From the: Department of Psychiatry and Psychotherapy, LMU University Hospital Munich

Dissertation

zum Erwerb des Doctor of Philosophy (Ph.D.)
an der

Medizinischen Fakultät der

Ludwig-Maximilians-Universität zu München

Delineating the Psychosocial Impact of the Coronavirus Pandemic

vorgelegt von:
Stephanie Viktoria Rek

aus:

Hamm, Germany

Jahr:
2022

Mit Genehmigung der Medizinischen Fakultät der

Ludwig-Maximilians-Universität zu München

First supervisor: *Prof. Dr. Frank Padberg*

Second supervisor: *Prof. Dr. Daniel Freeman*

Third supervisor: *Prof. Dr. Peter Falkai*

Fourth supervisor: *Prof. Dr. Markus Bühner*

Dean: **Prof. Dr. med. Thomas Gudermann**

Datum der Verteidigung:

21.11.2022

Affidavit

Affidavit

Rek, Stephanie Viktoria

Surname, first name

Nussbaumstraße 7

Street

80336, Munich, Germany

Zip code, town, country

I hereby declare, that the submitted thesis entitled:

Delineating the Psychosocial Impact of the Coronavirus Pandemic

is my own work. I have only used the sources indicated and have not made unauthorised use of services of a third party. Where the work of others has been quoted or reproduced, the source is always given.

I further declare that the submitted thesis or parts thereof have not been presented as part of an examination degree to any other university.

Munich, 15/12/2022

place, date

Stephanie Viktoria Rek

Signature doctoral candidate

Confirmation of congruency

Confirmation of congruency between printed and electronic version of the doctoral thesis

Rek, Stephanie Viktoria
_____
Surname, first name

Nussbaumstraße 7
_____
Street

80336, Munich, Germany
_____
Zip code, town, country

I hereby declare, that the submitted thesis entitled:

Delineating the Psychosocial Impact of the Coronavirus Pandemic

is congruent with the printed version both in content and format.

Munich, 15/12/2022 Stephanie Viktoria Rek
_____ _____
place, date Signature doctoral candidate

Table of content

List of abbreviations

CFA Confirmatory Factor Analysis

CM Childhood Maltreatment

CoPaQ COVID-19 Pandemic Mental Health Questionnaire

COVID-19 Coronavirus disease

DSM Diagnostic and Statistical Manual of Mental Disorders

EFA Explorative Factor Analysis

PTSD posttraumatic stress disorder

SARS-CoV-2 Severe acute respiratory syndrome coronavirus 2

WEIRD Western, Educated, Industrialized, Rich, and Democratic

WHO World Health Organization

List of publications

Peer-reviewed articles

Nenov-matt, T., Barton, B. B., Dewald-kaufmann, J., Goerigk, S., **Rek, S. V.**, Zentz, K., … Reinhard, M. A. (2020). Loneliness , Social Isolation and Their Difference : A Cross-Diagnostic Study in Persistent Depressive Disorder and Borderline Personality Disorder. Frontiers in Psychiatry, 11(December), 1–13. https://doi.org/10.3389/fpsyt.2020.608476

Reinhard, M. A., Zentz, K., Nenov-Matt, T., Barton, B. B., **Rek, S. V.**, Goerigk, S., ... & Padberg, F. (2021). Cognitive behavioral analysis system of psychotherapy reduces loneliness in patients with persistent depressive disorder. Journal of Affective Disorders Reports, 5, 100171. https://doi.org/10.1016/j.jadr.2021.100171

Rek, S. V., Bühner, M., Reinhard, M. A., Freeman, D., Keeser, D., Adorjan, K., … Padberg, F. (2021). The COVID-19 Pandemic Mental Health Questionnaire (CoPaQ): psychometric evaluation and compliance with countermeasures in psychiatric inpatients and non-clinical individuals. BMC Psychiatry, 21(1), 426. https://doi.org/10.1186/s12888-021-03425-6

Rek, S. V., Freeman, D., Reinhard, M. A., Bühner, M., Grosen, S., Falkai, P., … Padberg, F. (2021). Differential psychological response to the COVID-19 pandemic in psychiatric inpatients compared to a non-clinical population from Germany. European Archives of Psychiatry and Clinical Neuroscience. https://doi.org/10.1007/s00406-021-01291-7

Rek, S. V., Reinhard, M. A., Bühner, M., Freeman, D., Adorjan, K., Falkai, P., Padberg, F. (in press). Identifying potential mechanisms between childhood trauma and the psychological response to the COVID‐19 pandemic in Germany: a longitudinal study. Scientific Reports.

Rek, S. V., Sheaves, B., & Freeman, D. (2017). Nightmares in the general population: identifying potential causal factors. Social Psychiatry and Psychiatric Epidemiology, 52(9), 1123–1133. https://doi.org/10.1007/s00127-017-1408-7

Rosebrock, L., Černis, E., Lambe, S., Waite, F., **Rek, S. V.**, Petit, A., … Freeman, D. (2021). Catastrophic cognitions about coronavirus: the Oxford psychological

investigation of coronavirus questionnaire [TOPIC-Q]. Psychological Medicine, 1–10. https://doi.org/10.1017/S0033291721000283

Sheaves, B., Freeman, D., Isham, L., McInerney, J., Nickless, A., Yu, L.-M., … Barrera, A. (2018). Stabilising sleep for patients admitted at acute crisis to a psychiatric hospital (OWLS): an assessor-blind pilot randomised controlled trial. Psychological Medicine, 48(10), 1694–1704. https://doi.org/10.1017/S0033291717003191

Sheaves, B., Holmes, E. A., **Rek, S. V.**, Taylor, K. M., Nickless, A., Waite, F., … Freeman, D. (2019). Cognitive Behavioural Therapy for Nightmares for Patients with Persecutory Delusions (Nites): An Assessor-Blind, Pilot Randomized Controlled Trial. The Canadian Journal of Psychiatry, 070674371984742. https://doi.org/10.1177/0706743719847422

Weber, S., **Rek, S. V.**, Eser-Valeri, D., Padberg, F., Reiter, F. P., De Toni, E., … Denk, G. (2021). The Psychosocial Burden on Liver Transplant Recipients during the COVID-19 Pandemic. Visceral Medicine. https://doi.org/10.1159/000517158

1. Introductory Summary

Since 2019, the invisible threat of the coronavirus disease (COVID-19) pandemic has descended on the world like an invisible veil. Thought to have originated from China through transmission from animals to humans (World Health Organization [WHO], 2021), it has spread around the world in the beginning of 2020 (Chen Wang, Horby, Hayden, & Gao, 2020) and within Germany starting at the end of January 2020. Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is a highly contagious and potentially life-threatening virus. As of May 2022, German citizens have lived through four waves of infections and a fifth is ebbing away, which has resulted in around 25.890.456 confirmed cases with 137.888 deaths in Germany alone (WHO COVID-19 Dashboard). To contain the rapid spread of the virus, government officials were forced to enact rigorous and unprecedented measures to safeguard vulnerable groups, to prevent an overload of the health care system, and to ensure maintenance of essential infrastructure. In addition to a greater focus on personal hygiene, measures were mainly concerned with physical distancing and included curfews; nationwide travel restrictions; quarantine; closures of schools, universities, and recreational facilities; and remote work among others. These measures resulted in vast changes to daily life, negative economic side-effects (job insecurities, unemployment, poverty, and financial difficulties), and change or disruption of social networks. In this way, the pandemic constitutes a large-scale, collective stressor resulting from the inherent uncertainty, uncontrollability, and demanding nature of the situation (Brakemeier et al., 2020; Gruber et al., 2021). Due to the extent of this stressor, caution was called for early on in the pandemic that beyond the more prominent physical health crisis a more hidden mental health crisis could be emerging globally (Holmes et al., 2020). To quantify and potentially tackle this public health concern, the following three key research questions needed to be addressed:

i. What are the acute and long-term consequences of the pandemic on mental health?
ii. Who is particularly vulnerable to the adverse consequences of the pandemic?
iii. What are the underlying mechanisms contributing to the adverse psychological response to the pandemic?

Addressing these key research questions was also the aim of the current thesis focussing on the timeframe from April 2020 to May 2021. In subsequent sections, early studies on the psychosocial impact of the pandemic are described, followed by a clarification of the

limitations of these studies. Next the research projects of the current thesis are discussed followed by discussion of their limitations and future directions.

1.1 General population-based studies

At the beginning of the COVID-19 pandemic, information of the potential psychological impact of the pandemic in the general population was unknown and could only be estimated from previous infectious outbreaks such as the Severe Acute Respiratory Syndrome (SARS) epidemic in 2003. While the literature on the psychological impact of SARS is relatively scarce, a few general population studies exist. For example, Hawryluck et al. (2004) report on the psychological effects of quarantine during the SARS outbreak in a convenience sample of 129 community-dwelling, quarantined individuals from Canada who participated in an online survey. Around one third of participants reported symptoms of posttraumatic stress disorder (PTSD) and depression with longer durations of quarantine being associated with greater PTSD symptoms. In a separate study, Peng et al. (2010) investigated the psychological impact of the SARS epidemic post-outbreak based on a nationwide representative sample of the adult population in Taiwan and found a 11.7% prevalence rate of psychiatric morbidities (also see study of Ko, Yen, Yen, & Yang, 2006). Both of these studies thus suggest psychiatric symptom prevalence increases following infectious outbreak and related countermeasures (see Brooks et al., 2020 for a review on the psychological impact of quarantine). Importantly, however, interpretation of these studies is limited by the absence of baseline comparison data before the infectious disease outbreak and/or related countermeasures.

Following the onset of the COVID-19 pandemic, initial epidemiological studies were emerging in December, 2020 assessing the prevalence of psychiatric symptoms mostly related to stress, anxiety, and depression in the context of cross-sectional convenience samples. For instance, Wang et al. (2020) showed that among 1210 participants recruited into an online survey of the immediate psychological response to the COVID-19 pandemic in China, 16.5%, 28.8%, and 8.1% of participants reported depressive, anxiety, and stress symptoms of moderate to severe severity, respectively. Similarly, Mazza et al. (2020) reported high to very high levels of severity in 32.8%, 18.7%, and 27.2% of respondents for depressive, anxiety, and stress symptoms, respectively, in 2766 participants recruited online in Italy. 17 of such early studies were quickly summarised in a meta-analysis, which suggested prevalence rates of 33.7% for depressive symptoms (14 studies, n = 44,531), 31.9% for anxiety symptoms (17 studies, n = 63,439), and 29.6% for stress symptoms (5 studies, n = 9074) in the general population (Salari et al., 2020). This meta-analytic work and the underlying original studies have four important caveats, however. First and similar to evidence from the previous SARS epidemic, prevalence rates were

based on assessments after the pandemic started and without comparisons to pre-pandemic (baseline) rates. This prohibits any inferences as to whether symptom prevalence rates changed following the onset of the pandemic. Second, non-representativeness of convenience samples questions the validity of evidence for inferences about the general population (Pierce, McManus, et al., 2020). Third, meta-analyses dilute potential culture- and country-specific effects of the pandemic. These are particularly relevant when considering the heterogeneous impact of the pandemic and diverse reactions to it across countries (Manchia et al., 2022). Finally, these studies only assessed overall prevalence rates in their samples but did not stratify analyses for potentially vulnerable subgroups, such as those with pre-existing mental health conditions who may experience particularly severe symptom exacerbation due to a greater susceptibility to stress compared to the general population (Druss, 2020; Pfefferbaum & North, 2020; Yao, Chen, & Xu, 2020), an aspect which is discussed in the following sections.

1.2 Studies of vulnerable subgroups

Existing literature of the impact of disasters suggests that most individuals show an initial adverse psychological response, but this adverse psychological response resolves itself over time in the majority of individuals. In a minority of individuals, however, an enduring pattern of adverse mental health outcomes persists (North & Pfefferbaum, 2013), which highlights the importance of identifying risk factors for adverse mental health trajectories to identify and support these vulnerable populations. Here, identification of vulnerable groups who may be particularly reactive to stress and, thus, at heightened risk of adverse mental health sequelae is the first step into safeguarding these groups amidst the current and potential future pandemics. The second step is to identify mechanisms that are causally related to adverse mental health outcomes and amendable to intervention.

1.2.1 Risk factors

Previous research on the impact of disasters suggests that key risk factors for lower psychosocial functioning exist such as exposure to multiple concurrent stressors, pre-existing psychopathology as well as other inter-individual differences (North & Pfefferbaum, 2013). Among these inter-individual differences, particularly factors such as individual characteristics (e.g., vulnerabilities, past experiences), appraisals, and coping styles have been related to differences in the stress response (Lazarus & Folkman, 1984). Accordingly, it could be hypothesised that these inter-individual differences also matter in the stress response to the same objective event such as the pandemic.

1.2.2 Diathesis-stress model

An established framework that tries to explain why only some individuals will go on to develop mental health issues after exposure to environmental stressors is the diathesis-stress model (Monroe & Simons, 1991). According to this model, a combination of inherent vulnerabilities (e.g., genetic make-up, temperament) and adverse environment influences (e.g., natural disasters, childhood maltreatment) lead to the onset of psychiatric disorders (Hammen, Kim, Eberhart, & Brennan, 2009; Marin et al., 2011; Smoller, 2016). Accordingly, one would expect that individuals with a history of mental health issues – due to their inherent vulnerabilities – would exhibit a worse psychological response to the same set of COVID-19 specific stressors than non-clinical individuals. In line with this idea, early cross-sectional studies indeed reported worse psychosocial functioning in people with mental health disorders compared to non-clinical controls (Hao et al., 2020; Iasevoli et al., 2020; Van Rheenen et al., 2020). Importantly, however, none of these studies used measurements to assess specific mental health and stressor-related effects of the pandemic. Additionally, these studies again lacked pre-pandemic outcome measures, which is particularly problematic in the context of case-control studies of psychiatric patients and non-clinical controls, where one would – by definition – expect differences in psychopathology between groups independent from the pandemic. The studies of this thesis were conducted to address these research gaps as described in the following section.

1.3 Aims and results of this thesis

1.3.1 Study 1: Development and validation of psychometric tools to assess the mental health impact of the pandemic

As indicated before, psychometric tools are required that allow specific and valid assessments into the psychosocial impact of the pandemic. This includes – but is not limited to – factors such as contamination anxiety, institutional and political trust, conspiracy beliefs, COVID-19-related psychiatric symptoms, and an assessment of stressors specific and relevant to the current COVID-19 pandemic as well as their perceived impact for the individual, which is most relevant for the current thesis.

Based on these research needs, we developed the COVID-19 Pandemic Mental Health Questionnaire (CoPaQ) as a new and targeted measurement tool, which was evaluated in Study 1 regarding its psychometric properties. First, we explored the factor structure of the questionnaire in non-clinical individuals from the general population using Explora-

tory Factor Analysis (EFA), which was validated in a separate psychiatric inpatient sample by Confirmatory Factor Analysis (CFA) in a second step. Next, validated subscales of the CoPaQ were tested for their internal consistency and where applicable for construct and criterion validity. Overall, 12 out of 16 theoretically conceived subscales showed adequate psychometric properties and were retained in the final questionnaire version including the COVID-19 specific stressor impact subscale. As such, the CoPaQ is a validated and comprehensive measurement tool that aims at assessing the broad psychosocial impact of the pandemic.

1.3.2 Study 2: Evaluating the psychological impact of the pandemic in psychiatric patients as compared to non-clinical individuals

In order to determine whether the pandemic is indeed likely to be a driver of the increased mental health burden of psychiatric patients reported in early case-control studies (Hao et al., 2020; Iasevoli et al., 2020; Van Rheenen et al., 2020), it is important to assess and compare the COVID-19 specific stressors impact in psychiatric patients with serious mental health difficulties as compared to non-clinical individuals, which also allows for an empirical test of the diathesis-stress model (Monroe & Simons, 1991). Therefore, the objective of Study 2 was to test whether psychiatric patients were more negatively affected by COVID-19 specific stressors in terms of their psychosocial functioning than non-clinical individuals.

For this purpose, we report results from 108 non-clinical individuals recruited online from the general German population and 108 age-, sex- and employment status-matched psychiatric inpatients from all major diagnostic categories recruited from the LMU Psychiatry Biobank Munich study between April and December 2020. To circumvent the issue of unavailable pre-pandemic psychopathology data, we compared post-pandemic psychopathology levels between groups while controlling for the perceived stressfulness of different COVID-19 specific stressors. Participants completed a range of validated mental health questionnaires and self-reported on the impact of COVID-19 specific stressors (e.g., quarantine/curfew, small accommodation/home-office, financial difficulties, childcare responsibilities, and physical health concerns) with the CoPaQ. Using linear regression, we evaluated associations of case-control status, COVID-19-specific stressors and their interaction with mental health outcomes. In addition to general case-control differences in psychosocial functioning, results showed robust associations of the impact of COVID-19-specific stressors with mental health outcomes and evidence for their interaction on depression, loneliness, rumination, resilience, and well-being. As a general pattern, psychiatric inpatients exhibited marked mental health difficulties, relatively independent from the impact of COVID-19-specific stressors. In contrast, lower psychosocial

functioning was strongly associated with the impact of COVID-19-specific stressors in non-clinical individuals. These results oppose hypotheses from the diathesis-stress model and instead suggest that the potential for mental health difficulties following COVID-19 related stressors is greatest in individuals from the general population who face the greatest number and impact of individual COVID-19 specific stressors.

At the time Study 2 was conducted, evidence of longitudinal studies tracking the psychological response across different stages of the pandemic including pre-pandemic data were relatively scarce. From December 2020 onwards, initial high-quality longitudinal trajectory studies were emerging using general population-based datasets. Most of these studies (e.g., McGinty, Presskreischer, Han, & Barry, 2020; Pierce, Hope, et al., 2020) – but not all (Ettman et al., 2022) – observed an initial increase in psychosocial difficulties during the early stages of the pandemic, which subsided to pre-pandemic levels over time (e.g., Daly & Robinson, 2021; Daly, Sutin, & Robinson, 2020; Fancourt, Steptoe, & Bu, 2021; Pierce et al., 2021). Findings from these key large-scale studies and smaller investigations were summarised in a recent meta-analysis including data on 65 longitudinal cohort studies involving about 55,000 individuals published between January 2020 and January 2021. Results from this meta-analysis suggested that levels of anxiety and depression increased from March to April 2020 and declined to approximately pre-pandemic levels for anxiety – but not depression – by mid-2020 (also see Aknin et al., 2021; Manchia et al., 2022). Mixed findings were observed as to whether pre-existing mental disorders were associated with a worse psychological response to the pandemic. For example, Pan et al. (2020) provide longitudinal mental health comparisons before versus during the pandemic (April till May 2020) and using COVID-19-specific items beyond general symptom questionnaires using three Dutch case-control cohorts. In line with results from Study 2, the authors showed that patients' mental health functioning was similar before versus during the pandemic, while non-clinical individuals experienced more symptoms during compared to before the pandemic. In contrast, Pierce et al. (2021) showed that individuals from the UK who exhibited mental health deterioration over the course of the pandemic (until early October 2020) were more likely to have a pre-existing mental health diagnosis. Looking at systematic reviews of these and other studies, the sum of evidence does not suggest that individuals with pre-existing disorders experience particularly severe symptom aggravation compared with pre-pandemic levels (Manchia et al., 2022; Robinson, Sutin, Daly, & Jones, 2022). Several hypotheses have been brought forward to explain these unexpected findings such as mitigation strategy-induced relaxation, feelings of safety and simply regression to the mean (Pan et al. 2020). Pierce et al. (2020) stressed the importance of tracking the psychological response of psychiatric patients further into the pandemic to assess whether the chronicity of exposure to COVID-19 specific stressors matters.

Altogether the evidence indicates that mental health issues following the onset of the pandemic do not seem to be greater in psychiatric patients but could even be more severe for certain individuals in the general population such as those who experience the greatest number of COVID-19 specific stressors (Ahrens et al., 2021; Ettman et al., 2022). To prevent and/or treat these individuals, it is important to identify the mechanisms contributing to greater psychopathology during the pandemic, which was the focus of Study 3.

1.3.3 Study 3 & Appendix A: Identifying potential mechanisms underlying adverse psychological responses to the pandemic

As only briefly mentioned above as a particularly disruptive early life stressor, childhood maltreatment (CM) - including experiences of abuse and neglect - is an important transdiagnostic risk factor for adverse mental health trajectories throughout life as supported by a wealth of previous epidemiological work (e.g., Albott, Forbes, & Anker, 2018; Keyes et al., 2012; Li, D'arcy, & Meng, 2016; McLaughlin, Colich, Rodman, & Weissman, 2020; Nelson et al., 2020; Varese et al., 2012). As such, it is conceivable that CM-exposed individuals could also be at risk for adverse mental health trajectories during the COVID-19 pandemic. While this was supported in initial studies (e.g., Guo et al., 2020; Kim, Nyengerai, & Mendenhall, 2020; Seitz, Bertsch, & Herpertz, 2021; Tsur & Abu-Raiya, 2020), the underlying mechanisms are less well understood.

One key mechanism that has been put forward to explain the relationship between CM and reduced psychosocial functioning is a process called stress sensitisation (Berens, Jensen, & Nelson, 2017; Hammen, Henry, & Daley, 2000). That is, CM-exposed individuals are believed to become particularly sensitive/reactive to proximal stress, which predisposes them to adverse psychosocial outcomes later in life as depicted in Figure 1 (see Stroud, Harkness, & Hayden, 2018 for a review on stress sensitisation in depression). This is supported by alterations in the brain's stress regulation system in CM-exposed versus unexposed individuals (e.g., hypo-thalamic–pituitary– adrenal (HPA) axis and hippocampal volume; Cicchetti & Rogosch, 2012; Heim, Newport, Mletzko, Miller, & Nemeroff, 2008).

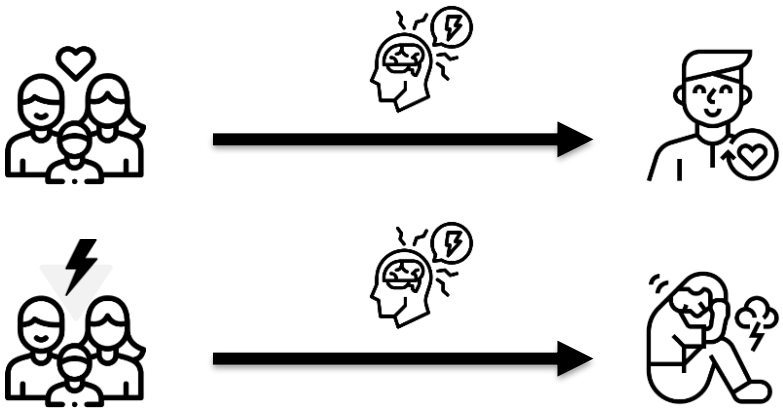


Figure 1. Depicted is the process of stress sensitisation following childhood trauma which predisposes to adverse mental health sequelae later in life. Icons are taken from flaticon.com.

This process of stress sensitisation may be particularly relevant during the inherently stressful COVID-19 pandemic. As of today, only one study by Kim et al. (2020) scrutinised perceived stress assessed by the Perceived Stress Scale (PSS; Cohen, Kamarck, & Mermelstein, 1994) as a plausible mechanism between CM and depressive symptoms in adolescents during the pandemic. However, in this study perceived stress was assessed broadly and not for COVID-19 specific stressors. Moreover, the sample consisted of adolescents and not adults questioning the generalisability of results. Finally, other important psychosocial outcomes such as anxiety, loneliness, and well-being were not considered, so that it is difficult to arrive at firm conclusion as to whether individuals who experienced CM perceive the COVID-19 specific stressors as more stressful, which could, in turn, increase the risk for different adverse psychosocial outcomes. As such, testing whether stress sensitisation in relation to the pandemic may be a key mechanism in the relationship of CM and adverse psychosocial outcomes is of pivotal importance since this is a mechanism amendable to interventions, for example, by specific stress-management-programs.

To this end, Study 3 (Appendix A) tested to what extent the impact of subjective perceived stress specific to the pandemic mediated the relationship between early CM and later adverse psychosocial outcomes compared to more established mediators of rumination and insecure attachment. This was tested using the prospective data of the individuals from the general population, which participated in the above-mentioned online survey and completed the baseline and 10-weeks follow-up assessment (April 2020 – May 2021). Self-report measures were used to assess childhood trauma, COVID-19 perceived stress, rumination and insecure attachment, and depression, anxiety, stress, loneliness, paranoia, and psychological well-being. We applied correlational and multiple mediation analyses including non-parametric bootstrap samples to test plausible mechanistic pathways. Childhood trauma was longitudinally associated with all adverse psychosocial outcomes. Multiple mediation analyses revealed that COVID-19 perceived stress, rumination, and

insecure attachment mediated this relationship. For the outcomes of anxiety and stress full mediation was observed. These results suggest COVID-19 specific stressor impact constitutes a potentially modifiable intervention target that is relevant even when considering more established mechanisms linking childhood trauma with increased psychopathology burden.

1.4 Limitations and future directions

Beyond the limitations discussed in the individual studies of this thesis, there are three key shortcomings of the broader literature that require addressing.

First, an abundance of studies relied on non-probability and convenience samples. These studies may suffer from important biases (e.g., internet access, interest, mental health status, age), so may not provide generalisable information of the psychosocial impact of the pandemic. Generalisable inferences for the whole population and vulnerable groups are a crucial requirement to develop an appropriate public health response, however. Specifically, high quality evidence is needed to i) quantify the scale of public health needs in the short and long term – particularly for vulnerable groups – and to ii) identify modifiable mechanisms of action contributing to mental health issues to mitigate their aggravation during the current pandemic and to prevent their occurrence in potential future pandemics. In a similar vein, most high-quality evidence on the psychosocial impact of the pandemic has been gathered in samples from so-called WEIRD (Western, Educated, Industrialized, Rich, and Democratic) populations (Henrich, Heine, & Norenzayan, 2010), which prohibits extrapolation of findings to other countries or ethnicities. While this is a limitation of research more generally, it is particularly relevant for research into the consequences of the COVID-19 pandemic, which has affected individual populations to a lesser and greater extent and was addressed with highly heterogeneous political and public health responses including the rollout of vaccines once these became available in the end of 2020. As such, more representative, cross-cultural analyses on the psychosocial impact of the pandemic are needed to appropriately allocate resources and reduce erroneous conclusions.

Second, the pandemic was an unprecedented event that hit the world unexpectedly and impacted a wide array of different psychosocial domains. As such, measures validly assessing this impact were lacking (particularly during the beginning of the pandemic) and most initial studies used single-item measures, questionnaires with unknown validity and reliability or questionnaires completely unspecific to the pandemic. Application of validated, reliable, and standardised measures has now become increasingly possible with an accumulating number of validated measures – such as the CoPaQ proposed in this

thesis – being published (e.g., Ahorsu et al., 2020; Freeman et al., 2020; Rosebrock et al., 2021; Rek et al., 2021). Such validation of measures is key to assure that theoretical constructs investigated in individual studies are indeed assessed in empirical practice. Due to the cross-cultural differences mentioned before as well as the research focus on WEIRD populations, it is key to translate and validate these measures for different populations and to test whether psychometric properties hold.

Third and finally, most research conducted in psychiatric patients did not distinguish between different psychiatric disorders, which prevents examination of changes in symptoms among specific patient groups. In theory, it is plausible that different patient groups may be differentially affected by the pandemic as also illustrated by Robinson et al. (2022) in the case of anxiety and depressive symptoms. For instance, pandemic countermeasures such as 'staying at home' orders may have resulted in decreased stress exposure (e.g., through social gatherings) in patients suffering from social phobia. Here, a worsening of symptoms may even be expected once the pandemic and related countermeasures subside and confrontation with other people will become more frequent again. In contrast, depressive disorders may have become more prevalent during the pandemic since access to events with potential positive reinforcements was limited during the pandemic (Lewinsohn, 1974). Future research would benefit from differentiating the psychological impact of the pandemic in these diagnostic groups and from assessing both the short- and long-term effects of the pandemic on psychosocial functioning using longitudinal trajectory studies.

1.5 Conclusion

This thesis aimed at further understanding the impact of the COVID-19 pandemic on psychosocial functioning by i) developing and validating a psychometrically sound measurement tool – the CoPaQ to assess the psychosocial consequences of the pandemic including the impact of COVID-19 specific stressors, ii) identifying vulnerable groups at risk for an adverse psychological sequelae during the pandemic by investigating differential associations of COVID-19 specific stressors with different psychosocial outcomes, and iii) pinpointing plausible mechanisms that are specific to the pandemic and amenable to treatment in order to promote psychosocial functioning more effectively and systematically. Taken together, results from studies in this thesis in combination with evidence from the broader literature suggests that psychosocial functioning is not particularly impaired in the vulnerable group of psychiatric patients as a consequence of the pandemic, whereas individuals from the general population who are exposed to a greater impact of COVID-19 specific stressors present with a worse psychological response and may be in need of prevention or treatment efforts. Here, stress sensitisation may be a plausible mechanism

by which individuals perceive objective stressors during the pandemic as particularly stressful putting them at greater risk to adverse psychological trajectories and being particularly relevant in CM-exposed individuals. This mechanism needs to be explored in future work using a causal-interventionist approach to triangulate evidence for causality. Since the pandemic is a global event, these studies should be conducted in non-WEIRD, cross-cultural samples. In sum, this evidence could help tackle mental health issues arising from the pandemic by identifying those in need of treatment and potentially limit arising psychopathology in future pandemics.

2. The COVID-19 Pandemic Mental Health Questionnaire (CoPaQ)

2.1 Contributions and reference

The study "The COVID-19 Pandemic Mental Health Questionnaire (CoPaQ): psychometric evaluation and compliance with countermeasures in psychiatric inpatients and non-clinical individuals" was published in *BMC Psychiatry* in August, 2021. SR, DF, MR, MB and FP were responsible for concept and design; SR, MB and FP for acquisition, statistical analysis, or interpretation of data; SR for drafting of manuscript; SR, MR and FP for administrative, technical, or material support; SR, MB, MR, DF, DK, KA, PF, FP for critical revision of content; and MB, MR, DF, FP for supervision.

Rek, S. V., Bühner, M., Reinhard, M. A., Freeman, D., Keeser, D., Adorjan, K., Falkai, P., Padberg, F. (2021). The COVID-19 Pandemic Mental Health Questionnaire (CoPaQ): psychometric evaluation and compliance with countermeasures in psychiatric inpatients and non-clinical individuals. BMC Psychiatry, 21(1), 426. https://doi.org/10.1186/s12888-021-03425-6

Rek et al. BMC Psychiatry (2021) 21:426
https://doi.org/10.1186/s12888-021-03425-6

BMC Psychiatry

RESEARCH Open Access

The COVID-19 Pandemic Mental Health Questionnaire (CoPaQ): psychometric evaluation and compliance with countermeasures in psychiatric inpatients and non-clinical individuals

Stephanie V. Rek[1,2*], Markus Bühner[3], Matthias A. Reinhard[1], Daniel Freeman[4], Daniel Keeser[1], Kristina Adorjan[1], Peter Falkai[1] and Frank Padberg[1]

Abstract

Background: The COVID-19 pandemic has greatly impacted people's lives across a broad spectrum of psychosocial domains. We report the development and psychometric evaluation of the self-report COVID-19 Pandemic Mental Health Questionnaire (CoPaQ), which assesses COVID-19 contamination anxiety, countermeasure necessity and compliance, mental health impact, stressor impact, social media usage, interpersonal conflicts, paranoid ideations, institutional & political trust, conspiracy beliefs, and social cohesion. Further, we illustrate the questionnaire's utility in an applied example investigating if higher SARS-Cov-2 infection rates in psychiatric patients could be explained by reduced compliance with preventive countermeasures.

Methods: A group of 511 non-clinical individuals completed an initial pool of 111 CoPaQ items (Open Science Framework: https://osf.io/3evn9/) and additional scales measuring psychological distress, well-being, and paranoia to assess construct validity and lifetime mental health diagnosis for criterion validity. Factor structure was determined by exploratory factor analyses and validated by conducting confirmatory factor analysis in the accompanying longitudinal sample ($n = 318$) and an independent psychiatric inpatient sample primarily admitted for major depressive-, substance abuse-, personality-, and anxiety disorders ($n = 113$). Internal consistency was assessed by Cronbach's Alpha and McDonald's Omega. For the applied research example, Welch t-tests and correlational analyses were conducted.

Results: Twelve out of 16 extracted subscales were retained in the final questionnaire version, which provided preliminary evidence for adequate psychometric properties in terms of factor structure, internal consistency, and construct and criterion validity. Our applied research example showed that patients exhibited greater support for COVID-19 countermeasures than non-clinical individuals. However, this requires replication in future studies.

* Correspondence: s.rek@med.uni-muenchen.de
[1]Department of Psychiatry and Psychotherapy, LMU University Hospital Munich, Nussbaumstraße 7, Munich, Germany
[2]International Max Planck Research School for Translational Psychiatry (IMPRS-TP), Munich, Germany
Full list of author information is available at the end of the article

Conclusions: We demonstrate that the CoPaQ is a comprehensive and valid measure of the psychosocial impact of the pandemic and could allow to a degree to disentangle the complex psychosocial phenomena of the pandemic as exemplified by our applied analyses.

Keywords: Coronavirus, Psychosocial impact, Questionnaire validation, Factor analysis, Preventive countermeasures

Introduction

The COVID-19 pandemic and related governmental restrictions and recommendations to contain the rapid spread of the coronavirus (e.g., stay-at-home orders & social distancing) have greatly changed people's lives. Early on, news outlets and initial research have cautioned that the COVID-19 pandemic would affect and be affected by a number of key aspects of individuals' lives. These aspects include mental health and pandemic-related stress, risk and protective factors (contamination anxiety, social media usage, interpersonal conflicts, mental health-protective behaviour), and individuals' perception of the political handling of the crisis (conspiracy beliefs, political and institutional trust, and support of public health directives; e.g. [1–3],). We developed the COVID-19 Pandemic Mental Health Questionnaire (CoPaQ) in order to capture this wide pandemic-related psychosocial spectrum applicable for different study populations. The self-report questionnaire was published on the Open Science Framework (OSF; https://osf.io/3evn9/) in German and English early on in the pandemic in April, 2020 [4]. Since then, the instrument has received recognition from the wider research community worldwide with translations into Spanish, Croatian, Portuguese, Greek, Hungarian, Korean, Nepalese, Czech, and Romanian illustrating that the questionnaire has been well received and was applied frequently in different countries and study populations. To date, however, a psychometric validation of the CoPaQ has been lacking.

The present study aims to provide a comprehensive description and psychometric evaluation of the CoPaQ. We recruited a group of non-clinical individuals online (n = 511) and psychiatric inpatients from the LMU Biobank study (n = 113). They completed the CoPaQ and validated self-report measures on psychological distress, wellbeing, and paranoia. To determine the factor structure, selection of items, and model fit, we applied exploratory factor analyses (EFA) in our non-clinical derivation sample. We then evaluated this factor structure by applying confirmatory factor analyses (CFA) using accompanying longitudinal 10-week follow-up data (n = 318) and separate CFA for the psychiatric inpatient sample. Internal consistency was determined using McDonald's Omega and Cronbach's Alpha across samples. For selected subscales of the CoPaQ, we evaluated criterion- and construct validity.

In addition to the psychometric validation of the CoPaQ, we illustrate the questionnaire's utility in an applied research example. Previously, two large US cohort studies have suggested that patients with a history of mental disorders have an increased risk for SARS-Cov-2 infection even when controlling for important socioeconomic and health-related factors [5, 6]. The authors suggest that one explanation for the increased risk of SARS-Cov-2 infection could be patients' lower compliance with public health directives (hygiene measures, social distancing guidelines, and political restrictions). However, this hypothesis and potential explanatory factors have not been investigated empirically.

A number of factors have been associated with individual differences in levels of compliance in the public with governmental guidelines. Higher levels of an individual's risk perception [7–9] as well as political and institutional trust [10] have been found to increase support for governmental regulations. Contrary to this, erroneous conspiracy beliefs about the origin of the coronavirus have been associated with reduced adherence to preventive measures [2]. Consequently, multiple plausible and partly diverging hypotheses could explain potential differences in support of governmental restrictions and regulations between psychiatric patients and non-clinical individuals. First, lower levels of trust may promote less adherent behaviours in psychiatric patients, which may be reflected in lower levels of COVID-19 institutional & political trust and higher levels of COVID-19 conspiracy beliefs and paranoid ideations, compared to non-clinical individuals. Conversely, psychiatric patients' adherence to COVID-19 countermeasures could be greater than in non-clinical controls as patients may exhibit higher levels of COVID-19 contamination anxiety, more COVID-19 physical risk factors, and overall greater general anxiety symptoms. These fear-related characteristics could promote protective behaviours against SARS-Cov-2 infection as reflected in higher levels of COVID-19 contamination anxiety, COVID-19 physical risk factors and general anxiety symptoms, compared to non-clinical individuals. Here, psychiatric patient populations may differ in their levels of mistrust, which is most characteristic for psychotic disorders and fear, which is most characteristic for anxiety disorders. In this study, we focused on a transdiagnostic psychiatric inpatient sample from all major diagnostic categories with most prominent prevalence of major depressive-, substance abuse-, personality-, and anxiety disorders. Testing these hypotheses requires the assessment of a number of COVID-19 related psychosocial

domains, which provides the ideal setting to explore the utility of the CoPaQ questionnaire in the context of our case-control sample.

Study Part 1: Questionnaire validation

Methods

CoPaQ construction

The initial item pool was devised by the study team (psychiatrist and clinical psychologists) based upon clinical experience, reference to the current diagnostic classification system of Diagnostic And Statistical Manual Of Mental Disorders, fifth edition [11], reference to existing measures [12], and an extensive internet search for current media and research outputs [13–16]. Thereafter, each item was evaluated with regard to its face and content validity by independent experts (two examinees). A final construct of questions was designed, ensuring no overlap. Due attention was given to ensure that the questions were framed in simple language, and worded positively, with no ambiguity.

The first part of the questionnaire served to characterise the population under study by asking about SARS-Cov-2 infection status, COVID-19 physical health risk factors (self/others), employment status, health insurance status, life time mental health diagnosis, etc. The subsequent item pool was devised to reflect the following COVID-19-related constructs: contamination anxiety (9 items), necessity of and compliance with countermeasures (29 items), mental health symptomatology (25 items), positive coping (12 items), stressors (29 items), interpersonal conflicts (5 items), social media usage (7 items), political and institutional trust (6 items), paranoid ideations (5 items), conspiracy beliefs (7 items), and social cohesion (6 items). The time period for all the items was either relating to the present moment or the previous 2 weeks. Items were rated on a 0 (not at all) to 4 (very much) scale.

We disseminated the questionnaire to the wider research community prior to validation to facilitate its use during the rapidly unfolding events during the pandemic.

Participants

To extract the items for the new measures of the psychosocial impact of the COVID-19 pandemic, a derivation sample of 511 participants from the general German population completed the full item pool (mean age = 30.12, SD = 11.15, female = 400, male = 110, diverse = 1). The derivation sample is part of an ongoing longitudinal survey into the mental health consequences of the pandemic. The subset of individuals who provided data for a second time (n = 318) formed our longitudinal validation sample (mean age = 30.54, SD = 11.28, female = 249, male = 68, diverse = 1). There were no significant differences between derivation sample and longitudinal validation sample in terms of age, sex, marital status, ethnicity, or employment status (p > .05). A second cross-validation sample consisted of 113 psychiatric inpatients (mean age = 43.93, SD = 14.64, female = 55, male = 58) recruited from the LMU Biobank study.

Procedure

Non-clinical participants were recruited online via social media advertisements (Facebook) and university mailing lists to participate in the survey including the CoPaQ and other questionnaires (see below). The survey was run using the secure online LimeSurvey software. A forced response format was applied and only complete responses were included in the current analyses (n = 592). We excluded participants who gave incorrect responses to more than one out of three included bogus items (e.g., "Please, indicate completely agree"; n = 47) and with response times < 25 min, which we considered highly unlikely (median completion duration = 48 min; interquartile range [IQR] = 38–60; n = 7). At the end, by entering their email addresses participants had the opportunity to be included in a prize draw and take part in the 10-week follow-up assessment. Those participants at the 10-week follow-up time point who had response times < 15 min, which we considered highly unlikely (median completion duration = 29 min, IQR = 23–39.5; n = 7), were additionally excluded.

Psychiatric inpatients were recruited as part of the LMU Biobank study from the Department of Psychiatry and Psychotherapy of the LMU University Hospital Munich. Participants filled out the CoPaQ and other questionnaires (see below) using paper-pencil (n = 144). Exclusion criteria comprised an insufficient comprehension of German, an acute psychotic or manic episode, or acute suicidality. Furthermore, psychiatric inpatients' responses were excluded if they had more than 10% missing data on each of the self-report questionnaires (n = 31). Missing values were then imputed using the *missForest* package [17] for non-parametric, iterative random-forest based imputation, which resulted in an imputation error of Out-of-bag$_{PFC}$ = 0.1748.

To ensure data integrity, careless responders (longest or average length of consecutive identical responses was ±3 SD of the respective sample mean) in the derivation sample (n = 27), longitudinal- (n = 5), and psychiatric validation samples (n = 0) were excluded from further analyses using the *Careless* package [18]. The final sample size of the derivation sample was n = 511, of the longitudinal validation sample n = 355, and of the psychiatric inpatient sample n = 113.

Other measures

Depression, Anxiety and Stress Scales-21 (DASS-21)

The total score of the German version of DASS-21 [19, 20] was included, which assesses psychological distress

during the past week. Items are rated on a Likert scale of 0 (did not apply to me at all) to 3 (applied to me very much or most of the time). Higher scores indicate greater distress (range 0–63). In clinical and non-clinical samples good psychometric properties of the DASS-21 have been reported [21].

Revised-Green et al. Paranoid Thoughts Scale (R-GPTS)

Paranoid ideations over the past fortnight were assessed with the total score of the German version of the 18-item R-GPTS [22, 23]. Items are rated on a 5-point Likert scale ranging from 0 (not at all) to 4 (totally). Higher scores indicate higher levels of paranoia (score range 0–72). Excellent psychometric properties of the scales have been reported for the English version [22].

WHO (Five) Well-Being Index (WHO-5)

Well-being over the past 2 weeks was assessed by the German version of the WHO-5 [24, 25]. Items are rated on a 6-point Likert scale ranging from 0 (not present) to 5 (constantly present), with higher scores indicating greater well-being (score range: 0–30). Good psychometric properties have been reported in previous research [26].

Statistical analyses

All analyses were conducted in *R* v4.0.3 [27].

Descriptive statistics and associations between variables were tested using bivariate Pearson's correlation coefficients, Chi-square tests (χ^2), and unpaired two-sample *t* tests (Welch t-test) when appropriate. We report magnitudes of effect sizes of 0.10 considered "small", those of 0.30 as "medium", and those of 0.50 as "large" according to Cohen [28].

We conducted exploratory factor analysis (EFA) based on polychoric correlations with the maximum likelihood estimator (ML) and oblimin rotation to assess the structure of items and refine the item pool by deleting poor-fitting items using the *Psych* package [29]. Items were then considered for deletion one at a time during EFA based on factor loadings (not loading higher than 0.30 on any factor, or loadings above 0.30 on more than one factor), communalities (<.30), content of items (e.g., theoretically inconsistent or redundant), item dependencies, sharp drop in item loading, and differences in response scale. In addition, items with an overall endorsement of < 10% across the derivation sample, longitudinal- and psychiatric validation samples were deleted. The number of factors to extract was determined through Empirical Kaiser Criterion (EKC), parallel analysis using polychoric correlations, and ML discrepancy function.

To validate the factor structure of the selected items per subscale, confirmatory factor analysis (CFA) with weighted least square mean and variance adjusted (WLSMV) estimator was conducted in the longitudinal and psychiatric validation samples using the *lavaan* package [30]. Model fit was assessed using the Comparative Fit Index (CFI; ≤.95 considered as acceptable) and Root Mean Square Error of Approximation (RMSEA; ≤ .08 considered as acceptable) following common recommendation [31]. Items, which loaded poorly on the factors in both validation samples, were deleted to arrive at the final version of the respective subscales of the questionnaire. Finally, we used modification indices to identify the best fitting model. Internal consistency of the different subscales with more than two items was determined by calculating McDonald's Omega (ω) and Cronbach's Alpha (α) using the *MBESS* package (v4.8.0; [32]).

Where appropriate, criterion and construct validity were established by testing differences (using Welch two sample t-tests) and strength of associations (using Pearson's *r*) in the derivation sample, respectively. To evaluate criterion validity of COVID-19 mental health impact subscales, we assessed if these subscales were associated with self-reported lifetime mental health diagnosis. In terms of construct validity, the COVID-19 mental health impact-, positive coping-, conspiracy-, and institutional & political trust subscale scores were correlated with different mental health outcome scores that related to psychological distress (DASS-21; [19]), psychological well-being (WHO-5;) [24], and paranoia (R-GPTS;) [22]).

Study Part 2: Research application

Methods

Matching

To obtain a more comparable case-control sample for our research application example, the clinical and non-clinical samples were matched on age, sex, and employment status using *R* software and the *MatchIt* (v4.1.0) package [33]. After matching, clinical and non-clinical samples were comparable in age and sex (age: $t(221.65) = -0.58$, $p = 0.564$; sex: $\chi^2(2) = 1.37$, $p = 0.505$), but differences remained for employment status ($\chi^2(6) = 21.98$, $p = 0.001$).

Measures

Following validation of the CoPaQ, we selected the subscales inquiring about perceived countermeasure necessity and countermeasure compliance as well as COVID-19 contamination anxiety, COVID-19 institutional & political trust, COVID-19 conspiracy beliefs, and COVID-19 physical health risk factors for our research application example. We further included data on the DASS-21 anxiety subscale and refer to this as 'general anxiety' throughout the manuscript to demarcate this construct from 'COVID-19 contamination anxiety'. Finally, we assessed paranoia using the R-GPTS total score.

Assessment of group differences

We conducted Welch two sample t tests and calculated standardised mean differences (SMD) to assess group differences in support of COVID-19 related governmental restrictions and recommendations regarding perceived countermeasure necessity and countermeasure compliance as well as COVID-19 contamination anxiety, COVID-19 institutional & political trust, COVID-19 conspiracy beliefs, COVID-19 physical health risk factors, general anxiety, and paranoia. To assess robustness of results, also against violations of homoscedasticity, we provide 95% bootstrapped confidence intervals (95% CI) of the SMD values using 5000 bootstrapped samples with replacement. All hypothesis testing was two-tailed according to $\alpha = 0.05$.

Correlation analysis

To explore the strength of statistical association between support of public health directives and COVID-19 contamination anxiety, COVID-19 institutional & political trust, COVID-19 conspiracy beliefs, COVID-19 physical health risk factors, general anxiety, and paranoia in clinical and non-clinical samples separately, we performed bivariate Spearman's rho (ρ) correlation analyses and tested whether the strength of associations differed between the clinical and non-clinical group by conducting Fisher Z transformations with adapted standard errors for Spearman's ρ [34].

Study Part 1: Questionnaire validation

Results

Descriptive statistics

We provide participant characteristics of the derivation sample, longitudinal validation sample, and psychiatric validation sample in Table 1. The majority of the psychiatric inpatient sample had received a clinician's confirmed clinical diagnosis based on the International Statistical Classification of Diseases and Related Health Problems, 10th revision (ICD-10) criteria of depression, substance abuse disorder, personality disorder, and anxiety disorder. Comorbidity was high with more than two-third of patients meeting criteria for more than one psychiatric diagnosis (see Supplementary Table 1 for more details).

Exploratory and confirmatory factor analyses

Standardised oblimin rotated factor loadings of the final items are presented in Table 2. Model fit indices and internal consistency estimates of the respective subscales are presented in Tables 3 and 4, respectively. An overview of item selection decisions and related criteria for each subscale can be found in the Supplementary Material. Items loading on the respective subscales can be summed for further analyses.

Study populations characteristics

From the first section of the CoPaQ, which aims at characterising participant under study, we decided to omit the answer option "Don't know". We further removed optional questions relating to psychotherapy via telephone or video platforms from the final questionnaire version.

COVID-19 contamination anxiety

Following criteria of poor fitting items (see Methods section), we deleted two items due to redundancy with similarly worded items. The EKC and parallel analysis indicated a 2-factor solution. During EFA, three additional items were deleted due to low factor loadings, factor cross-loadings and only one item loading onto the second factor. Therefore, a 1-factor solution was tested in a next step and all items were retained in the final model. The factor entailed items related to COVID-19 contamination anxiety (e.g., "I am worried I will infect myself with COVID-19"). Subsequently, CFAs in the longitudinal- and psychiatric validation samples were conducted using the 1-factor 4-item model identified during EFA, which showed a good model fit.

COVID-19 necessity of and compliance with countermeasures

Theoretical considerations, the EKC, and parallel analysis favoured a 1-factor solution for each of the respective COVID-19 countermeasures. During EFA all items were retained. CFAs in the longitudinal- and psychiatric validation samples provided good to acceptable model fit for the respective COVID-19 hygiene measures- (e.g., "regular washing of hands"), social distancing- (e.g., "cancelling private meetings and family visits"), anxiety buying- (e.g., "soap, detergent, cleaning products, washing powder, etc."), political restrictions- (e.g., "temporary closure of bars, pubs, theatres, cinemas, etc."), and solidarity-based behaviours (e.g., "offering help to close friends and family members") subscales. The three items assessing COVID-19 countermeasure compliance of hygiene measures, social distancing, and curfews were grouped into an overall index since they were relatively independent from each other.

COVID-19 mental health impact

Poor fitting items were deleted due to poor content fit, dependency or redundancy. The EKC and parallel analysis indicated a three-factor solution. EFA suggested good model fit. Only one additional item was deleted due to high factor cross-loadings. Thereafter, all items were retained in the final model. The first factor entailed items related to COVID-19 post-traumatic stress disorder (PTSD) symptoms (e.g., "have had powerful images or memories that sometimes come into my mind in

Table 1 Socio-demographics and baseline characteristics of the derivation sample, longitudinal validation sample, and psychiatric inpatient sample

	Derivation sample (*n* = 511)	Longitudinal sample (*n* = 318)	Psychiatric sample (*n* = 113)
Age, *mean (SD)*	30.12 (11.15)	30.54 (11.28)	43.93 (14.64)
Men sex, *n*	110	68	58
Employment status, *n (%)*			
Full-time employed	114 (22.3)	73 (23.0)	32 (28.3)
Part-time employed	72 (14.1)	47 (14.8)	15 (13.3)
Self-employed	16 (3.1)	11 (3.5)	4 (3.5)
Student	248 (48.5)	157 (49.4)	11 (9.7)
Retired	8 (1.6)	4 (1.3)	17 (15.0)
Caregiver	2 (0.4)	0 (0.0)	0 (0.0)
Not employed	14 (2.7)	8 (2.5)	26 (23.0)
Other	37 (7.2)	18 (5.7)	8 (7.1)
Self-reported lifetime diagnoses, *n (%)*			
Diagnostic categories			
Depressive Disorders	120 (23.5)	77 (24.2)	93 (82.3)
Bipolar Disorders	5 (1.0)	3 (0.9)	11 (9.7)
Psychotic Disorders	3 (0.6)	0 (0.0)	17 (15.0)
Anxiety Disorders	62 (12.1)	36 (11.3)	30 (26.5)
Post-Traumatic Stress Disorder	26 (5.1)	17 (5.3)	18 (15.9)
Obsessive-Compulsive and Related Disorders	7 (1.4)	7 (2.2)	6 (5.3)
Eating Disorders	28 (5.5)	14 (4.4)	17 (15.0)
Substance-Related and Addictive Disorders	9 (1.8)	3 (0.9)	31 (27.4)
Attention-Deficit/Hyperactivity Disorder	15 (2.9)	8 (2.5)	6 (5.3)
Somatoform Disorders	4 (0.8)	2 (0.6)	7 (6.2)
Personality Disorders	14 (2.7)	7 (2.2)	22 (19.5)
Autism Spectrum Disorder	4 (0.8)	3 (0.9)	8 (7.1)
Dementia	0 (0.0)	0 (0.0)	2 (1.8)

n indicates the number of participants
SD Standard Deviation

which I feel the experience of the COVID-19 pandemic is happening again in the here and now"), the second factor depicted COVID-19 sleep disturbance symptoms (e.g., "difficulty sleeping through the night"), and the third factor entailed items related to COVID-19 substance abuse (e.g., "have smoked considerably more cigarettes than usual"). Subsequently, CFAs in the longitudinal- and psychiatric validation samples were conducted using the 3-factor 13-item model identified during EFA, which did not provide a good model fit. Modification indices indicated dropping one additional poor fitting item, which was removed and the CFAs repeated. Now model fit indices suggested mixed results in the longitudinal validation sample with good to only adequate model fit according to RMSEA and CFI, respectively. Model fit in the psychiatric validation sample was good.

COVID-19-specific stressors impact

First, the not applicable answer option was recoded as zero and removed from in the final validated questionnaire version. Items with poorly fitting content were then deleted. In addition, items related to the ability to distance oneself from the stressors were deleted due to item dependency. As each stressor (e.g., "childcare", "being in quarantine" or "being in home office") can occur relatively independently, no factor analysis was applied for COVID-19-specific stressors, so the remaining items can be summed to an index.

COVID-19 positive coping

Three items were deleted due to poor item-scale content fit. The EKC and parallel analysis indicated a three-factor solution, which we evaluated in the subsequent EFA. During EFA, one additional item was deleted due

Table 2 Final items and factor loadings from EFA and CFAs in our three samples

	Derivation sample	Longitudinal validation sample	Psychiatric validation sample
	EFA Loadings	CFA Loadings	CFA Loadings
COVID-19 contamination anxiety			
I will infect myself with COVID-19	0.54	0.54	0.54
Please indicate how likely you think it is that you will be infected with COVID-19.	0.74	0.58	0.77
people close to me are infected with COVID-19.	0.88	0.89	0.65
I will infect other people with COVID-19.	0.79	0.72	0.73
COVID-19 hygiene measures			
keeping at least 1.5 m distance from other people	0.67	0.67	0.63
coughing or sneezing into the crook of your arm or into a handkerchief	0.71	0.52	0.54
not touching mouth, eyes or nose with hands	0.81	0.80	0.58
regular washing of hands	0.93	0.79	0.63
washing hands extensively (for at least 30 s)	0.92	0.82	0.79
increased disinfection of hands and objects.	0.68	0.65	0.68
COVID-19 social distancing			
cancelling private meetings and family visits	0.82	0.79	0.76
cancelling trips to other cities	0.90	0.85	0.69
avoiding visits to canteens and restaurants	0.87	0.79	0.82
avoiding touching (e.g. shaking hands or hugging) when greeting or saying goodbye to other people	0.78	0.74	0.47
moving your work to home office	0.71	0.64	0.39
COVID-19 anxiety buying			
soap, detergent, cleaning products, washing powder, etc.	0.88	0.84	0.89
food (vegetables, lentils, rice, pasta...)	0.94	0.88	0.95
water (20 l per person)	0.79	0.73	0.85
toilet paper	0.84	0.82	0.92
cash	0.59	0.53	0.62
COVID-19 political restrictions			
temporary closures of kindergartens, schools and universities	0.84	0.80	0.85
temporary border closures	0.74	0.67	0.71
temporary closures of playgrounds	0.85	0.75	0.90
temporary closure of bars, pubs, theatres, cinemas, etc.	0.87	0.78	0.72
temporary curfews	0.80	0.76	0.82
COVID-19 solidarity-based behaviours			
donating blood	0.63	0.70	0.54
supporting people at risk, such as shopping for them or staying at home to protect people at risk to protect people at risk	0.86	0.77	0.88
supporting people who are experiencing existential hardship due to the current situation	0.87	0.79	0.86
offering help to close friends and family members	0.81	0.71	0.57
donating blood	0.77	0.80	0.65
COVID-19 post-traumatic stress disorder symptoms			
have had upsetting dreams that replay part of the experience of the COVID-19 pandemic or are clearly related to it	0.51	0.61	0.60
have had powerful images or memories that sometimes come into my mind in which I feel the experience of the COVID-19 pandemic is happening again in the here and now	0.75	0.72	0.75

Table 2 Final items and factor loadings from EFA and CFAs in our three samples *(Continued)*

	Derivation sample	Longitudinal validation sample	Psychiatric validation sample
	EFA Loadings	CFA Loadings	CFA Loadings
have avoided internal reminders of the experience of the COVID-19 pandemic (e.g. thoughts, feeling, or physical sensations)	0.97	0.82	0.64
have avoided external reminders of the experience of the COVID-19 pandemic (e.g. people, places, conversations, objects, activities, or situations)	0.92	0.73	0.79
have been "super-alert", watchful, or on guard	0.45	0.56	0.67
COVID-19 sleep disturbances			
difficulty falling asleep (< 30 min)	1.02	0.82	0.88
difficulty sleeping through the night	0.77	0.87	0.79
early morning awakening	0.70	0.74	0.74
COVID-19 substance use			
have consumed substantially more alcohol than usual.	0.68		
have smoked considerably more cigarettes than usual	0.86	0.61	0.66
have consumed considerably more drugs (e.g. tranquilizers, sleeping pills or stimulants) than usual	0.63	0.63	0.61
have felt a strong desire to consume addictive substances (alcohol, cigarettes, drugs)	0.87	0.90	0.84
have not been able to control my use of addictive substances (alcohol, cigarettes, drugs)	0.90	0.58	0.50
COVID-19 daytime structure			
have maintained a regular daily routine	0.90	0.81	0.76
have planned the day as detailed as possible	0.80	0.79	0.95
have integrated sports and exercise into my daily life	0.39	0.55	0.58
COVID-19 social contacts			
have maintained my social contacts (telephone, visits or video chats)	0.47	0.68	0.65
have enjoyed the time together with people close to me	0.74	0.50	0.50
COVID-19 inner resources			
have sought stability in faith and/or religion	0.45		
have focused on my inner strengths, resources, abilities and talents	0.59	0.87	0.72
have changed my attitudes about what is really important to me in life	0.64	0.39	0.70
COVID-19 political and institutional trust			
have had the feeling that the political leadership was standing up for me	0.84	0.81	0.67
have perceived democracy as an effective form of government	0.85	0.75	0.77
have had the feeling that public institutions (e.g. police, judiciary) can be relied upon	0.78	0.79	0.82
have had the feeling that news and reports on the COVID-19 pandemic are being deliberately withheld	0.84	0.86	0.30
have perceived politicians as trustworthy	0.65	0.61	0.77
COVID-19 conspiracy beliefs			
have had the feeling that false reports or untruths about the COVID-19 pandemic are being deliberately disseminated on public broadcasting (e.g. radio and television stations).	0.62	0.49	0.62
have had the belief that there are alternative or secret explanations for current events	0.80	0.89	0.84
have had the belief that there is a relation between what is happening and the production and testing of biological weapons	0.88	0.72	0.77
have had the belief that what is happening here is the effect of a struggle or competition between different superpowers	0.95	0.77	0.84
have had the belief that this infection serves to deliberately reduce the world population, since there are no longer enough resources for everyone	0.85	0.64	0.88

Table 2 Final items and factor loadings from EFA and CFAs in our three samples *(Continued)*

	Derivation sample	Longitudinal validation sample	Psychiatric validation sample
	EFA Loadings	CFA Loadings	CFA Loadings
COVID-19 social cohesion			
there is greater solidarity and cohesion in our society.	0.84	0.79	
I am an integral part of our society or community.	0.61	0.61	
our nation is growing closer together.	0.93	0.79	

to low factor loadings. The first factor entailed items related to keeping a daytime structure (e.g., "have planned the day as detailed as possible"), the second factor depicted positive coping items in terms of social contacts (e.g., "have maintained my social contacts (telephone, visits or video chats)"), and the third factor entailed items related to inner strength (e.g., "have changed my attitudes about what is really important to me in life") during the pandemic. Subsequently, CFAs in the longitudinal- and psychiatric validation samples were conducted using the 3-factor 9-item model identified during EFA, which resulted in a poor model fit. Two additional items from the social contacts and inner strength subscales were deleted due to poor model and content fit. The subsequent model fit was good across samples.

COVID-19 institutional & political trust

First, we deleted one item due to item content. One item was reversed coded. The EKC and parallel analysis indicated a one-factor solution. During EFA all items were retained and related to political and institutional trust (e.g., "have had the feeling that the political leadership was standing up for me"). Subsequently, CFAs in the validation samples were conducted using the 1-factor 5-item model identified during EFA, which provided a poor model fit in the longitudinal validation sample and good model fit in the psychiatric validation sample.

COVID-19 conspiracy beliefs

We deleted one item due to a different response format. The EKC and parallel analysis indicated a 1-factor solution. During EFA all items were retained. The factor entailed items related to COVID-19 conspiracy beliefs (e.g., "have had the belief that what is happening here is the effect of a struggle or competition between different superpowers"). Subsequently, CFAs in our validation samples were conducted using the 1-factor 5-item model identified during EFA, which provided an acceptable model fit in the longitudinal but not in the psychiatric validation sample.

COVID-19 social cohesion

First, three items were removed due to item redundancy. The EKC and parallel analysis indicated a one-factor solution. During EFA all items were retained and related

Table 3 Model fit indices of the CFA analyses in the longitudinal validation sample

	Longitudinal validation sample	Psychiatric validation samples	
Subscale	**CFI**	**RMSEA**	**CFI**	**RMSEA**
COVID-19 contamination anxiety	0.996	0.039	1.000	< 0.001
COVID-19 hygiene measures	0.924	0.069	1.000	< 0.001
COVID-19 social distancing	1.000	< 0.001	0.979	0.061
COVID-19 anxiety buying	0.951	0.081	0.991	0.056
COVID-19 political restrictions	0.993	0.045	0.955	0.107
COVID-19 solidarity-based behaviours	0.988	0.037	1.000	< 0.001
COVID-19 mental health subscale	0.938	0.038	0.994	0.011
COVID-19 positive coping	0.979	0.049	0.965	0.066
COVID-19 institutional & political trust	0.931	0.138	0.997	0.027
COVID-19 conspiracy beliefs	0.924	0.069	0.880	0.119
COVID-19 social cohesion	1.000	< 0.001	n.a.	n.a.

CFI Comparative Fit Index, *RMSEA* Root Mean Square Error of Approximation, *n.a.* Heywood case

Table 4 Internal consistency estimates of the different CoPaQ subscales based on McDonald's Omega and Cronbach's Alpha in our three samples

	Derivation sample		Longitudinal validation sample		Psychiatric validation sample	
Subscale	**ω**	**α**	**ω**	**α**	**ω**	**α**
COVID-19 contamination anxiety	0.79	0.78	0.79	0.77	0.77	0.77
COVID-19 hygiene measures	0.83	0.83	0.86	0.84	0.81	0.81
COVID-19 social distancing	0.88	0.87	0.87	0.87	0.76	0.75
COVID-19 anxiety buying	0.86	0.85	0.88	0.87	0.93	0.92
COVID-19 political restrictions	0.88	0.88	0.86	0.86	0.90	0.90
COVID-19 solidarity-based behaviours	0.82	0.82	0.87	0.86	0.81	0.81
COVID-19 countermeasure compliance	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
COVID-19 PTSD symptoms	0.78	0.78	0.83	0.81	0.82	0.82
COVID-19 sleep disturbance	0.83	0.81	0.87	0.85	0.85	0.84
COVID-19 substance abuse	0.77	0.75	0.80	0.77	0.76	0.74
COVID-19-specific stressor impact	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
COVID-19 daytime structure	0.72	0.69	0.76	0.75	0.80	0.79
COVID-19 social contacts	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
COVID-19 inner strength	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
COVID-19 institutional & political trust	0.87	0.86	0.88	0.88	0.81	0.79
COVID-19 conspiracy beliefs	0.82	0.82	0.79	0.78	0.90	0.89
COVID-19 social cohesion	0.80	0.79	0.77	0.76	n.a.	n.a.

ω indicates McDonald's Omega. α indicates Cronbach's Alpha
n.a. not applicable

to COVID-19 social cohesion (e.g., "our nation is growing closer together"). Subsequently, CFAs in our validation samples were conducted using the 1-factor 3-item model identified during EFA, which provided a good model fit in the longitudinal sample, but resulted in model misspecification in the psychiatric validation sample.

Omitted subscales

The theoretically constructed subscales of COVID-19 media use (e.g., "have carried out an increased amount of research about the COVID-19 pandemic via the Internet"), COVID-19 interpersonal conflicts (e.g., "have had more physical arguments (e.g. beating, boxing, kicking) with people close to me"), and COVID-19 paranoid ideations (e.g., "have had the belief that the corona-virus was introduced to get at people like me") were omitted from the CoPaQ measure due to poor model fit during EFA.

Internal consistency

Overall, the CoPaQ subscale factors' internal consistency estimates ranged from acceptable to excellent in our derivation-, longitudinal- and psychiatric samples.

Construct and criterion validity

The COVID-19-specific stressor and mental health impact subscales were associated with all mental health outcomes and most strongly with greater psychological distress; the COVID-19 positive coping subscales were most strongly associated with greater psychological well-being; and the COVID-19 institutional & political trust and COVID-19 conspiracy beliefs subscales were most strongly associated with lower and higher paranoia levels, respectively (see Table 5). Table 6 shows the results for the evaluation of criterion validity, which shows that the COVID-19 mental health impact subscales were more strongly endorsed if the participant had self-reported a lifetime mental health diagnosis.

Study Part 2: Research application

Results

Assessment of group differences

Psychiatric inpatients indicated greater support of COVID-19 public health directives compared to non-clinical individuals in terms of the perception of necessity of hygiene measures ($t(199.93) = -2.84$; $p < 0.01$, 95% $CI_{bootstrappedSMD} = -0.60, -0.12$), political restrictions ($t(208.92) = -3.23$; $p < 0.01$; 95% $CI_{bootstrappedSMD} = -0.66, -0.18$), and overall compliance with countermeasures ($t(201.13) = -2.07$; $p = 0.04$; 95% $CI_{bootstrappedSMD} = -0.52, -0.01$). No difference between groups was evident for perception of necessity of social distancing ($t(198.19) = -0.87$; $p = 0.38$; 95% $CI_{bootstrappedSMD} = -0.37, 0.15$).

Table 5 Correlations between CoPaQ subscale scores and mental health outcomes

CoPaQ subscales	DASS-21 Total	WHO-5 Total	R-GPTS Total
COVID-19-specific stressor impact	.49**	−.41**	.34**
COVID-19 mental health impact			
PTSD symptoms	.42**	−.32**	.34**
Sleep disturbance	.47**	−.37**	.30**
Substance abuse	.29**	−.26**	.12**
COVID-19 positive coping			
Daytime structure	−.19**	.33**	−.05
Social contacts	−.33**	.40**	−16**
Inner strength	−.18**	.32**	.04
COVID-19 institutional & political trust	−.11*	.14**	−.13**
COVID-19 conspiracy beliefs	.14**	−.05	.30**

DASS-21 Depression, Anxiety, Stress Scales-21, *WHO-5* WHO-5 Well-being Index (WHO), *R-GPTS* Revised-Green et al. Paranoid Thoughts Scale
* indicates $p < .05$. ** indicates $p < .01$

Further, COVID-19 contamination anxiety, COVID-19 institutional & political trust, and COVID-19 conspiracy beliefs did not differ between groups, whereas psychiatric inpatients indicated higher levels of general anxiety and COVID-19 physical health risk factors compared to non-clinical individuals with medium to high effect sizes (see Table 7).

Correlational analysis

Bivariate Spearman's ρ correlations of support of public health directives with general anxiety, COVID-19 physical health risk factors, COVID-19 contamination anxiety, paranoia, COVID-19 institutional & political trust, and COVID-19 conspiracy beliefs are displayed in Table 8.

Necessity and compliance of COVID-19 public health countermeasure were positively associated with COVID-19 contamination anxiety and COVID-19 institutional & political trust in the clinical (Spearman's ρ coefficients ranged from .19 to .36) and non-clinical group (Spearman's ρ coefficients ranged from .36 to .64). Here, the strengths of associations were observed to be stronger in the non-clinical than the clinical sample. The difference in correlations was significant for COVID-19 institutional & political trust (Fisher's $Z_{\text{Hygiene measures}} = -4.30$, $p < 0.01$; $Z_{\text{Social distancing}} = -3.61$, $p < 0.01$; $Z_{\text{Political restrictions}} = -3.65$, $p < 0.01$; $Z_{\text{Compliance}} = -2.56$, $p = 0.01$) but not for contamination anxiety (Fisher's $Z_{\text{Hygiene measures}} = -0.16$, $p = 0.87$; $Z_{\text{Social distancing}} = -1.05$, $p = 0.29$; $Z_{\text{Political restrictions}} = -0.56$, $p = 0.57$; $Z_{\text{Compliance}} = -1.50$, $p = 0.13$). General anxiety was only associated significantly with the perception of necessity of political restrictions in the psychiatric inpatient sample ($\rho_{\text{Clinical sample}} = .31$; $\rho_{\text{Non-clinical sample}} = .07$). However, this difference in strength of associations was not statistically significant ($Z_{\text{Political restrictions}} = -1.80$, $p = 0.07$). In the non-clinical sample only, COVID-19 conspiracy beliefs were negatively associated with COVID-19 countermeasure necessity and compliance (absolute ρ coefficients ranged from 0.30 to 0.40). Fisher's Z tests indicated that these associations were significantly stronger in the non-clinical than clinical group for the perception of necessity of social distancing ($Z = 2.33$, $p = 0.02$) and political restrictions ($Z = 2.36$, $p = 0.02$) but not for hygiene measures ($Z = 1.72$, $p = 0.08$) or overall compliance ($Z = 1.21$, $p = 0.23$). In

Table 6 T-tests comparing CoPaQ mental health and disease worries subscale scores for relevant variables to establish criterion validity

		COVID-19 PTSD symptoms		COVID-19 sleep disturbance		COVID-19 substance use	
	n	Mean (SD)	t	Mean (SD)	t	Mean (SD)	t
Mental Health Diagnosis							
No	340	2.85 (3.51)	−2.20*	2.66 (3.37)	−4.54***	0.82 (1.90)	−3.30**
Yes	171	3.71 (4.46)		4.16 (3.59)		1.71 (3.27)	

P values based on Welch two sample t test
SD Standard Deviation
*$p < .05$, **$p < .01$, ***$p < .001$

Table 7 Descriptive statistics and differences of the independent variables

	Clinical sample		Non-clinical sample				
Subscales	**Mean (SD)**	**range**	**Mean (SD)**	**range**	**p**	**SMD**	**95% $CI_{bootstrapped}$**
DASS-21							
General anxiety	12.02 (9.98)	0–40	6.58 (6.88)	0–28	< 0.001***	−0.605	− 0.83, − 0.38
R-GPTS							
Paranoia	10.04 (13.10)	0–61	9.96 (9.57)	0–47	0.958	−0.007	− 0.25, 0.28
CoPaQ							
COVID-19 conspiracy beliefs	3.49 (4.76)	0–19	3.50 (4.10)	0–16	0.976	0.004	−0.25, 0.28
COVID-19 institutional & political trust	11.43 (4.88)	0–20	10.88 (6.20)	0–20	0.461	−0.098	−0.36, 0.16
COVID-19 physical health risk factors	0.98 (1.17)	0–5	0.62 (1.19)	0–7	0.022*	−0.304	−0.59, − 0.04
COVID-19 contamination anxiety	5.93 (3.46)	0–16	6.61 (3.94)	0–16	0.169	0.183	−0.07, 0.44

SD Standard Deviation, *SMD* Standardised Mean Difference, $CI_{bootstrapped}$ Confidence $Interval_{bootstrapped}$ (5000 times)

both samples, evidence for associations with paranoia and COVID-19 physical health risk factors was either absent or very small (absolute ρ coefficients ranged from 0.01 to 0.18).

Discussion

Understanding the psychosocial impact of the COVID-19 pandemic in different study populations has become an international priority. In this study, we report first findings from the assessment of psychiatric inpatients and non-clinical subjects using the CoPaQ tool that was designed to measure key psychosocial aspects of the pandemic including contamination anxiety, countermeasure necessity and compliance, mental health impact, COVID-19-specific stressor impact, social media usage, interpersonal conflicts, paranoid ideations, institutional & political trust, conspiracy beliefs, and social cohesion. The questionnaire was developed for application in different study populations, has been published on the Open Science Framework and is currently available in 11 languages. Here, we conducted a psychometric evaluation of the scale in its German version using data from a longitudinal sample of non-clinical individuals and psychiatric inpatients. Factor analyses indicated that 12 out of 16 extracted subscales showed acceptable to good model fit indices, internal consistency estimates and, where appropriate, construct and criterion validity in at least one validation sample. Therefore, these subscales were retained in the final version of the CoPaQ. Overall, the final version of the CoPaQ represents a valid measure that can help to better understand key aspects affected by the pandemic as illustrated by our research application example.

Psychometric validation in the longitudinal non-clinical and psychiatric validation samples demonstrated key strengths and limitations of individual CoPaQ subscales. The theoretically constructed 'COVID-19 social

Table 8 Spearman's ρ correlations in the clinical and non-clinical samples

	Clinical sample				Non-clinical sample			
	Perception of necessity of				**Perception of necessity of**			
Subscales	Hygiene measures	Social distancing	Political restrictions	Compliance	Hygiene measures	Social distancing	Political restrictions	Compliance
General anxiety	.14	.12	.31**	.15	.09	.06	.07	−.07
Paranoia	−.11	−.03	.05	−.01	−.09	−.02	.07	−.15
Institutional & political trust	.16	.19*	.20*	.23*	.64**	.60**	.61**	.53**
Contamination anxiety	.34**	.36**	.29**	.19*	.36**	.48**	.36**	.38**
Physical health risk factors	.07	.07	.06	.10	.02	−.12	−.18	−.08
Conspiracy beliefs	−.07	−.10	−.06	−.14	−.30**	−.40**	−.37**	−.30**

* indicates $p < .05$. ** indicates $p < .01$

media usage', 'COVID-19 interpersonal conflicts', and 'COVID-19 paranoid ideations' subscales were omitted from the final questionnaire version due to poor psychometric properties during EFA. In the longitudinal validation sample, the CoPaQ subscales of 'COVID-19 hygiene measures', 'COVID-19 anxiety buying', 'COVID-19 mental health', and 'COVID-19 conspiracy beliefs' only showed at least acceptable model fit for one of two indices and 'COVID-19 institutional & political trust' had poor model fit overall, which questions the utility of these subscales for repeated measurement designs. Similarly, in the psychiatric validation sample the subscale of 'COVID-19 political restrictions' showed acceptable model fit only according to CFI but not RMSEA and poor model fit was observed for the subscales of 'COVID-19 conspiracy beliefs' and 'COVID-19 social cohesion' limiting their valid application for this study population. However, internal consistency estimates of all subscales ranged from acceptable to excellent across samples. Moreover, where applicable we observed evidence for construct and criterion validity for the subscales of 'COVID-19-specific stressor impact', 'COVID-19 mental health impact', 'COVID-19 positive coping', 'COVID-19 institutional & political trust', and 'COVID-19 conspiracy beliefs'. Future research is needed to evaluate the psychometric properties of the CoPaQ in different languages/cultures and study populations of interest during the current pandemic (e.g., frontline health workers, vulnerable individuals with a physical condition at risk of a severe course of COVID-19, or caretakers).

In order to present a first use case for which new tools are required for addressing a research question specific for the COVID-19 pandemic, we investigated whether psychiatric inpatients may have lower compliance with preventive countermeasures as previously discussed by some authors [5, 6]. Contrary to this view, our results indicate that the support of public health directives to contain the spread of the coronavirus was indeed greater in psychiatric inpatients primarily admitted for major depressive-, substance abuse-, personality-, and anxiety disorders, compared to age-, sex-, and employment status matched non-clinical individuals. Results may be regarded as preliminary evidence against the hypothesis that higher SARS-Cov-2 infection rates in psychiatric patients are due to lower adherence to countermeasures [5, 6]. Findings from correlational analyses indicated that particularly trust in institutions & politics as well as contamination anxiety were associated with increased levels of support of public health directives during the pandemic in clinical- and non-clinical individuals, which is in line with previous research [7–10]. However, general anxiety was additionally associated with increased support of public health directives only in the clinical sample. This could indicate general anxiety is a putative driver of the increased reported support of countermeasures in psychiatric patients, that we observed in our sample. It is important to note, however, that these results are restricted by non-significant correlational differences between samples. Additionally, the psychiatric inpatient setting may explain part of our findings since non-acceptance and non-compliance may likely lead to hospital discharge, social pressure from hospital staff and fellow patients, and a greater uncontrollable risk of infection in a relatively crowded hospital environment. In addition, paper-pencil questionnaire completion in the psychiatric patient sample may have contributed to greater socially desirable responses compared to online completion in the non-clinical group. Moreover, our findings and conclusions may not be extended to other diagnoses (e.g., a sample consisting of patients with psychotic disorders only) or treatment settings (e.g., outpatients).

Limitations

There are obvious methodological limitations of our study: First, we have assessed construct validity and criterion validity for some but not all subscales of the CoPaQ. Future studies should test whether the other subscales assess what they are intended to measure. Second, since we applied the German version of the CoPaQ, generalisability of results to other languages/cultures is limited, which needs to be addressed in future research. Wider distribution of the CoPaQ and its translated versions in our open science approach would leverage such transcultural studies. Third, CFAs were based on relatively small sample sizes, which may have affected the robustness of results. As such, replications in larger study cohorts are needed. Fourth, the clinical and non-clinical samples are unlikely to fully represent the populations from which they were drawn. Finally, research needs to assess the CoPaQ's predictive validity, test-retest reliability, and conduct evaluations in other study populations.

Conclusion

Notwithstanding these caveats, the CoPaQ is a comprehensive, yet relatively brief self-assessment tool that covers a broad spectrum of pressing psychosocial topics during the current COVID-19 pandemic. The scale has the potential to facilitate the investigation of psychosocial reactions to the pandemic and could help assess the impact of potential future epidemics and pandemics if adapted accordingly. Our use case highlights its potential to untangle complex psychosocial aspects regarding levels of support of COVID-19 countermeasures in psychiatric inpatients and non-clinical individuals. Our findings stress the importance of transparent public health

communication to foster trust in institutions and politics as well as inform the public about the potential contagiousness of the coronavirus to increase acceptance and adherence with the different public health directives in clinical and non-clinical groups during the current pandemic.

Abbreviations

CoPaQ: COVID-19 Pandemic Mental Health Questionnaire; OSF: Open Science Framework; EFA: Explorative factor analysis; CFA: Confirmatory factor analysis; WLSMV: Weighted least square mean and variance adjusted; CFI: Comparative Fit Index; RMSEA: Root Mean Square Error of Approximation; ML: Maximum likelihood; Welch t-test: Unpaired two-sample *t* tests; IQR: Interquartile range; SD: Standard deviation; SMD: Standardised mean differences; χ2: Chi-square tests; ω: McDonald's Omega; α: Cronbach's Alpha; CI: Confidence intervals; *ρ*: Spearman's rho; ICD-10: International Statistical Classification of Diseases and Related Health Problems, 10th revision; PTSD: Post-traumatic stress disorder; DASS-21: Depression, Anxiety and Stress Scales-21; R-GPTS: Revised-Green et al. Paranoid Thoughts Scale; WHO-5: WHO (Five) Well-Being Index

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12888-021-03425-6.

Additional file 1. Online Supplementary Material includes an overview of clinician's ascertained psychiatric diagnoses, item selection procedure, and final questionnaire version. Table S1 - Clinician's ascertained psychiatric diagnoses in the psychiatric inpatient sample based on ICD-10.

Acknowledgments

We are grateful to individuals participating in the NEAR-Survey and the LMU Biobank. We also thank Dr. Marcel Minke from Limesurvey-Consulting.com as well as Dr. Peter Zill, Sylvia de Jonge, and Dr. Sven Wichert from the LMU Psychiatric Hospital for their support in database set-up and data acquisition. We also thank Dr. Adela Isvoranu for helpful feedback on an earlier version of this manuscript.

Authors' contributions

SR, DF, MR, MB and FP contributed to the study conception and design. Material preparation, data collection and analysis were performed by SR, MB and FP. The first draft of the manuscript was written by SR and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Funding

This work was supported by the Network of Academic Medical Research into COVID-19 (Netzwerk Universitätsmedizin - NUM; grant number 01KX2021), funded by the Federal Ministry of Education and Research (BMBF). Open Access funding enabled and organized by Projekt DEAL.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The ethics committee of the Ludwig-Maximilians-University Munich approved the study (clinical sample [Project Number: 18–716]; non-clinical sample [Project Number: 20–118]) and the study was conducted in accordance with the Declaration of Helsinki (Association 2014). All participants provided informed consent prior to participation.

Consent for publication

Not applicable.

Competing interests

The authors have no competing interests as defined by BMC, or other interests that might be perceived to influence the results and/or discussion reported in this paper.

Author details

[1]Department of Psychiatry and Psychotherapy, LMU University Hospital Munich, Nussbaumstraße 7, Munich, Germany. [2]International Max Planck Research School for Translational Psychiatry (IMPRS-TP), Munich, Germany. [3]Department of Psychology, LMU Munich, Munich, Germany. [4]Department of Psychiatry, University of Oxford, Oxford, UK.

Received: 9 April 2021 Accepted: 11 August 2021
Published online: 31 August 2021

References

1. Allington D, Duffy B, Wessely S, Dhavan N, Rubin J. Health-protective behaviour, social media usage and conspiracy belief during the COVID-19 public health emergency. Psychol Med. 2020;9:1-7. https://doi.org/10.1017/S003329172000224X.
2. Freeman D, Waite F, Rosebrock L, Petit A, Causier C, East A, Jenner L, Teale AL, Carr L, Mulhall S, Bold E. Coronavirus conspiracy beliefs, mistrust, and compliance with government guidelines in England. Psychol Med. 2020;21:1-3. https://doi.org/10.1017/S0033291720001890.
3. Gao J, Zheng P, Jia Y, Chen H, Mao Y, Chen S, et al. Mental health problems and social media exposure during COVID-19 outbreak. PLoS One. 2020;15(4):e0231924. https://doi.org/10.1371/journal.pone.0231924.
4. Rek SV, Freeman D, Reinhard M, Bühner M, Keeser D, Padberg F. The COVID-19 Pandemic Mental Health Questionnaire (CoPaQ): introducing a comprehensive measure of the psychosocial impact of the current coronavirus crisis. Open Sci Framew. 2020.
5. Taquet, M, Luciano, S, Geddes, JR, Harrison, PJ. Bidirectional associations between COVID-19 and psychiatric disorder: retrospective cohort studies of 62 354 COVID-19 cases in the USA. The Lancet Psychiatry. 2021;8(2):130–40. https://doi.org/10.1101/2020.08.14.20175190.
6. Wang, Q, Xu, R,Volkow, ND. Increased risk of COVID 19 infection and mortality in people with mental disorders: analysis from electronic health records in the United States. World Psychiatry. 2021;20(1):124–30. https://doi.org/10.1002/wps.20806.
7. Rubin GJ, Finn Y, Potts HWW, Michie S. Who is sceptical about emerging public health threats? Results from 39 national surveys in the United Kingdom. Public Health. 2015;129(12):1553–62 Available from: https://doi.org/10.1016/j.puhe.2015.09.004.
8. Cori L, Bianchi F, Cadum E, Anthonj C. Risk perception and covid-19. Int J Environ Res Public Health. 2020;17(9):3114. https://doi.org/10.3390/ijerph17093114.
9. Harper CA, Satchell LP, Fido D, Latzman RD. Functional fear predicts public health compliance in the COVID-19 pandemic. Int J Ment Health Addiction. 2020;27:1–4. https://doi.org/10.1007/s11469-020-00281-5.
10. Wahl I, Kastlunger B, Kirchler E. Trust in authorities and power to enforce tax compliance: an empirical analysis of the "Slippery Slope Framework". Law Policy. 2010;32(4):383–406. https://doi.org/10.1111/j.1467-9930.2010.00327.x.
11. American Psychiatric Association. Diagnostic and statistical manual of mental disorders. United States; 2013. p. 21.
12. Cloitre M, Shevlin M, Brewin CR, Bisson JI, Roberts NP, Maercker A, et al. The international trauma questionnaire: development of a self-report measure of ICD-11 PTSD and complex PTSD. Acta Psychiatr Scand. 2018;138(6):536–46. https://doi.org/10.1111/acps.12956.
13. Brooks SK, Webster RK, Smith LE, Woodland L, Wessely S, Greenberg N, et al. The psychological impact of quarantine and how to reduce it: rapid review of the evidence. Lancet. 2020;395(10227):912–20. https://doi.org/10.1016/S0140-6736(20)30460-8.
14. Chong M-Y, Wang W-C, Hsieh W-C, Lee C-Y, Chiu N-M, Yeh W-C, et al. Psychological impact of severe acute respiratory syndrome on health workers in a tertiary hospital. Br J Psychiatry. 2004;185(2):127–33. https://doi.org/10.1192/bjp.185.2.127.
15. Qiu J, Shen B, Zhao M, Wang Z, Xie B, Xu Y. A nationwide survey of psychological distress among Chinese people in the COVID-19 epidemic: implications and policy recommendations. Gen Psychiatry. 2020;33(2):19–21.
16. Wang C, Pan R, Wan X, Tan Y, Xu L, Ho CS, et al. Immediate psychological responses and associated factors during the initial stage of the 2019

coronavirus disease (COVID-19) epidemic among the general population in China. Int J Environ Res Public Health. 2020;17(5):1729. https://doi.org/10.3390/ijerph17051729.
17. Stekhoven DJ, Bühlmann P. MissForest—non-parametric missing value imputation for mixed-type data. Bioinformatics. 2012;28(1):112–8. https://doi.org/10.1093/bioinformatics/btr597.
18. Yentes RD, Wilhelm F. careless: Procedures for computing indices of careless responding. R Packag version. 2018;1(3):2018.
19. Henry JD, Crawford JR. The short-form version of the Depression Anxiety Stress Scales (DASS-21): construct validity and normative data in a large non-clinical sample. Br J Clin Psychol. 2005;44(2):227–39. https://doi.org/10.1348/014466505X29657.
20. Nilges P, Essau C. Die Depressions-Angst-Stress-Skalen. Schmerz. 2015;29(6):649–57. https://doi.org/10.1007/s00482-015-0019-z.
21. Antony MM, Cox BJ, Enns MW, Bieling PJ, Swinson RP. Psychometric properties of the 42-item and 21-item versions of the Depression Anxiety Stress Scales in clinical groups and a community sample. Psychol Assess. 1998;10(2):176–81. https://doi.org/10.1037/1040-3590.10.2.176.
22. Freeman D, Loe BS, Kingdon D, Startup H, Molodynski A, Rosebrock L, Brown P, Sheaves B, Waite F, Bird JC. The revised Green et al., Paranoid Thoughts Scale (R-GPTS): psychometric properties, severity ranges, and clinical cut-offs. Psych Med. 2021;51(2):244–53. https://doi.org/10.1017/S0033291719003155.
23. Rek SV, Freeman D, Reinhard M, Bühner M, Padberg F. Psychometric evaluation of the German Revised-Green et al. Paranoid Thought Scales (R-GPTS) across clinical and non-clinical samples. In preparation.
24. Organization WH. Wellbeing measures in primary health care/the DEPCARE project: report on a WHO meeting, Stockholm, Sweden 12-13 February 1998. In: Wellbeing measures in primary health care/the DEPCARE project: report on a WHO meeting, Stockholm, Sweden 12–13 February 1998; 1998.
25. Brähler E, Mühlan H, Albani C, Schmidt S. Teststatistische prüfung und normierung der deutschen versionen des EUROHIS-QOL lebensqualität-Index und des WHO-5 wohlbefindens-index. Diagnostica. 2007;53(2):83–96. https://doi.org/10.1026/0012-1924.53.2.83.
26. Topp CW, Østergaard SD, Søndergaard S, Bech P. The WHO-5 Well-Being Index: a systematic review of the literature. Psychother Psychosom. 2015;84(3):167–76. https://doi.org/10.1159/000376585.
27. Team RC. R: a language and environment for statistical computing; 2013.
28. Cohen J. Statistical power analysis for the behavioural sciences. Hillsdale: Laurence Erlbaum Associates. Inc; 1988.
29. Revelle W. psych: Procedures for psychological, psychometric, and personality research. R package version 2.1.6. Evanston: Northwestern University; 2021.
30. Rosseel Y. Lavaan: an R package for structural equation modeling and more. Version 0.5–12 (BETA). J Stat Softw. 2012;48(2):1–36.
31. Hu L, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. Struct Equ Model Multidiscip J. 1999;6(1):1–55. https://doi.org/10.1080/10705519909540118.
32. Kelley K, Lai K, Lai MK, Suggests M. Package 'MBESS'; 2020.
33. Ho D, Imai K, Imai MK. Package 'MatchIt.' Version; 2018.
34. Sheskin DJ. Handbook of parametric and nonparametric statistical procedures. crc Press; 2004.

Publisher's Note

3. Psychological response to the COVID-19 pandemic in patients versus controls

3.1 Contributions and reference

The study "Differential psychological response to the COVID-19 pandemic in psychiatric inpatients compared to a non-clinical population from Germany" was published in European Archives of Psychiatry and Clinical Neuroscience in July, 2021. SR, DF, MR, MB and FP were responsible for concept and design; SVR, MB and FP for acquisition, statistical analysis, or interpretation of data; SR for drafting of manuscript; SR, DF, MR, MB, SG, PF, KA and FP for critical revision of content; and DF, MR, MB and FP for supervision.

Rek, S. V., Freeman, D., Reinhard, M. A., Bühner, M., Grosen, S., Falkai, P., Adorjan, K., Padberg, F. (2021). Differential psychological response to the COVID-19 pandemic in psychiatric inpatients compared to a non-clinical population from Germany. European Archives of Psychiatry and Clinical Neuroscience. https://doi.org/10.1007/s00406-021-01291-7

European Archives of Psychiatry and Clinical Neuroscience (2022) 272:67–79
https://doi.org/10.1007/s00406-021-01291-7

ORIGINAL PAPER

Differential psychological response to the COVID-19 pandemic in psychiatric inpatients compared to a non-clinical population from Germany

Stephanie V. Rek[1,2] · Daniel Freeman[3] · Matthias A. Reinhard[1] · Markus Bühner[4] · Sofie Grosen[1] · Peter Falkai[1] · Kristina Adorjan[1] · Frank Padberg[1]

Received: 25 March 2021 / Accepted: 4 July 2021 / Published online: 15 July 2021

Abstract

The COVID-19 pandemic is an inherently stressful situation, which may lead to adverse psychosocial outcomes in various populations. Yet, individuals may not be affected equally by stressors posed by the pandemic and those with pre-existing mental disorders could be particularly vulnerable. To test this hypothesis, we assessed the psychological response to the pandemic in a case–control design. We used an age-, sex- and employment status-matched case–control sample ($n = 216$) of psychiatric inpatients, recruited from the LMU Psychiatry Biobank Munich study and non-clinical individuals from the general population. Participants completed validated self-report measures on stress, anxiety, depression, paranoia, rumination, loneliness, well-being, resilience, and a newly developed index of stressors associated with the COVID-19 pandemic. Multiple linear regression analyses were conducted to assess the effects of group, COVID-19-specific stressors, and their interaction on the different psychosocial outcomes. While psychiatric inpatients reported larger mental health difficulties overall, the impact of COVID-19-specific stressors was lower in patients and not associated with worse psychological functioning compared to non-clinical individuals. In contrast, depressive symptoms, rumination, loneliness, and well-being were more strongly associated with COVID-19-specific stressors in non-clinical individuals and similar to the severity of inpatients for those who experienced the greatest COVID-19-specific stressor impact Contrary to expectations, the psychological response to the pandemic may not be worse in psychiatric inpatients compared to non-clinical individuals. Yet, individuals from the general population, who were hit hardest by the pandemic, should be monitored and may be in need of mental health prevention and treatment efforts.

Keywords COVID-19 pandemic · Mental health · Psychiatric inpatients · COVID-19-specific stressors · Psychological response

Introduction

Many unprecedented stressors caused by the COVID-19 pandemic may contribute to increased psychological and emotional distress, reduced levels of well-being, and thus pose a substantial risk for an emerging mental health crisis worldwide [1]. While COVID-19 itself represents an obvious threat for physical health and imposes burden on individuals and groups worldwide, numerous stressors are also resulting from the politically enforced restrictions (e.g., stay-at-home orders) and recommended behaviours (e.g., physical distancing, often referred to as social distancing) to minimize face-to-face interactions. Although these may partly be latent changes to people's lives, these pandemic-related restrictions may have a profound and long-lasting societal

✉ Stephanie V. Rek
s.rek@med.uni-muenchen.de

1 Department of Psychiatry and Psychotherapy, LMU University Hospital Munich, Nussbaumstraße 7, Munich, Germany

2 International Max Planck Research School for Translational Psychiatry (IMPRS-TP), Munich, Germany

3 Department of Psychiatry, University of Oxford, Oxford, UK

4 Department of Psychology, LMU Munich, Munich, Germany

and economic impact on many individuals due to infringement, for example, on personal freedoms, uncertainty and concern over disease status, social isolation, job uncertainties, and financial hardship.

As vulnerability to psychosocial stressors varies, some individuals may be more affected by the adverse impact of the COVID-19 pandemic than others. According to the diathesis-stress-model [2] of mental disease, individual differences are thought to arise from a complex interplay between pre-existing risk factors (diatheses) and current environmental stressors. As such, environmental stressors may exert their most pronounced negative effects on mental health in vulnerable individuals with a specific genetic makeup and pre-existing mental health difficulties. This framework has been pioneered in the context of smoking [3] and has since been applied for a variety of other mental health disorders [4, 5]. In line with this theory, the psychological response to the pandemic should theoretically be greatest for vulnerable individuals with severe mental health disorders as has been predicted by several recent scientific publications [6–8]. Yet, it remains unclear if psychiatric patients experience more psychiatric symptoms specifically due to the COVID-19 pandemic. Addressing this key question is clinically relevant. It could help to identify individuals with the greatest mental health needs, develop appropriate mitigation strategies for managing the psychological consequences of the COVID-19 pandemic, and safeguard vulnerable individuals who were hit hardest by the pandemic.

The pandemic's psychological impact on patients with severe mental disorders remains largely unknown. Previous epidemics and pandemics have led to increased mental health difficulties [9, 10] and preliminary epidemiological studies and meta-analyses have quantified psychiatric symptom prevalence in the COVID-19 pandemic [11, 12]. In the general population, a prevalence of 29.6% for stress symptoms, 31.9% for anxiety symptoms, and 33.7% for depressive symptoms have been reported [12]. In such meta-analytic work, however, prevalence rates have not been interpreted in the context of symptom prevalence rates prior to the pandemic, which obfuscates inferences about the actual mental health impact of the pandemic. Initial longitudinal research comparing mental health difficulties before and during the pandemic describe an increase in mental health difficulties (e.g., anxiety, depression, stress, suicide risk, & post-traumatic stress) during the early stages of the pandemic using data from the UK Household Longitudinal Study panel [13]. In addition, a recent meta-analysis highlights a modest but consistent mental health impact of COVID-19 lockdown measures, particularly for depressive and anxiety symptoms [14]. Yet, the longer-term effects remain unknown and it is unclear if the pandemic has a particularly pronounced impact on the mental health of psychiatric patients. While initial case–control studies have found general differences in symptom prevalence rates as would be expected [15, 16], Pan et al. [17] also provided longitudinal mental health comparisons before versus during the early stages of the pandemic and using COVID-19-specific items beyond general symptom questionnaires in three large Dutch case–control cohorts. Interestingly, the authors demonstrate that patients' mental health functioning was similar before versus during the early stages of the pandemic, while healthy individuals experienced more symptoms during compared to before the pandemic. The authors offer several explanations of these findings including mitigation strategy-induced relaxation, feelings of safety, or simply regression to the mean. Similarly, a more recent longitudinal population-based study conducted in the United States showed a sharp initial increase in psychological distress in individuals with pre-existing mental health conditions during the early phases of the pandemic (April 2020). However, distress levels decreased to baseline levels in the weeks that followed (July 2020) highlighting the potential role of resilience in the psychological response to the pandemic [18]. Similar results were also observed by other research groups [19–22] and summarised in a systematic literature review of population-based longitudinal cohort studies [23]. The impact of COVID-19-specific stressors could offer an additional explanation, which can only be studied using a more fine-grained dissection of the pandemic's psychological response.

In the present study, we investigated the impact of COVID-19-specific stressors on a diverse range of psychosocial outcomes using validated self-report measurement scales in a case–control comparison matched on age, sex, and employment status and using the COVID-19-specific stressor impact index of the newly developed COVID-19 Pandemic Mental Health Questionnaire (CoPaQ) [24]. In line with the diathesis-stress-model, we hypothesised that psychiatric inpatients are more negatively affected by COVID-19-specific stressors compared to non-clinical controls from the general German population in terms of higher levels of anxiety, depression, stress, paranoia, rumination, and loneliness as well as lower levels of well-being and resilience.

Methods

Participants

Clinical sample

The clinical sample ($n = 108$) was recruited as part of the LMU Biobank study and was composed of psychiatric inpatients from the Department of Psychiatry and Psychotherapy of the LMU University Hospital Munich. Participants indicated

demographic information and filled out self-report questionnaires (order: CoPaQ, DASS-21, R-GPTS, WHO-5, UCLA, SNI, & BRS) using paper–pencil. Psychiatric inpatients with insufficient comprehension of German, an acute psychotic or manic episode, or acute suicidality were excluded from participation.

Non-clinical sample

The non-clinical control sample was recruited online from the general German population using advertisements on social media (Facebook) and via university mailing lists. Assessments were made via a secure online survey software (LimeSurvey). This study is part of an ongoing longitudinal survey into the mental health consequences of the pandemic. The non-clinical sample completed the same questionnaire batterie, which was presented in a block randomised order to reduce carry-over effects and using a forced response format. At the end, participants were asked to enter their email address to be included in a prize draw. The sample consisted of adults (18+ years). In total, 387 (77.87%) identified as women, 108 (21.73%) as men, and 2 (0.40%) as diverse with an age range from 18 to 75 years (mean = 30, standard deviation (SD) = 11).

Matching

To obtain a more comparable case–control sample in terms of key sociodemographic factors, the clinical and non-clinical samples were matched on age, sex, and employment status using *R* software and the *MatchIt* (v4.1.0) package [25]. Matching is preferable over sole adjustment of potential confounders in regression analyses since it increases sample comparability and efficiency of analyses as similar numbers of cases and controls are present across confounder strata [26]. After matching, clinical and non-clinical samples were comparable in age and sex (age: $t(212.56) = -1.47$, $p = 0.142$; sex: $\chi^2(1) = 0.07$, $p = 0.785$), but differences remained for employment status ($\chi^2(6) = 27.22$, $p < 0.001$).

Ethical approval and informed consent

The study was subject to ethics committee approval (clinical sample [Project Number: 18-716]; non-clinical sample [Project Number: 20-118]) and conducted in accordance with the Declaration of Helsinki [27]. All participants provided informed consent. Recruitment in both study groups took place between April-December 2020.

Data integrity and quality control

Integrity of participants' responses and data was ascertained in multiple pre-processing steps (see Supplementary Methods and Supplementary Fig. 1 for an overview).

Measures

COVID-19 Pandemic Mental Health Questionnaire (CoPaQ)

The CoPaQ (https://osf.io/3evn9/) [24] is a newly developed and highly comprehensive self-report measure assessing the psychosocial impact of the COVID-19 pandemic. For the purpose of this study, we included data of an index assessing the impact of COVID-19-specific stressors over the past 2 weeks from the CoPaQ. Individual stressors included among others quarantine/curfew, small accommodation/home-office, financial difficulties, childcare responsibilities, and physical health concerns; we provide a full list of items in Table 1 and Supplementary Fig. 2 depicts COVID-19-specific stressors inter-item correlations. Each stressor was rated using a 5-point Likert scale ranging from 0 (Not at all) to 4 (Very much) and participants' responses of "Not applicable" were recoded as 0. A sum score of all items was calculated as an index of COVID-19-specific stressors with higher scores indicating a greater stressor impact. We observed an acceptable internal consistency of the COVID-19-specific stressors scores with McDonald's Omega (ω) = 0.79 (95% confidence interval [CI]: 0.75–0.84). It is important to note, however, that stressors are likely to occur relatively independently, so a high internal consistency was not necessarily presumed.

Psychosocial outcome measures

We selected a diverse range of psychosocial outcome measures that have been reported to be of relevance during the current pandemic [12, 28–31]. This includes mental health symptomatology measures of stress, anxiety, depression, and paranoia; transdiagnostic mental health factor measures of loneliness and rumination; and positive psychological functioning measures of psychological well-being and resilience.

Mental health symptomatology

Depression, Anxiety and Stress Scales-21 (DASS-21) The German version of DASS-21 [32, 33] was used to measure anxiety, depression, and stress during the preceding week. Items are rated on a Likert scale of 0 (did not apply to me at all) to 3 (applied to me very much or most of the time). Higher scores indicate greater levels on each of the respective subscales. In clinical and non-clinical samples good psychometric properties of the scales have been reported [34]. In our study, DASS-21 subscale scores' internal consistency ranged from good to excellent: $\omega_{Anxiety} = 0.84$ (95% CI: 0.79, 0.88), $\omega_{Depression} = 0.93$ (95% CI: 0.92, 0.95), and $\omega_{Stress} = 0.89$ (95% CI: 0.86, 0.91).

Table 1 Socio-demographics and baseline characteristics of the matched clinical and non-clinical samples

	Clinical sample	Non-clinical sample
Age, mean *(SD)*	43.97 (14.71)	41.14 (13.54)
Women sex, *n (%)*	54 (50.00%)	51 (47.22%)
Employment status, *n (%)*		
Full-time employed	32 (29.63)	50 (46.30)
Part-time employed	17 (12.96)	14 (15.74)
Self-employed	15 (4.63)	5 (13.89)
Student	7 (6.48)	7 (6.48)
Retired	5 (16.67)	18 (4.63)
Caregiver	0 (0)	0 (0)
Not employed	24 (22.22)	14 (12.96)
Other	8 (7.41)	0 (0)
Essential activity for the maintenance of critical infrastructure, *n (%)*		
Doctors	1 (0.9)	2 (1.9)
Nurses	3 (2.8)	7 (6.5)
Clinical psychologist	0 (0)	1 (0.9)
Public safety and national security guards	0 (0)	1 (0.9)
Staff of local and national government	0 (0)	1 (0.9)
Supermarket vendors	2 (.9)	0 (0)
Professional cleaners	1 (0.9)	1 (0.9)
Other (not listed)	20 (18.5)	15 (13.9)
No	81 (75.0)	80 (74.1)
Self-reported lifetime diagnoses, *n (%)*		
Number of diagnoses		
0	0 (0)	71 (65.74)
1	29 (26.85)	18 (16.67)
2	37 (34.26)	12 (11.11)
3	24 (22.22)	7 (6.48)
> =4	18 (16.67)	0 (0)
Any diagnosis	108 (100)	37 (34.26)
Diagnostic categories		
Depressive disorders	88 (81.48)	30 (27.78)
Bipolar disorders	10 (9.26)	2 (1.85)
Psychotic disorders	17 (15.74)	1 (0.93)
Anxiety disorders	30 (27.78)	14 (12.96)
Post-traumatic stress disorder	17 (15.74)	2 (1.85)
Obsessive–compulsive and related disorders	6 (5.56)	1 (0.93)
Disorders		
Eating disorders	17 (15.74)	3 (2.78)
Substance-related and addictive disorders	30 (27.78)	4 (3.70)
Attention-deficit/hyperactivity disorder	6 (5.56)	3 (2.78)
Somatoform disorders	7 (6.48)	2 (1.85)
Personality disorders	22 (20.37)	1 (0.93)
Autism spectrum disorder	8 (7.40)	0 (0)
Dementia	2 (1.85)	0 (0)

n indicates the number of participants. *SD* Standard Deviation

Revised-Green et al. Paranoid Thoughts Scale (R-GPTS) The total score of the German version of the 18-item R-GPTS [35, 36] that includes two subscales of ideas of reference (e.g., "People definitely laughed at me behind my back") and ideas of persecution (e.g., "I was certain people did things in order to annoy me") assessed over the past fortnight were used to measures paranoia. Items are rated on a 5-point Likert scale ranging from 0 (not at all) to 4 (totally).

Scores can range from 0 to 72; higher scores indicate higher levels of paranoia. Excellent psychometric properties of the scales have been reported for the English version [36]. In our study, the R-GPTS subscale scores ranged from good to excellent with $\omega_{\text{Part A}} = 0.88$ (95% CI: 0.85, 0.91) and $\omega_{\text{Part B}} = 0.91$ (95% CI: 0.88, 0.94).

Transdiagnostic mental health factors

Perseverative Thinking Questionnaire (PTQ) The PTQ [37] consists of 15 items and is a self-report scale, which measures content-independent negative ruminative thinking. Items are rated on a 5-point Likert scale ranging from 0 (Never) to 4 (Almost always). Higher scores indicate higher levels of ruminative thinking and scores can range from 0 to 60. Good psychometric properties have been reported in previous research [37]. In our study, the internal consistency of the PTQ was excellent $\omega = 0.97$ (95% CI: 0.97, 0.98).

UCLA Loneliness Scale (UCLA) The German version of the UCLA [38, 39] was used to assess loneliness. The intensity and frequency of feelings of loneliness are assessed with 20 items using a 5-point Likert scale ranging from 1 (not at all) to 5 (totally). Reversed items were recorded and then averaged to form a mean score, with higher scores indicating greater loneliness. The German version of the UCLA has been reported to show high internal consistency and discriminant validity [39]. We observed an excellent internal consistency with $\omega = 0.93$ (95% CI: 0.91, 0.94).

Positive psychological functioning

Brief Resilience Scale (BRS) The German version of the six items BRS [40, 41] was used to assess resilience. Items are rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Reversed items were recoded to calculate mean scores with higher scores indicating greater resilience. Sound psychometric properties of the self-report questionnaire were reported in previous research [41]. In our study, internal consistency was good with $\omega = 0.88$ (95% CI: 0.85, 0.91).

WHO (Five) Well-Being Index (WHO-5) Participants were asked to complete the German version of the WHO-5 [42, 43] which assesses well-being over the past 2 weeks. Items are rated on a 6-point Likert scale ranging from 0 (not present) to 5 (constantly present). Scores are summed, with higher scores indicating greater well-being. Good psychometric properties have been reported in previous research [44]. We observed an excellent internal consistency with $\omega = 0.91$ (95% CI: 0.89, 0.93).

Statistical analyses

All analyses were conducted in *R* (v4.0.3; R Foundation for Statistical Computing) with packages *psych* (v1.8.12) [45], *lavaan* (v0.6-3.1295) [46], *careless* (v1.1.3) [47], *apaTables* (v2.0.5) [48], *MBESS* (v4.8.0) [49], and *missForest* [50].

Missing data

After conducting the different steps to ensure data integrity and quality (see Supplementary Fig. 1), we imputed missing values. Since we had continuous and categorical mixed-type data, missing data were handled by applying the non-parametric, iterative *MissForest* imputation, which is based on a random forest algorithm [50]. Out-of-bag (OOB) estimates per sample for the imputation error were $\text{OOB}_{\text{PFC}} < 0.001$ for the non-clinical and $\text{OOB}_{\text{PFC}} = 0.153$ for the clinical sample.

Descriptive statistics

First, internal consistency was calculated for the COVID-19-specific stressors index and all outcomes variables using McDonald's Omega [ω; 51] instead of Cronbach's α since assumptions are rarely met in practice [52; see "Measures"]. Descriptive statistics and the strength of statistical association between variables were tested using bivariate Pearson's correlation coefficients, Chi-square tests (χ^2), and unpaired two-sample *t* tests (Welch *t* test) when appropriate. We report magnitudes of effect sizes according to Cohen [53]: correlation coefficients of 0.10 are considered "small", those of 0.30 are "medium", and those of 0.50 are "large" with 95% CI using 5000 bootstrapped samples with replacement.

Multiple linear regression analyses

We ran multiple linear regression analyses to evaluate associations of case–control status, COVID-19-specific stressors and their interaction with mental health outcomes in the matched sample. These regression analyses were conducted unadjusted and adjusted for age, sex, and employment status. All independent variables were standardised to facilitate interpretation of regression coefficients (βs) and main effects. In an additional step, we repeated regression analyses using psychosocial outcome variables on their original scale and standardising these variables; results for outcome variables on original scales are presented in Tables and Figures and results for standardised outcome variables are presented in the Results section to facilitate comparison to other manuscripts and between scales, respectively. To assess the robustness of results, also against violations of homoscedasticity, we provide 95% bootstrapped CI using

5000 bootstrapped samples with replacement. All hypothesis testing was two-tailed according to $\alpha = 0.05$. R^2 is reported when appropriate.

Stratified analyses

To explore the respective impact of COVID-19-specific stressors on the different psychosocial outcome variables and in clinical and non-clinical samples separately, we performed additional group-stratified multiple regression analyses, again adjusted for age, sex, and employment status. For these analyses, both dependent and independent variables were standardised to allow effect size comparisons of the COVID-19-specific stressors predictor between samples and outcome variables.

Sensitivity analyses

To analyse the robustness and consistency of results, we applied four sets of sensitivity analyses. First, the same multiple linear regression analyses were repeated in the larger sample ($n = 605$) that was not matched on age, sex, and employment status, but also adjusted for these variables. Second, we repeated our primary analyses in the matched sample by excluding COVID-19-specific stressor items related to 'living in a small accommodation', 'office work', 'customer service', 'childcare', 'running school lessons', and 'employment uncertainties'. This was done to explore consistency of results for those COVID-19-specific stressors that applied equally well to community-dwelling individuals and psychiatric inpatients and, thus, are of relevance across contexts. Third, multiple linear regression analyses were repeated in the matched sample while additionally adjusting for essential work activity for the maintenance of critical infrastructure (i.e., participants were grouped into the following categories (a) health care worker, (b) essential worker but non-healthcare worker, and (c) non-essential worker) and, finally, in separate analyses we controlled for the date of assessment using a linear and quadratic effect of time in addition to the matching variables.

Results

Descriptive statistics

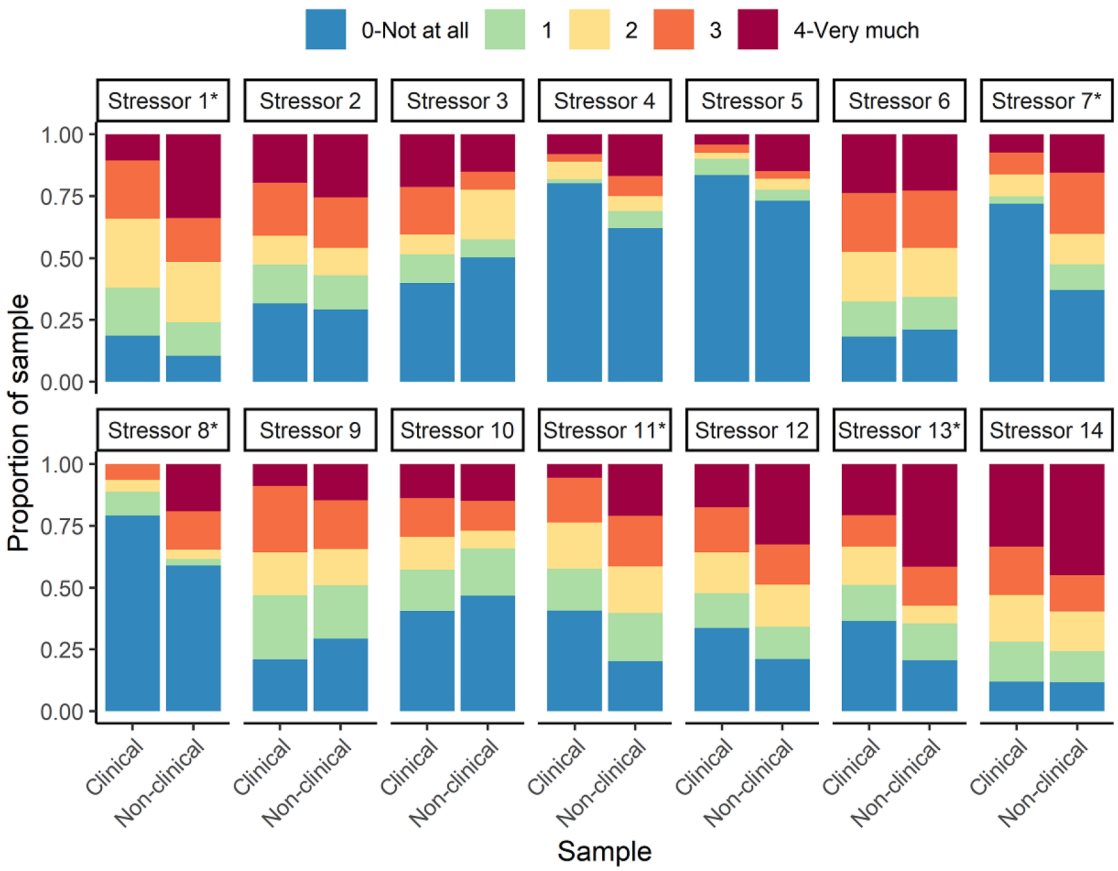
Socio-demographics and baseline characteristics of clinical and non-clinical samples are displayed in Table 1 including self-reported life-time diagnoses. Based on clinician ratings in the psychiatric inpatient sample the majority of patients suffered from depression (77.14%), substance abuse disorders (49.52%), personality disorders (22.86%), and anxiety disorders (21.96%) with 76.85% of patients qualifying for > 1 psychiatric diagnosis based on the 10th of the International Statistical Classification of Diseases and related Health Problems (ICD-10) criteria (see Supplementary Table 1 for details).

A comparison of COVID-19-specific stressors in the matched sample is shown in Fig. 1 (numeric results are presented in Supplementary Table 1). Overall, the total index score of COVID-19-specific stressors differed between groups ($t(198.83) = 2.43$, $p < 0.016$, Cohen's $d = 0.33$), in that the non-clinical sample indicated a greater impact of COVID-19-specific stressors. Results comparing differences in COVID-19-specific stressors between the clinical and non-clinical samples show that the non-clinical sample had higher levels of stressors related to the current pandemic, home-office, customer service, interpersonal conflicts, and job uncertainties. For all other COVID-19-specific stressors such as quarantine/curfew, childcare responsibilities, and physical health concerns we did not observe evidence for differences between groups.

Table 2 includes descriptive statistics of outcome variables and results of Welch t-tests between groups on the different psychosocial outcomes. Results show that psychiatric inpatients displayed greater mental health difficulties as indicated by higher levels of anxiety, depression, stress, rumination, loneliness and lower levels of well-being and resilience, compared to non-clinical individuals. Effect sizes were observed to be medium to large (absolute Standardised Mean Difference (SMD) ranged from 0.47 to 0.98). We did not observe evidence for differences in paranoia between groups.

Multiple linear regression analyses

Results of the multiple linear regression analyses are depicted in Fig. 2 and numeric results are reported in Supplementary Table 3. Throughout multiple linear regression analyses, we observed significant associations of COVID-19-specific stressors with all psychosocial outcome variables including mental health symptomatology (increased levels of depression (standardised β[SE] = 0.27[0.06]), anxiety (standardised $\beta = 0.34$[0.06]), stress (standardised $\beta = 0.33$[0.07]), and paranoia (standardised $\beta = 0.26$[0.07])), transdiagnostic mental health factors (increased levels of rumination (standardised $\beta = 0.25$[0.06]) and loneliness (standardised $\beta = 0.15$[0.07])), and positive psychological functioning (less psychological well-being (standardised $\beta = -0.21$[0.06]) and resilience (standardised $\beta = -0.21$[0.06])). Group status was also significantly associated with all psychosocial outcome variables (depression (standardised $\beta = 0.73$[0.12]), anxiety (standardised $\beta = 0.80$[0.12]), stress (standardised $\beta = 0.57$[0.13]), rumination (standardised $\beta = 0.72$[0.12]), loneliness (standardised $\beta = 0.66$[0.13]), well-being (standardised $\beta = -0.95$[0.12]), and resilience (standardised



Note. * indicates $p < .05$ based on χ2 tests. stressor 1 = the current pandemic, stressor 2 = living in a small accommodation, stressor 3 = being in quarantine, stressor 4 = childcare, stressor 5 = taking over school lessons., stressor 6 = the curfew, stressor 7 = being in home office, stressor 8 = customer service, stressor 9 = worries about my health, stressor 10 = worries of not being able to get medical care, stressor 11 = increased conflicts with people close to me, stressor 12 = financial worries, stressor 13 = uncertainties regarding my job, training place, studies or school, stressor 14 = fears of what the future will bring, or that I won't be able to cope with everything (cf. Supplementary Table 1).

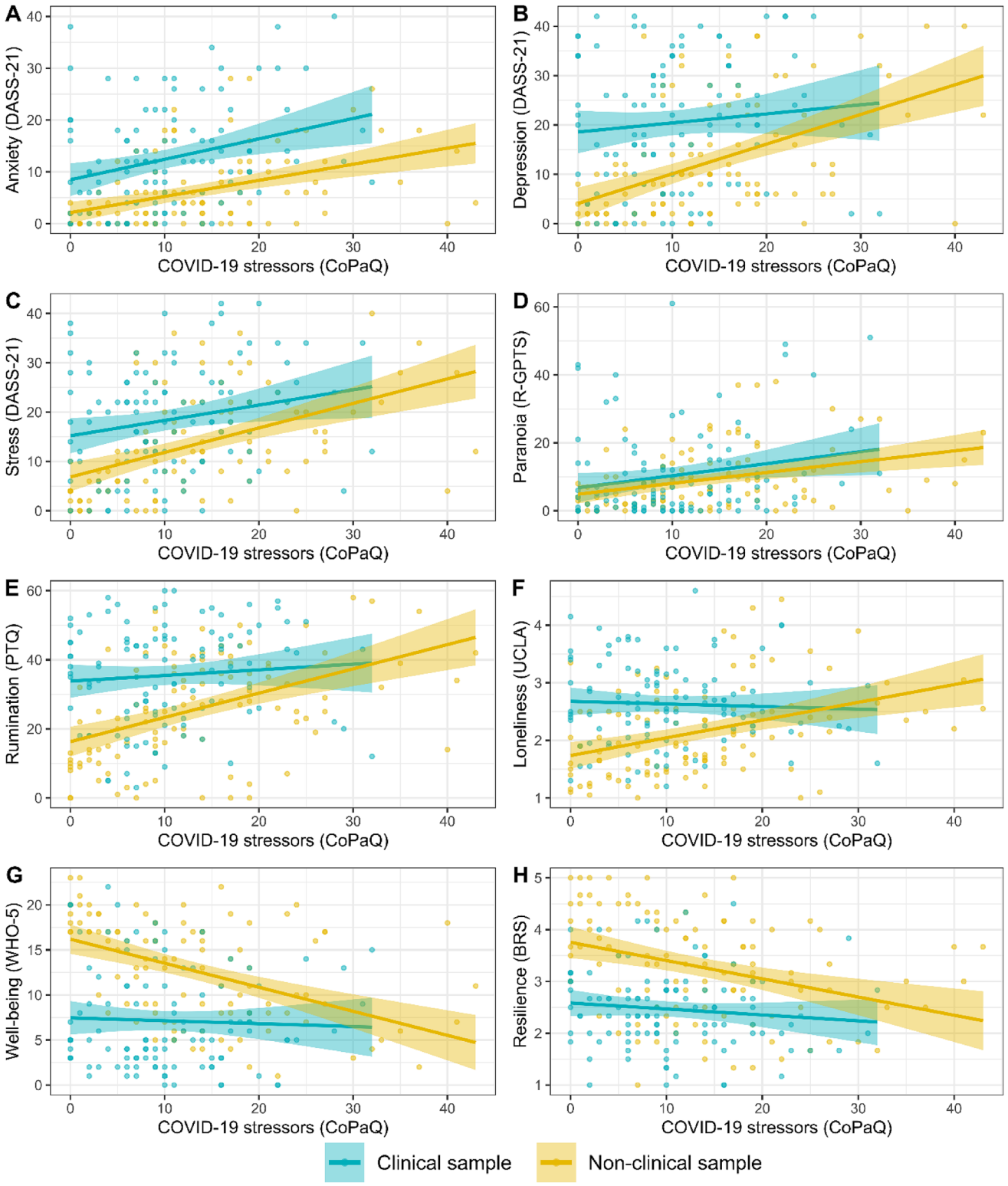
Fig. 1 Comparison of the COVID-19-specific stressors in the matched samples

β = − 0.91[0.12])); paranoia (standardised β = 0.21[0.13]) was the only exception. For the psychosocial outcome variables depression (standardised β = − 0.28[0.13]), rumination (standardised β = − 0.31[0.13]), loneliness (standardised β = − 0.40[0.13]), and well-being (standardised β = 0.33[0.12]), we observed evidence for group by

Table 2 Descriptive statistics and differences in psychosocial outcome variables between matched samples

Outcome	Clinical sample			Non-clinical sample			*p*	SMD	$CI_{bootstrappdSMD}$
	Mean (SD)	Range	IQR	Mean (SD)	Range	IQR			
Anxiety (DASS-21)	12.61 (9.87)	0–40	5.50–18	6.30 (7.06)	0–28	0–10	< 0.001***	0.69	0.45, 0.91
Depression (DASS-21)	20.5 (13.05)	0–42	8–32	12.13 (11.6)	0–40	2–19	< 0.001***	0.64	0.40, 0.89
Stress (DASS-21)	18.46 (10.95)	0–42	10–26	13.5 (10.18)	0–40	5.5–20.5	< 0.001***	0.46	0.20, 0.71
Paranoia (R-GPTS)	10.5 (13.22)	0–61	1–14	9.15 (8.94)	0–38	2–13.3	0.38	0.12	− 0.15, 0.36
Rumination (PTQ)	35.53 (14.48)	0–60	25–46	25.69 (14.99)	0–58	13.8–37.3	< 0.001***	0.64	0.39, 0.87
Loneliness (UCLA)	2.63 (0.72)	1–4.6	2.2–3.1	2.15 (0.77)	1–4.5	1.5–2.6	< 0.001***	0.62	0.37, 0.85
Well-being (WHO-5)	7.12 (5.56)	0–22	3–11	12.62 (5.65)	1–23	8–17	< 0.001***	− 0.88	− 1.10, − 0.65
Resilience (BRS)	2.46 (0.76)	1–4.5	1–2.8	3.28 (0.99)	1–5	1–4.0	< 0.001***	− 0.84	− 1.06, − 0.62

***Indicates $p < 0.001$. SD is used to represent standard deviation. *IQR* inter quartile range. *P* values based on Welch two-sample *t* test. *SMD* Standardised Mean Difference. $CI_{bootstrappedSMD}$ = 95% bootstrapped Confidence Interval of SMD



Note. Figure 1 shows the effect of group on different psychosocial outcomes (n=216). Dots represent individual data points and lines show linear regression slopes per group with shaded area for standard error (cf. Supplementary Table 3).

Fig. 2 Associations of COVID-19-specific stressors with psychosocial outcomes in the matched samples

stressors interactions in the unadjusted model. These interactions unequivocally displayed a relatively greater increase of mental health difficulties in the non-clinical sample while mental health difficulties in the clinical sample were relatively stable across levels of COVID-19-specific stressors. No evidence for group by stressor interactions were observed for anxiety (standardised $\beta = 0.08[0.13]$), stress (standardised $\beta = -0.15[0.13]$), paranoia (standardised $\beta = 0.03[0.14]$), and resilience (standardised $\beta = 0.21[0.13]$). When adjusting for age, sex, and employment status, findings remained substantially unchanged.

Stratified analyses

Figure 3 shows results of the patient-status stratified analyses with standardised dependent and independent variables and controlled for age, sex, and employment status (numeric results are displayed in Supplementary Table 4). In the non-clinical sample, we observed evidence of similarly strong associations between COVID-19-specific stressors and each psychosocial outcome (absolute beta coefficients ranged from 0.27 to 0.40). In contrast, in the clinical sample evidence for associations between COVID-19-specific stressors and depression, rumination, loneliness, well-being and resilience was either absent or negligible (absolute beta coefficients ranged from 0.07 to 0.16), while they were more similar to the non-clinical sample for anxiety, stress, and paranoia (absolute beta coefficients ranged from 0.24 to 0.35). These results also correspond to the findings of the multiple linear regression analyses.

Sensitivity analyses

Results of the four sensitivity analyses are presented in Supplementary Tables 5–8. Briefly, results remained substantially unchanged in sensitivity analyses using the (1) unmatched sample, (2) reduced COVID-19-specific stressor index (interaction analyses of the group by stressors on depression, rumination, loneliness, and well-being appeared somewhat more robust and additional evidence for stress and resilience was observed), (3) additionally adjusting for essential work activities, and (4) controlling for date of assessment.

Discussion

We followed the call by Holmes et al. [1] to assess the psychological response to the current pandemic by scrutinising the impact of COVID-19-specific stressors in vulnerable individuals with serious mental health disorders, compared to a matched sample of non-clinical controls. In line with the diathesis-stress-model [2] of mental disease, we hypothesised that the psychosocial impact of the pandemic is greatest in vulnerable individuals with severe mental health disorders. However, this hypothesis was not supported by our data. Instead, the impact of COVID-19-specific stressors was

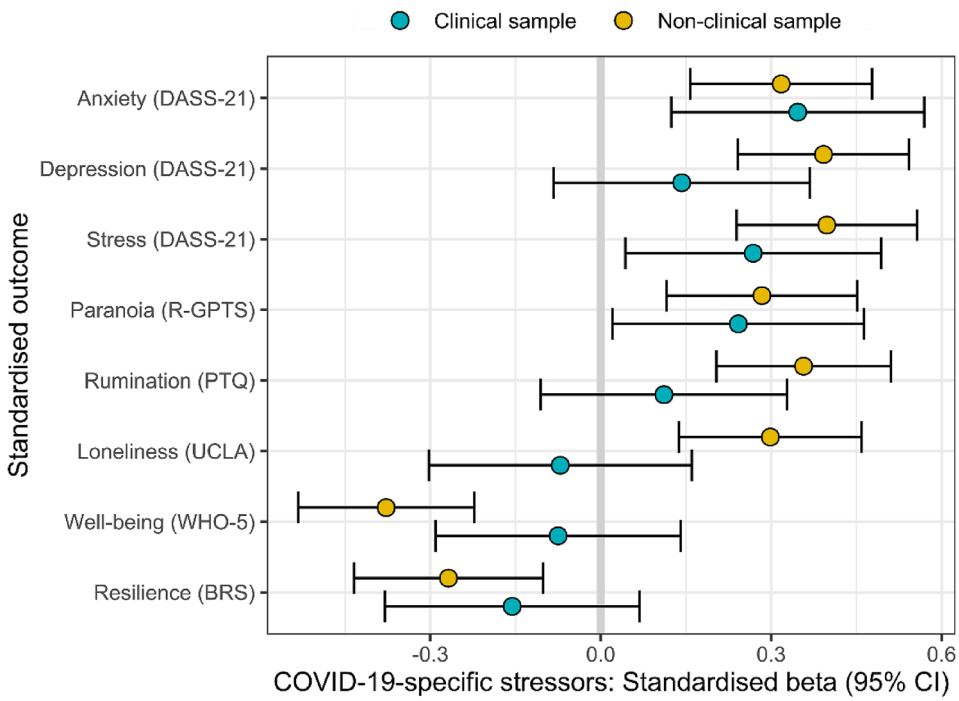


Fig. 3 Patient status-stratified standardised associations of COVID-19-specific stressors with psychosocial outcomes

Note. Results are based on the fully adjusted model run in the matched sample (cf. Supplementary Table 4).

greater in non-clinical than in clinical respondents and these stressors were an important determinant for psychosocial functioning especially in the non-clinical sample. Importantly, psychiatric inpatients did not show a more adverse psychological response to stressors posed by the pandemic in terms of worse psychological functioning compared to non-clinical controls and, interestingly, COVID-19-specific stressors were consistently more strongly associated with depression, rumination, loneliness, and well-being in our non-clinical sample. This association followed a dose–response relationship, in which non-clinical individuals experiencing the greatest impact of COVID-19-specific stressors exhibited mental health symptomatology levels of psychiatric inpatients. Sensitivity analyses did not substantially change our results supporting their robustness.

Our cross-sectional findings on COVID-19-specific stressors add to previous longitudinal research showing an increase in mental health difficulties when comparing levels before versus during the early stages of the pandemic. This has been observed in studies of non-clinical individuals from a large UK general population sample [13, 18] and three Dutch psychiatric case–control cohort samples [17] with no additional mental health deterioration in vulnerable individuals with pre-pandemic mental health conditions [23]. Pan et al. [17] offer several explanations of these findings including mitigation strategy-induced relaxation, feelings of safety, or simply regression to the mean in vulnerable individuals with pre-existing mental disorders, whereas Pierce et al. [13] highlight the importance of tracking the longitudinal impact further into the pandemic. Our findings suggest that the impact of COVID-19-specific stressors could offer an additional explanation. In alignment with the diathesis-stress-model, we observed an increase in mental health difficulties in our non-clinical sample with increasing levels of COVID-19-specific stressors following a dose–response relationship.

Surprisingly, our findings indicated that psychiatric inpatients exhibited different patterns of associations of COVID-19-specific stressors with depression, rumination, loneliness, well-being and resilience as compared to anxiety and stress. Anxiety and stress are related constructs and DASS-21 anxiety and stress subscales entail items on physiological hyperarousal and psychological over-reactivity [54], which can be interpreted as the body's and mind's response to stress. These stress responses involving physiological hyperarousal and psychological over-reactivity seemed to be independent of psychiatric patient status in the present study. Contrary to this, the other psychosocial outcomes such as depression remained relatively unchanged in the presence of stressors in our psychiatric inpatient sample. Thus, we support Pan et al.'s explanations of mitigation strategy-induced relaxation and feelings of safety, which may be particularly enhanced in a psychiatric inpatient setting. That is, psychiatric inpatients, who are partly shielded from their external environment through the cover of hospitalisation, may be confronted less directly with the aversive consequences of the pandemic, compared to non-clinical individuals. This could also be exemplified by greater levels of COVID-19-specific stressors in the non-clinical group, which may ultimately result in psychological exhaustion. As such, replication of our results in psychiatric outpatient settings is key. Yet, Robinson et al. [23] in their recent systematic meta-analysis of population-based studies also find no deterioration of mental health symptomatology in those individuals with mental health conditions and propose that patients may generally be less exposed to stressors such as social interactions during the pandemic. Following this line of argument, it will be key to continue tracking symptom trajectories in this vulnerable group to see whether mental health difficulties will increase once the pandemic and associated countermeasures subside. Alternatively, psychiatric symptoms in distinct domains may have shown ceiling effects in the clinical sample, whereby depression, rumination, loneliness, well-being, and resilience were at their relative respective maximum or minimum. While distributions of the psychosocial outcomes do not fully support this explanation (Supplementary Fig. 3), this hypothesis requires further investigation. We additionally agree with the proposed characterisation of longitudinal trajectories in future research further into the pandemic [1], since the prolonged/chronic exposure to major stressors and strains caused by the pandemic could result in a "wear and tear" reflected in worse long-term mental health outcomes and, as our findings suggest, this may particularly affect non-clinical individuals [55].

Strengths, limitations and future directions

Strengths of the present study include the examination of the psychological response to the pandemic based on (i) a wide array of key mental health measures, (ii) a large psychiatric inpatient sample, which is arguably one of the most vulnerable groups in terms of mental health difficulties, and (iii) use of a statistical matching procedure to a non-clinical group and a broad range of sensitivity analyses that supported the robustness of our results. This study has several important limitations. First and foremost, the study design is cross-sectional, which prevents causal interpretations. In particular, reverse causation or residual confounding cannot be excluded. For example, individuals with heightened anxiety levels may be more prone to experience a greater impact of COVID-19-specific stressors. Future longitudinal research is needed to assess directionality and evidence for temporality, which is one of Hill's [56] viewpoints on causation. Second, we report data of convenience samples in that our non-clinical sample was predominantly female and younger than the general population (prior to matching)

and the clinical sample represents a subset of patients from a single psychiatric hospital. While the generalisability of our findings is limited, the current study may have benefitted from the non-representativeness. The study was not set up to assess the prevalence of psychosocial difficulties but rather to identify in a case–control design whether stressors posed by the pandemic may differentially predict psychosocial difficulties. Therefore, the high number of individuals indicating psychosocial difficulties may have increased our statistical power to test these associations. However, replication of our results in more representative samples is key to determine the generalisability of our findings. By matching the clinical and non-clinical samples on age, sex, and employment status, we were able to mitigate these sample-dependent biases to some extent. However, the selection of less severely affected inpatients able to participate in a questionnaire-based study and exclusion of patients such as with acute psychosis and mania remains an important limitation of this study. Third, we report data of German samples, which limits cross-cultural generalizability. Fourth, we only relied upon self-report questionnaires. Finally, the items on COVID-19-specific stressor index may apply better to community-dwelling individuals than psychiatric inpatients. Yet, when applying sensitivity analyses with a reduced COVID-19-specific stressor index of stressors that apply equally well to both study groups, our results remained largely unchanged, which supports the robustness of our findings.

Conclusions

Notwithstanding these caveats, our results may contribute to a better understanding of the mental health consequences of the current COVID-19 pandemic that could have both reassuring and concerning implications. On the one hand, we show that the psychological response to the pandemic is not worse in vulnerable individuals with serious mental health disorders compared to non-clinical individuals. On the other hand, our findings show that non-clinical individuals who experienced the greatest impact of COVID-19-specific stressors have levels of depression, rumination, loneliness, and well-being similar to psychiatric inpatients. These results have clinical and societal relevance suggesting that inpatient treatment efforts for patients with high levels of COVID-19-specific stressors should focus particularly on anxiety and stress symptomatology. Our results for non-clinical individuals could also help to identify individuals who were hit hardest by the pandemic and may be in need of targeted prevention and treatment efforts.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s00406-021-01291-7.

Acknowledgements We are grateful to individuals participating in the NEAR-Survey and the LMU Biobank. We also thank Dr. Marcel Minke from Limesurvey-Consulting.com as well as Dr. Peter Zill, Sylvia de Jonge, and Dr. Sven Wichert from the LMU Psychiatric Hospital for their support in the database set-up and data acquisition.

Author contributions SVR, DF, MR, MB and FP contributed to the study conception and design. Material preparation, data collection and analysis were performed by SVR, MB and FP. The first draft of the manuscript was written by SVR and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Funding Open Access funding enabled and organized by Projekt DEAL. This work was supported by the Network of Academic Medical Research into COVID-19 (Netzwerk Universitätsmedizin—NUM; grant number 01KX2021), funded by the Federal Ministry of Education and Research (BMBF).

Declarations

Conflict of interest Prof. Padberg reports personal fees and non-financial support from Mag & More GmbH, Munich, Germany, personal fees and non-financial support from Brainsway Inc., Jerusalem, Israel, personal fees and non-financial support from neuroConn GmbH, Ilmenau, Germany, outside the submitted work. The other authors declare no competing interests.

References

1. Holmes EA, O'Connor RC, Perry VH et al (2020) Multidisciplinary research priorities for the COVID-19 pandemic: a call for action for mental health science. The Lancet Psychiatry. https://doi.org/10.1016/S2215-0366(20)30168-1
2. Zubin J, Spring B (1977) Vulnerability: a new view of schizophrenia. J Abnorm Psychol 86:103
3. Sullivan PF, Kendler KS (1999) The genetic epidemiology of smoking. Nicotine Tob Res 1:S51–S57
4. Colodro-Conde L, Couvy-Duchesne B, Zhu G et al (2018) A direct test of the diathesis–stress model for depression. Mol Psychiatry 23:1590–1596
5. Pruessner M, Cullen AE, Aas M, Walker EF (2017) The neural diathesis-stress model of schizophrenia revisited: an update on recent findings considering illness stage and neurobiological and methodological complexities. Neurosci Biobehav Rev 73:191–218
6. Reger MA, Stanley IH, Joiner TE (2020) Suicide mortality and coronavirus disease 2019—a perfect storm? JAMA Psychiat 77:1093–1094

7. Torjesen I (2020) Covid-19: Mental health services must be boosted to deal with "tsunami" of cases after lockdown. BMJ. https://doi.org/10.1136/bmj.m1994
8. Yao H, Chen JH, Xu YF (2020) Patients with mental health disorders in the COVID-19 epidemic. The Lancet Psychiatry 7:e21. https://doi.org/10.1016/S2215-0366(20)30090-0
9. Hawryluck L, Gold WL, Robinson S et al (2004) SARS control and psychological effects of quarantine, Toronto, Canada. Emerg Infect Dis 10:1206–1212. https://doi.org/10.3201/eid1007.030703
10. Wheaton MG, Abramowitz JS, Berman NC et al (2012) Psychological predictors of anxiety in response to the H1N1 (Swine Flu) pandemic. Cognit Ther Res 36:210–218. https://doi.org/10.1007/s10608-011-9353-3
11. Luo M, Guo L, Yu M, Wang H (2020) The psychological and mental impact of coronavirus disease 2019 (COVID-19) on medical staff and general public—a systematic review and meta-analysis. Psychiatry Res 291:113190. https://doi.org/10.1016/j.psychres.2020.113190
12. Salari N, Hosseinian-Far A, Jalali R et al (2020) Prevalence of stress, anxiety, depression among the general population during the COVID-19 pandemic: a systematic review and meta-analysis. Global Health 16:57. https://doi.org/10.1186/s12992-020-00589-w
13. Pierce M, Hope H, Ford T et al (2020) Mental health before and during the COVID-19 pandemic: a longitudinal probability sample survey of the UK population. The Lancet Psychiatry 7:883–892
14. Prati G, Mancini A (2021) The psychological impact of COVID-19 pandemic lockdowns: a review and meta-analysis of longitudinal studies and natural experiments. Psychol Med. https://doi.org/10.1017/S0033291721000015
15. Hao F, Tan W, Jiang L et al (2020) Do psychiatric patients experience more psychiatric symptoms during COVID-19 pandemic and lockdown? A case-control study with service and research implications for immunopsychiatry. Brain Behav Immun. https://doi.org/10.1016/j.bbi.2020.04.069
16. Iasevoli F, Fornaro M, D'Urso G et al (2020) Psychological distress in patients with serious mental illness during the COVID-19 outbreak and one-month mass quarantine in Italy. Psychol Med. https://doi.org/10.1017/S0033291720001841
17. Pan K, Kok AAL, Eikelenboom M et al (2020) Articles The mental health impact of the COVID-19 pandemic on people with and without depressive, anxiety, or obsessive-compulsive disorders : a longitudinal study of three Dutch case-control cohorts. The Lancet Psychiatry 0366:1–9. https://doi.org/10.1016/S2215-0366(20)30491-0
18. Daly M, Robinson E (2021) Psychological distress and adaptation to the COVID-19 crisis in the United States. J Psychiatr Res 136:603–609
19. Daly M, Sutin AR, Robinson E (2020) Longitudinal changes in mental health and the COVID-19 pandemic: evidence from the UK Household Longitudinal Study. Psychol Med. https://doi.org/10.1017/S0033291720004432
20. Castellini G, Cassioli E, Rossi E et al (2020) The impact of COVID-19 epidemic on eating disorders: a longitudinal observation of pre versus post psychopathological features in a sample of patients with eating disorders and a group of healthy controls. Int J Eat Disord 53:1855–1862
21. Schützwohl M, Mergel E (2020) Social participation, inclusion and mental well-being following SARS-CoV-2 related lockdown restrictions in adults with and without mental disorders. Results from a follow-up study in Germany. Psychiatr Prax. https://doi.org/10.1055/a-1202-242
22. Rutherford BR, Choi CJ, Chrisanthopolous M et al (2021) The COVID-19 pandemic as a traumatic stressor: mental health responses of older adults with chronic PTSD. Am J Geriatr Psychiatry 29:105–114
23. Robinson E, Sutin AR, Daly M, Jones A (2021) A systematic review and meta-analysis of longitudinal cohort studies comparing mental health before versus during the COVID-19 pandemic. medRxiv. https://doi.org/10.1101/2021.03.04.21252921
24. Rek SV, Bühner M, Reinhard MA et al (2021) The COVID-19 pandemic mental health questionnaire (CoPaQ): psychometric evaluation and compliance with countermeasures in psychiatric inpatients and nonclinical individuals. PREPRINT (Version 1), 22 April 2021. Available at Research Square. https://doi.org/10.21203/rs.3.rs-403892/v1
25. Ho DE, Imai K, King G, Stuart EA (2011) MatchIt: nonparametric preprocessing for parametric causal inference. J Stat Softw 42(8):1–28. https://www.jstatsoft.org/v42/i08/
26. Pearce N (2016) Analysis of matched case-control studies. BMJ. https://doi.org/10.1136/bmj.i969
27. Association GA of the WM (2014) World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. J Am Coll Dent 81:14
28. Ye B, Wu D, Im H et al (2020) Stressors of COVID-19 and stress consequences: The mediating role of rumination and the moderating role of psychological support. Child Youth Serv Rev 118:105466
29. Ran L, Wang W, Ai M et al (2020) Psychological resilience, depression, anxiety, and somatization symptoms in response to COVID-19: a study of the general population in China at the peak of its epidemic. Soc Sci Med 262:113261
30. Groarke JM, Berry E, Graham-Wisener L et al (2020) Loneliness in the UK during the COVID-19 pandemic: cross-sectional results from the COVID-19 Psychological Wellbeing Study. PLoS ONE 15:e0239698
31. Vindegaard N, Benros ME (2020) COVID-19 pandemic and mental health consequences: systematic review of the current evidence. Brain Behav Immun 89:531–542
32. Henry JD, Crawford JR (2005) The short-form version of the Depression Anxiety Stress Scales (DASS-21): Construct validity and normative data in a large non-clinical sample. Br J Clin Psychol 44:227–239
33. Nilges P, Essau C (2015) Die depressions-Angst-Stress-Skalen. Der Schmerz 29:649–657
34. Antony MM, Cox BJ, Enns MW et al (1998) Psychometric properties of the 42-item and 21-item versions of the Depression Anxiety Stress Scales in clinical groups and a community sample. Psychol Assess 10:176–181. https://doi.org/10.1037/1040-3590.10.2.176
35. Rek SV, Freeman D, Reinhard M et al (2021) Psychometric evaluation of the German Revised-Green et al. Paranoid Thought Scales (R-GPTS) across clinical and non-clinical samples. Manuscript in preparation
36. Freeman D, Loe BS, Kingdon D et al (2019) The revised Green et al., Paranoid Thoughts Scale (R-GPTS): psychometric properties, severity ranges, and clinical cut-offs. Psychol Med. https://doi.org/10.1017/s0033291719003155
37. Ehring T, Zetsche U, Weidacker K et al (2011) The Perseverative Thinking Questionnaire (PTQ): validation of a content-independent measure of repetitive negative thinking. J Behav Ther Exp Psychiatry 42:225–232
38. Russell D, Peplau LA, Cutrona CE (1980) The revised UCLA Loneliness Scale: concurrent and discriminant validity evidence. J Pers Soc Psychol 39:472–480. https://doi.org/10.1037/0022-3514.39.3.472
39. Döring N, Bortz J (1993) Psychometrische Einsamkeitsforschung: Deutsche Neukonstruktion der UCLA Loneliness Scale. Diagnostica 39(3):224–239

40. Smith BW, Dalen J, Wiggins K et al (2008) The brief resilience scale: assessing the ability to bounce back. Int J Behav Med 15:194–200
41. Chmitorz A, Wenzel M, Stieglitz RD et al (2018) Population-based validation of a German version of the Brief Resilience Scale. PLoS ONE 13:7–10. https://doi.org/10.1371/journal.pone.0192761
42. Bech P (1999) Health-related quality of life measurements in the assessment of pain clinic results. Acta Anaesthesiol Scand 43(9):893–896
43. Brähler E, Mühlan H, Albani C, Schmidt S (2007) Teststatistische prüfung und normierung der deutschen versionen des EUROHIS-QOL lebensqualität-Index und des WHO-5 wohlbefindens-index. Diagnostica 53:83–96
44. Topp CW, Østergaard SD, Søndergaard S, Bech P (2015) The WHO-5 Well-Being Index: a systematic review of the literature. Psychother Psychosom 84:167–176
45. Revelle W (2021) psych: Procedures for psychological, psychometric, and personality research. R package version 2.1.6. Northwestern University, Evanston, Illinois. https://CRAN.R-project.org/package=psych
46. Rosseel Y (2012) Lavaan: An R package for structural equation modeling and more. Version 0.5–12 (BETA). J Stat Softw 48:1–36
47. Yentes RD, Wilhelm F (2018) careless: procedures for computing indices of careless responding. R Packag version 1:2018
48. Stanley DJ, Spence JR (2018) Reproducible tables in psychology using the apaTables package. Adv Methods Pract Psychol Sci 1(3):415–431
49. Kelley K, Lai K, Lai MK, Suggests MASS (2020) Package 'MBESS'. CRAN2020 522
50. Stekhoven DJ, Bühlmann P (2012) MissForest—non-parametric missing value imputation for mixed-type data. Bioinformatics 28:112–118
51. McDonald RP (2013) Test theory: a unified treatment. Psychology press
52. McNeish D (2018) Thanks coefficient alpha, we'll take it from here. Psychol Methods 23:412
53. Cohen J (1988) Statistical power analysis for the behavioural sciences. Laurence Erlbaum Associates, Hillsdale, NJ
54. Clara IP, Cox BJ, Enns MW (2001) Confirmatory factor analysis of the Depression–Anxiety–Stress Scales in depressed and anxious patients. J Psychopathol Behav Assess 23:61–67
55. Guidi J, Lucente M, Sonino N, Fava GA (2020) Allostatic load and its impact on health: a systematic review. Psychother Psychosom 90:11–27
56. Hill AB (1965) The environment and disease: association or causation? Proc Roy Soc Med 58(5):295–300

References

Ahorsu, D. K., Lin, C.-Y., Imani, V., Saffari, M., Griffiths, M. D., & Pakpour, A. H. (2020). The fear of COVID-19 scale: development and initial validation. *International Journal of Mental Health and Addiction*, 1–9.

Ahrens, K. F., Neumann, R. J., Kollmann, B., Brokelmann, J., Von Werthern, N. M., Malyshau, A., … Wessa, M. (2021). Impact of COVID-19 lockdown on mental health in Germany: longitudinal observation of different mental health trajectories and protective factors. *Translational Psychiatry*, *11*(1), 1–10.

Aknin, L. B., De Neve, J.-E., Dunn, E. W., Fancourt, D. E., Goldberg, E., Helliwell, J. F., … Lyubomirsky, S. (2021). Mental health during the first year of the COVID-19 pandemic: A review and recommendations for moving forward. *Perspectives on Psychological Science*, 17456916211029964.

Albott, C. S., Forbes, M. K., & Anker, J. J. (2018). Association of childhood adversity with differential susceptibility of transdiagnostic psychopathology to environmental stress in adulthood. *JAMA Network Open*, *1*(7), e185354–e185354.

Berens, A. E., Jensen, S. K. G., & Nelson, C. A. (2017). Biological embedding of childhood adversity: from physiological mechanisms to clinical implications. *BMC Medicine*, *15*(1), 1–12.

Brakemeier, E.-L., Wirkner, J., Knaevelsrud, C., Wurm, S., Christiansen, H., Lueken, U., & Schneider, S. (2020). Die COVID-19-Pandemie als Herausforderung für die psychische Gesundheit. *Zeitschrift Für Klinische Psychologie Und Psychotherapie*.

Brooks, S. K., Webster, R. K., Smith, L. E., Woodland, L., Wessely, S., Greenberg, N., & Rubin, G. J. (2020). The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *The Lancet*, *395*(10227), 912–920.

Cicchetti, D., & Rogosch, F. A. (2012). Physiological measures of emotion from a developmental perspective: State of the science: Neuroendocrine regulation and emotional adaptation in the context of child maltreatment. *Monographs of the Society for Research in Child Development*.

Cohen, S., Kamarck, T., & Mermelstein, R. (1994). Perceived stress scale. *Measuring Stress: A Guide for Health and Social Scientists*, *10*, 1–2.

Daly, M., & Robinson, E. (2021). Psychological distress and adaptation to the COVID-19 crisis in the United States. *Journal of Psychiatric Research*, *136*, 603–609.

Daly, M., Sutin, A. R., & Robinson, E. (2020). Longitudinal changes in mental health and the COVID-19 pandemic: Evidence from the UK Household Longitudinal Study. *Psychological Medicine*, 1–10.

Druss, B. G. (2020). Addressing the COVID-19 pandemic in populations with serious mental illness. *JAMA Psychiatry*, *77*(9), 891–892.

Ettman, C. K., Cohen, G. H., Abdalla, S. M., Sampson, L., Trinquart, L., Castrucci, B. C., … Vivier, P. M. (2022). Persistent depressive symptoms during COVID-19: a national, population-representative, longitudinal study of US adults. *The Lancet Regional Health-Americas*, *5*, 100091.

Fancourt, D., Steptoe, A., & Bu, F. (2021). Trajectories of anxiety and depressive symptoms

during enforced isolation due to COVID-19 in England: a longitudinal observational study. *The Lancet Psychiatry*, *8*(2), 141–149.

Freeman, D., Loe, B. S., Chadwick, A., Vaccari, C., Waite, F., Rosebrock, L., … Vanderslott, S. (2020). COVID-19 vaccine hesitancy in the UK: the Oxford coronavirus explanations, attitudes, and narratives survey (Oceans) II. *Psychological Medicine*, 1–15.

Gruber, J., Prinstein, M. J., Clark, L. A., Rottenberg, J., Abramowitz, J. S., Albano, A. M., … Davila, J. (2021). Mental health and clinical psychological science in the time of COVID-19: Challenges, opportunities, and a call to action. *American Psychologist*, *76*(3), 409.

Guo, J., Fu, M., Liu, D., Zhang, B., Wang, X., & van IJzendoorn, M. H. (2020). Is the psychological impact of exposure to COVID-19 stronger in adolescents with pre-pandemic maltreatment experiences? A survey of rural Chinese adolescents. *Child Abuse & Neglect*, *110*, 104667.

Hammen, C., Henry, R., & Daley, S. E. (2000). Depression and sensitization to stressors among young women as a function of childhood adversity. *Journal of Consulting and Clinical Psychology*, *68*(5), 782.

Hammen, C., Kim, E. Y., Eberhart, N. K., & Brennan, P. A. (2009). Chronic and acute stress and the prediction of major depression in women. *Depression and Anxiety*, *26*(8), 718–723.

Hao, F., Tan, W., Jiang, L., Zhang, L., Zhao, X., Zou, Y., … Tam, W. (2020). Do psychiatric patients experience more psychiatric symptoms during COVID-19 pandemic and lockdown? A case-control study with service and research implications for immunopsychiatry. *Brain, Behavior, and Immunity*, (April), 0–1. https://doi.org/10.1016/j.bbi.2020.04.069

Hawryluck, L., Gold, W. L., Robinson, S., Pogorski, S., Galea, S., & Styra, R. (2004). SARS control and psychological effects of quarantine, Toronto, Canada. *Emerging Infectious Diseases*, *10*(7), 1206–1212. https://doi.org/10.3201/eid1007.030703

Heim, C., Newport, D. J., Mletzko, T., Miller, A. H., & Nemeroff, C. B. (2008). The link between childhood trauma and depression: insights from HPA axis studies in humans. *Psychoneuroendocrinology*, *33*(6), 693–710.

Henrich, J., Heine, S. J., & Norenzayan, A. (2010). Most people are not WEIRD. *Nature*, *466*(7302), 29.

Holmes, E. A., O'Connor, R. C., Perry, V. H., Tracey, I., Wessely, S., Arseneault, L., … Bullmore, E. (2020). Multidisciplinary research priorities for the COVID-19 pandemic: a call for action for mental health science. *The Lancet Psychiatry*, 547–560. https://doi.org/10.1016/S2215-0366(20)30168-1

Iasevoli, F., Fornaro, M., D'Urso, G., Galletta, D., Casella, C., Paternoster, M., … de Bartolomeis, A. (2020). Psychological distress in patients with serious mental illness during the COVID-19 outbreak and one-month mass quarantine in Italy. *Psychological Medicine*, 1–3. https://doi.org/DOI: 10.1017/S0033291720001841

Keyes, K. M., Eaton, N. R., Krueger, R. F., McLaughlin, K. A., Wall, M. M., Grant, B. F., & Hasin, D. S. (2012). Childhood maltreatment and the structure of common psychiatric disorders. *The British Journal of Psychiatry*, *200*(2), 107–115.

Kim, A. W., Nyengerai, T., & Mendenhall, E. (2020). Evaluating the mental health impacts of the COVID-19 pandemic: perceived risk of COVID-19 infection and childhood trauma predict adult depressive symptoms in urban South Africa. *Psychological Medicine*, 1–13.

KO, C., YEN, C., YEN, J., & YANG, M. (2006). Psychosocial impact among the public of the severe acute respiratory syndrome epidemic in Taiwan. *Psychiatry and Clinical Neurosciences*, *60*(4), 397–403.

Lancee, W. J., Maunder, R. G., & Goldbloom, D. S. (2008). Prevalence of psychiatric disorders among Toronto hospital workers one to two years after the SARS outbreak. *Psychiatric Services*, *59*(1), 91–95.

Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal, and coping*. Springer publishing company.

Lewinsohn, P. M. (1974). A behavioral approach to depression. *Essential Papers on Depression*, 150–172.

Li, M., D'arcy, C., & Meng, X. (2016). Maltreatment in childhood substantially increases the risk of adult depression and anxiety in prospective cohort studies: systematic review, meta-analysis, and proportional attributable fractions. *Psychological Medicine*, *46*(4), 717–730.

Lin, C. Y., Peng, Y. C., Wu, Y. H., Chang, J., Chan, C. H., & Yang, D. Y. (2007). The psychological effect of severe acute respiratory syndrome on emergency department staff. *Emergency Medicine Journal*, *24*(1), 12–17.

Liu, X., Kakade, M., Fuller, C. J., Fan, B., Fang, Y., Kong, J., … Wu, P. (2012). Depression after exposure to stressful events: lessons learned from the severe acute respiratory syndrome epidemic. *Comprehensive Psychiatry*, *53*(1), 15–23.

Manchia, M., Gathier, A. W., Yapici-Eser, H., Schmidt, M. V, de Quervain, D., van Amelsvoort, T., … Pinto, L. (2022). The impact of the prolonged COVID-19 pandemic on stress resilience and mental health: A critical review across waves. *European Neuropsychopharmacology*, *55*, 22–83.

Marin, M.-F., Lord, C., Andrews, J., Juster, R.-P., Sindi, S., Arsenault-Lapierre, G., … Lupien, S. J. (2011). Chronic stress, cognitive functioning and mental health. *Neurobiology of Learning and Memory*, *96*(4), 583–595.

Mazza, C., Ricci, E., Biondi, S., Colasanti, M., Ferracuti, S., Napoli, C., & Roma, P. (2020). A nationwide survey of psychological distress among Italian people during the COVID-19 pandemic: immediate psychological responses and associated factors. *International Journal of Environmental Research and Public Health*, *17*(9), 3165.

McGinty, E. E., Presskreischer, R., Han, H., & Barry, C. L. (2020). Psychological distress and loneliness reported by US adults in 2018 and April 2020. *Jama*, *324*(1), 93–94.

McLaughlin, K. A., Colich, N. L., Rodman, A. M., & Weissman, D. G. (2020). Mechanisms linking childhood trauma exposure and psychopathology: a transdiagnostic model of risk and resilience. *BMC Medicine*, *18*, 1–11.

Monroe, S. M., & Simons, A. D. (1991). Diathesis-stress theories in the context of life stress research: implications for the depressive disorders. *Psychological Bulletin*, *110*(3), 406.

Nelson, C. A., Scott, R. D., Bhutta, Z. A., Harris, N. B., Danese, A., & Samara, M. (2020). Adversity in childhood is linked to mental and physical health throughout life. *Bmj*, *371*.

North, C. S., & Pfefferbaum, B. (2013). Mental health response to community disasters: a systematic review. *Jama*, *310*(5), 507–518.

Pan, K., Kok, A. A. L., Eikelenboom, M., Horsfall, M., Jörg, F., Luteijn, R. A., … Giltay, E. J. (2020). Articles The mental health impact of the COVID-19 pandemic on people with and without depressive , anxiety , or obsessive-compulsive disorders : a longitudinal study of three Dutch case-control cohorts. *The Lancet Psychiatry*, *0366*(20), 1–9. https://doi.org/10.1016/S2215-0366(20)30491-0

Peng, E. Y.-C., Lee, M.-B., Tsai, S.-T., Yang, C.-C., Morisky, D. E., Tsai, L.-T., … Lyu, S.-Y. (2010). Population-based post-crisis psychological distress: an example from the SARS outbreak in Taiwan. *Journal of the Formosan Medical Association*, *109*(7), 524–532.

Pfefferbaum, B., & North, C. S. (2020). Mental health and the Covid-19 pandemic. *New England Journal of Medicine*, *383*(6), 510–512.

Pierce, M., Hope, H., Ford, T., Hatch, S., Hotopf, M., John, A., … McManus, S. (2020). Mental health before and during the COVID-19 pandemic: a longitudinal probability sample survey of the UK population. *The Lancet Psychiatry*, *7*(10), 883–892.

Pierce, M., McManus, S., Hope, H., Hotopf, M., Ford, T., Hatch, S. L., … Wessely, S. (2021). Mental health responses to the COVID-19 pandemic: a latent class trajectory analysis using longitudinal UK data. *The Lancet Psychiatry*, *8*(7), 610–619.

Pierce, M., McManus, S., Jessop, C., John, A., Hotopf, M., Ford, T., … Abel, K. M. (2020). Says who? The significance of sampling in mental health surveys during COVID-19. *The Lancet Psychiatry*, *7*(7), 567–568.

Rek, S. V, Bühner, M., Reinhard, M. A., Freeman, D., Keeser, D., Adorjan, K., … Padberg, F. (2021). The COVID-19 Pandemic Mental Health Questionnaire (CoPaQ): Psychometric Evaluation and Compliance with Countermeasures in Psychiatric Inpatients and Non-clinical Individuals.

Robinson, E., Sutin, A. R., Daly, M., & Jones, A. (2022). A systematic review and meta-analysis of longitudinal cohort studies comparing mental health before versus during the COVID-19 pandemic in 2020. *Journal of Affective Disorders*, *296*, 567–576.

Rosebrock, L., Černis, E., Lambe, S., Waite, F., Rek, S., Petit, A., … Freeman, D. (2021). Catastrophic cognitions about coronavirus: the Oxford psychological investigation of coronavirus questionnaire [TOPIC-Q]. *Psychological Medicine*, 1–10.

Salari, N., Hosseinian-Far, A., Jalali, R., Vaisi-Raygani, A., Rasoulpoor, S., Mohammadi, M., … Khaledi-Paveh, B. (2020). Prevalence of stress, anxiety, depression among the general population during the COVID-19 pandemic: a systematic review and meta-analysis. *Globalization and Health*, *16*(1), 57. https://doi.org/10.1186/s12992-020-00589-w

Seitz, K. I., Bertsch, K., & Herpertz, S. C. (2021). A Prospective Study of Mental Health During the COVID-19 Pandemic in Childhood Trauma–Exposed Individuals: Social Support Matters. *Journal of Traumatic Stress*.

Smoller, J. W. (2016). The genetics of stress-related disorders: PTSD, depression, and anxiety disorders. *Neuropsychopharmacology*, *41*(1), 297–319.

Stroud, C. B., Harkness, K. L., & Hayden, E. P. (2018). The stress sensitization model. In *The oxford handbook of stress and mental health*.

Tsur, N., & Abu-Raiya, H. (2020). COVID-19-related fear and stress among individuals who experienced child abuse: The mediating effect of complex posttraumatic stress disorder. *Child Abuse & Neglect*, *110*, 104694.

Van Rheenen, T. E., Meyer, D., Neill, E., Phillipou, A., Tan, E. J., Toh, W. L., & Rossell, S. L. (2020). Mental health status of individuals with a mood-disorder during the COVID-19 pandemic in Australia: initial results from the COLLATE project. *Journal of Affective Disorders*, *275*, 69–77.

Varese, F., Smeets, F., Drukker, M., Lieverse, R., Lataster, T., Viechtbauer, W., … Bentall, R. P. (2012). Childhood adversities increase the risk of psychosis: a meta-analysis of patient-control, prospective-and cross-sectional cohort studies. *Schizophrenia Bulletin*, *38*(4), 661–671.

Wang, Chen, Horby, P. W., Hayden, F. G., & Gao, G. F. (2020). A novel coronavirus outbreak of global health concern. *The Lancet*, *395*(10223), 470–473.

Wang, Cuiyan, Pan, R., Wan, X., Tan, Y., Xu, L., Ho, C. S., & Ho, R. C. (2020). Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (COVID-19) epidemic among the general population in China. *International Journal of Environmental Research and Public Health*, *17*(5), 1729.

World Health Organization. (2021). WHO-convened global study of origins of SARS-CoV-2: China part.

WHO COVID-19 Dashboard. Geneva: World Health Organization, 2020. Available online: https://covid19.who.int/ (last cited: 01/04/2022).

Yao, H., Chen, J. H., & Xu, Y. F. (2020). Patients with mental health disorders in the COVID-19 epidemic. *The Lancet Psychiatry*, *7*(4), e21. https://doi.org/10.1016/S2215-0366(20)30090-0

Appendix A: Potential mechanisms of the psychological responses to the pandemic

Contributions and reference

The study "Identifying potential mechanisms between childhood trauma and the psychological response to the COVID‐19 pandemic in Germany: a longitudinal study" was accepted for publication in Scientific Reports in May 2022. SR was responsible for writing of the original draft; MR, MB, DF, KA, PF, and FP for reviewing and editing the manuscript; SR, MR, and FP for conceptualisation of the study; SR for visualisations; SR, MR, and FP for data preparation and analysis; and SR, MR, MB, DF, and FP for supervision.

Publication:

Rek, S. V., Reinhard, M. A., Bühner, M., Freeman, D., Adorjan, K., Falkai, P., Padberg, F. (in press). Identifying potential mechanisms between childhood trauma and the psychological response to the COVID‐19 pandemic in Germany: a longitudinal study. Scientific Reports.

Note

The manuscript presented on the subsequent pages represents the most recent version of the manuscript in May 2022 and as accepted in Scientific Reports. It is identical in content, but has been formatted to align with the format of this thesis.

Identifying Potential Mechanisms between Childhood Trauma and the Psychological Response to the COVID-19 Pandemic in Germany: A Longitudinal Study

Stephanie V. Rek[1,2], Matthias A. Reinhard[1], Markus Bühner[3], Daniel Freeman[4], Kristina Adorjan[1], Peter Falkai[1], & Frank Padberg[1]

[1]Department of Psychiatry and Psychotherapy, LMU University Hospital Munich, Munich, Germany

[2]International Max Planck Research School for Translational Psychiatry (IMPRS-TP), Munich, Germany

[3]Department of Psychology, LMU Munich, Munich, Germany

[4]Department of Psychiatry, University of Oxford, Oxford, UK

Corresponding author:

Stephanie V. Rek

Department of Psychiatry and Psychotherapy

University Hospital

Ludwig Maximilians University of Munich

Nussbaumstraße 7

Munich, Germany

Email: s.rek@med.uni-muenchen.de

Phone: +49 89 4400-53432

Financial support: This work was supported by the Network of Academic Medical Research into COVID-19 (Netzwerk Universitätsmedizin - NUM; grant number 01KX2021), funded by the Federal Ministry of Education and Research (BMBF).

Abstract

Childhood maltreatment (CM) has been associated with adverse psychosocial outcomes during the pandemic, but the underlying mechanisms are unclear. In a prospective online study using baseline and 10-week follow-up data of 391 German participants, we applied multiple mediation analyses to test to what extent COVID-19 perceived stressors mediate the association between CM and later adverse psychosocial outcomes compared to established mediators of rumination and insecure attachment. We also explored the relative importance of different COVID-19 related stressors in predicting adverse psychological trajectories using elastic net regression. Results showed that CM was longitudinally associated with all adverse psychosocial outcome. COVID-19 perceived stressors, rumination, and insecure attachment mediated this relationship and full mediation was observed for the outcomes anxiety, stress and psychological well-being. COVID-19-related concerns about the future was most strongly and consistently associated with adverse psychosocial functioning. These findings provide preliminary evidence that COVID-19 perceived stressors, in particular concerns about the future, may be a key mechanism underlying the development of adverse psychosocial outcomes in individuals with a CM history. Thus, COVID-19 perceived stressors may require a higher priority for prevention and treatment efforts in vulnerable groups. Our results warrant replication in more representative cross-cultural samples.

Keywords: depression; anxiety; stress; loneliness; paranoia; psychological well-being; perceived stress; early adversity; multiple mediation

Introduction

It is obvious that the COVID-19 pandemic and its associated social restrictions placed an exceptional strain on individuals leading to a deterioration of mental health and well-being world-wide (1). Specifically, the pandemic has resulted in unprecedented major stressors that can pose enormous psychological challenges including a virtual standstill of our public and private lives, anxieties about getting infected, the course of disease, and receiving appropriate medical care as well as but not limited to job uncertainties and financial difficulties. In a recent study, we could show that a greater impact of such COVID-19-specific stressors during the pandemic was associated with increased psychological difficulties in a German general population sample (2). Moreover, representative cohort studies comparing changes in individuals before versus in the first few weeks of the initial lockdowns have suggested significant increases in mental health symptomatology (3,4), also summarised in a recent meta-analysis (5). In addition, longitudinal studies have identified heterogeneous trajectories of mental health symptomatology during the pandemic. Here, younger age, female sex, lower income levels, economic inactivity, and pre-existing mental health conditions have been associated with worse longitudinal psychological trajectories in terms of depression, anxiety, and loneliness (e.g., 6–11). This demonstrates the importance of inter-individual differences in mental health trajectories and emphasises that identification of important risk factors and accompanying underlying mechanisms is key, which could allow for targeted care or prevention approaches.

One group of individuals that may be particularly vulnerable to the effects of the COVID-19 pandemic on mental health are those who experienced childhood maltreatment (12). Childhood maltreatment (CM), which includes traumatic experiences of abuse and neglect, is arguably the most consistent transdiagnostic risk factor across psychiatric disorders and lower psychological well-being as shown in in multiple retrospective case-control and longitudinal studies (e.g., 13–19). In the context of the COVID-19 pandemic, CM exposed individuals showed greater mental health difficulties in terms of symptoms of anxiety, depression, and posttraumatic stress disorder (PTSD), compared to non-exposed individuals in initial cross-sectional (20–23) and longitudinal (24) studies. However, not all CM exposed individuals develop mental health difficulties in adulthood and, so far, little is known about the exact pathways through which CM leads to an increased mental health risk (14). In order to improve treatment or even prevent an adverse mental health cascade during the current pandemic, it is therefore crucial not only to identify vulnerable groups by environmental stratification based on CM criteria, but also to deepen our understanding of potential core mechanisms linking psychopathology to CM.

Stress sensitisation by early exposure to CM has been proposed as a key transdiagnostic mechanism leading to the evolvement of later psychopathology (25–28). In the current pandemic, for instance, CM exposed individuals may be sensitised and particularly reactive to stress, which could lead to the perception that COVID-19-related stressors are particularly stressful. In turn, this could increase levels of adverse psychosocial outcomes. We are aware of only one longitudinal study amidst the current COVID-19 pandemic that showed that perceived stress mediated the association of early life adversity and depressive symptom severity in adolescents (29). Yet, this study did not differentiate stressors specific versus unspecific to the COVID-19 pandemic. Further, it is unclear whether this mediation generalises to mental health conditions other than depression, and if it also occurs in adults. Finally, it is unclear to what extent perceived stress still plays a relevant mechanistic role when compared to established transdiagnostic mediators between CM and mental health such as rumination (e.g., 14,30–32) and insecure attachment (33,34). This can be tested using multiple mediation analyses adjusting for important confounding factors such as age, sex, income, educational attainment, and pre-existing mental health conditions.

This prospective study in individuals from the general population aims at investigating the relationship between CM and subsequent psychopathology and psychological well-being as well as the relative mediation via COVID-19 perceived stressors, rumination, and insecure attachment. Based on previous research and the theoretical considerations described above, we hypothesised i) that CM is associated with more adverse psychosocial outcomes in terms of depression, anxiety, stress, loneliness, paranoia, and psychological well-being, and ii) that these associations are mediated by COVID-19 perceived stressors, rumination, and insecure attachment. Understanding the factors linking higher rates of mental health difficulties during the current pandemic to CM can inform the development of targeted prevention and psychosocial treatment efforts. Since not all COVID-19 stressors may be equally important in predicting adverse psychosocial outcomes, we further explored their relative importance.

Methods

Participants and Procedure

A longitudinal survey in German language was conducted in adults (18+ years old) with varying levels of CM who were recruited online via social media platforms and university mailing lists (see Supplementary Material for study advertisement text). The secure online survey software (LimeSurvey) was used for assessments, which was set up using a forced response format to prevent missing data and questionnaire block randomisation to circumvent potential carry over effects. As a reimbursement participants could be included in a prize draw by entering their email address at the end of the survey. Recruitment and initial assessment took place between April 2020 – May 2021 with follow-up assessment 10 weeks after the initial assessment. Participants completed a range of questionnaires (see Supplementary Table 1 for an overview of all the questionnaires), we only selected a subset of questionnaires, which we deemed relevant to answer our research questions.

All participants provided informed consent prior to participation, the study was conducted in accordance with the Declaration of Helsinki (35) and approved by the Faculty of Medicine of the Ludwig-Maximilians-University Research Ethics Committee [Project Number: 20-118].

Measures

Exposure (at baseline)

Childhood Trauma Questionnaire (CTQ)

CM was assessed by the CTQ self-report questionnaire that comprises five subscales: emotional, physical, and sexual abuse as well as emotional and physical neglect (36; German version: 37). Each subscale consists of five items, which are rated on a 5-point Likert scale ranging from 1 (not at all) to 5 (very much). Reversed items were recoded. The subscale scores were calculated to represent a total score. Scores on the total scale range from 25 to 125 with higher scores indicating more severe CM. In previous research good psychometric properties of the questionnaire have been reported (36) and internal consistency of the total score at baseline was excellent in the present study (Cronbach's α=0.92).

Proposed Mediators (at baseline)

COVID-19-specific stressor impact index

The COVID-19-specific stressor impact index of the COVID-19 Pandemic Mental Health Questionnaire (CoPaQ) (38) was used to assess COVID-19 perceived stressors over the

past two weeks. The subscale includes different COVID-19 stressors (e.g., quarantine/curfew, small accommodation/home-office, financial difficulties, childcare responsibilities, and physical health concerns), which are rated on a 5-point Likert scale ranging from 0 (not at all) to 4 (very much). The "not applicable" answer option was recoded as zero. Scores are summed to form a total score, which can range from 0 to 56 and higher scores indicate greater COVID-19 perceived stressors. Preliminary psychometric evaluation of this subscale was reported to be sound (39). Internal consistency was not assessed for the COVID-19-specific stressor impact index since stressors can occur relatively independent from each other.

Perseverative Thinking Questionnaire (PTQ)

Rumination was assessed with the PTQ (40), which consists of 15 items rated on a 5-point Likert scale ranging from 0 (Never) to 4 (Almost always). Items on content-independent negative ruminative thinking can be summed to a total score, which can range from 0 to 60. Higher scores indicate higher levels of ruminative thinking. Ehring *et al*. (40) reported good psychometric properties of the scale and we observed excellent internal consistency (α=0.96).

Relationship Styles Questionnaire (RSQ)

We used the RSQ (41; German version: 42) to measure insecure attachment styles. The scale is comprised of 30 items, which are rate on a 5-point Likert scale ranging from 1 (not at all) to 5 (very much). Reversed items were recoded. Attachment avoidance and attachment anxiety were defined as proposed by Roisman *et al*. (43; Model 3A). At baseline, internal consistency estimates of the attachment avoidance and attachment anxiety subscales were good ($\alpha_{Avoidance}$=0.80; $\alpha_{Anxiety}$=0.80)

Psychosocial outcome variables (at 10-week follow-up)

Depression, Anxiety and Stress Scales (DASS-21)

We used the DASS-21 to measure levels of depression, anxiety, and stress during the preceding week (41; German version: 42). Items are rated on a 4-point Likert scale of 0 (did not apply to me at all) to 3 (applied to me very much or most of the time). Subscale scores can each range from 0 to 21, respectively, and higher scores indicate greater levels of psychopathology. Scores of each subscale were multiplied by two in order to convert scores to the full DASS-42 version (46). In clinical and non-clinical samples good psychometric properties of the scales have been reported (47). In our study, internal consistency estimates ranged from acceptable to excellent for each subscale ($\alpha_{Depression}$=0.93, $\alpha_{Anxiety}$=0.79, and α_{Stress}=0.89).

Revised-Green et al Paranoid Thoughts Scale (R-GPTS)

Paranoia over the past fortnight was assessed with the total score of the 18-item R-GPTS (44; German version: 45). Items are rated on a 5-point Likert scale ranging from 0 (not at all) to 4 (totally). Scores can range from 0 to 72; higher scores indicate higher levels of paranoia. Excellent psychometric properties of the scale have been reported (48). The German version was translated from the original English version following common guidelines for forward and backward translation (50). The final version was approved by one of the authors of the original version (D.F.). At T2, internal consistency of the total score was excellent (α=0.91).

UCLA Loneliness Scale (UCLA-LS)

Loneliness was assessed using the UCLA-LS (47; German version: 48), which includes 20 items rated on a 5-point Likert scale ranging from 1 (not at all) to 5 (totally). Items that were reversed were recoded. The average score was built to represent the mean, with higher scores indicating greater loneliness. Good psychometric properties of the scale have been reported in previous research (52). In our sample, internal consistency was excellent at the second assessment timepoint (α=0.94).

WHO (Five) Well-Being Index (WHO-5)

Psychological well-being was assessed with the WHO-5 (49; German version: 50). Five items are rated on a 6-point Likert scale ranging from 0 (at no time) to 5 (all of the time). Items were summed to represent the total score, which can range from 0 to 25, higher scores indicate greater well-being. Sound psychometric properties of the scale have been reported in previous research (55). In our sample, internal consistency was excellent at follow-up (α=0.90).

Statistical analyses

All analyses were conducted in R version 4.0.0 (56) with packages *psych* (version 1.8.12; 53), *lavaan* (version 0.6-3.1295; 54), and *glmnet* (version 4.1-1; 55).

First, bivariate Pearson's correlation coefficients and Chi-square tests (χ^2) were conducted to test associations between variables of interest.

Second, multiple mediation analyses using the maximum likelihood estimator were performed. CM was used as predictor variable and depression, anxiety, stress, loneliness, paranoia, and psychological well-being as outcome variables in separate mediation analyses. Mediator variables of COVID-19 perceived stressors, rumination, and attachment (anxious- and avoidant) were included simultaneously in the analyses and were allowed to correlate with each other. Standard errors were calculated using 10,000 bootstrap samples because some variables did not fully adhere to a normal distribution. We report bias-corrected 95% bootstrapped confidence intervals (CI) for the total (c),

direct (c'), and indirect effects. Subdivision of the total indirect effect to specific indirect effects allowed comparisons of the standardised effect sizes of each mediator. Standardised ordinary least squares regression coefficients are reported for all paths. To account for potential influences of age, sex, income, educational attainment, and pre-existing mental health conditions (as diagnosed by a doctor or therapist, see Supplementary Material for details), variables were included as covariates in each multiple mediation model. As a post-hoc sensitivity analysis, we also added relationship status as an additional covariate to each multiple mediation model, which we defined as follows: being in a relationship (married, partnership) versus not being in a relationship (divorced, widowed, single). Of note, since multiple comparisons were performed we controlled for false positive rate by using the Benjamini-Hochberg procedure (60).

Finally, to explore the relative importance of each of the different perceived COVID-19 stressors contributing to the total COVID-19 stressor index, we performed elastic net regression analyses (61) to explore the relative predictive value of individual stressors for adverse psychosocial functioning. This technique is an extension of ordinary least squares regression that better accounts for collinearity between baseline predictors and simplifies the statistical model using regularisation. It includes the two hyperparameters α (tuning parameter of 0 to 1, which controls the type of shrinkage and, thus, the estimation method) and λ (penalty parameter of 0 to 1, which controls the amount of shrinkage with higher values leading to greater penalisation). The optimal hyperparameter combination was determined using grid search by selecting the model with smallest root mean squared error (RMSE) within 10-fold cross-validation. Of note, regularisation with $\alpha=1$ equals Least Absolute Shrinkage and Selection Operator (LASSO) regression (62) and $\alpha=0$ equals Ridge (63) regression; α values between 0 to 1 reflect the relative balance between the two regression models. Elastic net regression models were controlled for age and sex.

Results

Sample characteristics

Six hundred sixty-eight participants completed the survey at baseline (T1) and 429 at the 10-week follow-up assessment (T2). To ensure high data quality, we excluded participants at baseline who answered more than 1 bogus item incorrectly (e.g., not checking "very much" for the item "Please, indicate 'very much'") (n=58). In addition, participants with response times less than 25 minutes at baseline (n=8) and less than 15 minutes at follow-up (n=8) were excluded, which were deemed unlikely response times on the basis of personal experiences and response time descriptive statistics (baseline response time: median=48 min, 1st quartile=38 min, 3rd quartile=61 min; follow-up: median=23 min, 1st quartile=29 min, 3rd quartile=40 min). We also removed 30 participants who did not have a matching id variable between baseline and follow-up assessment, which resulted from a rare failure of the software. Taken together, this led to a final sample of 391 individuals (77.43% females) on which analyses are based (age: mean=30.99, standard deviation[sd]=11.52). The final sample consisted of 91.82% participants who indicated German nationality, 47.83% were single (see Table 1 for more demographic and clinical characteristics). Of note, participants only completing the baseline assessment did not differ significantly from the follow-up sample in terms of age, sex, nationality, employment status, marital status, and pre-existing mental health conditions ($p>0.05$; see Supplementary Table 2).

Table 1. Baseline characteristics of analytic sample

	Descriptive statistics
Sample size, *n*	391
Age, *mean (SD)*	30.99 (11.52)
Women sex, *n (%)*	303 (77.49)
Employment status[a], *n (%)*	
Full-time employed	88 (22.51)
Part-time employed	63 (16.11)
Self-employed	14 (3.58)
Student	185 (47.31)
Retired	7 (1.79)
Caregiver	0 (0)
Not employed	11 (2.81)
Other	23 (5.88)
Freely disposable money per month, *n (%)*	
<100 €	28 (7.16)
100-250 €	84 (21.48)
250-500 €	111 (28.39)
500-1000 €	85 (21.74)
>1000 €	83 (21.23)
Educational attainment, *n (%)*	
Primary school	0 (0)
Secondary school	39 (9.97)
A-levels	352 (90.03)
Self-reported lifetime diagnoses, *n (%)*	
Number of diagnoses	
0	261 (66.75)
1	73 (18.67)
2	40 (10.23)
3	13 (3.32)
>= 4	4 (1.02)
Diagnostic categories	

	Descriptive statistics
Depressive Disorders	90 (23.02)
Bipolar Disorders	3 (0.77)
Psychotic Disorders	0 (0)
Anxiety Disorders	45 (11.51)
Post-Traumatic Stress Disorder	22 (5.63)
Obsessive-Compulsive and Related Disorders	7 (1.79)
Eating Disorders	18 (4.60)
Substance-Related and Addictive Disorders	4 (1.02)
Attention-Deficit/Hyperactivity Disorder	9 (2.30)
Somatoform Disorders	2 (0.51)
Personality Disorders	9 (2.30)
Autism Spectrum Disorder	3 (0.77)
Dementia	0 (0)

[a]Employment status was assessed in forced choice format, so participants had to indicate the option they identified with most.

Multiple mediation models

Descriptive statistics of proposed exposure, mediator, and outcome variables can be found in Table 2. As a prerequisite for mediation analyses, we observed bivariate correlations between all proposed exposure and mediator variables (path a), mediator and outcome variables (path b), and exposure and outcome variables (path c) as shown in Supplementary Table 3 and Supplementary Table 4. For example, COVID-19 perceived stressors were significantly associated with the predictor CM ($r=0.26$, $p<0.01$) and the criterion depression severity ($r=0.35$, $p<0.01$). Rumination was significantly related to the predictor ($r=0.27$, $p<0.01$) and criterion variable ($r=0.50$, $p<0.01$). Attachment anxiety was also significantly linked to CM ($r=0.25$, $p<0.01$) and depression severity ($r=0.32$, $p<0.01$), as was attachment avoidance ($r_{CM}=0.32$; $p<0.01$; $r_{Depression}=0.34$, $p<0.01$). Lastly, depressive symptom severity was significantly associated with CM severity ($r=0.35$; $p<0.01$).

Table 2. Descriptive statistics of exposure, proposed mediator, and psychosocial outcome variables

	Mean (SD)	Range	IQR
Exposure variable			
T1 Childhood Maltreatment (CTQ)	37.55 (12.93)	25-100	29-43
Proposed Mediators			
T1 COVID-19 Perceived Stressors (COPAQ)	13.63 (8.95)	0-47	7-20
T1 Rumination (PTQ)	27.70 (14.00)	0-59	17-38
T1 Anxious attachment	2.13 (0.91)	1-5	1.40-2.8
T1 Avoidant attachment	2.64 (0.77)	1-4.50	2-3.13
Criterion variables			
T2 Depression (DASS-21)	11.47 (10.75)	0-42	4-16
T2 Anxiety (DASS-21)	5.86 (6.86)	0-36	0-8
T2 Stress (DASS-21)	12.75 (9.77)	0-40	4-20
T2 Loneliness (UCLA-LS)	2.19 (0.72)	1-4.45	1.55-2.70
T2 Paranoia (R-GPTS)	8.33 (10.06)	0-57	1.5-11
T2 Well-being (WHO-5)	12.21 (5.71)	0-25	7.50-17

Note. SD = standard deviation. IQR = inter quartile range.

In separate multiple mediation models and as indicated by the total indirect effect, we observed evidence supporting overall mediation of effects of CM on the different outcome variables (i.e., depression, anxiety, stress, paranoia, loneliness, and psychological well-being) via COVID-19 perceived stressors, rumination, and attachment (anxious and avoidant) (see Table 3 and Figure 1). Specific indirect effects of the proposed mediators were significant for COVID-19 perceived stressors, rumination, and attachment avoidance across outcome variables. Attachment anxiety did not contribute additionally to the indirect effect in five out of six separate multiple mediation analyses; except paranoia. Full mediation between CM and anxiety as well as stress was observed as the direct effect (c') was no longer significant after inclusion of the proposed mediators. Partial mediation was observed for the relationship between CM and depression, paranoia, loneliness, and psychological well-being since the direct effect remained significant. This suggests that our proposed set of mediators did not fully explain this relationship. Of note, all results from multiple mediation analyses were adjusted for the potential confounders age, sex, income, educational attainment, and pre-existing mental health conditions and the mediators were allowed to correlate with each other (Supplementary Table 5 shows additional adjustment of relationship status, which did not alter the pattern of results substantially). When applying alpha correction for multiple testing, results remained largely unchanged but the specific indirect effect of attachment avoidance was no longer significant for the outcomes stress and paranoia. Moreover, full mediation was observed for psychological well-being (see Table 3).

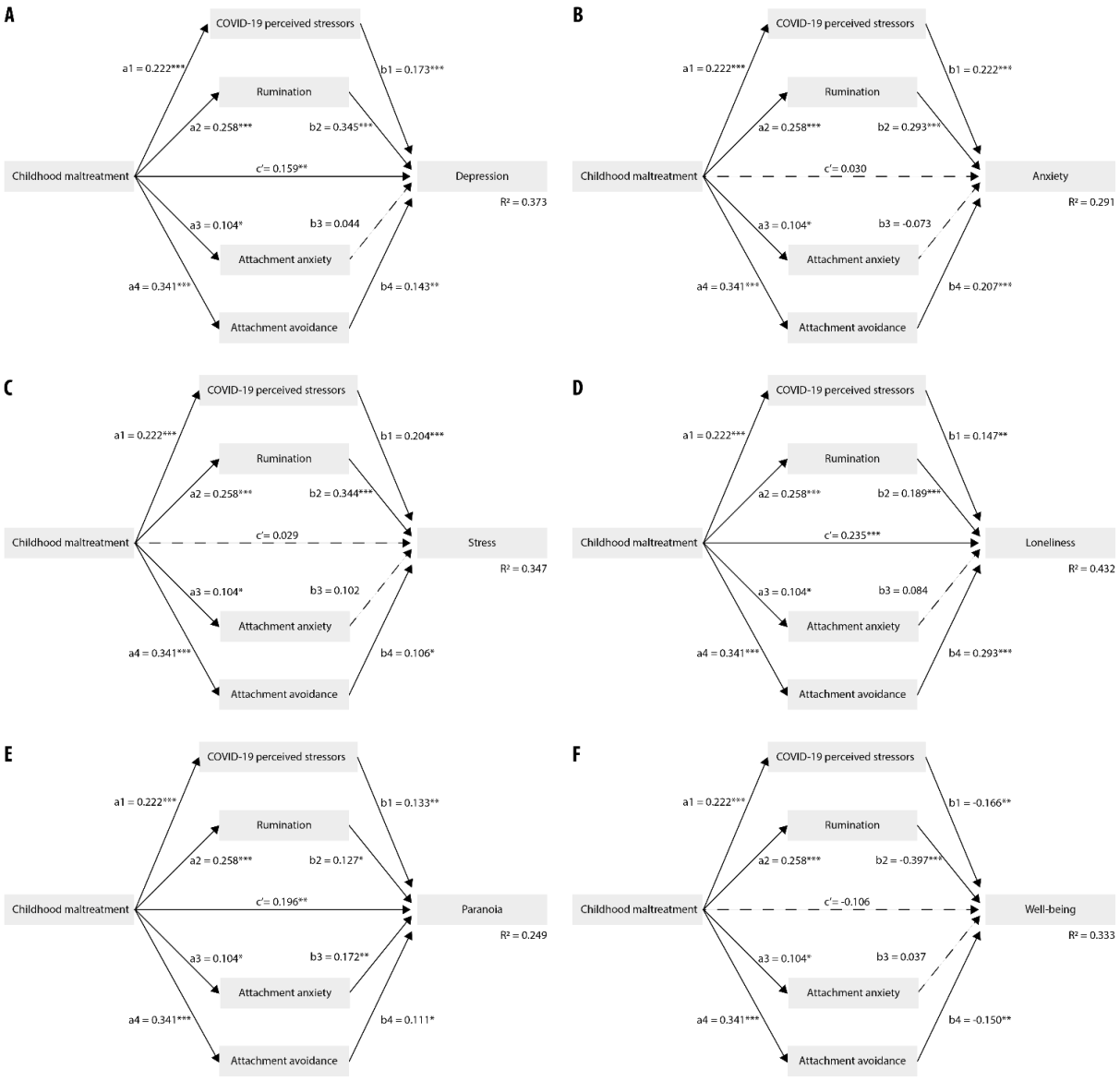
Table 3. Multiple mediation models with standardised bootstrap intervals

DV	Std. point estimate	SE	p	$p_{corrected}$	CI Lower	CI Upper	R^2
Depression							
Total (c)	0.340	0.050	<0.001	<0.001	0.185	0.383	0.373
Total indirect	0.181	0.027	<0.001	<0.001	0.100	0.206	
Specific indirect							
COVID-19 perceived stressors	0.038	0.012	0.009	0.014	0.012	0.060	
Rumination	0.089	0.018	<0.001	<0.001	0.041	0.113	
Attachment anxiety	0.005	0.005	0.474	0.511	-0.006	0.016	
Attachment avoidance	0.049	0.015	0.008	0.013	0.013	0.073	
Direct (c')	0.159	0.050	0.007	0.012	0.037	0.228	
Anxiety							
Total (c)	0.218	0.037	0.002	0.004	0.039	0.183	0.291
Total indirect	0.188	0.016	<0.001	<0.001	0.068	0.130	
Specific indirect							
COVID-19 perceived stressors	0.049	0.009	0.005	0.009	0.011	0.047	
Rumination	0.075	0.011	<0.001	0.001	0.019	0.063	
Attachment anxiety	-0.008	0.005	0.392	0.433	-0.015	0.003	
Attachment avoidance	0.070	0.011	<0.001	0.001	0.018	0.059	
Direct (c')	0.030	0.036	0.658	0.674	-0.057	0.084	
Stress							
Total (c)	0.210	0.044	<0.001	<0.001	0.070	0.243	0.347
Total indirect	0.181	0.025	<0.001	<0.001	0.088	0.186	
Specific indirect							
COVID-19 perceived stressors	0.045	0.012	0.005	0.009	0.014	0.061	
Rumination	0.089	0.016	<0.001	<0.001	0.038	0.101	
Attachment anxiety	0.011	0.006	0.172	0.201	-0.001	0.021	
Attachment avoidance	0.036	0.013	0.044	0.057	0.001	0.055	
Direct (c')	0.029	0.044	0.615	0.646	-0.065	0.107	
Loneliness							
Total (c)	0.425	0.003	<0.001	<0.001	0.019	0.032	0.432

DV	Std. point estimate	SE	p	$p_{corrected}$	CI Lower	CI Upper	R^2
Total indirect	0.190	0.002	<0.001	<0.001	0.008	0.015	
Specific indirect							
COVID-19 perceived stressors	0.033	0.001	0.010	0.015	0.001	0.004	
Rumination	0.049	0.001	0.003	0.006	0.001	0.005	
Attachment anxiety	0.009	<0.001	0.204	0.231	<0.001	0.002	
Attachment avoidance	0.100	0.001	<0.001	<0.001	0.004	0.009	
Direct (c')	0.235	0.003	<0.001	<0.001	0.008	0.02	
Paranoia							
Total (c)	0.314	0.054	<0.001	<0.001	0.136	0.347	0.249
Total indirect	0.118	0.021	<0.001	<0.001	0.051	0.134	
Specific indirect							
COVID-19 perceived stressors	0.030	0.010	0.023	0.032	0.006	0.046	
Rumination	0.033	0.013	0.054	0.067	0.001	0.053	
Attachment anxiety	0.018	0.008	0.085	0.102	0.001	0.032	
Attachment avoidance	0.038	0.015	0.047	0.060	0.001	0.059	
Direct (c')	0.196	0.053	0.004	0.008	0.046	0.255	
Psychological well-being							
Total (c)	-0.292	0.024	<0.001	<0.001	-0.176	-0.082	0.333
Total indirect	-0.186	0.014	<0.001	<0.001	-0.112	-0.057	
Specific indirect							
COVID-19 perceived stressors	-0.037	0.006	0.010	0.014	-0.031	-0.006	
Rumination	-0.102	0.011	<0.001	<0.001	-0.068	-0.027	
Attachment anxiety	0.004	0.003	0.555	0.583	-0.004	0.008	
Attachment avoidance	-0.051	0.008	0.005	0.009	-0.040	-0.008	
Direct (c')	-0.106	0.024	0.047	0.060	-0.092	0.001	

Note. DV = Dependent Variable; CI = Confidence Interval (bootstrapped); Std. = Standardised. Depicted are total, total indirect, specific indirect, and direct effects of the different multiple mediation models. $P_{corrected}$ = false discovery rate corrected p value.

Figure 1. Multiple mediation models



Note. The figure shows path diagrams for multiple mediation models for outcomes depression (A), anxiety (B), stress (C), loneliness (D), paranoia (E), and psychological well-being (F). Non-significant paths are visualised using dashed lines. Regression coefficients are standardised.

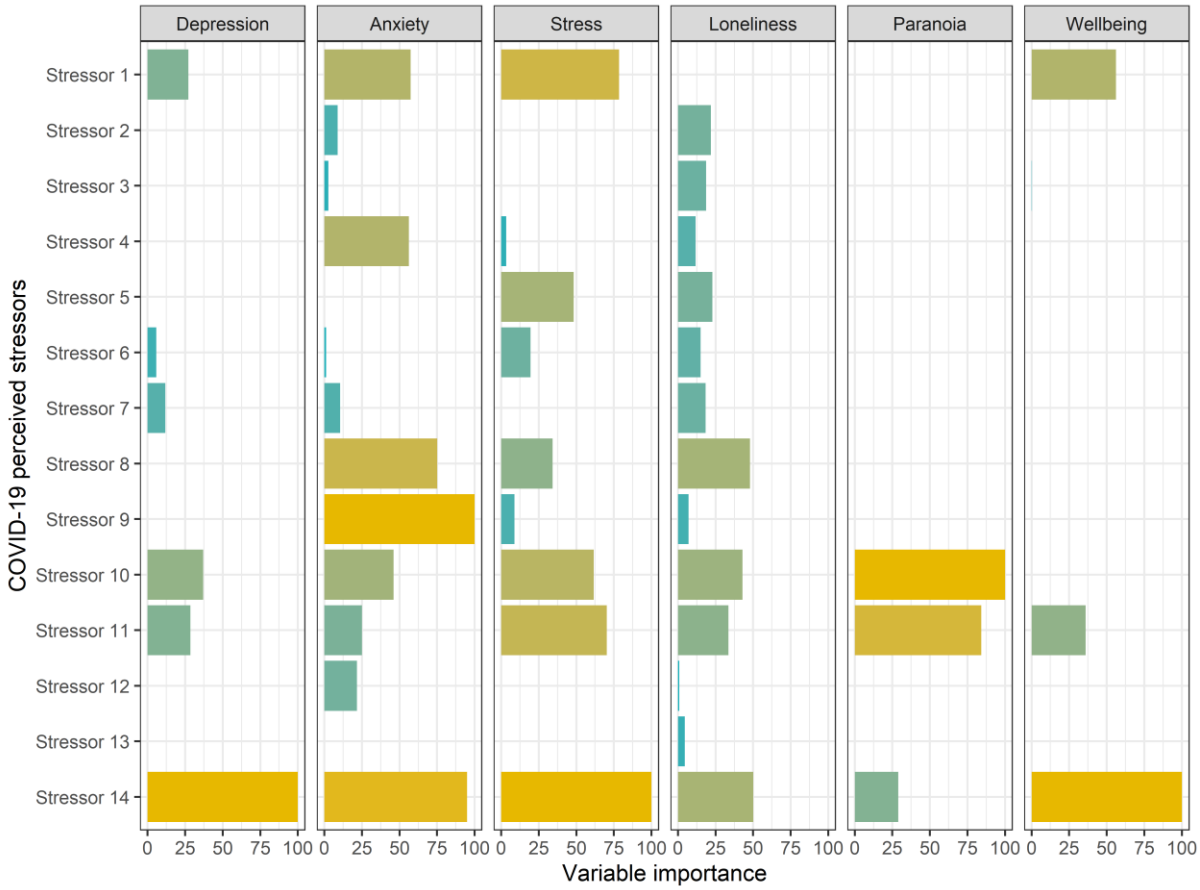
Elastic Net Regression

We explored the relative variable importance of different COVID-19 stressors in predicting psychosocial outcomes using elastic net regression and results from the selected models are depicted in Figure 2. Of note, the selected elastic net regression

model for outcome loneliness was ridge regression ($\alpha=0$), so none of the predictor variables were set exactly to zero, and LASSO ($\alpha=1$) for outcomes stress, paranoia, and wellbeing. The hyperparameter α was in between 0 to 1 for outcomes depression and anxiety reflecting the optimal balance between ridge and LASSO regression selected for these outcomes during cross-validation. Of note, analyses were adjusted for age and sex. See Supplementary Table 6 for hyperparameters of selected models.

A few COVID-19 stressors were rather consistently associated with adverse outcomes. Among them were “the current pandemic” (stressor 1), “worries of not being able to get medical care” (stressor 10), “increased conflicts with people close to me” (stressor 11), and “fears of what the future will bring, or that I won't be able to cope with everything” (stressor 14). In contrast, stressors such as “living in a small accommodation” (stressor 2), “being in home office” (stressor 7), and “uncertainties regarding my job, training place, studies or school” (stressor 13) were consistently unpredictive of adverse psychosocial outcomes. For some outcomes, the impact of COVID-19 perceived stressors was predominately associated with a few stressors that explained most of the variance. For example, levels of psychological well-being were only predicted by three COVID-19 stressors, namely “the current pandemic” (stressor 1), “increased conflicts with people close to me” (stressor 11), and “fears of what the future will bring, or that I won't be able to cope with everything” (stressor 14). For other psychosocial outcomes such as anxiety and loneliness, variable importance was rather equally distributed across stressors.

Figure 2. Relative importance of COVID-19 related stressors in predicting psychosocial outcomes



Note. Relative importance was extracted from elastic net regression models with optimal hyperparameters selected during cross-validation (see Supplementary Table 6). Analyses were adjusted for age and sex. Stressor 1 = the current pandemic, Stressor 2 = living in a small accommodation, Stressor 3 = being in quarantine, Stressor 4 = childcare, Stressor 5 = taking over school lessons, Stressor 6 = the curfew, Stressor 7 = being in home office, Stressor 8 = customer service, Stressor 9 = worries about my health, Stressor 10 = worries of not being able to get medical care, Stressor 11 = increased conflicts with people close to me, Stressor 12 = financial worries, Stressor 13 = uncertainties regarding my job, training place, studies or school, Stressor 14 = fears of what the future will bring, or that I won't be able to cope with everything.

Discussion

This prospective study scrutinised the pathway between CM and multiple key psychosocial outcomes (depression, anxiety, stress, paranoia, loneliness, and psychological well-being) during the COVID-19 pandemic regarding potential mediators: 1) COVID-19 perceived stressors, 2) rumination and 3) insecure attachment while adjusting for important confounders of age, sex, income, educational attainment, and pre-existing mental health conditions. Our findings showed that COVID-19 perceived stressors may be a robust mechanism mediating the effect between CM and adverse psychosocial outcomes during the current pandemic. We also observed that rumination and insecure attachment (particularly attachment avoidance) acted as important additional mediators of the relationship between CM and psychosocial outcomes. The relative contribution of each potential mediator suggested that rumination was most strongly associated with adverse psychosocial outcomes. Of note, full mediation was observed for anxiety, stress and psychological well-being but not depression, paranoia, and loneliness. Taken together, our study adds to the accumulating research that highlights the importance of considering early adverse experiences when evaluating the psychological response to the current pandemic (21-23, 28, 62). In addition, our findings suggest two important modifiable therapeutic targets, i.e. rumination and COVID-19 perceived stressors, the latter being specific to the pandemic for prevention and treatment efforts.

Our findings correspond well to the stress sensitisation hypothesis (27), which argues that early adverse experiences lead to stress sensitisation making individuals more reactive to later stressors and, thus, increasing the susceptibility for adult psychopathology. Indisputable, the current pandemic and associated countermeasures pose a heavy strain on many individuals with anxieties about the disease, temporary closures of educational institutes, enforced social isolation, job losses, and financial difficulties to name only a few of the many stressors associated with the pandemic. Our findings show that the subjective perception of such COVID-19 related stressors matters in the relationship between CM and later adverse psychosocial outcomes during the pandemic. Moreover, we show that the impact of some stressors may be more relevant than others. Here, our explorative analyses highlight that perceived stress related to the pandemic itself, interpersonal conflicts, concerns about medical care resources, and worries about the future were among the stressors that mattered most for almost all adverse psychosocial outcomes. In sum, these results advance previous research on the relationship between CM and later adverse psychosocial outcomes by quantifying the relevance of perceived stressors specific to the pandemic (29).

For the outcomes of depression, loneliness, and paranoia, we observed only partial mediation suggesting that other mechanisms may be relevant to explain the relationship between early CM experiences and later adverse psychosocial outcomes. In our study, we focused on relatively established subjective psychological mediators of perceived stressors (specific to the COVID-19 pandemic), rumination, and insecure attachment. Yet, there may be other potentially relevant psychological but also biological mediators of the relationship that we did not assess and which may help to identify additional factors that are amenable to treatment. Psychologically, for instance, recent research has highlighted the importance of perceived lack of social support during the current pandemic (64) and its transdiagnostic importance has also been discussed before the pandemic (14). Biologically, proinflammatory processes have been implicated in depressive symptomology specifically (65,66) and are proposed to explain the link between CM and later depression (67–69). As such, our study may have benefitted from inclusion of these factors and future longitudinal research should test their relative relevance in mediating the relationship between CM and later psychopathology in order to identify specific factors that can be therapeutically targeted.

Strengths and limitations

Strengths of the present study include i) the prospective study design, ii) assessment of perceived stressors specifically related to the COVID-19 pandemic, iii) simultaneous integration of established mediators of insecure attachment and rumination, iv) sophisticated analytical techniques, and v) inclusion of a broad array of key psychosocial outcomes. Yet, the study also has some important limitations. First, assessments are based exclusively on self-report questionnaires, so future research would benefit from inclusion of observer-based ratings, for example, by conducting structured interviews to assess attachment using the gold standard Adult Attachment Interview (70) or the Adult Attachment Projective (71). Second, although we report prospective data, only two timepoints of a 10-week time window were included and CM was assessed retrospectively. As several studies have shown a discrepancy between prospective and retrospective measures of CM (72,73), one has to be aware that CM scores always represent a subjective recall of adverse events during childhood which does not mean that this recall is invalid or less relevant. However, to minimise a potential recall bias, for example, due to current mood, we adjusted for self-reported life time mental health diagnoses. Yet, there may be other important confounders, for which we did not control. We also did not assess the specific forms, duration, or frequency of CM, which may be important moderators but beyond the scope of the present study. Third, assessments of COVID-19-specific stressors and mental health outcomes were made between April 2020 and May 2021, when the COVID-19 pandemic and related countermeasures varied in

Germany (ranging from lockdowns to easing of restrictions to distribution of vaccines). This changing external context and the associated psychological response could confound analyses and complicates pinpointing the exact impact of specific stressors over time. Finally, we report data of an online survey unrepresentative of the German population, in which female sex and relatively young participants were overrepresented. Therefore, replication in more representative or cross-national samples would allow for greater generalisability of findings.

Conclusion

The current prospective study investigated the impact of CM on later adverse psychosocial outcomes during the COVID-19 pandemic. After adjusting for key confounding variables, we showed that subjective perception of COVID-19 stressors matters in the psychological response to the pandemic in addition to more established mediators of rumination and insecure attachment. Our findings underscore the importance of stress sensitisation in childhood trauma-exposed individuals that is also present in the current pandemic. Importantly, identified mediators of COVID-19 perceived stressors, rumination, and insecure attachment fully explain the relationship between CM and anxiety, stress or psychological well-being and are amenable to psychological interventions. Thus, researchers and clinicians who encounter patients with a history of CM during the pandemic are advised to assess these key psychological mediators for more targeted prevention and treatment efforts in order to prevent deterioration of mental health.

Acknowledgment

We are grateful to individuals participating in the NEAR-Survey. We also thank Dr. Marcel Minke from Limesurvey-Consulting.com for the support in database set-up and data acquisition. This work was supported by the Network of Academic Medical Research into COVID-19 (Netzwerk Universitätsmedizin - NUM; grant number 01KX2021), funded by the Federal Ministry of Education and Research (BMBF).

Conflicts of Interest

Prof. Padberg reports personal fees and non-financial support from Mag & More GmbH, Munich, Germany, personal fees and non-financial support from Brainsway Inc., Jerusalem, Israel, personal fees and non-financial support from neuroConn GmbH, Ilmenau, Germany, outside the submitted work. The other authors declare no competing interests.

Author contributions

SR, MR and FP contributed to the study conception and design. Material preparation, data collection and analysis were performed by SR, MB and FP. The first draft of the manuscript was written by SR and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

References

1. Holmes EA, O'Connor RC, Perry VH, Tracey I, Wessely S, Arseneault L, et al. Multidisciplinary research priorities for the COVID-19 pandemic: a call for action for mental health science. The Lancet Psychiatry. 2020;547–60.
2. Rek S V, Freeman D, Reinhard MA, Bühner M, Grosen S, Falkai P, et al. Differential psychological response to the COVID - 19 pandemic in psychiatric inpatients compared to a non - clinical population from Germany. Eur Arch Psychiatry Clin Neurosci [Internet]. 2021; Available from: https://doi.org/10.1007/s00406-021-01291-7
3. Pierce M, Hope H, Ford T, Hatch S, Hotopf M, John A, et al. Mental health before and during the COVID-19 pandemic: a longitudinal probability sample survey of the UK population. The Lancet Psychiatry. 2020;7(10):883–92.
4. Shanahan L, Steinhoff A, Bechtiger L, Murray AL, Nivette A, Hepp U, et al. Emotional distress in young adults during the COVID-19 pandemic: Evidence of risk and resilience from a longitudinal cohort study. Psychol Med. 2020;1–10.
5. Robinson E, Sutin AR, Daly M, Jones A. A systematic review and meta-analysis of longitudinal cohort studies comparing mental health before versus during the COVID-19 pandemic. medRxiv. 2021;
6. Shevlin M, Butter S, McBride O, Murphy J, Gibson-Miller J, Hartman TK, et al. Refuting the myth of a 'tsunami'of mental ill-health in populations affected by COVID-19: Evidence that response to the pandemic is heterogenous, not homogeneous. Psychol Med. 2021;1–30.
7. Luchetti M, Lee JH, Aschwanden D, Sesker A, Strickhouser JE, Terracciano A, et al. The trajectory of loneliness in response to COVID-19. Am Psychol. 2020;
8. Bu F, Steptoe A, Fancourt D. Loneliness during a strict lockdown: Trajectories and predictors during the COVID-19 pandemic in 38,217 United Kingdom adults. Soc Sci Med. 2020;265:113521.
9. Fancourt D, Steptoe A, Bu F. Trajectories of anxiety and depressive symptoms during enforced isolation due to COVID-19 in England: a longitudinal observational study. The Lancet Psychiatry. 2021;8(2):141–9.
10. Saunders R, Buckman JEJ, Fonagy P, Fancourt D. Understanding different trajectories of mental health across the general population during the COVID-19 pandemic. Psychol Med. 2021;1–9.

11. van Zyl LE, Rothmann S, Zondervan-Zwijnenburg MAJ. Longitudinal trajectories of study characteristics and mental health before and during the COVID-19 lockdown. Front Psychol. 2021;12.

12. Iob E, Frank P, Steptoe A, Fancourt D. Levels of severity of depressive symptoms among at-risk groups in the UK during the COVID-19 pandemic. JAMA Netw open. 2020;3(10):e2026064–e2026064.

13. Keyes KM, Eaton NR, Krueger RF, McLaughlin KA, Wall MM, Grant BF, et al. Childhood maltreatment and the structure of common psychiatric disorders. Br J Psychiatry. 2012;200(2):107–15.

14. McLaughlin KA, Colich NL, Rodman AM, Weissman DG. Mechanisms linking childhood trauma exposure and psychopathology: a transdiagnostic model of risk and resilience. BMC Med. 2020;18:1–11.

15. Nelson CA, Scott RD, Bhutta ZA, Harris NB, Danese A, Samara M. Adversity in childhood is linked to mental and physical health throughout life. bmj. 2020;371.

16. Albott CS, Forbes MK, Anker JJ. Association of childhood adversity with differential susceptibility of transdiagnostic psychopathology to environmental stress in adulthood. JAMA Netw open. 2018;1(7):e185354–e185354.

17. Li M, D'arcy C, Meng X. Maltreatment in childhood substantially increases the risk of adult depression and anxiety in prospective cohort studies: systematic review, meta-analysis, and proportional attributable fractions. Psychol Med. 2016;46(4):717–30.

18. Varese F, Smeets F, Drukker M, Lieverse R, Lataster T, Viechtbauer W, et al. Childhood adversities increase the risk of psychosis: a meta-analysis of patient-control, prospective-and cross-sectional cohort studies. Schizophr Bull. 2012;38(4):661–71.

19. Hughes K, Lowey H, Quigg Z, Bellis MA. Relationships between adverse childhood experiences and adult mental well-being: results from an English national household survey. BMC Public Health. 2016;16(1):1–11.

20. Chi X, Becker B, Yu Q, Willeit P, Jiao C, Huang L, et al. Prevalence and psychosocial correlates of mental health outcomes among chinese college students during the coronavirus disease (covid-19) pandemic. Front psychiatry. 2020;11:803.

21. Lahav Y. Psychological distress related to COVID-19–the contribution of continuous traumatic stress. J Affect Disord. 2020;277:129–37.

22. Tsur N, Abu-Raiya H. COVID-19-related fear and stress among individuals who experienced child abuse: The mediating effect of complex posttraumatic stress disorder. Child Abuse Negl. 2020;110:104694.

23. Guo J, Fu M, Liu D, Zhang B, Wang X, van IJzendoorn MH. Is the psychological impact of exposure to COVID-19 stronger in adolescents with pre-pandemic maltreatment experiences? A survey of rural Chinese adolescents. Child Abuse Negl. 2020;110:104667.

24. Kim AW, Nyengerai T, Mendenhall E. Evaluating the mental health impacts of the COVID-19 pandemic: perceived risk of COVID-19 infection and childhood trauma predict adult depressive symptoms in urban South Africa. Psychol Med. 2020;1–13.

25. Heim CM, Entringer S, Buss C. Translating basic research knowledge on the biological embedding of early-life stress into novel approaches for the developmental programming of lifelong health. Psychoneuroendocrinology. 2019;105:123–37.

26. Tiwari A, Gonzalez A. Biological alterations affecting risk of adult psychopathology following childhood trauma: a review of sex differences. Clin Psychol Rev. 2018;66:69–79.

27. Hammen C, Henry R, Daley SE. Depression and sensitization to stressors among young women as a function of childhood adversity. J Consult Clin Psychol. 2000;68(5):782.

28. Berens AE, Jensen SKG, Nelson CA. Biological embedding of childhood adversity: from physiological mechanisms to clinical implications. BMC Med. 2017;15(1):1–12.

29. Gotlib IH, Borchers LR, Chahal R, Gifuni AJ, Ho T. Early Life Stress Predicts Depressive Symptoms in Adolescents During the COVID-19 Pandemic: The Mediating Role of Perceived Stress. Available SSRN 3606441. 2020;

30. Weissman DG, Bitran D, Miller AB, Schaefer JD, Sheridan MA, McLaughlin KA. Difficulties with emotion regulation as a transdiagnostic mechanism linking child maltreatment with the emergence of psychopathology. Dev Psychopathol. 2019;31(3):899.

31. Mansueto G, Cavallo C, Palmieri S, Ruggiero GM, Sassaroli S, Caselli G. Adverse childhood experiences and repetitive negative thinking in adulthood: a systematic review. Clin Psychol Psychother. 2021;

32. LeMoult J, Humphreys KL, King LS, Colich NL, Price AN, Ordaz SJ, et al. Associations among early life stress, rumination, symptoms of psychopathology, and sex in youth

in the early stages of puberty: A moderated mediation analysis. J Abnorm Child Psychol. 2019;47(2):199–207.

33. Ein-Dor T, Viglin D, Doron G. Extending the transdiagnostic model of attachment and psychopathology. Front Psychol. 2016;7:484.

34. Healy C, Eaton A, Cotter I, Carter E, Dhondt N, Cannon M. Mediators of the longitudinal relationship between childhood adversity and late adolescent psychopathology. Psychol Med. 2021;1–9.

35. Association GA of the WM. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. J Am Coll Dent. 2014;81(3):14.

36. Bernstein DP, Fink L, Handelsman L, Foote J. Childhood trauma questionnaire. Assess Fam violence A Handb Res Pract. 1998;

37. Klinitzke G, Romppel M, Häuser W, Brähler E, Glaesmer H. The German Version of the Childhood Trauma Questionnaire (CTQ): psychometric characteristics in a representative sample of the general population. Psychother Psychosom Med Psychol. 2011;62(2):47–51.

38. Rek SV, Freeman D, Reinhard M, Bühner M, Keeser D, Padberg F. The COVID-19 Pandemic Mental Health Questionnaire (CoPaQ): Introducing a comprehensive measure of the psychosocial impact of the current coronavirus crisis. Open Sci Framew. 2020;

39. Rek S V, Bühner M, Reinhard MA, Freeman D, Keeser D, Adorjan K, et al. The COVID-19 Pandemic Mental Health Questionnaire (CoPaQ): Psychometric Evaluation and Compliance with Countermeasures in Psychiatric Inpatients and Non-clinical Individuals. 2021;

40. Ehring T, Zetsche U, Weidacker K, Wahl K, Schönfeld S, Ehlers A. The Perseverative Thinking Questionnaire (PTQ): Validation of a content-independent measure of repetitive negative thinking. J Behav Ther Exp Psychiatry. 2011;42(2):225–32.

41. Griffin DW, Bartholomew K. The metaphysics of measurement: The case of adult attachment. 1994;

42. Steffanowski A, Oppl M, Meyerberg J, Schmidt J, Wittmann WW, Nübling R. Psychometrische Überprüfung einer deutschsprachigen version des relationship scales questionnaire (RSQ). Störungsspezifische Ther der Station Psychother Giess Psychosoz Verlag. 2001;320–42.

43. Roisman GI, Holland A, Fortuna K, Fraley RC, Clausell E, Clarke A. The Adult Attachment Interview and self-reports of attachment style: an empirical rapprochement. J Pers Soc Psychol. 2007;92(4):678.

44. Henry JD, Crawford JR. The short-form version of the Depression Anxiety Stress Scales (DASS-21): Construct validity and normative data in a large non-clinical sample. Br J Clin Psychol. 2005;44(2):227–39.

45. Nilges P, Essau C. Die Depressions-Angst-Stress-Skalen. Der Schmerz. 2015;29(6):649–57.

46. Lovibond PF, Lovibond SH. Depression anxiety and stress scales. Behav Res Ther. 1995;

47. Antony MM, Cox BJ, Enns MW, Bieling PJ, Swinson RP. Psychometric properties of the 42-item and 21-item versions of the Depression Anxiety Stress Scales in clinical groups and a community sample. Psychol Assess. 1998;10(2):176–81.

48. Freeman D, Loe BS, Kingdon D, Startup H, Molodynski A, Rosebrock L, et al. The revised Green et al. , Paranoid Thoughts Scale (R-GPTS): psychometric properties, severity ranges, and clinical cut-offs . Psychol Med. 2019;1–10.

49. Rek SV, Freeman D, Reinhard M, Bühner M, Padberg F. Psychometric evaluation of the German Revised-Green et al. Paranoid Thought Scales (R-GPTS) across clinical and non-clinical samples. Prep. 2021;

50. Brislin RW. Back-translation for cross-cultural research. J Cross Cult Psychol. 1970;1(3):185–216.

51. Russell D, Peplau LA, Cutrona CE. The revised UCLA Loneliness Scale: Concurrent and discriminant validity evidence. J Pers Soc Psychol. 1980;39(3):472–80.

52. Döring N, Bortz J. Psychometrische Einsamkeitsforschung: Deutsche Neukonstruktion der UCLA Loneliness Scale. Diagnostica. 1993;

53. Organization WH. Wellbeing measures in primary health care/the DEPCARE project: report on a WHO meeting, Stockholm, Sweden 12-13 February 1998. In: Wellbeing measures in primary health care/the DEPCARE project: report on a WHO meeting, Stockholm, Sweden 12-13 February 1998. 1998.

54. Brähler E, Mühlan H, Albani C, Schmidt S. Teststatistische prüfung und normierung der deutschen versionen des EUROHIS-QOL lebensqualität-Index und des WHO-5 wohlbefindens-index. Diagnostica. 2007;53(2):83–96.

55. Topp CW, Østergaard SD, Søndergaard S, Bech P. The WHO-5 Well-Being Index: a systematic review of the literature. Psychother Psychosom. 2015;84(3):167–76.

56. Team RC. R: A language and environment for statistical computing. 2013;

57. Revelle W, Revelle MW. Package 'psych.' Compr R Arch Netw. 2015;

58. Rosseel Y. Lavaan: An R package for structural equation modeling and more. Version 0.5–12 (BETA). J Stat Softw. 2012;48(2):1–36.

59. Friedman J, Hastie T, Tibshirani R. Regularization paths for generalized linear models via coordinate descent. J Stat Softw. 2010;33(1):1.

60. Thissen D, Steinberg L, Kuang D. Quick and easy implementation of the Benjamini-Hochberg procedure for controlling the false positive rate in multiple comparisons. J Educ Behav Stat. 2002;27(1):77–83.

61. Zou H, Hastie T. Regularization and variable selection via the elastic net. J R Stat Soc Ser B (statistical Methodol. 2005;67(2):301–20.

62. Tibshirani R. Regression shrinkage and selection via the lasso. J R Stat Soc Ser B. 1996;58(1):267–88.

63. Hoerl AE, Kennard RW. Ridge regression: Biased estimation for nonorthogonal problems. Technometrics. 1970;12(1):55–67.

64. Seitz KI, Bertsch K, Herpertz SC. A Prospective Study of Mental Health During the COVID-19 Pandemic in Childhood Trauma–Exposed Individuals: Social Support Matters. J Trauma Stress. 2021;

65. Kappelmann N, Lewis G, Dantzer R, Jones PB, Khandaker GM. Antidepressant activity of anti-cytokine treatment: a systematic review and meta-analysis of clinical trials of chronic inflammatory conditions. Mol Psychiatry. 2018;23(2):335–43.

66. Milaneschi Y, Kappelmann N, Ye Z, Lamers F, Moser S, Jones PB, et al. Association of Inflammation with Depression and Anxiety: Evidence for Symptom-Specificity and Potential Causality from UK Biobank and NESDA Cohorts. medRxiv. 2021;

67. Baumeister D, Akhtar R, Ciufolini S, Pariante CM, Mondelli V. Childhood trauma and adulthood inflammation: a meta-analysis of peripheral C-reactive protein, interleukin-6 and tumour necrosis factor-α. Mol Psychiatry. 2016;21(5):642–9.

68. Slavich GM, Irwin MR. From stress to inflammation and major depressive disorder: a social signal transduction theory of depression. Psychol Bull. 2014;140(3):774.

69. Nemeroff CB. The state of our understanding of the pathophysiology and optimal treatment of depression: Glass half full or half empty? Am J Psychiatry. 2020;177(8):671–85.

70. George C, Kaplan N, Main M. Attachment interview for adults. Unpubl manuscript, Univ California, berkeley. 1985;

71. Bauriedl-Schmidt C, Jobst A, Gander M, Seidl E, Sabaß L, Sarubin N, et al. Attachment representations, patterns of emotion regulation, and social exclusion in patients with chronic and episodic depression and healthy controls. J Affect Disord. 2017;210:130–8.

72. Baldwin JR, Reuben A, Newbury JB, Danese A. Agreement Between Prospective and Retrospective Measures of Childhood Maltreatment A Systematic Review and Meta-analysis. 2019;76(6):584–93.

73. Danese A, Widom CS. Objective and subjective experiences of child maltreatment and their relationships with psychopathology. Nat Hum Behav. 2020;4(8):811–8.

Acknowledgements

I am incredibly grateful to all the people who joined me on my PhD journey over the past three years.

First, I thank my supervisors for their continued support and guidance. As my first TAC member, I want to thank Frank Padberg for taking over the role as my primary supervisor, for his commitment, and particularly for sharing his knowledge and perspectives on clinical research and who helped me jump on the COVID-19 research train as quickly as we did. As my second TAC member, I want to thank Daniel Freeman who has been an incredible and continuous source of guidance, mentorship, and support since my Masters. His tremendous research expertise combined with his great sense of humour as well as sensitive and empathic nature have been invaluable. As my third TAC member, I want to thank Peter Falkai for insightful discussions and supervision during our TAC meetings, which has helped train my scientist-practitioner eye. As my fourth TAC member, I want to thank Markus Bühner for his kindness and in-depth methodological knowledge and supervision, which has definitively helped to strengthen my research. Finally, I want to thank my colleagues and co-authors for their help with my PhD projects and the supportive and collective environment at the clinic. There are too many people to mention, but I want to explicitly thank Matthias Reinhard for his kindness, calm and soothing nature, and his continued support and reliability.

I can also consider myself very lucky to have such fantastic family and friends in my private life who helped to ease more difficult phases during my PhD. In particular, I would like to thank Katharina Rek and Benjamin Weweck together with their wonderful little daughter Romy as well as Isabelle and Andreas von Loe and their incredibly cute twins Amelie and Moritz: All of you enrich my life in every single aspect! Thank you, Katharina, for always standing up for me like a lioness and your continued support during good and bad times over the past three years. Last but certainly not least, I would like to thank my super intelligent, creative, and caring partner Nils Kappelmann - his support is beyond words. You are my beloved and safe anchor and I hope you always will be!