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# Cognitive reserve and coping strategies predict the level of perceived stress during COVID-19 pandemic: A cross-sectional study

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## ABSTRACT

The COVID-19 pandemic and the measures to avert contagion heavily impacted individuals' mental health. In the present cross-sectional study, we investigate the relationship between cognitive reserve, coping modalities and the perceived stress during a chronic stage of COVID-19 pandemic by online administration of three standardized questionnaires in a sample of healthy volunteers covering a large lifespan (18–85 years). We found that positive orientation to problems and higher levels of cognitive reserve were associated with lower levels of stress. Conversely, coping strategies involving negation, substance consumption, and appeal to other people and religion to face everyday life, together with higher education, were associated with higher levels of stress. These results shade light on the long-term psychological consequences of COVID-19 and call for the development of psychological interventions improving coping and cognitive reserve, to preserve and restore mental health following the pandemic.

## 1. Introduction

The COVID-19 pandemic has dramatically transformed everyday life worldwide in a short period. Governments of most countries have adopted measures (including lockdowns, quarantines, self-isolation, travel restrictions, suspended social events, and closings of schools and businesses activities) to limit the spread of SARS-Cov-2 infection (Hsiang et al., 2020). Several studies showed that such measures impacted mental health, increasing levels of stress, anxiety, and depressive symptoms (for reviews and meta-analyses: Cénat et al., 2021; Salari et al., 2020), and also exacerbated feelings of hopelessness, sadness, loneliness, and even suicidal ideation (e.g. dos Santos et al., 2021; Solano et al., 2016; Wasserman, Iosue, Wuestefeld, & Carli, 2020). In Italy, where the Government has imposed exceptional measures to face the several pandemic waves, there has been evidence of increasing levels of anxiety, anger, depressive symptoms and sleep disturbances (Maggi et al., 2021a; Salfi et al., 2020; Santangelo et al., 2021). Although the immediate psychological response to the outbreak and quarantine was widely investigated, only few studies assessed the long-term psychological consequences of COVID-19 pandemic (Maggi et al., 2021b; Roma et al., 2020). To date scarce evidence is available on the chronic stress response related to the succeeding pandemic waves. Recently, Maggi et al. (2021b) assessed the evolution of mental health

status at two months from the quarantine, showing that the psychological symptoms outlasted the quarantine; moreover, severe psychological symptoms and fear of getting infected at baseline were associated with post-traumatic stress symptoms after the end of the lockdown.

This landscape calls for the assessment of the resources able to buffer against the effects of prolonged COVID-19 on mental health. As an instance, it has been shown that resilience mediated the relationships between depressive and anger symptoms and cognitive failures during quarantine (Maggi et al., 2021b; Santangelo et al., 2021). However, no study has assessed the effect of different coping strategies to face negative events, and of cognitive reserve (CR), on prolonged stress during the pandemic.

Coping strategies shape individual differences in reacting to emotions and stressful situations (Lazarus, 1996). Several functional and dysfunctional coping strategies have been described, ranging from avoidance of the stressful situation, to positive attitude in addressing problems, and to propensity to rely on social and transcendent support (Lazarus, 1996). The concept of CR, instead, refers to a set of factors and mentally stimulating activities which develop through life, may exert a protective role in several clinical and non-clinical populations (Opdebeeck, Martyr, & Clare, 2016; Stern, 2002) and modulate onset of psychological symptoms, such as apathy (Altieri, Trojano, Gallo, & Santangelo, 2020). CR proxies include everyday stimulating social and

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leisure activities, and can be assessed by means of standardized questionnaires (Altieri et al., 2018; Kartschmit, Mikolajczyk, Schubert, & Lacruz, 2019).

The aim of the present study was to investigate the relationship of coping strategies and CR levels with the perceived stress during long-term COVID-19 pandemic, i.e. after lockdown withdrawal but during persisting everyday life restrictions. A cross-sectional study was designed targeting perceived stress, coping strategies and levels of CR in different age stages. We expected that effective coping strategies and higher levels of CR could exert a protective role on the perceived stress level. The identification of a possible protective effect of CR and of coping strategies on the perceived stress could prompt psychological interventions to promote mental health in the COVID-19 post pandemic.

## 2. Materials and method

An online cross-sectional survey was implemented using EU-Survey to assess levels of perceived stress, CR and coping strategies during the long-term period of COVID-19 pandemic and disseminated through social media (Facebook and WhatsApp) and online groups. A snowball sampling strategy was adopted to recruit participants. The survey was open from September 2021 to January 2022, i.e. in the period covering the third and fourth waves of COVID-19 pandemic in Italy. Experimental procedures were approved by the Local Ethics Committee and conformed to the principles of the Declaration of Helsinki.

The methods and the related references are reported in Appendix. In extreme synthesis, in the survey we gathered informed consent, socio-demographic data and the Italian versions of three standardized questionnaires to assess perceived stress (*Perceived Stress Scale, PSS-10*), coping modalities (*Coping Orientation to Problems Experienced, COPE\_NVI*), and CR (*Cognitive Reserve Scale, i-CRS*).

### 2.1. Analysis

We computed descriptive statistics and correlations for sociodemographic data and the PSS-10, i-CRS and COPE\_NVI scores (Table 1).

We then applied a regression model to assess the association of age (coded as: “18–35” = 1, “36–64” = 2, “65–” = 3), sex (coded as: “male” = 1, “female” = 0), education (coded as: “primary” = 1, “middle-school” = 2, “high-school” = 3, “bachelor” = 4, “master-degree” = 5), scores at the i-CRS and the COPE\_NVI subscales (continuous variables) with PSS-10 scores (dependent variable). Before applying regression analyses, we assessed PSS-10 scores for normality by checking their skewness and Kurtosis, by the Shapiro-Wilk and the Kolmogorov-Smirnov tests, and by graphical visual methods (histograms and Q-Q

**Table 1**

Count number (N) or mean and standard deviation (SD), and Spearman correlations for the study variables (n = 206). For psychological scales, also alpha values are reported.

Factor	N or mean (SD)	Alpha	1	2	3	4	5	6	7	8	9
1. Gender (M/F)	83/123	–									
2. Age range (Young/Adult/Elderly)	69/69/68	–	0.41								
3. Education (Primary/Middle/High/Bachelor/Master)	15/44/92/17/38	–	–0.08	–0.50**							
4. i-CRS	52.04 (11.75)	0.74	–0.20**	0.07	0.29**						
5. COPE_NVI-Support	30.99 (8.78)	0.91	–0.30**	0.03	0.02	0.26**					
6. COPE_NVI-Avoidance	27.03 (7.39)	0.84	0.06	0.14*	–0.15*	–0.06	0.16*				
7. COPE_NVI-Positive attitude	31.49 (5.98)	0.78	–0.03	0.14*	–0.05	0.29**	0.31**	0.15*			
8. COPE_NVI-Orientation to problem	31.69 (6.78)	0.85	–0.01	0.16*	0.06	0.43**	0.26**	–0.04	0.57**		
9. COPE_NVI-Transcendent	22.26 (6.24)	0.86	–0.20**	0.37**	–0.39**	0.10	0.17**	–0.11	0.13*	0.08	
10. PSS-10	20.87 (6.74)	0.84	–0.09	0.04	0.00	–0.16*	0.18**	0.40**	–0.04	–0.23**	0.12*

i-CRS = Cognitive Reserve Scale — Italian version; COPE\_NVI = Coping Orientation to Problems Experienced — Italian version; PSS-10 = Perceived Stress Scale.

\* p < 0.05.

\*\* p < 0.01.

plot). Moreover, we tested for multicollinearity among the predictors by variance inflation factor (VIF), with values lower than 10 meaning no multicollinearity (Kennedy, 2003). All continuous variables were standardized prior to regression analyses. The level of significance was set at 0.05. Statistical analyses were performed by IBM SPSS Statistics v. 20.

## 3. Results

The overall sample included 206 participants from 18 to 85 years (Table 1). Analysis of VIF showed no collinearity issues among the predictors (VIF ranging from 1.20 to 1.70). Although the Shapiro-Wilk (W = 0.99; p = 0.04) and the Kolmogorov-Smirnov tests (K-S = 0.06, p = 0.03) were significant, the numerical (skewness = –0.1 SE = 0.17; kurtosis = –0.32, SE = 0.34), and visual methods to check for normality of data suggested that the PSS-10 scores approximated to a normal distribution showing just a weak left-skewness, with a small excess of observations in the left tail (Mishra et al., 2019). Thus, a multiple linear regression was run on PSS scores considered as a continuous dependent variable.

The linear regression model [F(9, 196) = 9.64, p < 0.001, adjusted-R<sup>2</sup> = 0.275] showed that the scores in the PSS-10 were significantly and negatively associated with the i-CRS scores, and COPE\_NVI-Orientation to problem (Table 2); conversely, the PSS-10 scores were significantly and positively related to education, COPE\_NVI-Support, COPE\_NVI-Avoidance, and COPE\_NVI-Transcendent (Table 2).

## 4. Discussion

The present study focused on the long-term consequences of COVID-

**Table 2**

Predictors significantly associated with PSS-10 after multiple linear regression.

Dependent variable	Predictors	beta	t	p
PSS-10	Age	0.06	0.89	0.37
	Sex	–0.04	–0.57	0.57
	Education	0.21	2.64	<b>0.01</b>
	i-CRS	–0.16	–2.20	<b>0.03</b>
	COPE-Support	0.19	2.81	<b>0.01</b>
	COPE-Avoidance	0.41	6.19	<b>&lt;0.01</b>
	COPE-Positive attitude	–0.03	–0.43	0.67
	COPE-Orientation to problem	–0.24	–3.03	<b>&lt;0.01</b>
	COPE-Transcendent	0.25	3.49	<b>&lt;0.01</b>

PSS-10 = Perceived Stress Scale; i-CRS = Cognitive Reserve Scale — Italian version; COPE\_NVI = Coping Orientation to Problems Experienced — Italian version. Values of p < .05 are highlighted in bold.

19 pandemic on mental well-being following the third and fourth waves of contagions in a sample of Italian healthy individuals. The results showed that high levels of CR (i.e. engagement in mental stimulating activities during the lifespan) and positive orientation to problems were associated with lower levels of perceived stress. Conversely, education and some coping strategies – including avoidance, looking for social support, transcendence, and humour – were associated with higher levels of stress.

#### 4.1. Factors associated with lower perceived stress

We observed that lower levels of perceived stress were associated with coping strategies oriented to problem solving, in terms of focused, effective, and mindful organization when facing difficult times. This finding is in line with studies on the positive effect of problem solving in reducing psychological stress and favouring well-being (Abdollahi et al., 2018; D'Zurilla and Sheedy, 1991; Largo-Wight, Peterson, & Chen, 2005; Ostell, 1991), also during the COVID-19 pandemic (Garbóczy et al., 2021).

Importantly, we observed for the first time that high levels of CR were associated with lower levels of stress during the long-term COVID-19 period, acting as a protective factor. This finding is in line with a previous study showing that healthy individuals with high levels of lifetime CR had a low level of apathy (Altieri et al., 2020). Our study complements this finding by exploring an additional psychological dimension, i.e. the perceived stress, and by assessing this construct during a period of major psychological distress. Targeting the same period of psychological burden, Maggi et al. (2021b) and Santangelo et al. (2021) showed that resilience could mediate the relationships between depressive and anger symptoms and cognitive failures. The relationship between CR and resilience is worth to be assessed, in terms of the specific contribution of each factor against psychological distress. To date the literature considers resilience as a dispositional construct (Babic et al., 2020; Davydov, Stewart, Ritchie, & Chaudieu, 2010; Ong, Bergeman, Bisconti, & Wallace, 2006), while CR is considered as a malleable factor that may be increased through life (Stern, Barnes, Grady, Jones, & Raz, 2019). Since CR could protect against cognitive decline (Stern, 2012), interventions aimed at increasing CR might help also preventing onset of cognitive failures during the pandemic (Santangelo et al., 2021).

#### 4.2. Factors associated with higher perceived stress

In our sample, education was significantly associated with perceived stress. Generally, education is considered an important protective factor against neurological and psychosocial issues (Livingston et al., 2020; Lóvén, Fratiglioni, Glymour, Lindenberg, & Tucker-Drob, 2020; Panico et al., n.d. under review), but literature on the effect of education on mental health during the COVID-19 outbreak provided conflicting evidence (Hossain et al., 2020). Some studies highlighted that education may exert a protective role, as poorer mental health status was significantly related to being less educated (Liang et al., 2020) and higher anxiety and depression were associated with a lower education level (Lei et al., 2020). However, other studies reported that some variables associated with education, such as academic or job related demands, may negatively affect psychological well-being during COVID-19 (Wang, Di, Ye, & Wei, 2020; Zhou et al., 2020). For instance, Wang et al. (2020) showed that individuals with high education had a high risk of depression, and professionals had a higher risk of depression than industry workers. Future studies should address the variables mediating this effect. However, as discussed by Wang et al. (2020), it is possible that professionals and individuals with high education might have experienced the most effects of the restrictive measure, resulting in a long time spent working from home, differently from their habits.

Avoidant coping predicted higher levels of stress. This is in line with the literature in the military field, showing that individuals who mainly

adopt denial, procrastination, or substance use, experience high level of mental distress ranging from emotional problems (Joseph, Andrews, Williams, & Yule, 1992), to traumatic stress symptoms (Johnsen, Eid, Laberg, & Thayer, 2002). In the context of the COVID-19 pandemic, Fluharty, Bu, Steptoe, and Fancourt (2021) have shown that people with greater use of avoidant coping displayed more mental health symptoms. Taken together, our results are in keeping with previous findings and shed a light on the effect of the avoidant coping on perceived stress during the ongoing pandemic.

We also observed that a high level of stress was associated with the use of coping strategies based on seeking social support and understanding from other people. This finding seems at odd with literature showing that engaging in meaningful relationships is often associated with positive effects (Ghafari, Mirghafourvand, Rouhi, & Osouli Tabrizi, 2021; Thoits, 2011). However, we might speculate that in the specific times of COVID-19 pandemic the coping strategy based on social support may detain a detrimental effect on psychological well-being as it reckons with the limitations to entertain social contacts due to the measures for contagion prevention.

Several studies showed a beneficial effect of religion, spirituality and humour on health (Koenig, 2012) also during the COVID-19 pandemic (Walsh, 2020). Our findings are not in line with these mainstream findings and suggest that the effect of spirituality might change when facing a chronic situation, such as the COVID-19 pandemic. We might speculate that individuals keen to appeal to religion, spirituality, and humour to face life situations may have experienced frustration in response to the prolonged exposure to a hurting situation. Although speculative, this hypothesis is compatible with previous research assessing the mechanisms mediating the effects of religion and spirituality on mental health. Baetz and Toews (2009) highlighted how religion can detain both a positive or negative effect on mental health depending on people's beliefs. In this regard, Allport and Ross (1967) distinguished between an extrinsic and intrinsic orientation to religion. While the former would describe an attitude to use religion for a sense of safety, amiability, and status, the latter would define an intrinsic acceptance of the religious beliefs. Importantly, an intrinsic attitude to religion is associated with low levels of depression, whilst an extrinsic attitude to religion may exert a detrimental effect on mood. Also, James and Wells (2003) discussed the mediating effect of beliefs on the relationship between religion and mental health. Individuals with strong religion and spirituality (intrinsic religiousness) may experience a sense of significance and perceived control in periods of high perceived stress. Conversely, people with a weaker belief system (extrinsic religiousness) may not be able to face the stressful situations (Wachholtz, Pearce, & Koenig, 2007). Individuals' beliefs and dispositions about religion should be investigated to clarify the relationship between religiosity and perceived stress observed in the present study, also distinguishing religion-related from humour-based coping which were collated in a single factor in the PSS.

#### 4.3. Limitations, clinical suggestions and future directions

Although this study provided novel clues on the factors associated with perceived stress after prolonged exposure to COVID-19 pandemic, some limitations need to be acknowledged. First of all, our cross-sectional study allowed to observe associations between factors but could not provide information about causal relationships. Second, the snowball recruitment strategy adopted did not allow to balance groups on a priori basis, limiting generalization of our results. Third, the online modality prevented us from assessing cognitive abilities reliably, particularly in elderly participants, but an online survey was the only available tool to reach a large sample of individuals in a limited time. Finally, we targeted some specific aspects of psychological functioning, i.e. the relationship between stress, CR and coping strategies. Future studies might assess the impact of other important psychological features, such as resilience and affective temperament (Baldessarini et al.,

2017), on the levels of perceived stress, and how our findings could be modulated by pre-existing pathological conditions. Moreover, it is important to consider that we addressed the effect of several waves of COVID-19 infection, which might mimic the prolonged stress response described by Selye (1950). In Selye's terms we investigated the 'resistance stage', whereas many studies described the acute changes in the levels of stress during COVID-19 (Daly & Robinson, 2021; Umucu & Lee, 2020; Vannini et al., 2021). As an instance, Daly and Robinson (2021) reported a sudden increase, followed by a decline, of psychological distress during the first wave of COVID-19 infection and lockdown restrictions. This pattern mimics the 'alarm reaction stage' described by Selye (1950), when a sudden unexpected event is faced. The changes in the levels of stress in Daly and Robinson's (2021) study followed the enforcement of stay-at-home orders and their subsequent lifting, which have probably contributed to the trend. In future studies it would be worth investigating how coping strategies and CR modulate perceived stress after prolonged stressful events such as the post-traumatic stress disorder, which might lie in what Selye (1950) described as an 'exhaustion stage'.

In conclusion, the present study revealed a positive association of positive orientation to problems and of CR with perceived stress, and a negative association of the coping strategies mainly based on avoidance and appeal to others and religion during a late stage of COVID-19 pandemic. These findings may call for the development of psychological interventions to improve coping abilities and CR (Beck, 2005; D'Zurilla and Nezu, 2010; David, Cotet, Matu, Mogoase, & Stefan, 2018; Ostell, 1991; see also Panico et al., n.d. under review), and/or at reducing avoidant behavior when facing everyday problems and emotional states (Mahoney, Newby, Hobbs, Williams, & Andrews, 2017) following the COVID-19 pandemic. Individuals might be assisted also in developing a more focused and effective orientation to problems (D'Zurilla and Nezu, 2010). Moreover, healthcare services and professionals may implement electronic devices and applications to help individuals to act against psychological disturbance and harm caused by chronic ongoing of the COVID-19 pandemic and promote social support requests (Panico, Cordasco, Vogel, Trojano, & Esposito, 2020; Wang et al., 2020). Finally, clinicians might encourage their patients engaging in cognitive stimulating activities – such as reading, hobbies, internet-based learning, and regular scheduling of household chores – to strengthen CR. These interventions might reveal useful to promote mental health during and following the COVID-19 pandemic.

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## CRedit authorship contribution statement

**Francesco Panico:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Visualization, Writing – original draft. **Sharon Mara Luciano:** Conceptualization, Data curation, Formal analysis, Investigation. **Laura Sagliano:** Formal analysis, Investigation, Supervision. **Gabriella Santangelo:** Funding acquisition, Supervision, Writing – review & editing. **Luigi Trojano:** Funding acquisition, Supervision, Writing – review & editing.

## Declaration of competing interest

None.

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## Appendix A. Detailed methods

### A.1. Survey development

The survey included several sections. In the informed consent section, the participants received illustration on the general structure of the study, i.e. assessing how individuals usually manage life events and their habits during the lifespan, without providing specific cues on the study purposes and predictions. In this section participants had to provide their consent for participation, which was mandatory to load the next sections of the survey. In a second section, sociodemographic data were collected (i.e. gender, age, education). Then perceived stress, coping modalities, and CR were assessed by means of three standardized questionnaires (described below). To avoid missing data in survey fulfilment we implemented the EU-Survey feature allowing to set all answers to items as mandatory.

### A.2. Perceived Stress Scale (PSS)

Perceived stress was assessed using the short version of the PSS (PSS-10; Cohen et al., 1983; Italian translation by Fossati, 2010). The PSS-10 is one of the most used psychological tools for assessing perception of stress, providing a measure of the degree to which situations of person's life are perceived as stressful, unpredictable, uncontrollable or overloading. For each of the ten items, people are asked to indicate how often they felt in a certain way in the last month. Items are measured on a Likert scale where participants have to indicate the frequency of some feelings and thoughts (0 = never to 4 = very often). Higher scores indicate higher level of perceived stress.

### A.3. Coping Orientation to Problems Experienced (COPE)

The COPE (Carver et al., 1989) is a self-report questionnaire taking into account different coping strategies. The Italian version of the scale (COPE\_NVI, Sica et al., 2008) consists of 60 items assessing how often individuals implement particular coping strategies to face difficult or stressful situations. The COPE-NVI provides five dimensions, i.e. social support (seeking support and understanding from other people), avoidance strategies (mental and physical detachment and possible drug use), positive attitude (positive attitude towards problems), orientation to problem (programming and organization of problem solving) and transcendent (using prayer, faith and humour to address a problem). Items are scored on a Likert scale from 1 = "I don't usually do it" to 4 = "I almost always do it". The score for each subscale is obtained by the sum of the scores of the items belonging to the same subcategory.

### A.4. Cognitive Reserve Scale (CRS)

The CRS is a questionnaire evaluating multiple proxies of CR (León-Estrada et al., 2017; León et al., 2014). The Italian version of the CRS (i-CRS; Altieri et al., 2018) is a self-rated questionnaire evaluating the engagement of a person in several activities, i.e. daily activities, training or information, hobbies, and social life. The i-CRS allows to assess CR in three life stages: young adulthood (18–35 years), middle adulthood (36–64 years), and late adulthood ( $\geq 65$  years). According to their ages, participants have to complete the questionnaire once, twice or three times referring to the main activities during young adulthood, middle adulthood and late adulthood. Items are scored on a Likert scale based on the frequency each activity is performed during a week (0 = never; 4 = twice or three-time a week). The total score of the i-CRS is obtained by the sum of each items. Depending on the age of participants the scores is averaged for each of the age period. The higher the score, the higher the level of CR.

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