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Research paper

The COVID-19 pandemic in Italy: Depressive symptoms immediately before and after the first lockdown

Emanuela Medda^{*}, Virgilia Toccaceli, Antonella Gigantesco, Angelo Picardi, Corrado Fagnani, Maria Antonietta Stazi

Center of Reference for Behavioral Sciences and Mental Health, Istituto Superiore di Sanità, Viale Regina Elena, 299, Rome 00161, Italy



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ABSTRACT

Background: Italy was one of the first countries to be heavily hit by the spread of the new Coronavirus. Longitudinal studies are needed to investigate the real effect of COVID-19 on adult mental health. The Italian Twin Registry carried out a study to investigate, over time, the course of depressive symptoms in the general population.

Methods: The study relies on data collected just before the beginning (February 2020) and the end (June 2020) of the first lockdown. Symptoms of depression were assessed using the Patient Health Questionnaire, and total scores or categorized depression scores were considered in the analyzes.

Results: A total of 1690 adult twins were recruited. The study showed a mean depression score of 1.11 immediately before lockdown and 1.20 immediately after, with an overall prevalence of depressive symptoms increasing from 33.6 to 38.9%. Depressive symptoms immediately after the restriction period were associated with Covid-19 symptoms affecting households, financial problems due to the pandemic and poor social support. Independently of the baseline risk of depressive symptoms, we observed an increased risk among younger and less educated people. Compared to the pre-lockdown period, women and middle-aged people also were found to be at greater risk of developing depressive symptoms.

Limitations: Possible participation bias and residual selection bias.

Conclusions: The study shows that the COVID-19 pandemic was associated with an increased depressive symptomatology and that, in such health emergency times, the most vulnerable persons are young adults, women, and those living in a socially, culturally, or economically disadvantaged environment.

1. Introduction

Italy was one of the first countries worldwide to be severely afflicted by the spread of the new Coronavirus. The Covid-19 pandemic has caused in this Country a total number of 4,271,276 confirmed cases with 127,775 deaths (Ministero della Salute, 2021) up to July 2021. In early March 2020, the Italian Government promptly introduced strict national measures to restrain the outbreak. Thanks also to the vaccination campaign, the incidence of the infection has been continuously decreasing throughout the Country until the beginning of July 2021, but a new rise in the number of cases was observed more recently (Ministero della Salute, 2021a). Therefore, in this unpredictable scenario, the question of mental health consequences and impact remains central, as Prati and colleagues (Prati et al., 2021) have recently stated in a review on the topic “given that the Covid-19 pandemic is likely to persist

through 2021, the question of the psychological impact of repeated or prolonged lockdowns will remain open”.

Indeed, there have been plenty of studies conducted during 2020 and the first months of 2021 that focused on the consequences of the pandemic and related lockdowns on the psychological and social well-being of people. Nonetheless, it should be noted that a high heterogeneity in terms of methods, periods of observations and populations' samples echoes on results. The findings may be, in fact, deeply influenced by differences in individual and collective attitude towards stressful extraordinary events like the unprecedented social life constraints experienced in different countries (Prati and Mancini, 2021).

Mental health symptoms such as depression, anxiety and stress have variably been reported during the outbreak of Covid-19 all over the world by cross-sectional studies examining samples of the general population (e.g. Wang et al. 2020a, Odriozola-Gonzalez et al. 2020a,

^{*} Corresponding author.

E-mail address: emanuela.medda@iss.it (E. Medda).

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Park et al., 2020) or specific sub-groups like students or workers (e.g. Cao et al. 2020, Odrizola-Gonzalez et al. 2020b). The vast majority of those studies have indicated that younger age was a predictor of depressive or anxiety symptomatology during the COVID-19 outbreak (Ahmed et al., 2020; Gao et al., 2020; Gonzalez et al., 2020; Huang and Zhao, 2020; Moreira et al., 2020). Among younger individuals, a large proportion had a student status, which was also found to be associated with higher levels of depressive symptoms and/or PTSD symptoms (Lei et al., 2020; Olagoke et al., 2020; Samadarshi et al., 2020; Wang et al., 2020a). Numerous studies highlighted how the pandemic has had a more negative impact on the female gender (Ahmed et al., 2020; Gao et al., 2020; Lei et al., 2020; González-Sanguino et al., 2020; Qiu et al., 2020; Wang et al., 2020a). Furthermore, individuals with chronic diseases or a history of psychiatric illness were indicated as suffering from more symptoms of anxiety and stress (Brooks et al., 2020; Mazza et al., 2020; Ozamiz-Etxebarria et al., 2020; Özdin and Özdin, 2020). For what concerns disadvantageous socioeconomic positions such as poor economic status, lower education attainment, and unemployment, they were found to be significant risk factors for developing symptoms of mental disorders, especially depressive symptoms during the pandemic period (Solomou and Constantinidou 2020; Pieh et al., 2020; Gao et al., 2020; Lei et al., 2020; Mazza et al., 2020; Olagoke et al., 2020; Wang et al., 2020b), although a few studies showed that individuals with higher education exhibited more depressive symptoms in comparison with less educated individuals (Wang et al., 2020b; Moghanibashi-Mansourieh 2020). In addition to those risk factors, a few studies also identified factors that protected individuals against psychopathological symptoms during the pandemic (Wang et al., 2020a; Zhang and Ma, 2020). For example, it was found that individuals with more social support during the pandemic had lower stress levels (Zhang and Ma, 2020).

After the initial outburst, a number of longitudinal studies have tried to analyze changes in psychological health before, during, and after lockdowns, in order to identify factors possibly contributing to the onset, increase or stability of different psychological symptoms. For example, the UK Household Longitudinal Study (Pierce et al., 2020; Daly et al., 2020) reported that mental health deteriorated in the period April–June 2020, compared to the recorded trends of 2018–2019. Moreover, young people, women, and high income (and high education) groups were found to be at higher risk of mental health deterioration. An increase in anxiety, depression and stress during the lockdown was recorded also in Spain (Planchuelo-Gomez et al., 2020). Moreover, a study conducted in the Netherlands (Van der Velden et al., 2021) found that the pandemic did not seem to substantially affect the prevalence of anxiety and depression during the first four months of social life constraints (March–June 2020). In accordance with the latter findings, the Prati and Mancino (2021) review and meta-analysis of longitudinal and experimental studies on the specific topic of mental health conditions concluded that the pandemic and related lockdowns did not have the same negative effects on mental health in terms of anxiety, depression, stress, and similar constructs in all countries. Moreover, among longitudinal studies, there were a few inconsistencies regarding the factors which were found to be particularly involved in making individuals mental health more vulnerable in the pandemic situation, several weeks after the outbreak of the pandemic (Fancourt et al., 2021). In the UK Household Longitudinal Study, for example, young people (18–34 years old), women, and individuals living with children, especially preschool aged children, were found to be at highest risk of mental health deterioration. Other longitudinal studies reaffirmed that younger adults showed particularly pronounced declines in mental health (Planchuelo-Gomez et al., 2020; Fancourt et al., 2021; Daly and Robison 2021) but some others found that 35–49 years old respondents were also at increased risk of declines in mental health (Daly et al., 2020). As regards female gender, it was found to be a consistent predictor of worse mental health by different longitudinal studies (Planchuelo-Gomez et al., 2020; Daly et al., 2020; Daly and Robison 2021; Fancourt et al., 2021). In

addition, several studies found that pre-existing vulnerabilities such as ethnicity or economic inequality (lower income categories) were risk factors for mental health problems following the inception of the pandemic (Sibley et al., 2020; Kikuchi et al., 2020; Daly and Robison, 2021; Fancourt et al., 2021), whereas some other studies revealed that although rates of mental distress were higher in people who, before lockdown, were unemployed or in other economically inactive roles, such as being a full-time student, the increase in mental distress compared to previous trends was greater among those who were employed before the pandemic or had a higher education or household income (Daly et al., 2020; Pierce et al., 2020). Finally, individuals experiencing persistent loneliness (before and after the COVID-19 outbreak) were also found to be at increased risk of suffering from anxiety and depression symptoms during and after the outbreak (Van der Velden et al., 2021).

In this framework, the present study provides further country-specific evidence on the extent to which mental health was actually affected by the pandemic and by the strict social measures implemented in Italy during the first nation-wide lockdown from March 9 to May 18, 2020. The Italian Twin Registry (ITR), a research infrastructure (Medda et al., 2019) of the Italian National Institute of Health, carried out a study to investigate over time (immediately before and after the Covid-19 lockdown) the occurrence of depressive symptoms in the general adult population, while taking into account the role of socio-demographic and cultural factors.

2. Methods

2.1. Participants and measures

The Italian Twin Registry is a population-based registry of voluntary twins who gave their consent to participate in the studies proposed by the ITR research group. To date, it consists of approximately 29,000 twins.

In February 2020, the ITR carried out a survey to investigate the genetic and environmental contributions to chronic pain occurrence in a sample of adult twins previously enrolled in the ITR and with a known email address. Later, in June 2020, a sample of adult twins, were contacted to investigate the physical and mental health impact of Covid-19 pandemic. Some of the twins participated to both online surveys, and information of participants were linked across the two waves. Below a brief description of the two surveys:

- During the first ITR survey (close to the beginning of lockdown, February 2020), in addition to questions related to chronic pain, self-perceived social support and symptoms of depression were also investigated. The three-item Oslo Social Support Scale (OSS-3) was administered to each of the participants and those who scored 3–8, 9–11 or 12–14 were classified as having “poor”, “moderate” or “strong” social support, respectively (Kocalevent et al., 2018; Dalgard et al., 2006). Symptoms of depression were assessed using the validated two-item Patient Health Questionnaire (PHQ-2) (Kroenke et al., 2003). The scale consists of the first two items (depressed mood and anhedonia) from the PHQ-9 (Kroenke et al., 2001) and total score ranges from 0 to 6 with higher scores indicating greater distress. Participants with PHQ-2 scores of 2 or greater were classified as having depressive symptoms (Levis et al., 2020).
- In June 2020 (close to the end of the lockdown), adult ITR twins were asked to complete a questionnaire to collect information about their (or their family members’) Covid-19 symptoms or positivity to SARS-Cov-2, number and characteristics of cohabitants during lockdown, households’ economic problems, occupation during the lockdown, referred residency in urban or rural area, preferred means of communication during pandemic. Depressive symptoms were measured using the 9-item version of the Patient Health Questionnaire (PHQ-9). Answers to the first two items of this scale were

extrapolated to define the presence of depression symptoms as done in the first survey.

Living abroad during the Italian lockdown was the only exclusion criterion for this study.

Subjects underwent an informed consent procedure to participate in the study. The research was approved by the Ethical committee of the Istituto Superiore di Sanità (May 2020).

2.2. Statistical analysis

PHQ-2 data were first summarised using means and standard deviations for the continuous total scale scores, or percentages for the dichotomous depression symptoms (cut-off score of 2), and were then compared between the two waves using the paired Student’s t-test of means (on the log-transformed total scores to reduce asymmetry) or the McNemar’s test of proportions.

The strength of the association (expressed as odds ratio, OR and 95% Confidence Intervals, 95% CI) between the presence of depressive symptoms (dependent variable) and participants’ socio-demographic characteristics was estimated by a logistic regression model. The extent to which the independent variables affect the dependent variable was estimated immediately before (Model 1, PHQ-2 in February 2020) and after lockdown (Model 2, PHQ-2 in June 2020). The effects of those characteristics in the first and the second survey were then compared to highlight differences between the two observation periods.

A third logistic regression model to assess the impact of the lockdown on the occurrence of depression symptoms immediately after the first Italian lockdown was then fitted (Model 3). The possible determinants were: Covid-19 symptoms among respondents and/or their family members, economic problems, perceived social support. The model took also into account previous depression condition, age, gender, and educational level.

A multiple linear regression approach (Model 4) was also applied using log transformed PHQ-2 total score as dependent continuous variable, with the aforementioned covariates.

In all regression models, p values and standard errors were adjusted for the non-independence of observations because of twin relatedness. All analyzes were performed using Stata software version 16 (Stata Corporation, College Station, TX, USA).

3. Results

About 7000 adult twins, enrolled in the ITR, were invited by email to join the chronic pain online survey and later to participate to the Covid-19 survey. The response rate was about 30% in both surveys and in line with other studies conducted by the ITR. Given the relatively low response rate, to exclude major selection biases in terms of depression vulnerability, depression scores and socio-demographic characteristics were compared between subjects participating in both waves and those taking part in the baseline assessment only. Mean PHQ2 scores were not different between either the two groups considered overall [3.18 (subjects at both waves), 3.26 (subjects at baseline only), $p = 0.09$] or in the socio-demographic variables subgroups.

A total of 1806 twins responded to both surveys, and 1690 subjects, not in pharmacological or psychological treatment for mental health disorders and informative for the PHQ-2 scales, were considered in the analyzes. Mean age was 45 years (range 18–93), with the majority of participants (63%) being women. Characteristics of the study sample are shown in Table 1.

The absolute and relative frequencies of subjects with or without depressive symptoms immediately before and after lockdown are showed in Table 2. During the observation period, the development of depressive symptoms was observed in about 19% of the sample whereas, up to 65% of the subjects were stable (without or with depressive symptoms, 47.5% and 19.9%, respectively). Subjects who increased

Table 1
Total sample sociodemographic characteristics (N = 1690).

	N	%
Age classes (years)		
≤34	459	27.16
35–49	567	33.55
50–64	490	28.99
65+	174	10.30
Gender		
Male	618	36.57
Female	1072	63.43
Area of residence		
North	917	54.42
Center	505	29.97
South and Isles	263	15.61
Educational Level		
High School or below	748	44.44
Bachelor Degree or above	935	55.56
Perceived social Support (Oslo Scale)		
Strong	293	17.35
Moderate	994	58.85
Poor	402	23.80

Table 2
Characteristics of the subgroups that decreased, were stable, or increased in depressive symptoms during the observation period.

Before lockdown	After lockdown	N	%	Age (Mean ± SD)	Female (%)
No depressive symptoms	No depressive symptoms	802	47.46	48.2 ± 14.0	60.1%
No depressive symptoms	Depressive symptoms	321	18.99	41.9 ± 14.2	68.9%
Depressive symptoms	No depressive symptoms	230	13.61	46.4 ± 16.0	58.3%
Depressive symptoms	Depressive symptoms	337	19.94	39.6 ± 15.2	69.7%

Presence of depressive symptoms were defined according to PHQ-2 cut off.

depressive symptoms were slightly younger compared to those who were stable without symptoms, while among subjects who meliorated their depressive state there were relatively more males than in the other subgroups.

Mean PHQ-2 total score was 1.11 before lockdown and 1.20 during lockdown (8% mean percent increase, $P < 0.001$), while the proportions of subjects with a score of 2 or above were 33.6% and 38.9% immediately before and after lockdown, respectively ($P < 0.001$) (Table 3).

Fig. 1 shows the results of the two logistic regression models for the occurrence of depressive symptoms immediately before (Model 1) and after lockdown (Model 2). Significant odds ratios were found in both models for younger age, low educational level, Southern Italian area of residence, and poor social support, which suggests a relevant role of these features as risk factors for depressive symptoms both before and after lockdown. In addition, the odds ratios estimated by Model 2 indicate that the chance of developing depressive symptoms during

Table 3
Mean of PHQ-2 score and prevalence of depressive symptoms.

	Total score Mean (SD)	Log (total score+2) Mean (SD)	P [†]	Prevalence *	P [†]
PHQ-2 Before lockdown	1.11 (1.29)	1.08 (0.38)	<0.001	33.55%	<0.001
PHQ-2 After lockdown	1.20 (1.19)	1.11 (0.36)		38.93%	

* Prevalence of depressive symptoms was calculated using a cut-off of 2.

† P values for differences in PHQ-2 score or prevalence between before and after lockdown.

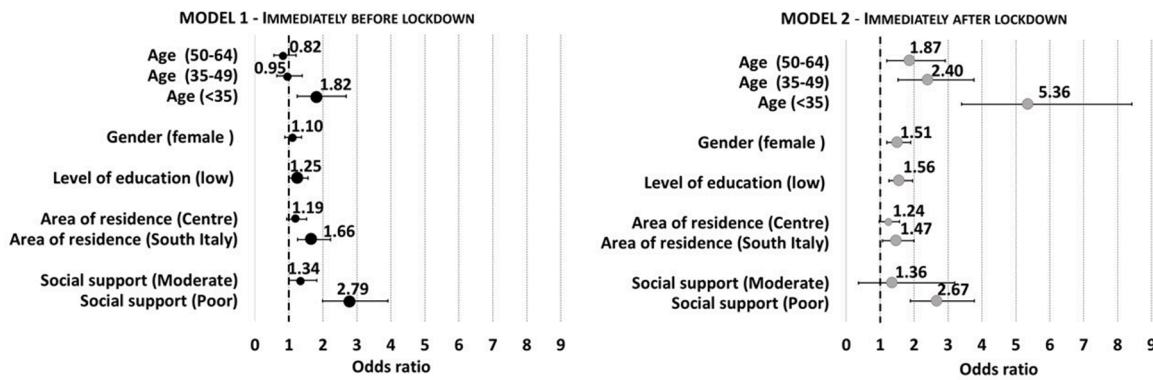


Fig. 1. Plot of logistic regression odds ratios (ORs) and 95% confidence intervals by observation period. Note: P values and Confidence Intervals were adjusted for within-pair correlations.

lockdown increases significantly also in middle age and in women. Moreover, the OR achieves statistical significance in subjects with a moderate social support.

As shown in Table 4 (Model 3), a threefold increase of risk of depression symptoms due to the lockdown was observed in those subjects with previous depression conditions. Independently of the effect of depression symptomatology at baseline, the logistic model showed that Covid symptoms in family members of twins and households' economic problems due to Covid pandemic were risk factors significantly associated to depressive symptoms after the restriction period. The occurrence of Covid-19 symptoms among the responding subjects did not seem to increase the probability of developing depressive symptoms. Younger age (≤ 34 , OR = 4.12 and 35–49, OR = 2.17), female gender (OR = 1.42), low educational level (<University degree, OR = 1.59) and poor social support (OR = 1.91) were the other determinants of depressive status.

These results were confirmed by the linear regression analysis (Model 4) and showed in Supplemental Table 1.

4. Discussion

To the best of our knowledge, this is the first Italian study in which the mental health effects of the Covid-19 lockdown were examined

Table 4

Logistic regression results for the occurrence of depression symptoms immediately after the first Italian lockdown in relation to subjects' characteristics (Model 3).

	Odds ratio	P	95%CI
Depression symptoms before lockdown	3.26	<0.001	2.57–4.13
Age			
50–64	1.75	0.04	1.03–2.98
35–49	2.17	0.004	1.28–3.67
≤ 34	4.12	<0.001	2.44–6.97
Gender (Female)	1.42	0.006	1.11–1.81
Low level of education (High school or below)	1.59	<0.001	1.25–2.01
Area of residence			
center	1.19	0.20	0.91–1.54
South and Isles	1.32	0.12	0.93–1.88
Household Covid-19 symptoms	1.72	0.005	1.17–2.51
Covid-19 symptoms	1.23	0.29	0.84–1.80
Economic problems	1.35	0.02	1.05–1.72
Social support (OSLO scale)			
Moderate	1.17	0.35	0.84–1.62
Poor	1.91	0.001	1.31–2.79

Dependent variable was dichotomous Total PHQ-2 (June 2020) based on a cut-off of 2.

P values and Confidence Intervals were adjusted for within-pair correlations. 95% CI: 95% Confidence Intervals.

longitudinally among individuals drawn from the general adult population, and it is one of the relatively few longitudinal studies on the mental health effects of the Covid-19 lockdown among general population samples worldwide. Regarding data quality, the assessment of depressive symptoms was conducted using a well-known and widely validated instrument, that was found to be up to 87% sensitive and 77% specific for cut-off score of 2 or greater in studies that used fully structured interviews as reference standards (Levis et al., 2020).

In the present study, 33.6% and 38.9% of the respondents reported substantial depressive symptoms immediately before and after the lockdown, respectively. In Italy, the prevalence of mental health disturbances during the lockdown has been documented in only a few cross-sectional community-based samples (Amerio et al., 2021; Fiorillo et al., 2020), and the comparison of our results with these studies is limited by differences in sampling frames, in interval between the lockdown and the assessment, and in measurement tools and thresholds used. For example, according to a recent Italian study in which the PHQ-2 was used, the prevalence of depressive symptoms was 14.3% and 33.2% before and during the lockdown, respectively (Amerio et al., 2021). However, comparisons with the present study are difficult because of differences in the study design. The Amerio et al. study had a cross-sectional design, and depressive symptoms were assessed after the lockdown by asking participants to refer to both before and during the lockdown, which entails the risk of recall bias. Moreover, that study used a different threshold for the PHQ-2 (i.e., 3 or more). Two other Italian studies that were performed during the lockdown period used the DASS-21 assessment instrument and reported mixed results, with prevalences of mental health disturbances ranging from 12.4% (Fiorillo et al., 2020) to 33% (Mazza et al., 2020). A limited number of other cross-sectional studies using the PHQ-2, conducted in other countries, such as the US and China, reported lower prevalences (Daly et al., 2021; Hou et al., 2020) However, these studies, too, used a different PHQ-2 cut-off of 3 or higher.

Given that prevalence estimates are of course substantially influenced by the cut-off score used, we were especially interested to evaluate the trend of depressive symptoms over time. Depressive symptoms showed a significant increase from February to June 2020, following the confinement caused by Covid-19 emergency. While the overall increase is statistically significant, it is small in size, such that it is of limited meaningfulness from a clinical point of view. Although the study design cannot fully disentangle the contribution of the pandemic and the related lockdown from the contribution of other risk factors for depression, the finding that about 30% of people who scored below the threshold for probable depression immediately before lockdown transitioned to a score suggesting probable depression after lockdown suggests that the overall increase in the presence and severity of depression is not accounted for by the natural course of depressive symptoms that were already present when the initial assessment took place.

Our finding of an increase in the presence and severity of depressive symptoms during the lockdown period is consistent with reports by other longitudinal studies, notwithstanding differences in assessment tools (Planchuelo-Gomez et al., 2020; Sibley et al., 2020; Daly et al., 2020; Kikuchi et al., 2020). In fact, the majority of prospective studies on general population samples suggest that depressive symptoms increased from February to March or April, and then gradually declined from late April or May in the post-lockdown context (Daly et al., 2021), or even sporadically resolved by June or July 2020 (Van der Velden et al., 2021). This symptoms trajectory, which was observed across different nations and countries, is consistent with a “resilient” response to stress. The relatively small magnitude of the increase in depressive symptoms that we observed suggest that the Italian population, too, has been generally resilient and had sufficient resources to cope with the Covid-19 adverse situation. However, while the average response was a resilient one, there were individuals who reported a steady and sustained decline in mental health over time (Pierce et al., 2021).

Our results are consistent with most studies from the USA and across Europe reporting a small to moderate deterioration in mental health during the early phase of the pandemic (Fancourt et al., 2021; Daly and Robinson, 2021) and, at the same time, evidence of a more severe worsening of mental health in particular population groups. In the present study, these groups were more likely to have pre-existing risk factors such as being younger, having lower educational level (both likely associated with a disadvantaged socioeconomic position), living in South Italy (the lowest income area of Italy), and having poor social support. This finding suggests that socio-economic disadvantages and mental health inequalities were accentuated by the lockdown.

The increased likelihood of depressive symptoms occurrence among younger adults during the lockdown is consistent with many studies on the psychological impact of Covid-19 pandemic (Daly et al., 2020, 2021; McGinty et al., 2020; Ferrucci et al., 2020; Varma et al., 2021; Pierce et al., 2020), and indicates that younger age should be given special consideration in assessing post Covid-19 emergence of psychiatric disturbances. In Italy, as well as in other countries, even before the Covid-19 emergency, young adults were more likely to be involved in precarious employment and in sectors which were at higher risk to shut down (such as catering business and entertainment activities), and this may have contributed to the increased risk of exacerbating depressive symptoms. It should be noted, however, that in the present study, a worsening in depressive symptoms following the lockdown was also observed in middle aged individuals. This suggests that the pandemic may have affected also other brackets of the population, likely characterised by financial distress or insecurity and, in general, by variously disadvantaged social positions (Martin-Carrasco et al., 2016). In our study, this hypothesis was corroborated by the observed increase in the greater power of economic problems in predicting poor mental health during the lockdown, compared to pre-lockdown period. At present, many persons, not only young persons, lost their jobs, and a state of socio-economic crisis persists throughout the country, particularly in Southern areas, so that a full return to normal activities is still delayed. As for policy recommendations, it is therefore vital to pay more attention to these disadvantaged individuals who might also experience an exacerbation of mental health difficulties produced by both financial insecurity and loss of any current form of government emergency assistance (such as unemployment benefits and temporary financial assistance for needy families), which cannot last indefinitely.

The present study also showed that women were more likely than men to have a deteriorating mental health trajectory. The association between depressive symptoms and female gender has been observed in other cross-sectional (Amerio et al., 2021; Ferrucci et al., 2020; Rossi et al., 2020) and longitudinal community studies (Daly et al., 2020; Pierce et al., 2021) and may be mostly explained by the known underlying vulnerability to common mental health problems (Weinberger et al., 2018). However, other factors may have played a role in women who were parents of young children, as school closures (Gadermann

et al., 2021) may have had a larger detrimental effect on mothers than fathers, if the mothers were to bear greater responsibility for supervision and education of children.

Besides economic factors, other factors have likely contributed to the increase in depressive symptoms that we observed. Indeed, the pandemic is affecting people’s mental health through several pathways, such as fear of contagion and of losing loved ones, worry over the development of the pandemic, and social isolation. Social distancing measures have greatly reduced the opportunity to receive social support from non-cohabiting relatives, romantic partners, or friends. The severe limitations imposed by the lockdown to friendly or intimate relationships have most likely had a serious impact on population mental health, and may have particularly affected some sociodemographic groups, such as adolescents, young adults, and women. Our finding that individuals lacking sufficient social support showed significantly worse mental health outcomes supports the results of other studies (Guerin et al., 2021) and suggests that particular attention should be paid to individuals from specific risk groups in the times of Covid-19, such as single or unemployed people, and the like.

There are some limitations to this study. First, due to the unpredictable health emergency situation, the study design and the variables to be investigated were not chosen a priori. There is a risk of participation bias, as the study population is represented by twins who participated to a chronic pain study in February 2020 and who subsequently gave their consent to take part in the Covid-related mental disorders study. However, the strength of the association between depression and the other covariates was similar in a sensitivity analysis considering the presence of chronic pain. Second, the use of a 2-item instrument to measure the severity of depressive symptoms implies some reduction in psychometric reliability, given the known correlation between reliability and number of items, and in the breadth of the assessment, as the instrument does not provide information about the presence of all 9 symptoms that underlie the diagnostic criteria for a major depressive episode. To partially mitigate this limitation, a recent individual participant data meta-analysis of 44 studies involving 10,627 participants reported only small differences in sensitivity and specificity between the PHQ-2 and the PHQ-9 (Levis et al., 2020), which suggests that the psychometric performance of the PHQ-2 is only marginally lower than that of the full PHQ-9. Another limitation is the low participation rate of the study (about 30%), which carries of the residual selection bias. However, we found no differences in the main sociodemographic characteristics between participants and those who did not take part in the study. Finally, the twin population enrolled on the ITR consist of more women, more educated and more urbanized people as compared to the general population, which suggests caution on the generalisability of the findings. While these limitations should be kept in mind, the main strength of our prospective study is the longitudinal wide collection of information on the same relatively large population-based sample. It is also important to point out that transferability of twin-study results to the whole general population has been widely demonstrated for several biomedical and psychological phenotypes (Andrew et al., 2001; Herskind et al., 2017).

In conclusion, the current study, while showing only a small impact of the lockdown on population mental health, supports previous reports that women, younger individuals, and people with insufficient social support or suffering with financial distress are at increased risk of poor mental health as a result of the pandemic. The current and future financial inequalities may further increase risks for poor mental health outcomes and so it will be extremely interesting to monitor the same population over time. Even if the impact of Covid-19 remained steadily moderate in terms of percentages of people with worsened mental health status, millions of individuals have been affected by the consequences of the pandemic, and this might pose serious and costly public health problems. Indeed, the toll that the COVID-19 crisis is taking on mental health is such that mental health systems are now more important than ever. Action is required to address the financial or occupational

uncertainty linked to the pandemic, and to implement innovative public health interventions that should be tailored to people's needs during the pandemic and should focus on individuals who are at higher risk of Covid-19 related mental health issues. Mental health services and interventions need to be innovatively planned to meet the varying and often complex needs that children, adolescents, caregivers, and families are facing during this pandemic period. Providing online assistance and making quality digital mental health resources available may help eliminate unnecessary access barriers.

CRedit authorship contribution statement

Emanuela Medda: Conceptualization, Formal analysis, Writing – original draft, Writing – review & editing. **Virgilia Toccaceli:** Conceptualization, Formal analysis, Writing – review & editing. **Antonella Gigantesco:** Methodology, Writing – original draft, Writing – review & editing. **Angelo Picardi:** Conceptualization, Formal analysis, Writing – review & editing. **Corrado Fagnani:** Formal analysis, Writing – review & editing. **Maria Antonietta Stazi:** Conceptualization, Writing – original draft, Formal analysis.

Declaration of Competing Interest

The authors have no conflict of interests to declare.

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Supplementary materials

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