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## Journal of Affective Disorders

journal homepage: [www.elsevier.com/locate/jad](http://www.elsevier.com/locate/jad)

# One-year into COVID-19 pandemic: Decision-making and mental-health outcomes and their risk factors

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## ARTICLE INFO

## Keywords:

Depression  
Anxiety  
Stress  
Decision-making  
Delay discounting task  
COVID-19

## ABSTRACT

**Background:** The COVID-19 pandemic represents an unprecedented worldwide crisis with serious socioeconomic, physical and mental health consequences. However, its long-lasting effects on both mental health and decision-making difficulties remain unexplored. This study aimed to determine the prevalence and severity of psychological disorders in Italy's populace one-year after the outbreak; further, we investigated potential risks impacting mental health and decision-making.

**Methods:** In March 2021, 586 individuals (18–73 years) completed an online-survey plus a computerized delay discounting task for hypothetical money rewards.

**Results:** Psychological symptoms prevalence exceeded the Italy's lockdown rates, with about one-third reporting moderate-to-extremely severe depression, another third anxiety, and the rest stress; mirrored by an increase of symptoms at clinically significant severity levels. One year into the pandemic, half of our sample presented at least one psychological problem, and one-third was at risk of developing a more clinically severe psychological outcome. Fear of job loss, loneliness and intolerance of uncertainty were among the major risk factors to mental health. Plus, social-relationships and financial uncertainty were key determinants of depression, while fear of COVID-19 infection predicted anxiety symptoms. For decision-making tendencies, elevated delay discounting rates, implying less future-oriented behaviors, were mostly predicted by increased job loss fear and older age (>35 years).

**Limitations:** This study provides cross-sectional evidence.

**Conclusions:** Depression, anxiety and stress levels were still alarming one-year into COVID-19. Individuals experiencing financial insecurity, loneliness and intolerance of uncertainty perhaps benefit most from early interventions. Governments need to implement timely recovery plans to reduce financial insecurity, given its significant mental health impact and decision-making outcomes.

## 1. Introduction

The current 2019 coronavirus disease (COVID-19) pandemic is the most severe health emergency ever declared by the World Health Organization, unprecedented in scale and scope, as it represents not only a public health crisis, but also a global mental health and socioeconomic crisis.

The prevalence and severity of psychological distress, depression, anxiety and post-traumatic stress disorders (PTSD) increased worldwide since its beginning. Further, the first longitudinal evidence tracking mental health trends during COVID-19's first semester (March–September 2020) confirmed these disorders to be profound and

enduring across Europe – likely to outlive the pandemic (Hansen et al., 2021; Pierce et al., 2021). Despite the lack of established effects across a longer period – one year after the pandemic outbreak – a few first studies were published, revealing high constant stress and anxiety levels in the general population, comparable to the first 2020 lockdown, along with a reduction of PTSD symptoms (Gori and Topino, 2021), as well as alarming depression and anxiety rates in a large student-cohort (Schmits et al., 2021). These works' notable limitations include brief screening scales assessing psychological disorders, thereby prohibiting capturing symptom severities, hence preventing comparing studies.

However, emerging data from a large cohort of low-income adults, one year after the start of the pandemic in United States (US) (Thorndike

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<https://doi.org/10.1016/j.jad.2022.04.144>

Received 2 October 2021; Received in revised form 19 April 2022; Accepted 24 April 2022

Available online 28 April 2022

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et al., 2022), explored the COVID-19-related stressors linked to depression and anxiety, showing that adults facing multiple stressors (such as health-related social needs) had worsening mental health symptoms over one year. Further, a US nationwide study reported that across the 12-months of the pandemic, depressive symptoms and anxiety were higher: in the youths as well as in adults reporting stress about COVID-19 and its related restrictions, and in those with intolerance of uncertainty and loneliness (MacDonald et al., 2022).

Another longitudinal cohort study in the United Kingdom (UK), examining two timepoints (June/July and November/December 2020) observed that mental health and well-being continued to worsen as socioeconomic inequalities persisted and as the COVID-19 pandemic progressed; demonstrating that being female and non-partnered were risk factors for experiencing greater mental health deterioration (Zaninotto et al., 2022). Indeed, analyzing the risk factors contributing to mental conditions – as effects of the pandemic – can be very informative, given that mental conditions are likely to manifest in different ways; plus, the level of mental health problems seems to vary depending on the pandemic stage, country, population groups and types of conditions (Lindert et al., 2021).

Yet, there is still little evidence about which risk factors and pandemic-related stressors contribute to mental health deterioration one year after the outbreak, focusing on relatively narrow aspects while failing to consider the diverse *psycho-socioeconomic* factors that can modulate such impact (Hampshire et al., 2021; Lindert et al., 2021; Pfefferbaum and North, 2020).

Clearly, business closures, unemployment and global financial insecurity portend and predispose poor mental health outcomes and profound economic anxiety (Bareket-Bojmel et al., 2020). Additionally, travel restrictions, school closures, sudden shifts to working from home, social gathering bans, as well as daily routine and social life disruptions; further contribute to mental health burden and loneliness (Killgore et al., 2020; Lee et al., 2021). In such a complex context, the evolving situation needs to be understood on multiple levels, by using a multifactorial approach to identify the major risk factors of psychological distress and determine which segments of society are still the most affected in the long-term.

Indeed, in its initial phase – that is, during the first 2020 semester – the COVID-19 pandemic had a larger adverse impact on mental health and well-being of some groups than others (Pierce et al., 2021; Robinson et al., 2022). Namely, common risk factors for mental health deterioration included being female, young (<40 years), unemployed, frequently exposed to COVID-19 mass media, pre-existing chronic physical/mental disorders or past infection with SARS-CoV-2 (Fiorenzato et al., 2021; Pierce et al., 2021; Xiong et al., 2020). However, whether these characteristics and groups are associated with sustained psychological distress, as the pandemic has continued, remains unclear. Some of the key determinants of mental health worsening perhaps have receded after the initial shock of the pandemic's onset and lockdown restrictions lifting – others potentially were prolonged and intensified, such as loneliness and financial insecurity (Chandola et al., 2020). After shutting the economy down, the effect of some stressors such as those related to unemployment and financial concern perhaps increased, as well as one-year of prolonged social restrictions conceivably exacerbated loneliness, despite the periodical easing of containment measures.

The COVID-19 pandemic can be conceptualized as a *pandemic of uncertainty*, due to the widening economic instability and other uncertain aspects including risk of contagion, uncertainty about return to work and social life, the virus's unpredictability and its variants' spread; hence, this uncertainty surrounding COVID-19 events seems to be an independent hazard to mental health and general well-being (Lee et al., 2021). In keeping with this view, among dispositional traits 'intolerance of uncertainty' is possibly a distinct risk factor to various mental health disorders, given its transdiagnostic nature (Carleton, 2016). Yet, the majority of previous studies, mostly relative to the lockdown period (Parlapani et al., 2020; Smith et al., 2020) did not study whether

'intolerance of uncertainty', as a dispositional trait, could directly predict the psychological distress associated to the COVID-19 pandemic. However, given these premises, individuals generally less tolerant of uncertainty may be at a higher risk to develop psychological disturbances, particularly one-year into the pandemic.

As the pandemic evolves along with psychological distress, interest is turning to a possible impact not only on mental health outcomes, but also on an individual's decision-making processes. Numerous lines of evidence (Liu et al., 2013; Malesza, 2019) demonstrated that high stress levels and negative prospective thinking significantly contribute to decision-making difficulties, resulting in greater impulsive behaviors and reduced cognitive control. The current situation can possibly influence decision-making processes and future-thinking, resulting in different behavioral outcomes. In this regard, an extensively used method to assess decision-making is through the delay discounting paradigm (temporal discounting), which can unveil two opposite behavioral tendencies – immediate- versus future-oriented – that is, a tendency to prefer smaller immediate rewards over future ones, despite the delayed reward's larger magnitude (Berns et al., 2007; Cona et al., 2019). Presently, in this COVID-19 context, the growing interest is oriented toward the relationship between decision-making and compliance with the virus containment measures enacted (DeAngelis et al., 2021; Nese et al., 2020; Wismans et al., 2021). These are indeed pivotal research questions for public mental health, as the impact of individual decision-making extends beyond the mitigation of viral spread and involves other well-being dimensions. Of note, delay discounting is strongly related to a wide variety of maladaptive behaviors such as pathological gambling, substance abuse, risky sexual behaviors or personal safety (Odum et al., 2020).

Given these concerns and the lack of studies reporting on data one year into the pandemic, this study's main goal is to establish how the general populace is responding to this prolonged pandemic exposure. Hence, we aimed to determine the prevalence and severity of mental health disorders in depression, anxiety and stress terms after one-year. Further, we wanted to examine possible risk factors and pandemic-related stressors that seemingly impact on mental health and decision-making – to identify the most vulnerable and affected groups. Leveraging findings from this pandemic's initial phase, we applied a multifactorial approach considering those *psycho-socioeconomic* factors that emerged as being particularly relevant during this pandemic such as loneliness, financial/job concerns, perceived uncertainty in several life domains (Chandola et al., 2020; Fiorenzato et al., 2021; Pierce et al., 2021; Robinson et al., 2022; Xiong et al., 2020). To achieve these objectives, one year after the outbreak, we administered a nationwide cross-sectional online-survey to reach a large cohort and ensure an adequate representation of Italy's populace. In addition, our survey included a computerized behavioral task for hypothetical monetary rewards, the delay discounting task (DDT), to objectively assess differences in behavioral tendencies, immediate- versus future-oriented.

## 2. Methods

### 2.1. Study design and participants

An anonymous online survey was shared through various platforms and mainstream social media from February 22 to March 22, 2021 – one year after the pandemic's outbreak. This timeframe was chosen to assess participants' responses between the final phase of the COVID-19 wave in Italy and the higher peak of its third wave. Specifically, during this period, confirmed new case incidences dramatically increased from 9,617 to 24,501 and revealed similar trends in Europe (see Supplementary Fig. 1), leading to stronger infections control measures in many other European countries (Nørgaard et al., 2021). To obtain a representative countrywide snapshot of Italy's populace, a snowball sampling method was used. Further, participants were encouraged to share and invite new respondents among their social contacts by emphasizing the

importance of involving the elderly and people with a poor internet access. Participation was voluntary and without compensation. A brief introduction informed the participants about our study's aims. Their informed consent was requested before starting the investigation. The survey took approximately 15 min and was anonymous, ensuring data confidentiality. Responses were considered eligible if participants: i) completed the entire survey, ii) were over 18 years-old, and iii) were living in Italy during the pandemic. Among a total of 610 responses via Qualtrics' platform, 586 were classified as eligible based on our inclusion criteria. This study was conducted in accordance with the Helsinki Declaration and approved by the ethical committee of the School of Psychology University of Padua, Padua, Italy.

## 2.2. Survey structure and outcome measures

The survey included three sections: i) sociodemographic features and COVID-19 related information were collected, ii) as a measure of decision-making, a hypothetical money reward task was presented – the DDT, and iii) presence of stress, depression, and general anxiety as well as intolerance of uncertainty were assessed through self-reporting questionnaires.

### 2.2.1. Sociodemographic and COVID-19 pandemic related information

An ad hoc questionnaire was set up to collect sociodemographic variables of interest, while the COVID-19 section was aimed at collecting information on job status, working and living conditions, of pandemic's impact on income, need of psychological counseling and about COVID-19 such as past infection with SARS-CoV-2 and vaccination. Furthermore, more specific questions on pandemic-related stressors included: i) potential fears such as fear of job loss/study delay, fear of relationship break-up, and fear of COVID-19 infection, which were assessed by means of a 4-point Likert scale (ranging from not at all, a little, moderately, a lot); ii) other specific questions about mass-media consumption on COVID-19 and loneliness during the pandemic that were assessed by means of using a 4-point Likert scale (never, sometimes, often, constantly). Finally, other specific questions investigating their own perceived uncertainty on various domains: financial, health, social relationships and couple relationship domains were rated on a 5-point sliding scale. The exact questions of the pandemic-related stressors survey are reported in the Supplementary Methods.

### 2.2.2. Decision-making: delay discounting task

In the DDT, participants were asked to choose between two virtual money amounts in each trial: a smaller hypothetical money amount to be given immediately (e.g., €10,000 today) versus a larger amount later (e.g., €40,000 in 1-month's time). Participants had to make five choices for each of the six delays (1 month, 6 months, 1 year, 3 years, 5 years, 10 years), and this process led to the indifference point — the point at which an individual was equally likely to choose a smaller reward sooner versus a larger reward later. Of note, the indifference point corresponds to the unshown sixth-choice immediate amount. The order of the six delays was kept constant, as previously described (Curtis et al., 2018). The delayed amount was fixed at €40,000, while the immediate amount was equal to €20,000 at the first choice and was going to increase/decrease based on the previous response.

Finally, to quantify the degree of delay discounting, the area under the curve (AUC) was calculated according to the indifference points at each delay. The DDT AUC ranges from 0 to 1 (high vs. no discount rate, respectively) and is considered as a reliable measure of immediate-oriented behaviors requiring self-control in cases of lower discount (i. e., preference for larger delayed rewards) versus future-oriented behaviors, that are more impulsive, in cases of higher discount rate (i.e., preference for smaller earlier rewards) (Berns et al., 2007; Myerson et al., 2001). Although this task was based on hypothetical rewards, a good correspondence with real ones has been demonstrated (Lagorio and Madden, 2005) as well as with nonmonetary outcomes (Odum et al.,

2020).

### 2.2.3. Depression, anxiety, stress and intolerance of uncertainty assessment

The Depression Anxiety Stress Scales-21 (DASS-21) was used to assess presence of depression, anxiety and stress by means of the validated Italian version, which showed excellent psychometric properties (Bottesi et al., 2015). DASS-21 is widely used to screen and control psychopathological symptoms in clinical practice, given its ability to assess with three 7-item subscales: depression (DASS-D), anxiety (DASS-A) and stress (DASS-S). Higher total scores indicate higher severity in terms of symptoms; to identify presence of clinically significant disturbances, the published cutoff scores for each subscale were adopted (Lovibond and Lovibond, 1996). DASS-21 internal consistency in the current samples was excellent for the total score ( $\alpha = 0.94$ ) and high for the subscales (DASS-D  $\alpha = 0.91$ ; DASS-A  $\alpha = 0.83$ ; DASS-S  $\alpha = 0.89$ ).

Intolerance of uncertainty was measured using the shortened Intolerance of Uncertainty Scale (IUS)(Carleton, 2016), which was recently revised (IUS-R) and translated into Italian (Bottesi et al., 2019). IUS-R consists of 12 items rated on a self-report 5-point Likert scale, where a higher total score indicates a more severe disposition to fear of unpredictable and uncertain future events. IUS-R total score ranges from 12 to 60. Some example items include: 'Unforeseen events upset me greatly', 'I should be able to organize everything in advance', 'The smallest doubt can stop me from acting' and 'I must get away from all uncertain situations'. The Italian IUS-R shows stable and strong psychometric properties as well as adequate reliability and validity (Bottesi et al., 2019). The internal consistency of the IUS-R in the current study was high with Cronbach's  $\alpha = 0.89$ .

## 2.3. Statistical analysis

Descriptive analyses were performed for all outcome measures. We summarized the participant characteristics and the Pearson correlations between the main constructs, considering correlations as weak, moderate, or strong when the correlation coefficient was below 0.30, between 0.30 and 0.60 and above 0.70, respectively.

Stepwise multiple linear regression analyses were conducted to determine the contribution of potential vulnerability and protective factors in explaining mental health, namely presence of depression, anxiety, and general distress as well as decision-making measured by delay discounting. This led to a total of four separate multiple regressions with the DASS-21 subscales and the DDT as independent variables. Whereas the following variables were included in each regression analysis as predictors: age, gender, fear of job loss/study delay, loneliness, fear of relationship break-up, fear of COVID-19 infection, intolerance of uncertainty (IUS-R total score), perceived uncertainty in the following domains: job/financial, health, partner-relationship and social relationships, and COVID-19 mass-media exposure. These factors were identified based on evidence relative to the pandemic's initial phase (Chandola et al., 2020; Fiorenzato et al., 2021; Goodwin et al., 2020; Pierce et al., 2021; Xiong et al., 2020).

We further tested presence of potential meaningful interactions between the significant predictors through moderated regression analysis. To obtain comparable coefficients and eliminate nonessential multicollinearity (Cohen et al., 2003), prior to creating interaction terms and entering them into the regression equations, we mean-centered the predictors, except for gender that was dummy coded (setting 'male' as reference). Whether a significant interaction emerged, this was probed with simple slopes analysis. The presence of multicollinearity was assessed by examining tolerance and Variance Inflation Factor (VIF) using the following cutoffs ( $>0.20$  and  $<5$ , respectively). Statistical analyses were performed using R 4.1.0.



### 3. Results

#### 3.1. Participant sociodemographic and COVID-19 related features

Total sample (N = 586) sociodemographic characteristics as well as COVID-19 related information are shown in Table 1. These sample characteristics are also displayed separately by age groups (18–24, 25–40, >40 years) in Supplementary Table 1.

#### 3.2. Prevalence of psychological distress

As shown in Fig. 1, the prevalence of participant reporting symptoms above the clinical cut-offs (Lovibond and Lovibond, 1996) was about the 54% for depression (n = 317), 36% for anxiety (n = 213), and 47% for stress (n = 278). The average score for depression, anxiety and stress was 11.76 (SD = 9.44), 6.85 (SD = 6.89) and 15.90 (SD = 8.59), respectively. The DASS-21 total score, measuring general distress, was

**Table 1**  
Total sample (N = 586) sociodemographic and COVID-19-related information.

	Group	N	%
<b>Age</b>	18–24	179	30.55
	25–40	238	40.61
	>40	169	28.84
	Min–max: 18–73		
<b>Sex</b>	Female	397	67.75
	Male	189	32.25
<b>Education</b>	Middle school	38	6.49
	High school	205	34.98
	Bachelor's degree	187	31.91
	Master's degree	115	19.63
	PhD/postgraduate	41	7.00
<b>Marital status</b>	Unmarried	368	62.80
	Married	191	32.59
	Separated/divorced	20	3.41
<b>Occupation</b>	Widower	7	1.20
	Teacher/researcher	47	8.02
	Medical staff	28	4.78
	Employee	148	25.26
	Freelancer	38	6.49
	Unemployed	18	3.07
	Student	174	29.69
	Retired	13	2.22
	Manager	24	4.10
	Workman	30	5.12
	Householder	16	2.73
	Other	50	8.53
	<b>Working condition</b>	Underemployed	45
Telework		71	12.12
Layoff		11	1.88
Student/retired		156	26.62
Part-time work		41	7.00
Working regularly		262	44.71
<b>Impact of pandemic on income</b>		No	306
	Yes	280	47.78
	Same income	147	25.09
	Increased income	29	4.95
	Income reduction	80	13.65
<b>COVID-19 mass media exposure</b>	Unemployed	24	4.10
	Never	89	15.19
	Sometimes	279	47.61
	Often	172	29.35
<b>Seek psychological help during the pandemic</b>	Continuously	46	7.85
	Yes	76	12.97
<b>Need of psychological counseling</b>	No	510	87.03
	Yes	199	33.96
<b>Psychotropic medications</b>	No	387	66.04
	Yes	28	4.78
<b>Number of cohabitants</b>	No	558	95.22
	1	66	11.26
	2 or more	148	25.26
<b>COVID-19 infection</b>	Yes	372	63.48
	No	58	9.90
<b>COVID-19 vaccinated</b>	No	528	90.10
	Yes	43	7.34
	No	543	92.66

about 34.51 (SD = 22.24).

#### 3.3. Multiple linear regression analyses

Stepwise multiple linear regressions were conducted to study potential vulnerability factors and pandemic-related stressors and their contribution to mental health and decision-making. The model fit and the statistics of the predictors having a statistically significant contribution to the models are presented in Table 2. No problems of multicollinearity arose (all tolerance factors >0.60 and all VIF<1.68). Pearson correlations between the dependent variables and predictors are reported in Table 3. Further in Supplementary Table 2, the descriptive data of the dependent variables and predictors are displayed for the whole sample and by age groups (18–24, 25–40, >40 years).

##### 3.3.1. Psychological distress – depression, anxiety, and stress

Following multiple regression analyses, the model better able to predict presence of depression, by explaining 51% of the variance, included the following factors: increased loneliness ( $\beta = 0.34$ ), intolerance of uncertainty (as assessed by IUS-R) ( $\beta = 0.34$ ), fear of job loss/study delay ( $\beta = 0.11$ ), social relationships and job/financial uncertainty ( $\beta = 0.11$ , and  $\beta = 0.09$ , respectively).

For anxiety symptoms, the model having the best fit ( $R^2_{Adj} = 0.30$ ) included similar predictors: increased loneliness ( $\beta = 0.25$ ), intolerance of uncertainty ( $\beta = 0.26$ ), fear of COVID-19 infection ( $\beta = 0.11$ ), fear of job loss/study delay ( $\beta = 0.10$ ) and social relationships uncertainty ( $\beta = 0.09$ ).

Likewise, for stress, the best model in predicting presence of generalized stress was able to explain 38% of its variance and included these vulnerability factors: loneliness ( $\beta = 0.33$ ), intolerance of uncertainty ( $\beta = 0.29$ ), fear of job loss/study delay ( $\beta = 0.10$ ) and social relationships uncertainty ( $\beta = 0.10$ ).

##### 3.3.2. Decision-making processes

Regarding DDT performance, the model having the best fit ( $R^2_{Adj} = 0.05$ ) included the following predictors that significantly contributed to delay discounting behaviors: gender, age, and fear of job loss/study delay. This implies that an increased fear of job loss/study delay ( $\beta = -0.15$ ), older age ( $\beta = -0.14$ ), and being female ( $\beta = -0.14$ ) were associated with greater delay discounting (more impulsive choices, as assessed by a lower DDT AUC score) (Table 2).

We further explored the presence of potential interactions between the significant predictors of delay discounting through a moderated regression analysis, which revealed a significant Age  $\times$  Fear of losing a job/study delay interaction ( $F_{1,578} = 5.67$ ,  $p = .018$ ,  $\eta^2 = 0.016$ ), while no other significant interactions were observed ( $p > 0.05$ ) (Table 4).

To probe this two-way interaction and verify the effect of Fear of job loss/study delay moderated by Age, a simple slope analysis was run. In this way, we obtained the effect of Fear of job loss/study delay on delay discounting, computed for three age ranges: young adults (mean age -1SD = 22 years), adults (mean age = 35 years) and for older adults (mean age + 1SD = 48 years). This analysis revealed that the effect of Fear of job loss/study delay in DDT score reduction (i.e., tendency to prefer immediate, smaller rewards) differed as a function of the age ranges; namely a significant negative linear relation was observed in the adult ( $\beta = -0.049$ ,  $t_{578} = -4.40$ ,  $p < 0.001$ ) and in the older adult groups ( $\beta = -0.084$ ,  $t_{578} = -4.90$ ,  $p < 0.001$ ) — but not in the younger individuals ( $\beta = -0.013$ ,  $t_{578} = -0.91$ ,  $p = 0.363$ ) (Fig. 2). That is, as age increased, the impact of Fear of job loss/study delay on the DDT score was more pronounced (i.e., steeper negative slope) — whereas no effect was observed in delay discounting of younger adults. This implies that more immediate-oriented decision-makings resulted as being significantly associated with an increased fear of losing a job/study delay, in the context of an increased age range.

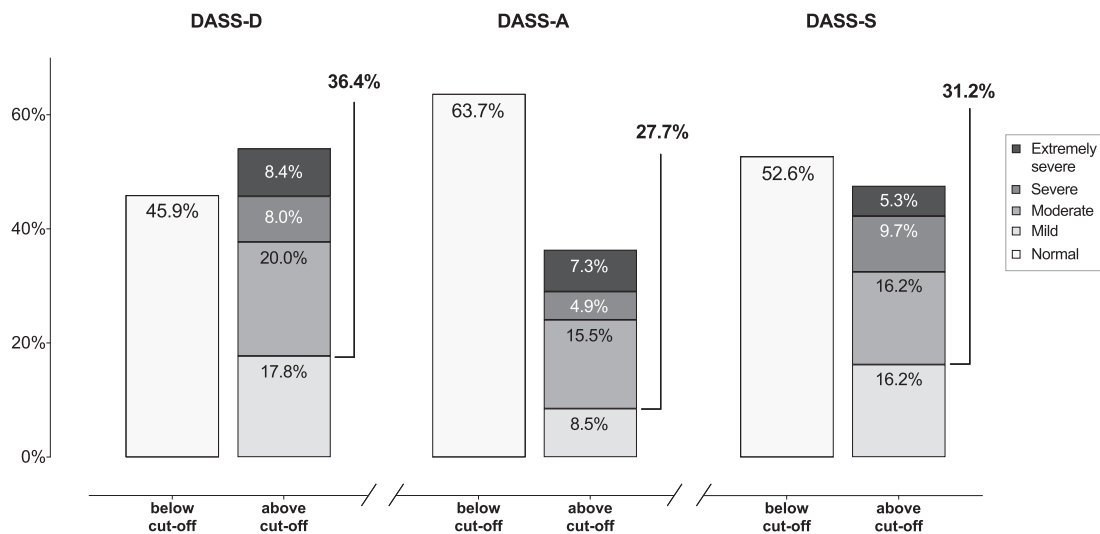


Fig. 1. Prevalence of depression, anxiety and stress across the continuum of severity.

Table 2 Association between significant sociodemographic and COVID-19 related features.

Dependent variable	Model fit	Predictors	Statistics			
			B [95% CI]	β	t	p
<b>Mental health</b>						
Depression (DASS-D)	F <sub>(5,580)</sub> = 122.83, p < 0.001, R <sup>2</sup> <sub>Adj</sub> = 0.51	Loneliness	3.84 [3.05, 4.64]	0.34	9.55	<0.001
		IUS-R	0.38 [0.31, 0.46]	0.34	10.45	<0.001
		Financial uncertainty	0.66 [0.21, 1.11]	0.11	2.88	0.004
		Fear of job loss/study delay	1.00 [0.32, 1.68]	0.11	2.89	0.004
		Social relationships uncertainty	0.55 [0.14, 0.96]	0.09	2.61	0.009
Anxiety (DASS-A)	F <sub>(5,580)</sub> = 49.83, p < 0.001, R <sup>2</sup> <sub>Adj</sub> = 0.30	Loneliness	2.10 [1.41, 2.79]	0.25	5.95	<0.001
		IUS-R	0.21 [0.15, 0.28]	0.26	6.65	<0.001
		Fear of COVID-19	0.89 [0.33, 1.46]	0.11	3.09	0.002
		Fear of job loss/study delay	0.67 [0.16, 1.18]	0.10	2.59	0.010
		Social relationships uncertainty	0.41 [0.05, 0.77]	0.09	2.23	0.026
Stress (DASS-S)	F <sub>(4,581)</sub> = 89.23, p < 0.001, R <sup>2</sup> <sub>Adj</sub> = 0.38	Loneliness	3.37 [2.56, 4.18]	0.33	8.149	<0.001
		IUS-R	0.30 [0.22, 0.37]	0.29	7.948	<0.001
		Fear of job loss/study delay	0.84 [0.25, 1.43]	0.10	2.795	0.005
		Social relationships uncertainty	0.58 [0.16, 1]	0.10	2.724	0.007
<b>Decision-making</b>						
Delay Discounting Task	F <sub>(3,582)</sub> = 11.30, p < 0.001, R <sup>2</sup> <sub>Adj</sub> = 0.05	Fear of job loss/study delay	-0.04 [-0.06, -0.02]	-0.15	-3.532	<0.001
		Gender, ref. Males	-0.07 [-0.11, -0.03]	-0.14	-3.330	<0.001
		Age	-0.003 [-0.004, -0.001]	-0.14	-3.307	0.001

Note. The following predictors were considered: Age, Gender, Fear of job loss/study delay, Fear of relationship break-up, Fear of COVID-19 infection, COVID-19 mass-media exposure, Loneliness, IUS-R total score, Job/financial uncertainty, Health uncertainty, Partner-relationship uncertainty, Social relationships uncertainty. IUS-R, Intolerance of Uncertainty Scale-Revised; DASS, Depression Anxiety Stress Scales.

#### 4. Discussion

The present study provides evidence of the prolonged COVID-19 pandemic impact on mental health as well as decision-making behaviors in the general population in Italy, one-year after the outbreak. By analyzing cross-sectional data with a multifactorial approach, we herein identify the major psycho-socioeconomic determinants and the pandemic-related stressors of psychological symptoms (depression, anxiety and stress) and decision-making behaviors, characterizing more vulnerable groups in the long-term.

##### 4.1. Psychological distress and related risk factors

In March 2021, we found alarming levels of moderate-to-extremely severe depression (36.4%), anxiety (27.7%) and stress (31.2%) — with depression and anxiety symptoms exceeding the lockdown rates in Italy (Fiorenzato et al., 2021; Lenzo et al., 2020; Mazza et al., 2020) and

Europe (González-Sanguino et al., 2020), while stress rates remained stably elevated.

Noteworthy, the higher prevalence of psychological distress was mirrored by a marked increase of individuals reporting symptoms at a clinically significant level – extremely severe – with the following percentages: 8.4 for depression, 7.3 for anxiety and 5.3 for stress. These prevalence rates were significantly higher than those reported during the lockdown in Italy: 4.7, 3.6 and 3.1%, respectively (Lenzo et al., 2020). Given these studies were comparable for the sample composition (age-, sex- and education-matched), as well as the clinical scale used (Lenzo et al., 2020), we can conclude from this comparison that a year into the pandemic led to a progressive worsening of symptoms severity, possibly exacerbating those symptoms already within clinically relevant severity levels. Of note, these prevalence rates are aligned with a second study (Mazza et al., 2020), although its authors applied different cut-offs to assess the severity, hampering these two studies' comparability (see transformed scores in Supplementary Table 3).

**Table 3**  
Pearson correlations between risk factors of mental health and decision-making tendencies.

VARIABLES	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
1. DDT	—															
2. DASS-D	-0.031	—														
3. DASS-A	-0.040	<b>0.636***</b>	—													
4. DASS-S	0.013	<b>0.744***</b>	<b>0.678***</b>	—												
5. Age	-0.098*	<b>-0.231***</b>	<b>-0.184***</b>	<b>-0.214***</b>	—											
6. Gender	-0.162***	<b>0.130**</b>	<b>0.144***</b>	<b>0.146***</b>	0.039	—										
7. Loneliness	-0.053	<b>0.592***</b>	<b>0.447***</b>	<b>0.529***</b>	<b>-0.279***</b>	<b>0.122**</b>	—									
8. IUS-R	-0.072	<b>0.568***</b>	<b>0.428***</b>	<b>0.484***</b>	<b>-0.248***</b>	0.094*	<b>0.425***</b>	—								
9. Fear of job loss/study delay	<b>-0.126**</b>	<b>0.406***</b>	<b>0.299***</b>	<b>0.320***</b>	<b>-0.319***</b>	<b>0.138***</b>	<b>0.376***</b>	<b>0.245***</b>	—							
10. Fear of relationship break-up	-0.027	<b>0.398***</b>	<b>0.296***</b>	<b>0.355***</b>	<b>-0.151***</b>	0.038	<b>0.457***</b>	<b>0.296***</b>	<b>0.313***</b>	—						
11. Fear of COVID-19 infection	-0.001	0.075	<b>0.180***</b>	0.110**	0.074	<b>0.165***</b>	0.084*	0.099*	<b>0.166***</b>	0.059	—					
12. Job/financial uncertainty	-0.062	<b>0.394***</b>	<b>0.236***</b>	<b>0.301***</b>	<b>-0.280***</b>	<b>0.149***</b>	<b>0.300***</b>	<b>0.277***</b>	<b>0.602***</b>	<b>0.250***</b>	<b>0.163***</b>	—				
13. Health uncertainty	-0.092*	0.110**	<b>0.170***</b>	<b>0.131**</b>	<b>0.159***</b>	<b>0.207***</b>	<b>0.127**</b>	0.094*	<b>0.152***</b>	<b>0.128**</b>	<b>0.476***</b>	<b>0.205***</b>	—			
14. Partner-relationship uncertainty	-0.012	<b>0.324***</b>	<b>0.246***</b>	<b>0.297***</b>	<b>-0.151***</b>	0.031	<b>0.420***</b>	<b>0.258***</b>	<b>0.206***</b>	<b>0.323***</b>	0.001	<b>0.207***</b>	<b>0.147***</b>	—		
15. Social relationships uncertainty	0.012	<b>0.398***</b>	<b>0.313***</b>	<b>0.357***</b>	-0.094*	0.094*	<b>0.433***</b>	<b>0.307***</b>	<b>0.270***</b>	<b>0.482***</b>	0.090*	<b>0.300***</b>	<b>0.259***</b>	<b>0.519***</b>	—	
16. COVID-19 media exposure	0.008	0.059	0.092*	0.087*	<b>0.155***</b>	0.002	0.082*	0.055	0.023	<b>0.120**</b>	<b>0.338***</b>	-0.027	<b>0.211***</b>	0.022	<b>0.150***</b>	—

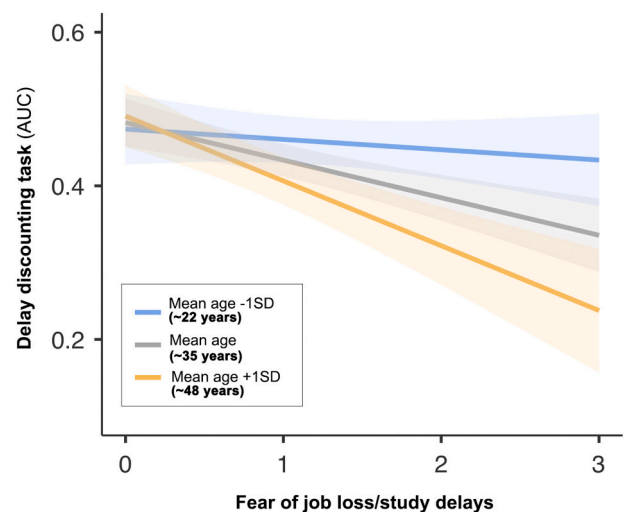
Note. \* p<0.05, \*\* p<0.01, \*\*\* p<0.001; DDT, delay discounting task; DASS, Depression Anxiety Stress Scales; DASS-D, depression, DASS -A, anxiety; DASS -S, stress; IUS-R, Intolerance of Uncertainty Scale-Revised. Pearson correlations in bold type were significant after Bonferroni's correction (p≤0.003).

**Table 4**  
Results of the multiple regression model including predictors of delay discounting and their interactions.

Model fit	Predictors	Statistics			
		B [95% CI]	β	t	p
F(7,578) = 7.38, p<0.001, R <sup>2</sup> <sub>Adj</sub> = 0.07	Age	-0.001 [-0.004, 0.002]	-0.168	-0.665	0.506
	Fear of job loss/study delay	-0.06 [-0.1, -0.03]	-0.187	-3.317	<0.001
	Gender, ref. males	-0.07 [-0.12, -0.03]	-0.139	-3.299	0.001
	Fear of job loss/study delay × Age	-0.004 [-0.007, -0.0007]	-0.131	-2.38	0.018
	Fear of job loss/study delay × Gender	0.02 [-0.02, 0.07]	0.047	1.08	0.281
	Age × Gender	-0.003 [-0.007, -0.0003]	-0.079	-1.777	0.076
	Fear of job loss/study delay × Gender × Age	0.002 [-0.002, 0.005]	0.047	1.039	0.299

Note. Bold p values indicate significant predictors.

Furthermore, our findings seem to converge with longitudinal evidence (Chandola et al., 2020; Pierce et al., 2021), which maps distinct mental health trajectories during the lockdown in the UK, wherein two



**Fig. 2.** Moderating effects of age on the relationship between fear of job loss and delay discounting task performance. Simple slopes with the prediction confidence intervals (95% CI) are represented.

groups emerged to be more vulnerable to mental worsening over time: the former presenting mental issues deteriorating rapidly since the pandemic onset and without recovery signs, versus the latter showing a steadily worsening of symptoms during the pandemic (Pierce et al., 2021). Following this perspective, we can surmise that possibly the

higher severity rates observed in our sample may be capturing those more vulnerable groups identified by [Pierce et al. \(2021\)](#), which were characterized by pre-existing mental conditions and financial distress: all risk factors that are going to dramatically increase during the pandemic's course. However, we are conscious that this is only a speculation, given that we did not assess the presence of previous mental illness diagnoses; in this regard, presence of previous mental disorders as well as financial distress seem to be relevant factors that should be considered by future longitudinal studies ([Lindert et al., 2021](#)).

Importantly, among the psychological symptoms assessed in our survey, depression was the most critical in terms of severity, with the extremely severe symptoms rates being almost doubled as compared to the lockdown assessment (8.4% vs. 4.7% ([Lenzo et al., 2020](#))), mirroring the evidence of increased suicidal thoughts rates across Europe, during this pandemic ([McCracken et al., 2020](#); [O'Connor et al., 2021](#)).

Moreover, looking at the comorbidity between depression, anxiety, and stress revealed a further clarifying perspective on pandemic impact, as the percentage of people meeting the criteria for a significant problem (moderate-to-extremely severe) in at least one condition was 49.3% (leaving 50.7% meeting criteria for no conditions) — overall, highlighting that half of our sample presented at least a psychological symptom after one-year into the pandemic. These results also showed a high comorbidity between psychological distress, with 15.9% of people reporting significant symptoms in three conditions and 14.3 in two, suggesting that one-third of our sample was at risk of developing a more severe psychological outcome, given that severity is strongly related to comorbidity ([Kessler et al., 2005](#)). Indeed, considering the comorbidity between psychological disorders – indirect measure of severity – is particularly relevant, as this can further help to identify unmet clinical needs and deliver preventive interventions for those at higher risks.

Overall, here we provide 'snapshot evidence' of the pandemic's impact on mental health, after 1-year from the outbreak, in Italy. Considering mental disorders prevalence across Europe as well as Italy, this finding adds to the view that mental health deterioration continued through Fall 2020 ([Pierce et al., 2021](#)) and afterwards ([Gori and Topino, 2021](#); [Schmits et al., 2021](#)), despite the previous slight psychological recovery (not to pre-pandemic levels) during Summer 2020, coinciding with the national lockdowns lifting in Europe. This worsening scenario was not driven exclusively by the reinforcement of regional lockdowns ([Chandola et al., 2020](#); [Pierce et al., 2021](#)), but mostly by other pandemic-related stressors, such as socioeconomic factors, which initially were poor predictors of psychological distress but gained a greater influence as the pandemic develops, hence exacerbating inequalities among the population.

In this regard, the novelty of this study lies in the identification of the risk factors and pandemic-related stressors having an impact on mental health one year into COVID-19 by considering a broad psychosocioeconomic context to achieve more insight on which groups are more vulnerable on the long-term.

Loneliness was the largest determinant of depression, anxiety and stress; while its impact on depression and anxiety is unsurprising and corroborates a bulk of evidence during the first outbreak (March–November 2020) ([Chandola et al., 2020](#); [Killgore et al., 2020](#); [Ypsilanti et al., 2021](#)). Our findings further underline loneliness's strong association with stress. A concerning result is that regarding the 24 and 6%, who often or constantly reported loneliness, respectively: that is, one-third of the sample was significantly feeling lonely one year into COVID-19. Given that in March 2021, there were only regional lockdowns across Italy, paralleled by periodical easing of containment measures, we can surmise that loneliness was mostly triggered by the prolonged effect of social restrictions, leading to a substantial social life disruption. Likewise, we found that greater uncertainty in social relationships emerged as an additional risk factor to mental health problems, consistent with the notion that the general population is experiencing a significant surge in loneliness and social disconnection as a consequence of the enacted restrictions. This is clinically meaningful,

as loneliness has been associated with a wide range of comorbid illnesses including substance use, physical health and cognitive decline ([Ingram et al., 2020](#)).

A further remarkable finding is that intolerance of uncertainty, as a dispositional trait, strongly predicted the psychological distress one year into the pandemic; in particular depression, followed by stress and anxiety symptoms, confirmed the transdiagnostic nature of this trait ([Carleton, 2016](#)) and its association with emotional disturbances observed during the lockdown ([Di Blasi et al., 2021](#); [Rettie and Daniels, 2020](#)). In this prolonged exposure to COVID-19 events, surrounded by rising uncertainties and unknowns, our data further underline the centrality of intolerance of uncertainty, which likely gained more predictive power as the pandemic develops. Hence, considering this vulnerable trait as a potential target in the transdiagnostic treatment of emotional disorders can provide effective treatment strategies directed to improving mental health through the reduction of uncertainty ([Boswell et al., 2013](#)).

Finally, as expected, the fear of job loss was among the greatest predictors of psychological distress one year into the pandemic, partially mirroring previous evidence ([Chandola et al., 2020](#); [Wilson et al., 2020](#)). Namely, fear of job loss is a key determinant of anxiety, and together with financial insecurity, a determinant of more severe depressive symptoms. In addition, a novel result was the association with stress disorders, not observed during the lockdown ([Wilson et al., 2020](#)), which can possibly reflect the prolonged effect of job loss fear on psychological burden over time. Indeed, as the pandemic develops, socioeconomic effects emerged as having a robust association with declining mental health, suggesting that mental health potentially continues to deteriorate if employers and legislators do not implement timely recovery plans to reduce job insecurity and financial concern. Of note, this variable was converted for our student subsample into 'fear of study delay'. Interestingly this emerged as a significant risk factor, predicting mental health worsening in terms of depression, anxiety and stress; as partially reported from the first lockdown evidence ([Dhar et al., 2020](#)).

The fear of being infected by COVID-19, in agreement with a previous study ([Mertens et al., 2020](#)), was a relevant factor in predicting anxiety. However, some of the hypothesized stressors did not emerge as the most relevant in predicting psychological distress, such as demographic factors or the COVID-19 mass-media exposure, which overall did not account for the largest share of variance. Nevertheless, correlation analyses indicate a positive association between psychological distress and being younger and/or female, confirming previous findings at the start of the pandemic ([Fiorenzato et al., 2021](#); [Xiong et al., 2020](#)).

#### 4.2. Decision-making processes and related risk factors

To our knowledge, this is the first study aimed at investigating the prolonged COVID-19 pandemic impact and its associated stressors on decision-making processes, one-year after its outbreak. Extant research indicates that elevated psychological distress can influence an individual's decision-making, resulting in greater impulsive behaviors and reduced cognitive control ([Liu et al., 2013](#)). Since this pandemic has globally exposed most individuals to unprecedented stress, in this context we assessed decision-making through a computerized hypothetical monetary DDT.

Our main finding indicates that elevated delay discounting – driven by more immediate-oriented behaviors – was mostly predicted by the interaction between higher financial insecurity (fear of job loss) and an older age. This robust association was statistically significant only within the adult and older adult groups (mean age: about 35 and 48 years, respectively), but not in the young (mean age: about 22 years). This result leads to the consideration that older adults experiencing financial insecurity are more prone to undervalue future outcomes and overvaluing immediate, but less profitable rewards. This tendency, translated into real life situations, can further contribute to money mismanagement as well as problematic behaviors in this pandemic



context.

By contrast, financial uncertainty seems to not affect decision-making in young adults; this last result is not surprising given that the youngest are mostly students and still unemployed in our sample, thus they perhaps perceive less responsibility in terms of monetary loss/income.

Regarding the other predictors, greater delay discounting was associated with being female, although the interaction model resulted as insignificant when this variable was included — by contrast a previous study during the lockdown showed women had a tendency to discount less than men (DeAngelis et al., 2021). Nonetheless, pre-pandemic evidence accounts are contradictory, with studies reporting: females discounting more than males (Reynolds et al., 2006), the opposite scenario Kirby and Maraković, 1996, and no gender differences (Logue and Anderson, 2001). Here, we can speculate that women showed higher delay discounting rates, preferring immediate smaller rewards than delayed larger gains, as a consequence of the stressful context induced by the COVID-19 crisis (Malesza, 2019), wherein females experienced higher general distress levels ( $36.91 \pm 23.38$ ) than men ( $29.47 \pm 18.71$ ). However, future investigations will be necessary to disentangle gender's role in the relationship between delay discounting and stressful conditions.

Altogether, our results lend support to the stress-vulnerability model (Sinha, 2001, 2008), suggesting that when individuals are strained (here exposed to a financial stressor), they shift to a more immediate-oriented decision-making, as reflected by more impulsive delay discounting.

In addition, more reward-oriented decision-making tendencies are frequently linked to psychopathology, maladaptive and risky health behaviors (Odum et al., 2020); our findings provide new insight into the risk factors to more immediate-oriented decision-making and consequently maladaptive behaviors in this pandemic context; namely fear of job loss, older age and being female.

Recently, a few studies observed an association between greater delay discounting and poor compliance with public health containment measures during this pandemic (DeAngelis et al., 2021; Nese et al., 2020; Wismans et al., 2021) as well as with appropriate mask-wearing behaviors (Byrne et al., 2021); indeed as for most healthy behaviors. Also, COVID-19 prevention heavily relies on an individual's decision-making, requiring a choice between immediate pleasant-rewards versus potentially healthier delayed rewards.

A final observation is that some of the hypothesized stressors were not associated with delay discounting behaviors such as intolerance of uncertainty and psychological distress; contrasting with a previous study, which found a direct weak association with stress (DeAngelis et al., 2021). A potential explanation can depend on our choice of a hypothetical monetary discounting task, which had possibly emphasized the financial instability factors, as a consequence of the financial crisis experienced during this pandemic (Wismans et al., 2021). Given that the equivalence between real and hypothetical monetary rewards has been largely demonstrated (Green and Lawyer, 2014; Odum et al., 2020), we believe our findings can be translated into real life evidence, highlighting that individuals affected by financial insecurity possibly present greater immediate-oriented daily behavior tendencies in the COVID-19 pandemic.

#### 4.3. Strengths and limitation

Our study has limitations that need to be addressed. The major shortcoming is the cross-sectional design, which prevented us to capture the various trajectories of mental health and decision-making over the pandemic's course. However, to our knowledge, this is the first published study reporting data on Italy's populace after 1-year into pandemic, analyzing detailed measures of psychological, social and economic stressors. Future longitudinal studies monitoring longer period will be necessary (Lindert et al., 2021; Pierce et al., 2021). Pandemic-associated stressors were self-reported measures, although

loneliness and financial concern have been described as stable factors, during the first pandemic semester (Chandola et al., 2020). Loneliness was assessed through a Likert-scale and not a standardized questionnaire, differently from other studies (Killgore et al., 2020) — but given the extraordinary situation these tools are possibly unsuitable to assess this novel 'imposed' loneliness, as results of social restrictions. Although in the current study, we have no measure of pre-existing mental conditions, the state of psychological distress (in terms of depression, anxiety and stress) as well as of the intolerance of uncertainty was measured by using validated clinical scales (DASS-21 and IUS-R), assessing the presence of symptoms over the previous 2-weeks (Bottesi et al., 2015, 2019).

Our research sampling was based on the snowball method, involving an online invitation, but leaving unexplored people not using networked devices. However, during this pandemic, this was our only feasible sampling method to reach a heterogeneous sample. In addition, we encouraged participants to invite the elderly and people with poor internet skills.

Our study is also characterized by several strengths. The sample embraces a large portion of individuals and has an adequate representation of Italy with an age range between 18 and 73 years, a pan-Italy distribution, and diverse educational levels. It is less balanced for gender, as about 68% were female, which is a frequent issue of many web-based surveys performed during this pandemic (Green et al., 2021). Also, together with more classical self-reported measures, our study used a computerized hypothetical monetary delay discounting task, which allows to objectively assess different decision-making tendencies.

## 5. Conclusions

This is one of the first studies to report data on mental health disorders one-year after the COVID-19 outbreak in Italy's general population. In March 2021, we found alarming levels of depression, anxiety and stress exceeding the initial lockdown rates, mirrored by an increase of symptoms at a clinically significant severity level — implying that a more prolonged deterioration in mental health occurred over time.

We identified distinct psycho-socioeconomic factors predicting mental health disorders and decision-making: with fear of job loss, loneliness and intolerance of uncertainty being among the major risk factors to mental health deterioration, with fear of job loss being strictly related to more impulsive decision-making tendencies. Given that more impulsive behaviors are frequently linked to psychopathology, maladaptive and risky health compartments, we believe addressing and facing the impact of these psycho-socioeconomic stressors is crucial for implementing efficacious preventive interventions, as well as to help mental health services in targeting more vulnerable groups, whom we identified herein.

In advance of further containment measures or future pandemics, public mental health should be a priority and support should be oriented toward more vulnerable groups. Furthermore, legislators need to implement timely recovery plans directed in reducing job insecurity and financial concerns, given those factors' significant impact on both mental health and decision-making outcomes after one-year into a pandemic.

## Funding source

This work was supported by Grant 'Giovani Ricercatori – Ricerca Finalizzata 2018' code GR-2018-12366002 from Ministry of Health, Italy and by STARS Starting Grant 'BeBrEvo' (University of Padua) to G. C. This work was carried out within the scope of the project "use-inspired basic research", for which the Department of General Psychology of the University of Padua has been recognized as "Dipartimento di Eccellenza" by the Ministry of University and Research. The authors declare no competing financial interests.

## CRedit authorship contribution statement

Authors EF and GC conceptualized the study and collected the data. EF ran the statistical analyses and wrote the first draft of the article. GC contributed to the interpretation of results and critically reviewed the draft. EF and GC contributed to the subsequent redrafting of the article. All authors contributed to and have approved the final manuscript.

## Declaration of competing interest

None.

## Acknowledgements

None.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jad.2022.04.144>.

## References

- Bareket-Bojmel, L., Shahar, G., Margalit, M., 2020. COVID-19-related economic anxiety is as high as health anxiety: findings from the USA, the UK, and Israel. *Int. J. Cogn. Ther.* 1–9 <https://doi.org/10.1007/s41811-020-00078-3>.
- Berns, G.S., Laibson, D., Loewenstein, G., 2007. Intertemporal choice – toward an integrative framework. *Trends Cogn. Sci.* 11, 482–488. <https://doi.org/10.1016/j.tics.2007.08.011>.
- Boswell, J.F., Thompson-Hollands, J., Farchione, T.J., Barlow, D.H., 2013. Intolerance of uncertainty: a common factor in the treatment of emotional disorders. *J. Clin. Psychol.* 69, 630–645. <https://doi.org/10.1002/jclp.21965>.
- Bottesi, G., Ghisi, M., Altoè, G., Conforti, E., Melli, G., Sica, C., 2015. The Italian version of the Depression Anxiety Stress Scales-21: factor structure and psychometric properties on community and clinical samples. *Compr. Psychiatry* 60, 170–181. <https://doi.org/10.1016/j.comppsy.2015.04.005>.
- Bottesi, G., Noventa, S., Freeston, M.H., Ghisi, M., 2019. Seeking certainty about intolerance of uncertainty: addressing old and new issues through the intolerance of uncertainty scale-revised. *PLOS ONE* 14, e0211929. <https://doi.org/10.1371/journal.pone.0211929>.
- Byrne, K.A., Six, S.G., Anaraky, R.G., Harris, M.W., Winterlind, E.L., 2021. Risk-taking unmasked: using risky choice and temporal discounting to explain COVID-19 preventative behaviors. *PLOS ONE* 16, e0251073. <https://doi.org/10.1371/journal.pone.0251073>.
- Carleton, R.N., 2016. Into the unknown: a review and synthesis of contemporary models involving uncertainty. *J. Anxiety Disord.* 39, 30–43. <https://doi.org/10.1016/j.janxdis.2016.02.007>.
- Chandola, T., Kumari, M., Booker, C.L., Benzeval, M., 2020. The mental health impact of COVID-19 and lockdown-related stressors among adults in the UK. *Psychol. Med.* 1–10 <https://doi.org/10.1017/S0033291720005048>.
- Cohen, J., Cohen, P., West, S.G., Aiken, L.S., 2003. *Applied multiple regression/correlation analysis for the behavioral sciences*. In: *Applied multiple regression/correlation analysis for the behavioral sciences*, 3rd ed, 3rd ed. Lawrence Erlbaum Associates Publishers, Mahwah, NJ, US.
- Cona, G., Koçillari, L., Palombit, A., Bertoldo, A., Maritan, A., Corbetta, M., 2019. Archetypes of human cognition defined by time preference for reward and their brain correlates: an evolutionary trade-off approach. *NeuroImage* 185, 322–334. <https://doi.org/10.1016/j.neuroimage.2018.10.050>.
- Curtis, B.J., Williams, P.G., Anderson, J.S., 2018. Objective cognitive functioning in self-reported habitual short sleepers not reporting daytime dysfunction: examination of impulsivity via delay discounting. *Sleep* 41, zsy115. <https://doi.org/10.1093/sleep/zsy115>.
- DeAngelis, B.N., Salah, A.B., al'Absi, M., 2021. Stress and COVID-19 related behaviours: the mediating role of delay discounting. *Stress Health*. <https://doi.org/10.1002/smi.3060> n/a.
- Dhar, B.K., Ayttey, F.K., Sarkar, S.M., 2020. Impact of COVID-19 on psychology among the university students. *Global Chall.* 4, 2000038 <https://doi.org/10.1002/gch2.202000038>.
- Di Blasi, M., Gullo, S., Mancinelli, E., Freda, M.F., Esposito, G., Gelo, O.C.G., Lagetto, G., Giordano, C., Mazzeschi, C., Pazzagli, C., Salcuni, S., Lo Coco, G., 2021. Psychological distress associated with the COVID-19 lockdown: a two-wave network analysis. *J. Affect. Disord.* 284, 18–26. <https://doi.org/10.1016/j.jad.2021.02.016>.
- Fiorenzato, E., Zabberoni, S., Costa, A., Cona, G., 2021. Cognitive and mental health changes and their vulnerability factors related to COVID-19 lockdown in Italy. *PLoS One* 16, e0246204. <https://doi.org/10.1371/journal.pone.0246204>.
- González-Sanguino, C., Ausín, B., Castellanos, M.Á., Saiz, J., López-Gómez, A., Ugidos, C., Muñoz, M., 2020. Mental health consequences during the initial stage of the 2020 coronavirus pandemic (COVID-19) in Spain. *Brain Behav. Immun.* 87, 172–176. <https://doi.org/10.1016/j.bbi.2020.05.040>.
- Goodwin, R., Hou, W.K., Sun, S., Ben-Ezra, M., 2020. Quarantine, distress and interpersonal relationships during COVID-19. *Gen. Psychiatry* 33. <https://doi.org/10.1136/gpsych-2020-100385>.
- Gori, A., Topino, E., 2021. Across the COVID-19 waves; assessing temporal fluctuations in perceived stress, post-traumatic symptoms, worry, anxiety and civic moral disengagement over one year of pandemic. *Int. J. Environ. Res. Public Health* 18, 5651. <https://doi.org/10.3390/ijerph18115651>.
- Green, R.M., Lawyer, S.R., 2014. Steeper delay and probability discounting of potentially real versus hypothetical cigarettes (but not money) among smokers. *Behav. Process.* 108, 50–56. <https://doi.org/10.1016/j.beproc.2014.09.008>.
- Green, H., Fernandez, R., MacPhail, C., 2021. Social media as a platform for recruitment to a national survey during the COVID-19 pandemic: feasibility and cost analysis. *JMIR Form. Res.* 5, e28656 <https://doi.org/10.2196/28656>.
- Hampshire, A., Hellyer, P.J., Soreq, E., Mehta, M.A., Ioannidis, K., Trender, W., Grant, J. E., Chamberlain, S.R., 2021. Associations between dimensions of behaviour, personality traits, and mental-health during the COVID-19 pandemic in the United Kingdom. *Nat. Commun.* 12, 4111. <https://doi.org/10.1038/s41467-021-24365-5>.
- Hansen, T., Sevenius Nilsen, T., Knapstad, M., Skirbekk, V., Skogen, J., Vedaa, Ø., Nes, R. B., 2021. COVID-fatigued? A longitudinal study of Norwegian older adults' psychosocial well-being before and during early and later stages of the COVID-19 pandemic. *Eur. J. Ageing*. <https://doi.org/10.1007/s10433-021-00648-0>.
- Ingram, I., Kelly, P.J., Deane, F.P., Baker, A.L., Goh, M.C.W., Raftery, D.K., Dingle, G.A., 2020. Loneliness among people with substance use problems: a narrative systematic review. *Drug Alcohol Rev.* 39, 447–483. <https://doi.org/10.1111/dar.13064>.
- Kessler, R.C., Chiu, W.T., Demler, O., Walters, E.E., 2005. Prevalence, severity, and comorbidity of 12-month DSM-IV disorders in the National Comorbidity Survey Replication. *Arch. Gen. Psychiatry* 62, 617–627. <https://doi.org/10.1001/archpsyc.62.6.617>.
- Killgore, W.D.S., Cloonan, S.A., Taylor, E.C., Dailey, N.S., 2020. Loneliness: a signature mental health concern in the era of COVID-19. *Psychiatry Res.* 290, 113117 <https://doi.org/10.1016/j.psychres.2020.113117>.
- Kirby, K.N., Maraković, N.N., 1996. Delay-discounting probabilistic rewards: rates decrease as amounts increase. *Psychon. Bull. Rev.* 3, 100–104. <https://doi.org/10.3758/BF03210748>.
- Lagorio, C.H., Madden, G.J., 2005. Delay discounting of real and hypothetical rewards III: Steady-state assessments, forced-choice trials, and all real rewards. In: *Behavioural Processes, Proceedings of the meeting of the Society for the Quantitative Analyses of Behavior (SQAB 2004)*, 69, pp. 173–187. <https://doi.org/10.1016/j.beproc.2005.02.003>.
- Lee, Y., Lui, L.M.W., Chen-Li, D., Liao, Y., Mansur, R.B., Brietzke, E., Rosenblat, J.D., Ho, R., Rodrigues, N.B., Lipsitz, O., Nasri, F., Cao, B., Subramaniapillai, M., Gill, H., Lu, C., McIntyre, R.S., 2021. Government response moderates the mental health impact of COVID-19: a systematic review and meta-analysis of depression outcomes across countries. *J. Affect. Disord.* 290, 364–377. <https://doi.org/10.1016/j.jad.2021.04.050>.
- Lenzo, V., Quattropiani, M.C., Musetti, A., Zenesini, C., Freda, M.F., Lemmo, D., Vegni, E., Borghi, L., Plazzi, G., Castelnovo, G., Cattivelli, R., Saita, E., Franceschini, C., 2020. Resilience contributes to low emotional impact of the COVID-19 outbreak among the general population in Italy. *Front. Psychol.* 11 <https://doi.org/10.3389/fpsyg.2020.576485>.
- Lindert, J., Jakubauskiene, M., Bilsen, J., 2021. The COVID-19 disaster and mental health—assessing, responding and recovering. *Eur. J. Pub. Health* 31, iv31–iv35. <https://doi.org/10.1093/eurpub/ckab153>.
- Liu, L., Feng, T., Chen, J., Li, H., 2013. The value of emotion: how does episodic prospection modulate delay discounting? *PLOS ONE* 8, e81717. <https://doi.org/10.1371/journal.pone.0081717>.
- Logue, A.W., Anderson, Y.D., 2001. Higher-education administrators: when the future does not make a difference. *Psychol. Sci.* 12, 276–281. <https://doi.org/10.1111/1467-9280.00351>.
- Lovibond, S.H., Lovibond, P.F., 1996. *Manual for the Depression Anxiety Stress Scales*. Psychology Foundation of Australia.
- MacDonald, J.J., Baxter-King, R., Vavreck, L., Naeim, A., Wenger, N., Sepucha, K., Stanton, A.L., 2022. Depressive symptoms and anxiety during the COVID-19 pandemic: large, longitudinal, cross-sectional survey. *JMIR Ment. Health* 9, e33585. <https://doi.org/10.2196/33585>.
- Malesza, M., 2019. Relationship between emotion regulation, negative affect, gender and delay discounting. *Curr. Psychol.* <https://doi.org/10.1007/s12144-019-00366-y>.
- Mazza, C., Ricci, E., Biondi, S., Colasanti, M., Ferracuti, S., Napoli, C., Roma, P., 2020. A nationwide survey of psychological distress among Italian people during the COVID-19 pandemic: immediate psychological responses and associated factors. *IJERPH* 17, 3165. <https://doi.org/10.3390/ijerph17093165>.
- McCracken, L.M., Badinlou, F., Buhman, M., Brocki, K.C., 2020. Psychological impact of COVID-19 in the Swedish population: depression, anxiety, and insomnia and their associations to risk and vulnerability factors. *Eur. Psychiatry* 63. <https://doi.org/10.1192/j.eurpsy.2020.81>.
- Mertens, G., Gerritsen, L., Duijndam, S., Saleminck, E., Engelhard, I.M., 2020. Fear of the coronavirus (COVID-19): predictors in an online study conducted in march 2020. *J. Anxiety Disord.* 74, 102258 <https://doi.org/10.1016/j.janxdis.2020.102258>.
- Myerson, J., Green, L., Warusawitharana, M., 2001. Area under the curve as a measure of discounting. *J. Exp. Anal. Behav.* 76, 235–243. <https://doi.org/10.1901/jeab.2001.76-235>.
- Nese, M., Riboli, G., Brighetti, G., Sassi, V., Camela, E., Caselli, G., Sassaroli, S., Borlimi, R., 2020. Delay discounting of compliance with containment measures during the COVID-19 outbreak: a survey of the Italian population. *J. Public Health (Berl.)*. <https://doi.org/10.1007/s10389-020-01317-9>.

- Nørgaard, S.K., Vestergaard, L.S., Nielsen, J., Richter, L., Schmid, D., Bustos, N., Braye, T., Athanasiadou, M., Lytras, T., Denissov, G., Veideman, T., Luomala, O., Möttönen, T., Fouillet, A., Caserio-Schönemann, C., Heiden, M. an der, Uphoff, H., Gkolfinopoulou, K., Bobvos, J., Paldy, A., Rotem, N., Kornilenko, I., Domegan, L., O'Donnell, J., Donato, F.D., Scortichini, M., Hoffmann, P., Velez, T., England, K., Calleja, N., Asten, L. van, Stoeldraijer, L., White, R.A., Paulsen, T.H., Silva, S.P. da, Rodrigues, A.P., Klepac, P., Zaletel, M., Fafangel, M., Larrauri, A., León, I., Farah, A., Galanis, I., Junker, C., Perisa, D., Sinnathamby, M., Andrews, N., O'Doherty, M.G., Irwin, D., Kennedy, S., McMenamin, J., Adlhoch, C., Bundle, N., Penttinen, P., Pukkila, J., Pebody, R., Krause, T.G., Mølbak, K., 2021. Real-time monitoring shows substantial excess all-cause mortality during second wave of COVID-19 in Europe, October to December 2020. *Eurosurveillance* 26, 2002023. <https://doi.org/10.2807/1560-7917.ES.2021.26.1.2002023>.
- O'Connor, R.C., Wetherall, K., Cleare, S., McClelland, H., Melson, A.J., Niedzwiedz, C.L., O'Carroll, R.E., O'Connor, D.B., Platt, S., Scowcroft, E., Watson, B., Zorzea, T., Ferguson, E., Robb, K.A., 2021. Mental health and well-being during the COVID-19 pandemic: longitudinal analyses of adults in the UK COVID-19 Mental Health & Wellbeing study. *Br. J. Psychiatry* 218, 326–333. <https://doi.org/10.1192/bjp.2020.212>.
- Odum, A.L., Becker, R.J., Haynes, J.M., Galizio, A., Frye, C.C.J., Downey, H., Friedel, J. E., Perez, D.M., 2020. Delay discounting of different outcomes: review and theory. *J. Exp. Anal. Behav.* 113, 657–679. <https://doi.org/10.1002/jeab.589>.
- Parlapani, E., Holeva, V., Nikopoulou, V.A., Sereslis, K., Athanasiadou, M., Godosidis, A., Stephanou, T., Diakogiannis, I., 2020. Intolerance of uncertainty and loneliness in older adults during the COVID-19 pandemic. *Front. Psychiatry* 11, 842. <https://doi.org/10.3389/fpsy.2020.00842>.
- Pfefferbaum, B., North, C.S., 2020. Mental health and the COVID-19 pandemic. *N. Engl. J. Med.* 383, 510–512. <https://doi.org/10.1056/NEJMp2008017>.
- Pierce, M., McManus, S., Hope, H., Hotopf, M., Ford, T., Hatch, S.L., John, A., Kontopantelis, E., Webb, R.T., Wessely, S., Abel, K.M., 2021. Mental health responses to the COVID-19 pandemic: a latent class trajectory analysis using longitudinal UK data. *Lancet Psychiatry* 8, 610–619. [https://doi.org/10.1016/S2215-0366\(21\)00151-6](https://doi.org/10.1016/S2215-0366(21)00151-6).
- Rettie, H., Daniels, J., 2020. Coping and tolerance of uncertainty: predictors and mediators of mental health during the COVID-19 pandemic. *Am. Psychol.* 76, 427. <https://doi.org/10.1037/amp0000710>.
- Reynolds, B., Ortengren, A., Richards, J.B., de Wit, H., 2006. Dimensions of impulsive behavior: personality and behavioral measures. *Personal. Individ. Differ.* 40, 305–315. <https://doi.org/10.1016/j.paid.2005.03.024>.
- Robinson, E., Sutin, A.R., Daly, M., Jones, A., 2022. A systematic review and meta-analysis of longitudinal cohort studies comparing mental health before versus during the COVID-19 pandemic in 2020. *J. Affect. Disord.* 296, 567–576. <https://doi.org/10.1016/j.jad.2021.09.098>.
- Schmits, E., Dekeyser, S., Klein, O., Luminet, O., Yzerbyt, V., Glowacz, F., 2021. Psychological distress among students in higher education: one year after the beginning of the COVID-19 pandemic. *Int. J. Environ. Res. Public Health* 18, 7445. <https://doi.org/10.3390/ijerph18147445>.
- Sinha, R., 2001. How does stress increase risk of drug abuse and relapse? *Psychopharmacology* 158, 343–359.
- Sinha, R., 2008. Chronic stress, drug use, and vulnerability to addiction. *Ann. N. Y. Acad. Sci.* 1141, 105.
- Smith, B.M., Twohy, A.J., Smith, G.S., 2020. Psychological inflexibility and intolerance of uncertainty moderate the relationship between social isolation and mental health outcomes during COVID-19. *J. Contextual Behav. Sci.* 18, 162–174. <https://doi.org/10.1016/j.jcbs.2020.09.005>.
- Thorndike, A.N., Fung, V., McCurley, J.L., Clark, C.R., Howard, S., Levy, D.E., 2022. COVID-19 stressors and one-year changes in depression and anxiety in a longitudinal cohort of low-income adults in the United States. *Prev. Med. Rep.* 26, 101730. <https://doi.org/10.1016/j.pmedr.2022.101730>.
- Wilson, J.M., Lee, J., Fitzgerald, H.N., Oosterhoff, B., Sevi, B., Shook, N.J., 2020. Job insecurity and financial concern during the COVID-19 pandemic are associated with worse mental health. *J. Occup. Environ. Med.* 62, 686–691. <https://doi.org/10.1097/JOM.0000000000001962>.
- Wismans, A., Letina, S., Wennberg, K., Thurik, R., Baptista, R., Burke, A., Dejardin, M., Janssen, F., Santarelli, E., Torrès, O., Franken, I., 2021. The role of impulsivity and delay discounting in student compliance with COVID-19 protective measures. *Personal. Individ. Differ.* 179, 110925. <https://doi.org/10.1016/j.paid.2021.110925>.
- Xiong, J., Lipsitz, O., Nasri, F., Lui, L.M.W., Gill, H., Phan, L., Chen-Li, D., Iacobucci, M., Ho, R., Majeed, A., McIntyre, R.S., 2020. Impact of COVID-19 pandemic on mental health in the general population: a systematic review. *J. Affect. Disord.* 277, 55–64. <https://doi.org/10.1016/j.jad.2020.08.001>.
- Ypsilanti, A., Mullings, E., Hawkins, O., Lazuras, L., 2021. Feelings of fear, sadness, and loneliness during the COVID-19 pandemic: findings from two studies in the UK. *J. Affect. Disord.* 295, 1012–1023. <https://doi.org/10.1016/j.jad.2021.08.031>.
- Zaninotto, P., Iob, E., Demakos, P., Steptoe, A., 2022. Immediate and longer-term changes in the mental health and well-being of older adults in England during the COVID-19 pandemic. *JAMA Psychiatry* 79, 151–159. <https://doi.org/10.1001/jamapsychiatry.2021.3749>.