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The effects of COVID-19 continuous traumatic stressors on mental health and cognitive functioning: A case example from Turkey

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Abstract

There is a need to accurately assess the specific impacts of the various traumatic stressors caused by COVID-19 on mental health. The goal was to evaluate the impact of different types of COVID-19 stressors (infection fears, lockdown, and economic stressors) on mental health and cognitive functioning. We used a sample of 262 Turkish adults. We administered an online questionnaire that included measures of COVID-19 traumatic stressors, PTSD, depression, anxiety, executive function deficits, and cumulative stressors and traumas (CST). The analyses included correlations, hierarchical regression, path analysis, and PROCESS mediation analysis. All COVID-19 traumatic stressors types and their cumulative load predicted PTSD, depression, anxiety, and executive function deficits after controlling for previous cumulative stressors and traumas and COVID-19 infection. COVID-19 lockdown's stressors were the strongest predictors, compared to COVID-19 fears and economic stressors. Path analysis and PROCESS mediation results indicated that COVID-19 traumatic stressors had direct effects on working memory deficits, direct and indirect effects on PTSD, depression, and anxiety, and indirect effects on inhibition deficits. Anxiety, depression, and inhibition deficits mediated its indirect effects on PTSD. The results have conceptual and clinical implications. COVID-19 continuous posttraumatic stress syndrome that includes comorbid PTSD, depression, anxiety, and executive function deficits is different and does not fit within the current trauma frameworks. There is a need for a paradigm shift in current stress and trauma frameworks to account for the COVID-19 continuous global stressors and for clinical innovations in intervention to help its victims.

Keywords COVID-19 traumatic stressors · Executive functions · PTSD · Depression · Anxiety

COVID-19 is continuous large-scale traumatic stressors that may continue till we achieve herd immunity. Continuous traumatic stress (CTS), a type III trauma, is the most severe traumatic stress, matched to types I and II (Kira, 2021). Type I trauma is a single traumatic event, while type II is a chain of recurrent episodes that persisted within a limited time scale and were blocked or expired. Type III, the most significant in its potentially harmful impact, is the continuous traumatic stress that can happen in various longitudinal pathways (Kira, 2021; Kira et al., 2008; Kira et al., 2013, b). CTS in COVID-19 requires continuing struggle to cope. Such continuation of distress may defy the person's coping assets. Tolerating distress would be especially difficult when the distressed person to be further exposed endlessly to the ongoing distressing stressors, escalating

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his/her vulnerabilities beyond a threshold (Goral et al., 2017; Kira, Shuwiekh, Rice, et al., 2020; Lahav, 2020). The threshold of continuous stressors tolerance is shaped primarily by the person's pattern of sensory processing. Individuals with hypersensitivity have a lower threshold, while those with hyposensitivity have a higher threshold (Dunn, 1997). Extreme sensory processing patterns are related to lower thresholds and are associated with depression (Serafini et al., 2017).

Additionally, COVID-19 is a multilayered, complex trauma with several psychological, economic, and social stressors (Kira, Shuwiekh, Rice, et al., 2020). One component of the impact of COVID-19 is the specific fears, perceived risk, phobia, and anxiety around infection and related morbidity and mortality (Ahorsu et al., 2020; Arpaci et al., 2020; Kira, Shuwiekh, Rice, et al., 2020; Lee, 2020; Pérez-Fuentes M del et al., 2020; Taylor et al., 2020; Yıldırım & Güler, 2020). Another component is the pervasive economic impact (e.g., McKibbin & Fernando, 2020). The impacts of the COVID-19 beyond fears of mortality and morbidity have become apparent amidst the slowing down of the economy with interruptions to global supply chains' production and functioning, resulting in major lays-off and loss of jobs and income, and downward mobility in the socio-economic structure (Kira, Shuwiekh, Alhuwailah, et al., 2020). The third component is the social impact of lockdown, isolation, and its impact on social relations. The COVID-19 pandemic has led, at specific points, to a complete shut-down of various activities. While the lockdown strategy was an essential step to curb the exponential rise of COVID-19 cases, the impact of lockdown was found to have a significant mental health impact with isolation, disturbing routines, and rising domestic violence (e.g., Odriozola-González et al., 2020; Rossi et al., 2020). Adding to those three significant stressors (are the potential secondary traumas of griefing the loss of loved ones to COVID-19 infection (e.g., Eisma et al., 2020). The cumulative impact of COVID-19 stressors might trigger first-episode psychosis (D'Agostino et al., 2021).

Another critical characteristic of COVID-19 trauma is it is collective and shared trauma. It is a global (pandemic) and still an uncontrollable virus. Studies of COVID-19 traumatic stressors have documented its severe impact on PTSD, depression, and anxiety worldwide. For different meta-analyses, see Bueno-Notivol et al., 2021; Cooke et al., 2020; Krishnamoorthy et al., 2020; Luo et al., 2020; Salari et al., 2020; Salehi et al., 2021; Vindegaard & Benros, 2020; Wu et al., 2020; Xiong et al., 2020; (see also Liu et al., 2020 for its effects in the USA, and Shuwiekh et al., 2020, for its differential effects in Arab countries).

Additionally, COVID-19 infection was associated with neurocognitive disorders (Mukaetova-Ladinska et al., 2021). The effects of acute stress, in general, were found to be associated with executive function deficits (for a meta-analysis, see Shields et al., 2016). It was found that the effects of acute stressors (traumatic stressors) on executive functions are mostly indirect via their adverse effects on mental health; only the most severe traumatic stressors such as discrimination and attachment disruptions have direct and indirect negative effects on executive function (Kira, Shuwiekh, Al-Huwailah, et al., 2020). A recent study documented the direct (and indirect) impact of COVID-19 traumatic stress as severe trauma on executive function deficits (Kira et al., 2021).

The impact of this disabling pandemic on minorities and immigrants (e.g., Rothman et al., 2020; Serafini et al., 2021) and on general practitioners working in the frontline with infected Covid-19 patients is well documented (Amerio et al., 2020). Importantly, there is an urgent need to provide adequate mental health care for the victims of COVID-19 severe and continuous stressors at the community-level. There is a clinical challenge of providing adequate mental health interventions to this new continuous trauma type.

The studies of the effects of COVID-19 traumatic stress on the Turkish population have been provided evidence of its detrimental impacts on the mental health of Turkish populations (e.g., Hacimusalar et al., 2020; Morgul et al., 2020; Özdin & Bayrak Özdin, 2020; Şahin et al., 2020; Satici et al., 2020; Yıldırım & Güler, 2020). However, most studies of the impact of COVID-19 on Turkey, and in general, did not measure the COVID-19 stressors directly (the independent variable) and did not control the effects of previous stressors and traumas the individual had been previously encountered. Further, most of the studies did not evaluate its impact on cognitive functioning.

The current study aims to examine the effects of COVID-19 traumatic stressors on mental health and executive functions in a Turkish population as a case example, after controlling for the previous stressors and traumas the individual encounters before exposure to COVID-19 stressors. Specifically, we need to know the effects of d COVID-19 stressors and their specific different and cumulative components effects on mental health as represented by measures of PTSD, depression, and anxiety and on cognitive functioning as represented by executive functions measures, after controlling for previous cumulative stressors and traumas and potential infection by COVID-19 virus.

Hypothesis 1: COVID-19 cumulative stressors and their different subtypes (COVID-19 fears, COVID-19 economic trauma, COVID-19 lockdown/ isolation, and disturbed routines) will be significant unique predictors of PTSD, depression, and anxiety after entering (Controlling for) previous cumulative life stressors and traumas and COVID-19 infection.

Hypothesis 2: COVID-19 traumatic stressors had direct and indirect (mediated) effects on working memory deficits, inhibition deficits, PTSD, depression, and anxiety.

Participants Age ranged from 18 to 73 (Mean = 28.25, SD = 10.35), with 70.6% males. For work, 51.9% students,15.3%

work with the government, 17.6% work in the private sector, 13.7% unemployed, and 1.5% retired. For marital status, 23.7% were married, 74.8% single, 1.1% were divorced, and .4% were widowed. For socioeconomic status (SES), 3.4% indicated that they belong to very low SES, 9.2% reported they belong to low SES, 75.2% to middle SES, while 11.8% reported belonging to high SES, and .4% to a very high SES. For religion, 88.9% were Muslims, and 11.1% reported other religions. For education, 1.1% of the participants have read and write proficiency, 13% have an intermediate level of education, 79.4% have college or university education, and 6.5% have graduate degrees.

Procedures We conducted this cross-sectional study from 2 October to 13 November 2020. We collected the data from 262 Turkish-speaking participants via a web-based self-report survey (Google Forms®). We used the snowball recruiting method to increase participation through social media (e.g., Facebook) and e-mail lists, mostly from North Cyprus Island, Mersin, and Adana's cities inTurkey. Participants were asked to complete a set of measures in the survey. Before filling the survey, we gave information about the study's purpose, and they have had to sign the online informed consent if they opted to participate. Inclusion criteria for participation in the study were: (a) being older than 18 years (b) being literate enough to take and access the online survey, and (c) the consent to participate. We did not provide a reward or incentive for participation. The Ethics Committee of the sponsored University approved the study.

Measures

COVID-19 traumatic stressors scale (Kira, Shuwiekh, Rice, et al., 2020): COVID-19 traumatic stress scale is a 12-item scale including three subscales (1) "threat/fear of the present and future infection and death" (5 items), (2)"traumatic economic stress" (4 items), and (3)"isolation and disturbed routines" (3 items). Items are scored on 5 points scale, with (1) indicating not at all and (5) very much. Examples of items include, "How concerned are you that you will be infected with the coronavirus?" "The Coronavirus (COVID-19) has impacted me negatively from a financial point of view." "Over the past two weeks, I have felt socially isolated as a result of the coronavirus." In the initial study (Kira, Shuwiekh, Kucharska, et al., 2020), the scale showed good construct convergent-divergent and predictive validity. In the current study, the scale had an alpha of .93. Its three Subscales had Cronbach alpha of .91, .83, and .88, respectively.

The Adult Executive Functioning Inventory (ADEXI; Holst & Thorell, 2018) was used to investigate executive functioning deficits. The ADEXI is a 14-item scale that measures working memory deficits (9 items) (e.g., "I have difficulty remembering lengthy instructions" and inhibition deficits (5 items) (e.g., "I tend to do things without first thinking about what could happen"). The participant is asked to rate the statement on a scale from 1 to 5, with "1" indicates that it is definitely not true, and "5" indicates it is definitely true. A higher score indicates higher deficits and a lower score indicates lower deficits. The ADEXI was explicitly developed to investigate deficits in working memory and inhibition and address the limitations of other rating instruments of executive functioning that often include items overlapped with ADHD symptom levels. This instrument has proven to discriminate well between adults with ADHD and controls (Holst & Thorell, 2018). Alpha for the total scale in current data is .87 and .80 for working memory and .70 for inhibition.

Cumulative stressors and traumas scale (CTS-S-36 items; Kira et al., 2008*)*. CST-S is based on the development-based trauma framework (DBTF) (e.g., Kira, 2001; Kira, 2019; Kira, 2021; Kira et al., 2018; Kira et al., 2019). The scale is designed to measure seven types of stressors/ traumas. Additionally, it includes three items that measure chronic and significant life stressors. The seven types of stressors/ traumas include collective identity traumas (e.g., discrimination and oppression). They include personal identity trauma (e.g., early childhood traumas such as child neglect and abuse). They include status identity/achievement trauma (e.g., failed business, fired, and drop out of school) (non-criterion A traumas). They also include survival trauma (e.g., get involved in combat, car accidents, and natural disasters). They include attachment trauma (e.g., abandonment by parents), secondary trauma (i.e., indirect trauma impact on others), and gender discrimination. The CST-S evaluates cumulative stressors and traumas concerning its mere occurrence, frequency, type, and negative and positive appraisals, and age of happening. However, in this short survey study, we used only frequency and occurrence questions. To answer each question on the scale, contributors were asked to specify their experience with an event on a 5-point Likert-type scale (0 = never; 4 = many times). The CST-S includes two overall measures for cumulative stressors and traumas' dose: occurrence, and frequency. Investigators can compute subscales for each of the stressor/trauma types. The CST-S has shown adequate internal consistency ($\alpha = .85$), and test-retest stability (.95 in 4 weeks), and predictive, convergent, and divergent validity in different studies (e.g., Kira et al., 2018; Kira et al., 2019; Kira, Barger, Shuwiekh, et al., 2020; Kira, Fawzi, & Fawzi, 2013). The measure has been translated and validated into different languages, including Arabic, Polish, Spanish, Turkish, Korean, Burmese, and Yoruba. In the present analysis, we used the cumulative stressors and trauma occurrence subscale. The current alpha of cumulative stressors and traumas occurrence is .97.

Posttraumatic Stress Disorder Checklist for DSM-5 (PCL-V; Blevins et al., 2015**).** PCL-V is a 20-item self-report

measure. Each item is scored on a five-point scale with "0," indicating "not at all" and 4 indicating "extremely." Initial research suggests that a PCL-5 cut-off score between 31 and 33 is indicative of PTSD. A provisional PTSD diagnosis can be made by treating each item rated as 2 = "Moderately" or higher as a symptom endorsed, then following the DSM-5 diagnostic rule, which requires at least: 1 B item (questions 1–5, re-experiencing), 1 C item (questions 6–7, avoidance), 2 D items (questions 8–14, Negative alterations in cognitions and mood), 2 E items (questions 15–20, hyperarousal). The Arabic version of PCL-V has been previously validated in Arabic samples (Ibrahim et al., 2018). Cronbach's alpha reliability of the scale in the current study was .95.

Generalized Anxiety Disorder-7 (GAD-7; Spitzer et al., 2006**).** GAD-7 is a 7-item self-report questionnaire that assesses general anxiety. An example of the items is "Feeling nervous, anxious, or on edge". Items are scored on a 4-point scale with (0) indicating "does not exist," and (3) indicating "nearly every day." The scores range between 0 and 21, with a cut-off point of 15, indicating severe GAD. The GAD-7 has a sensitivity of 89% and a specificity of 82%. Increasing scores on the scale have been strongly associated with multiple domains of functional impairment (Spitzer et al., 2006). The Arabic version of GAD-7 was previously validated in Arabic samples (Sawaya et al., 2016). Cronbach's alpha reliability for the scale in the current study was .91.

Patient Health Questionnaire-9 (PHQ-9; Kroenke et al., 2001) is a 9-item self-report questionnaire that objectifies the degree of depression severity. An example of the items is "Thoughts that you would be better off dead, or of hurting yourself". Items are scored on a 4-point scale with (0) indicating "does not exist," and (3) indicating "nearly every day." The scores range between 0 and 27, with a cut-off range of 15–19 indicating moderately severe depression and 20 and above indicating severe depression. The Arabic version of PhQ-9 was previously validated in Arabic samples (Sawaya et al., 2016). Cronbach's alpha reliability for the instrument in the current study was .88.

Analysis

We used Cohen's (1992, p.158) criteria and recommendations to confirm the sample size necessary to detect a medium population effect size at power = .80 for $\alpha = .05$ for the study's number of variables. The missing values were less than .05% and replaced by means. The data were analyzed utilizing IBM-SPSS 22 and AMOS 23. We conducted several hierarchical multiple regression analyses with PTSD, depression, and anxiety as dependent variables. We entered demographics as independent variables (gender, age, marital status, SES, and education) and COVID-19 infection in the first step. We added cumulative stressors and traumas and either COVID-19 traumatic stressors total score or one of its subscales (COVID-19 fears, COVID-19 economic trauma, COVID-19 isolation/ lockdown/ disturbed routines) in the second step to see the contribution of each and to control for the impact of previous cumulative stressors and traumas and COVID-19 infection that most other studies did not control.

We recoded the categorical variables into dummy variables. We tested for collinearity between variables and if the variance inflation factor (VIF) is less than 5.00 for all the models (e.g., Hair et al., 2017). Additionally, to test the model of the direct and mediated effects of COVID-19 traumatic stressors on PTSD, depression, and anxiety as mediated by working memory and inhibition deficits, we conducted a mediated path analysis. The Path model included COVID-19 traumatic stressors as an independent variable, working memory and inhibition deficits as mediating variables, and PTSD, depression, and anxiety as outcome variables. We reported direct, indirect, and total effects as standardized regression coefficients. We used a bootstrapping procedure with 10,000 bootstrap samples to examine the significance of direct, indirect (mediated effects), and total effects and 95% bias-corrected confidence intervals for each variable in the model. To simplify the presentation, we trimmed the model by eliminating the nonsignificant paths. Further, we tested alternative models to explore potentially better fitted or equally fitted models.

While path analysis can include several independent and dependent variables at the same time and identify the total direct and indirect effects, it cannot identify the mediators that contribute to the indirect effects or specifies the effect size of each mediator. For this reason, we supplemented path analysis by SPSS PROCESS macro (Hayes, 2013; Model 4) to test the COVID-19 traumatic stressors' indirect effects through the mediators and the relative strength of each (effect size and CIs). For PROCESS analysis, we utilized bootstrapping sampling ($n = 5000$) distributions to calculate the direct and indirect effects and CIs (95%) of the estimated effects.

Results

General Descriptives Thirty participants in the study reported (11.5%) that they had contracted the COVID-19 virus, and four (.05%) of them had been hospitalized. For cumulative stressors and trauma, the mean of occurrences was 7.73 with an SD of 4.90. For COVID-19 traumatic stressors, the mean was 37.25 with an SD of 9.04. For PTSD (M = 25.76, SD = 15.48), 33.2% scored at 31 or above which is the cut-off score for probable PTSD diagnosis. For the generalized anxiety disorder scale (M = 7.88, SD = 5.14), 12.6% scored at 15 or above, which is the cut-off score of severe generalized anxiety disorder. For depression (M = 9.90, SD = 5.74), 22.1% scored at or above 15, which is the cut-off score for moderate

depression, while 6.5% scored at or above 20, which is the cut-off score for severe depression. We should emphasize that all instruments used to assess anxiety, depression, and PTSD in this study are screening instruments and the high scores does not mean diagnosis.

Correlation Results *COVID-19 cumulative stressors*, in this Turkish sample, had the highest correlations with its COVID-19 fears, followed by COVID-19 related isolation (and disturbed routines) and economic stressors. It had a high correlation with generalized anxiety, depression, and PTSD. It had significant correlations with working memory deficits and inhibition deficits. *COVID-19 fears* had the highest correlations with COVID-19 relation isolation stressors, generalized anxiety, PTSD, and depression. *COVID-19 lockdown and related isolation and disturbed routines stressors* had the strongest correlations with CSTO, generalized anxiety, PTSD, and depression. It had significant correlations with working memory deficits and inhibition deficits Compared to the other two types of COVID-19 stressors (fears and economic stressors) in this Turkish sample. Table 1 detailed these relationships.

Hierarchical Multiple Regression Results

The analysis investigating the effects of the COVID-19 traumatic stressors on PTSD after entering COVID-19 infection and previous cumulative stressors and trauma occurrences (CSTO) indicated that the model accounted for ($R^2 = .305$) of the variance. While gender and SES were negative predictors, CSTO was a significant positive predictor (Beta = .16) of PTSD. However, COVID-19 traumatic stress added significant and higher variance to the model, above and beyond the impact of previous CSTO (Beta = .25). COVID-19 infection was a significant predictor of PTSD in the first step and lost its significance in the second step. Table 2 details these results.

Following the same steps for the impact of COVID-19 traumatic stressors on depression, the model accounted for ($R^2 = .301$) of the variance. While gender and education were negative predictors of depression, CSTO was a significant predictor (Beta = .22). However, COVID-19 traumatic stress added significant and higher variance to the model, above and beyond the impact of previous CSTO (Beta = .31). COVID-19 infection was not a significant predictor of depression. Table (1-S) in supplemental materials details these results.

Following the same steps for the impact of COVID-19 traumatic stressors on general anxiety, the model accounted for ($R^2 = .345$) of the variance. While gender and age were negative predictors of general anxiety, CSTO was a significant predictor (Beta = .27). However, COVID-19 traumatic stress added significant and higher variance to the model, above and beyond the impact of previous CSTO (Beta = .37). COVID-19 infection was not a significant predictor of anxiety. Table (2-S) in supplemental materials details these results.

Similar to results found for the overall COVID-19 scale, the analysis results investigate the effect of the COVID-19 threat/ fear of the present and future infection/death subscale on PTSD, after entering previous CSTO and COVID-19 infection, indicating a model accounting for ($R^2 = .290$) of the variance. While gender and SES were negative predictors of PTSD, CSTO was a predictor of PTSD (Beta = .20). Scores on the Threat/ Fear of infection/ death accounted for significant variance in predicting PTSD, above and beyond the impact of previous CST (beta = .20). COVID-19 infection was a significant predictor of PTSD in the first step and lost its significance in the second step. Table (3-S) in supplemental materials details these results.

Table 1 Zero-order correlation between the main variables

Variable	M(SD)	1	2	3	4	5	6	7	8	9	10
1.COVID-19 CTS	37.25 (9.04)	1									
2.COVID-19 Fears	15.21 (4.84)	.83***	1								
3.COVID-19 economic T	8.42 (3.40)	.65***	.26***	1							
4.COVID-19 Isolation	13.63 (3.63)	.78**	.48***	.33***	1						
5.CSTO	7.73 (4.90)	.28**	.15*	.30***	.23***	1					
6.Generalized Anxiety	7.88 (5.14)	.49***	.40***	.27***	.45***	.35***	1				
7.Depression	9.90 (5.74)	.44***	.34***	.23***	.42***	.29***	.76***	1			
8.PTSD	25.76 (15.48)	.41***	.31***	.27***	.35***	.26***	.67***	.66***	1		
9. Working memory deficits	20.93 (6.47)	.28***	.25***	.13*	.25***	.20***	.46***	.52***	.43***	1	
10. Inhibition Deficits	13.16 (4.09)	.17**	.05	.12	.24***	.17***	.42***	.51***	.52***	.67***	1

* $p < .05$, ** $p < .01$, *** $p < .001$

CSTO Cumulative stressors and traumas occurrences, *PTSD* Posttraumatic stress disorder

Table 2 Hierarchical multiple regression for the effects of COVID-19 cumulative traumatic stress on PTSD after controlling for previous CSTO and COVID-19 infection impact

	B	SE	Beta	t	Sig.	Lower Bound	Upper Bound	VIF	R^2 (change in R^2)	F for change in R^2
Model 1: Step One									.211	11.388
Gender	−9.06	1.93	−.27	−4.69	.000	−12.86	−5.25	1.032		p= .000
Age	−.13	.11	−.08	−1.18	.241	−.34	.09	1.640		
Marital Status	3.89	2.40	.12	1.616	.107	−.85	8.62	1.667		
SES	−7.26	1.46	−.28	−4.99	.000	−10.12	−4.39	1.021		
Education	1.82	1.84	.057	.990	.323	−1.80	5.44	1.050		
COVID-19 infection	3.916	1.816	.121	2.157	.032	.341	7.492	1.010		
Model 2: Step Two									.094	17.190
Gender	−7.24	1.85	−.21	−3.91	.000	−10.88	−3.59	1.079		p=.000
Age	−.14	.10	−.09	−1.35	.179	−.35	.07	1.766		
Marital Status	2.89	2.29	.09	1.27	.207	−1.61	7.39	1.713		
SES	−5.24	1.41	−.20	−3.73	.000	−8.01	−2.47	1.082		
Education	.67	1.74	.02	.39	.698	−2.74	4.09	1.062		
COVID-19 infection	2.774	1.722	.085	1.610	.109	−.619	6.166	1.010		
Cumulative Stressors and Traumas	.52	.18	.16	2.84	.005	.16	.87	1.184		
COVID-19 Traumatic Stress	.43	.09	.25	4.33	.000	.23	.62	1.214		

Results of the analyses investigating the effect of the COVID-19 economic trauma subscale on PTSD, controlling for previous CSTO, revealed a model accounting for (R^2 = .271) of the variance. Similar to previous results, while gender and SES were negative predictors of PTSD, CSTO was the strongest predictor of PTSD (Beta = .20). However, scores on the economic trauma subscale were a significant unique predictor of PTSD, accounting for variance above and beyond previous CSTO's impact (beta = .14). COVID-19 infection was a significant predictor of PTSD in the first step and lost its significance in the second step. Table (4-S) in supplemental materials details these results.

In the analysis investigating the effect of the COVID-19 disrupted routines and isolation subscale on PTSD, after entering previous cumulative stressors and trauma occurrences, the model accounted for (R^2 = .292) of the variance. While gender and SES were negative predictors of PTSD, CSTO was a predictor of PTSD (Beta = .18). However, disrupted routines and isolation subscale was the strongest predictor of PTSD above and beyond the impact of previous CSTO (beta = .22). COVID-19 infection was a significant predictor of PTSD in the first step and lost its significance in the second step. Table (5-S) in supplemental materials details these results. It seems that disrupted routines and isolation had the strongest effect size on PTSD compared to economic and fears impact in this Turkish sample. However, the cumulative effects of COVID-19 stressors are more indicative of its impact on PTSD, depression, and anxiety.

The analyses investigating the effects of COVID-19 traumatic stress three subscales on anxiety and depression showed similar results to those of PTSD. Tables 6-S-11-S, in the supplemental material detail the results of COVID-19 traumatic stress and its three subscales on depression and anxiety after entering CSTO and COVID-19 infection. In all the analyses, variance inflation factor (VIF) values indicated no collinearity presence in the data. The reversing of the steps in all analyses by entering COVID-19 traumas and cumulative stressors and traumas in the first steps before demographics did not change the results.

Path Analysis and PROCESS Mediation Results

The model fitted well with the data (Chi Square = 14.652,df = 8,p = .066,CFI = .992,RMSEA = .056). *COVID-19 traumatic stressors* had direct effects on working memory deficits, direct and indirect effects on PTSD, depression, and anxiety, and indirect effects on inhibition deficits. Its direct effect on PTSD accounted for 81% of its total effects on PTSD, while its direct effects on depression accounted for 40% of its total effects on depression. Its direct effects on generalized anxiety accounted for 30% of its total effects on generalized anxiety. Using PROCESS analysis to identify the mediators, generalized anxiety (effect size = .30, SE = .08, Z = 3.73, p = .000, LLCI = .16, ULCI = .46), depression (effect size = .18, SE = .07, Z = 2.30, p = .021, LLCI = .15, ULCI = .35) and inhibition deficits (effect size = .08, SE = .03, Z = 1.99, p = .046, LLCI = .03, ULCI = .17) were the significant mediators of the COVID-19 traumatic stressors on PTSD. Depression (effect size = .12, SE = .02, Z = 5.34, p = .000, LLCI = .08,

ULCI = .17), PTSD (effect size = .06, SE = .01, Z = 3.91, p = .000, LLCI = .04, ULCI = .09) and CSTO (effect size = .02, SE = .01, Z = 2.02, p = .043, LLCI = .01, ULCI = .02) were the significant mediators of the effects of COVID-19 traumatic stressors on generalized anxiety. COVD-19 stressors' indirect effects on inhibition deficits were mediated by their effects on working memory (effect size = .07, SE = .02, Z = 3.87, p = .000, LLCI = .04, ULCI = .11), and PTSD (effect size = .06, SE = .02, Z = 3.12, p = .002, LLCI = .03, ULCI = .09).

CSTO had direct effects on working memory deficits and direct and indirect effects on generalized anxiety. Its direct effects on generalized anxiety accounted for 71% of its total effects on generalized anxiety. It had indirect effects on inhibition deficits, depression, and PTSD. Using PROCESS analysis to identify the mediators, depression (effect size = .15, SE = .04, Z = 3.81, p = .000, LLCI = .08, ULCI = .24), PTSD (effect size = .07, SE = .02, Z = 3.34, p = .001, LLCI = .04, ULCI = .13) and COVID-19 traumatic stressors (effect size = .04, SE = .02, Z = 2.44, p = .015, LLCI = .01, ULCI = .07) were the significant mediators for the effects of CSTO on generalized anxiety. Its indirect effect on inhibition deficits is mediated by its direct effects on working memory (effect size = .09, SE = .03, Z = 2.74, p = .006, LLCI = .03, ULCI = .15), and PTSD (effect size = .07, SE = .02, Z = 2.73, p = .006, LLCI = .03, ULCI = .12).

Working memory deficits had direct effects on inhibition deficits, direct and indirect effects on depression. Its direct effects on depression accounted for 64% of its total effects on depression. It had indirect effects on PTSD and general anxiety. *Inhibition deficits* had direct effects on PTSD and indirect effects on depression and generalized anxiety. Using PROCESS analysis to identify the mediators, generalized anxiety (effect size = .21, SE = .04, Z = 5.75, p = .000, LLCI = .15, ULCI = .28) and PTSD (effect size = .07, SE = .03, Z = 2.30, p = .021, LLCI = .02, ULCI = .14) were the significant mediators of the indirect effects of working memory deficits on depression. Table 3 details direct, indirect, and total effects and 95% confidence intervals for each variable in the path model. Figure 1 delineates the direct paths between variables.

Discussion

Results of all analyses highlighted the significant impact of COVID-19 traumatic stressors on all the measured aspects of mental health (PTSD, depression, and anxiety) and cognitive functioning (working memory and inhibition) regardless of the impact of previous stressors traumas, as well as the potential impact of infection of COVID-19 virus on the individual. Focusing on the different COVID-19 stressor' types, disrupted routines, and isolation (lockdown) had the highest effect size on PTSD on this Turkish sample, compared to the other two measured components. Regardless, the cumulative effects of COVID-19 stressors are more indicative of its total impact on PTSD, depression, and anxiety, and cognitive functioning.

The relationships between different trauma types, the different outcomes of traumas (PTSD, depression, and anxiety), and cognitive functioning were long investigated in the literature. A recent study found that only severe and persistent traumas (e.g., attachment disruption and type III continuous traumas, such as gender discrimination by parent and COVID-19) directly affect executive functions. All other trauma types' negative impact on EF is indirect, via its mental health impact (e.g., PTSD, depression, and anxiety) (Kira et al., 2020, b, c, d, e, f; Kira et al., 2021). The impact of PTSD, depression, and anxiety on cognition and executive functions is well-documented (Esterman et al., 2019; Liu et al., 2019; for reviews and meta-analyses for PTSD see Woon et al., 2017; see also, Aupperle et al., 2012; Li et al., 2019; Quinones et al., 2020; for depression see McDermott & Ebmeier, 2009; see also Airaksinen et al., 2004; for anxiety see Gulpers et al., 2016; Moran, 2016; Shi et al., 2019). Post-trauma alterations in neurocognitive functioning are likely to reflect changes in underlying brain networks predictive of PTSD, depression, and anxiety (e.g., Messina et al., 2013).

The advantage of the current study compared to previous studies is that it separated the COVID-19 stressors and measured them as independent variables from the stress/ distress the COVID-19 caused. Some other studies confused the stressors (independent variables) with the stress (outcome) of COVID-19. Another advantage of the current study is that we controlled for previous cumulative stressors and trauma, then we can know the unique impact and effect size of different COVID-19 stressors and their cumulative direct and indirect effects. Additionally, our study is probably the first study that included the cognitive component (executive functions) of the impact of COVID-19 as part of the post-COVID-19 traumatic stress disorder syndrome.

Current research has significant conceptual and clinical implications. Conceptually, our stress and trauma platforms do not have to be disconnected from the realities of the phenomena we live in and study. We argue that the dominant mainstream trauma platforms do not probably fit the realities of the COVID-19 phenomenon, and there is a need to correct and expand our perspectives to appreciate the realities of its traumatic experiences that are continuous and complex. COVID-19 pandemic eluded the dominant stress and trauma platforms that only focus on past single traumas. COVID-19 traumatic stress is one form of type III continuous traumatic stressors identified in the literature (Kira, 2021) that does not fit the formula of PTSD-V criterion "A," which mainly focuses on past single trauma types. New frameworks and paradigms for traumatic stress that fit better the realities of the phenomena of

Table 3 The direct, indirect and total effects and 95% confidence intervals for each variable in the model

Causal variables	Endogenous variables				
	Working memory deficit	Inhibition deficit	PTSD	Depression	Generalized anxiety
COVID-19 Traumatic Stressors					
Direct Effects	.24** (.14/.34)	_____	.33* (.25/.41)	.17** (.05/.28)	.14*** (.08/.25)
Indirect Effects	_____	.16** (.09/.23)	.08*** (.04/.12)	.26*** (.19/.34)	.32* (.23/.39)
Total Effects	.24** (.14/.34)	.16** (.09/.23)	.41** (.32/.48)	.43* (.31/.53)	.46** (.37/.55
Cumulative Stressors and Traumas					
Direct Effects	13* (.01/.25)	_____	_____	_____	.10* (.02/.17)
Indirect Effects	_____	.08* (.01/.17)	.04* (.01/.09)	.05* (.01/.13)	.04* (.00/.09)
Total Effects	.13* (.01/.25)	.08* (.01/.17)	.04* (.01/.09)	.05* (.01/.13)	.14** (.05/.23)
Working Memory Deficits					
Direct Effects	_____	67*** (.59/.74)	_____	.27** (.18/.34)	_____
Indirect Effects	_____	_____	.31*** (.23/.41)	.15*** (.11/.22)	29*** (.23/.37)
Total Effects	_____	.67*** (.59/.74)	.31*** (.23/.41)	.42*** (.34/51)	.29*** (.23/.37)
Inhibition Deficits					
Direct Effects	_____	_____	.47** (.35/.56)	_____	_____
Indirect Effects	_____	_____	_____	.22*** (.17/.39)	.23** (.17/.30)
Total Effects	_____	_____	.47** (.35/.56)	.22*** (.17/.39)	.23** (.17/.30)
PTSD					
Direct Effects	_____	_____	_____	.48** (.47/.61)	.26* (.16/.34)
Indirect Effects	_____	_____	_____	_____	..24*** (.17/.33)
Total Effects	_____	_____	_____	.48** (.47/.61)	.50** (.43/.58)
Depression					
Direct Effects	_____	_____	_____	_____	.51** (.42/.60)
Indirect Effects	_____	_____	_____	_____	_____
Total Effects	_____	_____	_____	_____	.51** (.42/.60)
Squared R	.093	.442	380	.526	.653

* $p < .05$, ** $p < .01$, *** $p < .001$

real-life stressors need to be developed in an enhanced stressors and traumas platform. That makes us venture to propose the construct of post-COVID-19 traumatic stress disorder syndrome, which combines complex comorbidity of PTSD, depression, anxiety, and executive function deficits in addition to other neuropsychiatric symptoms generated by potential COVID-19 infection (e.g., Dinakaran et al., 2020; Nalleballe et al., 2020; van Vuren et al., 2021) or other symptoms that need to be explored in future studies. Taylor et al., 2020, proposed the concept of COVID stress syndrome, observing the unique picture of COVID-19 impact. Post-COVID-19 traumatic stress disorder syndrome is more complicated than one diagnostic category or only mental health dimension, including comorbid PTSD, depression, anxiety, and executive function deficits.

Clinically, the results highlighted the profound negative effect of COVID-19 stressors, especially lockdown-related stressors, and COVID-19 stressors cumulative impact. Current trauma-focused interventions designed for discrete type I or type II traumas may not be adequate in helping victims of type III continuous traumatic stressors, such as COVID-19. Such need is significant, especially for groups that previous studies found are most affected, such as COVID-19 health care workers and professionals, minorities, and refugees groups (Sahebi et al., 2021; Booth et al., 2021). There is a need for clinical prevention and intervention innovations to help COVID-19 victims who suffer COVID-19 continuous traumatic stress. Some suggested augmenting the cognitive and exposure approaches by adding pre-cognitive meta-motivational factors such as stimulating the "will-to exist-live and survive" (WTELS) (Kira, Özcan, Shuwiekh, et al., 2020; Kira, Shuwiekh, Kucharska, et al., 2020). Others tried to develop continuous trauma-focused interventions (e.g., Kira et al., 2015; Murray et al., 2013). A multi-systemic perspective may be appropriate to deal with such complex traumas that affect multiple systems (e.g., Bell et al., 2021).

Also, the current study indicated that any treatment program for COVID-19 stressors victims should include a cognitive training component considering the direct adverse effects

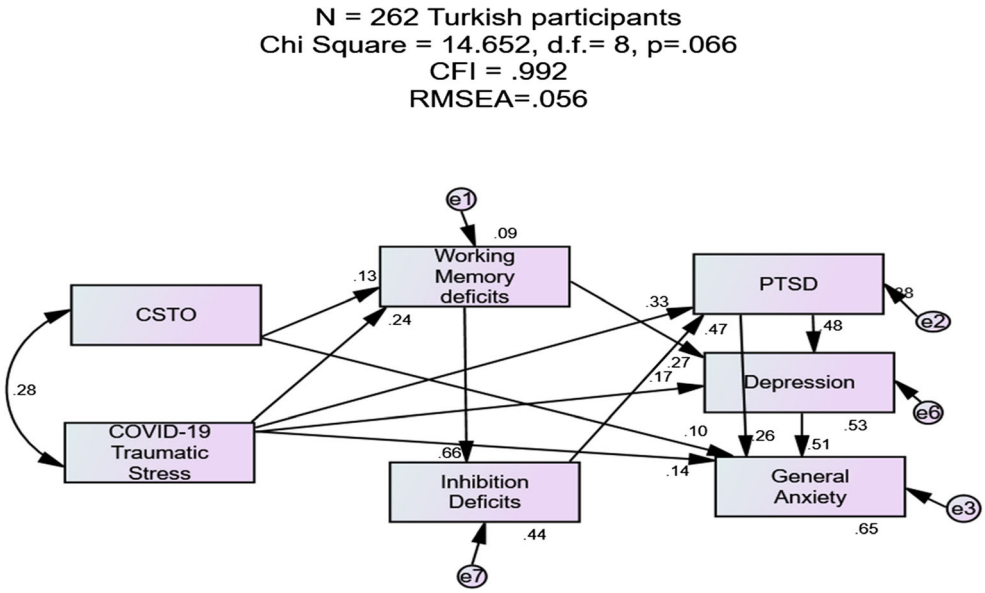

Fig. 1 Path Model for the direct effects of COVID-19 on mental health (PTSD, depression, and general anxiety mediated by working memory and inhibition deficits

of COVID-19 stressors on executive function. Cognitive training can be one of the keys to their mental health (e.g., Dias et al., 2017). Cognitive training should be part of the standard treatment protocol for treating COVID-19 survivors and maybe an essential part of PTSD, depression, and anxiety treatment. Targeting executive functions (inhibition and working memory) through cognitive training can facilitate cognitive, emotional, and behavioral change which proved to be effective (e.g., Takacs & Kassai, 2019).

Also, one of the critical factors that determine the person's coping response to cumulative, continuous stressors is his/her threshold of stress tolerance. The threshold of cumulative stressors tolerance is determined, at least in part, by the person's pattern of sensory processing. Sensory processing refers to the person's ability to register and modulate sensory information and organize its input to respond to situational demands (Miller et al., 2007). Extreme sensory processing patterns include hyper, and hyposensitivity to non-aversive stimuli (Miller et al., 2007). Individuals with hypersensitivity have a lower neurological threshold, while those with hyposensitivity have a higher neurological threshold (Dunn, 1997). Serafini et al., 2017 found that extreme sensory processing patterns, which is associated with lower neurological threshold, show a complex association with depression, impulsivity, alexithymia, and hopelessness. Interventions that help modulate extreme sensory patterns may help modulate the threshold of cumulative and continuous stressors and trauma tolerance such as those of COVID-19 and other cumulative and continuous stressors. Sensory modulation interventions used with special populations, children, and adults (e.g., Adams-Leask et al., 2018; Fisher & Brown, 2017; Machingura et al., 2018), needs to be developed for victims of cumulative and continuous stressors, which may help increase their resilience and tolerance to cumulative stressors.

The current study has several limitations. One of the limitations is that the study was conducted in convenient samples with limited and biased representation. Another limitation is that the measures used are based on participants' self-reports, which are subject to under-or over-reporting due to social desirability. Further, the scale used to assess executive functioning is a self-reported questionnaire of perceived impairments in specific domains that map onto possible executive function deficits. The ADEXI (the measure we used) has been tested and validated mainly in research aiming to distinguish between adults with ADHD / residual ADHD and "normals"; which may be different from the current study's context. Future studies may replicate the results using neuropsychological tests of executive functions. Another limitation is that the study utilized a cross-sectional design which is limited in its scope. Future studies can use longitudinal designs to reach accurate cause and effect estimations. Further, we have to caution that we talk about statistical probabilistic stochastic terms used in PROCESS analysis that do not mean the same thing in deterministic sciences of cause and effect when we talk about direct and indirect effects. Regardless of the limitations, current research provided compelling evidence of the severe significant impact of COVID-19 traumatic stressors on increased PTSD, depression, anxiety symptoms, and directly and indirectly negatively impacting executive functions, and questioned the adequacy of the current stressors and trauma frameworks.

Conclusive Remarks COVID-19 traumatic stressors are continuous type III traumas and significantly impact all the measured aspects of mental health (PTSD, depression, and anxiety) and cognitive functioning (working memory and inhibition). We argue that the dominant mainstream trauma platforms represented by Criterion "A" for PTSD, which mainly

focuses on past single trauma types, do not probably fit the realities of the COVID-19 stressors, which is a new trauma type. There is a need to correct and expand our perspectives to include traumatic experiences that are continuous and complex. That makes us further argue for the new conceptual construct of post-COVID-19 traumatic stress disorder syndrome, which combines complex comorbidity of PTSD, depression, anxiety, and executive function deficits in addition to other neuropsychiatric symptoms generated by potential COVID-19 infection. Current trauma-focused interventions designed for discrete type I or type II traumas may not be adequate in helping victims of type III continuous traumatic stressors, such as COVID-19. There is a need for clinical innovations to help deal with such trauma types beyond current clinical frameworks.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s12144-021-01743-2.

Data Availability The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval All procedures performed in studies involving human participants were following the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

Disclosure Statement There is no conflict of interest to disclose.

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