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András Matuz, Boróka Gács & Béla Birkás

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Reframing prolonged negative mental health effects of COVID-19: cognitive restructuring promotes posttraumatic growth

András Matuz[a,b], Boróka Gács[a] and Béla Birkás[a]

[a]Department of Behavioural Sciences, Medical School, University of Pécs, Pécs, Hungary; [b]Szentágothai Research Centre, University of Pécs, Pécs, Hungary

ABSTRACT

Objective: The study aimed to investigate the level of peritraumatic distress in relation to possible traumatic outcomes in university personnel and students across three pandemic waves.

Methods: Three cross-sectional surveys were conducted to investigate university students and staff ($n = 1426$). An online survey including the COVID-19 Peritraumatic Distress Index (CPDI), Ways of Coping, Impact of Events Scale (IES), and Posttraumatic Growth Inventory (PTGI) were administered across three waves. Psychometric properties of the Hungarian version of CPDI were assessed and associations between peri/posttraumatic stress and coping were explored. Cluster analysis based on posttraumatic stress and growth was used to identify subgroups.

Results: An increasing trend of peritraumatic stress over the waves was found. Regression analyses revealed that two coping styles, cognitive restructuring and problem analysis were negatively and positively associated, respectively, with both peritraumatic and posttraumatic stress. Two-step cluster analysis conducted on PTGI and IES scores yielded three clusters of posttraumatic changes: IES-low/PTGI-low, IES-high/PTGI-low and IES moderate/PTGI-high. Multinomial regression showed that cognitive restructuring and peritraumatic stress were significant predictors of cluster membership.

Conclusion: Our findings point out that cognitive restructuring may be effective for dealing with longer-term psychological results of traumatic life events, such as the COVID-19 pandemic, even in highly exposed groups of the society.

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COVID-19; PTSD; PTG; peritraumatic stress; cognitive reconstructing

Introduction

Patterns of negative emotions together with cognitive biases and physical stress responses experienced during or shortly after a traumatic event are referred to as peritraumatic distress (PD). PD can be defined as an acute state condition determined by trauma–related psychophysiological responses, with a tendency to diminish over

CONTACT Boróka Gács gboroka@hotmail.com Department of Behavioural Sciences, Medical School, University of Pécs, Szigeti str. 12, Pécs, 7624, Hungary

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time (see Thomas et al., 2012 for an overview). Peritraumatic reactions can be different, involving emotions (e.g. fear or helplessness), cognitions (e.g. dissociation), physiological changes (e.g. elevated heart rate) and various forms of behaviours (e.g. freezing) (Gorman et al., 2016). The COVID-19 pandemic has provoked various medical and psychological problems in millions of people and still has an impact on mental health of many individuals (Wolf & Schmitz, 2024). To estimate the negative effects of COVID-19-related distress on mental health, Qiu et al. (2020) developed the COVID-19 Peritraumatic Distress Index (CPDI). This self-report provides a comprehensive assessment of peritraumatic stress symptoms associated with COVID-19, including cognitive-, physical-, and social problems alongside depression and anxiety. The CPDI has been validated in many different cultures and languages (Böttcher et al., 2023; Costantini & Mazzotti, 2020; Jiménez et al., 2021; Liu & Heinz, 2020; Pedraz-Petrozzi et al., 2024), mostly supporting a two-factor structure. However, the label and interpretation of the factors varies across these studies as well as the items included in each factor necessitating further cross-cultural validation of the instrument. The current study aims to contribute to this in proving the two-factor structure and demonstrate the measurement invariance of the CPDI.

The level of distress individuals experience in relation to traumatic events (i.e. level of PD) may enhance the risk of various psychological symptoms and mental disorders (Megalakaki et al., 2021; Vance et al., 2018), such as PTSD (Yehuda, 2002). PTSD also develops after exposure to a potentially traumatic event, but compared to PD, it is more persistent and is considered as a mental disorder including symptoms such as avoidance, intrusive thoughts and hyperarousal (elevated reactivity) (APA, 2013). PD is considered as a reliable and consistent predictor of the severity of PTSD symptoms, regardless of individual's age, cultural background or of the type of trauma and form of exposure (Vance et al., 2018). Several studies focused on the prevalence, significance and effects of PD and PTSD in regard of the COVID-19 pandemic (Costantini & Mazzotti, 2020; Jahanshahi et al., 2020; Megalakaki et al., 2021; Pontoni et al., 2022). Relatively high proportion of participants reported moderate to severe symptoms of peritraumatic distress, with female gender, age, other stressful life events and lack of social support as consistent risk factors (Megalakaki et al., 2021; Pontoni et al., 2022). In relation to PTSD symptoms, various factors such as psychological stress, lack of social support or female gender have been identified as a possible risk factors across different phases of the pandemic (Dutheil et al., 2021; Greenberg & Rafferty, 2021). In line with this, an increase in PTSD symptoms was found even after the pandemic (Aslan & Çınar, 2022; Cénat et al., 2021; Holman et al., 2023; Megalakaki et al., 2021) suggesting, that despite of the reduction of acute threat and stress (e.g. PD) related to COVID-19, some individuals are still prone to develop PTSD.

During and after the pandemic, university students and staff members were reportedly experiencing heightened levels of stress, anxiety, and depression (Auerbach et al., 2020; Li et al., 2020; Sahu, 2020; Son et al., 2020; Zhou & Yao, 2020) as well as feelings of disconnection, decreased motivation and an increase of burnout rates (Chenneville et al., 2023; Firth et al., 2019; Gualano et al., 2020; Levecque et al., 2020; Marelli et al., 2021; Van Der Feltz-Cornelis et al., 2020). Additionally, elevated prevalence of PTSD symptoms among college students and university staff members was also observed in different waves of the COVID-19 (Aslan & Çınar, 2022; Fan et al., 2021; Goldstein et al.,

2023; Hu et al., 2023; Lee et al., 2021; Ochnik et al., 2021; Wang et al., 2023). Medical students in particular, showed higher levels of anxiety, depression, psychological distress and symptoms of PTSD compared to their age-matched peers (Ifthikar et al., 2021; Lyons et al., 2020; Pandey et al., 2021). Despite the implementation of support services and virtual resources suitable to reduce the level of PD, the prolonged psychological impact of the pandemic (e.g. PTSD symptoms) continues to be a significant concern for universities worldwide (Barbayannis et al., 2022; Moeller et al., 2022; Tang et al., 2020; Young et al., 2023). Although PTSD is likely to develop after highly challenging life events, it is also possible that these events result in positive changes. Posttraumatic growth (PTG) refers to the positive psychological changes individuals experience as a result of exposure to stressful, traumatic events, which manifest in the improvement of self-perception, social relationships and appreciation of life (Tedeschi & Calhoun, 2004). Similar to PTSD, studies reported relatively high prevalence of PTG in context of the COVID-19 pandemic (Li et al., 2022; Prieto-Ursúa & Jódar, 2020; Serpa-Barrientos et al., 2023). Psychological growth can be facilitated by cognitive restructuring, a process altering how individuals identify, evaluate and modify their maladaptive thoughts responsible for maintaining their level of distress (Clark, 2013). This cognitive adjustment helps to change the personal narrative and to develop a more comprehensive understanding of the self, others and the situation leading to personal, social and/or spiritual growth (Clark, 2013; Tedeschi & Calhoun, 2004). Cognitive appraisal and core beliefs regarding the resources and the demands of the stressful situation are considered as central determinants of level of stress and coping (Clark, 2013; Lazarus & Folkman, 1984). Consequently, cognition-based interventions and psychotherapy methods are effective and strongly recommended for promoting PTG (Chew et al., 2020; Tedeschi & Calhoun, 2004) and for the treatment of PTSD (APA, 2017; Watkins et al., 2018). Correspondingly, the level of perceived threat of the COVID-19 pandemic influences the extent of changes in stress reactions and the adequacy of personal adjustment, which may alter the course of the posttraumatic outcome.

Taking these findings together, former studies established that both PTSD and PTG are common after stressful or potentially traumatic events, such as the COVID-19 pandemic. The lasting effects of this pandemic provide an opportunity to explore patterns of psychological adjustment or maladaptation in samples of university staff (academic teachers and administrative staff) and students. The present study aimed to investigate the level of peritraumatic distress in relation to possible post-traumatic outcomes (PTSD or PTG) across three different time periods of the pandemic in samples of university employees and students. The periods were selected according to the trends of the pandemic, the increase of prevalence of COVID-19 was the starting point of each period and were labelled as waves by the official news portals of the country. More specifically, 1) we utilized the psychometric validation of the COVID-19 Peritraumatic Distress Index, a self-report questionnaire to measure the level of COVID-19- related PD in a Hungarian sample and 2) expected an increase in levels of both PD factors across three different phases of COVID-19. Furthermore, we hypothesized that 3) in the third wave of COVID-19, higher levels of PD will significantly predict PTSD symptoms and to a lesser extent, indicators of PTG and 4) suggested, that cognitive restructuring will be negatively associated with PTSD symptoms and factors of PD, while positively with indicators of PTG.

Methods

Participants

A total of 1426 individuals, University personnel and undergraduate students (373 men, 1053 women), aged between 18 and 76 ($M = 34.04$, SD = 13.58) with a range of demographic and socio-economic backgrounds were recruited for the study and completed the questionnaires. Over half the sample were students (53.2%) and 667 (46.8%) were university personnel.

Procedure

The research was conducted at the University of Pécs and assessed the impact of the first, second and third waves of the pandemic on the workers and students in three phases, between 22 June and 7 July 2020, 24 November and 14 December 2020, and 17 May and 7 June 2021 separately. The data was collected online using Google Forms, with 463 completions in the first wave 685 in the second and 278 in the third. No data was collected before the onset of the first wave of the pandemic.

Respondents were recruited through e-mail: the link of the questionnaires with a short description of the study was sent by e-mail to all university staff and students in Hungarian. Although it is out of the scope of the current investigation, an attempt was made to explore within-subject changes as well, and therefore, the respondents were asked for their contact information as well as a self-generated code. Participants in the second and third waves were additionally asked to provide their code if they had already participated in our research before. Only the data from the first response of an individual was used for data analysis. The online questionnaire took about 20 min to complete and the respondent may withdraw from the study at any time without giving any reason. The survey contained questions regarding age, gender, type of status (student or employee), place of residence and presence of household members (alone; roommate; spouse/partner; parents) during the pandemic.

The research was approved by the Hungarian United Ethical Review Committee for Research in Psychology (EPKEB, Ref. No. 2020-78) and was carried out in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki). Electronic informed consent was obtained from all participants.

Measures

COVID-19 peritraumatic distress index

The psychological distress related to COVID-19 was measured with the Hungarian translation of the CPDI. The CPDI consists of 24 items designed to assess the frequency of affective, behavioural, cognitive and physical symptoms of distress as well as social disruption related to COVID-19 (Qiu et al., 2020). Each item is rated on a 5-points Likert scale ranging from 0 ('*Never*') to 4 ('*Most of the time*'). Accordingly, scores on the original version of CPDI range between 0 and 96. Respondents were instructed to reflect on the effects of the COVID-19 pandemic when providing their responses.

In former studies, (Böttcher et al., 2023; Jiménez et al., 2021; Pedraz-Petrozzi et al., 2024), two subscales were identified by exploratory factor analysis: a stress-related subscale (i.e. the severity of stress symptoms) that consisted of 11-15 items and an information processing-related subscale (i.e. rumination or the effect of negative information perceived by the individual) consisting of 6-8 items. In our sample, the two-factor solution was supported (see Results for further details), and the Cronbach's α values of stress and COVID-19 information subscales were .92 and .72, respectively (reliability measures in the three waves separately are presented in Supplementary Table S3). To adapt CPDI to Hungarian, we used the forward-backward translation protocol. The English version of CPDI was first translated to Hungarian, then an independent translator translated the text back to the original language. The translations were then compared, and inconsistencies were discussed until consensus was reached. In order to validate the Hungarian version, exploratory and confirmatory analyses were utilized and convergent validity was evaluated (see Results for further details).

Beck depression inventory

Depressive symptoms were measured by the shortened Hungarian version of the Beck Depression Inventory (BDI-H). This Hungarian version was developed by Mária Kopp and colleagues (Kopp et al., 1998), and its psychometric properties were analyzed by Rózsa et al. (2001). Although the Beck Depression Inventory (BDI) has several abbreviated versions, such as the 13-item short form and the 7-item Fast Screen (Beck et al., 1974; Beck et al., 1996), in Hungary, the 9-item version has been officially validated and is the standard short form used for depression assessment (Kopp et al., 1995; Köteles et al., 2009; Simor et al., 2012; Lakatos et al., 2017; Spányik et al., 2022; Ujma et al., 2023). This questionnaire consists of 9 items depicting depressive symptoms (e.g. disturbances of sleep, fatigue, lack of interest in other people etc.). Respondents are required to rate the severity of depressive symptoms over the past week on a scale ranging from 0 to 3. Total scores on BDI thus range between 0 and 27, with higher scores indicating more severe depression-related symptoms. The Cronbach's α value of BDI in our sample was .88.

Spielberger state-trait anxiety inventory

We used the short version of the Hungarian translation of the Spielberger State-Trait Anxiety Inventory (STAI-H, Spielberger et al., 1983) to measure state as well as trait anxiety (Zsido et al., 2020). This questionnaire consists of 10 items: 5 items each for trait and state anxiety. Respondents are required to rate each item on a 4-point Likert-scale (0 refers to '*Not at all*', while 3 refers to '*Very much so*'). Total scores on both trait and state anxiety subscales range between 0 and 15. Higher scores on state anxiety indicate that the individual temporarily experiences higher levels of anxiety, while higher scores on trait anxiety indicate predisposition to perceive higher levels of anxiety. In our sample, both subscales showed adequate reliability (based on Cronbach's α values): State anxiety: .93, Trait anxiety: .87.

Ways of coping

To assess the strategies in coping with stressful situations, we used the shortened 16-item Hungarian version of the Ways of Coping questionnaire (WOC-H, Folkman & Lazarus, 1980; Rózsa et al., 2008). Respondents indicated to what extent they use the listed strategies to cope with stressful situations on a 4-points Likert scale (0 referred to '*Not at all*, 3 referred to '*Very typical of me*'). The questionnaire has four subscales: cognitive restructuring/adaptation, problem analysis, stress reduction (by eating; drinking; smoking) and passive coping/helplessness. The cognitive restructuring subscale showed adequate reliability (α = .75), while the other subscales turned out to have low reliability. therefore, for data analysis, we did not use the subscales, stress reduction (α = .56) and passive coping (α = .07) and removed item #14 to increase the Cronbach's α of the problem analyzing subscale to an acceptable level (α =.63). The highest potential score on the cognitive restructuring subscale is 21, while the lowest is 0. Higher scores indicate that the individual seeks to identify and change negative thoughts. Scores on the problem analysis subscale range between 0 and 9, with higher scores indicating predisposition to seek the source of stress and potentially eliminate or reduce it.

Impact of events scale

To assess the stress reactions evoked by the COVID-19 pandemic, we used the Hungarian version of the Impact of Events Scale-Revised (IES-R-H, Horowitz et al., 1979; Weiss, 2007; Kocsis-Bognár et al., 1995; Perczel-Forintos et al., 2018). This 22-item questionnaire consists of three subscales: avoidance (i.e. the tendency to avoid situations that remind the individual of the traumatic event), hyperarousal (i.e. increased sensitivity to external stimuli) and intrusiveness (i.e. the tendency for re-living the events triggered by stimuli associated with the traumatic event). Respondents are asked to indicate the frequency of post-traumatic distress symptoms over the past week on a 5-points Likert-scale (0 referred to '*Not at all*', 4 referred to '*Often*'). According to the recommended statistical practice with IES-R (see Weiss, 2007 for details), for the calculation of subscales, we computed the means of items for each subscale and thus, they ranged between 0 and 4. Cronbach's α values for the three subscales were as follows: avoidance: .77, hyperarousal: .86, intrusiveness: .86. In the instructions, we specified that the items referred to the COVID-19 induced crisis and that the respondents should rate the items based on the impact the COVID-19 pandemic had on them.

Posttraumatic growth inventory

The 21-item Hungarian version of the Posttraumatic Growth Inventory (PTGI-H) was used to assess perceived positive changes in five domains of life after COVID-19 (Tedeschi & Calhoun, 2004; Kovács et al., 2012). Accordingly, the PTGI has five subscales: social relationships (7 items; total score range: 0-35; α = .89), new possibilities (5 items; total score range: 0-25; α = .89), spiritual change (2 items; total score range: 0-10; α = .70), personal strength (4 items; total score range: 0-20; α = .85) and appreciation of life (3 items; total score range: 0-15; α = .87). Items were rated from 0 ('Not at all') to 5 ('Very great degree'). Higher scores on PTGI subscales indicate that the individual experienced greater positive changes after challenging times.

Importantly, the PTGI and IES questionnaires were administered during the third wave only.

Data analysis

Statistical analyses were performed using R (version 3.6.1.) and SPSS (version 28). Missing data were replaced by median values. To assess the factor structure of the Hungarian version of the CPDI, both exploratory factor analysis (EFA) using weighted least squares method for extraction and confirmatory factor analysis (CFA) were performed. EFA and CFA were carried out using the 'psych' (Revelle, 2018) and 'lavaan' packages (Rosseel, 2012), respectively. Prior to the analysis, the sample was randomly split into two subsamples with equal sizes ($n = 713$) using the random package in Python (version 3.8) and EFA was carried out in the first, while CFA was carried out in the second subsample. The two subsamples did not differ in terms of age ($Z = -0.263$, $p = .793$), sex ($\chi^2(1) = 2.846$, $p = .092$), time of response (i.e. first, second and third waves; $\chi^2(2) = .781$, $p = .677$) and the CPDI items ($Z = 0 - 1.387$, $p = .165 - 1$; for a detailed description see supplementary Table S1). This data split procedure was implemented to verify that the latent structure of CPDI identified through EFA was not a result of chance or specific characteristics of the sample. To achieve this, the model's fit was tested using CFA in a separate sample.

For EFA, a polychoric correlation matrix was created since CPDI items had ordinal response options. Parallel analysis (Horn, 1965), minimum average partial (MAP) test (Velicer, 1976) and the visual scree test were used to determine the optimal number of factors using the 'psych' and 'nFactors' packages in R (Raiche et al., 2020). Based on previous research (Jiménez et al., 2021), the factors were assumed to be correlated and thus, an oblique rotation method (promax) was employed. Construct validity of the instrument was assessed by conducting correlation analyses on CPDI, BDI and STAI scores.

To explore the predictors of COVID-related stress, linear regression was used with CPDI scores as the outcome and the predictors wave (dummy coded; the reference category was the first wave) and two subscales of the WOC questionnaire, cognitive restructuring and problem analysis. In addition, the demographic variables age and sex (dummy coded) were also entered into the models to control for their effects. Since factor analysis supported the two-factor solution for CPDI, the predictors of the two subscales were tested separately. In the subsample of the respondents from the third wave, predictors of the impact of COVID-19 measured by the IES questionnaire as well as posttraumatic growth measured by PTGI were also explored by a series of linear regression analyses. The outcome variables were the three subscales of IES and five subscales of PTGI, whilst the following predictors were entered into the models: sex, age, Cognitive restructuring, Problem analysis and the two subscales of CPDI. Based on the Breusch-Pagan test, the homoscedasticity assumption was violated for most of the multiple regression models, and therefore, robust estimation methods were utilized. All regression analyses were carried out using the 'estimater' package (Blair et al., 2019).

Two-steps cluster analysis was conducted to identify subgroups based on the three IES and five PTGI subscales. A series of univariate analyses of variance (ANOVA) was conducted to test whether IES and PTGI scores differed significantly across the identified clusters. Finally, multinomial logistic regression was used to identify the

significant predictors of cluster membership. Regression and cluster analyses in the third wave sample were conducted on a sample of 274 individuals (i.e. the data of 4 people had to be dropped due to large number of missing information on PTGI and IES scales).

Results

Descriptive statistics and demographics

Descriptive statistics of demographics and the measured variables, separately for the three waves, are summarized in Table 1. Respondents from the three waves significantly differed in terms of age ($F(2, 1423) = 35.52$, $p < .001$), with those in the second wave being significantly younger than respondents in the first ($t(1423) = -6.13$, $p < .001$) and third ($t(1423) = -7.53$, $p < .001$) waves. They also significantly differed in terms of occupation ($\chi^2(2) = 110.08$, $p < .001$): .the proportion of students was higher in the sample collected in the second compared to the first ($\chi^2(2) = 69.02$, $p < .001$) and third ($\chi^2(2) = 79.32$, $p < .001$) waves.

Exploratory factor analysis

The factorability was confirmed by Bartlett's test of sphericity ($X^2(276) = 12865$, $p < .001$) as well as the Kaiser-Meyer-Olkin index (KMO = .93). Item #12 exhibited

Table 1. Descriptive statistics over the three waves.

	COVID-19 waves					
	First wave ($n = 463$)		Second wave ($n = 685$)		Third wave ($n = 274$)	
Variables	Mean	SD	Mean	SD	Mean	SD
Demographics						
Age	35.96	13.40	31.07	13.33	38.17	12.83
Sex (% female)	73.2%		74.2%		76.4%	
Occupation (% student)	42.5%		67.4%		36.0%	
Questionnaires						
BDI	3.73	4.72	5.39	5.37	5.52	5.41
CPDI INF	5.37	3.87	6.03	3.78	6.09	3.95
CPDI STR	13.26	10.95	18.31	12.88	18.7	13.66
STAI STA	3.80	3.84	5.39	4.51	4.87	4.41
STAI TRA	4.74	3.85	6.00	4.34	5.39	4.45
WOC CR	10.51	4.24	10.15	4.09	8.93	4.45
WOC PA	4.96	2.09	4.99	2.13	4.08	2.34
IES IN	–	–	–	–	1.14	0.98
IES AV	–	–	–	–	1.24	0.77
IES HY	–	–	–	–	1.09	0.92
PTGI SR	–	–	–	–	10.69	7.57
PTGI NP	–	–	–	–	9.73	6.94
PTGI PS	–	–	–	–	8.28	5.55
PTGI AL	–	–	–	–	7.86	4.61
PTGI SC	–	–	–	–	2.47	2.78

Notes: BDI = Beck's Depression Inventory; CPDI = COVID-19 Peritraumatic Distress Index; STAI = Spielberger State-Trait Anxiety Inventory; WOC = Ways of Coping questionnaire; IES = Impact of Events Scale; PTGI = Posttraumatic Growth Inventory; INF = COVID-19 Information; STR = Stress; STA = State Anxiety; TRA = Trait Anxiety; CR = Cognitive Reframing; PA = Problem Analysis; IN = Intrusion; AV = Avoidance; HY = Hypervigilance; SR = Social Relationships; NP = New Possibilities; PS = Personal Strength; AL = Appreciation of Life; SC = Spiritual Change.

low communality (.13) and was removed from the analysis. Parallel analysis suggested that the optimal number of factors was seven, while MAP as well as the scree test suggested an optimal number of two. The two-factor solution was also supported by theory and therefore, we retained two factors for rotation. After rotation, the two factors explained 54.9% of the variance. Item #22 showed cross-loading (factor loadings of .43 and .40 on the first and the second factors, respectively) and was therefore removed. Following Jiménez et al. (2021) the first factor was labelled as stress symptoms and the second factor was labelled as COVID-19 Information. The stress symptoms factor consisted of 15 items (1, 4, 6, 7, 13-21, 23, 24) and accounted for 42% of the variance, while the COVID-19 information factor consisted of 6 items (2, 3, 5, 8-11) and accounted for 13% of the variance. Factor loadings and communality scores are presented in Table 2. Based on Cronbach's α values, both factors showed adequate reliability: stress symptoms: .93, COVID-19 information: .76. The two factors correlated positively (r = .52). The mean score on the stress symptoms factor was 16.84 (SD = 13.04), while it was 5.87 (SD = 4.07) on the COVID-19 information factor. Since two items were dropped, the scores on the Hungarian version of CPDI range between 0 and 60 for the stress subscale, and between 0 and 24 for the COVID-19 information subscale.

Table 2. Factor loadings from exploratory factor analysis.

		Factor loadings		
	Items	*Factor 1*	*Factor 2*	*Communality*
1	Compared to usual, I feel more nervous and anxious	**.83**	.00	.68
2	I feel insecure and bought a lot of masks, medications, sanitizer, gloves and/or other home supplies	.24	**.51**	.45
3	I can't stop myself from imagining myself or my family being infected and feel terrified and anxious about it	.34	**.47**	.50
4	I feel empty and helpless no matter what I do	**.89**	−.09	.71
5	I feel sympathetic to the COVID-19 patients and their families. I feel sad about them.	.22	**.37**	.27
6	I feel helpless and angry about people around me, governors, and media	**.61**	.06	.41
7	I am losing faith in the people around me	**.59**	.10	.42
8	I collect information about COVID-19 all day. Even if it's not necessary, I can't stop myself	−.07	**.78**	.56
9	I will believe the COVID-19 information from all sources without any evaluation	−.14	**.70**	.41
10	I would rather believe in negative news about COVID-19 and be skeptical about the good news	.04	**.64**	.44
11	I am constantly sharing news about COVID-19 (mostly negative news)	−.26	**.83**	.53
13	I am more irritable and have frequent conflicts with my family	**.81**	−.05	.61
14	I feel tired and sometimes even exhausted	**.93**	−.15	.74
15	Due to feelings of anxiety, my reactions are becoming sluggish	**.92**	−.02	.82
16	I find it hard to concentrate	**1.00**	−.22	.82
17	I find it hard to make any decisions	**.87**	−.06	.71
18	During this COVID-19 period, I often feel dizzy or have back pain and chest distress	**.80**	.02	.65
19	During this COVID-19 period, I often feel stomach pain, bloating, and other stomach discomfort	**.77**	.02	.62
20	I feel uncomfortable when communicating with others	**.73**	−.01	.52
21	Recently, I rarely talk to my family	**.60**	−.04	.33
23	I lost my appetite	**.61**	.13	.47
24	I have constipation or frequent urination	**.52**	.21	.43

Notes: Extraction method: Weighted least squares; Rotation method: Promax. Bold shaded factor loadings within the columns indicate the items that load on each factor.

Confirmatory factor analysis

Mardia's test indicated that data of the second subsample was not normally distributed on the multivariate level (kurtosis = 95.26, $p < .001$). Consequently, the Weighted Least Squares Mean and Variance Adjusted estimator method was used for CFA. The proposed two-factor model had a satisfactory fit in general. CFI and TLI values indicated a very good fit as both were above the criteria of .95 (CFI = .99, TLI = .99). The RMSEA was close to the criteria of 0.06 but still above (.063, CI90% = .059 – .068), while SRMR was .072. Figure 1 shows the standardized factor loadings and residual variances of the two-factor model.

Convergent validity

The stress symptoms factor showed strong positive correlation with trait anxiety (rho = .72, $p < .001$), state anxiety (rho = .75, $p < .001$) and depression (rho = .83, $p < .001$). The COVID-19 information factor correlated moderately positively with trait anxiety (rho = .42, $p < .001$), state anxiety (rho = .40, $p < .001$) and depression (rho = .38, $p < .001$).

Predictors of stress symptoms and COVID-19 information

Results of regression analyses focusing on the prediction of the two subscales of CPDI, stress symptoms and COVID-19 information, are presented in Table 3. Below we only report the significant findings. Wave was a significant predictor in both models: individuals who responded during the second (stress: ß = .29, SE = .06, $p < .001$; information:: ß = .16, SE = .06, $p = .01$) and third (stress:: ß = .44, SE = .07, $p < .001$; information: ß = .19, SE = .08, $p = .01$) waves experienced more severe stress symptoms and were more strongly affected by negative information compared to first wave's respondents. Cognitive restructuring was a significantly negative predictor of both outcomes, stress (ß = −0.23, SE = .03, $p < .001$) and information (ß = −0.11, SE = .03, $p < .001$). Problem analysis was a significantly positive predictor of stress (ß = −0.13, SE = .03, $p < .001$) as well as information (ß = .12, SE = .03, $p < .001$). That is, higher scores on cognitive restructuring and lower scores on problem analysis were associated with less stress-related symptoms and less negative influence by COVID-19-related information. Age was a significantly negative predictor of stress (ß = −0.24, SE = .02, $p < .001$): with increasing age we found less stress-related symptoms. Finally, sex was a significant predictor of COVID-19 information as male respondents were less affected by negative information (ß = −0.21, SE = .06, $p < .001$).

Predictors of impact of event subscales and posttraumatic growth

Results of the analyses focusing on the prediction of IES and PTG subscales are summarized in Table 4. The stress symptoms factor of CPDI was positively associated with all three subscales of IES (intrusiveness: ß = .46, SE = .07, $p < .001$; avoidance: ß = .38, SE = .07, $p < .001$; hyperarousal: ß = .68, SE = .06, $p < .001$), while the information factor was positively associated with the hyperarousal (ß = .11, SE = .05, $p = .02$) and intrusiveness

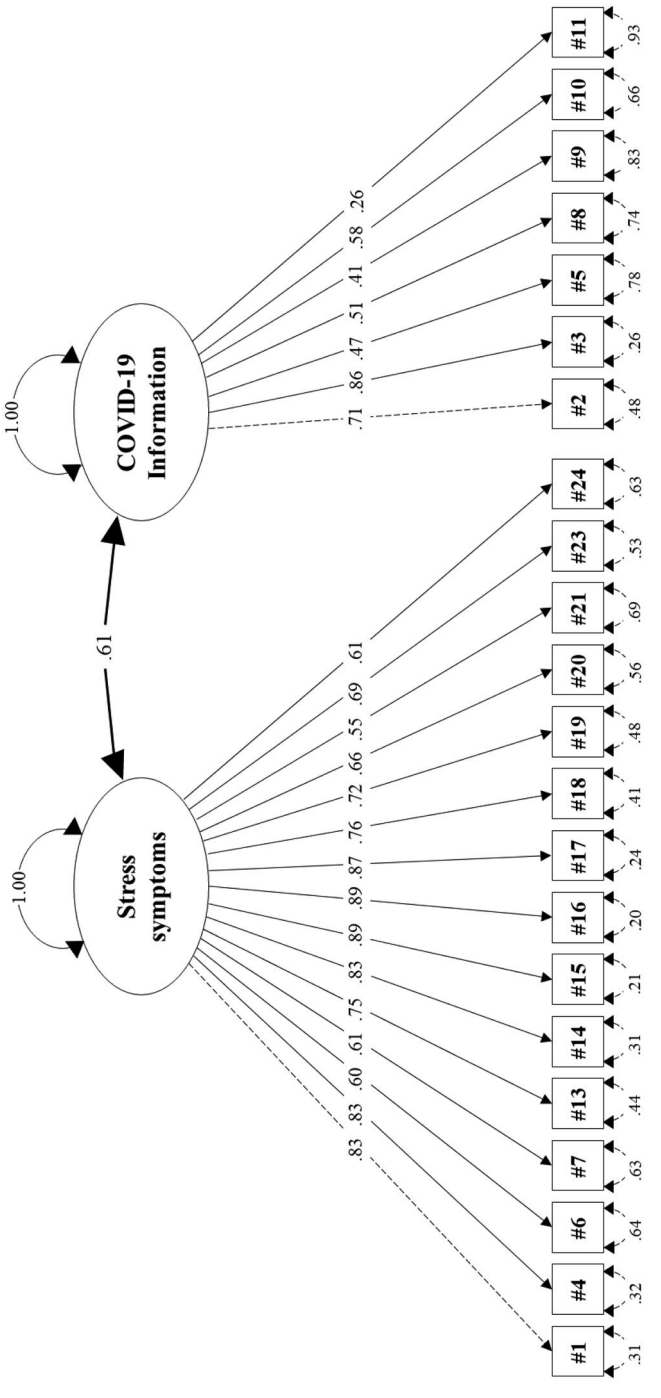

Figure 1. Confirmatory factor analysis (CFA) model of the 2-dimensional model of CPDI with standardized estimates and correlations between factors.

(ß = .23, SE = .06, $p < .001$) subscales only. Regarding the coping strategies, problem analysis was positively associated with each of the IES subscales (intrusiveness: ß = .21, SE = .05, $p < .001$; avoidance: ß = .17, SE = .07, $p = .01$; hyperarousal: ß = .10, SE = .05,

Table 3. Results of regression analyses investigating the predictors of CPDI factors.

Predictor/Outcome	CPDI Stress		CPDI Information	
	ß	*SE*	*ß*	*SE*
Sex (Ref. = female)	−.01	.06	−.21***	.06
Age	−.24***	.02	−.01	.03
Second wave (Ref. = 1. wave)	.29***	.06	.16*	.06
Third wave (Ref. = 1. wave)	.44***	.07	.19*	.08
Problem analysis	.13***	.03	.12***	.03
Cognitive restructuring	−.23***	.03	−.11***	.03

Notes: ß = standardized coefficients, SE = robust standard errors.
*$p < .05$; *** $p < .001$.

Table 4. Results of regression analyses investigating the predictors of IES and PTGI factors.

Predictor/Outcome		Sex (Ref. = female)	Age	CPDI stress	CPDI info	Problem analysis	Cognitive recon-structing
IES factors							
Intrusiveness	ß	−.01	.01	.46***	.23***	.21***	−.11*
	SE	.10	.04	.07	.06	.05	.05
Avoidance	ß	−.12	.04	.38***	−.05	.17*	−.02
	SE	.13	.07	.07	.07	.07	.07
Hyperarousal	ß	−.07	−.01	.68***	.11*	.10*	−.11*
	SE	.07	.04	.06	.05	.05	.05
PTGI factors							
Social relationships	ß	−.29*	.00	−.11	.20**	.09	.25***
	SE	.13	.07	.09	.07	.07	.07
New possibilities	ß	−.08	−.08	−.07	.12	.11	.29***
	SE	.13	.07	.09	.07	.07	.07
Personal strength	ß	−.12	−.08	−.13	.10	−.02	.39***
	SE	.13	.07	.08	.07	.07	.07
Appreciation life	ß	−.33*	−.02	−.13	.33***	.02	.15*
	SE	.14	.07	.08	.06	.07	.07
Spiritual change	ß	−.33	.05	−.03	.14[m]	−.04	.29***
	SE	.13	.06	.09	.07	.06	.06

Notes: ß = standardized coefficients, SE = robust standard errors.
*$p < .05$; ** $p < .01$; *** $p < .001$; [m] $p < .1$.

p = .03), while cognitive restructuring was negatively associated with the hyperarousal (ß = −0.11, SE = .05, p = .02) and intrusiveness (ß = −0.11, SE = .05, p = .048) subscales of IES. This suggests that those who tend to apply problem analysis as a coping strategy were more likely, while those who tend to apply cognitive restructuring were less likely to suffer from hyperarousal and intrusive memories. Finally, sex and age were not significant predictors of any of the IES subscales.

For posttraumatic growth, the COVID-19 information factor of CPDI was found to be a significantly positive predictor of social relationships (ß = .20, SE = .07, p = .009) and appreciation of life (ß = .33, SE = .06, $p < .001$). That is, individuals who were affected by COVID-related negative information reported positive changes in their social life and their philosophy of life. In addition, cognitive restructuring was positively associated with all subscales of PTGI suggesting that the use of this coping strategy increases the likelihood of positive posttraumatic changes in each domain (social relationships: ß = .25, SE = .07, $p < .001$; new possibilities: ß = .29, SE = .07, $p < .001$; personal strength: ß = .39, SE = .07, $p < .001$; appreciation of life: ß = .15, SE = .07, p = .047; spiritual change: ß = .29, SE = .06, $p < .001$). Moreover, the analyses revealed that female respondents were more likely to experience positive changes in

Table 5. Results of the multinomial regression analysis investigating the predictors of cluster membership.

Cluster	Predictor	Wald	Standard error	OR	P-value
Cluster 1 (low IES and low PTGI)	Sex (ref. = female)	.087	.426	.882	.768
	Age	.015	.016	.998	.901
	Problem analysis	4.839	.890	.822	.028
	Cognitive restructuring	.677	.053	.957	.411
	CPDI Stress	16.779	.020	.921	<.001
	CPDI Information	14.277	.066	.779	<.001
Cluster 3 (moderate IES, high PTGI)	Sex (ref. = female)	2.523	.414	.518	.112
	Age	.909	.015	.985	.341
	Problem analysis	5.175	.083	.828	.023
	Cognitive restructuring	11.330	.047	1.173	<.001
	CPDI Stress	21.130	.018	.920	<.001
	CPDI Information	.407	.055	.966	.523

Notes: Cluster 2 (high IES, low PTGI) was used as reference category. *IES* = scores on the Impact of Events Scale, *OR* = Odds ratio; *PTGI* = scores on the Posttraumatic Growth Inventory.

their social life (ß = −0.29, SE = .13, p = .03) and their philosophy of life (ß = −0.33, SE = .14, p = .02) compared to male respondents.

Results of cluster analysis and multinomial regression

PTGI and IES subscales were subjected to two-steps clustering to identify subgroups with different levels of posttraumatic growth and long-lasting stress-related symptoms. Based on the Bayesian information criterion, the 3-class solution was supported (average Silhouette = .40). In this solution, 28.8%of the sample (n = 79) belonged to the cluster with low scores on both IES and PTGI. The second cluster (32.8%, n = 90) included individuals with high IES scores but moderate PTGI scores. Finally, in the third cluster (38.4%, n = 105), individuals showed high PTGI scores and moderate IES scores. The three clusters significantly differed in terms of each IES and PTGI subscale (all Fs > 18, all ps < .001; for further information see the Supplementary Table S2).

Cluster membership was then subjected to multinomial logistic regression with the second cluster (high IES, moderate PTGI) being the reference category (see Table 5). The analysis revealed that those who belonged to the first cluster (low IES, low PTGI) had less COVID-19-related stress symptoms (OR = .92, SE = .02, p < .001), were less affected by negative COVID-19-related information (OR = .78, SE = .07, p < .001), and were less likely to use problem analysis (OR = .82, SE = .89, p = .03) as a coping strategy compared to individuals in the second cluster. Similarly, individuals in the third cluster (moderate IES, high PTGI) had less COVID-related stress symptoms (OR = .92, SE = .02, p < .001) and were less likely to use problem analysis (OR = .83, SE = .08, p = .02) as a coping strategy compared to the reference group. Importantly, it has also been revealed that members of the third cluster were more likely to use cognitive restructuring as a coping strategy relative to members of the second cluster (OR = 1.17, SE = .05, p < .001).

Discussion

The current study provides a snapshot for the extended psychological effects of the pandemic in a sample of university personnel and students. The Hungarian version

of the COVID-19 Peritraumatic Distress Index was validated and similar to former findings (Böttcher et al., 2023; Jiménez et al., 2021; Pedraz-Petrozzi et al., 2024), two-factors have been revealed: stress symptoms and COVID-19 information. As expected, both factors showed positive associations with indicators of negative emotions, anxiety and depression suggesting that elevated PD reflected by the CPDI questionnaire reliably signals impairments of mental health (Thomas et al., 2012; Megalakaki et al., 2021). These positive associations between trait, state anxiety, depression and both factors of COVID-19-related PD contribute to the convergent validity of the CPDI. Furthermore, depression and anxiety are considered as the most prominent mental health problems related to distress in both university students and staff (Auerbach et al., 2020; Li et al., 2020; Sahu, 2020; Son et al., 2020; Zhou & Yao, 2020). Accordingly, our results support this notion showing, that a higher degree of pandemic-related PD and increased anxiety and depression are significantly correlated. Additionally, the negative influence of PD on mental health was significantly greater in the latter periods of the pandemic compared to the first wave indicating that the severity of the effects of distress tends to increase as time goes by. Former studies lacked this temporal comparison and thus were somewhat limited to exploring the long-term effects of PD caused by the COVID-19 pandemic.

In line with our predictions, both symptoms of post-traumatic distress and positive changes related to post-traumatic growth were found to be equivalently prevalent in the third wave, with PD as a significant predictor of PTSD and partially of PTG. This confirms previous findings revealing both negative (Aslan & Çınar, 2022; Fan et al., 2021; Ifthikar et al., 2021; Lee et al., 2021; Ochnik et al., 2021; Wang et al., 2023) and positive outcomes of the COVID-19 pandemic (Li et al., 2022; Prieto-Ursúa & Jódar, 2020; Serpa-Barrientos et al., 2023). Thus, our findings suggest that higher levels of distress associated with the pandemic might not only have detrimental but also beneficial consequences. Importantly, however, we also found that the post-traumatic processes in the third wave depended on the level of exposure to negative information regarding COVID-19, COVID-19-related distress, and coping style. More specifically, symptoms of PTSD (i.e. tendency to avoid situations that remind the individual of the traumatic event or showing increased sensitivity to external stimuli) are more pronounced in individuals who are more affected by COVID-19-related negative information, show elevated levels of COVID-19-related distress and tend to use problem analysis as a coping style. Post-traumatic growth (i.e. experiencing personal strength or appreciation of life), however, seems to be rather triggered by cognitive restructuring and negative information related to the pandemic. Therefore, it can be assumed, that not the overall level of distress, but rather the ability to identify negative thoughts potentially induced by negative information and replace them with more positive affirmations (Clark, 2013; Tedeschi & Calhoun, 2004) might be important to positively alter the course of mental health changes during the pandemic. In addition, cognitive restructuring was an important predictor of PTG and a significant protective factor against PTSD symptoms suggesting, that revising the evaluation of situational cues and information to alter the negative interpretations of an event (e.g. the pandemic) is helpful to prevent the long-lasting negative outcomes of COVID-19.

The results of the cluster and multinomial regression analyses may reinforce the reasoning above. In our study, three clusters were detected. The first cluster presented

low levels of both PTSD symptoms and PTG. The second cluster showed severe PTSD symptoms and intermediate levels of PTG. In contrast, the third cluster showed intermediate levels of PTSD but high levels of PTG. Further analyses of these clusters revealed that the mental-health outcomes of the pandemic (e.g. level of PTSD and PTG) depended on coping styles and levels of the PD-factors. That is, higher levels of COVID-related stress and the utilization of the coping strategy of problem analysis, were associated with a higher likelihood of showing PTSD symptoms with no remarkable positive changes after the stress exposure. In contrast, those individuals who tended to utilize another strategy, namely cognitive restructuring, showed lower levels of PTSD and higher levels of PTG. To conclude, these analyses provided further support for the notion that cognitive restructuring plays a key role in promoting positive changes after stress exposure.

In our view, this is a meaningful finding, not only because it contributes to the understanding of distress and coping outcomes in the context of the pandemic, but also in relation to psychological therapy and support, perhaps prevention, to puffer COVID-19-related negative mental health consequences and promote psychological well-being. Similar to former findings (Chew et al., 2020; Tedeschi & Calhoun, 2004; Watkins et al., 2018), our results suggest that cognitive restructuring may be highly effective and suitable for dealing with longer-term psychological results of traumatic life events, such as the COVID-19 pandemic, even in highly exposed groups of the society.

Although this study contributes to both, theory and practice, certain limitations must be acknowledged. Our sample consisted of university students and staff and therefore, the generalisability of the results on the relationship between coping, COVID-19-related stress and PTG is restricted. The samples collected during the first and second waves of the pandemic were not matched in age and occupation, and therefore, our findings regarding the increasing COVID-19-related stress from the first to the second wave might be affected by age and occupation differences. Another limitation is that the problem analysis scale showed relatively low reliability in our sample, which puts a ceiling on the validity of this scale, and so these results should be interpreted with caution. In addition, it should also be mentioned that two other subscales of the Ways of Coping questionnaire, stress reduction and passive coping, showed inadequate reliability estimates in our sample and were therefore excluded from the analysis. However, it would be interesting to also see the relationship between these coping mechanisms and COVID-19-related stress as well as PTG. Future studies may consider using other instruments to measure stress reduction and passive coping.

To conclude, this study showed that COVID-19-related stress in university students and staff increased across the waves of the pandemic. This stress induced by the pandemic was also associated with symptoms of PTSD; however, positive outcomes of the exposure to stress have also been registered (e.g. PTG). We identified a specific cluster of individuals who experienced PTG beside just moderate levels of PD. Another notable finding is that cognitive restructuring was associated with both the negative and positive outcomes of pandemic-induced stress. Consequently, it can be suggested that the utilization of cognitive restructuring may play a key role in whether staff and students experience positive or negative changes after longer periods of stress exposure.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Data availibility statement

The data that support the findings of this study are openly available in Mendeley Data at https://data.mendeley.com/datasets/msxv59kwcx/1 reference number 10.17632/msxv59kwcx.1.

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