Psychiatric impact of the COVID-19 pandemic : role of the lockdown and of social inequalities

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Psychiatric impact of the COVID-19 pandemic :

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Impact psychiatrique de la pandémie de COVID-19 :

Rôle du confinement et des inégalités sociales

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RÉSUMÉ EN FRANÇAIS

Contexte : L'épidémie de COVID-19 s'est propagée à travers le monde depuis décembre 2019. Pour tenter de la contenir, des mesures préventives comme la distanciation sociale, les fermetures économiques, et les fermetures d'écoles ont été mises en place, apportant avec elles un risque accru d'effet potentiellement négatifs sur la santé mentale chez les adultes et les enfants. Bien que les connaissances concernant la réponse aux traumatismes soient désormais mieux connues, la description de la santé mentale durant l'épidémie reste limitée. En particulier, le rôle des caractéristiques socioéconomiques familiales et la santé mentale parentale restent peu étudiés.

Objectif : L'objectif de notre travail de thèse était d'étudier la santé mentale durant les périodes de confinement et de déconfinement dans des populations diverses d'adultes et d'enfants issus de la population générale, en prenant en compte leurs caractéristiques individuelles préalables.

Méthodes : Nous avons analysé les données recueillies dans le cadre des cohortes TEMPO, ELFE, et COMET. Notre schéma d'étude a été transversal pour les données à l'inclusion et longitudinal pour les données de suivi. Pour chaque cohorte, une première analyse descriptive a été réalisée. Des analyses multivariées de régression logistique, multinomiale ou linéaire en fonction du type de données ont été utilisées.

Résultats : Les résultats mettent en évidence des liens entre les symptômes de détérioration de santé mentale et le confinement lié à la COVID-19, et permettent d'alimenter les réflexions sur des programmes d'intervention et de prévention précoce.

Mots clés : Santé mentale, épidémiologie, étude de population, longitudinale

RÉSUMÉ SUBSTANTIEL EN FRANÇAIS

En 2020, alors que l'épidémie de COVID-19 se propageait et que les mesures de confinement et de restrictions sociales atteignaient leur apogée, ce travail sur l'impact psychiatrique de ces mesures sanitaires s'est imposé.

En effet, bien que ces mesures étaient nécessaires et ont permises de réduire drastiquement le nombre de nouvelles infections, permettant ainsi au secteur de la santé de consolider ses capacités afin de traiter les patients infectés, il est devenu clair également que ces réponses politiques ont eu un impact sur la santé et le bien-être des populations dans tous les secteurs de la société, ainsi que sur les déterminants de santé.

Confronté à de nouvelles vagues d'infections à l'automne 2020 et à l'hiver 2020/2021, ainsi qu'à la mise en place de nouveaux confinements dans de nombreux pays, il est apparu important de comprendre l'impact positif et négatif des confinements sur la santé et le bien-être des populations afin d'informer les réponses politiques futures.

Ce travail s'est déroulé entre novembre 2020 et novembre 2022 et a pris appui sur 3 cohortes épidémiologiques françaises.

Concernant les enfants, il avait été auparavant démontré que dans certaines populations particulières, telles que les enfants de travailleurs de la santé (1) , les enfants atteints d'une maladie chronique (2) ou ceux souffrant de TDAH avant l'épidémie (3, 4), l'épidémie de COVID-19 et les mesures de confinement de la maladie qui l'accompagnent ont eu un impact sur le bien-être psychologique. Cependant, bien que la recherche souligne

les risques pour la santé mentale des enfants associés à l'anxiété, au manque de contacts avec les pairs, aux possibilités réduites de régulation du stress ou à la maladie mentale des parents (5–7), et plusieurs rapports (8–10) appelant à poursuivre les recherches, il existait au début du travail de thèse peu de données épidémiologiques sur la santé mentale des enfants face à l'épidémie de COVID-19.

Compte tenu des associations bien connues entre des caractéristiques familiales telles que la santé mentale des parents (11–13), un faible niveau socio-économique (13, 14) avec un risque élevé de difficultés en santé mentale des enfants (11, 12), nous avons choisi d'examiner spécifiquement le rôle de ces facteurs.

Le but de notre 1ère étude était donc d'évaluer les corrélats familiaux et individuels des symptômes de difficultés émotionnelles et d'hyperactivité/inattention chez les enfants dans un échantillon provenant de la population générale en France. Cette étude s'est basée sur les données issues d'une étude longitudinale d'une cohorte de parents ayant pris part en 2020 à un questionnaire en ligne de l'étude TEMPO (Trajectoires épidémiologiques en population).

Au 17 mars 2020, 7730 cas de COVID-19 étaient enregistrés par l'agence de santé publique française (Santé Publique France), avec parmi eux 2759 personnes hospitalisées et 700 en réanimation, poussant le gouvernement français a organisé un confinement. Du 24 mars au 28 avril 2020, les participants de TEMPO étaient invités par courriel à compléter en ligne un questionnaire de façon hebdomadaire. Les 4 questionnaires initiaux portés sur les caractéristiques socio-démographiques, le travail, l'infection à la COVID-19, la santé générale la santé mentale, et les abus de substances. Durant la 5ème semaine de confinement, les participants étaient interrogés sur la santé mentale de leurs enfants. Au total 432

participants ont été inclus dans notre étude. Les données ont été analysées à l'aide de modèles de régression logistique.

Le SDQ (Strenghts and Difficulties Questionnaire) était utilisé pour mesurer les symptômes émotionnels et comportementaux (hyperactivité/inattention) des enfants. Il s'agit d'un questionnaire de 25 items pouvant être utilisé chez les enfants de 4-17 ans. Les caractéristiques des enfants incluaient le sexe, l'âge, les difficultés de sommeil et le temps d'écran. Les caractéristiques familiales sociodémographiques incluaient la situation familiale, les difficultés financières, les symptômes anxiodépressifs des parents ou les symptômes de COVID-19 chez les parents.

Au final, il a été mis en évidence que les difficultés émotionnelles et comportementales des enfants étaient associées avec la santé mentale des parents et les difficultés socioéconomiques. De même, un temps d'écran augmenté et des difficultés de sommeil étaient associés à des difficultés psychologiques chez les enfants.

Dans cette 1ère étude, nous mettons en évidence des facteurs de risque important de difficultés en santé mentale chez les enfants, qui nécessitent une surveillance renforcée de ces derniers en période de confinement, par exemple concernant leur hygiène de sommeil et la mise en place de méthodes de relaxation. Par ailleurs des recommandations concernant le temps d'écran doivent être mise à jour, la plupart de la scolarité s'étant effectuée en ligne en période de confinement.

Concernant la 2ème partie du travail, nous nous sommes attachés à l'aspect économique de la crise du COVID-19 et à ses répercussions sur l'état de santé mentale des enfants. En effet, peu d'études longitudinales sur les difficultés de santé mentale des enfants dans ce contexte de crise économique, spécialement en Europe, ont été réalisées. Notre objectif

était d'investiguer l'association entre le statut socio-économique de la famille et la santé mentale des enfants pendant le confinement.

Les données longitudinales provenaient de 4575 enfants âgés de 8 à 9 ans en 2020 et participant à la cohorte de naissance basée sur la population ELFE (Etude Longitudinale Française depuis l'Enfance) qui étudie la santé, le développement et la socialisation des enfants. Les parents ont été invité à remplir le questionnaire SDQ lorsque les enfants avaient (a) 5 ans et (b) 9 ans, 9 ans étant l'âge qui correspondait à la période de fermeture de l'école en raison de la pandémie de COVID-19 en France. Nous avons récupéré les données de la cohorte ELFE recueillies sur les enfants de la naissance à 5 ans (naissance, 1 an, 2 ans, 3,5 ans et 5 ans). Le statut socio-économique (SSE) a été mesuré sur la base des informations obtenues lorsque l'enfant avait 5 ans. Les données ont été analysées à l'aide de modèles de régression logistique multinomiale. Les niveaux élevés de symptômes du trouble déficitaire de l'attention/hyperactivité (TDAH) chez les enfants pendant la période de fermeture de l'école étaient significativement associés à un faible SSE familial antérieur (ORa 1,26, IC à 95 % 1,08-1,48). Les symptômes élevés d'hyperactivité/inattention et de symptômes émotionnels des enfants étaient associés à une baisse de revenu pendant la crise de la COVID-19 (respectivement, ORa 1,38, IC à 95 % 1,16-1,63 et ORa 1,23, IC à 95 % 1,01-1,51). De plus, lors du test des interactions, un SSE antérieur faible était significativement associé à un risque plus élevé de symptômes émotionnels (ORa 1,54, IC à 95 % 1,07–2,21), uniquement pour les enfants dont les familles avaient connu une baisse de revenu, tandis que le sexe, la séparation parentale et les problèmes de santé mentale antérieurs n'étaient pas associés. Cette étude souligne l'impact de la crise financière liée à l'épidémie de COVID-19 sur la santé mentale des enfants. Le SSE familial préexistant avant le confinement et les

difficultés financières plus proches pendant la crise du COVID-19 ont été négativement associés aux difficultés psychologiques des enfants pendant la période de fermeture de l'école. La pandémie a donc vraisemblablement exacerbé les problèmes de santé mentale chez les enfants défavorisés dont les familles souffrent de difficultés financières.

Enfin dans la 3ème partie de cette thèse, nous avons souhaité nous intéresser aux adultes et explorer aussi la période post-confinement. Afin de réaliser cela, nous avons pu travailler sur une cohorte française adulte en étudiant les effets du confinement et ceux du post-confinement sur une période de 1 année.

L'objectif en particulier était de déterminer comment les individus avaient pu être affectés à travers le temps et d'identifier des groupes "à risque" nécessitant un soutien supplémentaire pour leur santé mentale. Le travail s'est appuyé sur l'étude COMET (COVID-19 Mental Health Survey) qui est une étude internationale, longitudinale et qui avait pour but d'évaluer l'impact des symptômes durant la pandémie de COVID-19, et d'identifier les individus à risque ou résilient par rapport aux symptômes. Les participants ont été recrutés en mai 2020 par la méthode « boule de neige » ("snowball sampling") utilisant la liste de courriel des universités et diverses plateformes de réseaux sociaux. Après la 1ère vague de données (4 Mai - 7 juillet 2020), les participants étaient invités à contribuer à 3 collectes de données additionnels entre 4 septembre - 5 octobre, 7 décembre 2020 - 10 janvier 2021, et 19 mars - 23 avril 2021. Au total 681 participants ont été recrutés.

Les mesures de santé mentale comprenaient la dépression mesurée avec le Patient Health Questionnaire 9, l'anxiété mesurée avec le Generalized Anxiety Disorder 7, l'état de stress posttraumatique mesurée avec le PTSD Check List 5. Les covariables comprenaient des variables sociodémographiques (âge, genre, statut marital, éducation, type de travail,

salaire…) et des données relatives à la santé : maladie psychiatriques antérieures, conditions médicales, tabac, alcool, drogues, ainsi que des variables liées aux restrictions imposées sous la COVID-19.

Des analyses descriptives et analytiques (analyse de cluster par k means et par régression logistique, (test de permutation, test d de Cohen) ont été réalisées. Un groupe de scores élevés et un groupe de scores faibles de santé mentale ont été identifiés. Dans les deux groupes, les scores de santé mentale variaient considérablement dans le temps. Les niveaux de tous les scores de santé mentale étaient les plus bas lorsque les restrictions liées à la COVID-19 ont été levées et les plus élevés lorsque les restrictions étaient en place, à l'exception de l'état de stress post traumatique. Aucun score de santé mentale n'est revenu au niveau précédent ou au niveau initial du confinement ($p < 0,05$).

Les participants présentant des niveaux élevés de symptômes étaient caractérisés par un âge plus jeune (OR : 0,98, IC 95 % : 0,97-0,99), des antécédents de troubles mentaux (OR : 3,46, IC 95 % : 2,07-5,82), une expérience de la violence domestique (OR : 10,54, IC 95 % : 1,54–20,68) et les problèmes médicaux (OR : 2,16, IC 95 % : 1,14–4,03).

En conclusion, cette étude a révélé des différences subtiles mais bien existantes dans l'évolution des trajectoires des symptômes au cours de la première année de la pandémie de COVID-19, et a mis en évidence plusieurs caractéristiques associées aux deux clusters. En particulier, les jeunes participants ayant des antécédents médicaux et de santé mentale, et ceux qui ont souffert de violence domestique, semblaient éprouver des niveaux plus graves de dépression, d'anxiété et de SSPT au début de la période de restrictions. Ces niveaux ont rapidement diminué lorsque les restrictions ont été levées. Ainsi, bien qu'une grande proportion d'individus dans la population générale puisse ne pas sembler avoir été touchée

dans une large mesure, leur santé mentale dans plusieurs domaines s'est détériorée au fil du temps et pourrait continuer à le faire alors que la pandémie se poursuit.

Reconnaître les trajectoires de symptômes de ces différents groupes issus de la population générale peut permettre des actions de prévention, des soins ou des interventions ciblés, en s'assurant à ce que les personnes du groupe de faibles niveaux de problèmes de santé mentale reviennent à des niveaux normaux de symptômes, et si ce n'est pas le cas, en proposant des suivis. Enfin, il est important de noter que fin avril 2021, ces deux groupes montraient des améliorations significatives de leur santé mentale, mais continuaient de connaître une prévalence plus élevée de problèmes de santé mentale qu'au début de la pandémie.

Même si de nombreuses personnes se sont adaptées à l'expérience du confinement et ont peut-être même connu de nouvelles améliorations de leur santé mentale à la levée du confinement, l'assouplissement du confinement peut avoir posé de nouveaux défis à d'autres, notamment en perturbant les routines nouvellement acquises et les schémas d'adaptation.

RÉSUMÉ EN ANGLAIS

Context: The COVID-19 epidemic has spread worldwide since December 2019. To contain it, preventive measures including social distancing, economic shutdown, and school closures were introduced, carrying the risk of mental health burden in adults and children. Although the knowledge base regarding response to trauma and adverse events in general has broadened, descriptions of their mental health during epidemics remain scarce. In particular, the role of family socioeconomic characteristics and parental mental health are poorly understood.

Objective: The objective of this thesis was to explore the impact of the containment measures and of lift of the lockdown measures on psychiatric symptoms on diverse populations such as adults and children, considering their individuals characteristics.

Methods: Data come from TEMPO, ELFE and COMET cohort. Our study design was cross-sectional at inclusion and longitudinal for follow-up data. Multivariate analysis have been carried out on variables of interest, including logistic, multinomial or linear regression depending on the type of data.

Results: Results show an association between mental health deterioration and containment measures related to COVID-19.

Keywords Mental health, epidemiology, community survey, longitudinal

RESEARCH UNIT

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Épidémiologie développementale, promotion de la santé mentale et de la réussite éducative – HEALTHY / Santé et réussite des jeunes

PUBLICATIONS AND SCIENTIFIC COMMUNICATIONS

Publications related to this thesis

1. **Moulin F**, El-Aarbaoui T, Bustamante JJH, Héron M, Mary-Krause M, Rouquette A, Galéra C, Melchior M. Risk and protective factors related to children's symptoms of emotional difficulties and hyperactivity/inattention during the COVID-19-related lockdown in France: results from a community sample. Eur Child Adolesc Psychiatry Published Online First: 9 March 2021. doi:10.1007/s00787-021-01752-3
2. **Moulin F**, Bailhache-Lerouge M, Monnier M, Thierry X, Vandentorren S, Côté S. M, Falissard B, Simeon T, Geay B, Marchand L, Dufourg M. N, Charles M.A, Ancel P.Y, Melchior M, Rouquette A, Galera C and for the SAPRIS study group. Longitudinal impact of psychosocial status on children mental health in the context of COVID-19 pandemic restriction. Eur Child Adolesc Psychiatry. doi :10.1007/s00787-022-02010-w
3. **Moulin F**, Monnier M, Jean F, Melchior M, Patanè M, Pinucci I, Sijbrandij M, Van der Waerden J, Galera C. Longitudinal impact of the COVID-19 pandemic on mental health in a general population sample in France: evidence from the COMET Study. Accepted September 2022, Journal of Affective Disorders.
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Scientific communications related to the thesis

1. European Child and Adolescent Psychiatry Congress**,** June 2022, Maastricht, The Netherlands. **Moulin F**. Longitudinal impact of psychosocial status on children mental health in the context of COVID-19 pandemic restriction. Oral Presentation
2. French Congress of Psychiatry, December 2021, Montpellier, France, Santé mentale en période d'épidémie de COVID-19: données longitudinales issues d'enquêtes en population générale en France. Melchior M, Mary-Krause M, Rouquette A, **Moulin F.** Oral presentation

LIST OF ABBREVIATIONS

AUDIT Alcohol Use Disorders Identification Test

COMET COVID-19 Mental Health Survey

COVID-19 Coronavirus Disease 2019

DSM Diagnostic and Statistical Manual of Mental Disorders

ELFE Étude Longitudinale Française depuis l'Enfance

EPIPAGE Etude épidémiologique sur les petits âges gestationnels

ESPT Etat de stress post-traumatique

INSERM Institut national de la santé et de la recherche médicale

ORa Odds Ratio ajusté

PCL 5 PTSD Check List 5

PHQ-9 Patient Health Questionnaire 9

QOL Quality Of Life

SAPRIS Santé, pratiques, relations et inégalités sociales

SDQ Strenghts and Difficulties Questionnaire

SSE Statut socio-économique antérieur

TDAH Trouble de l’Attention Hyperactivité

TEMPO Trajectoires épidémiologiques en population

1. SCIENTIFIC PROBLEMATIC

1.1 Mental health in the context of the COVID-19 pandemic lockdown

In response to the coronavirus disease 2019 (COVID-19) pandemic (15), governments worldwide adopted measures in order to reduce transmission, culminating in March and April 2020 in most of the countries in staying at home and physical and 'social' distancing measures, often named as 'lockdown'.

While these measures helped to reduce the number of new infections, gaining valuable time for the health sector to strengthen its capacity and expertise for dealing with infected patients, it has become clear that the policy response had broad impacts on the health of populations and affected all health determinants. Confronted with new waves of infections in autumn 2020 and winter 2020/2021 and the imposition of new lockdowns in many countries, it was crucial to understand the positive and negative impacts of lockdowns on the mental health of populations in order to inform future policy responses.

As an example, a study conducted in the UK in May 2020 found that academic peer-reviewed research literature was scarce regarding the impacts of quarantine periods and social distancing on health. (16)

Some prior epidemics led to stress and new mental health and substance use issues. As the COVID-19 pandemic continues, different populations are at increased risk to experience poor mental health and may face challenges accessing needed care.

Overall, almost half of the studies explore the impact of lockdown measures on mental health (1, 17–38). While the rapid implementation of quarantine, isolation and social distancing measures seems to be the most effective strategy to contain the spread of the virus, these measures, when implemented at short notice, can produce alarm and anxiety. (37) The studies reported a high burden of mental health problems among several groups of the population who experienced quarantine or isolation such as the infected patients, the general population and health workers. Prevalent mental health issues included anxiety, (1, 18, 19, 25, 27, 29)(34, 37–39) depression, (18, 19, 25, 26, 38, 39) post-traumatic stress disorder (PTSD), stress,(1, 18, 20, 21, 23–27, 37–39) and stigmatization. In particular among children, older people and health workers the evidence suggests a link between PTSD and quarantine or isolation.(1, 23, 26, 27, 38, 39). Stigma was linked both to quarantine and isolation (26)and particularly experienced by health workers (1) and children (27, 36); the two groups experienced stigma due to quarantine even if they had been confirmed to be negative.(27, 36)

1.1.1 Children

Social isolation in children may increase the risk for cardiovascular disease, reduce physical activity and have negative effects on mental health (40, 41) such as an increased likelihood of high rates of depression and anxiety during and after enforced isolation.(41)Quarantine in children is linked to anxiety, stress and depression and can become a risk factor for child growth and development.(18) Isolation and quarantine together are related to an increased risk of requiring mental health services and to higher levels of post-traumatic stress.(39)

In our study, we first assessed family and individual correlates of children's symptoms of emotional difficulties and hyperactivity/inattention in a community-based sample in France, using the longitudinal survey of a cohort of parents who took part in the 2020 online assessment of the TEMPO COVID-19 study.

We also assessed the impact of prior low socioeconomic status on children's emotional and ADHD symptoms during the COVID-19 lockdown and investigated in a subgroup of vulnerable children with pre-existing socioeconomic difficulties, which other social factors could exacerbate these mental health difficulties.

1.1.2 Adults

Throughout the pandemic, anxiety, depression, sleep disruptions, and thoughts of suicide have increased for many young adults. They have also experienced a number of pandemic-related consequences – such as closures of universities, transitioning to remote work, and loss of income or employment – that may contribute to poor mental health.

In our study, we aimed to identify the **trajectories** of anxiety, depression and PTSD symptoms during and after the easing of lockdown in France (encompassing the whole period of lockdown, easing of lockdown, and freedom,) 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.

Adults Experiencing Job Loss or Income Insecurity

Research from prior economic downturns showed that job loss was associated with increased depression, anxiety, distress, and low self-esteem and may lead to higher rates of substance use disorder and suicide. During the pandemic, adults in households with job loss or lower incomes reported higher rates of symptoms of mental illness than those without job or income loss.

1.1.3 Older people

Studies suggested a greater vulnerability of older people for secondary transmission than other household members.(42) Other negative consequences were also experienced, particularly if isolation was in place for an extended period, and the loneliness caused by social isolation were associated with impaired cognitive function in older adults. (31) Older people who went through lockdown with the subsequent reduction in social participation and physical activity during home confinement were typically more inactive and more disposed to chronic disease.(43)

We did not investigate the effect of lockdown on elderly in our study as the population targeted was younger.

1.1.4 Well-being and quality of life

Only five systematic reviews were retrieved on well-being and quality of life (QOL).(1, 19, 20, 34, 44) Importantly, four systematic reviews explored the impact of lockdown measures on health workers in terms of well-being and QOL.(1, 19, 20, 34)According to the evidence summarized in these studies, healthcare professionals who had been quarantined had more severe symptoms of post-traumatic stress than the general population, felt stigmatized,

presented more avoidance behavior's, reported huger lost income and were more affected at the psychological level.(1)

Finally, lockdown and social distancing were linked in the general population to a negative psychosocial impact, an increased prevalence of depression, anxiety, sleep, alcohol use disorders and the fear of being infected. People were also worried about their loved ones.(19, 20, 40)

1.1.5 Substance abuse

The four systematic reviews (17, 19, 38, 45)focused on the correlation of infection control measures and substance abuse found that lockdown was associated with increased alcohol use disorders in the general population, (19) and social isolation and quarantine were identified as potential contributors to the aggravation of substance abuse. (17, 38)

We took in account substance abuse in the first study as correlates of parental variables and in the 3d study we examined whether or not alcohol, tobacco and illegal drug use were associated with higher level of symptoms.

1.2 Policy Responses and Considerations in France

Throughout the pandemic, leading public health organizations — including the Center for Disease Control and Prevention, the World Health Organization, and the United Nations — have released general resources aiming to address the mental health and well-being of both general populations and high-risk groups during the pandemic.

France has been one of the European countries particularly affected by the spread of COVID-19. Until July 2021, there were more than 6.3 million COVID-19 cases and more than 110,000 deaths in France (46). 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 (47–49). In between lockdowns, the French population had to comply with strict sanitary measures including wearing masks, social distancing, remote working, and various curfews (50).

In November 2020, at the very beginning of this research project, the French National Academy of Medicine published a press release (51) stating that several surveys reported measurable negative effects of the COVID-19 pandemic on people's mental health, both in the general population and in clinical practice.

According to this release, these effects are observed in patients who showed COVID-19 symptoms. Beyond the infectious episode, at least 20% of them showed psychological sequelae: chronic anxiety disorders, post-traumatic stress disorder, depressive pathology (52). "The neuro-inflammatory disturbances caused by the virus could be one of the determining factors. It could also later on affect the quality of brain ageing. At the forefront of the pandemic, caregivers are recognized at risk of developing psychological disorders(53) , in particular anxiety-depressive disorders and post-traumatic stress.(53)"

In November, a “Santé Publique France” survey found a 20% rate of depressive symptoms in the general population (54), with people who were inactive or in a precarious financial situation, students, people with a history of psychological disorders or with

disabilities were particularly exposed to the risk of depressive disorders. It also stated that “The COVID-19 pandemic induces a set of negative events involving collective and individual resilience capacities as well as revealing vulnerabilities, particularly psychological ones. It is important to take into account the specific vulnerabilities inherent in some living conditions: professional, social and emotional isolation, disability (55). These are powerful factors in revealing unrecognized individual vulnerabilities, leading to acute or long-term decompensations.”

Later on, in March 2022, the World Health Organization (WHO) published a scientific brief [56] entitled “Mental health and COVID-19: Early evidence of the pandemic’s impact”, aiming to present current evidence regarding the mental health aspects of the pandemic and inform prevention, response, and recovery efforts worldwide, and summarizes recent estimates of the Global Burden of Disease 2020 study.

The effects of coronavirus disease 2019 (COVID-19) on mental health and well-being are likely to be profound and long-lasting [57, 58]and will extend beyond those who have been directly affected by the virus. However, it is unclear who will be affected and to what extent such effects will generalize across all aspects of mental health.

Evidence from previous public health epidemics (for example the severe acute respiratory syndrome such as SARS virus) [59, 60] illustrated that the adverse effects are more common in some groups and that the detrimental effects are more pronounced among certain aspects of mental health than others. Increased risk of suicide was evident following SARS in older adults [61]. Cross-sectional [62] and longitudinal evidence (over 4 weeks) [63] from China during the early stages of the outbreak of COVID-19 found high levels of mental health

problems and distress in the general population. Data from the UK (University College London COVID-19 Social Study), which started post-pandemic, suggests self-harm and thoughts of suicide/self-harm were higher among women, minority ethnic groups, people experiencing socioeconomic disadvantage and those with mental disorders [64]. Repeated cross-sectional and longitudinal analysis of individual responses to the UK, including pre-pandemic data, have also demonstrated that mental health deteriorated in the early stages of the pandemic. [65] All these studies point to elevated rates of anxiety, depression, stress, suicide risk and post-traumatic stress in the initial stages of the pandemic.

Given the pandemic's implications for both people with new or pre-pandemic mental health conditions, the crisis spotlights new and existing barriers to accessing mental health and substance use disorder services. Limited access to mental health care and substance use treatment is in part due to a current shortage of mental health professionals, which has been exacerbated by the pandemic. The pre-pandemic shortage of psychiatric hospital beds has also worsened with the surge of COVID-19 patients needing beds at hospitals across the French nation.

2. THESIS PURPOSES

The main objective of this thesis was to explore the impact of the containment measures and of lift of the lockdown measures on psychiatric symptoms on diverse populations such as adults and children, considering their individual characteristics. Notably we aimed to: 1) assess the familial and individual symptoms of emotional and hyperactivity/inattention symptoms on children in a sample coming from the general population; 2) assess the influence of socioeconomic aspect and its repercussions on children mental health, during the period of school closure due to COVID-19; 3) explore the effect of lockdown and post-lockdown on their mental health of adults.

3. RESULTS

3.1 First publication:

As the coronavirus (COVID-19) epidemic progresses worldwide, on March 17th 2020 the French Government ordered a nationwide lockdown, with strict social restrictions and limitations of individuals' movements. Families were confined to their homes, with the risk of job loss, salary reduction or closure of regular activities such as schools. According to UNESCO, as of April 1st 2020, the infection has caused 194 countrywide closures around the world, thus affecting 1 598 099 000 students, knowing that school closures have been shown to have an

impact on children psychological difficulties [8, 41, 66], school closure may also cause disruptions in physical activity, social interactions, and mental health of children and adolescents.

Prior studies on the health impact of a quarantine [8, 67, 68] have shown that when children are out of school, they are physically less active, have longer screen time and irregular sleep patterns, resulting in weight gain and loss of cardiorespiratory fitness, which can all subsequently impact their psychological well-being.

There is evidence that in some special populations, such as children of health workers [1], children with a chronic disease [2] as well as those suffering from ADHD before the epidemic [3, 4], the COVID-19 outbreak and the accompanying disease containment measures introduced had an impact on psychological well-being. However, though research highlights children's mental health risks associated with anxiety, lack of peer contacts, reduced opportunities for stress regulation or parental mental illness [5–7], and several reports [8–10] [1, 13, 14] call for further research, to date there is little epidemiological data on the mental health of children drawn from the community in face of the COVID-19 19 epidemic.

Given the well-known associations between family characteristics such as parental mental health [11–13], low socioeconomic position [13, 14]and offspring high risk of poor mental health [11, 12], we chose to specifically examine the role of these factors.

The aim of our study was to assess family and individual correlates of children's symptoms of emotional difficulties and hyperactivity/inattention in a community-based sample in France.

We assumed that children's characteristics such as sleeping difficulties, elevated screen time use, as well as the family's circumstances including parents' marital situation (single vs. living together), financial difficulties, low income and unstable work situation during lockdown, parents' symptoms of anxiety and depression or substance use, and parents' experience of COVID-19 symptoms were correlated to children's psychological difficulties and studied these characteristics.

3.2 Second publication:

The burden in mental issues worldwide [69] has disproportionately impacted vulnerable populations, notably children and adolescents [5, 6, 9, 70–77]. As is commonly observed, the epidemic has led to major socioeconomic disparities in mental health, the poorest and less educated populations being the most exposed to a range of deleterious risk factors [78–80]. Recent studies emphasize this negative impact of social inequalities on children's mental health [78, 81]. Of note, the pandemic has caused an unprecedented financial crisis worldwide and pushed millions of families below the poverty line, [82] exposing children and adolescents to high levels of psychological distress [78–80] . As found in a US study [80], further risk factors for mental health difficulties in children are hardship during the crisis, including caregiving burden, and parents' job loss and income reduction. Even in countries where the welfare state has intensively attempted to mitigate the economic impact of the COVID-19 crisis (e.g. France,

Germany), financial difficulties during the lockdown occurred and were related to worsened mental health in children [71, 83]. Moreover, protection measures such as lockdown, curfews and school closures have disproportionally affected families with prior low SES.[82]

Despite the well-known association between low SES and children's mental health problems during [69–71] and outside [79, 84] the pandemic context, some issues remain elusive. Some studies showed the impact on children mental health of other risk factors such as parental separation, and the sex of the child [85] . First, most studies are cross-sectional and the impact of a pre-existing socioeconomic disadvantage on children's mental health during the COVID-1919 has hardly been studied within a longitudinal framework [86]. Second, interactions between socioeconomic difficulties and risk factors, including sex of the child and parental separation, which have been shown to be linked with SES before the pandemic [79, 87] have not been considered. Understanding the consequences of the COVID-19 crisis on those vulnerable children already at risk of mental health problems is essential for rapidly developing policies and interventions to mitigate the mental health problems of vulnerable groups of children already living in a deprived socioeconomic environment [88].

The aim of our study was: a) to assess the impact of prior low socioeconomic status (SES) on children's emotional and Attention-Deficit/Hyperactivity Disorder (ADHD) symptoms during the COVID-19 lockdown, taking into account current financial and prior mental health problems four years before, and b) to investigate, in a subgroup of vulnerable children with pre-existing socioeconomic difficulties, which other social factors such as parental separation, sex or decline in income during the lockdown could exacerbate these mental health difficulties. c) We also assessed the impact of pre-existing mental health disorders before the

lockdown on the mental health during the lockdown, as well as the impact of financial insecurity.

3.3 Third publication:

In this study, we extend our research on adults, and also explore the effect of lockdown and post-lockdown on their mental health.

Since the beginning of the COVID-19 pandemic, several studies [89] have reported high levels of mental health problems worldwide in the adult population. General population studies have found that clinically significant mental illness increased in the early weeks of the pandemic among adults.[90, 91] In particular, worse mental health was found in younger [65] and financially insecure adults. Other reported risk factors included being a woman, having pre-existing mental and physical health conditions or living alone [92].

However, in some countries such as UK and Australia where the restrictions were very strict [93], symptoms of depression and anxiety in the general population gradually decreased over time during the lockdown periods [65, 87, 94–97][98]. 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 [65, 87, 94–97][98]. Of note, few other studies [99–101] have reported the different trajectories of mental health status across distinct lockdown phases. A British systematic review [97] 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 [102] 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 [103–105].

France has been one of the European countries particularly affected by the spread of COVID-19. Until July 2021, there were more than 6.3 million COVID-19 cases and more than 110,000 deaths in France [46]. 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 [47–49]. In between lockdowns, the French population had to comply with strict sanitary measures including wearing masks, social distancing, remote working and various curfews [50].

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, [106] 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 [107] 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[108] symptomatology, except in very specific populations [109–111]. 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[112]. 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.

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4. PUBLISHED ARTICLES (IN ACCORDANCE WITH THE THESIS)

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Title page

Title: Risk and protective factors related to children's symptoms of emotional difficulties and hyperactivity/inattention during the COVID-19 related lockdown in France: results from a community sample

Running head: Mental health in children during COVID-19

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Declarations

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Conflicts of interest/Competing interests: *The authors declare that they have no conflicts of interest.*

Ethics approval: The TEMPO study received approval from France's national committees for data protection (CCTIRS: Comité Consultatif sur le Traitement des Informations pour la Recherche en Santé: CNIL: Commission Nationale Informatique et Liberté).

Availability of data and material: Upon request.

Code availability: STATA 16.1 (StataCorp, College Station, Texas, USA)

ABSTRACT

Objective: The COVID-19 epidemic has spread worldwide since December 2019. To contain it, preventive measures including social distancing, economic shutdown, and school closures were introduced, carrying the risk of mental health burden in adults and children. Although the knowledge base regarding children's response to trauma and adverse events in general has broadened, descriptions of their mental health during epidemics remain scarce. In particular, the role of family socioeconomic characteristics and parental mental health are poorly understood. **Methods:** We assessed the correlates of children's emotional difficulties and symptoms of hyperactivity/inattention during the COVID-19 lockdown in a French community-based sample. Data came from 432 community-based parents (27-46 years, TEMPO cohort) and their children (mean age 6.8 +/- 4.1) interviewed online. Children's symptoms of emotional difficulties and hyperactivity/inattention were assessed using the parent reported Strengths and Difficulties Questionnaire during the 5th week of home confinement. Family socioeconomic characteristics and parental mental health and substance use were assessed weekly during the first 5 weeks of home confinement. Data were analyzed using logistic regression models. **Results:** 7.1% of children presented symptoms of emotional difficulties and 24.7% symptoms of hyperactivity/inattention. Family financial difficulties and parental symptoms of anxiety and depression, as well as children's sleeping difficulties and screen time, were associated with the presence of psychological difficulties. **Conclusion:** Children's emotional and behavioural difficulties are associated with parental mental health and socioeconomic difficulties. In the unprecedented situation of the COVID-19 epidemic, parents and professionals involved in caring for children should pay special attention to their mental health needs.

Keywords: Children's mental health; self-report; epidemiology; community survey: COVID-19

1. Introduction

As the coronavirus (COVID-19) epidemic progresses worldwide, on March 17th 2020 the French Government ordered a nationwide lockdown, with strict social restrictions and limitations of individuals' movements. Families were confined to their homes, with the risk of job loss, salary reduction or closure of regular activities such as schools. According to UNESCO, as of April 1st 2020, the infection has caused 194 countrywide closures around the world, thus affecting 1 598 099 000 students, knowing that school closures have been shown to have an impact on children psychological difficulties [1-3], school closure may also cause disruptions in physical activity, social interactions, and mental health of children and adolescents.

Prior studies on the health impact of a quarantine [1, 4, 5] have shown that when children are out of school, they are physically less active, have longer screen time and irregular sleep patterns, resulting in weight gain and loss of cardiorespiratory fitness, which can all subsequently impact their psychological well-being.

There is evidence that in some special populations, such as children of health workers [6], children with a chronic disease [7] as well as those suffering from ADHD before the epidemic [8, 9], the COVID-19 outbreak and the accompanying disease containment measures introduced had an impact on psychological well-being. However, though research highlights children's mental health risks associated with anxiety, lack of peer contacts, reduced opportunities for stress regulation or parental mental illness [10-12], and several reports [1, 13, 14] call for further research, to date there is little epidemiological data on the mental health of children drawn from the community in face of the COVID 19 epidemic.

Given the well-known associations between family characteristics such as parental mental health [15-17], low socioeconomic position [17] [18] and offspring high risk of poor mental health[15, 16], we chose to specifically examine the role of these factors.

The current study

The aim of our study was to assess family and individual correlates of children's symptoms of emotional difficulties and hyperactivity/inattention in a community-based sample in France.

We assumed that children's characteristics such as sleeping difficulties, elevated screen time use, as well as the family's circumstances including parents' marital situation (single vs. living together), financial difficulties, low income and unstable work situation during lockdown, parents' symptoms of anxiety and depression or substance use, and parents' experience of COVID-19 symptoms were correlated to children's psychological difficulties and studied these characteristics.

2. Methods

2.1 Setting and study design

Data for this study come from a longitudinal survey of a cohort of parents who took part in the 2020 online assessment of the TEMPO (Trajectoires EpidéMiologiques en Population) COVID 19 study (www.tempo.inserm.fr).

2.1.1 Sample characteristics

The TEMPO study was set up in 2009 to examine associations between life circumstances and substance use and mental health in young adults**.** All TEMPO participants have a parent who took part in the GAZEL cohort study [19, 20]. TEMPO study participants were recruited in 1991 when 2,585 children aged 4-16 were selected to take part in a survey of their mental health. In 2009, all 1991 study participants (aged 22-35 at the time) were invited to participate again: 1103 agreed, of whom 752 agreed to a longitudinal follow-up [21]. In 2011, we conducted a new wave of data collection and the study sample was expanded to all GAZEL participants' offspring aged 18 to 37 years [22]. (Figure 1). The TEMPO study received approval from France's national committees for data protection (CCTIRS: Comité Consultatif sur le Traitement des Informations pour la Recherche en Santé: CNIL: Commission Nationale Informatique et Liberté).

2.2 Sample

On March 17h 2020, 7.730 cases of COVID-19 were reported by France's public health authorities, among them 2759 were hospitalized and 700 were in intensive care [63], pushing the French government to order a nationwide lockdown. From March 24th to April 28th 2020, TEMPO participants were invited by email to complete a weekly online questionnaire. The 4 initial questionnaires focused on socio-demographics, work characteristics, COVID-19 infection, general and mental health, as well as substance use. During the 5th week of lockdown, the questionnaire assessed participants' children's mental health and was completed by 432 participants. Participants who had more than one child were asked to complete the questionnaire in reference to their youngest child. Sample characteristics are

described in **Table 1**. In total, 432 participants, including 276 women (65%) and 148 men (34.9%), completed the study questionnaire about their children: 31 (7.2%) children had signs of emotional difficulties and 107 (24.8%) of symptoms of hyperactivity/inattention.

2.3 Ethical section

The TEMPO study received approval from France's national committees for data protection (CCTIRS: Comité Consultatif sur le Traitement des Informations pour la Recherche en Santé: CNIL: Commission Nationale Informatique et Liberté).

2.4 Measures

2.4.1 Children

We used the SDQ to ascertain symptoms of emotional difficulties and hyperactivity/inattention.

2.4.1.1 Emotional and hyperactivity/inattention symptoms

Children's symptoms of emotional difficulties as well as hyperactivity/inattention were reported by parents using the Strengths and Difficulties Questionnaire (SDQ) during the 5th week (from 20th to 26th of April 2020) of home confinement. The SDQ is a brief, 25-item, measure of behavioral and emotional difficulties that can be used in children and young people aged 4–17 years [23-25]. In this study, we used 2 subscales: "emotional difficulties" and symptoms of "hyperactivity/inattention", with 5 items each. Each item was scored on a 3 points ordinal Likert scale (0 "not true"; 1 "somewhat true"; 2 "certainly true"). A cut-off of >3 out of 10 was used to detect high symptom levels on emotional difficulties scale and of >5 out

of 10 to detect high symptoms levels on hyperactivity/inattention scale. The internal consistency of the subscales was acceptable (Cronbach's α of 0.62 for emotional difficulties and 0.74 for symptoms of hyperactivity/inattention).

2.4.1.2 Risk factors of children's psychological difficulties

Risk factors studied in this investigation included children's age, sleep and screen time use, family socio-demographic characteristics, parents' mental health and substance use, and parents' experience of COVID-19 symptoms.

2.4.1.3 Children's characteristics (sociodemographics, sleeping difficulties, screen time)

The child's sociodemographic characteristics included *sex* (female vs. male), *age* (> or =< 6 years old).

Sleeping difficulties were assessed by the following questions: "During the preceding 7 days, did your child have difficulties sleeping that: appeared or increased or decreased or disappeared or stayed stable or no difficulties." We created the following categories "Sleeping difficulties (including "sleeping difficulties that "appeared" or "increased" or "stayed stable") vs. "No sleeping difficulties" (including "no difficulties", or "difficulties disappeared" or "difficulties decreased").

Screen time was assessed by the following questions: "During the preceding 7 days, how much time has your child spent in front of a screen (TV, tablet, computer, smartphone..) per day. We created the 2 following categories: "Less than 1 hour", vs. "More than 1 hour", based on the American Academy of Pediatrics new Recommendations for Children's Media Use [61]

2.4.2 Parents

2.4.2.1 Family socio-demographic characteristics

Socio-demographic characteristics studied include: family situation (single vs. couple), financial difficulties in the preceding 5 weeks (yes vs. no), household monthly income (2500 euro or less vs. > 2500 euro)(in reference to the average income in France) [62] and work situation during lockdown (normal /distance working vs. job loss/ unemployment vs. sick leave).

2.4.2.2 Parents' mental health

To assess *parents' symptoms of anxiety and depression* during the first 5 weeks of lockdown, we used weekly repeated measures of the subscale assessing anxious-depressed symptoms in the Adult Self Report Scale (ASR) [26], creating a dichotomized T-score with a cut-off based on +1 standard deviation from the mean. Additionally, using an assessment of ASR-based anxious-depressed symptoms obtained in the TEMPO study in 2018, we also identified parents' symptoms of anxiety and depression before lockdown, which were studied in additional analyses.

2.4.2.3 Parents' substance use

Participants reported levels of substance use and abuse during the first 5 weeks of lockdown in weekly questionnaires.

Tobacco smoking status was assessed using the following question in week 1: "Are you a regular or occasional smoker?" coded yes vs. no.

Alcohol use was assessed using the French version of the Alcohol Use Disorders Identification Test (AUDIT-C) [27, 28]. This brief three-item alcohol screening tool developed by the WHO focuses on the frequency and quantity of alcohol consumption [29], matches DSM IV criteria for alcohol abuse and dependence and is validated against clinical diagnosis. Audit-C test scores of 3 or more for women and 4 or more for men were considered to indicate a heightened risk for hazardous drinking/alcohol use disorder [29, 30].

2.4.2.4 COVID-19 symptoms of the parents

Parents' COVID-19 symptoms during the first 5 weeks were ascertained weekly by the following question: "Did you present symptoms of COVID-19 infection (fever, cough, loss of taste or smell)"? Based on participants' weekly repeated responses ("yes" vs. "no") we created a variable indicating the presence of symptoms prior to the measure of children's psychological difficulties.

2.5 Statistical analyses

First, descriptive statistics including frequencies and percentages were used to characterize the study population (Table 1). We tested bivariate associations between potential individuals and family risk factors, and children's symptoms of emotional difficulties or hyperactivity/inattention using the Chi square test (**Table 2** and **Table 3**).

Second, to identify factors associated with children's emotional difficulties and symptoms of hyperactivity/inattention, we used logistic regression with the alpha value set at $P<0.05$. We built one model, adjusting for the child's age and sex, and an additional multivariate model

adjusting for all variables that were significantly associated with the study outcomes in bivariate analyses.

Additional analyses

We tested for statistical interactions between children's age and sex on the one hand and parents' mental health and financial difficulties on the other. None of these statistical interactions were statistically significant.

All statistical analyses were conducted using STATA 16.1 (StataCorp, College Station, Texas, USA).

3. Results

3.1 Sample characteristics (Table 1)

Sample characteristics are described in **Table 1**. In total, 432 participants, including 276 women (65%) and 148 men (34.9%), completed the study questionnaire about their children: 31 (7.2%) children had signs of emotional difficulties and 107 (24.8%) of symptoms of hyperactivity/inattention.

Table 2 and **Table 3** show factors associated with children's emotional difficulties and symptoms of hyperactivity/inattention.

3.2 Risk factors of children's emotional difficulties and symptoms of hyperactivity/inattention (Tables 2 & 3)

Emotional symptoms

Age- and sex-adjusted logistic regression analyses **(Table 2)** showed that the odds of children's high levels of emotional difficulties were elevated among those who had sleeping difficulties (OR 2.6, 95% CI 1.2– 5.7), whose screen time was more than 1 hour per day (OR 6.8, 95% CI 1.5 – 30.9), whose parents had symptoms of anxiety-depression during lockdown (OR 8.1, 95% CI 2.4– 26.8), or who had financial difficulties (OR 4.2, 95% CI 1.6– 11.0).

Family situation (OR 1.2, 95% 0.6-2.7), the number of children in the family (OR 1.0, 95% 0.3-3.2), income (OR 1.1, 95% 0.5-2.4), job situation (OR 1.6 95% 0.7-3.5), COVID-19 symptoms (OR 1.7, 95% 0.5-5.3), and parents' substance use, such as tobacco consumption (OR 2.3, 95% 0.8-6.6) and problematic alcohol consumption (OR 0.7, 95% 0.1-3.8) were not associated with children's high levels of emotional difficulties.

These associations did not change in a multivariate regression models, except for sleep difficulties and financial difficulties, which were no longer associated with children's emotional symptoms.

Symptoms of hyperactivity/inattention

Age- and sex-adjusted logistic regression analyses **(Table 3)** showed that the odds of children's symptoms of hyperactivity/inattention were elevated among children who had sleeping difficulties (OR 2.0, 95% CI 1.1-3.3), had parents with symptoms of anxiety or depression (OR 2.6, 95% CI 1.1-1.2), financial difficulties (OR 2.3, 95% CI 1.1-4.6), or who were unemployed (OR 1.8, 95% CI 1.1-3.3).

The child's screen time (OR 1.3, 95% CI 0.9-1.9), the responding parent's sex (OR 0.7, 95% CI 0.4-1.2), the family situation (OR 1.4, 95% CI 0.9-2.3), the number of children in the family

(OR 0.6, 95% CI 0.3-1.5), parents' substance use such as tobacco consumption (OR 0.8, 95% 0.4-1.6) and problematic alcohol consumption (OR 1.2, 95% 0.7-1.9), COVID symptoms (OR 0.9, 95% CI 0.4-2.1), or income (OR 1.0, 95% CI 0.6-1.7) were not associated with children's elevated levels of symptoms of hyperactivity/inattention.

These associations did not change in a multivariate regression model, except for sleeping difficulties and parental work situation, which were no longer associated with children's symptoms of hyperactivity/inattention.

4. Discussion

4.1 Main findings

Ours is one of the first studies to explore children's psychological symptoms and their correlates during the COVID-19 epidemic and associated lockdown. Overall, when adjusting on age and sex, children's emotional difficulties and symptoms of hyperactivity/inattention were significantly associated with their sleeping difficulties and screen time exposure, their parents' symptoms of anxiety or depression and financial difficulties. Parental employment situation was associated with children's symptoms of hyperactivity/inattention only, in an age and sex-adjusted model. Overall, children's symptoms of frequent psychological difficulties are associated with known risk factors of youth mental health problems. Children of parents who have psychological difficulties or who experience socioeconomic difficulties should benefit from special attention from primary and mental health practitioners.

4.2 Interpretation of study findings

We discuss our findings on the role of parents' mental health and socioeconomic characteristics on the one side, and children's sleep disorders and screen time use on the other side.

4.2.1 Parents' characteristics

In accordance with previous research [31-33], parents' symptoms of anxiety or depression during lockdown, as well as parents' preexisting mental health difficulties, were associated with a higher level of children's emotional difficulties and symptoms of hyperactivity/inattention.

In a stressful period such as the COVID-19 epidemic and resulting disruptions of daily life, parents are the best resource for children to seek help from. Good parenting skills are hence crucial when children are confined at home [1]. In general, children with a mentally ill parent more frequently experience negative emotions, including anger, fear, and sadness. They also show higher levels of disturbed attachment and difficulties in emotional regulation [34]. Consequently, they are at elevated risk of internalizing problems, such as depression and anxiety [15, 16].

Concerning children's symptoms of hyperactivity/inattention, the study of Zhang [9] showed that they were related to parent's mood during the COVID-19 outbreak in China. Additionally, parents of children with ADHD experience high levels of daily child-rearing stressors [35, 36], therefore this association may also be bidirectional. The special combination of school closures and children staying at home might bring elevated difficulties and stress for both children and their parents. Our results have significant clinical implications

concerning the importance of assessing parents' negative mood when evaluating children's well-being. During periods of lockdown, when assessing a child, mental health practitioners should pay further attention to the mental health status of the parents, especially looking for depression or anxiety symptoms.

Similarly, independently of home confinement, previous research has reported that children of parents with substance use disorders, [37-39], have an elevated likelihood of additional mental disorders. However, we found no relationship between parental consumption of tobacco or alcohol and offspring psychological difficulties. This may reflect low rates of tobacco and alcohol use among TEMPO cohort participants. [40]

In our study, having a parent who presented with symptoms of COVID-19 was not associated with a higher score of emotional difficulties or hyperactivity/inattention. In a recent Chinese study [31], having relatives or acquaintances infected with COVID19 was an independent risk factor of anxiety among college students, probably due to the high contagiousness of the illness [41]. It is important to note that parental COVID-19 symptoms were self-reported since biological testing was hardly available during the lockdown. It may also be that individuals who were too ill were not able to respond to TEMPO study questionnaires.

Parental financial difficulties and work situation were associated with children's emotional difficulties and symptoms of hyperactivity/inattention. Stability of family income has been found to be significantly associated with youth anxiety during the COVID 19 crisis, due to links with psychological and economic pressure [31, 42].

Our findings indicate an increased risk of psychological difficulties in children whose family had psychological or financial difficulties during lockdown. This result is consistent with previous studies, which demonstrated that parents with financial difficulties are at higher risk of mental health difficulties such as anxiety. Economic decline [43] is associated with increased mental health problems for youths that may be affected by its consequences on adult unemployment and mental health, such as depression [14, 44].

4.2.2 Children's characteristics

Children's elevated levels of emotional difficulties and symptoms of hyperactivity/inattention were associated with sleeping difficulties. Because both were measured simultaneously, it is possible that these relationships are bidirectional. Children who are anxious or experience symptoms of depression frequently have sleeping problems, which sometimes appear as a key symptom of distress [18, 45]. Symptoms of hyperactivity and inattention are core symptoms of ADHD. Similarly, ADHD may disrupt sleep by increasing the probability of bedtime struggles or resistance, limit-setting sleep problems, inadequate sleep hygiene, and insufficient sleep disorder or poor sleep quality. In turn, sleep problems may result in ADHD-like day-time behaviors [46].

In the specific context of COVID-19, Zhang et al [9] showed that children who have ADHD and experience low overall mood are most likely to see their symptoms of ADHD, including sleep patterns, worsen. Another study [13] found that poor sleep, including nightmares, is among the most frequently reported children's conditions during the COVID-19 outbreak.

In our study, children with emotional difficulties or symptoms of hyperactivity/inattention

spent more time in front of a screen during the COVID19 outbreak than children without such symptoms, which is line with previous studies showing that increased screen time may exacerbate risk for depression, anxiety, suicide, and inattention among children and adolescents [47]. Excessive screen time may also be associated with health risks including poor sleep and sedentarity, which further exacerbate risk of children's psychological difficulties [48, 49]. It is however important to note that our study being cross-sectional, screen use may also be a consequence of children's psychological difficulties, both potentially reinforcing one another. Kiraly et al [50] made some practical guidance to prevent children's problematic Internet use and emphasize that monitoring and regulating screen time is crucial and can be implemented by involving young people in rule-making [51].

Paradoxically, during the COVID-19 pandemic, many mental health educational resources and support services were offered via online platforms, which required screen use. Obviously, screen time may become over-present during periods of school closure [48], and existing guidelines need to be adequately updated to remain relevant. A recent literature review emphasized that not all screen time is equal - e.g. doing online lessons for school is different from social media use, which is different from video games. [52]

4.3 Strengths and limitations

Our study's main strengths are that it was conducted in the community and started prior to the COVID-19 epidemic, making it possible to control for preexisting risk factors. However, it also has some limitations that need to be highlighted. First, all measures were based on self-

reports, including the children's SDQ scores, which could have been influenced by parental emotional state [53]. Still, parental evaluations are appropriate given the young mean age of surveyed children (i.e. 6 years). Importantly, the performance and validity of the parent-reported SDQ in French [25]suggests that it is a good approximation of a psychiatric interview, in studies of population representative samples [54-56]. Second, we did not assess children's emotional difficulties and hyperactivity/inattention before the COVID-19 epidemic, so we have no information concerning pre-existing vulnerabilities. Children who experienced psychological difficulties prior to the pandemic or had pre-existing mental health problems are at high risk of having symptoms of anxiety [57]. Third, though some variables were assessed longitudinally on a weekly basis during lockdown, the causal relationship between children's and parents' characteristics and children's emotional difficulties or symptoms of hyperactivity/inattention cannot be confirmed as children's symptoms were assessed only once. A recent study [58] outlined the need for longitudinal mental health research with children during and after lockdown. Fourth, the relatively small sample of the study limited the statistical power of some analyses. This suggests that a larger sample may show evidence of other risk factors of children's psychological difficulties. Fifth, participants were more likely to live with a partner, have higher education and hold a managerial position than middle-aged adults of the same age in France. Reassuringly, we observed a similar rate of lifetime unemployment compared to the general population [17, 59]. Overall, associations between parental mental health and socio-economic characteristics, as well as children's sleep and screen use, may actually be stronger than we report. Sixth, children's age range was limited, as the study did not include many very young or adolescent children. However, a focus on pre-teenagers made it possible for us to study a coherent demographic group. Seventh, our

measure of children's emotional and behavioural difficulties was dichotomized, which may have limited the statistical power of our analyses, however we used a validated cut-off, and were thus able to identify children with potentially clinically relevant psychological difficulties.

4.4 Implications

The aim of our study was to assess family and individual risk factors of children's symptoms of emotional difficulties and hyperactivity/inattention in a community-based sample in France.

While the COVID19 pandemic is spreading all over the world, attention is mostly focused on adults, hiding the public mental health burden in children. Our results underline the necessity to consider long-term mental health effects on this worldwide situation on children, who account for 42% of the world's population. [60].

Risk factors of children's mental health difficulties identified in our study, which have previously been reported, may require special monitoring during the time of the pandemic. For instance, paying attention to sleep difficulties and nightmares, and suggesting sleep hygiene and relaxation methods, could be especially worthwhile during the epidemic [13]. Moreover, screen time guidelines need to updated, as many children and adolescents will not attend school.

Further longitudinal studies should be conducted in order to test prospective risk factors of children's mental health difficulties. Indeed, even as restrictions are lifted and schools re-

open, the psychological impact of the pandemic will last. Increased awareness of the risk factors of mental health difficulties in children in this unprecedented event is needed to prevent them in the short and long terms.

Acknowledgements

We thank TEMPO and GAZEL study participants who provided data for this project.

Figure

Design of the cohort study using both TEMPO participants' and GAZEL participants'.

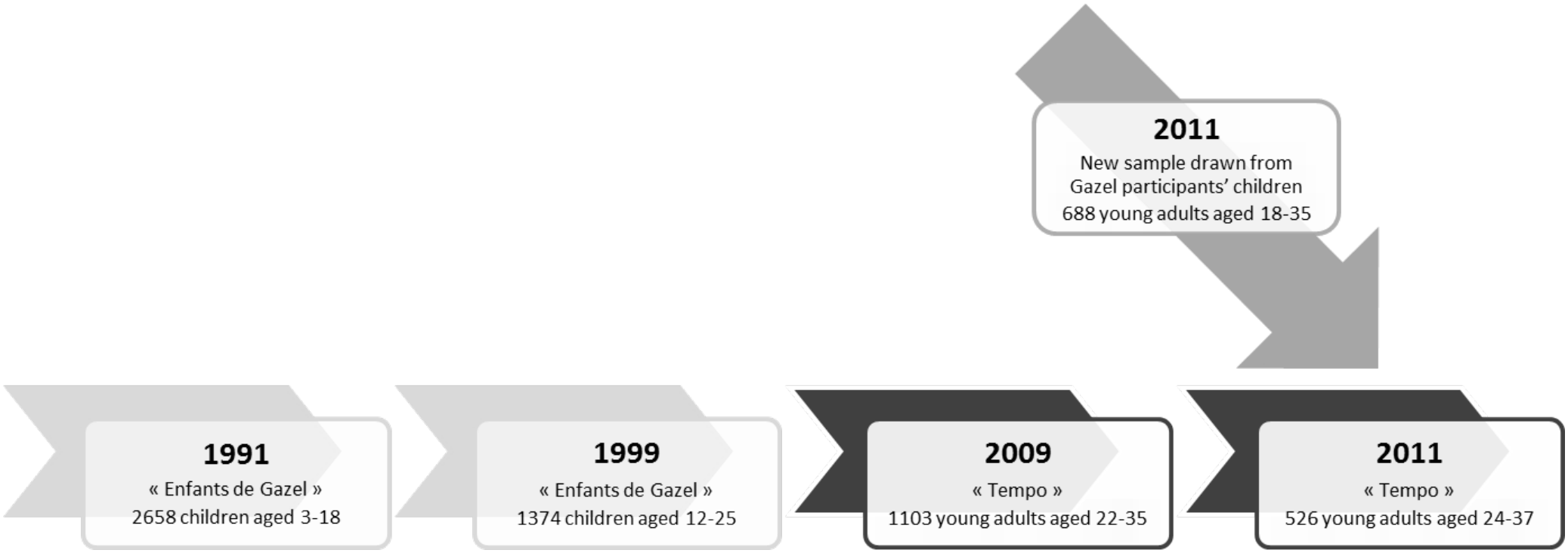

Table 1 Descriptive characteristics of children of TEMPO 2020 study participants during the COVID 19 lockdown in France (n=432)

Variable	Frequency (%)
SDQ scores in the children	
High Emotional difficulties	
Yes	31(7.2)
No	401(92.8)
High Hyperactivity/inattention	
Yes	107(24.8)
No	325(75.2)
Children's characteristics	
Age	
<= 6 years	172(51.5)
>6 years	162(48.5)
Sex	
Female	164(48.9)
Male	171(51.0)
Sleeping difficulties	
Yes	69(21.2)
No	256(78.8)
Screen time (per day)	
<1h	88(26.8)
>1h	240(73.1)
Family sociodemographic characteristics	
Parental situation during COVID19 lockdown	
Single /Biological parents not living together	152(40.2)
Parental couple living together	226(59.8)
Sex of the responding participant	
Female (Yes)	276(65.0)
Male	148(34.9)

Number of children in the family	
<=2	185(80.8)
>2	44(19.2)
Financial difficulties	
No	382(89.9)
Yes	43(10.1)
Average Family Income (/month)	
<=2500 euros (Ref)	148(34.3)
>2500 euros	284(65.7)
Job situation	
Normal / Distance working	289(76.0)
Unemployment / Job loss during confinement/Sick leave	119(29.1)

Parental characteristics	
COVID-19 symptoms	
Yes	28(6.5)
No	404(93.5)
Parental mental health difficulties during lockdown	
Symptoms of anxiety-depression	
Yes	118(27.3)
No	314(72.7)
Substance use	
Tobacco smoker	
Yes	49(16.8)
No	243(83.2)
Problematic alcohol use	
Yes	31(10.9)
No	254(89.1)

SDQ: Strength and Difficulties Questionnaire

Note 1: Frequency and percentages for categorical variables

Note 2: Owing to missing values, the frequencies of some categorical variables do not add up to 432

Table 2

Table 2 Parental characteristics and children's psychological emotional difficulties during COVID 19 lockdown in France (TEMPO COVID-19 Questionnaire 2020**,** age and sex-adjusted odds ratios, multivariate model, Chi Square tests)

Emotional symptoms							
Characteristics[a]	Yes	No	Chi² test P-Value	Age and Sex adjusted OR	95% Wald CI	Multivariate model OR [c]	95% Wald CI
Children's characteristics							
Age			0.3	1.5	0.7-3.2	1.1	0.4-2.6
<= 6 years old	13(41.9)	159(52.4)					
>6 years old	18(58.0)	144(47.5)					
Sex			0.2	1.0	0.9-1.1	1.8	0.7-4.1
Female	18(58.0)	146(48.0)					
Male (Ref)	13(41.9)	158(51.9)					
Sleeping difficulties			**<0.05**	**2.6**[b]	1.2-5.7	2.0	0.8-4.8
No (Ref)	19(61.3)	237(80.6)					
Yes	12(38.7)	57(19.3)					
Screen time per day			**<0.05**	**6.8** [b]	1.5-30.9	**6.2** [b]	1.4- 28.0
<1h (Ref)	2 (6.4)	86(28.9)					
>1h	29(93.5)	211(71.0)					
Family sociodemographic characteristics during lockdown							
Family situation			0.8	1.2	0.6-2.7	0.7	0.3-1.9
Single / Biological parents not living together	12(41.4)	140(40.1)					
Couple	17(58.6)	209(59.9)					
Sex of the responding parent during the 5 week			**<0.05**	2.5	0.9-6.8	1.7	0.6-6.1
Female	26(83.9)	250(63.6)					
Male (Ref)	5(16.1)	140(36.4)					
Number of children in the family			0.8	1.0	0.3-3.2	0.9	0.3-3.1
<= 2	18(81.8)	167(80.7)					
> 2	4(18.1)	40(19.3à					
Financial difficulties			**<0.05**	**4.2** [b]	1.6-11.0	2.3	0.8-6.2
No (Ref)	22(73.3)	360(91.4)					
Yes	8(26.7)	3558.9)					
Income			0.8	1.1	0.5-2.4	0.9	0.4-2.1
2500 euros or less (Ref)	30(28.0)	118(36.3)					
>2500 euros	77(71.9)	207(63.7)					
Job situation			0.2	1.6	0.7-3.5	1.3	0.5-3.2
Normal activity / Teleworking	17(68)	272(76.6)					
Unemployment / Job loss during confinement /Sick leave	11(39.2)	108(28.4)					
Parental characteristics during lockdown							
COVID-19 symptoms (during lockdown)			0.3	1.7	0.5-5.3	2.2	0.6-10.0
Yes	4(11.4)	27(6.9)					

No	31(88.6)	369(93.1)					
Parental mental health							
Symptoms of anxiety-depression during lockdown			**<0.05**	**8.1** [b]	2.4-26.8	**5.7** [b]	2.4-5.1
No (Ref)	8(50)	133(84.1)					
Yes	8(50)	25(15.8)					
Parents' substance use							
Tobacco (regular smoker >10 /day)			0.06	2.3	0.8-6.6	1.4	0.4-5.4
Yes	10(58.8)	73(36.3)					
No	7(41.2)	128(63.7)					
Problematic consumption of alcohol			0.8	0.7	0.1-3.8	0.4	0.07-2.8
Yes	2(9.5)	29(11)					
No	19(90.5)	235(89.0)					

Note. TEMPO = Trajectoires Epidémiologiques en Population; CI = confidence interval; OR = odds ratio.

[a] Owing to missing values, the frequencies of some categorical variables do not add up to 432

[b] Statistically significant ($p<0.05$)

[c] Multivariate model: age and sex adjusted analysis, additionally adjusted on all variables that were significant in bivariate analysis ($p<0.05$): sleeping difficulties, screen time, sex of the responding parent, financial difficulties, symptoms of anxiety-depression during lockdown

Table 3

Table 3 Parental characteristics and children's symptoms of hyperactivity/inattention during the COVID 19 lockdown in France (TEMPO Covi19 Questionnaire 202O**,** age and sex-adjusted odds ratios, multivariate model, Chi Square tests)

	Hyperactivity/inattention symptoms						
Characteristics [a]	Yes	No	Chi² test P-Value	Age and sex – adjusted OR	95% Wald CI	Multivariate model OR [c]	95% Wald CI
Children characteristics							
Age			0.4	0.9	0.9-1.0	1.1	0.6-1.9
<= 6 years old (Ref)	51(48.1)	121(53.1)					
>6 years old	55(51.9)	107(46.9)					
Sex				0.7	0.4-1.1	0.7	0.4-1.1
Female	46(42.9)	118(51.7)	0.7				
Male (Ref)	61(57.1)	110(48.2)					
Sleeping difficulties			**<0.05**	**2.0** [b]	1.1-3.3	1.7	0.9-3.0
No (Ref)	75(70.7)	181(82.6)					
Yes	31(29.2)	38(17.3)					
Screen time per day			0.07	1.3	0.9-1.9	1.5	0.8-2.8
<1h (Ref)	22(20.5)	66(29.8)					
>1h	85(79.4)	155(70.1)					
Family sociodemographic characteristics during lockdown							
Family situation			0.6	1.4	0.9-2.3	1.3	0.7-2.1
Single /Biological parents not living together	42(42.4)	110(39.4)					
Couple (Ref)	57(57.6)	169(60.6)					
Sex of the responding parent			0.8	0.7	0.4-1.2	0.6	0.3-0.9
Female (Ref)	68(64.1)	208(65.4)					
Male	38(35.8)	110(34.6)					
Number of children in the family			0.3	0.6	0.3-1.5	0.6	0.2-1.4
<=2	57(85.0)	128(79.0)					
>2	10(14.9)	34(20.9)					
Financial difficulties			**<0.05**	**2.3** [b]	1.1-4.6	**4.3** [b]	1.1-17.9
No (Ref)	86(81.9)	296(92.5)					
Yes	19(18.1)	24(7.5)					
Income			0.1	1.0	0.6-1.7	1.0	0.6-1.8
2500 euros or less (Ref)	30(28.0)	118(36.3)					
>2500 euros	77(71.9)	207(63.7)					
Job situation			0.1	**1.8** [b]	1.1-3.3	1.7	1.0-2.9
Normal activity / Teleworking	67(64.4)	222(73.0)					
Unemployment / Job loss during confinement / Sick leave	37(35.6)	82(26.9)					
Parental characteristics during lockdown							
COVID symptoms for parents			0.8	0.9	0.4-2.1	0.9	0.3-2.4
Yes	9(8.5)	26(8.0)					
No	97(91.5)	299(92.0)					

Parental mental health							
Anxious-depressive symptoms during the first 5 weeks of lockdown			0.1	**2.6** [b]	1.0-7.1	**2.5** [b]	1.4-4.2
No (Ref)	35(74.5)	106(83.5)					
Yes	12(25.5)	21(16.5)					
Drugs consumption for the parents							
Tobacco (regular smoker >10 /day)			0.9	0.8	0.4-1.6	1.6	0.6-3.6
Yes	19(38)	64(38.1)					
No (Ref)	31(62)	104(61.9)					
Problematic consumption of alcohol since beginning of home confinement			0.06	1.2	0.7-1.9	0.8	0.3-2.1
Yes	21(23.3)	50(18.2)					
No (Ref)	69(76.7)	224(81.7)					

Note. TEMPO = Trajectoires Epidémiologiques en Population; CI = confidence interval; OR = odds ratio.

[a] Owing to missing values, the frequencies of some categorical variables do not add up to 432

[b] Statistically significant ($p<0.05$)

[c] Multivariate model: age and sex adjusted analysis, additionally adjusted on all variables that were significant in bivariate analysis ($p<0.05$): sleeping difficulties, financial difficulties, job situation, symptoms of anxiety-depression during lockdown

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Title page

Title: Longitudinal impact of psychosocial status on children's mental health in the context of COVID-19 pandemic restrictions

Running head: SES and mental health in children during COVID-19 pandemic

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ABSTRACT

Objective: Emerging research suggests that the prevalence of child and adolescent mental health problems has increased considerably during the COVID-19 crisis. However, there have been few longitudinal studies on children's mental health issues according to their social determinants in this context, especially in Europe. Our aim was to investigate the association between family socioeconomic status (SES) and children' mental health during the period of school closure due to COVID-19**. Methods:** Longitudinal data came from 4575 children aged 8-9 years old in 2020 and participating in the ELFE population-based birth cohort that focuses on children's health, development and socialization. Parents completed the Strengths and Difficulties Questionnaire (SDQ) when children were a) five years of age and b) nine years of age, which corresponded to the period of school closure due to the COVID-19 pandemic in France. We retrieved data from the ELFE cohort collected on children from birth to age 5 years (birth, 1 year, 2 years, 3,5 years and 5 years). Socioeconomic status (SES) was measured based on information obtained when the child was 5 years old. Data were analyzed using multinomial logistic regression models. **Results:** Children's elevated levels of symptoms of Attention-deficit/Hyperactivity disorder (ADHD) during the period of school closure were significantly associated with prior low family SES (aOR 1.26, 95% CI 1.08 – 1.48). Children's elevated symptoms of hyperactivity/inattention and of emotional symptoms were associated with decline in income during the COVID crisis (respectively aOR 1.38, 95% CI 1.16

– 1.63 and aOR 1.23, 95% CI 1.01 – 1.51). Moreover, when testing interactions, a low prior SES was significantly associated with a higher risk of emotional symptoms aOR 1.54 (1.07 – 2.21), only for children whose families experienced a decline in income, while gender, parental separation and prior mental health difficulties were not associated. **Conclusion:** This study underlines the impact of the financial crisis related to the COVID-19 epidemic on children's mental health. Both pre-existing family SES before lockdown and more proximal financial difficulties during the COVID crisis were negatively associated with children's psychological difficulties during the period of school closure. The pandemic appears to exacerbate mental health problems in deprived children whose families suffer from financial difficulties.

Keywords: Child mental health, epidemiology, COVID-19, socioeconomic inequality, France

1. Introduction

Since the beginning of the COVID-19 crisis, there has been a dramatic increase in mental health issues worldwide [1]. This burden has disproportionately impacted vulnerable populations, notably children and adolescents [2–12]. As is commonly observed, the epidemic has led to major socioeconomic disparities in mental health, the poorest and less educated populations being the most exposed to a range of deleterious risk factors [13–15]. Recent studies emphasize this negative impact of social inequalities on children's mental health [13, 16]. Of note, the pandemic has caused an unprecedented financial crisis worldwide and pushed millions of families below the poverty line, [17] exposing children and adolescents to high levels of psychological distress [13–15] . As found in a US study [15], further risk factors for mental health difficulties in children are hardship during the crisis, including caregiving burden, and parents' job loss and income reduction. Even in countries where the welfare state has intensively attempted to mitigate the economic impact of the COVID crisis (e.g. France, Germany), financial difficulties during the lockdown occurred and were related to worsened mental health in children [3, 18]. Moreover, protection measures such as lockdown, curfews and school closures have disproportionally affected families with prior low SES.[17]

Despite the well-known association between low SES and children's mental health problems during [1–3] and outside [14, 19] the pandemic context, some issues remain elusive. Some studies showed the impact on children mental health of other risk factors such as parental separation, and the sex of the child [20] . First, most studies are cross-sectional and the impact of a pre-existing socioeconomic disadvantage on children's mental health during the COVID19 has hardly been studied within a longitudinal framework [21]. Second,

interactions between socioeconomic difficulties and risk factors, including sex of the child and parental separation, which have been shown to be linked with SES before the pandemic [14, 22] have not been considered. Understanding the consequences of the COVID19 crisis on those vulnerable children already at risk of mental health problems is essential for rapidly developing policies and interventions to mitigate the mental health problems of vulnerable groups of children already living in a deprived socioeconomic environment [23].

The aim of our study was: a) to assess the impact of prior low socioeconomic status (SES) on children's emotional and Attention-Deficit/Hyperactivity Disorder (ADHD) symptoms during the COVID-19 lockdown, taking into account current financial and prior mental health problems four years before, and b) to investigate, in a subgroup of vulnerable children with pre-existing socioeconomic difficulties, which other social factors such as parental separation, sex or decline in income during the lockdown could exacerbate these mental health difficulties. c) We also assessed the impact of pre-existing mental health disorders before the lockdown on the mental health during the lockdown, as well as the impact of financial insecurity.

2. Methods

2.1 Setting and study design

The SAPRIS ("SAnté, Perception, pratiques, Relations et Inégalités Sociales en population générale pendant la crise COVID-19") survey was set up to study the main epidemiological, social and behavioral challenges of the COVID-19 epidemic in France. More details on this project are available elsewhere [24]. Briefly, SAPRIS is based on questionnaires sent to five

large French cohorts, three of adults (Constances, E3N-E4N and NutriNet-Santé) and two of children (ELFE/EPIPAGE-2).

2.1.1 Sample

The ELFE study is an ongoing multidisciplinary [25, 26][23,24], nationally representative birth cohort study, which originally included 18329 infants (18040 mothers) born in France in 2011. For this study, 4904 parents answered the questionnaires related to their children. This large loss of participants was probably due to the context of the COVID19 crisis. Among them, 329 children were excluded because of missing data. In total, we used data collected on 4575 children (Supplementary Figure 1).

Data were reported by parents during school closures (from April 16 to May 4, 2020, and/or from May 5 to June 21, 2020) [24]. To study the link between social inequalities and children's mental health prior to the COVID 19 crisis, we retrieved data from the ELFE cohort collected on the child from birth to age 5 (birth, 1 year, 2 years, 3.5 years and 5.5 years).

2.3 Measures

2.3.1 Emotional and hyperactivity/inattention symptoms

Symptoms of hyperactivity/inattention and emotional symptoms were ascertained by two subscales of the Strengths and Difficulties Questionnaire (SDQ) [27, 28], a widely used measure of children’s mental health which has satisfactory psychometric properties [29, 30]. These symptoms were collected at two key times. First, when the children were 5 years old. Secondly, during the first school closure in France, when the children were 8 to 9 years old. These symptoms were reported by parents on a 3-point scale (not true, somewhat true, and

certainly true; ranges from 0–2) to indicate the extent to which each item applied to their children [18, 28]. The following items were used to assess symptoms of hyperactivity/inattention: “Restless, overactive, cannot stay still for long”; “Constantly fidgeting or squirming”; “Easily distracted, concentration wanders”; “Thinks things out before acting”; and “Sees tasks through to the end, good attention span”. The five items used to assess the emotional symptoms were: “Complains of headache/stomachache”; “Many worries, often seems worried”; “Often unhappy, down-hearted or tearful”; “Nervous or clingy in new situations, easily loses confidence”; and “Many fears, easily scared”. From the parents' responses to the five items of each subscale, we calculated scores that ranged from 0 to 10 with cut-offs of the French version of the SDQ [31]. Concerning hyperactivity/inattention, a score ≤5 is considered normal, equal to 6 as borderline state, and >6 as abnormal. For emotional symptoms, a score ≤3 is considered normal, equal to 4 as borderline state, and >4 as abnormal.

2.3.2 Socioeconomic characteristics

We were interested in two aspects of families’ socioeconomic characteristics: prior socioeconomic status (SES) and decline in parental income during the COVID 19 school closure.

a) Prior SES (very low and low vs. high and very high) was built from three sub-dimensions [31]

:

- *The level of education* of each parent at 5 years old (0. Secondary education ≤ high

school level, 1. First-cycle higher education (Grade 12 + 2), 2. Higher education (> Grade 12 +2)). We retrieved the information from previous questionnaires (questionnaire at 3 years, 2 years, 1 year, 2 months, at birth) in the event of missing data.

- *Occupational grade* of parents at 5 years old (6. Executive, 5. Intermediate executive, 4. Self-employed worker, 3. Employee, 2. Laborer, 1.Unemployed)
- *Household income* at 5 years old.

If information concerning both the mother's and the father's education level was available, these were averaged. Otherwise only the mother's or father's education level was considered. Next, the scores on the three dimensions were centered and reduced. A global score of SES was calculated, as in another national longitudinal survey [31]. This was defined as the average of the scores of the three centered and reduced sub-dimensions. If information for one of the dimensions was missing, it was not considered in the calculation of the global SES score, and we imputed by the mean of the available dimension. This overall SES score was centered and then reduced. Finally, we built the categorical variable SES with four modalities: very low (x< 1st quartile), low (1st quartile <= x < Median), high (median <= x <3rd quartile) and very high (x ≥ 3rd quartile).

b) We also gathered data on the financial situation during COVID-19 school closure (declining vs constant income) as perceived by the parents during the first lockdown in France.

2.3.3 Covariates

Several covariates measured during the period of school closure were taken into

account such as children's sex (female vs. male), family structure (child living with both parents: yes vs no), children's sleeping difficulties (yes vs no). We also adjusted on children's emotional or hyperactivity/inattention symptoms (abnormal vs normal) at 5 years old.

2.4 Procedure

Ethical approval and informed consent were obtained from each participant before enrolment in the ELFE cohort. The SAPRIS survey was approved by the Inserm ethics committee (approval #20-672 dated March 30, 2020) [24].

2.5 Statistical analyses

First, observations with missing data on both study outcomes (symptoms of hyperactivity/inattention and emotional difficulties) and for our main variable of interest, SES at 5 years old, were removed.

Then we described children's and family's sociodemographic characteristics, (i.e., frequency with percentages for categorical variables and means and standard deviation for quantitative variables).

We used Classification and Regression Tree methods (CART, imputation method for mixed data: both Continuous and Categorical) to account for missing data. [32]

In addition, we tested the association between variables such as prior SES, declining income during COVID19 and children's mental health (i.e., hyperactivity/inattention and emotional symptoms during school closure) using binary logistic regressions unadjusted and

adjusted to estimate odds ratios (OR) and 95% confidence intervals (CI). We also compared participants and non-participants **(Supplementary Table 3).**

Statistical models were controlled on the child's sex, symptoms of hyperactivity/inattention and emotional difficulties at 5 years old, sleeping difficulties and family structure of the child. Several interactions (e.g. prior SES*financial situation during school closure) were tested in simple models with "hyperactivity/inattention symptoms" or "emotional symptoms" measured during school closure as dependent variable and "prior socioeconomic status" as independent variable. Secondly, these same models and interactions were estimated by adding the adjustment on the hyperactivity/inattention symptoms at 5 years, the emotional symptoms at 5 years, the child's sex and some variables measured during school closure: if the child lived with both parents, the child's sleeping difficulties and hyperactivity/inattention or emotional symptoms. If there was significant interaction of interest in these more complex models, we presented the analyses by stratifying on the interaction variable. (Supplementary Table 1 and 2)

Data were analyzed using the *stat* package in *R (version 3.6.1)* with binary logistic regressions specified using the *glm* function. The *mice* package and its *cart* method were used to perform multiple imputations.

3. Results

3.1 Sample characteristics (Tables 1 and 2)

Sample characteristics are described in **Table 1**. In total, 4575 children were included. At 5 years of age, 696 (15.8%) children had signs of hyperactivity/inattention symptoms and 880 (19.9%) showed emotional symptoms. During school closure at 9 years of age, 944 (20.6%) children had hyperactivity/inattention symptoms, whereas 569 (12.4%) presented emotional symptoms. 2571 (56.4%) of mothers had higher education, whereas 2013 (44.5%) of fathers had higher education.

3.2 Association between parental SES and children's symptoms of hyperactivity/inattention and emotional difficulties (Tables 2 and 3)

Tables 2 and 3 show the associations between children's hyperactivity/inattention and emotional difficulties during lockdown and prior SES, as well as declining income.

Symptoms of hyperactivity/inattention

Adjusted logistic regression analyses (**Table 2**) showed that the likelihood of having high levels of symptoms of hyperactivity inattention was elevated among children whose parents had low or very low SES (OR 1.26, 95% CI 1.08 – 1.48), and whose parents suffered a decline in income during the COVID-19 lockdown (OR 1.38 95% CI 1.16-1.63). Results showed that the probability of an increase in the score was associated with SES.

Emotional symptoms

Adjusted logistic regression analyses (**Table 3**) showed that the risk of having abnormal emotional symptoms was higher among children whose parents suffered a decline in income during the COVID-19 lockdown (OR 1.23, 95% CI 1.01-1.51). However, a prior low or very low

SES was not significantly associated with emotional symptoms during school closure (OR 1.12, 95% CI 0.92-1.36).

Additional interaction analyses (**Table 4**) showed that emotional symptoms were higher in children with a low prior SES and whose parents suffered a decline in income during the COVID19 crisis. Other interaction analyses were not statistically significant.

Overall, non-participants were more frequently male, had more hyperactivity/inattention symptoms, lived less frequently with both parents and have worst prior SES (Supplementary Table 3).

4. Discussion

4.1 Main findings

Overall, and as expected, children from disadvantaged socioeconomic backgrounds (i.e. with a low family SES four years before) displayed higher levels of ADHD and emotional symptoms during lockdown than those from more advantaged families. After accounting for pre-existing mental health difficulties, while prior parental low SES was still associated with ADHD symptoms during school closure, we found an interactive effect between family SES at 5 years and financial decline during the COVID crisis with regard to children's emotional symptoms. Only children from families with both a low SES at 5 years and suffering a decline in income during the COVID crisis presented significantly high levels of emotional symptoms.

4.2. Interpretation of findings

To our knowledge, this is the first study in France to describe children's mental health during the school closure due to COVID-19 according to pre-existing family SES.

Our findings confirm the concern that the COVID-19 crisis, and particularly the lockdown period, was significantly associated with a deterioration in the mental health of children of lower SES. While a decline in income during the COVID-19 crisis was directly linked to both ADHD and emotional symptoms, only emotional symptoms were impacted by the combination of a prior low SES and a decline in income during the crisis.

Irrespective of the COVID-19 context, Reiss et al [14] already showed that indicators of low SES, including household income, parental education and parental unemployment, as well as a high number of stressful life situations, were associated with more mental health problems in children and adolescents, and that parental education was the strongest predictor. In our study, low parental education and occupation and low income 4 years before contributed to higher hyperactivity inattention symptoms in children during lockdown. The importance of parental education in children's mental health was also determined by other studies. McLaughlin et al. [15] reported in a nationally representative US sample of 5,692 adults that low parental education significantly predicted disorder persistence and severity, whereas financial hardship predicted the onset of disorders at every life-course stage.

Concerning maternal education, findings are in line with a previous study [33] investigating trajectories of mental health problems by maternal education. Children of mothers with a low educational level had significantly more mental health problems during childhood and adolescence than children of mothers with a high level.

A recent population-based and cross-sectional Chinese study [34] demonstrated socioeconomic inequality in children's mental health during the pandemic. Interestingly, thanks to our longitudinal design, we also found that the pandemic also exacerbated socioeconomic inequalities in children's mental health, especially in vulnerable children already suffering from hyperactivity inattention. In line with this result, a British study[23] showed that a higher proportion of families living in poverty in pre-lockdown reported experiencing financial stress during the lockdown, demonstrating the adverse economic effects of the lockdown on already poor families.

There is a lot of evidence that SES is associated with ADHD [35] but few about his link with emotional symptoms. While a decline in income during the COVID crisis was a significant factor contributing to a concurrent higher risk of both ADHD and emotional symptoms, this was particularly true with regard to emotional symptoms in the subgroup of children displaying prior socioeconomic vulnerability, as suggested by the interaction we found. This finding has important consequences. While UNICEF [16, 17] warned in 2020 that the number of children living below their respective national poverty lines could soar over the coming years, and called for the urgent transfer of cash to low-income countries, the need for governmental financial assistance measures for poor families in developed countries also seems to be a priority in terms of mental health.

The stability of family income during the COVID-19 lockdown has already been found to affect the mental health of young people significantly during the COVID 19 crisis, due to the psychological and economic pressure they face [18, 36–44]. Parental mental health difficulties may also be an intermediate factor. Indeed, in accordance to previous research [37, 38, 45], parents' symptoms of anxiety or depression during lockdown as well as their

preexisting mental health difficulties were associated with a higher level of children's emotional difficulties and symptoms of hyperactivity/inattention.

Interestingly, other factors like parental separation or sex of the child did not increase the risk.

Unsurprisingly, children with high levels of ADHD symptoms and emotional symptoms before the lockdown experienced higher levels of ADHD and emotional symptoms during the school closure, respectively, taking in account SES and other covariates. Of note, having high levels of emotional symptoms four years before did not increase the risk of having high levels of ADHD symptoms during the lockdown. Similarly, having high levels of ADHD symptoms four years before did not increase the risk of having high levels of emotional symptoms during the lockdown. These findings highlight the importance of longitudinal analyses because mental health problems in children are a critical issue in this phase of development from childhood to adolescence. This strong continuity of symptoms suggests the adverse mental health effects of the lockdown on already deprived families [23].

We assume that children with previous ADHD and emotional disorders are particularly exposed to psychological distress during the pandemic due to loss of daily routines caused by school closures and home confinement. As Jefsen suggests [45], this may be reduced by supporting families to maintain the framework of family life, despite the unusual circumstances that they find themselves in. The evidence clearly suggests that children suffering from previous emotional or ADHD symptoms, and who normally had access to specialized psychiatric care prior COVID-19 pandemic, have had more severe symptoms. In addition, their parents have likely struggled to look after their children in a confined space, since they were not allowed to go out. However, some studies reported opposite results

between degradation and improvement of symptoms, unlike the general population [46, 47].

4.3 Strengths and limitations

The main strength of this study is that it was based on a community sample, followed participants during the first lockdown period, but started prior to the COVID-19 epidemic, making it possible to include preexisting risk factors in a longitudinal design. Second, as we assessed children's emotional difficulties and hyperactivity/inattention before the pandemic, we had information concerning pre-existing vulnerabilities. Third, it included a large number of parent respondents during school closures in France at the beginning of the pandemic. It also included pre-term children, a population more at risk of hyperactivity/inattention, so it provides more power for studying risk and protective factors in a lockdown situation. Fourth, we were able to control for a wide range of possible covariates among the sociodemographic and socioeconomic characteristics of children's families. Fifth, we used validated measures of hyperactivity/inattention and emotional symptoms (SDQ) with satisfactory psychometric properties[28, 29].

However, the study also has limitations. First, all measures were based on self-reports, including the SDQ reported by parents, so the emotional state of parents may have influenced their responses [36]. However, parental evaluations are appropriate in this setting, given the young mean age of the children (5 to 8 years old). It must be acknowledged that the SDQ does not allow a diagnosis. However the SDQ has satisfactory psychometric properties and the performance and validity of the parent-reported SDQ in

French [27] suggests that its performance is similar to that of psychiatric interviews [30], though, ADHD is a clinical diagnosis based on symptomatology and associated impairments. Second, only a few parents reported their alcohol and smoking consumption as well as their mental disorders, which prevented us from taking these variables into account in our analyses. Third, although it would have been of interest to assess the peer-relationship, pro-social behavior and conduct problem subscales of the SDQ, it was not feasible in the present study. Fourth, the SES was constructed as a combination of 3 dimensions. We assumed that each dimension has an equal impact, as it has been used in other birth cohorts such as the Quebec Longitudinal Study of Child Development (QLSCD) cohort [48], and we assumed it was an appropriate proxy of the SES. Finally, we did not assess in this study the impact of lockdown on disruptions of physical activities and excessive use of screen time, but previous studies showed those factors to be highly related to hyperactivity symptoms [18, 49] .

4.4 Implications for policy and practice

The mental health gap between advantaged and disadvantaged children has not been reduced over the last 20 years, and there is evidence that it may even be increasing. [44] The unprecedented combination of school closures and children having to stay at home very likely creates difficulties and stress for both children and their parents.

In addition, the decline in income during school closure that some families suffered was a strong predictor of children's psychological difficulties in this study. However, it is more appropriate to talk of financial stress in the context of uncertainty, since other studies have subsequently shown that the financial compensation measures that the French authorities implemented functioned well. Therefore, maintaining such state-aided assistance for

children from socially deprived backgrounds, even in developed countries, seems a priority in terms of public mental health. Children suffering from ADHD and emotional symptoms and with preexisting vulnerabilities such as prior low SES and low parental educational level may require special guidance during a pandemic. The potential benefits of closing schools to curb the spread of a virus like COVID-19 need to be weighed against the effects on children's mental health. In addition, while a return to school may be welcomed by many pupils, others might feel anxious or frightened [18], so further longitudinal studies focusing on the return to school and the social interactions engendered are needed.

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Table 1. Characteristics of children and household in French SAPRIS-ELFE cohort study (n=4575)

	n (%) or mean (SD)
Child sex	4539 (99.2)
Male	2268 (50.0)
Female	2271 (50.0)
Children mental health	
Hyperactivity/inattention symptoms (at 5 years old)	4414 (96.5)
Abnormal and boundary state	696 (15.8)
Normal	3718 (84.2)
Hyperactivity/inattention symptoms (during school closure)	4575 (100.0)
Abnormal and boundary state	944 (20.6)
Normal	3631 (79.4)
Emotional symptoms (at 5 years old)	4414 (96.5)
Abnormal and boundary state	880 (19.9)
Normal	3534 (80.1)
Emotional symptoms (during school closure)	4575 (100.0)
Abnormal and boundary state	569 (12.4)
Normal	4006 (87.6)
During school closure	
Child lived with both parents	4575 (100.0)
Yes	3994 (87.3)
No	581 (12.7)
Child sleeping difficulties	4570 (99.9)
Yes	1778 (38.9)
No	2792 (61.1)
Perceived financial situation	4546 (99.4)
Declining income	1209 (26.6)
Constant income	3337 (73.4)
Household socioeconomic characteristics	
Mother’s education level	4556 (99.6)
Secondary school completed or less	903 (19.8)
Fist cycle program of higher education	1082 (23.7)
Second or more cycle program of higher education	2571 (56.4)
Father’s education level	4528 (99.0)
Secondary school completed or less	1599 (35.3)
Fist cycle program of higher education	916 (20.2)
Second or more cycle program of higher education	2013 (44.5)
Parents' occupational category	4308 (94.2)
Executive	1316 (30.5)
Intermediate and executive	1162 (27.0)
Intermediate and employee	1161 (26.9)
Independent	121 (2.8)
Laborer	278 (6.5)
Both inactive or only one employee/laborer	270 (6.3)
Household income by month	4220 (92.2)
Mean (SD) in euros	4567.88 (3786.77)
Prior socioeconomic status	4575 (100.0)
Low and very low	2289 (50.0)
High and very high	2286 (50.0)

Table 2. Association between children's hyperactivity/inattention symptoms (abnormal and boundary state vs normal) during school closure and family characteristics including parents' prior socioeconomic status: unadjusted and adjusted binary logistic regressions (n=4575)

	OR (95% CI)*	aOR (95% CI)**
SES characteristics		
Prior socioeconomic status (High and very high: ref. group)		
Low and very low	1.47 [1.27-1.70]	1.26 [1.08-1.48]
Financial situation during school closure (Constant income: ref. group)		
Declining income	1.46 [1.25-1.71]	1.38 [1.16-1.63]
Mental health		
Hyperactivity/inattention at 5 years (Normal: ref. group)		
Abnormal and boundary state	3.92 [3.30-4.66]	3.53 [2.93-4.24]
Emotional symptoms at 5 years (Normal: ref. group)		
Abnormal and boundary state	1.60 [1.35-1.90]	1.15 [0.95-1.39]
Covariates during COVID-19 school closure		
Child sex (Male: ref. group)		
Female	0.54 [0.47-0.63]	0.49 [0.42-0.58]
Child living with both parents (Yes: ref. group)		
No	1.43 [1.17-1.75]	1.23 [0.99-1.54]
Child has sleeping difficulties (No: ref. group)		
Yes	2.45 [2.12-2.84]	2.14 [1.82-2.50]
Emotional symptoms (Normal: ref. group)		
Abnormal and boundary state	3.27 [2.72-3.94]	2.60 [2.11-3.20]

*unadjusted odds ratios and confidence interval

**adjusted odds ratios and confidence interval

Table 3. Association between children's emotional symptoms (abnormal and boundary state vs normal) during school closure and family characteristics including parents' prior socioeconomic status: unadjusted and adjusted binary logistic regressions (n=4575)

	OR (95% CI)*	aOR (95% CI)**
SES characteristics		
Prior socioeconomic status (High and very high: ref. group)		
Low and very low	1.25 [1.04-1.49]	1.12 [0.92-1.36]
Financial situation during school closure (Constant income: ref. group)		
Declining income	1.38 [1.14-1.67]	1.23 [1.01-1.51]
Mental health		
Hyperactivity/inattention at 5 years (Normal: ref. group)		
Abnormal and boundary state	1.61 [1.29-2.01]	1.07 [0.83-1.36]
Emotional symptoms at 5 years (Normal: ref. group)		
Abnormal and boundary state	2.63 [2.17-3.19]	2.21 [1.80-2.71]
Covariates during COVID-19 school closure		
Child sex (Male: ref. group)		
Female	1.43 [1.20-1.71]	1.64 [1.35-1.99]
Child lived with both parents (Yes: ref. group)		
No	1.22 [0.95-1.57]	0.99 [0.75-1.30]
Child has sleeping difficulties (No: ref. group)		
Yes	4.51 [3.72-5.46]	3.70 [3.04-4.51]
Hyperactivity/inattention symptoms (Normal: ref. group)		
Abnormal and boundary state	3.27 [2.72-3.94]	2.64 [2.14-3.25]

*unadjusted odds ratios and its confidence interval

**adjusted odds ratios and its confidence interval

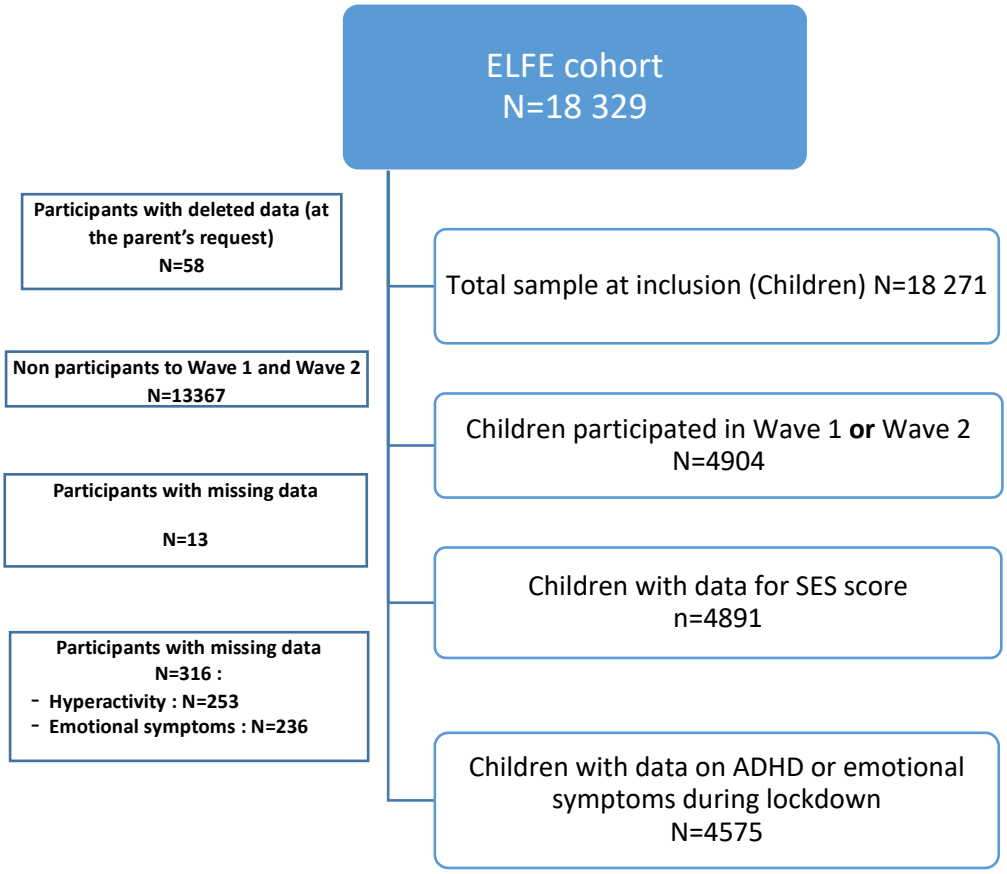
Table 4. Association between children's emotional symptoms (abnormal and boundary state vs normal) during school closure and socioeconomic characteristics of families whose income declined vs. remained constant during school closure: unadjusted and adjusted binary logistic regressions (n=4546)

	Declining income (n=1209)		Constant income (n=3337)	
	OR (95% CI)*	aOR (95% CI)**	OR (95% CI)*	aOR (95% CI)**
Prior socioeconomic status (High and very high: ref. group)				
Low and very low	1.60 [1.14-2.24]	1.54 [1.07-2.21]	1.08 [0.87-1.33]	0.98 [0.77-1.22]

*unadjusted odds ratios and its confidence interval

**adjusted odds ratios and its confidence interval. Results are adjusted on hyperactivity/inattention symptoms at 5 years, emotional symptoms at 5 years, the child sex and some variables measured during school closure: if child lived with both parents, hyperactivity/inattention symptoms and child's sleeping difficulties.

Supplementary Figure 1. Flowchart of the ELFE cohort



Supplementary Table 1. Interactions tested in models with hyperactivity/inattention symptoms measured during school closure as dependent variable and prior SES as independent variable (n=4575).

Interactions tested	OR (95% CI)
Prior socioeconomic status*child's sex	1.10 [0.81; 1.48]
Prior socioeconomic status*child lived with both parents during school closure	1.20 [0.76; 1.89]
Financial situation during school closure*sex	0.99 [0.72; 1.36]
Financial situation during school closure*child lived with both parents during school closure	1.57 [1.02; 2.42]
Prior socioeconomic status*financial situation during school closure	0.82 [0.60; 1.13]

Supplementary Table 2. Interactions tested in models with emotional symptoms measured during school closure as dependent variable and prior SES as independent variable (n=4575).

Interactions tested	OR (95% CI)
Prior socioeconomic status*child's sex	0.92 [0.64; 1.32]
Prior socioeconomic status*child lived with both parents during school closure	0.61 [0.36; 1.03]
Financial situation during school closure*sex	0.87 [0.59; 1.28]
Financial situation during school closure*child lived with both parents during school closure	0.97 [0.56; 1.66]
Prior socioeconomic status*financial situation during school closure	1.49 [1.01; 2.22]

Supplementary Table 3. Comparison of included participants and non-included participants (N=18 271)

Characteristics [n (%) or mean (SD)]	Participants (n=4575)	Non participants (n=13696)	p value
Child sex	4539 (99.2)	13517 (98.7)	**0.02**
Male	2268 (50.0)	7018 (51.9)	
Female	2271 (50.0)	6499 (48.1)	
Children mental health			
Hyperactivity/inattention symptoms (at 5 years old)	4414 (96.5)	6835 (49.9)	**<0.001**
Abnormal and boundary state	696 (15.8)	1387 (20.3)	
Normal	3718 (84.2)	5448 (79.7)	
Hyperactivity/inattention symptoms (during school closure)	4575 (100.0)	74 (0.5)	0.22
Abnormal and boundary state	944 (20.6)	11 (14.9)	
Normal	3631 (79.4)	63 (85.1)	
Emotional symptoms (at 5 years old)	4414 (96.5)	6835 (49.9)	0.24
Abnormal and boundary state	880 (19.9)	1425 (20.8)	
Normal	3534 (80.1)	5410 (79.2)	
Emotional symptoms (during school closure)	4575 (100.0)	92 (0.7)	0.86
Abnormal and boundary state	569 (12.4)	12 (13.0)	
Normal	4006 (87.6)	80 (87.0)	
During school closure			
Child lived with both parents	4575 (100.0)	301 (2.2)	**<0.001**
Yes	3994 (87.3)	241 (80.1)	
No	581 (12.7)	60 (19.9)	
Child sleeping difficulties	4570 (99.9)	161 (1.2)	0.49
Yes	1778 (38.9)	67 (41.6)	
No	2792 (61.1)	94 (58.4)	
Perceived financial situation	4546 (99.4)	237 (1.7)	0.56
Declining income	1209 (26.6)	59 (24.9)	
Constant income	3337 (73.4)	178 (75.1)	
Household socioeconomic characteristics			
Mother's education level	4556 (99.6)	10293 (75.2)	**<0.001**
Secondary school completed or less	903 (19.8)	4691 (45.6)	
Fist cycle program of higher education	1082 (23.7)	2219 (21.6)	
Second or more cycle program of higher education	2571 (56.4)	3383 (32.9)	
Father's education level	4528 (99.0)	10941 (79.9)	**<0.001**
Secondary school completed or less	1599 (35.3)	6281 (57.4)	
Fist cycle program of higher education	916 (20.2)	1736 (15.9)	
Second or more cycle program of higher education	2013 (44.5)	2924 (26.7)	
Parents' occupational category	4308 (94.2)	6438 (47.0)	**<0.001**
Executive	1316 (30.5)	1217 (18.9)	
Intermediate and executive	1162 (27.0)	1411 (21.9)	
Intermediate and employee	1161 (26.9)	1851 (28.8)	
Independent	121 (2.8)	372 (5.8)	
Laborer	278 (6.5)	788 (12.2)	
Both inactive or only one employee/laborer	270 (6.3)	799 (12.4)	
Household income by month	4220 (92.2)	6492 (47.4)	**<0.001**
Mean (SD) in euros	4567.88 (3786.77)	4039.53 (4347.97)	
Prior socioeconomic status	4575 (100.0)	11297 (82.5)	**<0.001**
Low and very low	2289 (50.0)	8251 (73.0)	
High and very high	2286 (50.0)	3046 (27.0)	

Supplementary Table 4. Data on SES for each time point (N=4575)

	N
Mother's education level	**4556**
5 years old	304
3,5 years old	4141
2 years old	72
1 year old	21
2 months	18
Father's education level	**4528**
5 years old	33
3,5 years old	4268
2 years old	89
1 year old	71
2 months	67
Parents' occupational category	**4308**
Household income by month	**4220**

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4.3 Third article: "Longitudinal impact of the COVID-19 pandemic on mental health in a general population sample in France: evidence from the COMET Study"- Journal of Affective Disorders

Published article:

Moulin F, Monnier M, Jean F, Melchior M, Patanè M, Pinucci I, Sijbrandij M, Van der Waerden J, Galera C. Longitudinal impact of the COVID-19 pandemic on mental health in a general population sample in France: evidence from the COMET Study. Journal of Affective Disorders. Available online 1 October 2022. doi: https://doi.org/10.1016/j.jad.2022.09.142

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Highlights

- Longitudinal studies encompassing period of lockdown and freedom are scarce
- Few studies investigated the impact of the COVID-19 pandemic on PTSD symptomatology
- The easing of lockdown is associated with decreases in depression, anxiety and PTSD
- Differences in symptom trajectories during the Covid-19 pandemic exist

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 latent growth mixture modeling 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.

Keywords: COVID-19, Mental health; self-report; epidemiology; longitudinal; cohort

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

Running head: Mental health during COVID-19

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., 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 more than 6.3 million COVID-19 cases and more than 110,000 deaths in France (France, n.d.). 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," 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.) 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.

2.3 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.

2.3.1 Mental health measures

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.

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 – 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.

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).

2.3.3 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.

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).

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 Questionaire 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 3–14, 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."

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.

2.5 Statistical analyses

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 10000 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).

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 (± 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.

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

Figure 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.

Figure 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 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%, $p<0.001$), and reported more domestic violence than cluster 1 (2.1% vs. 0.2%, $p<0.001$). 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%, $p<0.001$) and was more likely to have a history of mental disorders (19% vs. 6.3%, $p<0.001$) than cluster 2.

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.

COVID-19-related variables (number of COVID regulations, experiencing a loss of income, experiencing a work modification, going outdoors less than 3/week, experiencing COVID-related distress, time spent looking at COVID news) did not differ between the two clusters.

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).

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

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.

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.

Declarations

Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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.

Availability of data and material: 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.

Acknowledgements: None

Figure titles

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

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

Figure 1

Click here to access/download;Figure;Figure 1 R1.pdf

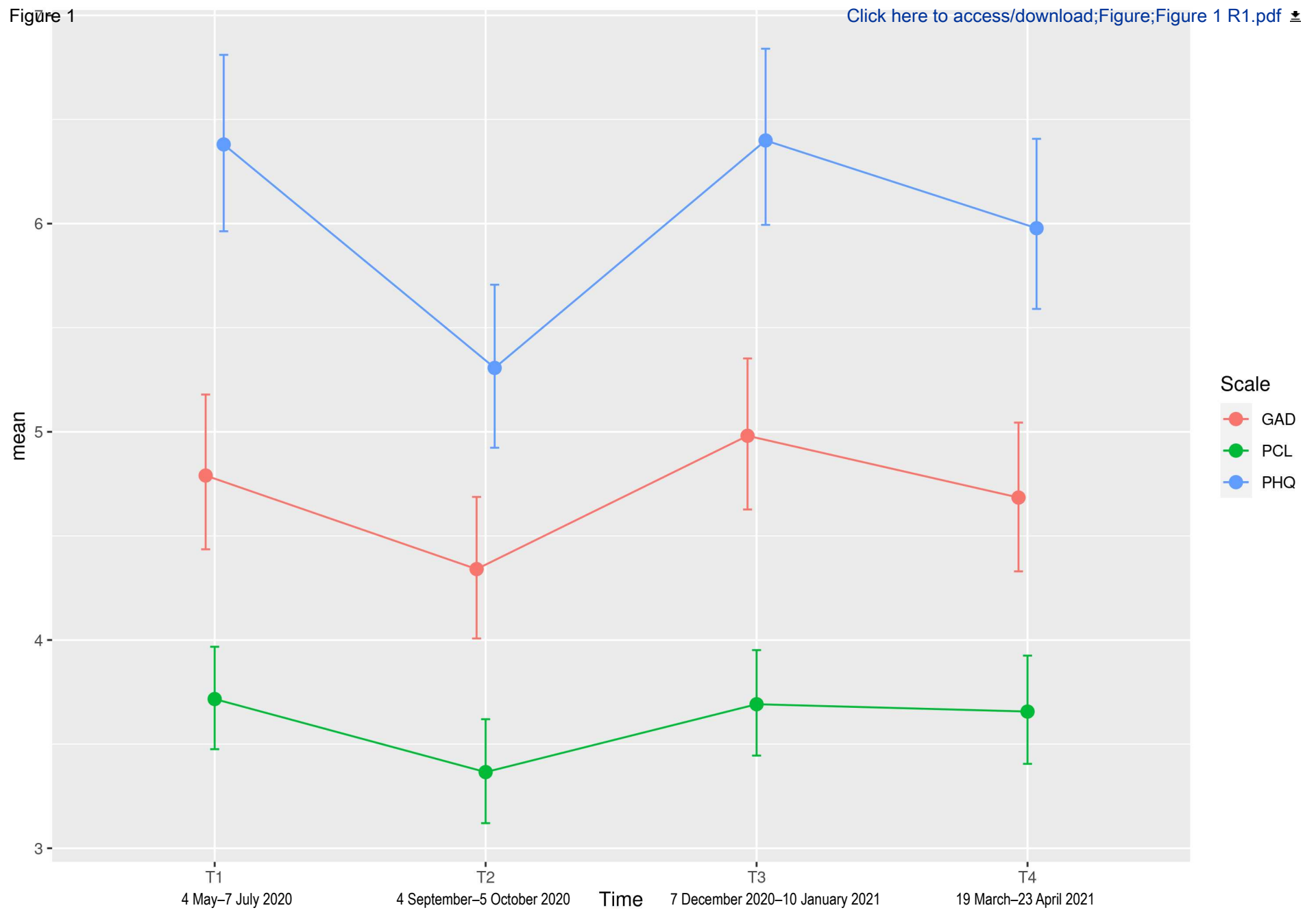

Figure 2

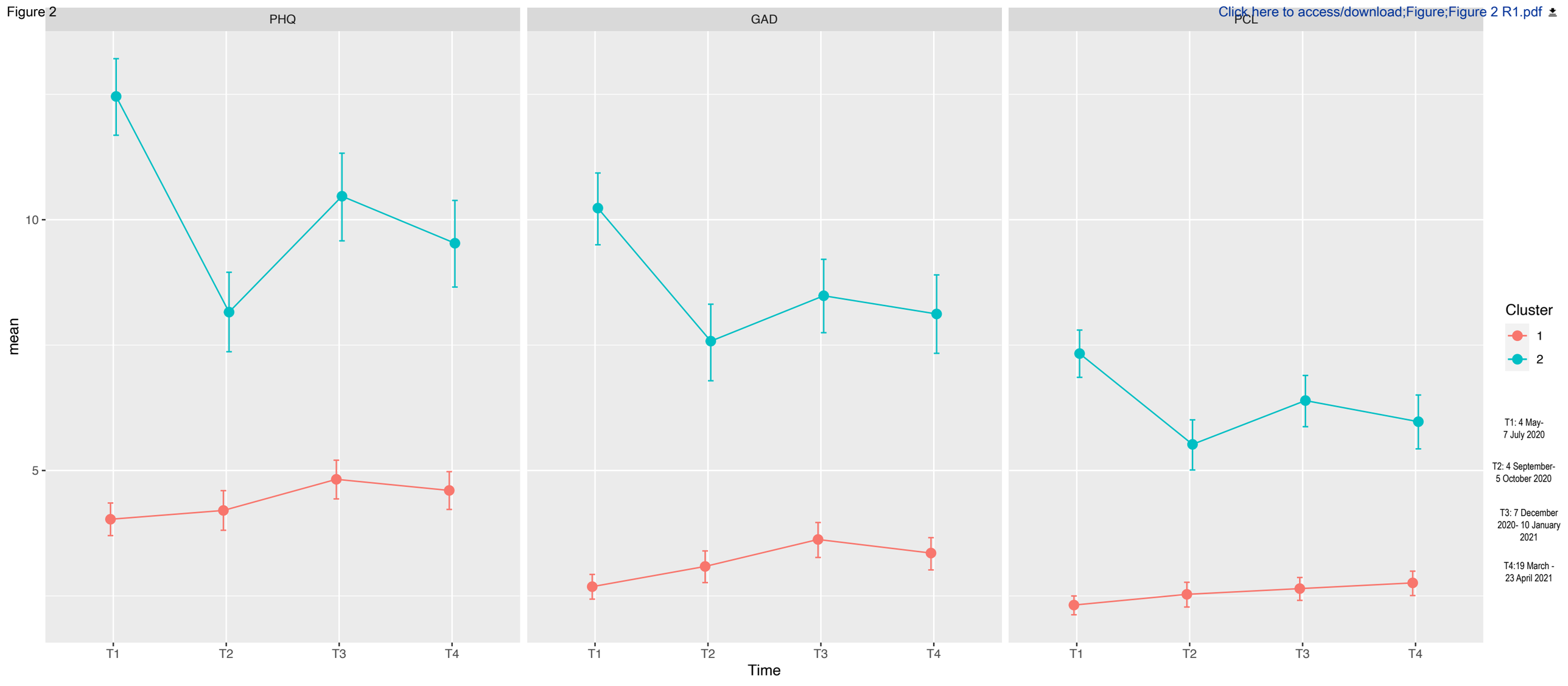

Table 1 Characteristics of participants, according to time

Total sample (N=681)		Time 1	Time 2	Time 3	Time 4	
		Mean (SD) / Frequency (%)				Comparison between waves: p
Participants characteristics						
Sex: female	78.56 (535)					
Age (years)	46.6 (15.34)					
Medical issue: yes	6.31 (43)					
Mental disorder history: yes	9.84 (67)					
Scales						
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
COVID related variables						
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	45.3 (1234)	49.19 (335)	40.68 (277)	43.32 (295)	48.02 (327)	< 0.001

COVID: some or a lot	

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 10000 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.

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)**			
		Socio-Demographic features			
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**
		Mental health features			
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%) %(n) or m(sd)	Cluster 2 High level of symptoms (N = 190, 27.9%) %(n) or m(sd)	OR (2.5% CI – 97.5% CI)	adjusted OR* (2.5% CI – 97.5% CI)	Comparison Between subgroups P-value
Mental health scales					
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**
Covid-19 related variables					
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: forth 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
			Cohen's d for paired data		p*
Cluster 1 (N =491, % = 72.1)					
PHQ score	-	0.03	0.11†	-0.04	0.03
GAD score	-	0.09	0.11†	-0.05	< 0.001
PCL score	-	0.07	0.03	0.03	0.04
Cluster 2 (N =190, % = 27.9)					
PHQ score	-	-0.58†	0.31†	-0.13	< 0.001
GAD score	-	-0.39†	0.12	-0.05	< 0.001
PCL score	-	-0.44†	0.18†	-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 10000 replications for comparison through time points

†: $p < 0.05$ for Wilcoxon signed rank test with continuity correction; ‡: $p < 0.001$ for Wilcoxon signed rank test with continuity correction

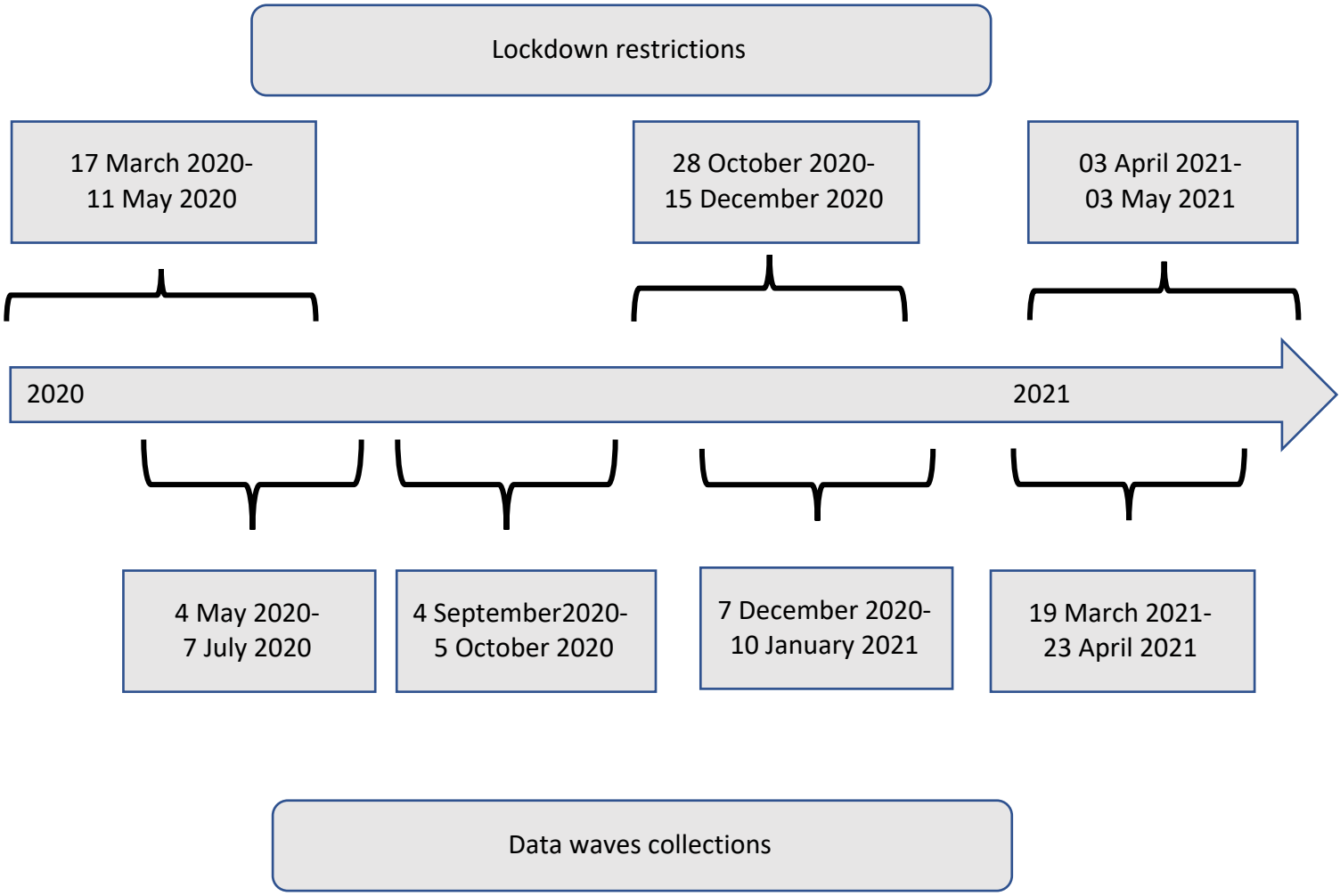
Lockdown restrictions
17 March 2020-
11 May 2020
28 October 2020-
15 December 2020
03 April 2021-
03 May 2021
2020
2021
4 May 2020-
7 July 2020
4 September2020-
5 October 2020
7 December 2020-
10 January 2021
19 March 2021-
23 April 2021
Data waves collections

Table S1 Study of selective attrition by comparing difference between participants with no missing data for PHQ at time 4 and participants with missing data at time 4

	Participants with no missing data at T4	Participants with missing data at T4	p
	Mean (SD) / Frequency (%)		
Subjects features at inclusion:			
Sex: female	81.80 (328)	73.82 (203)	0.02
Age (years)	47.79 (14.96)	44.6 (14.67)	0.008
Medical issue: yes	6.17(25	6.52 (18)	0.98
Mental disorder history: yes	8.64 (35)	7.69 (1)	NC
Loneliness: yes	21.23 (86)	17.88 (49)	0.33
Private outdoor			
- no	15.8 (64)	15.94 (44)	0.95
- between 1 and 10 m2	22.72 (92)	23.91 (66)	
- between 10 and 100 m2	20.25 (82)	21.01 (58)	
- lager than 100 m2	41.23 (163)	39.13 (108)	
Relationship status			NC
- single	18.02 (73)	15.38 (2)	
- couple	68.64 (278)	76.92 (10)	
- other	13.33 (54)	7.69 (1)	
Having children: yes	35.57 (143)	39.34 (107)	0.36
Hurted by partner: yes	0.26 (1)	0 (0)	NC
Tobacco: yes	25.25 (102)	7.69 (1)	NC
Alcohol: yes	43.18 (174)	23.08 (3)	0.25
Illegal drugs use: yes	6.68 (27)	100 (13)	NC
Scales at inclusion:			
PHQ score	6.4 (5.8)	6.35 (5.38)	0.74
GAD score	4.85 (4.93)	4.96 (4.93)	0.94
PCL score	3.7 (3.45)	3.77 (3.14)	0.35
OSSS score	10 (2.48)	9.94 (2.17)	0.58
COVID linked variables at inclusion:			

Number of regulations for COVID	7.49 (3.17)	7.64 (3.11)	0.58
Reduction of income: yes	4.23 (17)	7.69 (1)	NC
Work modification: yes	69.38 (281)	65.57 (279)	0.34
Going outdoor: < 3/week	83.91 (339)	76.82 (10)	0.45
Distress related to COVID: some or a lot	52.11 (210	61.54 (8)	0.70
Financial support	2.48 (10)	7.69 (1)	NC
Hours spent on covid news	25.72 (29.22)	35.42 (35)	0.31

T4 : time 4; p value; SD: standard deviation
Padua inventory score, medical issue history, PHQ: patient health questionnaire; GAD: generalized anxiety disorder scale; PCL: PTSD check list DSM-5; OSSS: Oslo social support scale;
NC: Not computable

Table S2 Full description of the available data

			Total sample (N=676))
	N	**Missing**	**% (n) or mean (sd)**
Subjects features at inclusion:			
Sex: female	676	5	78.55 (531)
Age (years)	650	31	46.49 (14.92)
Medical issue: yes	681	0	6.31 (43)
Mental disorder history: yes	676	5	9.91 (67)
Loneliness: yes	679	2	19.88 (135)
Private outdoor	681	0	
- no	-	-	15.86 (108)
- between 1 and 10 m2	-	-	23.2 (158)
- between 10 and 100 m2	-	-	20.56 (140)
- larger than 100 m2	-	-	40.38 (275)
Area of living	665	16	
- urban	-	-	52.03 (346)
- suburban	-	-	20.6 (137)
- rural	-	-	27.37 (182)
Size of place	678	3	
- under 30 m2	-	-	4.42 (30)
- between 30 and 50 m2	-	-	11.21 (76)
- between 50 and 80 m2	-	-	24.19 (164)
- between 80 and 110 m2	-	-	23.89 (162)

			Total sample (N=676))
	N	**Missing**	**% (n) or mean (sd)**
- between 110 and 140 m2	-	-	16.22 (110)
- between 140 and 170 m2	-	-	11.65 (79)
- between 170 and 200 m2	-	-	3.54 (24)
- larger than 200 m2	-	-	4.87 (33)
Job	678	3	
- job activity	-	-	5.75 (39)
- apprenticeship	-	-	73.6 (499)
- unemployment	-	-	11.36 (77)
- house wife	-	-	9.29 (63)
Job COVID exposure: yes	680	1	22.5 (153)
Health worker exposed: yes	678	3	10.77 (73)
Educational level: more than 2 years post graduate	680	1	88.53 (602)
Religion: yes	678	3	26.7 (181)
Relationship status	680	1	
- single	-	-	20.15 (137)
- couple	-	-	67.79 (461)
- other	-	-	12.06 (82)
Having children: yes	674	7	37.09 (250)
Old people at home: yes	677	4	80.95 (548)
Hurted by partner: yes	665	16	0.6 (4)

			Total sample (N=676))
	N	**Missing**	**% (n) or mean (sd)**
Tobacco: yes	673	8	27.64 (186)
Alcohol: yes	675	6	51.26 (346)
Drugs: yes	676	5	8.88 (60)
Padua Inventory score	636	45	23.75 (9.36)
Scales:			
PHQ score	1907	817	5.98 (5.39)
GAD score	1934	790	4.67 (4.75)
PCL score	1943	781	3.64 (3.37)
OSSS score	1953	771	9.9 (2.42)
COVID linked variables:			
Number of regulations for COVID	1973	751	6.81 (2.88)
Reduction of income: yes	1957	767	16.5 (323)
Work modification: yes	1963	761	62.4 (1225)
Going outdoor: < 3/week	1963	761	25.11 (493)
Distress related to COVID: some or a lot	1965	759	46.67 (917)
Financial support	1528	1196	7.79 (119)
Hours on COVID news	1946	778	37.12 (57.61)

n = count ; % = percentage ; m = mean ; sd = standard deviation

S3 Fluctuations in mental health scores over time

Total sample (N=681)		**Time 1**	**Time 2**	**Time 3**	**Time 4**	
		Mean (SD) / Frequency (%)				**Comparison between waves: p**
			Scales			
PHQ score	6.02 (5.43)	6.38 (5.64)	5.31 (5.13)	6.4 (5.55)	5.98 (5.31)	< 0.001
Cohen's d between consecutive time points		**-**	***-0.17***	***0.18***	***-0.07***	
GAD score	4.7 (4.75)	4.79 (4.91)	4.34 (4.59)	4.98 (4.78)	4.68 (4.72)	0.02
Cohen's d between consecutive time points		**-**	***-0.09***	***0.11***	***-0.05***	
PCL score	3.61 (3.35)	3.72 (3.34)	3.37 (3.29)	3.69 (3.36)	3.66 (3.39)	0.03
Cohen's d between consecutive time points		**-**	***-0.1***	***0.08***	***-0.01***	

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 10000 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.

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5. CONCLUSIONS

The objective of this thesis was to explore the impact of the containment measures and of lifting of COVID-19 lockdown measures on mental health on diverse populations such as adults and children, considering their individuals characteristics.

Concerning children, our findings indicated an increased risk of psychological difficulties in children whose parents had symptoms of anxiety and depression and whose families faced financial difficulties. Children's sleeping difficulties and screen time were also associated with the presence of psychological difficulties. Children's elevated symptoms of hyperactivity/inattention and of emotional symptoms were associated with decline in income during the COVID-19 crisis, which underlines the impact of the financial crisis related to the COVID-19 epidemic on children' mental health. Both pre-existing family SES before lockdown and more proximal financial difficulties during the COVID-19 crisis were negatively associated with children's psychological difficulties during the period of school closure.

In adults, our work 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. 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.

We identified a high and a low cluster of mental health scores during the lockdown. 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.

Participants with high levels of symptoms were characterized by younger age, prior history of mental disorders, experience of domestic violence and medical issues.

6. Discussion: Mental health in Europe: Post pandemic Impact... and War in Ukraine

As we studied the impact of lockdown on mental health, we also showed that the easing of lockdown has also posed new challenges for others, including disrupting newly learned routines and coping patterns.

As highlighted by a UK paper[1] published in September 2021, much research has focused on how the COVID-19 lockdown itself impacted mental health, but by contrast, research on how people adjusted to the release from lockdown has been scarce. For example, this UK study was the first to investigate the factors that might impact adjustment following the release of COVID-19 lockdown restrictions. They showed that individuals with a history of any mental disorder therefore appear to be disproportionately affected and may struggle to adjust to the lifting of lockdown.

Europe and the world have changed dramatically since the first COVID-19 cases appeared in early 2020. With the fast development of vaccines and boosters, societies have re-opened following two years of limiting restrictions. Any opportunity, however, for society and the economy to recuperate from the COVID-19 pandemic has been abruptly put on hold by the onset of the war in Ukraine in March 2022.

In France

In March 2020, Public Health France have put in place a "psycho-behavioural" surveillance system after the beginning of the first lockdown, named Coviprev, in order to follow the evolution of behaviors and mental health and identify the most vulnerables.

Some public health devices were implemented such as digital campaigns to help French people to live better the lockdown.

President Macron announced in October 2021 changes to the mental health system, which was due to take effect in 2022, with for example, psychological consultations partially reimbursed by the state, the creation of 800 jobs in psychological health centers, and extra funding and support for research. However, French psychiatric services, and more globally psychiatric services in Europe, is deteriorating with less human resources and with previous repeatedly slashed funding to the psychiatric sector.

In Europe

In Europe, a recent study [2, 3] in October 2022 made by Eurofound (*European Foundation for the Improvement of Living and Working Conditions*) showed that despite the lifting of most COVID-19 restrictions across EU Member States, mental health levels remained lower in spring 2022 than they were at the start of the pandemic. This could be attributed to the war in Ukraine for which majority of respondents expressed high or very high concern. If this COVID-19 e-survey highlighted the heavy toll of the pandemic, it also reflected a new uncertain future caused by the war in Ukraine and a high inflation. The latest results, from spring 2022, provided the following insights: as found in our COMET study, overall, mental well-being did not recover to the level that might have been expected, despite the lift of most COVID-19 restrictions. The effects of restrictions were strongest among younger people, for whom mental well-being has improved.

In a Czech paper[4], it is indeed explained that the Russian-Ukrainian War that began on 24 February 2022, has become one of the largest humanitarian emergencies since World War II, with over 7.7 million Ukrainian refugees having fled their country to date, according to UNHCR in October 2022 [5]. The public's mental health and well-being are affected by various disasters every year, with man-made disasters including military conflicts, such as the Russian-Ukrainian War [6]. And consequently, Europe is exposed to inflation, meaning that many people continue to express uncertainty about their living and working conditions.

The re-opening of schools has reduced the extreme work–life balance conflicts that respondents were forced to deal with during the pandemic, but new challenges emerge. Another new reality brought on by the pandemic is the widespread backlog in healthcare

provision, particularly with regards to hospital and psychiatrist specialist care. Clearly, the system needs support to cope with the high levels of mental healthcare problems. The challenges brought by the crisis, placed huge pressure on national and international institutions to have the support of its citizens. It is to fear a worsening of mental health of Europeans: the future will tell if we were right or wrong. As highlighted in our 3 different studies, the need for longitudinal follow-up after this extraordinary crisis is needed more than ever.

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7. LIST OF ANNEXES

ANNEX 1

Published article

Monnier M, Moulin F, Thierry X, Vandentorren S, Côté S, Barbosa S, Falissard B, Bernard J, Plancoulaine S, Charles MA, Ancel PY, Melchior M, Rouquette A, Galera G. Children's mental health, health behaviors, schooling, sociodemographic and socioeconomic characteristics during school closure in France due to COVID-19: the SAPRIS cohort. Scientific report, doi:10.1038/s41598-021-01676-7

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ANNEX 2

Published article:

Bailhache M, Monnier M, Moulin F, Thierry X, Vandentorren S, Côté S, Barbosa S, Falissard B, Bernard J, Plancoulaine S, Charles MA, Ancel PY, Melchior M, Rouquette A, Galera G..: Emotional and attention-deficit/hyperactivity disorder symptoms of preterm vs. full-term children during COVID-19 pandemic restrictions. Pediatr Res 2022; 1–8, doi:10.1038/s41390-022-02037-4.1-8

Available at the following URL: https://www.nature.com/articles/s41390-022-02037-4

ANNEX 3

Published article:

Monnier M, Moulin F, Bailhache M, Thierry X, Vandentorren S, Côté S, Falissard B, Simeon T, Geay B, Marchand L, Dufourg MN, Charles MA, Ancel PY, Melchior M, Rouquette A, Galera G, The SAPRIS Study Group, and the ELFE Joint Unit. Parents' depression and anxiety associated with hyperactivity-inattention and emotional symptoms in children during school closure due to COVID-19 in France. March 2023, Scientific reports, doi: 10.1038/s41598-023-31985-y

Available at the following URL: https://doi.org/10.1038/s41598-023-31985-y

ANNEX 4

Published article:

Francois J, Moulin F, Schwartz A, Castel L, Montagni I, Macalli M, Notredame CE, Côté S Galéra C "Association between Attention Deficit Hyperactivity Disorder symptoms and Illicit Stimulants use following one year among French university students of the i-Share cohort" Social Psychiatry and Psychiatric Epidemiology. June 2023, doi: 10.1007/s00127-023-02499-9

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ANNEX 5

Other publications

1. **Moulin F**, Ponte B, Pruijm M, Ackermann D, Guessous I, Ehret G, Bonny O, Pechere-Bertschi A, Staessen J. A., Paccaud F, Mohaupt M, Martin P.Y, Burnier M, Vogt B, Devuyst O, Bochud M. Heritability of renal function parameters and electrolytes levels in the Swiss population. 5C.09, Journal of Hypertension: 2015; 33. doi: 10.1097/01.hjh.0000467539.29779.1a
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7. Jean F, **Moulin F**, Castel L, Montagni I, Macalli M, Schwartz A, Notredame C-E, Côté S, Galéra C, Association of attention deficit hyperactivity disorder symptoms and stimulant drugs use after one year among students of the i-Share cohort (annex 4

Chapters of book

8. **Moulin F** & Galéra C. (2016). Chapitre 13. Suicide et TDAH chez l'adulte et l'enfant. Dans : Manuel Bouvard éd., Trouble Déficit de l'Attention avec ou sans

Hyperactivité de l'enfant à l'adulte: Approche développementale (pp. 237-248). Paris: Dunod. doi.org/10.3917/dunod.bouva.2016.01.0237

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Title : Psychiatric impact of the COVID-19 pandemic : Role of the lockdown and of social inequalities

Abstract

Context: The COVID-19 epidemic has spread worldwide since December 2019. To contain it, preventive measures including social distancing, economic shutdown, and school closures were introduced, carrying the risk of mental health burden in adults and children. Although the knowledge base regarding response to trauma and adverse events in general has broadened, descriptions of their mental health during epidemics remain scarce. In particular, the role of family socioeconomic characteristics and parental mental health are poorly understood. **Objective:** The objective of this study was to explore the impact of the containment measures and of lift of the lockdown measures on psychiatric symptoms on diverse populations such as adults and children, considering their individuals characteristics. **Methods:** Data come from TEMPO, ELFE and COMET cohort. Our study design was cross-sectional at inclusion and longitudinal for follow-up data. Multivariate analysis have been carried out on variables of interest, including logistic, multinomial or linear regression depending on the type of data. **Results:** Results show an association between mental health deterioration and containment measures related to COVID-19 19.

Keywords Mental health, epidemiology, community survey, longitudinal

Titre : Impact psychiatrique de la pandémie de COVID-19 : Rôle du confinement et des inégalités sociales

Résumé

Contexte : L'épidémie de COVID-19 s'est propagée à travers le monde depuis décembre 2019. Pour tenter de la contenir, des mesures préventives comme la distanciation sociale, les fermetures économiques, et les fermetures d'écoles ont été mises en place, apportant avec elles un risque accru d'effet potentiellement négatifs sur la santé mentale chez les adultes et les enfants. Bien que les connaissances concernant la réponse aux traumatismes soient désormais mieux connues, la description de la santé mentale durant l'épidémie reste limitée. En particulier, le rôle des caractéristiques socioéconomiques familiales et la santé mentale parentale restent peu étudiés. **Objectif :** L'objectif de notre travail était d'étudier la santé mentale durant les périodes de confinement et de déconfinement dans des populations diverses d'adultes et d'enfants, en prenant en compte leurs caractéristiques individuelles préalables. **Méthodes :** Nous avons analysé les données recueillies dans le cadre des cohortes TEMPO, ELFE, et COMET. Notre schéma d'étude a été transversal pour les données à l'inclusion et longitudinal pour les données de suivi. Pour chaque cohorte, une première analyse descriptive a été réalisée. Des analyses multivariées de régression logistique, multinomiale ou linéaire en fonction du type de données ont été utilisées. **Résultats :** Les résultats mettent en évidence des liens entre les symptômes de détérioration de santé

mentale et le confinement lié à la COVID-1919, et permettent de proposer des programmes d'intervention et de prévention précoce.

Mots clés : Santé mentale, épidémiologie, étude de population, longitudinale

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