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Variations in mindfulness associated with the COVID-19 outbreak: Differential effects on cognitive failures, intrusive thoughts and rumination

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Abstract

The lockdown due to the coronavirus outbreak in 2019 (COVID-19) has caused psychological distress and cognitive discomfort for emerging adults, who have experienced increased rumination, intrusive thoughts and cognitive failures. States of mindfulness and being in the moment can prevent anxiety and fear associated with the lockdown and alleviate ruminative and automatic negative thinking. This longitudinal study investigated the role of mindfulness before and during the COVID-19 lockdown in protecting a sample of emerging adults from experiencing cognitive failures, intrusive thoughts and rumination and examined how lockdown-related variables—emotions, socio-economic status and housing conditions—influenced this mindfulness profile. The results showed overall more cognitive failures and rumination during lockdown, especially in participants whose mindfulness status diminished. However, these signs of cognitive distress remained stable or decreased among participants who reported improved changes in mindfulness. Financial difficulties and a reduced sense of privacy associated with the lockdown predicted lower stability in mindfulness profiles. The state of being fully aware of what is happening in the present moment may be helpful in reducing cognitive discomfort and psychological maladjustment, especially during stressful times such as lockdowns.

INTRODUCTION

The emergence of the coronavirus pandemic (COVID-19) led to a worldwide socio-economic crisis and rapidly developing psychological distress (Serafini et al., 2020). Confinement during lockdown and prohibitions on movements at leisure and in the workplace accompanied by growing feelings of vulnerability have strongly impacted the population worldwide (Zhai & Du, 2020). Many mental health issues such as growing distress, anxiety, depression and frustration have emerged since the COVID-19 outbreak (Duan & Zhu, 2020).

The escalation of new cases, alongside ineffective and anxiety-provoking information, has led people to seek protection from the risks of contagion. The avoidance of infectious diseases has its roots in the phylogenetic history of human beings. There is consistent evidence that infectious diseases have played a decisive evolutionary role in human development, leading to the idea of a *behavioural immune system* (Troisi, 2020). Together with the physiological immune system, human beings have developed a set of *proactive, emotional and cognitive responses*, which guide behaviours, such as avoiding people who seem to be infected or at risk of infection. Indeed, the best defence against the disease is adopting appropriate behaviours in line with available knowledge and applying them in daily life with perspicacity and caution. On the one hand, fear of contagion and *germ panic* (Tomes, 2000) play a role in individuals' ability to protect themselves; on the other hand, this fear can generate dysfunctional processes, maladaptive lifestyle choices and psychological side effects that undermine a sense of well-being during outbreaks (Lee, 2020).

Anxiety and psychological distress

Psychosocial responses to infectious disease outbreaks can easily turn into psychological distress such as high level and prolonged anxiety, panic and depression, as occurs, for example, with mental rumination (Khan et al., 2020; Yan et al., 2021). Mazza et al. (2020) found that effects reported in the literature on the current COVID-19 outbreak are similar to those found in earlier studies on the psychological effects of quarantines during past epidemics (SARS, H1N1, Ebola, MERS, equine flu). During and after mandatory quarantines, the psychological impact of epidemics is marked by increasing distress levels, frustrations and stigma, high levels of post-traumatic stress, and increased prevalence of depressive symptoms and the experience of social isolation (Hall et al., 2008; Philip & Cherian, 2020; Taylor et al., 2008; Zong et al., 2010).

Studies from China, where the virus appeared earlier, also highlight individual differences in psychological responses to the crisis. Psychological symptoms have been more intense in women than men and in both young people and the elderly than mature adults (Ho et al., 2020; Qiu et al., 2020; Wang et al., 2020).

del Carmen Pérez-Fuentes et al. (2020), Madani et al. (2020), Brooks et al. (2020) and Di Giuseppe et al. (2020) have all underlined how social isolation contributes to alterations in the psychological balance in adults. A significant change in daily habits has been noted with respect to rising and sleeping times, use of the Internet and hours devoted to reading. Stressful factors such as prolonged confinement, existential anxiety experienced due to the thought of being infected, frustration, boredom,

lack of contact with significant people and restrictions on personal space at home contribute to the development of a perception of threat characterized by the attribution of negative meanings to initially neutral stimuli (Brooks et al., 2020; Peteet, 2020).

Obsessive behaviours such as compulsive control and decontamination, pessimism about their health status, the over-interpretation of bodily sensations as unequivocal signals of dangerous symptoms of the disease and *over-prudential* attitudes have also been noted (Blakey & Abramowitz, 2017).

Coping capacity can also be impaired during a pandemic. A study conducted during the H1N1 outbreak by Taha et al. (2014) found emotionally focused coping strategies such as self-blame, a strong sense of guilt, rumination and resignation were positively associated with anxiety about the virus.

Anxiety, cognitive discomfort and the protective role of mindfulness thinking

As noted in the literature, the consequences of tragic events, such as an unexpected pandemic, depend on how humans cope with their anxiety (Souadka et al., 2020). As stated by Asmundson and Taylor (2020), anxiety was experienced by many people in daily life during the pandemic. Some people crowded the hospital emergency room, and others, the physician offices. On the contrary, individuals with low level of anxiety may be reluctant to comply with warnings regarding bringing the pandemic under control, denying the possibility of contagion (Choi et al., 2020). Schimmenti et al. (2020) argue that improving self-appraisal of the body, emotion and regulation, fostering attachment security, adopting an attitude of acceptance and promoting responsibility are key to addressing psychological maladjustment due to anxiety and fear of contagion.

A sudden change in habits, anxiety, worries for oneself and loved ones and economic worries associated with the epidemic inevitably change our cognitive frames of reference. The cognitive dimension has certainly attracted less attention than psychological distress. Moreover, cognitive discomfort following a period of exposure to stress—in this case, the pandemic and consequent lockdown—can lead to increased predispositions to cognitive failures in the process of everyday life (Broadbent et al., 1982; Carrigan & Barkus, 2016).

In this regard, Boals and Banks (2020) suggest that stress and anxiety impact general cognitive functioning. During the pandemic, students and colleagues of the two authors reported the difficulty they had experienced staying focused and productive. The authors also reviewed the abundant research demonstrating the negative effects of stress and anxiety on cognitive functioning (Boals & Banks, 2020). According to Boals and Banks (2012), the relationship just described is mediated by mind wandering (MW), which affects attentional and executive processes, thereby preventing access and processing of the traces in working memory needed to perform normal duties and conduct professional activities. In a similar vein, Lee (2020) conducted a study on intrusive thoughts associated with the pandemic. Dysfunctional thoughts about COVID-19 were significantly associated with anxiety about the virus, spiritual crises, substance abuse, spikes of despair and suicidal thoughts (American Psychiatric Association, 2013). Disturbing thoughts were tied to functional and cognitive impairments and could be debilitating and unhealthy (Taylor, 2019). Moreover, MW is described as an attentional switch from a current task to unrelated thoughts and feelings (Giambra, 1989) that seems to overlap with the notion of intrusive thinking (Seli et al., 2016). It appears that MW competes for limited executive and attentional resources (Banks & Boals, 2017). Hence, the pandemic and conditions of forced inactivity associated with the lockdown both have enormous potential to generate MW, characterized as interruptions of task focus by task-unrelated thoughts (Smallwood & Schooler, 2006). Constantly searching for breaking news on the pandemic, repeatedly trying to make contact with loved ones who may be far away or sick and actions associated with mitigating concerns about current or upcoming

financial difficulties constitute strong limitations on maintaining attention on ongoing work or study activities. Moreover, these behaviours were found to generate negative moods, which, in turn, exacerbated cognitive failures in daily life for individuals who reported high levels of MW (McVay et al., 2009).

The personal disposition and awareness, which result from 'paying attention in a particular way: on purpose, in the present moment, and non-judgmentally' (Kabat-Zinn 1994, p. 4), can help people focus on the task at hand, avoiding distractions and interruptions from intrusive thoughts. Being mindful encourages people to remain in the present moment. This propensity is linked to several health benefits such as lower levels of perceived stress, anxiety and depression, and improvements in the general sense of well-being and resilience (Khoury et al., 2015; Roulston et al., 2018; Scarnera et al., 2009; Sharma & Rush, 2014; Teper et al., 2013). Moreover, this state of mind could be considered a useful protective factor for anxiety because it is associated with self-awareness (Di Giuseppe et al., 2019). Conversano et al. (2020) found that dispositional mindfulness protected individuals from the current intensity of mental distress, while improved levels of mindfulness resulted in significant reductions in mental discomfort. Matiz et al. (2020) have shown that mindful thinking allows individuals to enhance their resilience and improve their well-being during crucial events, such as the COVID-19 lockdown. It has been shown that mindfulness reduces negative affective states and post-traumatic and depressive symptoms and plays a key role in coping with stress caused by pandemics (Farb et al., 2012). Scholars dealing with stress disorders consider the *three C model* (control, coherence and connection) to be useful in the pandemic context: reasonable *control* of personal resources allows for reorganisation of daily activities; a search for *coherence* helps individuals make sense of what is happening; and *connection* with others helps maintain balance even in crisis conditions (Polizzi et al., 2020). While connection is partially threatened by the lockdown itself, control and consistency can be more easily achieved if the person is a *mindful thinker*.

Effects of pandemic on family life

The emergence of the coronavirus pandemic has impacted individuals and, in turn, families, increasing stresses due to socio-economic disparities, pre-existing illness and underscoring the precariousness of interpersonal relationships (Adamczyk et al., 2021; Amsalem et al., 2020). Connectedness, good organisation and communication within the family help overcome these effects due to the pandemic and related restrictions. Family connections, in particular, family support in terms of psychological care and financial sustenance, help people deal with negative emotions, such as feelings of distress and worry, especially in times of adversity and uncertainty (Cohen & Syme, 1985; Nitschke et al., 2020; Zaki & Williams, 2013). Living with uncertainties has led to dysfunctional mechanisms for coping and adaptation (Rolland, 2020). Lower income, crowded living conditions and communication issues exacerbate a family's psychological well-being. All of these factors are compounded by isolation in lockdown and have made people vulnerable to health risks such as anxiety, depression or even suicide during the pandemic (Aronson, 2020).

The present study

Shortly before the media spread news of the pandemic in Italy and the lockdown, we had started conducting research on the relationship between mindfulness status and psychological and cognitive outcomes in a sample of emerging adults. It is known that young adults are involved in mind

wandering processes and this makes them a particularly interesting group to study (Jackson & Balota, 2012; Stawarczyk et al., 2014). The advent of lockdown provided us with an opportunity to study changes in mindfulness status, in cognitive discomfort and in their relationship that occurred during the pre-lockdown to lockdown period. At the beginning of the pandemic, young adults showed high perceived vulnerability, manifesting a low sense of belonging and connection with others and poor observance of safety rules (Barari et al., 2020; de Francisco Carvalho et al., 2020). Subsequently, as noted by Germani, Buratta, et al. (2020), Germani, Delvecchio, et al. (2020), emerging adults found it difficult to react successfully and satisfactorily to the COVID-19 restrictions, leading to anxiety and stress: isolation and social distance led to psychological maladjustment (Cao et al., 2020; Li et al., 2020). Emerging adults experience considerable exposure to social media and, consequently, have been especially apprehensive about the virus in terms of risk of infection and their role as possible asymptomatic carriers (Liao et al., 2020).

To the best of our knowledge, there are no studies on individual dispositions to mindful thinking as a result of the outbreak. During the current pandemic, increased uncertainty about the future and threats to personal security (physical, social, emotional and financial) justified the emergence of anxiety and frustration. People may also experience resentment or dissatisfaction with governmental institutions for not moving as fast and as efficiently as they had hoped, or towards people for not being as careful as they would like them to be in terms of social distancing or the use of protective devices. Reactive behaviours to this anomalous situation are particularly likely among emerging adults. They suffer from concerns for their own health and that of their relatives, worries about the financial condition of their families and the consequences of forced cohabitation, which has obliged them to spend entire days in the same physical space of the rest of the family, increasing unwanted interactions with relatives. Since these difficult conditions occurred simultaneously during the pandemic, all the above-mentioned sources of distress were activated at once.

The innovative contribution of this study lies in choosing several outcomes to measure the impact of cognitive discomfort on emerging adults: rumination, intrusive thoughts and cognitive failures. These factors were recorded at two time points: before and during the lockdown on the same sample, coupling the responses of each participant at Time 1 and Time 2. Variables associated with the effects of the lockdown—COVID-related emotions (perceived anxiety during the lockdown and the sense of perceived family support during lockdown), socio-economic status (SES) and housing conditions— were also studied to ascertain their involvement in predicting mindfulness profiles.

The aims of the present study were (a) to establish pre- and during-COVID-19 mindfulness profiles in emerging adults; (b) to investigate how COVID-related emotions, socio-economic status and housing conditions influenced profile membership; and (c) to investigate whether there were differences across mindfulness profiles with respect to cognitive failures, intrusive thoughts and rumination. In relation to (b), we hypothesised that high level in COVID-related emotions, low SES and difficult housing conditions would negatively impact on mindfulness status. As for (c), we expected increased levels of cognitive failure, intrusive thoughts and rumination in profiles characterized by low level of mindfulness at both time points.

METHOD

Participants and procedure

A power analysis was carried out using G*Power 3.1 (Faul et al., 2009) to estimate the suitable sample size, using the following parameters: p level of .05; medium effect size (0.25); and power of 0.80.

Results indicated that a sample size of 128 participants was adequate to warrant an 80 per cent chance of correctly rejecting the null hypothesis.

At the end of the enrolment procedure, a convenience sample of 181 healthy emerging adults (157 females) took part in the study. All emerging adults were from Apulia, Italy, and were university students following an introductory course in psychology (i.e., age mean $\pm$ *SD* 22.10 $\pm$ 1.80; level of education in years mean $\pm$ *SD* 16.50 $\pm$ 1.48). All the participants were enrolled for the first observation from 3 to 9 February 2020, before the lockdown was announced, during so-called *Phase 1* of the quarantine, which remained effective from 3 to 10 April 2020, approximately one month after the beginning of the nationwide lockdown on 9 March 2020. The second observation was carried out on 9 April 2020.

All participants were blind to the hypothesis of the study and provided informed consent. Participation was anonymous and voluntary. They completed the questionnaires in Italian through an online survey platform (Google Modules) under the direct control of the research assistants. Participants were asked to complete the same survey twice at Time 1(before the lockdown) and at Time 2 (during the lockdown), about 8 weeks later. All participants completed both surveys. The Ethical Committee of the Institution approved the general study protocol (n. 3660-CEL03/17), and the whole study was performed following the Helsinki Declaration and its later amendments.

Materials

The inclusion criteria for all participants were as follows: (a) to have completed the entire survey; and (b) to be between the ages of 18 and 29 during the period of the study.

Pre- and post-measures

The *Five Facet Mindfulness Questionnaire* (FFMQ; Baer et al., 2006) consisted of 39 items measuring five facets: (a) describing/labelling with words—the individual's capacity to recognize and label the thoughts and feelings they experience; (b) observing/noticing/attending to sensations/perceptions/thoughts/feelings—the individual's tendency to be aware of and recognize their thoughts and feelings; (c) acting with awareness—the individual's ability to stay present and aware in the moment while ignoring or sidestepping potential distractions; (d) nonjudging of experience—the tendency towards objective consideration of thoughts and feelings and the rejection of assigning value to these thoughts and feelings; and (e) nonreactivity to inner experiences—the individual's ability to remain calm and objective when faced with thoughts or feelings that may usually elicit emotional responses. The FFMQ had high internal consistency with an alpha of .90 (Cronbach's alpha coefficient of each subscale was .93 in observing, .73 in describing, .87 in acting with awareness, .88 in nonjudging of experience and .77 in nonreactivity). Confirmatory factor analysis indicated that a theoretically derived 5-factor model provided a good fit ($\chi^2_{676} = 927.641$, RMSEA = 0.045 [90% confidence interval = 0.038–0.052], TLI = 0.910, CFI = 0.920). The chi-square statistic was significant ($p = .001$), but the RMSEA value did not exceed the acceptable threshold value of 0.06 or the 90 per cent confidence interval around the RMSEA point estimate. Moreover, the test–retest reliability coefficients for the five facets ranged between 0.70 and 0.81, showing good reliability over time. The final score was based on a Likert-like scale from 1 (never or very rarely true) to 5 (very often or always true) obtained by summing up responses. Higher scores on the FFMQ indicated, also, a greater tendency to be mindful.

The *Cognitive Failures Questionnaire* (CFQ; Broadbent et al., 1982) consisted of 25 items referring to forgetfulness, that is a tendency to let one's mind wander away from something known or planned, and distractibility and false triggering, that is interrupted processing of sequences of cognitive and motor actions, respectively. The CFQ, based on a 5-point Likert-like scale from never (0) to very often (4), had good internal consistency of 0.87. The final score was the sum of the answers for each item. Higher scores on the CFQ indicated a greater tendency for cognitive failures.

The *White Bear Suppression Inventory* (WBSI; Wegner & Zanakos, 1994) consisted of a 15-item questionnaire that was designed to measure thought suppression (ridding the mind of unwanted thoughts) and *intrusions* (stuck thoughts that cause great distress). WBSI scoring is based on a 5-point Likert-like scale from strongly disagree (1) to strongly agree (5); the higher the sum of the answers for each item, the greater the inclination to have intrusive thoughts. Its internal consistency was 0.92.

The *Ruminative Responses Scale* (RRS; Treynor et al., 2003) consisted of 22 items measuring two aspects of rumination, brooding and reflective pondering, and depression. The questionnaire showed good internal consistency of 0.94, and answers were given on a Likert-like scale from 1 (almost never) to 4 (almost always). The final score was the sum of the answers for each item, and higher scores corresponded to being more ruminative.

Lockdown-related measures

Participants answered questions about their level of perceived anxiety during the lockdown, using an adapted version of the Short Health Anxiety Inventory (Salkovskis et al., 2002), which contained 18 items assessing health anxiety independently of physical health status. The responses were scored on a 4-point Likert-like scale, with a maximum score of 72 points. The questionnaire showed good internal consistency of 0.88. Furthermore, one item was administered to evaluate their sense of perceived family support during lockdown on a scale from 1 (not at all supported) to 7 (always supported).

Socio-economic status was assessed by administrating two items related to homeownership and potential family financial difficulties associated with the lockdown, on a dichotomous scale, that is a 2-point scale that offered only yes or no options. This housing-based index of socio-economic status was previously used by Ghawi et al. (2015) and was derived from real property data.

Finally, participants were rated for their housing conditions during the lockdown. They were asked questions about the number of cohabitants and the usable floor space in m^2. An index called *usable floor space for cohabitant ratio* was calculated by dividing the square metres of the house by the number of cohabitants. Furthermore, one more dichotomous question, requiring a yes/no answer, was administered about their perceived protection of privacy during the lockdown.

Statistical analysis

Longitudinal data are data in which each variable is measured repeatedly over time. To identify different phenotypes within the population as a function of attitude/behaviour variables, there are two main approaches, including latent transition analysis (LTA), which uses longitudinal data to identify movements between the subgroups over time (Hickendorff et al., 2018; Schreiber, 2017), and cluster analysis. Clustering entails dividing the population into homogeneous subgroups. In the past, different methods have been proposed: various model-based classification methods relying on mixture models (Chiou & Li, 2007; Genolini et al., 2015; Muthén & Shedden, 1999) and several variants of *k*-means (Divoux et al., 2010; Genolini et al., 2013, 2016; Genolini & Falissard, 2010; Mackelprang et al.,

2012; Pingault et al., 2011; Röcke & Lachman, 2008; Zhu & Qu, 2018). Preliminarily, several of the aforementioned strategies were compared. Finally, we used a two-step clustering procedure (Hair & Black, 2000; Röcke & Lachman, 2008) carried out at Time 1 and Time 2, which generated the most simple and interpretable membership model. Firstly, the Ward hierarchical cluster analysis was performed for pre-evaluation of the number of clusters. Then, *K*-means analysis was carried out by using the prespecified number of clusters (i.e., two). Finally, participants were differentiated into distinct phenotypes of mindfulness. Notwithstanding mindfulness was measured using a well-validated trait measure, the use of cluster analysis has allowed to classify data into structures that were more easily manipulated; moreover, it has permitted to put groups similar observations into homogeneous subsets.

Moreover, three standard (i.e., all the predictors enter in the analysis simultaneously) multinomial logistic regressions were used to predict the probability that individuals belonged to each cluster given three groups of predictors: (a) COVID-related emotions, (b) socio-economic status and (c) housing conditions during the pandemic.

Finally, three comparisons between the mindfulness profiles were run with mixed-factor ANOVAs (Group: 4 between-subject levels × Time: 2 within-subject levels; Tukey's post hoc test) on CFQ, WBSI and RRS as dependent variables, independently. Statistical analyses were performed using SPSS software, version 21, and jamovi 1.1.9.

RESULTS

To reach the first objective of the study, participants were clustered on the basis of their scores with respect to the five facets of the FFMQ questionnaire. At Time 1, a simple two-cluster solution (high and low mindfulness) was found to be most effective according to the preliminary hierarchical cluster analysis (Ward's method). These two clusters identified the groups as higher/lower on all five dimensions of the FFMQ questionnaire. This model of clustering was also perfectly suitable at Time 2 (Table 1). As can be seen from Table 1, post hoc pairwise comparisons indicated that the participants classified within the 'high' cluster differed significantly from those in the 'low' cluster, both at T1 and at T2.

For this reason, participants were easily classified into four groups based on the intersections of their membership at Time 1 and Time 2: high mindfulness at both times (HH, stable high mindfulness, 64 participants), low mindfulness at both times (LL, stable low mindfulness, 61 participants), high at Time 1 but low at Time 2 (HL, decreased mindfulness, 42 participants), and a residual group of participants, who were low at Time 1 but high at Time 2 (LH, improved mindfulness, 14 participants). As emerged from this classification (Table 2), some of the individuals were classified into the same subgroup at both T1 and T2 (stable high 60.38%, stable low 88.34%), and a smaller part of the sample showed a change of state: one part improved (18.66%), while another worsened (39.62%).

Descriptive statistics and preliminary analyses are reported in Table 3.

In order to reach the second objective, the following predictors were included in three multinomial logistic regression analyses: (a) lockdown-related affects (anxiety and the sense of receiving family support during the lockdown); (b) socio-economic status (homeownership and having financial difficulties associated with the lockdown); and (c) housing conditions during the lockdown (number of cohabitants, usable floor space in m^2, usable floor space per cohabitant ratio and protection of privacy during the lockdown) (Table 4). First of all, the comparisons of HH, LL and HL groups with the residual LH group were not significant. Consequently, HH (OR = 0.40, 95% CI 0.19–0.86) and HL (OR = 0.39, 95% CI 0.16–0.96) were approximately 2.5 times less likely to have financial difficulties than LL. Finally, the probability of feeling that personal privacy was protected was approximately 3 times higher for HH (OR = 2.99, 95% CI 1.09–8.23) and HL (OR = 3.30, 95% CI 0.98–11.10) than LL.

TABLE 3 Descriptive statistics for each group and for each variable, statistics for differences between groups, *p*-values and effect sizes

Measure	HH (*N* = 64)	HL (*N* = 42)	LH (*N* = 14)	LL (*N* = 61)	Test (*F* or χ^2)	*p*	Effect size (partial Eta² or Cramer's V)
Gender (f/m)	51/13	39/3	13/1	54/7	4.76	.19	0.16
Age (years)	22.72 ± 4.29	22.07 ± 2.15	22.64 ± 2.56	21.87 ± 0.91	1.04	.38	0.02
Education (years)	16.55 ± 1.38	16.62 ± 1.34	16.79 ± 1.12	16.23 ± 1.75	0.94	.43	0.02
Lockdown-related affects							
Anxiety	15.61 ± 6.08	15.40 ± 5.76	15.71 ± 6.09	17.90 ± 8.64	1.54	.21	0.03
Perceived family support	5.25 ± 1.94	4.95 ± 1.87	5.14 ± 1.99	4.97 ± 1.76	0.32	.81	0.00
Socio-economic status							
Homeownership (yes/no)	54/10	42/0	11/3	53/8	7.98	<.05	0.21
Financial difficulties (yes/no)	16/48	9/33	5/9	27/34	7.95	<.05	0.21
Housing conditions							
Number of cohabitants	2.89 ± 1.39	2.67 ± 0.87	3.14 ± 0.86	2.87 ± 0.81	0.80	.50	0.01
Usable floor space (m2)	124.31 ± 53.91	131.60 ± 69.13	126.36 ± 84.37	125.44 ± 74.03	0.11	.96	0.00
Usable floor space for cohabitant ratio	50.45 ± 28.06	54.31 ± 30.31	43.12 ± 29.22	46.59 ± 26.01	0.90	.44	0.02
Protection of the privacy (yes/no)	57/7	38/4	11/3	45/16	7.33	.06	0.20

Abbreviations: HH, high mindfulness at T1 and T2; HL, high mindfulness at T1 and low at T2; LH, low mindfulness at T1 and high at T2; LL, low mindfulness at T1 and T2.

TABLE 1 Descriptives of cluster defining variables at Time 1 (T1) and Time 2 (T2), using the five facets of the FFMQ questionnaire. Post hoc tests using the Bonferroni correction were also performed

	High		Low		p-Value
	M	**SD**	**M**	**SD**	
Clusters at T1					
Observing	26.972	0.468	25.16	0.556	<.001
Describing	30.613	0.539	25.28	0.641	<.001
Acting with awareness	25.169	0.361	19.72	0.428	<.001
Nonjudging of experience	28.150	0.437	19.613	0.519	<.001
Nonreactivity	21.198	0.370	18.293	0.440	<.001
Clusters at T2					
Observing	27.628	0.545	24.262	0.474	<.001
Describing	30.576	0.516	23.757	0.449	<.001
Acting with awareness	22.512	0.457	20.514	0.398	<.001
Nonjudging of experience	27.576	0.570	20.689	0.496	<.001
Nonreactivity	21.410	0.411	18.068	0.358	<.001

TABLE 2 Distribution of cluster membership at Time 2 (T2) on the basis of cluster membership at Time 1 (T1), using the five facets of the FFMQ questionnaire

	Cluster membership at T2	
Cluster membership at T1	**High**	**Low**
High		
n	64	42
%	60.38	39.62
Low		
n	14	61
%	18.66	81.34

Note: Percentages are based on T1 cluster membership. Thus, row adds up to 100%.

To reach the third objective of the present study, three mixed-factor ANOVAs were performed, using Group (four levels: HH, high mindfulness; LL, low mindfulness; HL, diminished mindfulness; LH, improved mindfulness) and Time (two levels: T1 and T2) to test each outcome, namely cognitive failures, intrusive thoughts and rumination, as repeated-measure variables.

Cognitive failures

The results were as follows: the main effect of Group $F(3, 177) = 7.32$, $p < 0.001$; $\eta_p^2 = .11$ (means and SDs: HH 44.69 ± 1.71; LL 54.50 ± 1.76; HL 55.36 ± 2.11, LH 49.40 ± 3.67) and the main effect of Time $F(1, 177) = 26.48$, $p < .001$; $\eta_p^2 = .13$ (means and SDs: T1: 45.76 ± 1.07; T2: 56.21 ± 1.97)

TABLE 4 Odd ratios, 95% confidence intervals and *p*-values for lockdown-related affects, socio-economic status and housing conditions. The LL group was taken as a reference

Predictor	HH-LL		HL-LL		LH-LL	
	OR (95% CI)	*p*-Value	OR (95% CI)	*p*-Value	OR (95% CI)	*p*-Value
Lockdown-related affects						
Anxiety	0.98 (0.93–1.03)	.422	0.97 (0.90–1.03)	.319	0.97 (0.88–1.06)	.498
Perceived family support	0.89 (0.71–1.12)	.334	0.82 (0.64–1.05)	.112	0.95 (0.66–1.35)	.785
Socio-economic status						
Homeownership (yes/no)	0.66 (0.23–1.88)	.440	4992.59 ($1.36*e^{-23}$–$1.83*e^{+30}$)	.785	0.50 (0.11–2.25)	.364
Financial difficulties (yes/no)	0.40 (0.18–0.86)	.020	0.39 (0.16–1.96)	.040	0.63 (0.18–2.18)	.470
Housing conditions						
Number of cohabitants	2.06 (0.83–5.08)	.117	1.28 (0.45–3.62)	.643	1.56 (0.42–5.77)	.688
Usable floor space (m²)	0.98 (0.96–1.09)	.060	0.99 (0.97–1.01)	.321	0.99 (0.96–1.02)	.504
Usable floor space for cohabitant ratio	1.04 (0.99–1.09)	.072	1.02 (0.97–1.08)	.280	1.01 (0.93–1.09)	.786
Protection of the privacy (yes/ no)	2.99 (1.09–8.23)	.033	3.30 (0.98–11.10)	.040	1.35 (0.31–5.84)	.855

Abbreviations: HH, high mindfulness at T1 and T2; HL, high mindfulness at T1 and low at T2; LH, low mindfulness at T1 and high at T2; LL, low mindfulness at T1 and T2.
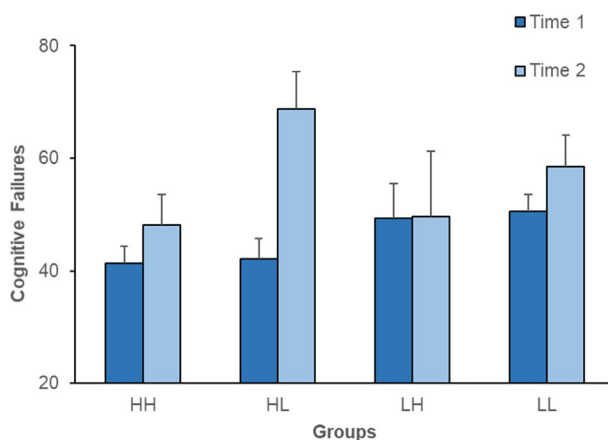
FIGURE 1 Mean and standard errors in bars for the total score on the Cognitive Failures Questionnaire for each group at T1 and T2. HH, high mindfulness at T1 and T2; HL, high mindfulness at T1 and low at T2; LH, low mindfulness at T1 and high at T2; LL, low mindfulness at T1 and T2 [Colour figure can be viewed at wileyonlinelibrary.com]

were both statistically significant. The post hoc analysis (Tukey's HSD test) regarding the variable Group showed a significant effect between HH and HL and between HH and LL ($p < .05$). Moreover, the interaction Group × Time $F(3, 177) = 8.79$, $p < .001$; $\eta_p^2 = .13$ proved to be significant. From the inspection of the graph (Figure 1), all groups reported diminished performance on CFQ from T1 to T2, except for the improved mindfulness group LH, which showed substantial balance between the two observations.

Intrusive thoughts

The results were as follows: the main effect of Group $F(3, 177) = 17.36$, $p < .001$; $\eta_p^2 = .23$ (means and SDs: HH 47.45 ± 1.27; LL 60.05 ± 1.30; HL 49.86 ± 1.57, LH 53.68 ± 2.73) and the main effect of Time $F(1, 177) = 6.92$, $p = .009$; $\eta_p^2 = .04$ (means and SDs: T1: 51.32 ± 0.91; T2: 54.20 ± 1.19) were statistically significant. The post hoc analysis (Tukey's test) of the variable Group showed a significant effect between HH and LL and between HL and LL ($ps < .05$). The first-order interaction did not reach statistical significance.

Rumination

The results were as follows: the main effect of Group $F(3, 177) = 10.67$, $p < .001$; $\eta_p^2 = .15$ (means and SDs: HH 51.60 ± 1.53; LL 62.10 ± 1.57; HL 50.14 ± 1.90, LH 54.71 ± 3.27) and the interaction Group × Time $F(3, 177) = 2.71$, $p = .04$; $\eta_p^2 = .01$ proved to be significant. Group showed a significant effect between HH and LL and between HL and LL ($p < .05$). From inspection of the graph (Figure 2), all groups reported increases in RRS from T1 to T2, excepted for the improved mindfulness group, LH, which showed a reduction between the two observations.
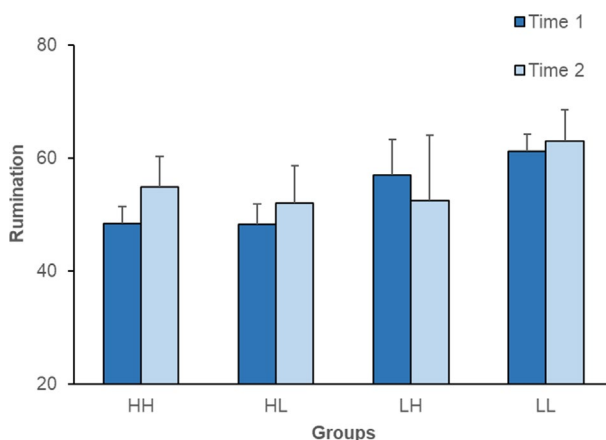
FIGURE 2 Mean and standard errors in bars for the total score on the Ruminative Responses Scale for each group at T1 and T2. HH, high mindfulness at T1 and T2; HL, high mindfulness at T1 and low at T2; LH, low mindfulness at T1 and high at T2; LL, low mindfulness at T1 and T2 [Colour figure can be viewed at wileyonlinelibrary.com]

DISCUSSION

The present study was focused on mindfulness status before and during the Italian lockdown, and how mindfulness status affected cognitive failures, intrusive thoughts and rumination. Growing interest in mindfulness has led to an increasing number of studies in clinical and nonclinical contexts (Kabat-Zinn, 2003). In the present study, it was hypothesised that mindfulness, as a state of mind, might improve tolerance of the effects of social isolation due to lockdown. We considered the interaction between time and mindfulness phenotypes to be relevant because we were interested in changes over time.

The sample group enrolled in the study was composed of emerging adults. Emerging adulthood refers to the age range between 18 and 25 (Arnett, 2000). It is a period characterized by changes in autonomy, identity and social roles. As stated by Arnett (2000, p. 469),

> emerging adulthood is a time of life when many different directions remain possible, when little about the future has been decided for certain, when the scope of independent exploration of life's possibilities is greater for most people than it will be at any other period of the life course.

This group is particularly sensitive to COVID-19 pandemic-related worries related to self-autonomy and intimacy (Germani, Buratta, et al., 2020). Moreover, the instability and low predictability of the emergency produced high levels of anxiety and stress (Li et al., 2020).

Emerging adults were classified, using pre- and post-data, into four groups. The following phenotypes were identified: (a) stable-high (high mindfulness before and during lockdown), (b) stable-low (low at both times), (c) diminishing (diminished mindfulness) and (d) improving (improved mindfulness). First, a methodological and statistical issue arose: the four mindfulness profiles emerged from two-cluster analyses combined that were run on data from Time 1 and Time 2. Consequently, the size of the LH group (improved mindfulness) was not based on the authors' choice; it should be considered a residual group, and therefore, any related statistical results should be considered with

caution. Nonetheless, the fact that a group of participants experienced improved mindfulness during the lockdown suggested to the researchers that for some people, the lockdown provided an opportunity to think more intensely and effectively about themselves, leading to the perception of positive changes in mindset. Participating intensely in virtual classrooms, being massively exposed to social media activities where they could communicate their anxiety or concerns and, in other words, feeling themselves to be part of a broader community probably contributed to decreased loneliness. Improving meaningful social relationships and contacts under lockdown could have improved mindfulness (Fried et al., 2020; Lindsay et al., 2019; Stieger et al., 2020). This option merits more detailed attention in future research.

The findings suggested that the stable-low profile is characterized by perceptions of more financial difficulties and low feelings of privacy associated with the lockdown, compared with the stable-high and diminishing profiles.

It is known that mindful individuals are less prone to be affected by common forms of psychological distress (for a review, see Keng et al., 2011). Moreover, there is evidence that mindfulness can be helpful during epidemics. Cheung (2015) showed that mindfulness was an effective way to cope with stress and that mindfulness techniques reconnected people with a sense of mental and bodily peacefulness, decreasing their worry during Ebola outbreaks. These severe epidemics—which led to psychological consequences such as those attributed to the recent coronavirus pandemic—have emerged periodically, affecting people in several African countries. Also, it is likely that individuals who experienced diminished mindfulness during the lockdown phase benefitted from remaining aware or mindful and paying attention to their thoughts and feelings, compared with those who were not able to do so, even in nonemergency situations. Similar challenges can arise in relation to financial difficulties. It is known that people with low incomes worry more about their finances than those with higher incomes (Gallup, 2017; Johar et al., 2015); consequently, financial difficulties were likely to have negative effects on mental health (Gathergood, 2012), psychological well-being (Haushofer & Shapiro, 2016) and cognitive functioning (Mani et al., 2013). This could lead to passive self-focused thoughts on negative feelings (de Bruijn & Antonides, 2020), decreasing awareness and nonjudgemental acceptance (Teper et al., 2013). Correspondingly, it was plausible that crowded housing would create stress in the home and have negative consequences for inhabitants. Living in crowded conditions also limits privacy (Evans, 2003). Lack of privacy can result in stress, difficult social interactions and behavioural problems for all household members (Evans et al., 1998) and could lead to decreased mindful awareness (Wahbeh et al., 2011).

The results showed an increment in cognitive failures, intrusive thoughts and rumination during lockdown, compared with the pre-lockdown phase across all groups. Moreover, cognitive discomfort, cognitive failures, intrusive thoughts and rumination were negatively related to mindfulness. In particular, all groups experienced increased cognitive failures and rumination—except the group with improved mindfulness. Probably the positive changes in the mindset of this last group led to a greater self-awareness, decreasing mind wandering.

The pandemic has been a traumatic event for many individuals. Traumatic events are conditions outside of human control, beyond usual human experience, that may cause feelings of being in danger (Christianson & Loftus, 1987). During the COVID-19 pandemic, everyone was exposed and reacting to a confusing, stressful and sometimes frightening situation. Unwanted thoughts or images, negative feelings, avoidance of reminders of current conditions and problems with attention, arousal and reactivity were a direct consequence of this exposure (Perkonigg et al., 2000). All of these are characteristics associated with post-traumatic stress disorder (Yehuda, 2002). A negative correlation between measures of mindfulness and cognitive failures has been found in traumatic events (Cheyne et al., 2006; Herndon, 2008; Lau et al., 2006). Moreover, stressful or traumatic events have been

shown to increase cognitive failures due to stress-related intrusive thoughts and avoidance (Klein & Barnes, 1994) in emerging adults, on laboratory-based measures (Klein & Boals, 2001; Sliwinski et al., 2006) and also in everyday situations (Boals & Banks, 2012; Spano et al., 2019). Furthermore, in line with the literature, ruminative thinking was associated with low levels of mindfulness (Deyo et al., 2009). The pandemic situation has involved deficiencies in distress tolerance (Boals & Banks, 2020). Rumination is a response to distress characterized by repetitive focus on the symptoms, causes and consequences of one's distress (Nolen-Hoeksema et al., 2008). A lack of mindfulness manifests as not attending to one's present internal and external experience in a nonjudgemental and accepting manner (Baer et al., 2006). During lockdown, emerging adults with high levels of mindfulness managed to act with awareness reducing mind wandering during daily activities. These results are in line with those found in studies using distress tolerance tasks (Feldman et al., 2014).

This study has some limitations. First, we used convenience sampling, which resulted in more female participants. In future studies, it will be necessary to balance the composition of the sample with respect to gender. Moreover, there could also be some limitations regarding the generalizability of the results due to the common variance among the questionnaires.

Directions for future research related to this work will focus on (a) expanding these empirical results to different groups of people such as adults and the elderly and monitoring the long-term effects of lockdown on cognitive discomfort, given that with increasing age, individuals showed less psychological distress (Conversano et al., 2020); (b) clarifying the construct of mind wandering; and (c) developing a mind wandering questionnaire that takes into account the most important related constructs.

In conclusion, the present study has shown that mindfulness status has suffered from the impact of the lockdown. Worries related to the pandemic produced psychological maladjustment and cognitive discomforts, such as cognitive failures and ruminative thinking, related to mind wandering. General cognitive discomfort was experienced by emerging adults. However, while cognitive failures strongly increased among those who passed from high to low levels of mindfulness, cognitive failures and rumination remained stable or decreased among those who reported positive changes in mindfulness. In view of a possible new wave of infection, mindfulness-based approaches may be helpful strategies to offer people at high risk of psychological maladjustment and cognitive discomfort.

CONFLICT OF INTEREST
The authors have no conflicts of interest to declare.

ETHICAL STATEMENT
Data collection was reviewed and approved by local ethics committee and research meets the ethical guidelines, including adherence to the legal requirements of the study country.

DATA AVAILABILITY STATEMENT
The data sets generated during and/or analysed during the current study are available.

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