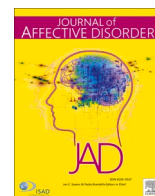




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## Research paper

# Longitudinal impact of the COVID19 pandemic on mental health in a general population sample in France: Evidence from the COMET Study

Flore Moulin<sup>a,f,\*</sup>, François Jean<sup>a,b,f</sup>, Maria Melchior<sup>c</sup>, Martina Patanè<sup>d</sup>, Irene Pinucci<sup>d,e</sup>, Marit Sijbrandij<sup>d</sup>, Judith van der Waerden<sup>c</sup>, Cédric Galéra<sup>a,f,g,\*\*</sup>

<sup>a</sup> University of Bordeaux, France

<sup>b</sup> Department of Psychiatry and Addictology, Calais Hospital, Calais, France

<sup>c</sup> Sorbonne Université, INSERM, Institut Pierre Louis d'Epidémiologie et de Santé Publique (IPLESP), Equipe de Recherche en Epidémiologie Sociale (ERES), Paris, France

<sup>d</sup> VU University Amsterdam, Department of Clinical, Neuro- and Developmental Psychology, World Health Organization Collaborating Center for Research and Dissemination of Psychological Interventions, and Amsterdam Public Health Institute, 1081, HV, Amsterdam, the Netherlands

<sup>e</sup> Department of Human Neurosciences, Sapienza University, Rome, Italy

<sup>f</sup> Bordeaux Population Health Research Center, INSERM U 1219, Bordeaux, France

<sup>g</sup> Department of Child and Adolescent Psychiatry, Centre Hospitalier Charles Perrons, Bordeaux, France



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## ABSTRACT

**Background:** To study the longitudinal impact of co-occurring mental health problems, and to identify vulnerable groups in need of mental health support during the COVID-19 pandemic.

**Methods:** Analyses were based on data from 681 French participants in the international COVID-19 Mental Health Study, collected at four times (05/2020–04/2021). Symptoms of depression, anxiety and post-traumatic stress disorder (PTSD) were assessed using the Patient Health Questionnaire 9, the Generalized Anxiety Disorder-7 and the PTSD Check List for DSM-5. We performed k-means for longitudinal data to build trajectories of adults' depression, anxiety and PTSD symptoms and identify subgroups psychologically vulnerable. We then assessed whether mental health trajectories were predicted by lockdown regulations.

**Results:** A high and a low cluster of mental health scores were identified. In both groups, mental health scores varied significantly across time. Levels of all mental health scores were lowest when COVID-19-related restrictions were lifted and highest when restrictions were in place, except for PTSD. No scores returned to the previous level or the initial level of mental health ( $p < 0.05$ ).

Participants with high levels of symptoms were characterized by younger age (OR: 0.98, 95 % CI: 0.97–0.99), prior history of mental disorders (OR: 3.46, 95 % CI: 2.07–5.82), experience of domestic violence (OR: 10.54, 95 % CI: 1.54–20.68) and medical issues (OR: 2.16, 95 % CI: 1.14–4.03).

**Limitations:** Pre-pandemic data were not available and the sample was recruited mainly by snowball sampling.

**Conclusion:** This study revealed subtle differences in the evolution of symptom trajectories during the first year of the Covid-19 pandemic, and highlighted several characteristics associated with the two clusters.

## 1. Introduction

Since the beginning of the COVID-19 pandemic, several studies (WHO, 2022) have reported high levels of mental health problems worldwide. General population studies have found that clinically significant mental illness increased in the early weeks of the pandemic among adults (Every-Palmer et al., 2020; Shevlin et al., 2020). In particular, worse mental health was found in younger (Pierce et al.,

2020a) and financially insecure adults. Other reported risk factors included being a woman, having pre-existing mental and physical health conditions or living alone (Dickerson et al., 2022).

However, in some countries such as UK and Australia where the restrictions were very strict (“Oxford COVID-19 Government Response Tracker”, n.d.), symptoms of depression and anxiety in the general population gradually decreased over time during the lockdown periods (Fancourt et al., 2021; Pierce et al., 2021, 2020a, 2020b; Robinson et al.,

\* Correspondence to: F. Moulin, University of Bordeaux, France.

\*\* Correspondence to: C. Galéra, Department of Child and Adolescent Psychiatry, Centre Hospitalier Charles Perrons, Bordeaux, France.

E-mail addresses: [fmoulin.science@gmail.com](mailto:fmoulin.science@gmail.com) (F. Moulin), [cedric.galera@u-bordeaux.fr](mailto:cedric.galera@u-bordeaux.fr) (C. Galéra).

2022; Terhaag et al., 2021; Daly et al., 2020). Observed increases were larger and persistent for depressive symptoms, as opposed to smaller changes in anxiety disorder symptoms and measures of overall mental health functioning (Fancourt et al., 2021; Pierce et al., 2021, 2020a, 2020b; Robinson et al., 2022; Terhaag et al., 2021; Daly et al., 2020). Of note, few other studies (Batterham et al., 2021; Hyland et al., 2021; Lu et al., 2022) have reported the different trajectories of mental health status across distinct lockdown phases. A British systematic review (Robinson et al., 2022) showed that increases were most pronounced among samples with pre-existing physical health conditions and there was no evidence of any change in symptoms among samples with a pre-existing mental health condition.

Most studies so far have focused on average symptom levels, but this can obscure different patterns of experiences. There is emerging evidence that particular groups may have had different symptom trajectories across the pandemic. For example, a British study (Saunders et al., 2021) of self-reported depression and anxiety symptoms in primary mental health care services highlighted a trajectory of patients at particularly high risk of increased mental distress due to the pandemic. Other studies reported that individuals with pre-existing mental health conditions experienced worsening mental health during lockdown (Burton et al., 2021; Fiorillo et al., 2020; Pan et al., 2021).

France has been one of the European countries particularly affected by the spread of COVID-19. Until July 2021, there were >6.3 million COVID-19 cases and >110,000 deaths in France (n.d.-a, n.d.-b). To limit the spread of the virus, the French government declared three national lockdowns: 17 March–11 May 2020, 28 October–15 December 2020, and 3 April–3 May 2021. This involved the closing of schools, universities, public spaces and imposed stay-at-home measures except for vital needs (“Covid-19: Un 2e Confinement National à Compter du 29 Octobre Minuit. Available online: <https://www.vie-publique.fr/en-bref/276947-covid-19-un-2e-confinement-national-compter-du-29-octobre-minuit>”, n.d.; “De Déclaration, M. Emmanuel Macron, Président de la République, sur la Mobilisation Face à L'épidémie de COVID-19, la Guerre Sanitaire Contre le Coronavirus et sur les Nouvelles Mesures Adoptées Report du 2e Tour des Municipales, Suspension des Réformes”, n.d.; “De Déclaration, M. Jean Castex, Premier Ministre, sur les Nouvelles Mesures de Lutte Contre L'épidémie de Covid-19 (Restrictions Etendues à L'ensemble du Territoire, Fermeture des Ecoles Pour 3 Semaines), à l'Assemblée Nationale le 1er Avril. 2021. Available online: <https://www.vie-publique.fr/discours/279306-jean-castex-01042021-extension-mesures-anti-covid-fermeture-ecoles>”, n.d.). In between lockdowns, the French population had to comply with strict sanitary measures including wearing masks, social distancing, remote working and various curfews (“Loi du 9 Juillet 2020 Organisant la Sortie de L'état D'urgence Sanitaire. Available online: [https://www.vie-publique.fr/loi/2745\\_01-loi-9-juillet-2020-organisant-la-sortie-de-letat-durgence-sanitaire](https://www.vie-publique.fr/loi/2745_01-loi-9-juillet-2020-organisant-la-sortie-de-letat-durgence-sanitaire)”, n.d.).

While most studies to date have focused on the initial period of the worldwide pandemic (March–June 2020), longitudinal studies collecting data on a one-year interval and therefore encompassing the whole period of lockdown, easing of lockdown, and freedom, are scarce. In France, (Ramiz et al., 2021) a longitudinal study conducted between April 15, 2020, and May 4, 2020 showed a mental health deterioration with increased symptoms of depression and anxiety during the first lockdown, while another survey (France, n.d.-a, n.d.-b) showed that mental health fluctuated during lockdown and the subsequent periods. Furthermore, very few studies have investigated the impact of the COVID-19 pandemic on PTSD (Cao et al., 2021) symptomatology, except in very specific populations (Megalakaki et al., 2021; Sheng et al., 2021; Solomon et al., 2021). Therefore, it remains to be explored whether mental health continued to deteriorate during the first year of the pandemic (March 2020–April 2021) or whether there were also signs of stabilization or improvement in the mental health of the general adult population during this period (Joshi et al., 2021). Furthermore, it remains to be clarified whether there were risk factors associated with

different mental health trajectories.

Thus, further monitoring of changes in mental health, and particularly of depression, anxiety and PTSD, and ensuring that adequate clinical treatment is available will be of importance. Since psychiatric symptoms tend to co-occur, it appears relevant to appraise them all together instead of separately, as in most prior research. To our knowledge, no previous study has modelled the trajectories of three different mental health outcomes (depression, anxiety and PTSD) simultaneously over time. This study aimed to identify the trajectories of anxiety, depression and PTSD symptoms during and after the easing of lockdown in France using mixed regression modeling and exploring participants' social characteristics and health-related factors associated with these trajectories. The objective was to determine how individuals have been affected over time and to identify groups that may need additional support for their mental health.

## 2. Methods

### 2.1. Setting and study design

The COVID-19 Mental Health Survey (COMET) study is an international, online longitudinal survey aimed at evaluating the course of mental health symptoms during the COVID-19 pandemic and the identification of individuals who are at risk or resilient to these symptoms (Laham et al., 2021). The COMET consortium includes participants from 14 countries (The Netherlands, Italy, Switzerland, Turkey, Spain, Germany, France, United Kingdom, Sweden, South Africa, Indonesia, China, Australia and the United States). Participants were recruited in May 2020 through a snowball sampling strategy using university mailing lists and various social media platforms. Inclusion criteria for participation in the study were: (a) being 18 years of age or older; (b) having an adequate command of one of the study languages (Dutch, English, German, Italian, French, Swedish, Turkish, Mandarin or Bahasa Indonesian); (c) providing informed consent online. Before committing to the study, participants were given information about the study and its objectives and their informed consent was obtained through a secure web link before starting the survey. Participation was voluntary and participants were free to withdraw from the survey at any time. Additionally, they were compensated by participation in a draw for one of ten 50-euro vouchers. In total, 8084 participants were recruited for the first data wave.

Participants were invited to complete a Computer-Aided Web Interviewing (CAWI) survey containing validated questionnaires on depression, anxiety, PTSD, substance use, loneliness, coping, social support, contamination fear, and questions on socio-demographic factors during the COVID-19 pandemic. Questionnaires were available in the languages spoken in participating countries. After the first data wave (4 May–7 July 2020), participants were invited to contribute to three additional data collection waves that took place from 4 September–5 October 2020, 7 December 2020–10 January 2021, and 19 March–23 April 2021. For the purpose of the present study, we used only the data from participants who indicated during the first data collection wave that they were resident in France. Initially, 681 French participants were recruited, with  $n = 442$ ,  $n = 441$  and  $n = 424$  participating in the follow-up waves.

The COMET study was approved by the ethical review board of the Faculty of Behavioral and Movement Sciences of Vrije Universiteit Amsterdam (VCWE-2020-077). The French contribution to the COMET consortium is in accordance with the Règlement Général sur la Protection des Données (RGPD) and the Informatique et Libertés law. Personal data are protected according to EU and national laws.

### 2.2. Measures

Validated longitudinal measures were used for data collection. They were based on their length (short), administration (easily done through

a digital platform), and feasibility in a self-isolation or quarantine context.

### 2.2.1. Mental health measures

**2.2.1.1. Depression.** Patient Health Questionnaire – 9 items (PHQ-9) (M, 2001): a self-report measure that can be used to screen depressive symptoms and to diagnose depressive disorders. Higher scores indicate more severe depression (Kroenke et al., 2001). The scale includes nine questions with overall scores ranging from 0 to 27, with scores of 0–4 indicating minimal depression, 5–9 = mild depression, 10–14 = moderate depression, 15–19 = moderately severe depression and 20 = severe depression.

**2.2.1.2. Anxiety.** Generalized Anxiety Disorder scale – 7 items (GAD-7) (Micoulaud-Franchi et al., 2016): this scale measures anxiety symptoms. Each item is scored on a 0–3 scale with the total score ranging from 0 to 21. Higher scores indicate more severe anxiety symptoms (Spitzer et al., 2006). Scores of 0–4 indicate minimal anxiety, 5–9 = mild anxiety, 10–14 = moderate anxiety and 15–21 = severe anxiety.

**2.2.1.3. Posttraumatic stress disorder** (Ashbaugh et al., 2016). We measured symptoms of PTSD during the past week with the 4-item version of the Post-traumatic Stress Disorder Checklist for DSM-5 (PCL-5). Higher scores indicate more severe symptoms of PTSD (Price et al., 2016).

### 2.2.2. Covariates

Covariates included in the multivariate analysis were socio-demographic, health-related and COVID-19 related characteristics associated ( $p < 0.20$ ) with mental health outcomes. When potential covariates showed a significant difference between the four data collection waves, an average score was used.

**2.2.2.1. Socio-demographic variables.** Age (in years), gender (male; female; other), marital status (married/domestic relationship or civil union; in a steady relationship whether cohabitating or not; single; divorced/separated/widowed), number of persons living in the household, area of residence (urban; suburban; rural), years of education, labor market characteristics (employed; student; unemployed; retired), change in work frequency due to COVID-19 (no change; change to more/fewer hours; job stopped/lost job; does not apply), income reduction (no reduction; reduction with governmental support; reduction without governmental support), financial worries in the last four weeks (yes vs. no).

**2.2.2.2. Health-related variables.** Pre-existing mental illnesses (yes vs. no), pre-existing medical conditions, past-year unhealthy use of tobacco, alcohol and drugs (including illicit drugs and unhealthy use of prescription drug) was assessed with the Substance Use Brief Screen (yes vs. no) (McNeely et al., 2015).

Loneliness was assessed with the Brief Cope Questionnaire at each data wave using the following item, do you feel lonely? (yes vs. no). At each data wave, social support was measured using the Oslo Social Support Scale (OSSS-3) (Kocalevent et al., 2018). This scale determines the level of social support based on three questions scored on a four to five-point scale. The overall OSSS-3 score ranges from 3 to 14, with higher scores being indicative of higher levels of social support. Categories usually applied are 3–8 = poor support; 9–11 = moderate support; and 12–14 = strong support.

**2.2.2.3. COVID-19 related variables.** Number of COVID-19 regulations imposed by authorities in the week prior to the questionnaire; appropriateness of imposed COVID-19 regulations (disagree; neutral; agree), frequency of going outdoors in the past two weeks (never/rarely; >3

times a week), being quarantined for suspected COVID-19 infection (yes vs. no), knowing someone who has been infected with COVID-19 (yes vs. no), experiencing distress over coronavirus (very little; some; a lot), domestic violence during COVID: Has your partner ever physically hurt you since the COVID-19 pandemic? (yes vs. no). Individual variables were used to describe the cohort.

### 2.3. Statistical analyses

#### 2.3.1. Descriptive statistics

First, we reported participants' features for the full study and according to the data collection waves. To study differences in characteristics between the data collection waves, we used permutation tests (general symmetry test for continuous variables and marginal homogeneity test for discrete variables) based on Monte-Carlo approximation with 10,000 replications (Hothorn et al., 2021, 2008; Strasser and Weber, 1999). Permutation tests are robust to non-normality, heteroscedasticity, and a low number of blocks.

Next, to explore the difference between a wave and the next one, we computed the Cohen's  $d$  for paired data and to test the difference we used Wilcoxon signed rank test with continuity correction (Supplementary material).

#### 2.3.2. Longitudinal associations between cluster analysis

Second, we conducted a cluster analysis using kml3d (Genolini, 2017; Genolini et al., 2015) on joint trajectories of depression symptoms, anxiety symptoms and PTSD symptoms. Kml3d adapts k-means clustering to longitudinal data. The cluster analysis allows participants with different trajectories through the study to be separated. The Calinski-Harabasz index (Caliński and Harabasz, 1974) was used to determine the optimal number of clusters. Next, we studied associations of cluster membership with the level of mental health symptoms and socio-demographic features using logistic regression models. Models were adjusted on variables significantly associated with cluster membership. We computed odd ratios and performed likelihood ratio tests. Collinearity was checked using the generalized variance inflation factor (Fox et al., 2021; Fox and Monette, 1992).

Next, we described the mental health scales for each cluster and according to waves inside each cluster. For each cluster, we studied differences in characteristics between the data collection waves in the same way as for the global sample.

Alpha risks were fixed at 5 %. All  $p$ -values were two-tailed.

To account for missing data in the analyses, we performed imputations. We used the MICE algorithm adapted for the nested structure by participants (Azur et al., 2011; Buuren and Groothuis-Oudshoorn, 2021, 2011) based on 20 datasets and 20 iterations.

We performed all analyses using R version 4.1.2 (R Core Team, 2021) and the ggplot package for graphs (Adler and Murdoch, 2021; Wickham, 2016; Wickham et al., 2021).

## 3. Results

### 3.1. Participants' characteristics (Table 1)

Participants' characteristics are described in Table 1. In total, 681 participants completed the study questionnaire at wave 1: 535 (78.6 %) were women; the mean age was 46.6 ( $\pm 15.3$ ) years. Among them, 6.3 % had a current or past medical issue and 9.8 % had been previously diagnosed with a mental illness.

#### 3.1.1. Mental health outcomes

For each mental health outcome (PHQ, GAD and PCL), scores were significantly different between the different study waves. All three mental health scores were lower at time 2, when the lockdown was lifted, (average scores (SD) of 5.3 (5.1), 4.3 (4.5) and 3.4 (3.3) respectively), and highest at time 3 (6.4 (5.5) and 4.9 (4.7) for PHQ and GAD),

**Table 1**  
Characteristics of participants, according to time.

Total sample (N = 681)		Time 1	Time 2	Time 3	Time 4	Comparison between waves: p
		Mean (SD)/frequency (%)				
<b>Participants characteristics</b>						
Sex: female	78.56 (535)					
Age (years)	46.6 (15.34)					
Medical issue: yes	6.31 (43)					
Mental disorder history: yes	9.84 (67)					
<b>Scales</b>						
PHQ score	6.02 (5.43)	6.38 (5.64)	5.31 (5.13)	6.4 (5.55)	5.98 (5.31)	<0.001
GAD score	4.7 (4.75)	4.79 (4.91)	4.34 (4.59)	4.98 (4.78)	4.68 (4.72)	0.02
PCL score	3.61 (3.35)	3.72 (3.34)	3.37 (3.29)	3.69 (3.36)	3.66 (3.39)	0.03
<b>COVID related variables</b>						
Number of regulations for COVID	6.77 (2.92)	7.55 (3.14)	6.15 (2.82)	6.84 (2.91)	6.54 (2.6)	<0.001
Reduction of income: yes	16.74 (456)	24.23 (165)	14.39 (98)	15.12 (103)	13.22 (90)	<0.001
Work modification: yes	62.37 (1699)	67.99 (463)	55.51 (378)	62.26 (424)	63.73 (434)	<0.001
Going outdoor: <3/week	25.33 (690)	40.68 (277)	15.27 (104)	25.99 (177)	19.38 (132)	<0.001
Distress related to COVID: some or a lot	45.3 (1234)	49.19 (335)	40.68 (277)	43.32 (295)	48.02 (327)	<0.001

Note 1: n = count; % = percentage; m = mean; sd = standard deviation, p = p-value; p-values from general symmetry test for continuous variables and marginal homogeneity test for discrete variables with Monte Carlo simulated p-value based on 10,000 replications

Note 2: p\*: p-value indicating the response differences between each data time period; Time 1: 4 May–7 July 2020; Time 2: 4 September–5 October 2020; Time 3: 7 December 2020–10 January 2021; Time 4: 19 March–23 April 2021.

except for the PCL score (3.7) (3.4), which was higher at time 2.

### 3.1.2. COVID-19 related covariates

The frequency of regulations for COVID-19, the reduction of income, the frequency of work modification and the frequency of going out less than three days/week were the highest during time 1 when the sanitary measures were very strict (7.5 %, 24.2 %, 67.9 % and 40.7 %, respectively), whereas the numbers were the lowest for time 2, except for the reduction of income.

Full description of the available data is provided in the Supplementary Table S2.

Fig. 1 represents changes in average scores for the three mental health measures over time during the four data collection waves.

### 3.2. High and low levels of mental health symptoms: two cluster trajectories

Overall, we identified two clusters: one with a high level of mental health scores and the other with a low level of mental health scores.

Fig. 2 shows trajectories associated with high and low levels of mental health scores over time, detailed for each score and according to study wave. Cluster 1 refers to the group with a low level of mental health scores (N = 491). Cluster 2 refers to the group with a high level of mental health scores on all three measures (N = 190).

Cluster 2 showed the same pattern for all three scores with a steep decrease during the first period (T1-T2, restrictions lifted), then an increase during the second period (T2-T3, implementation of a new lockdown) and a decrease during the third period (T3-T4, fewer restrictions). Concerning the trajectory of cluster 1, PHQ and GAD scores

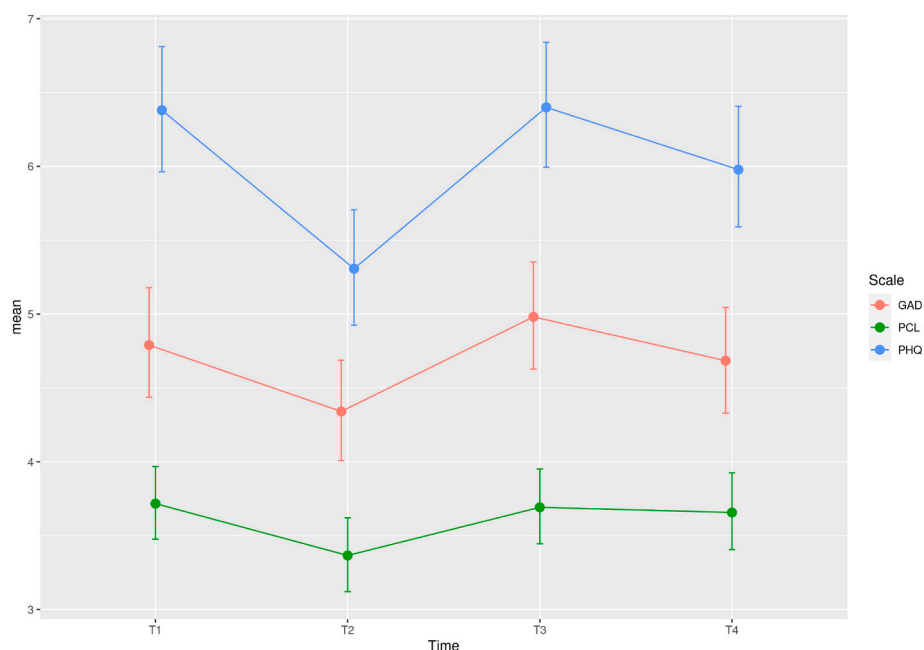


Fig. 1. Changes in average scores for the three mental health measures over time during the four data collection waves.



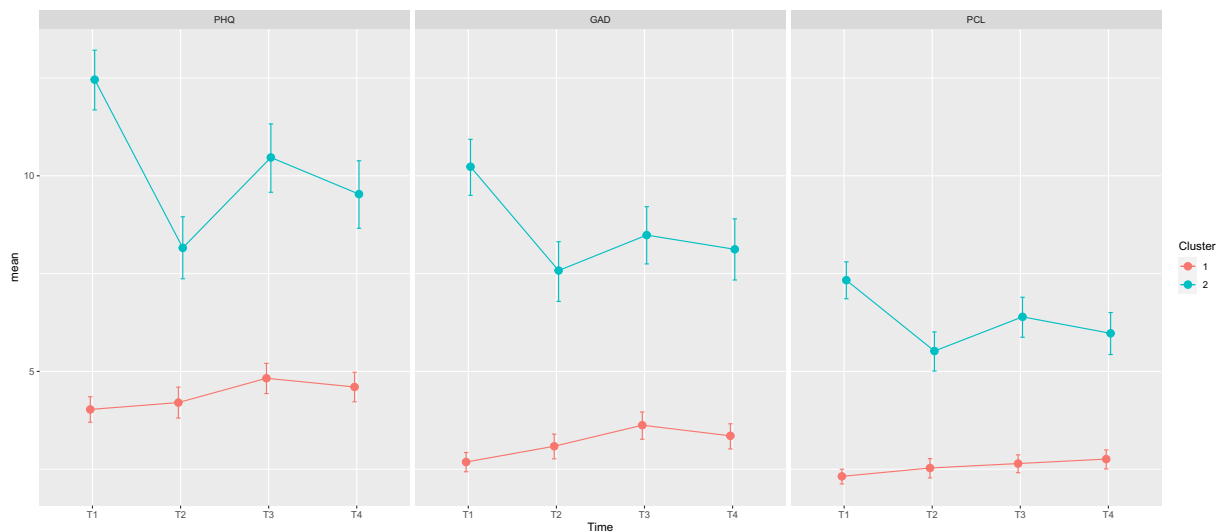


Fig. 2. Trajectories associated with high and low levels of mental health scores over time for each score and according to study wave.

showed an increase during the first and second period and then a slight decrease. PCL scores showed a gradual increase until the end of the follow-up.

Overall, in both clusters, mental health scores varied significantly between the different time periods. While cluster 2 showed a decrease during period 1 followed by an increase during period 2 and then a recovery during period 3, cluster 1 showed overall lower symptoms but also an increase during period 1 and period 2 and a decrease in period 3 (except for PCL). No scores returned to the previous level or the initial level of mental health.

### 3.3. Characteristics and predictors associated with high/low levels of mental health scores

Tables 2 and 3 shows factors associated with high and low levels of mental health symptoms. Adults with high levels (cluster 2) and low levels (cluster 1) differed significantly on several sociodemographic characteristics. Cluster 2 was significantly younger (44.4 % vs. 47.4 %,  $p < 0.05$ ), and reported more domestic violence than cluster 1 (2.1 % vs. 0.2 %,  $p < 0.05$ ). All mental health diagnoses were highly prevalent in cluster 2, which might explain their higher symptom scores throughout

the study period. Concerning health, cluster 2 had more medical issues (10 % vs. 4.9 %,  $p < 0.05$ ) and was more likely to have a history of mental disorders (19 % vs. 6.3 %,  $p < 0.001$ ) than cluster 1.

Logistic regression analyses (Tables 2 and 3) showed that the odds of belonging to cluster 2 of high levels of symptoms was elevated in younger participants (OR: 0.98, 95 % CI: 0.97–0.99), those with a history of mental disorders (OR 3.5, 95 % CI 2.1–5.8), those who experienced domestic violence (OR 10.5, 95 % CI 1.5–20.7) and those who had a medical issue (OR 2.2, 95 % CI 1.1–4.0). These associations did not change in a multivariate regression model, except for medical issues, which were no longer associated with the high symptoms trajectory.

Table 4 showed in the group with low levels (cluster 1), a significant and slight increase PHQ and GAD scores only between T2 and T3 (PHQ:  $d = 0.11$ ,  $p < 0.05$ , GAD:  $d = 0.11$ ,  $p < 0.05$ ). On the contrary, in the group with high levels (cluster 2), there was a significant decrease between T1 and T2 (PHQ:  $d = -0.58$ ,  $p < 0.01$ ; GAD:  $d = -0.39$ ,  $p < 0.01$  and PCL:  $d = -0.44$ ,  $p < 0.01$ ). Only PHQ score and PCL scores significantly increased between T2 and T3 (respectively,  $d = 0.31$ ,  $p < 0.05$ , and  $d = 0.18$ ,  $p < 0.05$ ).

Table 2  
Socio-demographics and health predictors at T1 associated with mental health symptom trajectory clusters during the COVID-19 pandemic in France.

	Cluster 1 Low level of symptoms (N = 491, 72.1 %)	Cluster 2 High level of symptoms (N = 190, 27.9 %)	OR (2.5 % CI–97.5 % CI)	Adjusted OR* (2.5 % CI–97.5 % CI)	Comparison between subgroups P-value
	% (n) or m(sd)	% (n) or m(sd)			
<b>Socio-demographic features</b>					
Age (years)	47.4 (15.1)	44.4 (15.7)	0.98 (0.97–0.99)	0.98 (0.97–1.00)	0.02
Sex: female	77.8 (382)	80.5 (153)	1.2 (0.7–1.8)	0.9 (0.6–1.6)	0.43
Medical issue: yes	4.9 (24)	10 (19)	2.2 (1.1–4.0)	1.8 (0.8–4.0)	0.02
Religious practice: yes	25.3 (124)	30.5 (58)	1.3 (0.9–1.9)	1.0 (0.6–1.7)	0.17
Domestic violence: yes	0.2 (1)	2.1 (4)	10.5 (1.5–20.7)	5.8 (0.4–140.5)	0.01
<b>Mental health features</b>					
Mental health issue history: yes	6.3 (31)	19 (36)	3.5 (2.1–5.8)	2.5 (1.3–4.7)	<0.001
Loneliness: yes	9.8 (48)	45.8 (87)	7.8 (5.2–11.9)	6.7 (4.1–11.1)	<0.001
Alcohol use: yes	49.3 (242)	56.3 (107)	1.4 (0.9–1.8)	1.3 (0.8–1.9)	0.1
Tobacco use: yes	25.9 (127)	31.1 (59)	1.3 (0.9–1.8)	1.1 (0.7–1.8)	0.18
Illegal drug use (3 or more days during pandemic): yes	7.5 (37)	12.6 (24)	1.8 (1.0–3.0)	1.5 (0.7–2.9)	0.04

n: count; %: percentage; m: mean; sd: standard deviation; OR: odd ratio; CI: confident interval; \*: adjusted on age at T1, Padua inventory score at T1, medical issue history at T1, mental health issue history at T1, loneliness at T1, recreational medication at T1, work modification at T1, distress related to COVID at T1, Oslo social support scale at T1, number of hour on COVID news at T1.  
T1: first time of assessment.

**Table 3**

Mental health scales and COVID related variables at T1 associated with mental health symptom trajectory clusters during the COVID-19 pandemic in France.

	Cluster 1 Low level of symptoms (N = 491, 72.1 %)	Cluster 2 High level of symptoms (N = 190, 27.9 %)	OR (2.5 % CI–97.5 % CI)	Adjusted OR* (2.5 % CI–97.5 % CI)	Comparison between subgroups P-value
	%(n) or m(sd)	%(n) or m(sd)			
<b>Mental health scales</b>					
PHQ score at T1	4 (3.6)	12.5 (5.4)	1.5 (1.4–1.6)	1.4 (1.3–1.5)	<0.001
PHQ score at T2	4.2 (4.5)	8.2 (5.6)	1.1 (1.1–1.2)	1.1 (1.0–1.2)	<0.001
PHQ score at T3	4.8 (4.4)	10.5 (6.1)	1.2 (1.2–1.3)	1.2 (1.1–1.2)	<0.001
PHQ score at T4	4.6 (4.3)	9.5 (6)	1.2 (1.1–1.2)	1.2 (1.1–1.2)	<0.001
GAD score at T1	2.7 (2.8)	10.2 (5.1)	1.6 (1.5–1.8)	1.5 (1.4–1.7)	<0.001
GAD score at T2	3.1 (3.6)	7.6 (5.3)	1.2 (1.2–1.3)	1.3 (1.2–1.3)	<0.001
GAD score at T3	3.6 (3.8)	8.5 (5.2)	1.2 (1.2–1.3)	1.2 (1.2–1.3)	<0.001
GAD score at T4	3.4 (3.6)	8.1 (5.5)	1.6 (1.2–1.3)	1.2 (1.2–1.3)	<0.001
PCL score at T1	2.3 (2.1)	7.3 (3.3)	1.9 (1.7–2.0)	1.7 (1.5–1.9)	<0.001
PCL score at T2	2.5 (2.8)	5.5 (3.6)	1.3 (1.2–1.4)	1.3 (1.2–1.4)	<0.001
PCL score at T3	2.7 (2.6)	6.4 (3.6)	1.4 (1.3–1.5)	1.4 (1.3–1.5)	<0.001
PCL score at T4	2.8 (2.7)	6 (3.8)	1.3 (1.2–1.4)	1.3 (1.2–1.4)	<0.001
<b>Covid-19 related variables</b>					
Work modification at T1	64.8 (318)	76.3 (146)	1.7 (1.2–2.6)	1.9 (1.2–3.1)	0.005
Distress related to COVID at T1: some or a lot	28.5 (189)	76.9 (146)	5.3 (3.6–7.8)	3.3 (2.1–5.2)	<0.001
Social support at T1	10.3 (2.3)	9.1 (2.4)	0.8 (0.7–0.8)	0.9(0.8–0.9)	<0.001
Financial support at T1: yes	12.6 (62)	13.2 (25)	1.0 (0.6–1.7)	1.0 (0.5–1.8)	0.969
Hours spent on COVID news at T1	47.9 (68.1)	59.7 (78.1)	1.0 (1.0–1.0)	0.9 (0.9–1.0)	0.619

n: count; %: percentage; m: mean; sd: standard deviation; OR: odd ratio; CI: confident interval; \*: adjusted on age at T1, Padua inventory score at T1, medical issue history at T1, mental health issue history at T1, loneliness at T1, recreational medication at T1, work modification at T1, distress related to COVID at T1, Oslo social support scale at T1, number of hours on COVID news at T1.

PHQ: patient health questionnaire; GAD: generalized anxiety disorder scale; PCL: PTSD check list DSM-5; OSSS: Oslo social support scale; T1: first time of assessment; T2: second time of assessment; T3: third time of assessment; T4: fourth time of assessment.

**Table 4**

Comparison of mental health scales through the different time points.

	Time 1	Time 2	Time 3	Time 4	Comparison through time points p*
	Cohen's d for paired data				
<b>Cluster 1 (N = 491, % = 72.1)</b>					
PHQ score	–	0.03	0.11 <sup>†</sup>	–0.04 <sup>‡</sup>	0.03
GAD score	–	0.09	0.11 <sup>†</sup>	–0.05	<0.001
PCL score	–	0.07	0.03	0.03	0.04
<b>Cluster 2 (N = 190, % = 27.9)</b>					
PHQ score	–	–0.58 <sup>†</sup>	0.31 <sup>†</sup>	–0.13	<0.001
GAD score	–	–0.39 <sup>†</sup>	0.12	–0.05	<0.001
PCL score	–	–0.44 <sup>†</sup>	0.18 <sup>†</sup>	–0.09	<0.001

p\*: p-values from general symmetry test for continuous variables and marginal homogeneity test for discrete variables with Monte Carlo simulated p-value based on 10,000 replications for comparison through time points.

<sup>†</sup> p < 0.05 for Wilcoxon signed rank test with continuity correction.

<sup>‡</sup> p < 0.001 for Wilcoxon signed rank test with continuity correction.

## 4. Discussion

### 4.1. Main findings

The study assessed the impact of lockdown in the first year of the COVID-19 pandemic on concurrent mental health trajectories in a general population-based sample in France. To our knowledge, this is the first longitudinal study concomitantly examining trajectories of different mental health outcomes across the first 12 months of the COVID-19 pandemic and their associations with sociodemographic,

health and COVID-19-related factors. We found that the COVID crisis heavily impacted the occurrence and persistence of multiple mental health problems over time. We distinguished two clusters of participants: those with high mental health symptoms (27.9 %) and those experiencing low mental health symptoms (72.1 %). Interestingly, symptom trajectories over time within the clusters showed a differential pattern. Whereas the cluster with high symptoms showed worsening mental health during periods of restrictive measures but also improvement after the restrictions ended, the cluster showing low initial mental health symptoms also showed a deterioration over time but did not return to the level of mental health at the start of the COVID-19 pandemic. In coherence with our findings, the study of Pan (Pan et al., 2021) also found that healthy people were more responsive to the restrictions.

### 4.2. Interpretation of study findings

#### 4.2.1. Joined mental health trajectory for depression, anxiety and PTSD

Our analyses showed that the easing of national restrictions was associated with observable decreases in the risk of having symptoms of depression, anxiety and PTSD, although symptoms decreased after the easing of lockdown. Being younger, experiencing domestic violence, having physical health issues, and having a previous mental health history were risk factors of mental health symptoms.

Being younger has been associated with increased depression and anxiety in several studies (Fancourt et al., 2021; Shevlin et al., 2020; Xiong et al., 2020), while physical health concerns have also been implicated in increased risk (Every-Palmer et al., 2020; McGinty et al., 2020; Shevlin et al., 2020). The increased risk for younger people (Ramiz et al., 2021) may be explained not only by higher exposure to the media and to social media (Qiu et al., 2020) but also by school closures and not being able to connect with peers or being more vulnerable to economic consequences such as losing one's job (Collaborators et al., 2021).

Concerning physical domestic violence, the United Nations (Women, n.d.) already warned that since the outbreak of COVID-19, emerging

data and reports from those on the front lines have shown that all types of violence against women and girls, particularly domestic violence, have intensified in many countries (Ertan et al., 2020; Sharma and Borah, 2020). We found that being exposed to domestic violence contributed to being in an adverse mental health trajectory. Domestic violence is an important public health concern, and the pandemic has once again put this in the spotlight.

Contrary to previous studies, having financial difficulties was not associated with the high symptoms trajectory. These findings are not consistent with previous research reporting that unemployment, job insecurity, financial instability and food insecurity were associated with stress, anxiety and depression (Frasquilho et al., 2016). However, in France, financial support was given to occupational groups that were directly affected by the first lockdown, such as catering staff and the self-employed.

#### 4.2.2. Changes in mental health trajectories

While symptom levels of mental health problems did not return to the level at the start of the COVID-19 pandemic for the group with high symptoms trajectories, like Daly (Daly et al., 2020) we found evidence of adjustment and coping after the initial stress of the pandemic in the group with low symptoms trajectories, as the proportion of participants with mental health problems decreased from a high of 12.4 % in May 2020 to 9.5 % in May 2021. In this group, the initial rise in mental health problems followed by a downward trend observed from June to September is consistent with a pattern of ‘recovery’ that is commonly observed in response to stressful or traumatic life events (Infurna and Luthar, 2018). These findings may in part be explained by stay-at-home restrictions that potentially provided a more structured routine and reduced exposure to external stressors (e.g. large social gatherings) among those with more severe mental health conditions (Robinson et al., 2022).

Interestingly, the cluster with low initial mental health symptoms showed a deterioration over time without returning to their baseline level of mental health. This novel finding emphasizes the impact of the pandemic COVID-19 on the whole population, including those who had no serious mental health problems prior to the crisis.

As social lockdown measures continue to be eased worldwide, we need to know whether these initial changes in mental health return to baseline levels over a longer period and if this specific group, which is also larger, will experience lasting psychological consequences. In particular, the risk of younger adults developing mental health problems is concerning, as they may be experiencing mental health difficulties for the first time, and it is unclear whether they are at a higher risk for chronic or recurrent symptoms. Therefore, to mitigate this risk, effective early intervention strategies should be deployed.

#### 4.3. Strengths and limitations

The main strength (Laham et al., 2021) of this study is its longitudinal design. By collecting data at four different time points (three during confinement and one outside of it), we were able to appraise changes in depression, anxiety and PTSD throughout the different stages of the pandemic. This longitudinal design guaranteed that the mental health variations observed could not be due to differences in sampling strategies across time periods (Daly et al., 2020). Furthermore, data were collected in real time, therefore minimizing recall bias.

However, the study also has some limitations (Laham et al., 2021). First, the COMET study was set up as a response to the emergence of the COVID-19 pandemic, so we did not have any pre-pandemic data allowing the variables of interest to be compared. Therefore, we cannot be sure whether the trajectories of mental health that we identified are a reaction to the pandemic, or whether they are the continuation of tendencies in subgroups that are already present in the population. A recent systematic review and meta-analysis of longitudinal cohort studies (Robinson et al., 2022) showed a significant but statistically small

increase in mental health symptoms prior to and during the COVID-19 pandemic in 2020.

Second, our sample was recruited mainly by snowball sampling using social media platforms and university mailing lists. This might have resulted in a selection bias and might preclude any generalizability in terms of prevalence rates. Furthermore, our sample had an over-representation of females, middle-aged individuals, highly educated persons and employees whose income was not affected by the crisis. This precludes any inferences regarding the size of the trajectories we found in relation to the French general population and might have led to an underestimation of the impact on under-represented groups (e.g., the deprived).

Third, although we used validated tools to measure our outcomes, answers were self-reported which could introduce an information bias. However, it is difficult to estimate to what extent this affected our results since the study focused largely on mental health in COVID-19, a subject in which epidemiological information is still lacking.

Fourth, the study sample size did not allow us to conduct further stratified analysis of differences in outcomes according to socio-demographic indicators. However, we are able to investigate whether the present outcomes are replicated in the whole COMET cohort, which includes 8084 persons and gives more statistical power to detect small differences.

Fifth, the analyses examined changes in symptoms during and after the easing of national lockdown restrictions. Although several important covariates were considered, residual confounding cannot be ruled out.

Finally, although trajectories were identified during the initial year 2020–2021 of the pandemic, we do not know whether they re-emerged in subsequent lockdowns, including for the same people. However, a new COMET data collection wave is in preparation so we might see how these trajectories evolve further.

#### 4.4. Implications

This study revealed subtle differences in the evolution of symptom trajectories during the first year of the Covid-19 pandemic, and highlighted several characteristics associated with the two clusters. In particular, young participants with previous medical and mental health issues, and those who suffered from domestic violence, appeared to experience more severe levels of depression, anxiety and PTSD at the beginning of the period of restrictions. These levels rapidly decreased when restrictions were lifted. Thus, while a large proportion of individuals in the general population might not appear to have been impacted to a large extent, their mental health across several domains did deteriorate over time and might continue to do so as the pandemic continues.

Recognizing the likely symptom trajectories of different groups in the general population may allow for prevention, targeted care or interventions, ensuring that those in the cluster with low levels of mental health issue experience the predicted reductions in symptoms, and if not, offering treatment to address any mental health problems. By late April 2021, these two clusters showed significant improvements in their mental health but continued to experience a higher prevalence of mental health problems than at the beginning of the pandemic.

Even though many people adapted to the experience of lockdown and may even have experienced further improvements in mental health as lockdown lifted, the easing of lockdown may have posed new challenges for others, including disrupting newly learned routines and coping patterns.

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## Ethics approval

The study was conducted according to the guidelines of the Declaration of Helsinki and was approved by the ethical review board of the Faculty of Behavioral and Movement Sciences of Vrije Universiteit Amsterdam (VCWE-2020-077). The French contribution to the COMET consortium is in accordance with the Règlement Général sur la Protection des Données (RGPD) and the Informatique et Libertés law. Personal data is protected according to EU and national laws.

## CRedit authorship contribution statement

Concept and design: FM, FJ, CG.

Acquisition, analysis, or interpretation of data: All authors.

Drafting of the manuscript: FM.

Critical revision of the manuscript for important intellectual content: All authors.

Statistical analysis: FJ.

## Conflict of Interest

The authors declare that they have no conflicts of interest.

## Data availability

The data underlying the findings cannot be made freely available because of ethical and legal restrictions. This is because the present study includes a large number of variables that, together, could be used to re-identify the participants based on a few key characteristics and then be used to access other personal data. Therefore, the French ethical authority strictly forbids making such data freely available. However, anonymous data can be accessed upon request from the COMET consortium.

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