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PERCEIVED STRESS AND PSYCHOLOGICAL RESILIENCE: THE SERIAL MEDIATION OF COGNITIVE CONTROL AND COGNITIVE FLEXIBILITY

Seda Donat Bacıoğlu[1], Oya Onat Kocabıyık[2]

[1] Department of Educational Sciences, Faculty of Education, Trakya University
[2] Department of Psychology, Faculty of Literature, Namık Kemal University

The present study aims to investigate the mediator role of cognitive control and cognitive flexibility in the relationship between university students' perceived stress and their psychological resilience during COVID-19 pandemic. The sample consisted of 405 university students. The findings showed that perceived stress indirectly via cognitive control and cognitive flexibility effects psychological resilience of university students during pandemic. Cognitive control and cognitive flexibility mediates the relationship. The negative effect of perceived stress on cognitive control and cognitive flexibility caused a decrease in students' psychological resilience. The cognitive flexibility has a positive effect on university students' psychological resilience. Interventions and techniques for stress management can support cognitive control and cognitive flexibility of young people under high stress, this may contribute to increasing psychological resilience of them. Implications for intervention are discussed.

Keywords: perceived stress; psychological resilience; cognitive control; cognitive flexibility

In the COVID-19 pandemic, which has affected the lives of all individuals globally, especially young university students' mental health was at risk

SEDA DONAT BACIOĞLU, http://orcid.org/0000-0001-9901-0601; OYA ONAT KOCABIYIK, http://orcid.org/0000-0003-0449-2893. Correspondence concerning this article should be addressed to Seda Donat Bacıoğlu, Trakya University Education Faculty, Ismail Hakkı Tonguç Yerleşkesi 22030 Edirne, Turkey; e-mail: sedadonatbacioglu@trakya.edu.tr.

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due to the experiences such as social isolation, quarantine, and distance education. Disrupted daily life routines such as eating and drinking, sleeping, and physical movement had a negative effect on youths' physical and psychological health (Gracia et al., 2021). The consequences of the pandemic for academic life were that distance education increased burnout in students and class participation decreased (Chen et al., 2020), while the postponement of graduations and the loss of internship and job opportunities increased stress (Aucejo et al., 2020; Byrnes et al., 2020).

From a developmental perspective, young people are generally more flexible and adaptable in accepting new situations and changes (Cheng et al., 2014). However, studies conducted during the quarantine period reveal that young people's perceived stress levels were high (Furstova et al., 2022), while their psychological resilience levels were lower than normative data (Killgore et al., 2020).

Resilience studies conducted among young people before the pandemic show that active coping with stress (doing something to get out of the situation) and positive reframing (seeking the positive and favourable side to the situation) is positively associated with resilience (Morán et al., 2010). On the other hand, prior studies on extreme stress caused by diseases similar to COVID-19 also argued that building resilience in such situations is more complex than in less stressful conditions (Luthar et al., 2000). In this case, in the relationship between perceived stress and resilience, it is essential to identify mediating factors, such as cognitive control and cognitive flexibility, which help explain why perceived stress is related to resilience. Mediating factors clarify the underlying mechanisms through which perceived stress impacts resilience, indicating that these factors link stress to resilience. In contrast, moderating factors influence the strength or direction of this relationship rather than explaining how or why it occurs. Focusing on cognitive control and flexibility as mediators, we aim to understand the specific cognitive processes through which perceived stress affects psychological resilience.

Perceived Stress During the Pandemic

Stress has always been the focus of attention in the research because, at some point in life, every person faces stress. Beyond the approaches that define stress as a physiological response and stimulus to environmental stimuli (Holmes & Rahe, 1967; Selye, 1976), Lazarus defined stress as

"a particular relationship between the person and the environment that the person appraises as being taxing or exceeding his or her resources and endangering his or her well-being" (Lazarus & Folkman, 1984, p. 19). This appraisal-based understanding of stress has been further expanded by theories that explore its effects on cognitive functioning and resilience.

Eysenck's theory of anxiety and cognitive performance provides a framework for understanding how stress impacts cognitive capacities and, consequently, resilience. According to Eysenck et al. (2007), stress and anxiety deplete cognitive resources such as attention, problem-solving, and decision-making capabilities by increasing the cognitive load. When cognitive resources are strained, individuals are less able to maintain resilience, as their ability to adapt to and manage stressors becomes compromised. For instance, individuals experiencing high levels of stress often struggle with cognitive control and flexibility, essential functions for psychological resilience (Schmeichel & Tang, 2015). From this point, perceived stress can impair resilience by overloading cognitive systems critical for effective coping and adaptation. As a result, resilience is less likely to influence perceived stress levels. Still, perceived stress negatively impacts resilience by reducing the individual's ability to maintain cognitive control and flexibility. Studies by Killgore et al. (2020) and Chu et al. (2022) provide empirical evidence supporting this directionality, highlighting that individuals under high perceived stress tend to show decreased resilience and impaired cognitive functioning.

In addition, during the COVID-19 pandemic, individuals have been exposed to long-lasting, high-level, and life-changing stressors (Tedeschi et al., 2018). Due to the contagious and deadly effects of COVID-19, the declaration of a pandemic was perceived as a threat (Attema et al., 2021). People continuously reappraised the nature of the stressor and the resources available to respond to it (Chu et al., 2022). From this point, the first studies of the pandemic show that individuals' stress levels were high (Mazza et al., 2020; Wand et al., 2020). Some findings show that exposure to high levels of stress was associated with various negative outcomes, such as insomnia, alcohol abuse, depression and anxiety, increased loneliness, and suicidal ideation (Reger et al., 2020; Serafini et al., 2020). Studies evaluating the perceived stress levels of university students also have remarkable findings. For example, perceived stress levels of about 41% in Spain (Rodríguez-Rey et al., 2020), 25% in China (Cao et al., 2020), and 28% in Ethiopia (Simegn et al., 2021) were recorded in students.

Perceived Stress and Psychological Resilience During the Pandemic

The fact that some people cope with stressful experiences better than expected, given the nature of adversity, is the essence of the concept of resilience (Parsons et al., 2016). There are different approaches to understanding resilience, but in this study, resilience is considered as resistance to illness, adaptation, thriving, and the ability to bounce back or recover (Smith et al., 2008). According to Fletcher and Sarkar (2013), resilience modulates how an event is evaluated, and based on this evaluation, different coping strategies are engaged to manage the stress. Findings of studies examining the relationship between perceived stress and resilience during the pandemic period reveal a negative relationship (Li et al., 2021; Manomenidis et al., 2019). For example, in a study involving healthcare professionals, nurses' perceived stress levels were found to be high, while their psychological resilience and stress management levels were found to be low (Croghan et al., 2021).

Contrary to studies showing an increase in mental health problems, there are also studies demonstrating that many individuals could adequately cope with COVID-19 pandemic stressors (Bendau et al., 2020; Gonzalez-Sanguino et al., 2020). Morales-Vives et al. (2020) demonstrated that people who were best adapted to quarantine exhibited higher levels of resilience and successful coping. A few cross-sectional studies conducted with university students report that online social networks (Sarmiento et al., 2021), family harmony (Chen & Bonanno, 2021), sense of humor (Bonanno, 2021), good communication in online education (Apolloni et al., 2021), keeping regular routines (Browning et al., 2021), and limiting screen time (Padrón et al., 2021) increased resilience and facilitated coping. These results suggest that resilience played a critical role in managing the perceived stressful situation in the early stage of the pandemic.

The Mediating Role of Cognitive Control and Cognitive Flexibility

Cognitive control and flexibilty, which come into play to make cognitive evaluations during stress, are supported by the prefrontal cortex (Diamond, 2014). Cognitive control directs the attention to relevant information by rejecting that which is irrelevant to the situation (or goal). For example, in a stressful situation, it allows one to focus on information about the threat and information that helps to eliminate the stress. And, cognitive control allows the reframing of negatively evaluated stressful events and facilitates

the downregulation of negative affect through cognitive reevaluation (Schmeichel & Tang, 2015).

Cognitive flexibility is widely accepted as a basic function of cognitive control (Diamond, 2013). It is a person's ability to regulate her cognitive processes in order to adapt to new and unexpected conditions (Canas et al., 2006). The ability to focus on information, eliminate unnecessary information, and shift the attention flexibly between multiple sources of information serves an adaptive function in coping with stress (Gabrys et al., 2018).

There are limited studies on the adaptive function of cognitive control and flexibility during the pandemic. For example, one study found that cognitively flexible people adapted more effectively in order to meet their social needs in new ways during the pandemic, and that as a result they complied more with social distancing rules (Seiter & Curran, 2021). Cognitive control and cognitive flexibility were found to be negatively associated with COVID-19 risk perception (Afshari et al., 2021). Khoo et al. (2021) studied undergraduate students in Singapore and found that better cognitive control predicted lower COVID-19 stress.

Adapting to the restrictive and isolating conditions of the pandemic requires cognitive reframing. When the perspective changes, individuals may reappraise stressful situations, negative experiences or negative emotions and may be less prone to harm (Cheng et al., 2014). On the other hand, cognitive control that is not accompanied by cognitive flexibility may impair ruminative coping and mental health (Lackner et al., 2015). For example, in China, a group of young participants with suicidal ideation reported more negative perceptions about the pandemic than those who did not have this ideation (Zhu et al., 2021). The results of a study examining insomnia and related psychological factors in Italy revealed an association between low cognitive flexibility and severe insomnia (Bacaro et al., 2020). Another study findings found the cognitive flexibility reduced stress-related intake of high-fat food (Sadler et al., 2021). Cognitive flexibility can be discriminatory in coping with stress (Cheng et al., 2014).

The Present Study

The COVID-19 pandemic was a challenging and stressful process in itself, and its effects are still evident. Based on prior research in the field of perceived stress, resilience and cognitive control/flexibility, the present

study had three main aims. Firstly, this study was conducted during the pandemic period. The results of this study will contribute to the literature in terms of how we respond to stress in the face of challenging and stressful events or situations in the future. Secondly, this study analyzed the mediating effect of cognitive control and cognitive flexibility on the relationship between perceived stress and resilience, which will fill the gap in previous research. Thirdly and lastly, during the COVID-19 pandemic, young people were the most vulnerable groups; they had the most difficulty in coping with stress (Aslan et al., 2020). The findings of the current study can encourage the use of strategies that expand young people's adaptive capacity for information processing and flexibility in coping with stress. For this purpose, the following hypotheses were formed:

H1. Cognitive control mediates the relationship between perceived stress and psychological resilience.

H2. Cognitive flexibility mediates the relationship between perceived stress and psychological resilience.

H3. Cognitive control and cognitive flexibility serially mediate the relationship between perceived stress and psychological resilience.

METHOD

Participants

The participant group of this study consisted of 405 university students aged 18–40. The mean age of the participants was 21.79 ($SD = 2.46$; 72.1% were women and 27.9% were men). Most of them were undergraduate students (97%), with 91% studying at a four-year faculty, 7% studying at college and 2% at vocational school.

Data Collection Tools

The Perceived Stress Scale (PSS) was developed by Cohen et al. (1983) to measure people's subjective perceived stress and was adapted into Turkish by Eskin et al. (2013), who conducted the validity and reliability study. The scale, which consists of 14 items in total, is a 5-point Likert type scale

(from 0 = *never* to 4 = *very often*). The scale scores range from 0 to 54, and a high score indicates that the person has a high perception of stress. In the adaptation study of the scale for Turkish, the Cronbach's alpha internal consistency coefficient was calculated as .84. The internal consistency coefficients of the Turkish versions of the PSS were .84 and the test-retest reliability coefficients of the three versions were .87. In this study, the Cronbach's alpha internal consistency coefficient calculated for reliability was .81 for the overall scale.

The Brief Resilience Scale (BRS) was developed by Smith et al. (2008) to measure psychological resilience in individuals. The Turkish adaptation of the scale was carried out by Doğan (2015). The scale, which consists of 6 items in total, is a 5-point Likert type scale (from 1 = *strongly disagree* to 5 = *strongly agree*). To determine the construct validity of the scale, exploratory factor analysis was performed for 4 different sample groups, and it was determined that the scale had a single factor structure that explained 57% to 67% of the total variance. The internal consistency reliability coefficients of the scale were found to range between .80 and .91, while the test-retest reliability coefficient ranged between .62 and .69. In this study, the Cronbach's alpha internal consistency coefficient calculated for reliability was .84.

The Cognitive Control and Flexibility Questionnaire (CCFQ) was developed by Gabrys et al. (2018) and adapted into Turkish by Demirtaş (2019). The scale aims to measure an individual's ability to control intrusive and unwanted (negative) thoughts and emotions, and to cope flexibly with a stressful situation. It is a 7-point Likert-type scale (from 1 = *strongly disagree* to 7 = *strongly agree*) consisting of 18 items in total. In the Turkish adaptation study of the scale, following CFA, the fit index values were reported as $\chi^2/df = 2.63$, RMSEA = .08, CFI = .96, IFI = .96. The reliability of the CCFQ was assessed using Cronbach's alpha coefficients. For the Cognitive Flexibility Scale, the internal consistency was 0.83, and for the Cognitive Control Scale it was 0.84.

Procedure and Preparing the Data for Analysis

The research data were collected through an online survey in the spring semester of the 2021 year. Participants read and approved the informed consent form before being included in the study. An ethics committee approval for the study was obtained from the university where the researchers worked.

The data analysis was carried out in several steps. Firstly, the data set was evaluated regarding certain requirements such as outliers, missing values, and normality assumptions (Byrne, 2010; Hayes, 2018). Univariate outliers were examined with standard z-scores and box plots, while multivariate outliers were examined with Mahalanobis distance values. The normality assumption regarding the research variables was evaluated using histogram analysis and skewness and kurtosis coefficients. Accordingly, skewness/kurtosis coefficients in the range of +2 to –2 were considered to indicate a normal distribution (George & Mallery, 2010). Based on this evaluation, we identified and excluded 12 participants whose responses were classified as univariate outliers before proceeding with the analysis. Secondly, descriptive statistics related to the research variables are presented in the study. Accordingly, the bilateral relationships and the mean and standard deviation values related to the research variables are presented. Thirdly and lastly, a serial multiple mediation analysis was conducted. The research model consisted of the PROCESS Model 6 proposed by Hayes (2018). Data analysis was performed with the SPSS PROCESS Macro. The serial multiple mediation model allows both parallel and serial multiple mediation analysis to be performed (Hayes, 2018).

A serial multiple mediation analysis was performed with the bootstrapping method as suggested by Hayes (2018). In the bootstrapping method, a significant mediation effect can be mentioned if the confidence interval for the indirect effect does not include zero (Hayes, 2018). Before proceeding to the analyses, other assumptions required by serial multiple mediation analysis were examined. Multicollinearity, variance inflation factor (VIF), tolerance, and Durbin-Watson (DW) values were examined and checked. The examinations showed that all VIF values were less than 10 and tolerance values were greater than .10. Furthermore, a DW statistic of 1.98 was obtained. When the values are evaluated together, it can be concluded that there is no problem of multicollinearity in the established mediation model. Consequently, the analyses were conducted with the data consisting of 405 participants.

RESULTS

Descriptive Statistics for the Research Variables

Descriptive statistics such as Pearson correlation results, mean, standard deviation and bilateral relationships between the variables are charted in Table 1.

Perceived stress is negatively and significantly correlated with cognitive control ($r = –.59$, $p < .05$), cognitive flexibility ($r = –.56$, $p < .05$), and psychological resilience ($r = –.57$, $p < .05$). In addition to this, cognitive control is positively and significantly correlated with cognitive flexibility ($r = .83$, $p < .05$) and psychological resilience ($r = .68$, $p < .05$), and cognitive flexibility is positively and significantly correlated with psychological resilience ($r = .63$, $p < .05$).

Table 1

Descriptive Statistics for the Research Variables

Variable	Range	*M*	*SD*	1	2	3	4
Perceived stress (1)	16–68	44.25	8.65	–	–.59*	–.56*	–.57*
Cognitive control (2)	11–63	38.26	9.76	–	–	.83*	.68*
Cognitive flexibility (3)	14–63	39.04	9.73	–	–	–	.63*
Psychological resilience (4)	6–30	17.72	5.15	–	–	–	–

*$p < .05$

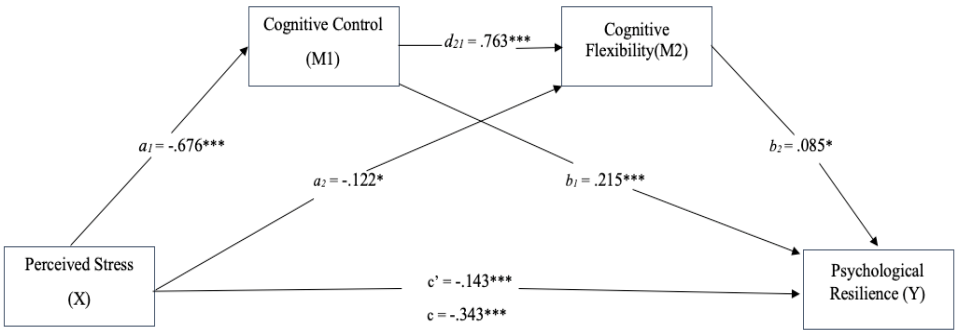
Serial Multiple Mediation Analysis

Upon meeting the assumptions required for serial multiple mediation analysis, we carried out the analyses. Figure 1 presents the serial multiple mediation of cognitive control and cognitive flexibility in the relationship between perceived stress and psychological resilience. It also shows that perceived stress is negatively and significantly associated with cognitive control ($B = –0.676$, $t = –15.03$, $p < .001$) and cognitive flexibility ($B = –0.122$, $t = –3.19$, $p < .01$). Cognitive control is positively and significantly associated with cognitive

flexibility (B = 0.763, t = 22.38, p < .001) and psychological resilience (B = 0.215, t = 6.30, p < .001). Furthermore, cognitive flexibility is positively and significantly associated with psychological resilience (B = 0.085, t = 2.56, p < .05).

Figure 1

Serial Multiple Mediation Findings



Note. The values shown are non-standardized coefficients; c = total effect, c' = direct effect.

*p < .01, ***p < .001.

Table 2 presents the indirect effects of perceived stress on psychological resilience through the mediating variables of cognitive control and cognitive flexibility. The total effect of perceived stress on psychological resilience was significant, B = –0.34, 95% CI [–0.39, –0.29], indicating a substantial relationship between these two variables. When the direct effect was considered, perceived stress showed a significant negative association with psychological resilience, B = –0.14, 95% CI [–0.19, –0.09].

Table 2

Indirect Effect of Perceived Stress on Psychological Resilience via Serial Mediation

		95% *CI*	
Model Pathway	Coefficient	LL	UL
Total Effect	–.34	–.39	–.29
Direct Effect	–.14	–.19	–.09
Total Indirect Effect	–.19	–.24	–.15
PS→CC→CF	–.14	–.20	–.08
PS→CF→PR	–.01	–.02	–.01
PS→CC→CF→PR	–.04	–.08	–.01

Note. LL = Lower Limit, UL = Upper Limit, PS = Perceived Stress, PR = Psychological Resilience, CC = Cognitive Control, CF = Cognitive Flexibility

The analysis revealed a significant indirect effect of perceived stress on psychological resilience, B = –0.19, 95% *CI* [–0.24, –0.15]. More clearly, the indirect effect of perceived stress on psychological resilience through cognitive control alone was significant, B = –0.14, 95% *CI* [–0.20, –0.08], indicating that cognitive control plays a substantial mediating role. Similarly, the indirect effect through cognitive flexibility alone was also significant, B = –0.01, 95% *CI* [–0.02, –0.01]. Finally, the serial mediation pathway, involving cognitive control and cognitive flexibility, was significant, B = –0.04, 95% *CI* [–0.08, –0.01], suggesting that perceived stress impacts psychological resilience through a sequential process involving both mediators.

DISCUSSION

In this study, the mediating role of cognitive control and cognitive flexibility in the relationship between university students' perceived stress and their psychological resilience during the course of the COVID-19 pandemic was examined. The results indicated that cognitive control and cognitive flexibility had multiple mediating effects on the relationship between perceived stress and psychological resilience. It was observed that cognitive control and cognitive flexibility indirectly affected the relationship between perceived stress and psychological resilience. The negative effect of perceived stress on cognitive control and cognitive flexibility caused a decrease in students' psychological resilience.

Perceived stress may impair the individual's capacity to make cognitive evaluations during stress (Eysenck et al., 2007). Studies have shown that better cognitive control reduces COVID-19 stress (Khoo et al., 2021) and supports cognitive reappraisal and emotion regulation skills that are critical for stress regulation (Hoorelbeke et al., 2015; Schmeichel & Tang, 2015), and that better reevaluation processes are associated with lower perceived stress (Jamieson et al., 2013). Therefore, our findings suggest that cognitive control plays a mediating role in the relationship between perceived stress and psychological resilience, helping individuals better regulate stress and maintain resilience in challenging situations.

Cognitive flexibility, which is regarded as a basic function of cognitive control (Diamond, 2013), is effective in the individual's application of functional strategies in coping with stress (Uysal Cantürk, 2021). The findings of this study demonstrated that cognitive control was positively correlated with cognitive flexibility, and that cognitive flexibility increased psychological resilience in university students. Similarly, previous studies indicate that people with high cognitive flexibility have higher resilience (Arıcı Özcan et al., 2019), and reveal the benefits of cognitive flexibility in adaptive coping with stress (Cheng et al., 2014). Flexible copers are likely to employ more than one coping response, quickly measure the success of different strategies, and switch to a different response if the first one is not successful (Kato, 2012). Koç's (2020) study showed that as university students' cognitive flexibility increased, their psychological resilience increased and their attitudes towards coping with stress diversified. It has been observed that students with low perceived stress level and high cognitive flexibility related to COVID-19 exhibited more resilient behaviors in coping with the traumatic experience (Luo et al., 2022). These findings add to the empirical evidence for the mediation of cognitive flexibility in the relationship between perceived stress and psychological resilience.

Higher perceived stress is linked to lower cognitive control, which is further associated with reduced psychological resilience. Cognitive control refers to the ability to manage thoughts and behaviors, and stress weakens this ability, making it harder to adapt to challenges (Schmeichel & Tang, 2015). The findings show that as perceived stress increases, cognitive control decreases, which in turn relates to lower resilience.

On the other hand, cognitive flexibility plays a complementary role by allowing individuals to adapt their thinking and behaviors in response to changing stressors. It is crucial for coping with stress because it supports

using varied cognitive and emotional strategies when dealing with challenges. Previous studies have shown that individuals with higher Cognitive Flexibility demonstrate better emotional regulation and greater resilience when facing adversity (Martin & Rubin, 1995).

Our findings indicate that Perceived Stress is negatively associated with both Cognitive Control and Cognitive Flexibility, and these reductions, in turn, are associated with lower levels of Psychological Resilience. This aligns with the transactional model of stress (Lazarus & Folkman, 1984), which posits that evaluating stressors and coping with them are key determinants of resilience. The mediation results suggest that interventions to enhance Cognitive Control and Cognitive Flexibility could mitigate the adverse effects of perceived stress on resilience. By improving these cognitive capacities, individuals may become more resilient in the face of stress.

While our findings suggest that perceived stress influences resilience through cognitive mechanisms, it is important to consider the potential for a reciprocal relationship. In line with Lazarus and Folkman's (1984) transactional model of stress, resilience may also shape how individuals perceive and respond to stressors. Recognising a reciprocal interaction implies that resilience could act not only as an outcome but also as a dynamic factor influencing stress perception. Such an acknowledgement provides a more comprehensive understanding of the observed relationships and supports the theoretical validity of our model.

Limitations and Future Directions

This study has some limitations. Firstly, the results cannot be generalised to different age groups since the participants were undergraduate and postgraduate students. Secondly, the study was conducted online, and the scales were based on self-reports. Thirdly, as this is a cross-sectional study, the findings should be interpreted cautiously due to the study's failure to establish causal relationships. While the study provides insights into associations between perceived stress, cognitive control, cognitive flexibility, and psychological resilience, it cannot confirm the directionality or causation of these relationships. Moreover, potential confounding variables, such as individual differences in personality traits or past stress experiences, may influence the observed relationships. Future studies employing longitudinal or experimental designs are recommended to address these limitations and further explore the temporal dynamics of these variables. However, the study

sample had a higher proportion of female participants, which may have limited the generalizability of our findings across genders. To address this limitation, future research should aim to achieve balanced gender representation or examine the relationships between perceived stress, cognitive control, cognitive flexibility, and psychological resilience, specifically by gender.

CONCLUSIONS

University students are currently a group that is concerned about the deterioration of their mental health (Milojevich & Lukowski, 2016). When the lockdown was declared shortly after the pandemic broke out, universities and students were caught unprepared for many things. Inconsistent government policies and practices caused further stress. Among the future crisis management policies of universities, efforts to protect young people's mental health should be made in advance. The present study's findings can contribute to the development of stress management programs targeting cognitive control and cognitive flexibility for university students in times of crisis. By offering new experiences in the learning environment, school programmes can supply the alternative ways of thinking, to think in creative and practical ways (divergent thinking). It can be recommended that mental health professionals working in campus counseling centres include practices aimed at developing cognitive flexibility skills for helping individuals with high stress levels.

Finally, cross-cultural comparative studies can improve our ability to cope with stress at a global level. For this reason, it is recommended to conduct studies on the methods of coping with stress in university students living in different countries.

CRediT Author Statement

SEDA DONAT BACIOĞLU (60%): conceptualization, methodology, software, validation, formal analysis, resources, writing (original draft), supervision, writing (review and editing).

OYA ONAT KOCABIYIK (40%): formal analysis, resources, writing (original draft).

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