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

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Abstract:	Background: The lockdown due to the coronavirus outbreak in 2019 (COVID-19) has caused psychological distress and cognitive discomfort for emerging adults. States of mindfulness and being in the moment can prevent anxiety and fear associated with the lockdown as well as alleviate ruminative and automatic negative thinking. Methods: 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. Results: The results showed overall more cognitive failures and rumination, especially in participants whose mindfulness status diminished during lockdown, and it remained stable or decreased among participants who reported a positive change in mindfulness. Fear, financial difficulties, and a reduced sense of privacy associated with the lockdown predicted lower stability in mindfulness profiles. Conclusions: The state of being fully aware to what is happening in the present moments may be helpful for reducing cognitive discomfort and psychological maladjustment, especially during stressful times such as lockdowns.

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Background: The lockdown due to the coronavirus outbreak in 2019 (COVID-19) has caused psychological distress and cognitive discomfort for emerging adults. States of mindfulness and being in the moment can prevent anxiety and fear associated with the lockdown as well as alleviate ruminative and automatic negative thinking. **Methods**: 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. **Results**: The results showed overall more cognitive failures and rumination, especially in participants whose mindfulness status diminished during lockdown, and it remained stable or decreased among participants who reported a positive change in mindfulness. Fear, financial difficulties, and a reduced sense of privacy associated with the lockdown predicted lower stability in mindfulness profiles. **Conclusions**: The state of being fully aware to what is happening in the present moments may be helpful for reducing cognitive discomfort and psychological maladjustment, especially during stressful times such as lockdowns.

Keywords

Mindfulness, emerging adults, covid-19 lockdown, longitudinal study, cognitive failures, intrusive thoughts

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, prohibitions on individuals' movements at leisure and in the workplace accompanied by growing feelings of vulnerability have strongly impacted the population worldwide (Zhai and Du 2020). Many mental health issues such as growing distress, anxiety, depression, and frustration have emerged since the COVID-19 outbreak (Duan and Zhu 2020).

The escalation of new cases, alongside ineffective and anxiety-provoking information, has led to fear of contagion. Fear 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 *behavioral immune system* (e.g., Troisi 2020). Together with the physiological immune system, human beings have developed a set of *proactive, emotional, and cognitive responses* which guide behaviors, such as avoiding people who seem to be infected or at risk of infection. Indeed, the best defense against the disease is adopting appropriate behaviors 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).

Fear of contagion and psychological distress

The reasonable fear of being infected, a fundamental condition for behavioral protection from contagion, 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). Mazza and colleagues (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, fear, frustrations, and stigma, high levels of post-traumatic stress, as well as increased prevalence of depressive symptoms and the experience of social isolation (Philip and Cherian, 2020; Taylor et al. 2008; Hall et al. 2008).

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

Obsessive behaviors 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 were also manifested (Blakey and 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 for the virus.

Fear of contagion, 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 and fears (Souadka et al. 2020). Schimmenti and colleagues (2020) concluded that fear during the COVID-19 pandemic comprises four domains that represent the bodily, interpersonal, cognitive, and behavioral features of fear: fear of the body/fear for the body that is related to physical vulnerability and the need for self-protection; fear of significant others/fear for significant others linked to interpersonal relationships and social distancing; fear of not knowing/fear of knowing linked to cognitive aspects such as controlling the situation and coping with the pandemic; and finally, fear of taking action/fear of inaction regarding COVID-19 related behaviors and their consequences, as revealed for instance, in poorly thought-out' activities or paralyzing actions. The authors 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 fear of contagion.

A sudden change in habits, fear of contagion, 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. However, 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 experienced staying focused and productive. The authors also reviewed the abundant research demonstrating he negative effects of stress and anxiety on cognitive functioning (Boals and Banks 2020). According to Banks and Boals (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 and 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 and 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 on-going work or study activities.

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 (e.g., Teper et al. 2013; Scarnera et al. 2009). 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). It has been shown that mindfulness reduces negative affective states as well as 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 reorganization of daily activities; a search for *coherence* helps individuals make sense of what is happening; and *connection* with others helps with maintaining 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 (Amsalem et al. 2020). Connectedness, good organization, and communication within the family helps overcome these effects due to the pandemic and related restrictions. Family connections, and 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 and Syme 1985; Zaki and Williams 2013; Nitschke et al. 2020). 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 wellbeing. 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 (e.g., Aronson 2020).

The present study

We had started to conduct research on the relationship between mindfulness status and psychological and cognitive outcomes in a sample of emerging adults, shortly before the media spread news of the pandemic in Italy and the lockdown. It is known that young adults are involved in mind wandering processes and this makes them a particularly interesting group to study (e.g., Jackso & Balota, 2012; Stawarczyk, Majerus, Catale, & D'Argembeau, 2014). The advent of pandemic provided us with an opportunity to study changes that occurred during the pre-lockdown to lockdown, in mindfulness status, cognitive discomfort, as well as in their relationship. At the beginning of the pandemic young adults showed a low perceived vulnerability, manifesting a low sense of belonging and connection with others and the lack of observance of safety rules (e.g., de Francisco Carvalho, Pianowski, & Gonçalves, 2020, Barari et al., 2020). Subsequently, as noted by Germani and colleagues (2020a, b), emerging adults have found difficult to react successfully and satisfactorily to the COVID-19restrictions, leading to anxiety and stress. Isolation and social distance have led them to psychological maladjustment (e.g., Li et al. 2020, Cao et al., 2020). Emerging adults experience considerable exposure to social media, and consequently, more apprehensive about the virus in terms of risk of infection and their role as possible asymptomatic carriers (e.g., Liao 2020).

To the best of our knowledge, there are no studies on individual dispositions to mindful thinking as a result of the outbreak. For this study, we chose 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. Variables associated with the effects of the lockdown – COVID-related emotions (perceived fear associated with the lockdown, 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; we hypothesized that high level in COVID-related emotions, low SES and difficult housing conditions would negatively impact on mindfulness status; and c) if there were differences across mindfulness profiles with respect to cognitive failures, intrusive thoughts, and rumination; 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 0.05; 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% chance of correctly rejecting the null hypothesis.

At the end of the enrolment procedure, a convenience sample of one hundred and eighty-one 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±sd 22.10 ± 1.80; level of education in years mean±sd 16.50 ± 1.48). All the participants were enrolled for the first observation from 3-9 February 2020, before the lockdown was announced, during so-called *Phase 1* of the quarantine, which remained effective from 3-10 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). Participants were asked to complete the same survey twice at Time 0 and at Time 1, about 8 weeks later. All participants completed both administrations. The Ethical Committee of the Institution approved the study protocol (n. 3660-CEL03/17 (November 2017)), and the whole study was performed following the Helsinki Declaration and its later amendments.

Materials

The inclusion criteria for all participants were: 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 very good internal consistency with an alpha of .90. 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 points Likert-like scale from never (0) to very often (4), had good internal consistency of .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 and 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 .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 .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 were rated on their COVID-related emotions. The level of perceived fear associated with the lockdown was assessed, using a questionnaire inspired by the Fear of Coronavirus-19 Scale (Ahorsu et al. 2020). They answered 7

questions about their fear of contracting the virus, perceptions of the future, and lockdown-related feelings. A total score was calculated by adding up each item's score (ranging from 1 to 7). Moreover, 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. 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 home ownership and potential family financial difficulties associated with the lockdown, on a dichotomous scale, i.e. a two-point scale which offered only yes or no options. This housing-based index of socioeconomic status was previously used by Ghawi and colleagues (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 meters 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

Descriptive statistics and a cluster analysis were carried out by using a 2-step process for Time 0 and Time 1, before and during the lockdown, respectively. 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 sub-sets.

Moreover, three standard (i.e., all the predictors enter in the analysis simultaneously) Multinomial Logistic Regression were used to predict the probability that individuals belonged to each cluster outcome given three groups of predictors: 1) COVID-related emotions, 2) socio-economic status, and 3) 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. Post hoc test: Tukey) on on CFQ, WBSI and RRS as dependent variables, independently. Statistical analyses were performed using SPSS software, version 21 and jamovi 1.1.9.

Results

In order 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 0, a simple two-cluster solution 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 the five dimensions of the FFMQ questionnaire. Consequently, the five dimensions were not analysed separately. This model of clustering was also appropriate at Time 1. For this reason, participants were easily classified into four groups as emerged by the intersection of their the membership in both time 0 and time 1: high mindfulness at both times (HH, 64 participants), low mindfulness at both times (LL, 61 participants), high at Time 0 and low at Time 1 (HL, decreased mindfulness, 42 participants), and a residual group of participants with low at time 0 and high at time 1 (LH, improved mindfulness, 14 participants). Descriptive statistics and preliminary analyses are reported in Table 1.

Insert Table 1 here

In order to reach the second objective, the following predictors were included in three multinomial logistic regression analyses: 1) lockdown-related affects (fear, anxiety, and the sense of receiving family support during the lockdown); 2) socio-economic status (home ownership and having financial difficulties associated with the lockdown), and 3) 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 2). First of all, the comparisons of HH, LL and HL groups with the residual LH group were not significant. Consequently, the latter group was not mentioned from now on. HH (OR= 0.38, 95% CI 0.22-0.67) and HL (OR= 0.39, 95% CI 0.21-0.72) groups were approximately 2.50 times less likely to have a high average fear score than LL. Moreover, 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.

Insert Table 2 here

In order to reach the third objective of the present study, three Mixed-ANOVAs were performed, using Group (four levels: HH, high mindfulness; LL, low mindfulness, HL, diminished mindfulness, LH, improved mindfulness) and Time (two levels: T0 and T1) 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; η_p^2= 0.11 (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<0.001; η_p^2= 0.13 (means and sds: T0: 45.76±1.07; T1: 56.21±1.97) 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 HH and LL (p<0.05). Moreover, the interaction Group x Time F (3, 177) = 8.79, p<0.001; η_p^2= 0.13 proved to be significant. From the inspection of the graph (see Figure 1) all groups reported diminished performance on CFQ from T0 to T1, except for the improved mindfulness group LH, which showed substantial balance between the two observations.

Insert Figure 1 here

Intrusive thoughts

The results were as follows: the main effect of Group F (3, 177) = 17.36, p<0.001; η_p^2= 0.23 (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=0.009; η_p^2 = 0.04 (means and sds: T0: 51.32±0.91; T1: 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<0.05). 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<0.001; η_p^2= 0.15 (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 x Time F (3, 177) = 2.71, p=0.04; η_p^2= 0.01 proved to be significant. Group showed a significant effect between HH and LL, and HL and LL (p<0.05). From inspection of the graph (see Figure 2), it can be seen that all groups reported increases in RRS from T0 to T1, excepted for the improved mindfulness group, LH, which showed a reduction between the two observations.

Insert Figure 2 here

Discussion

The present pre and post study was focused on mindfulness status before and during the Italian lockdown, and how mindfulness status affected cognitive failures, intrusive thoughts, and rumination. The growing interest in mindfulness has led to an increasing number of studies in clinical and non-clinical contexts, such as sport and teaching

mindfulness-based interventions (e.g., Kabat-Zinn 2003). In the present study, it was hypothesized 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 et al. 2020b). Moreover, the instability and low predictability of the emergency produced high levels of anxiety and stress (e.g., Li et al. 2020).

Emerging adults were classified, using pre and post data, into four groups. The following phenotypes were identified: (1) stable-high (high mindfulness before and during lockdown), (2) stable-low (low at both times), (3) diminishing (diminished mindfulness), and (4) improving (improved mindfulness). First, a methodological and statistical issue arose: the four mindfulness profiles emerged from two cluster analyses combined together that were run on data from time 0 and time 1. 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. It is worthwhile noting that in all the analyses performed this group seemed to have a marginal role. 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 fears or concerns, in other words, feeling themselves to be part of a broader community contributed to decreased loneliness. Improving meaningful social relationships and contacts under lockdown could have improved mindfulness (Lindsay et al. 2019; Fried 2020; 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 personal fears, more financial difficulties, and low feelings of privacy associated with the lockdown, compared to the stable-high and diminishing profiles.

It is known that mindful individuals are less prone to be affected by common forms of psychological distress such as fear (for a review, 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 fear and that mindfulness techniques

reconnected people with a sense of mental and bodily peacefulness, decreasing their fear during Ebola outbreaks. These severe epidemics – which led to psychological consequences similar to 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 to those who were not able to do so, even in non-emergency situations. Similar differences arose with respect to financial difficulties. It is well 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 and Shapiro 2016), and cognitive functioning (Mani et al. 2013). This could lead to passive self-focused thoughts on negative feelings (de Bruijn and Antonides 2020), decreasing awareness and non-judgmental acceptance (e.g., 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 behavioral problems for all household members (Evans et al. 1998) and could lead to decreased mindful awareness (Wahbeh et al. 2011).

Cognitive discomfort, cognitive failures, intrusive thoughts, and rumination showed a relation with mindfulness: participants with a high level of mindfulness showed the best performance across all outcomes. Generally, the results showed an increment in cognitive failures, intrusive thoughts, and rumination during lockdown, compared to the pre-lockdown phase across all groups. But changes in mindfulness relative to the period before lockdown showed that all groups experienced increased risk of incurring 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 can be considered to be a traumatic event. Traumatic events are conditions outside of human control, beyond usual human experience, that may cause feelings of being in danger (Christianson and 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 posttraumatic stress disorder (Yehuda 2002). A negative correlation between measures of mindfulness and cognitive failures has been found in traumatic events (e.g., Lau et al. 2006; Cheyne et al. 2006; Herndon 2008). Moreover, stressful or traumatic events have been shown to increase cognitive failures due to stress-related intrusive thoughts and avoidance (e.g., Klein and Barnes 1994). in emerging adults, not only on laboratory-based measures

(Klein and Boals 2001; Sliwinski et al. 2006) but also in everyday situations (e,g., Boals and Banks 2012).). Furthermore, in line with the literature, ruminative thinking was associated with low levels of mindfulness (e.g., Deyo et al. 2009). The pandemic situation has involved deficiencies in distress tolerance (Boals and 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 non-judgmental 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 (e.g., Feldman et al. 2014).

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

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Table 1. Descriptive statistics for each group and for each variable, statistics for differences between groups, p-values and effect sizes. HH: high mindfulness at T0 and T1; HL: high mindfulness at Time 0 and low at Time 1; LH: low mindfulness at time 0 and high at time 1; LL: low mindfulness at T0 and T1.

Measure	HH (N=64)	HL (N=42)	LH (N=14)	LL (N=61)	Test (F or χ2)	p	Effect size (partial Eta2 or Cramer's V)
Gender (f/m)	51/13	39/3	13/1	54/7	4.76	0.19	0.16
Age (years)	22.72±4.29	22.07±2.15	22.64±2.56	21.87±0.91	1.04	0.38	0.02
Education (years)	16.55±1.38	16.62±1.34	16.79±1.12	16.23±1.75	0.94	0.43	0.02
Lockdown-related Affects							
Fear	3.52±0.76	3.58±0.73	3.76±0.80	4.09±0.88	5.95	<.001	0.09
Anxiety	15.61±6.08	15.40±5.76	15.71±6.09	17.90±8.64	1.54	0.21	0.03
Perceived Family Support	5.25±1.94	4.95±1.87	5.14±1.99	4.97±1.76	0.32	0.81	0.00
Socio-economic status							
Home ownership (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	0.50	0.01
Usable Floor space (m2)	124.31±53.91	131.60±69.13	126.36±84.37	125.44±74.03	0.11	0.96	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	0.44	0.02
Protection of the privacy (yes/no)	57/7	38/4	11/3	45/16	7.33	0.06	0.20

Table 2. 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. HH: high mindfulness at T0 and T1; HL: high mindfulness at Time 0 and low at Time 1; LH: low mindfulness at time 0 and high at time 1; LL: low mindfulness at T0 and T1.

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						
Fear	0.38 (0.22-0.67)	< .001	0.39 (0.21-0.72)	0.003	0.63 (0.27-1.45)	0.273
Anxiety	0.98 (0.93-1.03)	0.422	0.97 (0.90-1.03)	0.319	0.97 (0.88-1.06)	0.498
Perceived Family Support	0.89 (0.71-1.12)	0.334	0.82 (0.64-1.05)	0.112	0.95 (0.66-1.35)	0.785
Socio-economic status						
Home ownership (yes/no)	0.66 (0.23-1.88)	0.440	$4992.59\,(1.36^{*}e^{-23}$ -1.83 $^{*}e^{+30})$	0.785	0.50 (0.11-2.25)	0.364
Financial difficulties (yes/no)	0.40 (0.18-0.86)	0.020	0.39 (0.16-1.96)	0.040	0.63 (0.18-2.18)	0.470
Housing conditions						
Number of Cohabitants	2.06 (0.83-5.08)	0.117	1.28 (0.45-3.62)	0.643	1.56 (0.42-5.77)	0.688
Usable Floor space (m2)	0.98 (0.96-1.09)	0.060	0.99 (0.97-1.01)	0.321	0.99 (0.96-1.02)	0.504
Usable Floor Space for Cohabitant ratio	1.04 (0.99-1.09)	0.072	1.02 (0.97-1.08)	0.280	1.01 (0.93-1.09)	0.786
Protection of the privacy (yes/no)	2.99 (1.09-8.23)	0.033	3.30 (0.98-11.10)	0.040	1.35 (0.31-5.84)	0.855

Figure 1. Mean and standard errors in bars for the total score on the Cognitive Failures Questionnaire for each Group at Time 0 and Time 1. HH: high mindfulness at T0 and T1; HL: high mindfulness at Time 0 and low at Time 1; LH: low mindfulness at time 0 and high at time 1; LL: low mindfulness at T0 and T1.

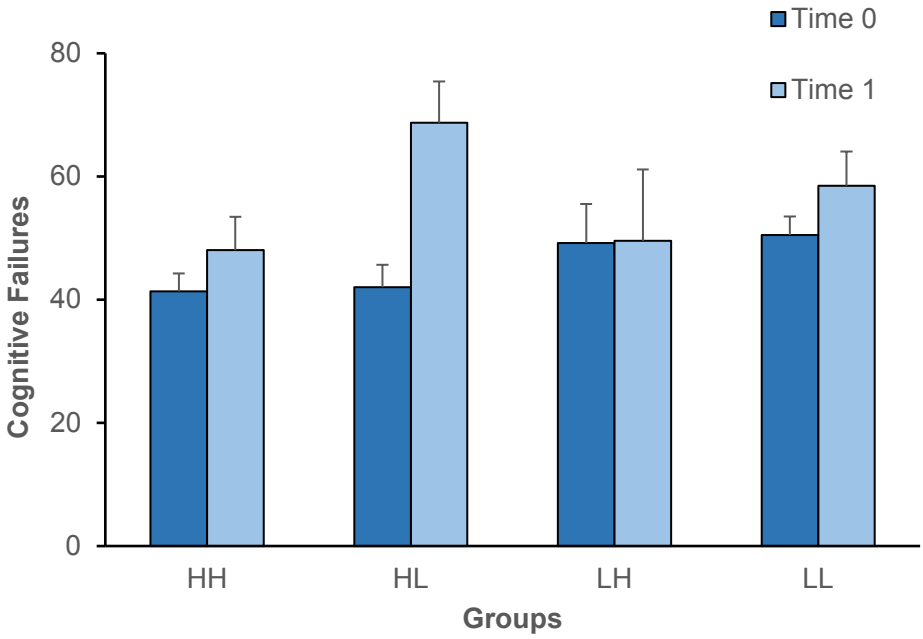

Figure 2. Mean and standard errors in bars for the total score on the Ruminative Responses Scale for each Group at Time 0 and Time 1. HH: high mindfulness at T0 and T1; HL: high mindfulness at Time 0 and low at Time 1; LH: low mindfulness at time 0 and high at time 1; LL: low mindfulness at T0 and T1.