 1000); PTGI = Post-traumatic Growth Inventory.

Continuous independent variables: PTGI-12 = the total score of the best-fit 12-item 2-factor bifactor model of the PTGI.

Dummy coded independent variables: sex (0 = *female*, 1 = *male*), COVID-19 period (0 = *decline*, 1 = *peak*), and the other dummy variables (0 = *no*, 1 = *yes*). A sample of questions for Step 3 is available by contacting the corresponding author (or by downloading supplementary documents from http://www.hulilab.com/home/viewshare/29).

(e.g., fear) on the PTS and the PTG, and captured the mutual and positive predictions between PTS and PTG (see Tables 2 and 3, and the online supplementary documents). The current findings presented the treasured baseline information for further studies of the long-term post-traumatic impact of COVID-19. More essentially, the underlying positive relationship between PTS and PTG, though small in statistics, implied a 'phoenix renascence' in the era of post-COVID-19 (Tamiolaki & Kalaitzaki, 2020).

The main implications and the most innovative findings of the current study are three-fold. First, the current authors have been concerned that participants' psychometric characteristics in evaluating the PCL-C and the PTGI items could be varied amongst populations as well as traumatic circumstances. Therefore, the current authors conducted the CMA analyses. Results showed that rather than the default models of the two scales, the bifactor structure proposed by Reise (2012) was the best structural model of the PCL-C and the PTGI as per the current data. More importantly, the CMA results highlighted that only selected items of the PTGI (i.e., 12 items) described by Weiss and Berger (2006) should be used to evaluate the PTG with the current participants in the context of COVID-19. Interestingly, although some other researchers also recommended the short versions of the PTGI (e.g., 10- or 12-item) *ad hoc* COVID-19, their

proposals were mainly due to the time consumption issue instead of empirical evidence (e.g., Robles-Bello, Sánchez-Teruel, & Naranjo, 2020; Vazquez et al., 2021). The current results bridged this research gap.

Second, previous researchers commonly conducted linear regressions on the PCL-C. Nevertheless, the current data illustrates a highly skewed distribution of the PCL-C in the general population (i.e., with an inflated portion of participants being almost absent of PTS, 39.2%). This type of distribution severely violated the normality assumption for conducting linear regressions (Afifi et al., 2007). Instead, Afifi et al. (2007) recommended the TPM procedure (i.e., logistic-part and linear-part regressions; see Tables 2 and 3). The current results of TPM revealed some important findings. According to the linear regression of PCL-C-converted, a feeling of happiness on the testing day was a negative predictor (i.e., a protector) of PCL-C-converted, while the other negative emotions (i.e., anxiety, anger, sadness, and fear) were positive predictors (i.e., stressors) of PCL-C-converted. However, according to the logistic regression of the PCL-C-dummy (i.e., 0 = *almost absent of PTS* vs. 1 = *mild to severe PTS*), all emotions were positive predictors. Similarly, two items of the Risk perceptions (Risk#1 = *COVID-19 is a severe outbreak*; Risk#2 = *COVID-19 is close to me.*) were protectors of PCL-C-converted, but were stressors of the PCL-C-dummy. Innovatively, the current results implied that the absence of PTS in some individuals could be due to their insensitivity to the changes of their inner emotions and external risks. This innovative proposal waits to be verified by further empirical studies tapping into both the PTS and these sensitivities. Nevertheless, it should be noted that without the TPM, the above intriguing findings could not be revealed. As far as the current authors are aware, this is the first study of the TPM on PTS in the context of COVID-19.

Third, the current findings revealed that the relationships between age and the post-traumatic reactions (i.e., PTS and PTG) were not linear (see the online supplementary documents). Noticeably, previous researchers frequently tapped into their linear relationships and observed inconsistent results (e.g., Chi et al., 2020; Di Tella et al., 2020; González-Sanguino et al., 2020). In this study, we found that the middle-aged Chinese participants (i.e., '40s' and '50s') reported the highest PTS together with the highest PTG, which was in line with the 'two facets' theory (Solomon & Dekel, 2007). Concurrently, the proposed 'phoenix renascence' (Tamiolaki & Kalaitzaki, 2020) could appear in these middle-aged Chinese cohorts (i.e., *r* between PTGI and PCL-C-converted = .18 for these middle-aged participants, but < .01 for the overall sample). To date, COVID-19 has already turned into a multi-faceted crisis, covering areas of health, economy, education, and international relationships (see the Introduction section). The current authors are concerned that relative to other age groups, the middle-aged Chinese people might receive the highest pressure to actively cope with all of these life changes (e.g., family income, education for children, aged care for parents, etc.), resulting in the enhanced PTS/G. This theoretical proposal waits to be confirmed by empirical studies.

Similarly, the relationship between education and PTS/G was curvilinear. Nonetheless, the previous conclusions of 'lower-educated individuals suffering more PTS' were mainly based on a linear assumption (L. Liang et al., 2020).

The current results suggested that, along with education levels, the trajectory of PTS due to COVID-19 was a '∪', while that of the PTG was a '∩'. The opposite curviness matched well with the 'two cancel-out extremes' theory (Frazier et al., 2001). Specifically, people with moderate education (i.e., 'high school') had the lowest PTS but highest PTG (i.e., *r* between their PTGI and PCL-C-converted = .02). An explanation of the above effect could include three points. First of all, some researchers found that the level of intelligence tends to be negatively correlated with PTS (Barry et al., 2012; Kildahl, Bakken, Iversen, & Helverschou, 2019). Secondly, Chinese people with higher education (i.e., 'university' and 'post-graduate') may be more stressed to maintain their higher living standard (e.g., pay off the house loan and credit cards) under the circumstance of COVID-19. Finally and unexpectedly, some evidence suggested that intelligence could also be negatively correlated with PTG (Goldberg Looney, 2017). Consistently, the '∩' curve of the PTGI identified with the current participants indicated a possible ceiling effect of mental growth in light of education. In all, moderately educated Chinese individuals (i.e., moderate social pressures and living standards) turned out to have the optimal combination of the PTS and the PTG due to COVID-19.

Besides the above main findings, a few interesting minor findings are worth mentioning. First of all, in line with a previous study (Liu et al., 2020), PTS due to COVID-19 was higher for female than male participants. Researchers generally concur with the above sex effect on PTS (Carmassi et al., 2020; Olff, 2017), but its underlying reason was unclear. According to cross-cultural researchers (Zhao et al., 2018; Zhao et al., 2019; Zhao et al., 2020), Chinese females are known to have high empathic personal distress (i.e., the aversive feelings when witnessing others' sufferings) as well as a high interdependent self-construal (i.e., a blurred boundary between 'self' and 'others'). Hence, facing COVID-19, Chinese females might encounter double-fold stress (i.e., PTS together with personal distress). Similarly, marriage was found to be a stressor of PTS in this study, which is contrary to the findings of Western and Asian clinical workers (e.g., d'Ettorre et al., 2021). On the one hand, the previous researchers stated that living with a life partner was a protector of PTS for clinical workers fighting COVID-19 (d'Ettorre et al., 2021), but the negative impact on the mental wellness of their partners was a concern (Ying et al., 2020). On the other hand, relative to Westerners, researchers found that Chinese (both females and males) suffered more empathic personal distress (Zhao, Neumann, Yan, Djekic, & Shum, 2021) and were with a stronger interdependent self-construal (Zhao et al., 2019). Therefore, in the context of COVID-19 (i.e., a stressful event for both sides of a marriage), married Chinese people might experience the double-fold stress as well. Finally, the current results showed that physical reactions (e.g., losing appetite and insomnia) are significant stressors of PTS. Intriguingly, researchers found that regular physical exercise could be a protector of mental problems due to COVID-19 (Carriedo et al., 2020; Y. Zhang et al., 2020), and physical exercise is known to have a benign impact on appetite (Bilski, Teległów, Zahradnik-Bilska, Dembiński, & Warzecha, 2009; Blundell, Gibbons, Caudwell, Finlayson, & Hopkins, 2015) and sleep quality (Baron, Reid, & Zee, 2013;

Passos, Poyares, Santana, Tufik, & Mello, 2012). Therefore, future researchers may consider incorporating physical exercise in the mental supporting programs for coping with COVID-19.

This investigation has several limitations. First, the current study was a cross-sectional investigation on the first wave of the virus spread; however, to understand the posttraumatic impact of COVID-19 on the general population, longitudinal observations are highly recommended (e.g., Brailovskaia & Margraf, 2020). Second, although the current sample was large, participants recruited online might not represent the entire general population as for the PTS/G traits. Further investigation might consider recruiting participants according to census reports. Third, not all of the variance of PTS/G could be explained by the independent variables investigated in this study. Researchers proposed that personality traits (e.g., resilience and optimism; Kaye-Kauderer et al., 2021), philosophical views of the world (e. g., benevolence and humanity; Vazquez et al., 2021), and engagement in physical activities (Carriedo et al., 2020; Y. Zhang et al., 2020) may all have an impact on individuals' post-traumatic reactions. Including these psychological and physical factors might be able to explain individual differences in the PTS/G to a larger extent, which should be considered in further investigations. Fourth, the underlying diseases (e.g., diabetes and cardiovascular diseases) were not collected from the participants. However, as an underlying disease may increase one's vulnerability to COVID-19 (e. g., diabetes Bello-Chavolla et al., 2020), it is worthy of research attention.

Finally, because we had limited research funding and human resources, and the current sample size was big, we had to use 'lucky draws' to reimburse our participants. This type of reimbursement might have an impact on recruitment; for example, someone who was interested in gambling might be more interested to participate than those who were not. Nevertheless, we explained our situation at the beginning of the online survey. Specifically, we stressed that the current study was conducted to increase our understanding of the impact of COVID-19 on the general population. Each participant would help us to obtain priceless knowledge on this research topic. Therefore, we sincerely invited participants to answer the questionnaires carefully and honestly, and encouraged them to help us broadcast the online survey to other people.

References

Afifi, A. A., Kotlerman, J. B., Ettner, S. L., & Cowan, M. (2007). Methods for improving regression analysis for skewed continuous or counted responses. *Annual Review of Public Health*, *28*, 95-111. https://doi.org/10.1146/annurev.publhealth.28.082206.094100.

Allen, P., Bennett, K., & King, J. (2010). *PASW statistics by SPSS: A practical guide, version 18.0*. National Library of Australia.

American Psychiatric Association. (1980). *Diagnostic and statistical manual of mental disorders: Vol. 3*Washington, DC: American Psychiatric Association.

Baron, K. G., Reid, K. J., & Zee, P. C. (2013). Exercise to improve sleep in insomnia: exploration of the bidirectional effects. *Journal of Clinical Sleep Medicine*, *9*, 819-824. https://doi.org/10.5664/jcsm.2930.

Barry, A. E., Whiteman, S. D., & MacDermid Wadsworth, S. M. (2012). Implications of posttraumatic stress among military-affiliated and civilian students. *Journal of American College Health*, *60*, 562-573. https://doi.org/10.1080/07448481.2012.721427.

Bello-Chavolla, O. Y., Bahena-López, J. P., Antonio-Villa, N. E., Vargas-Vázquez, A., González-Díaz, A., Márquez-Salinas, A., Fermín-Martínez, C. A., Naveja, J. J., & Aguilar-Salinas, C. A. (2020). Predicting mortality due to SARS-CoV-2: A mechanistic score relating obesity and diabetes to COVID-19 outcomes in Mexico. *The Journal of Clinical Endocrinology & Metabolism*, *105*, 2752-2761. https://doi.org/10.1210/clinem/dgaa346.

Bilski, J., Teległów, A., Zahradnik-Bilska, J., Dembiński, A., & Warzecha, Z. (2009). Effects of exercise on appetite and food intake regulation. *Medicina Sportiva*, *13*, 82-94. https://doi.org/10.2478/v10036-009-0014-5.

Bisson, J. I. (2007). Post-traumatic stress disorder. *BMJ*, *334*, 789-793. https://doi.org/10.1136/bmj.39162.538553.80.

Blekas, A., Voitsidis, P., Athanasiadou, M., Parlapani, E., Chatzigeorgiou, A. F., Skoupra, M., Syngelakis, M., Holeva, V., & Diakogiannis, I. (2020). COVID-19: PTSD symptoms in Greek health care professionals. *Psychological Trauma: Theory, Research, Practice, and Policy*, *12*, 812-819. https://doi.org/10.1037/tra0000914.

Blundell, J., Gibbons, C., Caudwell, P., Finlayson, G., & Hopkins, M. (2015). Appetite control and energy balance: Impact of exercise. *Obesity reviews*, *16*, 67-76. https://doi.org/10.1111/obr.12257.

Boals, A., & Schuettler, D. (2011). A Double-edged Sword: Event Centrality, PTSD and Posttraumatic Growth. *Applied Cognitive Psychology*, *25*, 817-822. https://doi.org/10.1002/acp.1753.

Brailovskaia, J., & Margraf, J. (2020). Predicting adaptive and maladaptive responses to the Coronavirus (COVID-19) outbreak: A prospective longitudinal study. *International Journal of Clinical and Health Psychology*, *20*, 183-191. https://doi.org/10.1016/j.ijchp.2020.06.002.

Carmassi, C., Foghi, C., Dell'Oste, V., Cordone, A., Bertelloni, C. A., Bui, E., & Dell'Osso, L (2020). PTSD symptoms in healthcare workers facing the three coronavirus outbreaks: What can we expect after the COVID-19 pandemic. *Psychiatry Research*, *292* Article 113312. https://doi.org/10.1016/j.psychres.2020.113312.

Carriedo, A., Cecchini, J. A., Fernández-Río, J., & Méndez-Giménez, A. (2020). Resilience and physical activity in people under home isolation due to COVID-19: A preliminary evaluation. *Mental Health and Physical Activity*, *19*, Article 100361. https://doi.org/10.1016/j.mhpa.2020.100361.

Cheng, S. K., Chong, G. H., Chang, S. S., Wong, C. W., Wong, C. S., Wong, M. T., & Wong, K. C. (2006). Adjustment to severe acute respiratory syndrome (SARS): Roles of appraisal and post-traumatic growth. *Psychology and Health*, *21*, 301-317. https://doi.org/10.1080/14768320500286450.

Chi, X., Becker, B., Yu, Q., Willeit, P., Jiao, C., Huang, L., Hossain, M. M., Grabovac, I., Yeung, A., Lin, J., Veronese, N., Wang, J., Zhou, X., Doig, S. R., Liu, X., Carvalho, A. F., Yang, L., Xiao, T., Zou, L., Fusar-Poli, P., & Solmi, M. (2020). Prevalence and Psychosocial Correlates of Mental Health Outcomes Among Chinese College Students During the Coronavirus Disease (COVID-19) Pandemic. *Frontiers in Psychiatry*, *11*, Article 803. https://doi.org/10.3389/fpsyt.2020.00803.

Cho, A. J., Lee, H.-S., Lee, Y.-K., Jeon, H. J., Park, H. C., Jeong, D.-W., Kim, Y.-G., Lee, S.-H., Lee, C.-H., & Yoo, K. D. (2020). Post-traumatic stress symptoms in hemodialysis patients with MERS-CoV exposure. *BioPsychoSocial Medicine*, *14*, 1-6. https://doi.org/10.1186/s13030-020-00181-z.

Crocq, M. A., & Crocq, L. (2000). From shell shock and war neurosis to posttraumatic stress disorder: A history of psychotraumatology. *Dialogues in Clinical Neuroscience*, *2*, 47-55. https://doi.org/10.31887/DCNS.2000.2.1/macrocq.

d'Ettorre, G., Ceccarelli, G., Santinelli, L., Vassalini, P., Innocenti, G. P., Alessandri, F., Koukopoulos, A. E., Russo, A., d'Ettorre, G., & Tarsitani, L. (2021). Post-Traumatic Stress symptoms in healthcare workers dealing with the COVID-19 pandemic: A systematic review. *International Journal of Environmental Research and Public Health*, *18*, Article 601. https://doi.org/10.3390/ijerph18020601.

Daniel, J. (2020). Education and the COVID-19 pandemic. *Prospects*, *49*, 91-96. https://doi.org/10.1007/s11125-020-09464-3.

Di Tella, M., Romeo, A., Benfante, A., & Castelli, L. (2020). Mental health of healthcare workers during the COVID-19 pandemic in Italy. *Journal of Evaluation in Clinical Practice*, *26*, 1583-1587. https://doi.org/10.1111/jep.13444.

Forte, G., Favieri, F., Tambelli, R., & Casagrande, M. (2020). COVID-19 pandemic in the Italian population: Validation of a post-traumatic stress disorder questionnaire and prevalence of PTSD symptomatology. *International journal of environmental research and public health*, *17*, Article 4151. https://doi.org/10.3390/ijerph17114151.

Frazier, P., Conlon, A., & Glaser, T. (2001). Positive and negative life changes following sexual assault. *Journal of Consulting and Clinical Psychology*, *69*, 1048-1055. https://doi.org/10.1037/0022-006x.69.6.1048.

Gao, C., Shi, D., & Maydeu-Olivares, A. (2020). Estimating the maximum likelihood root mean square error of approximation (RMSEA) with non-normal data: A Monte-Carlo study. *Structural Equation Modeling: A Multidisciplinary Journal*, *27*, 192-201. https://doi.org/10.1080/10705511.2019.1637741.

Goldberg Looney, L. (2017). *A Hierarchical Linear Modeling Approach to Predicting Trajectories of Posttraumatic Growth in Veterans Following Acquired Physical Disability*. 2017. https://doi.org/10.25772/M1GA-5V47.

González-Sanguino, C., Ausín, B., Castellanos, M.Á., Saiz, J., López-Gómez, A., Ugidos, C., & Muñoz, M. (2020). Mental health consequences during the initial stage of the 2020 Coronavirus pandemic (COVID-19) in Spain. *Brain, Behavior, and Immunity*, *87*, 172-176. https://doi.org/10.1016/j.bbi.2020.05.040.

Goral, A., Gelkopf, M., & Greene, T. (2020). Do posttraumatic stress symptoms mediate the relationship between peritraumatic threat and posttraumatic growth? A prospective experience sampling study. *Anxiety, Stress, & Coping*, *33*, 89-99. https://doi.org/10.1080/10615806.2019.1692825.

Greenberg, D., & Hibbert, P. (2020). From the editors—Covid-19: Learning to hope and hoping to learn. *Academy of Management Learning and Education*, *19*, 123-130. https://doi.org/10.5465/amle.2020.0247.

Grifoni, A., Weiskopf, D., Ramirez, S. I., Mateus, J., Dan, J. M., Moderbacher, C. R., Rawlings, S. A., Sutherland, A., Premkumar, L., Jadi, R. S., Marrama, D., de Silva, A. M., Frazier, A., Carlin, A. F., Greenbaum, J. A., Peters, B., Krammer, F., Smith, D. M., Crotty, S., & Sette, A. (2020). Targets of T Cell Responses to SARS-CoV-2 Coronavirus in Humans with COVID-19 Disease and Unexposed Individuals. *Cell*, *181*, 1489-1501. https://doi.org/10.1016/j.cell.2020.05.015.

Guarner, J. (2020). Three Emerging Coronaviruses in Two Decades: The Story of SARS, MERS, and Now COVID-19. *American Journal of Clinical Pathology*, *153*, 420-421. https://doi.org/10.1093/ajcp/aqaa029.

Ho, S. M., Chan, C. L., & Ho, R. T. (2004). Posttraumatic growth in Chinese cancer survivors. *Psycho-Oncology*, *13*, 377-389. https://doi.org/10.1002/pon.758.

Ikizer, G., Karanci, A. N., Gul, E., & Dilekler, I. (2021). Post-traumatic stress, growth, and depreciation during the COVID-19 pandemic: Evidence from Turkey. *European Journal of Psychotraumatology*, *12*, Article 1872966. https://doi.org/10.1080/20008198.2021.1872966.

Jansen, L., Hoffmeister, M., Chang-Claude, J., Brenner, H., & Arndt, V. (2011). Benefit finding and post-traumatic growth in long-term colorectal cancer survivors: Prevalence, determinants, and associations with quality of life. *British Journal of Cancer*, *105*, 1158-1165. https://doi.org/10.1038/bjc.2011.335.

Kalaitzaki, A. (2020). *Positive and negative mental health outcomes and internal resources among the general population in Greece: A nation-wide survey amid COVID-19 lockdown*. 2020. https://doi.org/10.31234/osf.io/g29eb.

Kaye-Kauderer, H., Feingold, J. H., Feder, A., Southwick, S., & Charney, D. (2021). Resilience in the age of COVID-19. *BJPsych Advances*, *27*(3), 166-178. https://doi.org/10.1192/bja.2021.5.

Keith, T. Z. (2014). *Multiple regression and beyond: An introduction to multiple regression and structural equation modeling*. Routledge.

Kildahl, A. N., Bakken, T. L., Iversen, T. E., & Helverschou, S. B. (2019). Identification of post-traumatic stress disorder in individuals with autism spectrum disorder and intellectual disability: A systematic review. *Journal of Mental Health Research in Intellectual Disabilities*, *12*, 1-25. https://doi.org/10.1080/19315864.2019.1595233.

Kubany, E. S., Leisen, M. B., Kaplan, A. S., Watson, S. B., Haynes, S. N., Owens, J. A., & Burns, K. (2000). Development and preliminary validation of a brief broad-spectrum measure of trauma exposure: the Traumatic Life Events Questionnaire. *Psychological Assessment*, *12*, 210-224. https://doi.org/10.1037/1040-3590.12.2.210.

Li, H., Zhang, Y., Wu, K., Wang, L., Shi, Z., & Liu, P. (2010). Diagnostic utility of the PTSD Checklist in detecting PTSD in Chinese earthquake victims. *Psychological Reports*, *107*, 733-739. https://doi.org/10.2466/03.15.20.PR0.107.6.733-739.

Liang, L., Ren, H., Cao, R., Hu, Y., Qin, Z., Li, C., & Mei, S. (2020). The effect of COVID-19 on youth mental health. *Psychiatric Quarterly*, *91*, 1-12. https://doi.org/10.1007/s11126-020-09744-3.

Liang, X., Zhu, Y., & Fang, Y. (2020). COVID-19 and post-traumatic stress disorder: A vicious circle involving immunosuppression. *CNS Neuroscience & Therapeutics*, *26*, Article 876. https://doi.org/10.1111/cns.13431.

Liu, N., Zhang, F., Wei, C., Jia, Y., Shang, Z., Sun, L., Wu, L., Sun, Z., Zhou, Y., Wang, Y., & Liu, W. (2020). Prevalence and predictors of PTSS during COVID-19 outbreak in China hardest-hit areas: Gender differences matter. *Psychiatry Research*, *287*, Article 112921. https://doi.org/10.1016/j.psychres.2020.112921.

Marmar, C. R., Schlenger, W., Henn-Haase, C., Qian, M., Purchia, E., Li, M., Corry, N., Williams, C. S., Ho, C.-L., Horesh, D., Karstoft, K.-I., Shalev, A., & Kulka, R. A. (2015). Course of Posttraumatic Stress Disorder 40 Years After the Vietnam War:

Findings From the National Vietnam Veterans Longitudinal Study. *JAMA Psychiatry, 72*, 875-881. https://doi.org/10.1001/jamapsychiatry.2015.0803.

Muthén, L. K., & Muthén, B. O. (1998). *Mplus user's guide* (7th ed.). Muthén & Muthén.

Olff, M. (2017). Sex and gender differences in post-traumatic stress disorder: An update. *European Journal of Psychotraumatology, 8*, https://doi.org/10.1080/20008198.2017.1351204.

Osei-Bonsu, P. E., Weaver, T. L., Eisen, S. V., & Vander Wal, J. S. (2012). Posttraumatic Growth Inventory: Factor structure in the context of DSM-IV traumatic events. *ISRN Psychiatry, 2012*, Article 937582. https://doi.org/10.5402/2012/937582.

Passos, G. S., Poyares, D. L. R., Santana, M. G., Tufik, S., & Mello, M. T.d (2012). Is exercise an alternative treatment for chronic insomnia? *Clinics, 67*, 653-659. https://doi.org/10.6061/clinics/2012(06)17.

Petrosillo, N., Vicenconte, G., Ergonul, O., Ippolito, G., & Petersen, E. (2020). COVID-19, SARS and MERS: Are they closely related? *Clinical Microbiology and Infection, 26*, 729-734. https://doi.org/10.1016/j.cmi.2020.03.026.

Pevehouse, J. C. (2020). The COVID-19 Pandemic, International Cooperation, and Populism. *International Organization, 74*, E191-E212. https://doi.org/10.1017/S0020818320000399.

Prati, G., & Pietrantoni, L. (2014). Italian adaptation and confirmatory factor analysis of the full and the short form of the Posttraumatic Growth Inventory. *Journal of Loss and Trauma, 19*, 12-22. https://doi.org/10.1080/15325024.2012.734203.

Rabaan, A. A., Al-Ahmed, S. H., Haque, S., Sah, R., Tiwari, R., Malik, Y. S., ... Rodriguez-Morales, A. J. (2020). SARS-CoV-2, SARS-CoV, and MERS-COV: A comparative overview. *Le Infezioni in Medicina, 28*, 174-184.

Rajgor, D. D., Lee, M. H., Archuleta, S., Bagdasarian, N., & Quek, S. C. (2020). The many estimates of the COVID-19 case fatality rate. *The Lancet Infectious Diseases, 20*, 776-777. https://doi.org/10.1016/S1473-3099(20)30244-9.

Reise, S. P. (2012). The rediscovery of bifactor measurement models. *Multivariate Behavioral Research, 47*, 667-696. https://doi.org/10.1080/00273171.2012.715555.

Robles-Bello, M. A., Sánchez-Teruel, D., & Naranjo, N. V. (2020). Variables protecting mental health in the Spanish population affected by the COVID-19 pandemic. *Current Psychology*, 1-12. https://doi.org/10.1007/s12144-020-01132-1.

Sass, D. (2011). Testing measurement invariance and comparing latent factor means within a confirmatory factor analysis framework. *Journal of Psychoeducational Assessment, 29*, 347-363. https://doi.org/10.1177/0734282911406661.

Solomon, Z., & Dekel, R. (2007). Posttraumatic stress disorder and posttraumatic growth among Israeli ex-pows. *Journal of Traumatic Stress, 20*, 303-312. https://doi.org/10.1002/jts.20216.

Tamiolaki, A., & Kalaitzaki, A. E. (2020). That which does not kill us, makes us stronger": COVID-19 and posttraumatic growth. *Psychiatry Research, 289*, Article 113044. https://doi.org/10.1016/j.psychres.2020.113044.

Tedeschi, R. G., & Calhoun, L. G. (1996). The Posttraumatic Growth Inventory: Measuring the positive legacy of trauma. *Journal of Traumatic Stress, 9*, 455-471. https://doi.org/10.1007/BF02103658.

Vazquez, C., Valiente, C., García, F. E., Contreras, A., Peinado, V., Trucharte, A., & Bentall, R. P. (2021). Post-traumatic growth and stress-related responses during the COVID-19 pandemic in a national representative sample: The role of positive core beliefs about the world and others. *Journal of Happiness Studies, 11*, 1-21. https://doi.org/10.1007/s10902-020-00352-3.

Vidya, C. T., & Prabheesh, K. P. (2020). Implications of COVID-19 pandemic on the global trade networks. *Emerging Markets Finance and Trade, 56*, 2408-2421. https://doi.org/10.1080/1540496X.2020.1785426.

Walton, M. (2020). Post Traumatic Growth during a pandemic: A literature review. *International Journal of Research in Medical and Basic Sciences, 6*, 1-8.

Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., McIntyre, R. S., Choo, F. N., Tran, B., Ho, R., Sharma, V. K., & Ho, C. (2020). A longitudinal study on the mental health of general population during the COVID-19 epidemic in China. *Brain Behavior and Immunity, 87*, 40-48. https://doi.org/10.1016/j.bbi.2020.04.028.

Wang, J., & Wang, X. (2012). *Structural equation modeling: Applications using Mplus.* John Wiley & Sons.

Wang, L., Li, Z., Shi, Z., Zhang, J., Zhang, K., Liu, Z., & Elhai, J. D. (2011). Testing the dimensionality of posttraumatic stress responses in young Chinese adult earthquake survivors: Further evidence for "dysphoric arousal" as a unique PTSD construct. *Depression and Anxiety, 28*, 1097-1104. https://doi.org/10.1002/da.20823.

Weathers, F., Litz, B., Herman, D., Huska, J. A., & Keane, T. (1993). T*he PTSD Checklist (PCL): Reliability, validity, and diagnostic utility. Paper Presented at the Annual Convention of the International Society for Traumatic Stress Studies.*

Weaver, T. L., Griffin, M. G., & Mitchell, E. R. (2014). Symptoms of posttraumatic stress, depression, and body image distress in female victims of Pphysical and sexual assault: Exploring integrated responses. *Health Care for Women International, 35*, 458-475. https://doi.org/10.1080/07399332.2013.858162.

Weiss, T., & Berger, R. (2006). Reliability and validity of a Spanish version of the Posttraumatic Growth Inventory. *Research on Social Work Practice, 16*, 191-199. https://doi.org/10.1177/1049731505281374.

World Health Organization. (2020). *WHO Director-General's opening remarks at the media briefing on COVID19-March.* 2020. http://www.un.org.cn/info/7/1044.html.

Wu, K. K., Chan, S. K., & Ma, T. M. (2005). Posttraumatic stress after SARS. *Emerging Infectious Diseases, 11*, 1297-1300. https://doi.org/10.3201/eid1108.041083.

Xiao, S., Luo, D., & Xiao, Y. (2020). Survivors of COVID-19 are at high risk of posttraumatic stress disorder. *Global Health Research and Policy, 5*, 1-3. https://doi.org/10.1186/s41256-020-00155-2.

Yang, X. Y., Yang, H. A., Liu, Q. G., & Yang, L. Z. (2007). The research on the reliability and validity of PCL-C and influence factors. *China Journal of Health Psychology, 15*, 6-9.

Yin, Q., Chen, A., Song, X., Deng, G., & Dong, W. (2021). Risk Perception and PTSD Symptoms of Medical Staff Combating Against COVID-19: A PLS Structural Equation Model [Original Research]. *Frontiers in Psychiatry, 12*, Article 607612. https://doi.org/10.3389/fpsyt.2021.607612.

Zhang, L., Zhu, F., Xie, L., Wang, C., Wang, J., Chen, R., Jia, P., Guan, H., Peng, L., & Chen, Y. (2020). Clinical characteristics of COVID-19-infected cancer patients: A retrospective case study in three hospitals within Wuhan, China. *Annals of Oncology, 31*, 894-901. https://doi.org/10.1016/j.annonc.2020.03.296.

Zhang, Y., & Ho, S. (2011). Risk Factors of Posttraumatic Stress Disorder among Survivors after the 512 Wenchuan Earthquake in China. *PloS One, 6*, Article e22371. https://doi.org/10.1371/journal.pone.0022371.

Zhang, Y., Zhang, H., Ma, X., & Di, Q. (2020). Mental Health Problems during the COVID-19 Pandemics and the Mitigation Effects of Exercise: A Longitudinal Study of College Students in China. *International Journal of Environmental Research and Public Health, 17*, Article 3722, https://doi.org/10.3390/ijerph17103722.

Zhao, Q., Neumann, D. L., Cao, X., Baron-Cohen, S., Sun, X., Cao, Y., Yan, C., Wang, Y., Shao, L., & Shum, D. H. (2018). Validation of the empathy quotient in Mainland China. *Journal of Personality Assessment, 100*, 333-342. https://www.tandfonline.com/doi/full/10.1080/00223891.2017.1324458.

Zhao, Q., Neumann, D. L., Cao, Y., Baron-Cohen, S., Yan, C., Chan, R. C., & Shum, D. H. (2019). Culture—sex interaction and

the self-report empathy in Australians and mainland Chinese. *Frontiers in Psychology, 10*, Article 396. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6422933/pdf/fpsyg-10-00396.pdf.

Zhao, Q., Ren, Q., Sun, Y., Wan, L., & Hu, L. (2020). Impact factors of empathy in mainland Chinese youth. *Frontiers in Psychology, 11*, Article 688. https://doi.org/10.3389/fpsyg.2020.00688.

Zhao, Q., Neumann, D. L., Yan, C., Djekic, S., & Shum, D. H. (2021). Culture, sex, and group-bias in trait and state empathy. *Frontiers in Psychology, 12*, Article 561930. https://doi.org/10.3389/fpsyg.2021.561930.

Zhou, Y., MacGeorge, E. L., & Myrick, J. G. (2020). Mental health and its predictors during the early months of the COVID-19 pandemic experience in the United States. *International Journal of Environmental Research and Public Health, 17*, Article 6315. https://doi.org/10.3390/ijerph17176315.

Zhang, N., Wu, K., Zhang, Y., Liu, Z., & Zhou, X. (2020). Psychological predictors of posttraumatic growth among adult survivors of Wenchuan earthquake in China, Asian Journal of Psychiatry, Volume 53, Article 102309. https://doi.org/10.1016/j.ajp.2020.102309.

Ying, Y., Ruan, L., Kong, F., Zhu, B., Ji, Y., & Lou, Z. (2020). Mental health status among family members of health care workers in Ningbo, China, during the coronavirus disease 2019 (COVID-19) outbreak: a cross-sectional study. BMC psychiatry, 20(1), 1-10, Article 379. https://doi.org/10.1186/s12888-020-02784-w

Wathelet, M., Fovet, T., Jousset, A., Duhem, S., Habran, E., Horn, M., Debien, C., Notredame, C.-E., Baubet, T., & Vaiva, G. (2021). Prevalence of and factors associated with post-traumatic stress disorder among French university students 1 month after the COVID-19 lockdown. *Translational Psychiatry, 11*(1), Article 327. https://doi.org/10.1038/s41398-021-01438-z