
Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Journal of Affective Disorders 315 (2022) 70–95

Contents lists available at ScienceDirect

Journal of Affective Disorders

journal homepage: www.elsevier.com/locate/jad

# The global evolution of mental health problems during the COVID-19 pandemic: A systematic review and meta-analysis of longitudinal studies

Jude Mary Cénat [a,*], Seyed Mohammad Mahdi Moshirian Farahi [b], Rose Darly Dalexis [c], Wina Paul Darius [a], Farid Mansoub Bekarkhanechi [d], Hannah Poisson [d], Cathy Broussard [a], Gloria Ukwu [a], Emmanuelle Auguste [a], Duy Dat Nguyen [a], Ghizlène Sehabi [a], Sarah Elizabeth Furyk [a], Andi Phaelle Gedeon [a], Olivia Onesi [a], Aya Mesbahi El Aouame [a], Samiyah Noor Khodabocus [a], Muhammad S. Shah [d], Patrick R. Labelle [e]

[a] School of Psychology, University of Ottawa, Ontario, Canada
[b] Department of Psychology, Carleton University, Ontario, Canada
[c] Interdisciplinary School of Health Sciences, University of Ottawa, Ontario, Canada
[d] Faculty of Medicine, University of Ottawa, Ontario, Canada
[e] Library, University of Ottawa, Ottawa, Ontario, Canada

ARTICLE INFO

*Keywords:*
COVID-19 pandemic
Mental health problems
meta-analysis
Longitudinal studies

ABSTRACT

*Background:* The COVID-19 pandemic impacted mental health, but the global evolution of mental health problems during the pandemic is unknown. We conducted a systematic review and meta-analysis of longitudinal studies to evaluate the global evolution of mental health problems during the pandemic.

*Methods:* To conduct this systematic review, we searched for published articles from APA PsycInfo (Ovid), CINAHL (EBSCOhost), Embase (Ovid), MEDLINE (Ovid), and Web of Science. Longitudinal (at least 2 waves during the COVID-19 pandemic) and peer-reviewed articles on mental health problems conducted as from 2020 and after were included in the current study. Of 394 eligible full texts, 64 articles were included in the analysis. We computed random effects, standardized mean differences, and log odds ratio (LOR) with 95 % CIs. The meta-analysis protocol was registered with PROSPERO (CRD42021273624).

*Results:* Results showed that anxiety (LOR = −0.33; 95 % CI, −0.54, −0.12) and depression symptoms (LOR = −0.12; 95 % CI, −0.21, −0.04) decreased from baseline to follow up. However, other mental health problems showed no change. Higher prevalence rates (40.9 %; 95 % CI, 16.1 %–65.8 %) of psychological distress were found in months after July 2020, respectively, while there were no significant month differences for the prevalence of other mental health problems. Higher means of anxiety ($d$ = 3.63, 95 % CI, 1.66, 5.61), depression ($d$ = 3.93; 95 % CI, 1.68, 6.17), and loneliness ($d$ = 5.96; 95 % CI, 3.22, 8.70) were observed in May 2020. Higher prevalence of anxiety, depression, and PTSD and higher means of anxiety, depression and loneliness were observed in North America. The prevalence of psychological distress and insomnia was higher in Latin America and Europe, respectively.

*Limitations:* There is a lack of longitudinal studies in some parts of the world, such as Africa, the Caribbean, India, the Middle East, in Latin America, and Asia.

*Conclusions:* Results indicated that anxiety and depression symptoms decreased during the COVID-19 pandemic while other mental health problems showed no statistical change. The findings reveal that mental health problems peaked in April and May 2020. Prevalence of mental health problems remains high during the pandemic and mental health prevention, promotion and intervention programs should be implemented to mitigate the consequences of the COVID-19 pandemic on the global population.

* Corresponding author at: School of Psychology (Clinical), University of Ottawa, 136 Jean-Jacques-Lussier, 4017, Vanier Hall, Ottawa, Ontario K1N 6N5, Canada.
*E-mail address:* jcenat@uottawa.ca (J.M. Cénat).

https://doi.org/10.1016/j.jad.2022.07.011
Received 1 February 2022; Received in revised form 17 June 2022; Accepted 7 July 2022
Available online 14 July 2022

## 1. Introduction

As of December 1, 2021, there have been over 263.5 million confirmed cases of SARS-CoV-2, with >5.2 million deaths worldwide (John Hopkins University, 2021). COVID-19 has had significant impacts on the mental health of affected populations, regardless of age and gender (Cénat et al., 2021; Racine et al., 2021; Zhao et al., 2021). A meta-analysis of 65 longitudinal studies comparing the changes in mental health problems before and during the COVID-19 pandemic showed a significant increase in anxiety, depression, and general mental health symptoms (Robinson et al., 2022). Meta-analyses of studies among different populations have shown that mental health problems, including depression, anxiety, PTSD, psychological distress, sleep problems, and substance use disorders, have increased during the pandemic (Cénat et al., 2021; Pappa et al., 2020; Prati and Mancini, 2021; Sideli et al., 2021). A meta-analysis of 29 studies conducted on children and adolescents in 11 countries (Brazil, Canada, China, Ecuador, Germany, Greece, Italy, Jordan, Portugal, Spain, and the US) showed that symptoms of severe anxiety and depression were twice as high during the pandemic than they were before (Racine et al., 2021).

However, longitudinal studies conducted during the pandemic have not yielded conclusive results. While some studies showed that symptoms of mental health problems tended to decrease over time (Batterham et al., 2021), others showed the opposite or stable conditions (Shevlin et al., 2021a). The successive waves of the COVID-19 pandemic led public health authorities and governments to take unprecedented measures of classroom closure, remote work, confinement, deconfinement, reconfinement, and physical distancing, which could explain disturbances in the mental health of different segments of the population (Jüni et al., 2020; Kamerlin and Kasson, 2020; Primc and Slabe-Erker, 2020). In addition, the stress associated with the infection of relatives, the risk of being infected, social isolation, economic crisis, financial insecurity, and impoverishment of vulnerable populations are factors that put the public at risk of developing symptoms of mental health disorders (Bel et al., 2021; Buheji et al., 2020; Cénat et al., 2020a; Cheng et al., 2021; Kim and Ryu, 2021). However, given the heterogeneity of the longitudinal results, an effort to summarize the current findings is necessary to examine the evolution of the mental health of the world population throughout the COVID-19 pandemic.

Numerous systematic reviews have been conducted on mental health problems during the COVID-19 pandemic(Cénat et al., 2021; Pappa et al., 2020; Prati and Mancini, 2021; Santabárbara et al., 2021; Sideli et al., 2021), including two comparing mental health problems before and after (Prati and Mancini, 2021; Robinson et al., 2022). However, to our knowledge, none has documented how mental health problems have evolved during the pandemic. The current study aims to assess the global evolution of mental health problems during the COVID-19 pandemic. We conducted: 1) meta-analyses of the global evolution of the prevalence of clinically significant symptoms of depression, anxiety, PTSD, psychological distress, from March 2020; 2) meta-analyses of the global evolution of symptoms of depression and anxiety using mean scores. For both prevalence of clinically significant symptoms and mean scores, we also examined differences between gender, age, geography, and measures used.

## 2. Methods

### 2.1. Protocol and registration

The meta-analysis project was registered with PROSPERO (CRD42021273624). No similar systematic reviews were registered. The last version of the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) reporting guideline was used (see Fig. 1) ("Comprendre la loi traitant de violence et de harcèlement au travail |

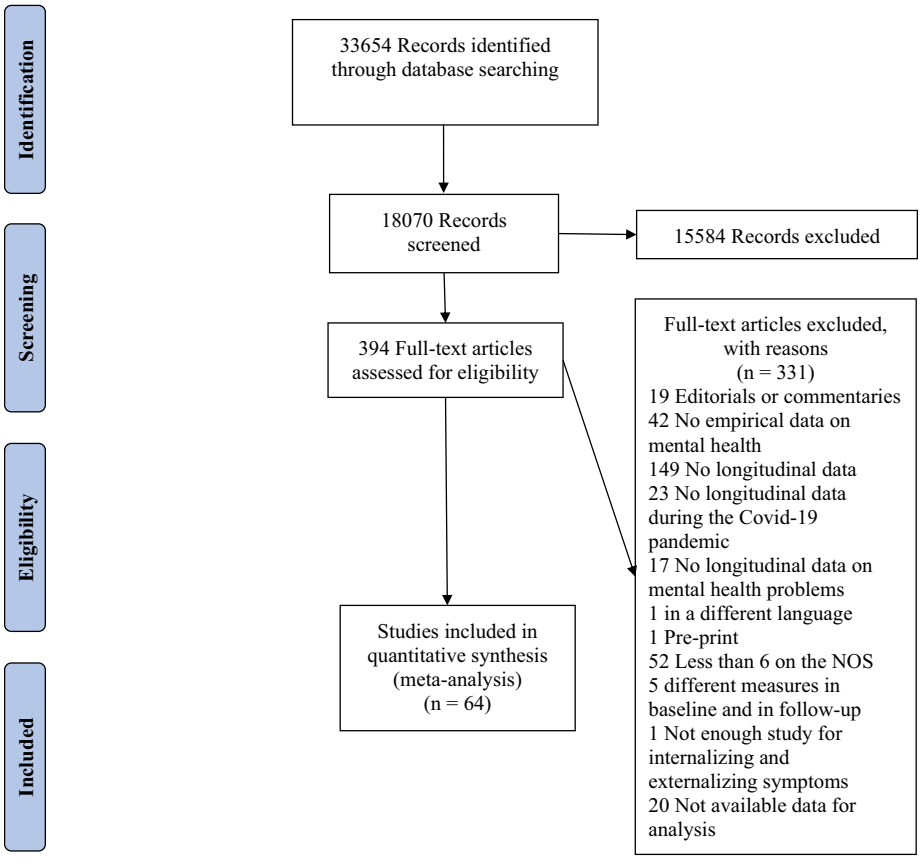



**Fig. 1.** PRISMA chart for the meta-analysis search process.

Ontario.ca," n.d.) (Page et al., 2021).

### 2.2. Identification and Selection of Studies

This meta-analysis focuses on mental health problems during the COVID-19 pandemic as reported specifically through longitudinal studies. A research librarian with experience in planning systematic reviews assisted in drafting, developing, and implementing a search strategy to find pertinent published articles in APA PsycInfo (Ovid), CINAHL (EBSCOhost), Embase (Ovid), MEDLINE (Ovid), and Web of Science (see online materials, eMethods: Search strategy). The strategy from a previous meta-analysis served as a basis for the one developed for this current review (Cénat et al., 2021). It was also informed, in part, by examining reviews related to COVID-19 (Helliwell et al., 2020; Levay and Finnegan, 2021; Nussbaumer-Streit et al., 2020) and focused on psychological distress (Brooks et al., 2016; Thekkumpurath et al., 2008; Wade et al., 2016). Additionally, it was done by consulting COVID-19 search strategies used by other information professionals (compiled by the Medical Library Association; Lalonde, 2020). Search filters on longitudinal and observational studies were also considered when designing search lines related to this aspect of the research question (Li et al., 2019; Healthcare Improvement Scotland, n.d.). The final search strategy was executed on September 1, 2021, and it included relevant subject headings and keywords. Database results were limited to those published from 2020. To complement the database searches, a simpler strategy was used to find a reference on LitCovid - an up-to-date curated list of references related to research on COVID-19. The complete search strategy is available in Supplementary File 1. Citations were imported into Covidence™, an online tool used to manage various steps of a systematic review's screening phases. Duplicate references were identified and removed once imported into Covidence. Additional duplicates were identified and excluded while screening references.

### 2.3. Inclusion and exclusion criteria

Our inclusion criteria consisted of the following: 1) conducted as from 2020 (we decided to consider the studies from January although the pandemic was declared in March in order to have a better consideration for those conducted in China), 2) using a longitudinal design with at least two-time points during the COVID-19 pandemic, 3) conducted on mental health problems such as depression, anxiety, psychological distress, insomnia, PTSD, and substance use, and 4) published in a peer-reviewed journal. Only quantitative studies conducted with validated self-reported questionnaires or structured clinical interviews in person or online were included. We excluded studies with the following criteria: 1) only conducted during a one-time point during the COVID-19 pandemic, 2) used a cross-sectional method, 3) a psychological/medical intervention was used, and 4) preprint articles.

### 2.4. Steps for selection

Using the five databases, we found 33,654 articles, which were imported into the Covidence™ tool. After removing the duplicates, the title and abstract of 18,070 studies were screened. A total of 394 full-text studies were assessed for eligibility, while 253 of them were rejected for different reasons (20 editorials or commentaries; 42 no empirical data on mental health; 149 no longitudinal data; 23 no longitudinal data during the COVID-19 pandemic; 17 no longitudinal data on mental health problems; one in a different language; one preprint). A total of 141 articles were retained for evaluation of quality, and 52 were excluded for having scores less than six on the Newcastle-Ottawa Scale (NOS). Finally, 25 other articles were excluded for different reasons (19 no available data for analysis; five different measures were used in the baseline and the follow-up; one not enough study for internalizing and externalizing symptoms). Consequently, 64 articles were included in the current study. Fig. 1 presents the PRISMA chart.

The different selection steps including title-abstract and full-text screening, data extraction, and assessment of quality were conducted by pairs of coders consisting of 16 V-TRaC Lab members (EA, FMB, SF, OO, DN, MS, HP, GS, CB, PJ, GU, APG, GR, MKR, AM, SK). Disagreements in screening and coding were resolved by four authors (JMC, SMMMF, RDD, WPD).

### 2.5. Data extraction and management

The 16 V-TRaC Lab members were trained to extract data by a research librarian and the first author. The extracted data included: authors, publication date, country, geographical region, time intervals between the baseline and the last follow-up, time interval between each time point, number of time points, sample size at each time point, female sample size at each time point, means (SD) of age at baseline, measures and their cut-off scores (if applicable), number of individuals with depression, anxiety, psychological distress, insomnia, PTSD, substance use, loneliness, and suicidal ideation at each time point, female proportion who met the screening criteria at each time point, means (SD) of depression, anxiety, psychological distress, insomnia, PTSD, substance use, loneliness, and suicidal ideation at each time point. For studies that have reported mental health problems before the COVID-19 pandemic, we only extracted data from the time points during the COVID-19 pandemic. Therefore, to be included, studies conducted before and during the pandemic must have at least two time points (waves) during the pandemic. As the main aim of the present study was to provide the estimated prevalence of mental health problems, we contacted the researchers who did not provide the number of individuals who met screening criteria for mental health problems in their articles. Of the contacted researchers, only three sent us the requested data.

### 2.6. Quality assessment

To assess the quality of the studies, we utilized the Newcastle-Ottawa Scale (NOS). The NOS is a tool for assessing the risk of bias and the quality of longitudinal and case-control studies (Wells et al., 2000). There are three general indicators: selection, compatibility, and outcome. The selection indicates whether the reported sample of a study is representative of the general population. The comparability indicates whether there were any controlling variables in the reported studies. The outcome indicator focuses on the outcome assessment, the adequacy of completion follow-up, and the adequacy of the time interval. Papers can be scored a maximum of four points for selection, two points for compatibility, and three points for outcome. The highest total score is 9. Studies with scores of 6 points or more are usually included in meta-analyses (Yates et al., 2019). Quality of assessment of included articles is presented in Table 1.

### 2.7. Statistical analysis

Two different approaches were used to analyze the data. All statistical analysis was performed using Stata SE 16.

### 2.8. Cross-sectional analysis

#### 2.8.1. Prevalence estimates

We considered the prevalence rates across time points which were cross-sectionally compared. To account for the heterogeneity of studies' results, random-effects meta-analyses were conducted on the proportions of individuals who met the diagnostic/screening criteria for depression, anxiety, PTSD, psychological distress, insomnia, substance use, loneliness, and suicidal ideation. Cochrane $Q$ and the inconsistency index ($I^2$) were used to assess statistical heterogeneity. Random-effects subgroup meta-analyses were also performed to compare pooled prevalence rates between different regions, gender, age, and types of measures. The subgroup analysis criterion had to have at least two time

**Table 1**
Studies characteristics.

| Source | Year of publication | Country | Sample characteristics | Sample size at the baseline | Females' % at the baseline | Age (mean or range) | N of waves | Time interval in months | Anxiety measure | Depression measure | Psychological distress measure | PTSD measure | Substance use measure | Insomnia measure | Loneliness measure | Suicidal ideation measure | Quality score |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ahmed et al. | 2021 | China | Employee | 451 | 80 % | Different ages | 3 | 2.00 | | | The Kessler Psychological Distress Scale (K6) | | | | | | 8 |
| Ahrens et al. | 2021 | Germany | | 523 | 69 % | 31.53 | 8 | 2.00 | | | The General Health Questionnaire (GHQ-28) and the Patient Health Questionnaire (PHQ-4) | | | | | | 6 |
| Amanzio et al. | 2021 | Italy | Older adults with least two chronic pathologies | 50 | 80 % | 70.04 | 2 | 6.00 | Hamilton Anxiety Rating Scale (HAM-A) | Beck's Depression Inventory (BDI) | | | | | | | 7 |
| Andersen et al. | 2021 | France | Community | 417 | 64 % | 40.00 | 7 | 1.25 | | | Anxious/ Depressed syndrome subscale-ASR | | | | | | 6 |
| Batterham et al. | 2021 | Australia | General | 1293 | 50 % | 46.00 | 7 | 3.00 | General Anxiety Disorder-7 (GAD-7) | The Patient Health Questionnaire (PHQ-9) | | | | | | | 6 |
| Baumann et al. | 2021 | USA | Emergency physicians | 426 | 45 % | 30–44 | 2 | 1.00 | | | | The Primary Care PTSD Screen for DSM-5 (PC-PTSD-5) | | | | | 6 |
| Bendau et al. | 2021 | Germany | General | 1855 | 77 % | 38.76 | 4 | 1.00 | General Anxiety Disorder (GAD-2) | The Patient Health Questionnaire (PHQ-2) | The Patient Health Questionnaire (PHQ-4) | | | | | | 6 |
| Bhuiyan et al. | 2021 | USA | General | 8392 | 84 % | 47.53 | 2 | 2.00 | Hospital Anxiety and Depression Scale (HADS-A) | Hospital Anxiety and Depression Scale (HADS-D) | | | | | | | 6 |
| Brunoni et al. | 2021 | Brazil | public servants of t | 1943 | 58 % | 62.30 | 3 | 5.00 | The Depression, Anxiety and Stress Scale – 21 (DASS-21) | The Depression, Anxiety and Stress Scale – 21 (DASS-21) | | | | | | | 8 |
| Casali et al. | 2021 | Italy | General | 254 | 79 % | 36.05 | 2 | 8.00 | | | The General Health Questionnaire (GHQ-12) | | | | | | 6 |
| Chen et al. | 2021 | China | Hospitalized patients with COVID-19 | 163 | 49 % | 40.00 | 2 | 2.00 | General Anxiety Disorder (GAD-7) | The Patient Health Questionnaire (PHQ-9) | | | | | | | 6 |
| Chew et al. | 2020 | Singapore | Residents from the National Healthcare Group (NHG) Residency Programs | 274 | 51 % | 30.60 | 2 | 3.00 | | | | The Impact of Event Scale - Revised (IES-R) | | | | | 6 |

(*continued on next page*)

**Table 1** (*continued*)

| Source | Year of publication | Country | Sample characteristics | Sample size at the baseline | Females' % at the baseline | Age (mean or range) | N of waves | Time interval in months | Anxiety measure | Depression measure | Psychological distress measure | PTSD measure | Substance use measure | Insomnia measure | Loneliness measure | Suicidal ideation measure | Quality score |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cousijn et al. | 2021 | Netherlands | Cannabis users and control | 183 | NA | 18–46 (Cannabis users), 18–31 (control group) | 2 | 2.00 | Mental health (DSM-5-CCSM) | Mental health (DSM-5-CCSM) | | | | The MINI version 7.0.0 DSM-5 CUD | | | 7 |
| Czeisler et al. | 2021a | USA | General | 5470 | 51 % | 18 years and older | 2 | 3.00 | | | | COVID-19 – related trauma- and stressor-related disorders | Not mentioned | Not mentioned | | Not mentioned | 6 |
| Czeisler et al. | 2021b | Australia | General | 331 | 48 % | 18 years and older | 2 | 5.00 | | | Not mentioned: anxiety or depression | | | | | | 7 |
| Dalkner et al. | 2021 | Austria | Control and Bipolar | 48 | 63 % | 41.00 | 2 | 1.50 | The Brief Symptom Inventory 18 (BSI-18) | Beck's Depression Inventory (BDI-2) | The Brief Symptom Inventory 18 (BSI-18) | | | | | | 6 |
| Daly and Robinson | 2021 | USA | General | 5664 | 51 % | 48.90 | 8 | 3.00 | | | The Patient Health Questionnaire (PHQ-9) | | | | | | 7 |
| Daly et al. | 2021 | USA | General | 6819 | 52 % | 48.40 | 2 | 1.00 | | The Patient Health Questionnaire (PHQ-2) | | | | | | | 6 |
| Fanari and Segrin | 2021 | USA | Students | 133 | 78 % | 20.60 | 2 | 6.00 | | | | | | | The UCLA Loneliness Scale | | 6 |
| Fancourt et al. | 2021 | United Kingdom | General | 17,090 | 51 % | 18 years and older | 20 | 5.00 | General Anxiety Disorder (GAD-7) | The Patient Health Questionnaire (PHQ-9) | | | | | | | 7 |
| Fenollar-Cortes et al. | 2021 | Spain | General | 164 | 75 % | 38.90 | 3 | 1.50 | The Depression, Anxiety and Stress Scale – 21 (DASS-21) | The Depression, Anxiety and Stress Scale – 21 (DASS-21) | | | | | | | 7 |
| Gonzalez-Sanguino et al. | 2020 | Spain | General | 3444 | 75 % | 18 years and older | 3 | | General Anxiety Disorder (GAD-2) | The Patient Health Questionnaire (PHQ-2) | | Post Traumatic Stress Disorder (PCL-C) | | | | | 6 |
| Groarke et al. | 2021 | United Kingdom | General | 1925 | 70 % | 37.01 | 3 | 2.00 | | The Patient Health Questionnaire (PHQ-9) | | | | | | | 8 |
| Gulliver et al. | 2020 | Australia | General | 857 | 49 % | 50.02 | 2 | 1.00 | General Anxiety Disorder (GAD-7) | The Patient Health Questionnaire (PHQ-9) | | | | | | | 6 |
| Han et al. | 2021 | China | Cancer survivors | 130 | 50 % | 56.60 | 2 | 5.00 | The Symptom Checklist-90 (SCL-90) | The Symptom Checklist-90 (SCL-90) | | | | | | | 6 |

(*continued on next page*)

**Table 1** (*continued*)

| Source | Year of publication | Country | Sample characteristics | Sample size at the baseline | Females' % at the baseline | Age (mean or range) | N of waves | Time interval in months | Anxiety measure | Depression measure | Psychological distress measure | PTSD measure | Substance use measure | Insomnia measure | Loneliness measure | Suicidal ideation measure | Quality score |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hennigan et al. | 2021 | Ireland | Pre-existing Anxiety | 24 | 67 % | 37.40 | 2 | 6.00 | Beck Anxiety Inventory (BAI) and the Hamilton Anxiety Rating Scale (HARS) | | | | | | | | 7 |
| Iob et al. | 2020 | United Kingdom | General | 51,417 | 51 % | 48.80 | 7 | 2.00 | | The Patient Health Questionnaire (PHQ-9) | | | | | | | 6 |
| Iovino et al. | 2021 | USA | Family caregivers | 337 | 64 % | 18 years and older | 2 | 6.00 | The Depression, Anxiety and Stress Scale – 21 (DASS-21) | The Depression, Anxiety and Stress Scale – 21 (DASS-21) | Not mentioned | | | | | | 7 |
| Johansson et al. | 2021 | Sweden | University students | 1364 | 76 % | 26.80 | 2 | 9.00 | The Depression, Anxiety and Stress Scale – 21 (DASS-21) | The Depression, Anxiety and Stress Scale – 21 (DASS-21) | | | | | | | 6 |
| Khan and Kadoya | 2021 | Japan | | 4253 | 35 % | 50.32 | 2 | 12.00 | | | | | | | The UCLA Loneliness Scale | | 6 |
| Kimura et al. | 2021 | Japan | Mothers | 2489 | 100 % | 35.50 | 2 | 4.00 | | | The Kessler Psychological Distress Scale (K6) | | | | | | 6 |
| Kulbin et al. | 2021 | Estonia | General | 202 | 90 % | 45.56 | 3 | 6.00 | The Emotional State Questionnaire (EST-Q2) | The Emotional State Questionnaire (EST-Q2) | | The PTSD Checklist Civilian version (PCL-C) | Alcohol Use Disorders Identification Test. AUDIT-C | The Emotional State Questionnaire (EST-Q2) | | | 6 |
| Kyzar et al. | 2021 | USA | Community | 52 | 62 % | 46.00 | 2 | 6.00 | General Anxiety Disorder (GAD-7) | The Patient Health Questionnaire (PHQ-9) | | The PTSD Checklist Civilian version (PCL-C) | | The Insomnia Severity Scale (ISS) | | | 6 |
| Lee et al. | 2020 | USA | Community | 564 | 61 % | 25.10 | 2 | 3.00 | | The Patient Health Questionnaire (PHQ-4) | | | | | The three-item Loneliness Scale | | 6 |
| Lopez Steinmetz et al. | 2021 | Argentina | College students | 1492 | 84 % | 23.58 | 2 | 1.00 | State-Trait Anxiety Inventory (STAI) | Beck's Depression Inventory (BDI-2) | The Kessler Psychological Distress Scale (K10) and the General Health Questionnaire (GHQ-12) | | | | | | 6 |
| Lopez-Morales et al. | 2021 | Argentina | Women | 204 | 100 % | 32.56 | 4 | 2.00 | | Beck's Depression Inventory (BDI-2) | | | | | | | 8 |
| Marroquìn et al. | 2020 | USA | General | 118 | 46 % | 41.54 | 2 | 1.00 | General Anxiety Disorder (GAD-7) | Center for Epidemiologic Studies Depression Scale (CES-D) | | | | | | | 6 |

(*continued on next page*)

**Table 1** (*continued*)

| Source | Year of publication | Country | Sample characteristics | Sample size at the baseline | Females' % at the baseline | Age (mean or range) | N of waves | Time interval in months | Anxiety measure | Depression measure | Psychological distress measure | PTSD measure | Substance use measure | Insomnia measure | Loneliness measure | Suicidal ideation measure | Quality score |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mergel and Schutzwoh | 2021 | Germany | Participants with chronic/ acute mental disorders and without mental disorders | 106 | 48 % (chronic), 60 % (acute), 75 % (without mental health disorders) | 49.70 (chronic), 44.00 (acute), 41.00 (without mental health disorders) | 2 | 3.00 | The Brief Symptom Inventory 18 (BSI-18) | | | | | | | | 6 |
| Messiah et al. | 2021 | USA | BS patients | 39 | 87 % | 50.28 | 2 | 4.00 | The Quick Inventory of Depressive Symptomatology-Self-report (QIDS-SR16) | The Quick Inventory of Depressive Symptomatology-Self-report (QIDS-SR16) | | | | | | | 7 |
| Moya et al. | 2021 | Colombia | Caregivers | 803 | 97 % | 29.05 | 3 | 8.00 | The Symptom Checklist-90 (SCL-90) | The Symptom Checklist-90 (SCL-90) | | | | | | | 6 |
| Niedzwiedz et al. | | United Kingdom | General | 12,492 | 53 % | 18 years and older | 5 | 6.00 | | | The General Health Questionnaire (GHQ-12) | | | | | | 6 |
| Nisticò et al. | 2021 | Italy | Eating disorders | 40 | 97 % | 30.10 | 2 | 2.00 | The Depression, Anxiety and Stress Scale – 21 (DASS-21) | The Depression, Anxiety and Stress Scale – 21 (DASS-21) | | | | | | | 6 |
| O'Connor et al. | 2020 | United Kingdom | General | 3077 | 55 % | 18 years and older | 3 | 0.50 | General Anxiety Disorder (GAD-7) | The Patient Health Questionnaire (PHQ-9) | | | | | | Adult Psychiatric Morbidity Survey | 7 |
| Osaghae et al. | 2021 | USA | Adults undergoing COVID-19 testing | 267 | 71 % | 18 years and older | 2 | 4.00 | General Anxiety Disorder (GAD-7) | The Patient Health Questionnaire (PHQ-9) | | | Alcohol Use Disorders Identification Test. AUDIT-C | | | | 6 |
| Parker et al. | 2021 | USA | Hospitalized COVID-19 patients | 44 | 35 % | 59.00 | 2 | 0.50 | Hospital Anxiety and Depression Scale (HADS-A) | Hospital Anxiety and Depression Scale (HADS-D) | | | | | | | 6 |
| Pizzonia et al. | 2021 | USA | Community | 635 | 49 % | 38.52 | 2 | 3.00 | | | | | | Insomnia Severity Index (ISI) | | | 7 |
| Quaglieri et al. | 2021 | Italy | General | 123 | 74 % | 33.90 | 5 | 2.00 | State-Trait Anxiety Inventory (STAI) | | | | | | | | 6 |
| Ripoll et al. | 2021 | Spain | General | 681 | 77 % | 18 years and older | 2 | 2.00 | General Anxiety Disorder (GAD-7) | The Patient Health Questionnaire (PHQ-9) | | | Psychotropic drugs consumption (yes or no) | | | | 6 |
| Ruggieri et al. | 2020 | Italy | General: Facebook users | 113 | 62 % | 32.05 | 3 | 1.25 | The Depression, Anxiety and Stress Scale – 21 (DASS-21) | The Depression, Anxiety and Stress Scale – 21 (DASS-21) | | | | | | | 6 |
| Riehm et al. | 2021 | USA | General | 6863 | 52 % | 18 years and older | 10 | 5 | | | The Patient Health Questionnaire (PHQ-4) | | | | | | 6 |

(*continued on next page*)

**Table 1** (*continued*)

| Source | Year of publication | Country | Sample characteristics | Sample size at the baseline | Females' % at the baseline | Age (mean or range) | N of waves | Time interval in months | Anxiety measure | Depression measure | Psychological distress measure | PTSD measure | Substance use measure | Insomnia measure | Loneliness measure | Suicidal ideation measure | Quality score |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rumas et al. | 2021 | USA _Canada | Community | 797 | 55 % | 32.20 | 2 | 1.00 | | | | | | | The UCLA Loneliness Scale | | 6 |
| Russell et al. | 2021 | USA | Caregivers and non-caregivers | 801 | 54 % | 35.29 | 2 | 2.00 | The Depression, Anxiety and Stress Scale – 21 (DASS-21) | The Depression, Anxiety and Stress Scale – 21 (DASS-21) | | | | | | | 7 |
| Shevlin et al. | 2021 | United Kingdom | General | 2025 | 51 % | Adult | 3 | 3.00 | | | The Patient Health Questionnaire Anxiety-Depression Scale (PHQ-ADS) | The International Trauma Questionnaire (ITQ) | | | | | 6 |
| Shuster et al. | 2021 | USA | General | 1426 | 49 % | 35.04 | 10 | 2.00 | State-Trait Anxiety Inventory (STAI) | The Zung Self-Rating Depression | | | | | | | 7 |
| Soldevila-Domenech et al. | 2021 | Spain | Old adults with at least 4 SCD-Plus features and APOE ε4 carriers | 16 | 62 % | 65.80 | 3 | 2.00 | | | The General Health Questionnaire (GHQ-12) | | | | | | 6 |
| Somma et al. | 2021 | Italy | General | 304 | 76 % | 35.28 | 2 | 2.00 | DSM-5 Level 2 Anxiety | DSM-5 Level 2 Depression | | | | | | | 7 |
| Stevenson and Wakefield | 2021 | United Kingdom | | 457 | 70 % | 37.60 | 2 | 4.00 | Hospital Anxiety and Depression Scale (HADS-A) | Hospital Anxiety and Depression Scale (HADS-D) | | | | | The Short loneliness Scale | The Suicide Behaviors Questionnaire-Revised (SBQ-R) | 7 |
| Sueki and Ueda | 2021 | Japan | General | 6683 | 49 % | 46.50 | 2 | 3.00 | | | | | | | | The Suicidal Ideation Scale | 6 |
| van Breen et al. | 2021 | 23 countries | The PsyCorona database | 4606 | 73 % | | 4 | | | | | | | | Self-report Loneliness | | 6 |
| van der Velden et al. | 2021 | Netherlands | General | 4084 | 51 % | 18 years and older | 2 | 3.25 | | | The Mental Health Index or Inventory (MHI-5) | | | | | | 6 |
| Vlake et al. | 2021 | Netherlands | ICU COVID-19 patients | 118 | 33 % | 36–77 years old | 3 | 6.00 | Hospital Anxiety and Depression Scale (HADS-A) | Hospital Anxiety and Depression Scale (HADS-D) | | The Impact of Event Scale - Revised (IES-R) | | | | | 9 |
| Yocum et al | 2021 | USA | Adults with bipolar disorder and control group | 435 | 87 % | Adult | 3 | 1.00 | General Anxiety Disorder (GAD-7) | The Patient Health Questionnaire (PHQ-9) | | | | Pittsburgh Sleep Quality Index (PSQI) | | | 8 |
| Zheng et al. | 2021 | USA/ Canada | General | 2463 | 84 % | 44.94 | 2 | 0.50 | | Center for Epidemiologic Studies Depression Scale (CESD-10) | | | | | | | 6 |
| Zhou et al. | 2021 | China | Frontline healthcare workers | 494 | 83 % | 33.76 | 2 | 1.25 | | | The Symptom Checklist-90 (SCL-90) | | | Pittsburgh Sleep Quality Index (PSQI) | | | 6 |

points per group (Robinson et al., 2022). For example, we did not perform a subgroup analysis of the differences between measures underlying substance use prevalence as there were not enough time points per measure. Furthermore, the region groups consisted of Europe, North America, Latin America, Asia-Pacific (including Australia and Asian countries), and Africa. Multiple meta-regression analyses with random effects were conducted considering the percentage of females with mental health problems and age means at baseline, as well as regions, and type of measures. The models without multicollinearity were reported.

#### 2.8.2. Mean differences

For the continuous data, we computed standardized mean differences (SMD) based on the one-sample Cohen's *d* of each mental health problem to account for different measures that were utilized by other studies to make a comparable scaling. Cohen's *d* effect size with a 95 % CI was reported. For Cohen's d considering SMD, 0.2–0.5 values are considered small, 0.5–0.8 values are considered medium, and values >0.8 are considered large effects (Andrade, 2020). A series of meta-analyses with random effects were performed. Cochrane *Q* and the inconsistency index ($I^2$) were used to assess statistical heterogeneity. A subgroup analysis of the differences in month, region, and type of measure was conducted. The subgroup analysis criterion was to have at least two time points per group. Furthermore, multiple meta-regression models with random effects were applied to test the associations of the proposed groups' age means at baseline, and female percentage at baseline with the effect size of each mental health problem. Multicollinearity assumption was checked for each model. The grouping variables were the same as the prevalence estimates procedure.

### 2.9. Longitudinal analysis

Pooled prevalence rates between time points were evaluated performing random effects. There were not many time points in January and February 2020 as well as after July 2020. Therefore, both January and February were grouped as the first category, after July time points were categorized as one group. We compared the effect estimates between baseline and the last follow-up. First, we computed the log odds ratio (LOR) with a 95 % confidence interval (CI) for the prevalence between the baseline and the last follow-up. Negative LOR is considered as a decrease in the prevalence from the baseline to the last follow-up. Positive LOR is considered an increase in the prevalence from the baseline to the last follow-up. Second, the SMD in pooled SDs between the baseline and the last follow-up was used to calculate Cohen's *d* effect size with a 95 % CI. Then, we converted Cohen's *d* effect sizes to LOR in order to integrate longitudinal studies reported means of mental health problems and studies that reported the prevalence rates. The grouping variables included regions and measures used. The meta-analysis on the LORs across studies and the subgroup meta-analyses were conducted using random effects. The subgroup analysis criterion was to include a group with at least two studies. Multiple meta-regression analyses were performed to examine the associations of moderators, including time intervals between baseline and the last follow-up, region, type of measures, age means and female percentage at baseline, with the LOR of each mental health problem. Funnel plots and Eager's regression (models with/without moderators) were applied to examine publication bias for both approaches. The meta-analyses were conducted using Stata SE 16.

## 3. Results

### 3.1. Study characteristics

The search identified 33,654 studies as shown in Fig. 1. In total, 78 full-text studies received a score of 6 or more in the quality assessment. Fourteen studies were excluded as there was no available data for analysis ($N = 9$; the research team contacted the authors, but four did not answer and five authors said that the data were not available). There were also not enough studies for internalizing and externalizing symptoms ($N = 1$). Furthermore, there were five studies that used different measures at baseline and follow-ups, resulting in the inclusion of 64 studies in the current study (Fig. 1). Thirty-seven studies were conducted on anxiety, 40 on depression, 18 on psychological distress, 8 on PTSD, five on substance use, 6 on insomnia, 8 on loneliness, and four on suicidal ideation. In total, there was a sample of 170,827 participants at baseline. The sample size ranged from 16 to 51,417. The mean (SD) age of participants at baseline was 40.92 (SD = 10.82). The proportion of females at baseline ranged from 33 % to 100 % with means of 65 % (SD = 17 %). The number of time points ranged from two to 20 with a time interval of two weeks to nine months between baseline and the last follow-up measure (M = 3.27, SD = 2.35). The means of quality assessment score were 6.44 (0.71). Most studies were from North America ($N = 20$), United Kingdom ($N = 7$), and Italy ($N = 6$). Moreover, four studies were from China, four studies were from Spain, three studies were from the Netherlands, three were from Australia, three were from Germany, three were from Japan, and two were from Argentina. There was one paper reported from the following regions: Estonia, Austria, Japan, France, Brazil, Colombia, Singapore, Ireland, and Sweden. There was one paper which reported the outcome in 23 countries. The characteristics of the included studies are presented in Table 1. In the following sections, we used the term "wave" to designate the "time-points measurement".

### 3.2. Prevalence estimates and mean differences

#### 3.2.1. Anxiety

*3.2.1.1. Prevalence estimates.* Twenty-two studies reported the anxiety prevalence (Amanzio et al., 2021; Batterham et al., 2021; Bendau et al., 2021; Brunoni et al., 2021; Fancourt et al., 2021; Fenollar-Cortés et al., 2021; Hennigan et al., n.d.; Kulbin et al., 2021; Kyzar et al., 2021; López Steinmetz et al., 2021; Marroquín et al., 2020; Messiah et al., 2021; Moya et al., 2021; Nisticò et al., 2021; O'Connor et al., 2020; Osaghae et al., 2021; Parker et al., 2021; Quaglieri et al., 2021; Ripoll et al., 2021; Ruggieri et al., 2021; Vlake et al., 2021; Yocum et al., 2021). Ten studies reported the prevalence in three waves, 7 studies reported it in three waves, there were one four waves, one five waves, one seven waves, and one twenty-wave study. The pooled anxiety prevalence was 25 % (95 % CI, 20.7 %–29.3 %, see eTable 1). The heterogeneity level in the analysis was high ($I^2 = 99.64$ %, $Q = 14{,}072.95$, $p < .0001$). In terms of region, there were 50 waves conducted in Europe, 14 waves conducted in North America, 7 waves in Asia-Pacific (Australia), and 8 waves in Latin America. There was a higher prevalence rate in North America (Prevalence = 43.0 %; 95 % CI, 27.1 %-58.8) in comparison to Europe (Prevalence = 22.1 %; 95 % CI, 18.3 %–25.9 %), Latin America (Prevalence = 20.5 %; 95 % CI, 6.2 %–34.9 %), and Asia-Pacific (Prevalence = 15.0 %; 95 % CI, 13.6 %–16.4 %). A significant difference between regions were found ($\chi^2 = 23.50$, $p < .001$). The highest heterogeneity was observed in studies conducted in Europe.

The GAD-7 was used in 40 waves, the DASS-21 was used in 8 waves, the STAI was used in 7 waves, the SCL-90 was used in five waves, the HAM-A (HARS) was used in 7 waves, the HADS-A was used in five waves, the GAD-2 was used in four waves, the EST-Q2 was used in three waves, and the BAI was used in two waves. There were significant group differences across types of measures ($\chi^2 = 249.09$, $p < .0001$). The studies that used the STAI (Prevalence = 56.4 %; 95 % CI, 52.8 %–60.1 %) reported a higher prevalence than those that used the SCL-90 (Prevalence = 37.8 %; 95 % CI, 10.2 %–65.4 %), the GAD-2 (Prevalence = 28.8 %; 95 % CI, 23.3 %–34.2 %), the GAD-7 (Prevalence = 21.5 %; 95 % CI, 15.4 %–27.5 %), the EST-Q2 (Prevalence = 21.3 %; 95 % CI, 16.8 %–25.7 %), HADS-A (Prevalence = 21.2 %; 95 % CI, 9.4 %–32.9

%), HAM-A (Prevalence = 16.5 %; 95 % CI, 9.7 %–23.3 %), the DASS-21 (Prevalence = 16.5 %; 95 % CI, 5.5 %–27.5 %), and the BAI (Prevalence = 15.8 %; 95 % CI, 5.6 %–26.1 %). The highest heterogeneity was observed in studies that used the GAD-7. Meta-regression showed that the pooled prevalence rate is associated with female prevalence rate ($B = 0.81$, $p < .001$). The multiple meta-regression model explained 98.88 % of the variation in the anxiety prevalence rate. The Eager's test showed significant publication bias for the model with moderators, while it showed the opposite for those without moderators.

*3.2.1.2. Mean differences.* There were 15 studies (Bhuiyan et al., 2021; Chen et al., 2021; Cousijn et al., 2020; Dalkner et al., 2021; González-Sanguino et al., 2021; Gulliver et al., 2021; Han et al., 2021; Iovino et al., 2021; Johansson et al., 2021; López-Morales et al., 2021; Mergel and Schützwohl, 2021; Russell et al., 2021; Shuster et al., 2021; Somma et al., 2021; Stevenson and Wakefield, 2021) which reported the means of anxiety. Ten studies reported the anxiety means in two waves, two studies reported it in three waves, one study reported it in 10 waves, and one study reported it in four waves. Two studies (Cousijn et al., 2020; Dalkner et al., 2021) reported the means of anxiety in two different populations and one study (Mergel and Schützwohl, 2021) reported it in three different populations. The pooled effect size between studies was 2.52 (95 % CI 1.69, 3.36; see eTable 2). The heterogeneity was high ($I^2 = 98.00$ %. $Q = 2449.91$ $p < .0001$). Sixteen waves were conducted in North America, 15 waves were conducted in Europe, 7 waves were conducted in Asia-Pacific, and four waves were conducted in Latin America. Group differences underlying the region ($\chi^2 = 195.96$, $p < .001$) and measures ($\chi^2 = 258.08$, $p < .001$). A higher effect size was

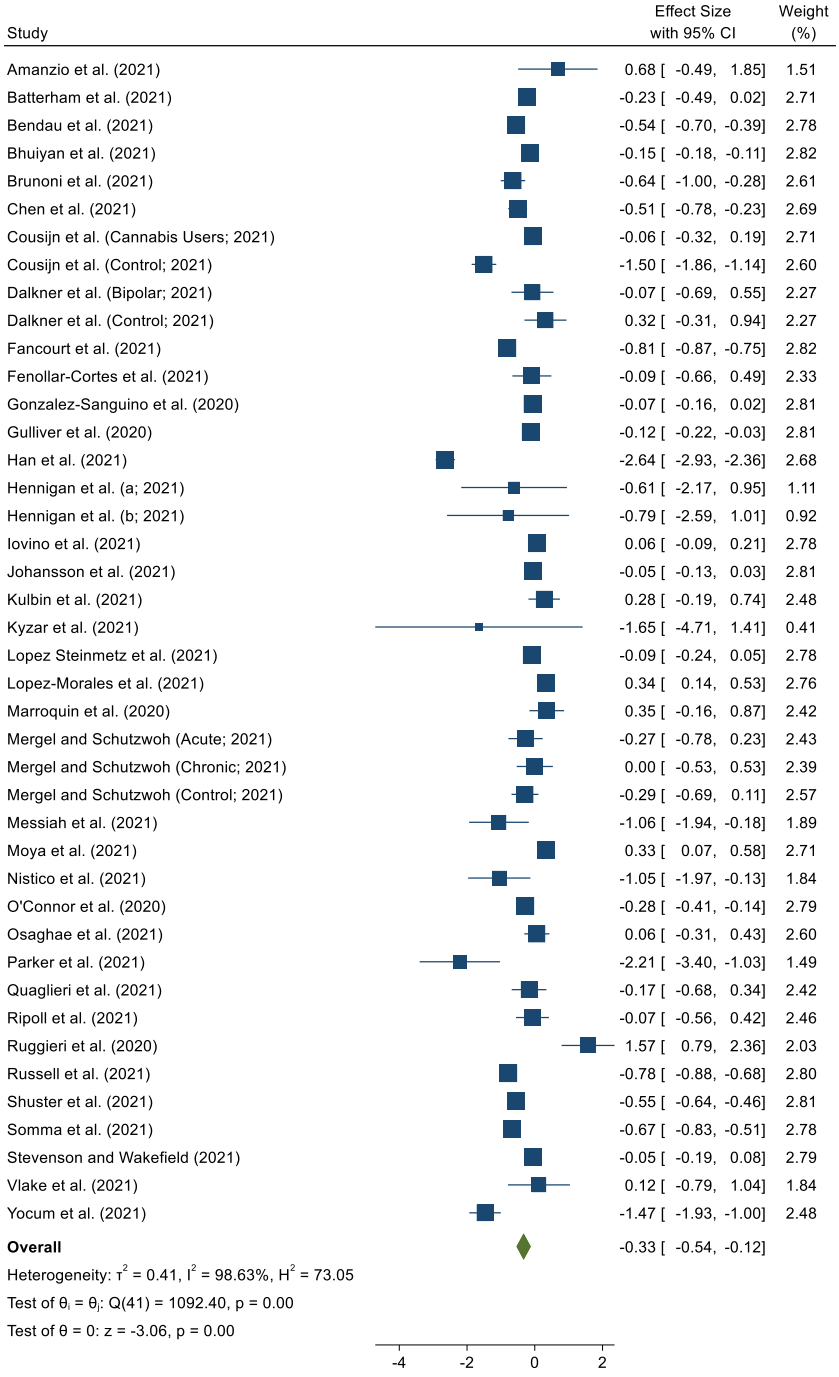



**Fig. 2.** Changes in anxiety symptoms from the baseline to the follow-up.

reported in studies conducted in North America ($d = 4.85$), and in studies that used the EST-Q2 ($d = 6.09$). Meta-regression showed that age at baseline ($B = -0.25$, $p < .001$) and measures ($B = 0.34$, $p = .033$) are associated with the pooled effect size of anxiety. The model explained 51.66 % of the variation in the anxiety effect size.

*3.2.1.3. Longitudinal analysis.* Regarding longitudinal prevalence differences, there were 17 waves in March, 18 waves in April, 15 waves in May, 13 waves in June, 9 waves in July, and 6 waves in the following months (one in September three in October, one in November). There was only one wave in January–February that was not included in the subgroup analysis. No group differences regarding months were found ($\chi^2 = 7.45$, $p = .189$). Regarding longitudinal mean differences, two waves were conducted in the month of January–February, four waves were conducted in March, 16 waves were conducted in April, 11 waves were conducted in May, five waves were conducted in June, and four waves were conducted in months after July (one August, two September, and one October). Significant group differences between months were found ($\chi^2 = 13.81$, $p = .017$). Higher means were observed in May ($d = 3.63$). Results are presented in Fig. 16.

Regarding the differences between baseline and the last follow-up, the results showed a significant decrease in anxiety (LOR = −0.33; 95 % CI, −0.54, −0.12; Fig. 2 and Table 2). The heterogeneity of the pooled effect size was high ($I^2 = 98.63$ %. $Q = 1092.40$ $p < .001$). In total, 12 studies were conducted in North America, 16 (two studies had two different groups of participants) in Europe, four in Asia-Pacific, and four studies in Latin America. There were no differences between regions ($\chi^2 = 3.19$, $p = .364$; Fig. 3). Regarding the measures, 10 studies used the GAD-7, 7 studies used the DASS-21, four studies used the STAI, and four studies used the HADS-A and the DSM-5-based tools. There were two studies for the GAD-2, the SCL-90, the BSI-18, and the HAM-A. No group differences between measures were found ($\chi^2 = 4.34$, $p = .825$; Fig. 3). The moderators were not statistically associated with the effect size. No indication of publication bias was observed.

### 3.2.2. Depression

*3.2.2.1. Prevalence estimates.* Twenty-six studies reported the prevalence of depression (Amanzio et al., 2021; Batterham et al., 2021; Bendau et al., 2021; Dalkner et al., 2021; Daly et al., 2021; Fancourt et al., 2021; Fenollar-Cortés et al., 2021; Groarke et al., 2021; Iob et al., 2020; Kulbin et al., 2021; Kyzar et al., 2021; Lee et al., 2020; López-Morales et al., 2021; López Steinmetz et al., 2021; Marroquín et al., 2020; Messiah et al., 2021; Moya et al., 2021; Nisticò et al., 2021; O'Connor et al., 2020; Osaghae et al., 2021; Parker et al., 2021; Ripoll et al., 2021; Ruggieri et al., 2021; Vlake et al., 2021; Zheng et al., 2021). Twelve studies reported the prevalence in two waves, 9 in three waves, two in 7 waves, and two in four waves. There was one twenty-wave study. The pooled prevalence across all-time points and studies was 26.8 % (95%CI, 23.7 % - 29.9 %, see eTable 1). A significant heterogeneity between studies was found ($I^2 = 99.89$, $Q = 20{,}578.82$, $p < .0001$).

Eighteen waves were conducted in North America, 56 waves were conducted in Europe, 12 waves were conducted in Latin America, and 7 waves were conducted in Asia-Pacific (Australia). A higher prevalence rate of depression was observed in North America (Prevalence = 38.3 %; 95 % CI, 27.2 %–49.5 %) in comparison with Europe (Prevalence = 24.6 %; 95 % CI, 22.9 %–26.4 %), Latin America (Prevalence = 20.9 %; 95 % CI, 9.9 %–32.0 %), and Asia-Pacific (Prevalence = 20.6 %; 95 % CI, 19.2 %–21.9 %). The group difference test was significant ($\chi^2 = 20.81$, $p < .001$). Higher heterogeneity was observed in the waves conducted in Latin America. The PHQ-9 was used in 44 waves, the DASS-21 was used in 11 waves, the BDI-2 was used in 10 waves, the PHQ-2 was used in 8 waves, the HADS-D was used in five waves, the EST-Q2 and the SCL-90 was used in three waves, and there were two waves for the QIDS-SR16, the CES—D, and the CESD-10. There was a significant difference across measures ($\chi^2 = 2408.10$, $p < .0001$). Studies that used the QIDS-SR16 (Prevalence = 83.1 %; 95 % CI, 70.9 %–95.2 %) and the CESD-10 (Prevalence = 70.2 %; 95 % CI, 69.9 %–71.5 %) reported a greater prevalence rate of depression, respectively. The prevalence was 37.0 % for the CES—D, 30.4 % for the BDI-2, 24.4 % for the PHQ-9, 23.8 % for the SCl-90, 23.1 % for the EST-Q2, 23.0 % for the PHQ-2, 22.4 % for the HADS-D, and 21.4 % for the DASS-21. The highest heterogeneity index was observed within waves that used the DASS-21. Multiple meta-regression showed that the prevalence rate of depression in females is positively associated with the pooled prevalence of depression ($B = 0.95$ $p < .0001$). Moreover, measures ($B = 0.01$, $p = .001$) were significantly associated with the prevalence of depression. The model explained 98.18 % of variation in the depression prevalence rate. Eager's test revealed a significant publication bias for the model with moderators and the model without moderators.

*3.2.2.2. Mean differences.* Fourteen studies reported the means of depression (Bhuiyan et al., 2021; Chen et al., 2021; Cousijn et al., 2020; González-Sanguino et al., 2021; Gulliver et al., 2021; Han et al., 2021; Iovino et al., 2021; Johansson et al., 2021; Mergel and Schützwohl, 2021; Russell et al., 2021; Yocum et al., 2021). Ten studies reported the means in two waves, three in three waves, and one in 10 waves. The effect size of depression between studies was 2.69 with a 95 % CI of 1.74 and 3.64. The heterogeneity was high ($I^2 = 97.78$ %. $Q = 1979.93$ $p < .0001$). Nineteen waves were conducted in North America, 13 waves were conducted in Europe, and 7 waves were conducted in Asia-Pacific. The Zung Self-Rating Depression was used in 10 waves, the PHQ-9 was used in 7 waves, the DSM-5-based tools were used in four waves, the DASS-21 was used in 6 waves, the HADS-D was used in four waves, the PHQ-2 was used in three waves, the BDI-2 was used in three waves, the SCL-90 was used in three waves, the BSI-18 was used in two waves. Group differences underlying the measures ($\chi^2 = 1365.21$, $p < .0001$) and regions ($\chi^2 = 33.04$, $p < .001$) were significant where a higher depression was reported in the waves conducted in North America ($d = 4.76$) and the waves that used the Zung Self-Rating Depression ($d = 7.46$). Meta-regression showed that months ($B = -0.93$, $p = .022$) are associated with the pooled effect size of depression. The model explained 47.48 % of the variation in the depression effect size.

*3.2.2.3. Longitudinal analysis.* Regarding the prevalence, of the 93 waves, two waves were in January–February, 22 waves were in March, 27 waves were in April, 16 waves were in May, 11 waves were in June, 9 waves were in July, and 6 waves were in the following months (one in August, one in September, two in October, one in November, and one in February 2021). The group difference between months was not significant ($\chi^2 = 11.53$, $p = .073$). Regarding mean differences, two waves were in January–February, four waves were in March, 14 waves were in April, 11 waves were in May, five waves were in June, and three waves were in months after July (two in September and one in October). Significant group differences between months were found ($\chi^2 = 12.77$, $p = .026$). Higher wave means were reported in May ($d = 3.93$) compared to other months. Results are presented in Fig. 2.

**Table 2**
Longitudinal effect sizes of mental health problems.

| Outcome | LOR | 95 % CI | z | *p*-Value |
|---|---|---|---|---|
| Anxiety | −0.33 | −0.54, −0.12 | −3.06 | 0.002 |
| Depression | −0.12 | −0.21, 0.04 | 2.80 | 0.005 |
| Psychological distress | 0.01 | −0.72, 0.74 | 0.02 | 0.98 |
| PTSD | −0.00 | −0.17, 0.17 | −0.02 | 0.98 |
| Substance use | −0.06 | −0.29, 0.16 | −0.55 | 0.58 |
| Insomnia | 0.43 | −0.13, 0.98 | 1.49 | 0.14 |
| Loneliness | 0.04 | −0.00, 0.09 | 1.96 | 0.05 |
| Suicidal ideation | 0.05 | −0.08, 0.17 | 0.73 | 0.47 |

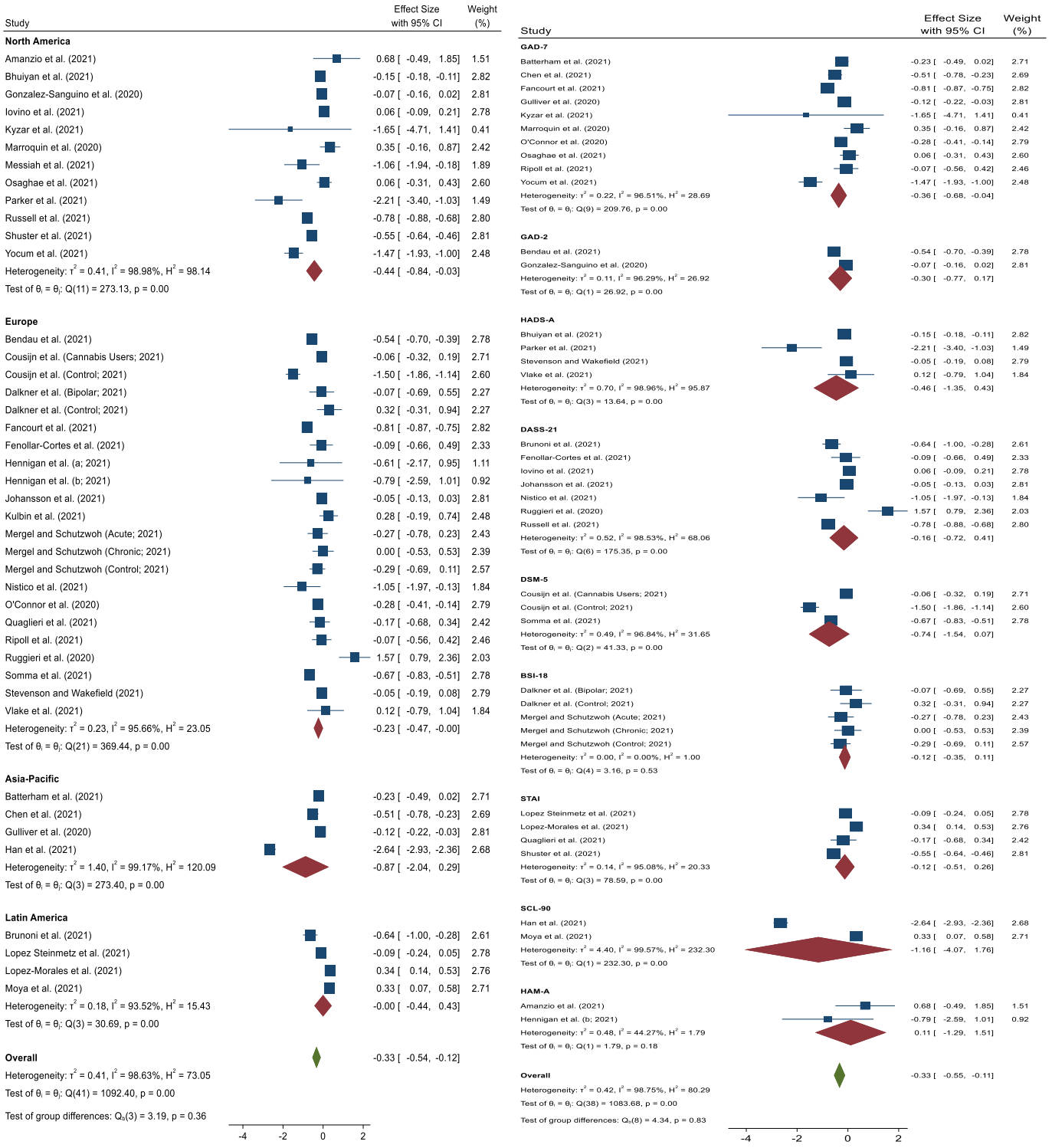



**Fig. 3.** The LOR of anxiety across regions and measures.

Concerning the differences between baseline and the last follow-up, the results showed a significant decrease in depression (LOR = −0.12; 95 % CI, −0.21, −0.04; Fig. 4 and Table 2). The heterogeneity of the pooled effect size was high ($I^2 = 92.15$ %. $Q = 465.51$ $p < .001$). In total, 14 studies were conducted in North America, 18 (two studies had two different groups of participants and one study had three different groups of participants) in Europe, four in Asia-Pacific, and four in Latin America. There were no differences between regions ($\chi^2 = 0.66$, $p = .882$; Fig. 5). Regarding the measures, 11 studies used the PHQ-9, 7 studies used the DASS-21, four studies used the PHQ-2, four studies used the BDI-2, four studies used the HADS-D, two studies used the DSM-5-based tools, two studies used the SCL-90, and one study used the BSI-18 (this study had three different groups of participants). Insignificant group differences between measures were found ($\chi^2 = 8.05$, $p = .328$; Fig. 5). The meta-regression model was not significant. No indication of publication bias was observed.

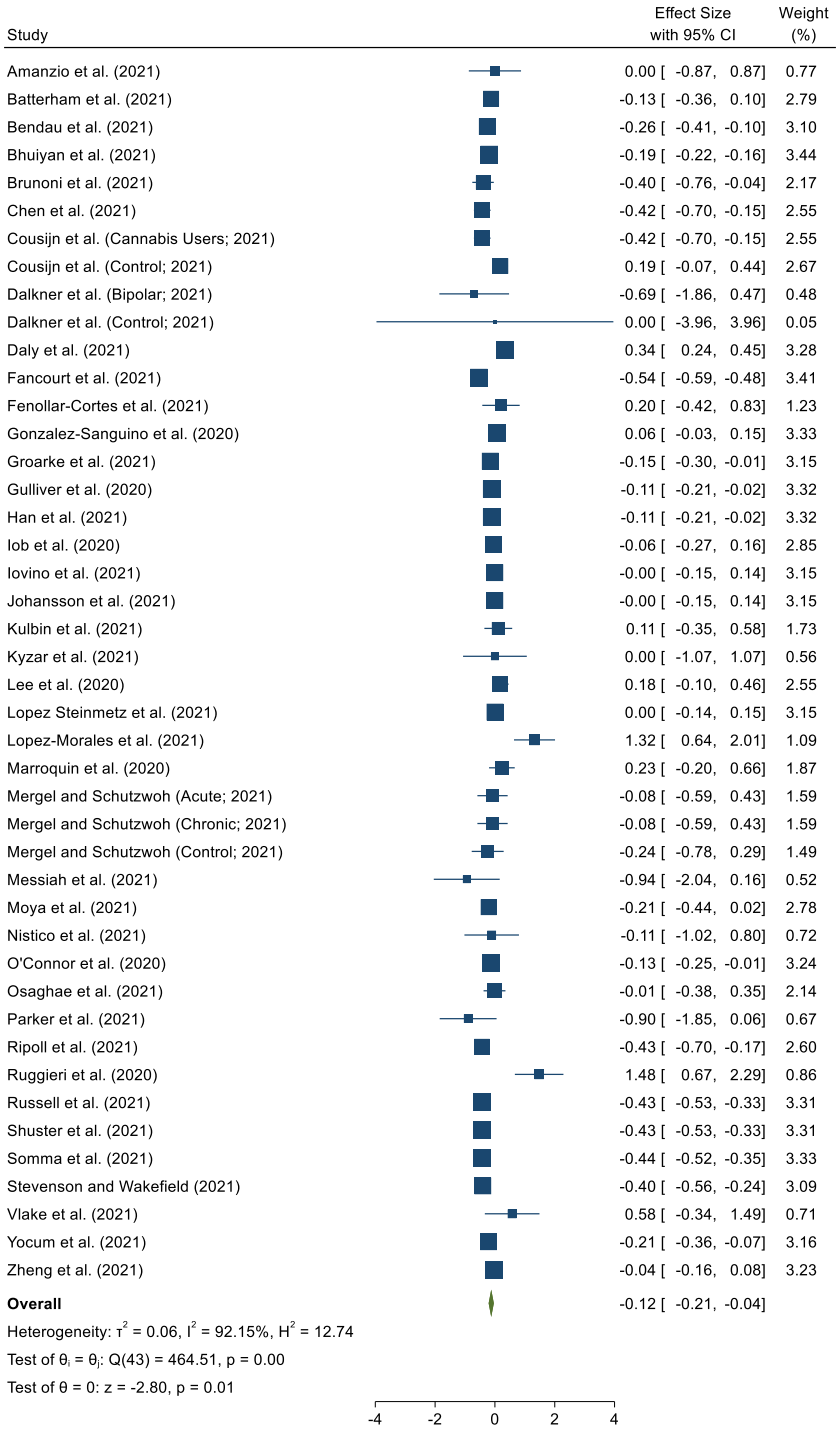



**Fig. 4.** Changes in depression symptoms from the baseline to the follow-up.

### 3.2.3. *Psychological distress*

*3.2.3.1. Prevalence estimates.* Thirteen studies reported prevalence of psychological distress (Andersen et al., 2021; Bendau et al., 2021; Casali et al., 2021; Czeisler et al., 2021a, 2021b; Dalkner et al., 2021; Kimura et al., 2021; López Steinmetz et al., 2021; Niedzwiedz et al., n.d.; Riehm et al., 2021; Shevlin et al., 2021b; Vlake et al., 2021; Zhou et al., 2021). One study used two different measures (the GHQ-12 and the K-10) for measuring psychological distress (López Steinmetz et al., 2021). Seven studies reported the prevalence in two waves, two in three waves, there was one four waves, one five waves, one seven waves, and one ten-wave study. The pooled prevalence rate was 30.5 % (95 % CI, 25.0 %–36.0 %). A high heterogeneity between studies was found ($I^2$ = 99.86, $Q$ = 11,603.95, $p < .0001$). Regarding regions, there were 25, 12, 6, and four waves that reported prevalence of psychological distress in Europe, North America, Asia-Pacific, and Latin America (a paper with two different measures), respectively. A higher prevalence of psychological distress was reported in Latin America (Prevalence = 66.6 %; 95 % CI, 59.6 %–73.6 %) than in North America (Prevalence = 31.2 %; 95 % CI, 29.2 %–33.2 %), Europe (Prevalence = 27.4 %; 95 % CI, 19.5 %–35.3 %), and Asia-Pacific (Prevalence = 18.0 %; 95 % CI, 8.9 %–27.0 %). Group differences were significant ($\chi^2$ = 104.34, $p < .001$).

In terms of the measures, the PHQ-4 was used in 17 waves, the GHQ-12 was used in 9 waves, the ASR was used in 9 waves, the K-10 was used

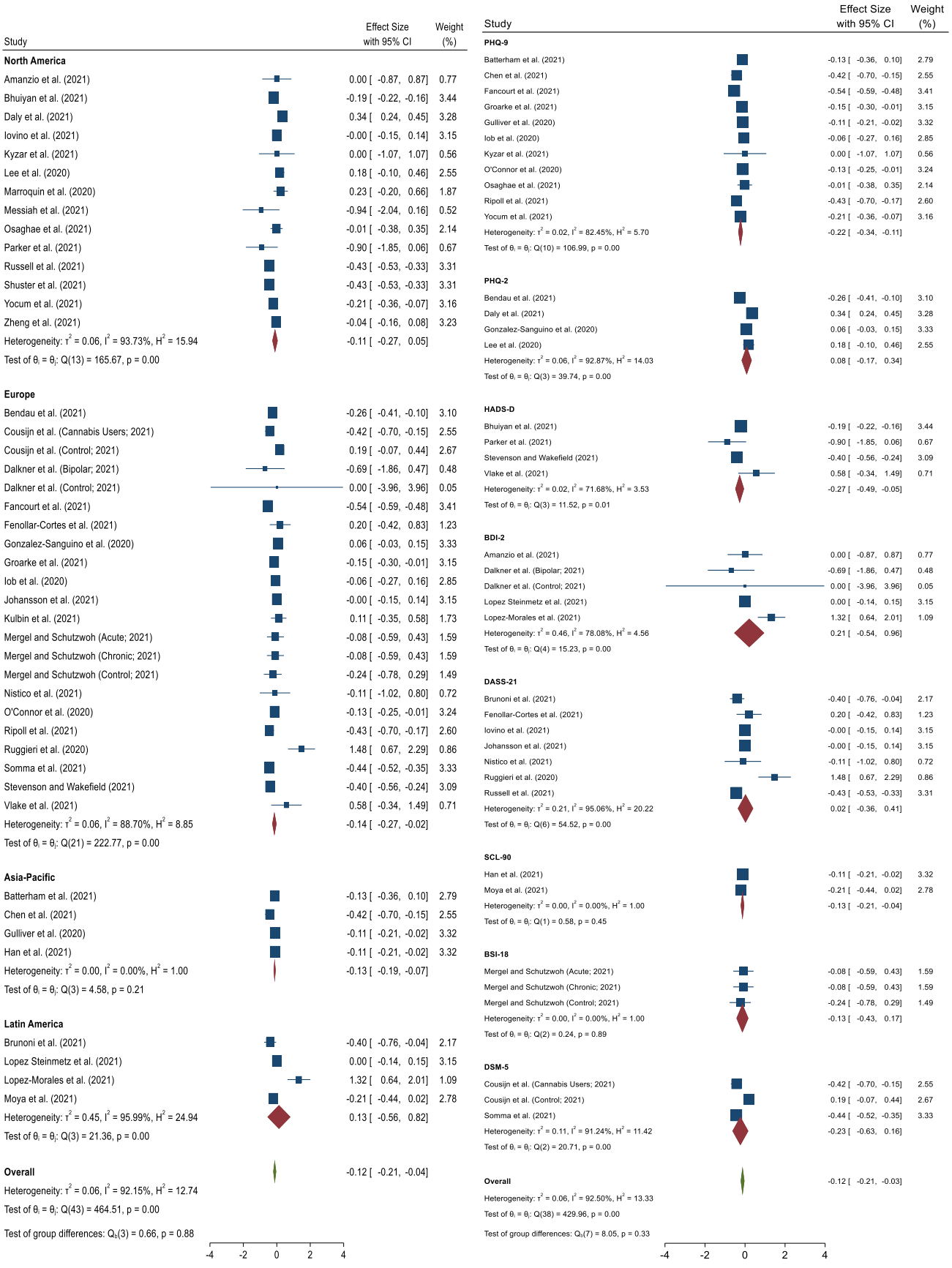



**Fig. 5.** The LOR of depression across regions and measures.

in two waves, the K-6 was used in two waves, and the SCL-90 was used in two waves. The type of measures used were unknown in four waves. The subgroup analysis showed that the prevalence rate significantly differed across the type of measures ($\chi^2 = 4047.83$, $p < .0001$). The studies that used the K-10 (Prevalence = 72.6 %; 95 % CI, 71.1 %–74.2 %) and the GHQ-12 (Prevalence = 46.2 %; 95 % CI, 28.1 %–64.6 %) reported a higher prevalence in comparison with studies that used other types of measures. The meta-regression model was insignificant. No indication of publication bias was found in the model with/without moderators.

*3.2.3.2. Mean differences.* Five studies reported the means of psychological distress (Ahmed et al., 2021; Ahrens et al., 2021; Daly and Robinson, 2021; Iovino et al., 2021; Soldevila-Domenech et al., 2021). Two studies reported the psychological distress means in three waves, two studies reported the means in 8 waves (one paper reported psychological distress means using two different measures), and one study reported the mean in two waves. The pooled psychological distress effect size across studies was 1.68 with a 95 % CI of 1.15 and 2.20. The heterogeneity was high ($I^2 = 96.87$ %. $Q = 991.96$ $p < .001$). Ten waves were conducted in North America, 11 waves were conducted in Europe, and three waves were conducted in Asia. Moreover, the PHQ-4 was used in 16 waves, the GHQ-28 was used in 11 waves, the K-6 was used in three waves, and there was no information about the measures which were used in two waves. No group differences between regions were found ($\chi^2 = 4.97$, $p = .083$), however, there were significant group differences regarding measures ($\chi^2 = 362.77$, $p < .001$). The waves that used unknown measures had a higher effect size ($d = 3.96$, 95 % CI, 3.59, 4.33). Meta-regression showed that region ($B = 1.12$, $p = .001$) and measures ($B = 1.32$, $p < .001$) are associated with the pooled effect size of psychological distress. The model explained 57.05 % of the variation in the psychological distress means.

### 3.3. Longitudinal analysis

There were two waves in January–February, 8 waves in March, 11 waves in April, 7 waves in May, 8 waves in June, four waves in July, and five waves in months after July (three in September, one in November, one in December). The prevalence rate was statistically different across month of measurement ($\chi^2 = 105.99$, $p < .001$). A high prevalence rate was reported in April (Prevalence = 39.5 %; 95 % CI, 26.7 %–52.3 %) and the months after July (Prevalence = 40.9 % (95 % CI, 16.1 %–65.8 %). The prevalence of psychological distress was 10.0 % (95 % CI, 8.9 %–11.1 %) in January–February, 31.2 % (95 % CI, 17.1 %–45.3 %) in March, 25.2 % (95 % CI, 19.8 %–30.7 %) in May, 21.5 % (95 % CI, 15.6 %–27.3 %) in June, and 24.4 % (95 % CI, 19.9 %–28.8 %) in July. Of 24 waves, one was in January–February, four were in March, 9 were in April, 6 were in May, three were in June, and one was months after July (one, October). We did not include the January–February and months after July group in the analysis. No group differences regarding months were found ($\chi^2 = 3.54$, $p = .315$). Results are presented in Fig. 2.

The prevalence of psychological distress slightly increased (but insignificantly) between baseline and follow-up (LOR = 0.01; 95 % CI, −0.72, 0.74; Fig. 6 and Table 2). High heterogeneity was observed ($I^2 = 99.88$, $Q = 2463.87$, $p < .0001$). Nine studies reported the outcome in Europe, four studies reported it in North America, four studies were from Asia-Pacific, and one paper was from Latin America. However, as the paper in Latin America used two different measures for each time point, this group was included in the analysis. No significant group differences regarding the region were observed ($\chi^2 = 2.17$, $p = .538$; Fig. 7). In terms of the measures, four studies used the PHQ-4, three studies used the GHQ-12, the K-6, the GHQ-28, and two did not mention the measure used. There was only one study per the following measures: the K-10, the PHQ-ADS, the Anxious/Depressed syndrome subscale-ASR, the SCL-90, the MHI-5, and the BSI-18. Hence, these measures were not included in the subgroup analysis. Significant group differences concerning the measures were found ($\chi^2 = 10.28$, $p = .036$; Fig. 7) where a higher effect size was observed in the studies used the GHQ-25 (LOR = 2.78). Meta-regression showed that age at baseline ($B = 0.19$, $p < .001$) is associated with the effect size. There were significant publication biases for both models (with/without moderators).

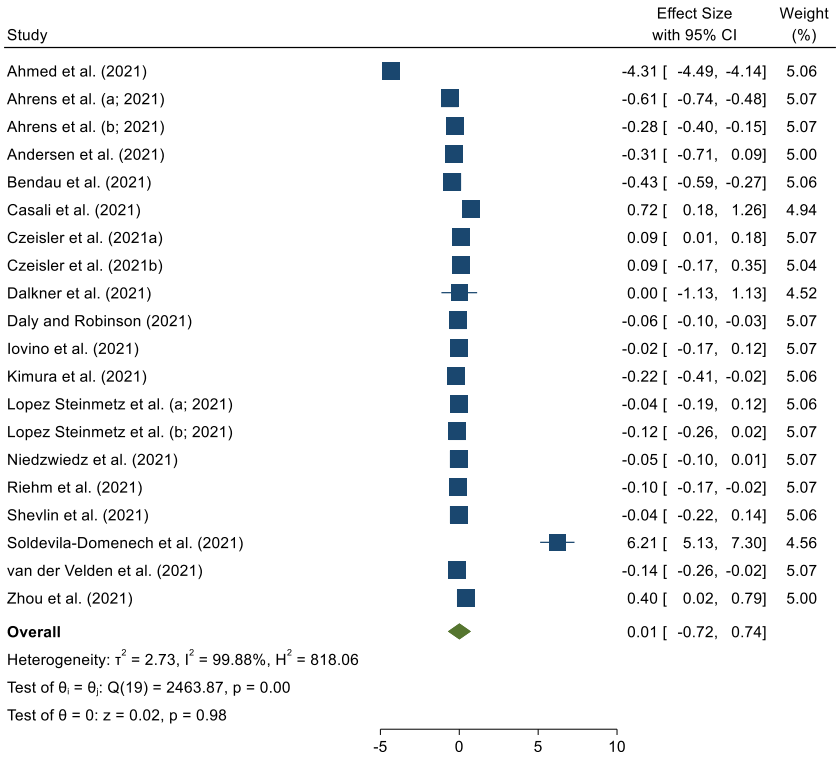



**Fig. 6.** Changes in psychological distress symptoms from the baseline to the follow-up.

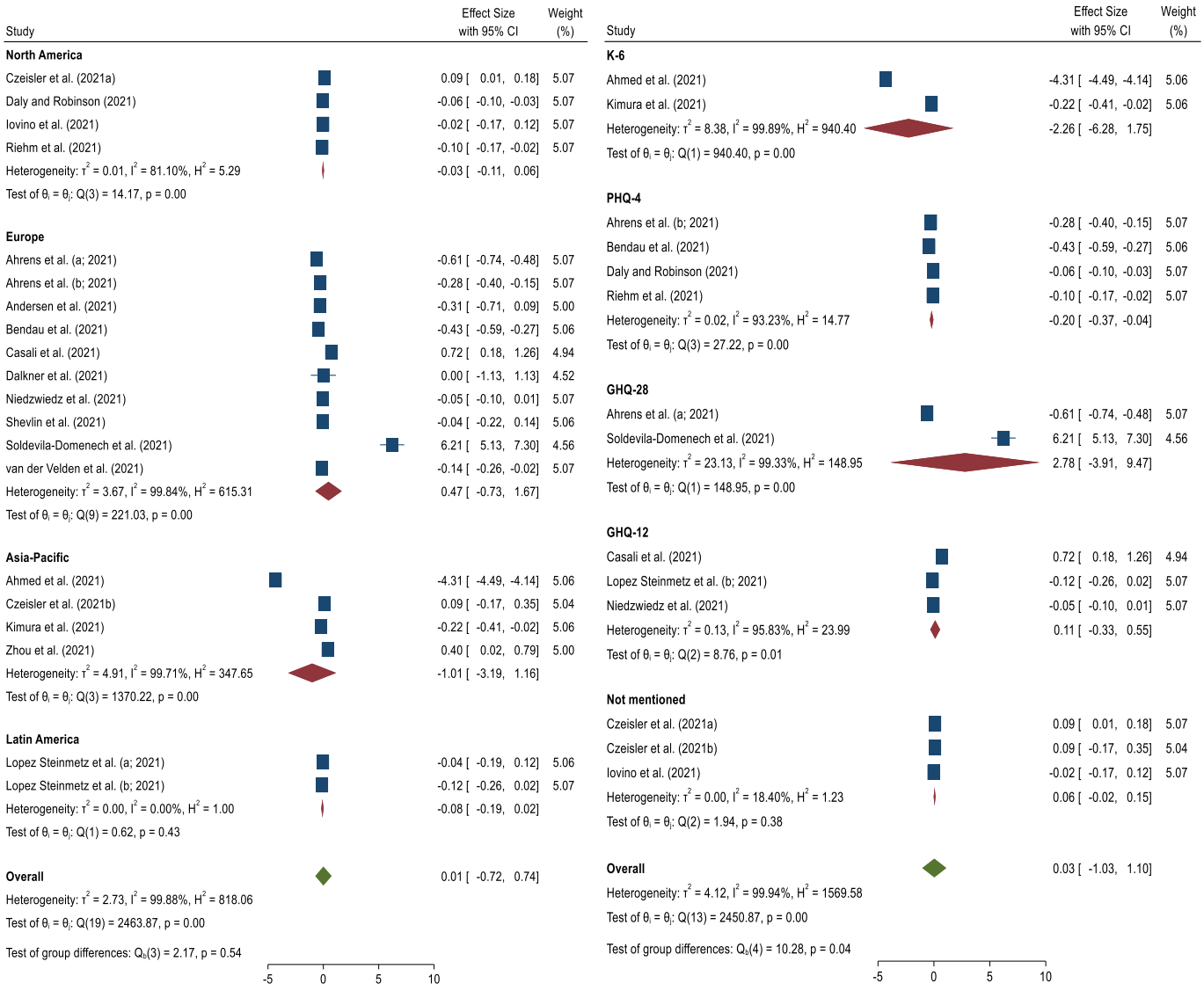



**Fig. 7.** The LOR of psychological distress across regions and measures.

### 3.3.1. PTSD

In total 8 studies were on PTSD, of which 6 reported PTSD prevalence estimates (Baumann et al., 2021; Czeisler et al., 2021a, 2021b; Kulbin et al., 2021; Kyzar et al., 2021; Shevlin et al., 2021a; Vlake et al., 2021) and two studies reported means (SD) of the PTSD symptoms (Chew et al., 2020; González-Sanguino et al., 2021). As there were not at least three studies that reported PTSD means, we did not conduct separate analysis on mean differences. However, we included these two studies in the longitudinal meta-analysis to compare the LORs after converting Cohen's *d*. Two studies reported means of PTSD in three and two waves, respectively(Chew et al., 2020; González-Sanguino et al., 2021). Three studies reported the prevalence in three waves and three studies reported it in two waves. The pooled prevalence across all-time points and studies was 17.5 % with a 95 % confidence interval of 14.1 % and 20.9 %. Significant heterogeneity between studies was found ($Q = 404.57$, $p < .0001$), indicating a severe difference between the prevalence rate of PTSD. A total variation of 95.75 was observed among the studies. Six waves were reported in North America and 9 waves were reported in Europe. Studies in North America (Prevalence = 23.3 %; 95 % CI, 18.5 %–28.0 %) reported a higher prevalence of PTSD in comparison with studies in Europe (Prevalence = 14.4 %; 95 % CI, 12.2 %–16.6 %). The differences were statistically significant ($\chi^2 = 10.90$, $p = .001$). In terms of the measure type, the IES-R and the ITQ tools were used in three waves. The PCL-C was used in five waves and the PC-PTSD-5 and the COVID-19 TSRD were used in two waves. There was a significant difference between the type of measures ($\chi^2 = 70.82$, $p < .001$). The studies that used the COVID-19 TSRD (Prevalence = 27.9 %; 95 % CI, 24.7 %–31.2 %) reported a higher prevalence than those using the PC-PTSD-5 (Prevalence = 22.2 %; 95 % CI, 17.2 %–27.3 %), the PCL-C (Prevalence = 16.5 %; 95 % CI, 13.8 %–19.3 %), the ITQ (Prevalence = 15.8 %; 95 % CI, 14.4 %–17.1 %), and the IES-R (Prevalence = 8.5 %; 95 % CI, 4.9 %-12.2 %), The multiple meta-regression showed that the region is negatively associated with the PTSD prevalence ($B = -0.10$, $p < .001$). The model explained 53.02 % of the variation in the PTSD prevalence estimate. No indication of publication bias was found for the model without moderators while the model with moderators had a significant publication bias.

*3.3.1.1. Longitudinal analysis.* There was only one time point that was reported in March and none in January–February. Four waves reported the prevalence in April and months after July (one in September, one in October, one in November, and one in February 2021). There were two-time points that reported PTSD prevalence in May, June, and July. Subgroup analysis showed that the prevalence rates of PTSD did not differ across months ($\chi^2 = 4.38$, $p = .357$). Results are presented in Fig. 2.

The second approach of the analysis showed that the PTSD prevalence decreased (insignificantly) between baseline and follow-up (LOR = −0.00; Fig. 8 and Table 2). Considerable heterogeneity was observed ($I^2$ = 79.15 %. $Q$ = 44.33 $p$ < .0001). Two studies used the IES-R and three studies used the PCL-C. Only one study used other measures. Therefore, we conducted a subgroup analysis on the difference between the IES-R and the PCL-C. No group differences between these two measures were found ($\chi^2$ = 0.00, $p$ = .952; Fig. 9). Four studies were conducted in Europe and three studies were conducted in North America. As there was only one study conducted in Asia, this region was not included in the subgroup analysis. The PTSD effect size was higher in North America than in Europe ($\chi^2$ = 40.75, $p$ < .001; Fig. 9). The meta-regression analysis showed that the region ($B$ = −0.34, $p$ < .001) is significantly associated with the PTSD effect size. No indication of publication bias was found in the model with moderators or without moderators.

### 3.3.2. Substance use

In total, five studies reported substance use, with four studies (Czeisler et al., 2021b; Kulbin et al., 2021; Osaghae et al., 2021; Ripoll et al., 2021) reporting substance use prevalence estimates. There was one study (Cousijn et al., 2020) (two waves) that reported mean (SD) of substance use, which was included in the longitudinal analysis on the LORs. Three studies reported the substance use prevalence in two waves and one study reported it in three waves. Pooled prevalence of substance use was 24.0 % (95 % CI, 17.8 %–30.1 %). A large heterogeneity was observed among studies ($I^2$ = 98.44 %, $Q$ = 163.37, $p$ < .0001). In terms of the measures, five time points used the AUDIT-C, two time points that used the psychotropic drugs consumption and two time points did not mention what measures were used. There was a significant difference regarding measures ($\chi^2$ = 63.96, $p$ < .0001), where a higher prevalence was reported in studies that used the AUDIT-C (Prevalence = 31.8 %; 95 % CI, 27.8 %–35.7 %) in comparison with the studies that used the psychotropic drugs consumption (Prevalence = 15.9 %; 95 % CI, 13.6 %–18.2 %) and unknown measure (Prevalence = 14.2 %; 95 % CI, 12.4 %–15.9 %). There were four time points in North America and five time points in Europe where the prevalence rates were not statistically significant across these two regions ($\chi^2$ = 0.02, $p$ = .90). The meta-regression model was insignificant. The Eager's test showed a significant publication bias.

*3.3.2.1. Longitudinal analysis.* Concerning the months, two time points were reported in April, June, and months after July. There was only one time point for March, May, and July. April and March were grouped as April–March, May and June were grouped as May–June, and July and months after July were grouped as July and after. No significant group differences were observed ($\chi^2$ = 0.67, $p$ = .714). Considering the second approach, prevalence of substance use decreased between baseline and follow-up (LOR = −0.06; Fig. 10 and Table 2). No statistical heterogeneity was found between studies ($I^2$ = 70.74 %, $Q$ = 16.12, $p$ = .003). There were not enough studies per measure, hence, we did not conduct subgroup analyses on measure differences of the effect sizes. Three studies were conducted in Europe and two studies were conducted in North America. The effect size was found to differ by region ($\chi^2$ = 4.53, $p$ = .033; Fig. 11) where a higher LOR was observed in studies conducted in North America (LOR = 0.14) in comparison with Europe (LOR = −0.20). The moderators of interest were not statistically associated with the substance use effect sizes. No publication of bias was observed.

### 3.3.3. Insomnia

Six studies reported insomnia (prevalence estimate = 5, means = 1) (Czeisler et al., 2021b; Kulbin et al., 2021; Kyzar et al., 2021; Pizzonia et al., 2021; Yocum et al., 2021; Zhou et al., 2021). Four studies reported the prevalence in two waves and two studies reported it in three waves. The study that reported insomnia means was only included in the longitudinal analysis. Studies reported a pooled prevalence of 22.2 % (95 % CI, 16.0 %–28.4 %) with an indication of high heterogeneity across studies ($I^2$ = 99.56, $Q$ = 958.74, $p$ < .0001). Moreover, there were three and five waves that used EST-Q2 and PSQI, respectively. A study used ISS in two waves and one study did not mention the measure tool. As well, there were two, three, and 7 waves in Asia, Europe, and North America. A higher prevalence was reported in Europe (Prevalence = 30.8 %; 95 % CI, 27.1 %–34.4 %) than in Asia (Prevalence = 21.7 %; 95 % CI, 9.6 %–33.8 %) and North America (Prevalence = 18.8 %; 95 % CI, 9.7 %–27.8 %). Studies that used the EST-Q2 reported a higher prevalence rate (Prevalence = 30.8 %; 95 % CI, 27.1 %–34.4 %) than studies that used the ISS (Prevalence = 28.5 %; 95 % CI, 19.9 %–37.2 %), the PSQI (Prevalence = 23.2 %; 95 % CI, 18.6 %–27.9 %), and other (Prevalence = 2.8 %; 95 % CI, 0.01 %–6.3 %). Both regions ($\chi^2$ = 7.12, $p$ = .028) and measure ($\chi^2$ = 128.02, $p$ < .001) group differences were significant. The moderators of interest were not statistically associated with the insomnia prevalence estimates. A significant publication bias was found.

*3.3.3.1. Longitudinal analysis.* There was only one wave in February and March which was regrouped. There were two waves in May and June. There were three waves in April and in the months after July. The group differences were not significant ($\chi^2$ = 2.44, $p$ = .655). The second approach of the analysis showed an insignificant increase in the prevalence of insomnia (LOR = 0.43; Fig. 12 and Table 2). A considerable heterogeneity was found ($I^2$ = 96.17 %, $Q$ = 139.48, $p$ < .001). No subgroup analyses in either region or measures were conducted as there were not enough studies per group. The moderators of interest were not statistically associated with the effect sizes of insomnia. No publication of bias was observed.

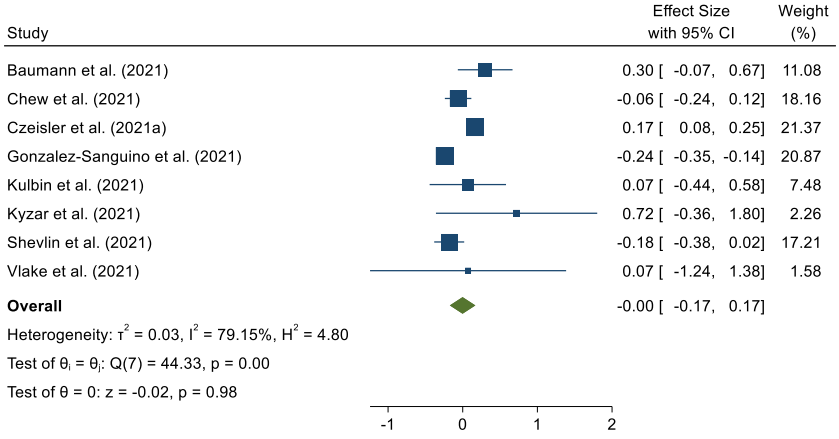



**Fig. 8.** Changes in PTSD symptoms from the baseline to the follow-up.

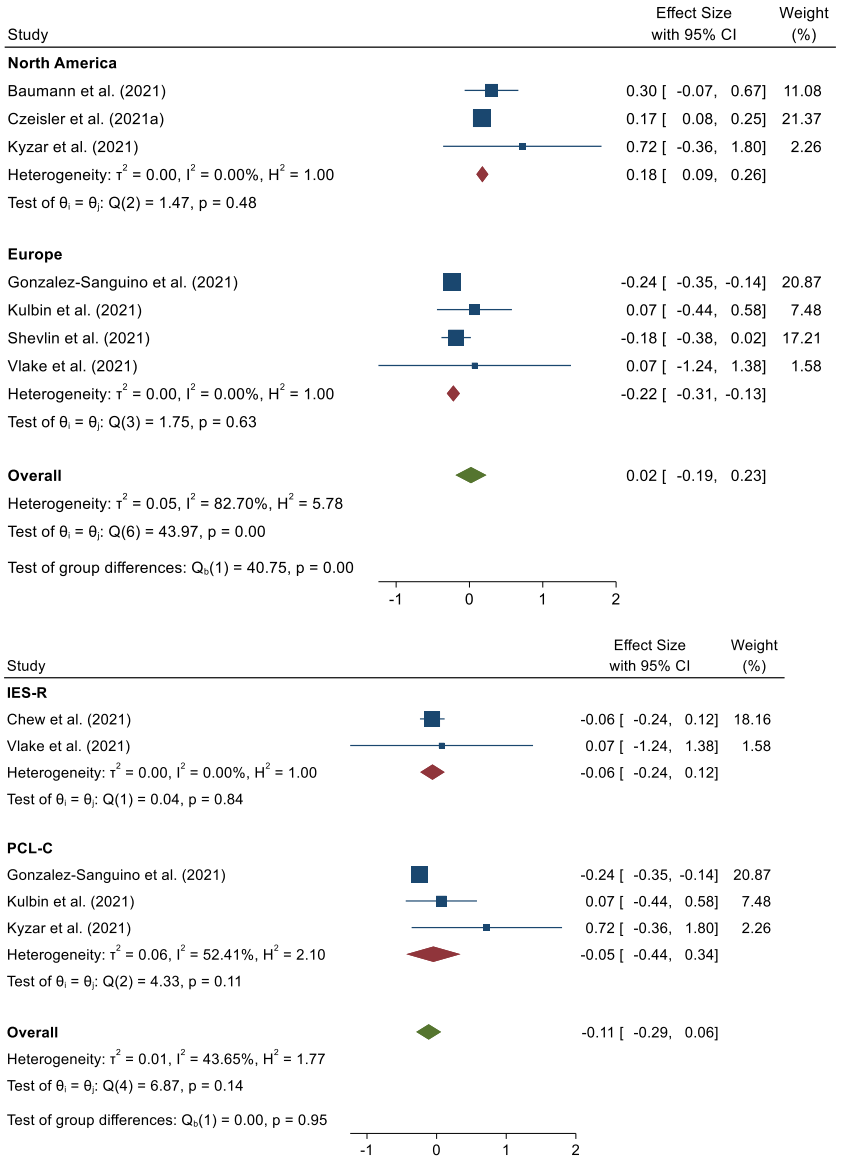



**Fig. 9.** The LOR of PTSD across regions and measures.

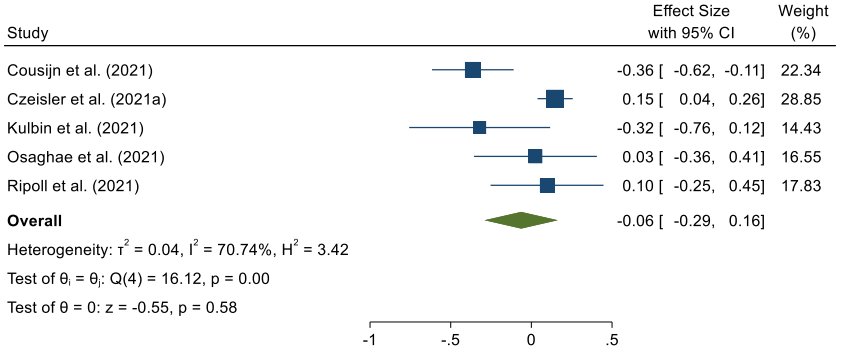



**Fig. 10.** Changes in substance use symptoms from the baseline to the follow-up.

### 3.3.4. *Loneliness*

*3.3.4.1. Mean differences.* In total, 8 studies reported loneliness means (Ahrens et al., n.d.; Fanari and Segrin, 2021; Groarke et al., 2021; Lee et al., 2020; Rumas et al., 2021; Saidur et al., 2021; Stevenson and Wakefield, 2021; van Breen et al., 2021). One study reported the mean of loneliness in 23 countries(van Breen et al., 2021). Five studies reported the means in two waves, one paper reported it in three waves, one study reported the means in 8 waves, and one paper reported it in four waves (the paper with a report in 23 countries; each country was

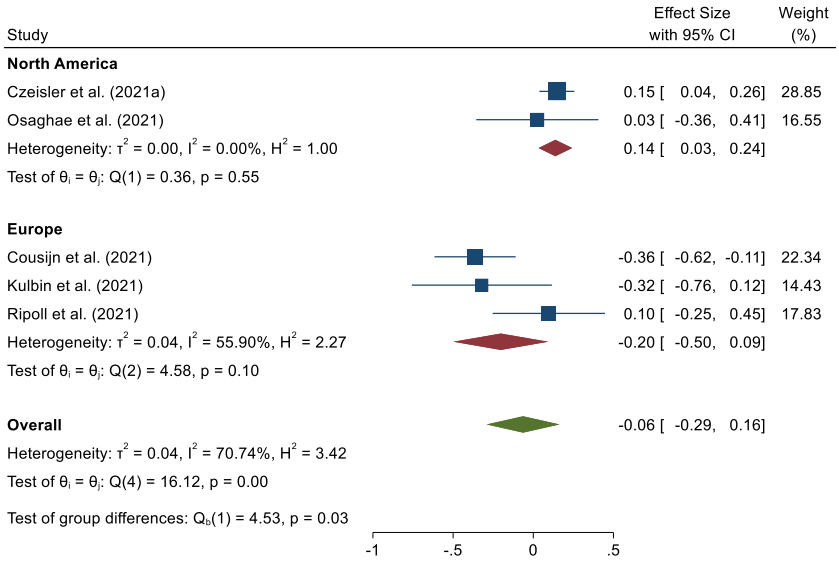



**Fig. 11.** The LOR of substance use across regions.

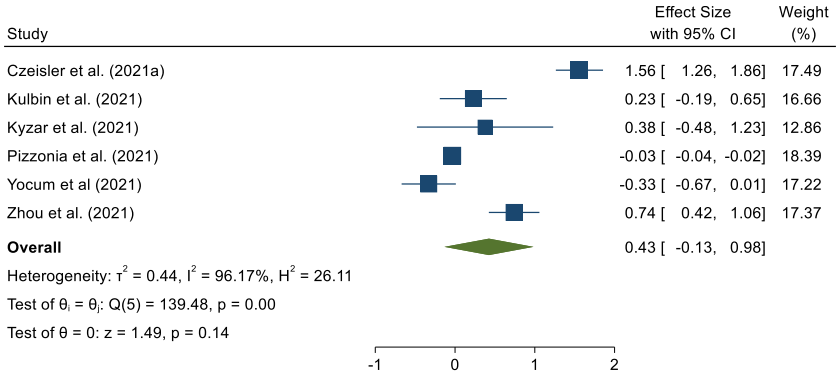



**Fig. 12.** Changes in insomnia symptoms from the baseline to the follow-up.

included in the analysis, separately). The pooled loneliness effect size across studies was 2.15 with a 95 % CI of 1.83 and 2.48. The heterogeneity was high ($I^2$ = 99.12 %. $Q$ = 12,655.54 $p$ < .001). Fourteen waves were conducted in North America, 69 waves were conducted in Europe, 22 waves were conducted in Asia-Pacific, and four waves were in Latin America and four waves were in Africa. Moreover, the self-report scale was used in 92 waves (four waves in 23 countries), the UCLA Loneliness Scale was used in 9 waves, the LON was used in 8 waves, and the three-item Loneliness Scale and the Short Loneliness Scale were used in two waves. There were significant differences between regions ($\chi^2$ = 15.46, $p$ = .004). A higher effect size was observed in the waves conducted in North America ($d$ = 3.25, 95 % CI, 1.24, 5.26) than the waves conducted in Europe ($d$ = 2.17, 95 % CI, 1.84, 2.50), Africa ($d$ = 1.67, 95 % CI, 1.50, 1.83), Asia-Pacific ($d$ = 1.61, 95 % CI, 1.45, 1.77), and Latin America ($d$ = 1.51, 95 % CI, 1.34, 1.67). Moreover, significant group differences between measures were found ($\chi^2$ = 4516.38, $p$ < .0001). A higher effect size was observed in the waves that used the LON ($d$ = 5.73, 95 % CI, 5.61, 5.84) in comparison with the UCLA ($d$ = 4.47, 95 % CI, 1.45, 7.48), the Short Loneliness Scale ($d$ = 2.48, 95 % CI, 2.25, 2.71), the Three-item Loneliness Scale ($d$ = 1.65, 95 % CI, 1.42, 1.88), and the self-report scale ($d$ = 1.62, 95 % CI, 1.59, 1.65). Meta-regression showed that region ($B$ = −9.66, $p$ < .001), measures ($B$ = −1.53, $p$ = .001), and age at baseline ($B$ = 0.67, $p$ = .001) are associated with the pooled effect size of loneliness. The model explained 36.55 % of the variation in the loneliness effect size.

*3.3.4.2. Longitudinal analysis.* Two waves were conducted in January–February, four were in March, 8 were in April, 6 were in May, and three were months after July (two in September and one in February 2021). The subgroup analyses showed that the effect size of loneliness was 1.02 (95 % CI, −0.03, 2.07) in January–February, 1.84 (95 % CI, 1.49, 2.19) in March, 2.01 (95 % CI, 1.67, 2.36) in April, 5.96 (95 % CI, 3.22, 8.70) in May, and 1.58 (95 % CI, 0.45, 2.71) in following months. The group differences regarding the month were significant ($\chi^2$ = 12.00, $p$ = .017). The means of loneliness slightly decreased (but insignificantly) between the baseline and follow-up (LOR = 0.04; 95 % CI, −0.00, 0.09; Fig. 13). A moderate heterogeneity was observed ($I^2$ = 44.83, $Q$ = 50.28, $p$ = .008). Fifteen studies reported the outcome in Europe, 7 in Asia-Pacific, and five in North America. One study was from Latin America, and one was conducted in Africa. No significant group differences regarding the region were observed ($\chi^2$ = 2.61, $p$ = .271; Fig. 14). In terms of the measures, four studies used the UCLA, and 23 studies used the self-report scale (one paper with a report in 23 countries). There was only one study per the following measures; the Three-item Loneliness Scale, the Short Loneliness Scale, and the LON. No group differences concerning the measures were found ($\chi^2$ = 1.15, $p$ = .283; Fig. 14). The moderators were not significant in the meta-regression model. There was a significant publication bias in the model without moderators, while it was not significant in the model with moderators.

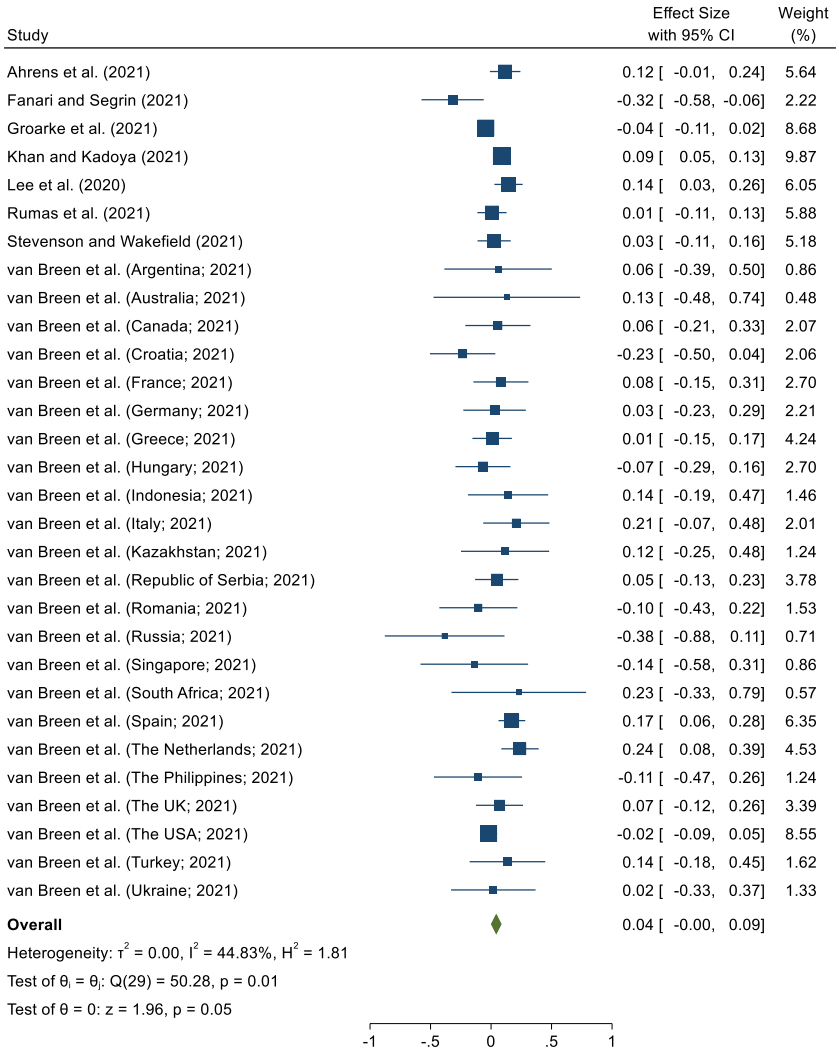



**Fig. 13.** Changes in loneliness from the baseline to the follow-up.

### 3.3.5. *Suicidal ideation*

*3.3.5.1. Longitudinal analysis.* There were two studies that reported the suicidal ideation prevalence (Czeisler et al., 2021b; Connor et al., 2020) and two studies that reported suicidal ideation means (Ng et al., 2020; Sueki and Ueda, 2021). Accordingly, no meta-analysis on either prevalence differences or mean differences was conducted. We only performed longitudinal meta-analysis on the differences between baseline and the last follow-up using LOR. The values of the Cohen's d of the studies with means were converted to LOR. The suicidal ideation increased (but insignificantly) between baseline and follow-up (LOR = 0.05; 95 % CI, −0.08, 0.17; Fig. 15 and Table 2). A considerable heterogeneity was observed ($I^2 = 81.33$, $Q = 19.81$, $p = .0002$). There were not enough studies per region groups (North America = 1, Europe = 2, and Asia = 1) as well as the measures. Also, the observations regarding female's proportion and age means at baseline were not enough to include them in the meta-regression analysis. A meta-regression analysis was performed on the relationship between the suicidal ideation effect size and time interval between the baseline and the last follow-up which was insignificant. A significant indication of publication bias was observed.

## 4. Discussion

This systematic review aimed to examine the global evolution of mental health problems (depression, anxiety, PTSD, psychological distress, insomnia, loneliness, and suicidal ideations) during the COVID-19 pandemic. For all disorders considered, the results showed a spike in mental health problems during the first wave of the COVID-19 pandemic, particularly in April and May 2020, depending on the disorder considered. This period coincides with the first measures of social isolation, confinement, travel restrictions, university, and school closures, and the closure of "non-essential" but important services to people (Chu et al., 2020; Haug et al., 2020). This period also corresponds to the time when the pandemic, especially in May, caused the most deaths in Europe and North America where a majority of the included studies were conducted. The number of cases, the overcrowding of hospitals, the number of deaths, the constant presence of the pandemic situation in the media with daily press briefings by different levels of government (mayors, governors, health ministers, prime ministers), the martial tone of the heads of state, the fear of being infected, and of infecting loved ones are the primary reasons that could explain the spike in mental health problems (for depression, anxiety, psychological distress and loneliness) in May 2020 (Cénat et al., 2020b). Moreover, another spike in psychological distress experienced after July 2020 in North America coincides with the months of October and December, when COVID-19 has caused many deaths in the United States (John Hopkins University, 2021). Finally, the month of May 2020 also coincides with the uncertainty of the populations, the massive job loss, with social and economic measures that did not always reassure the populations, especially in the United States(Parolin et al., 2020; Raifman et al., 2021; van Dorn et al., 2020). These different reasons may explain the spike

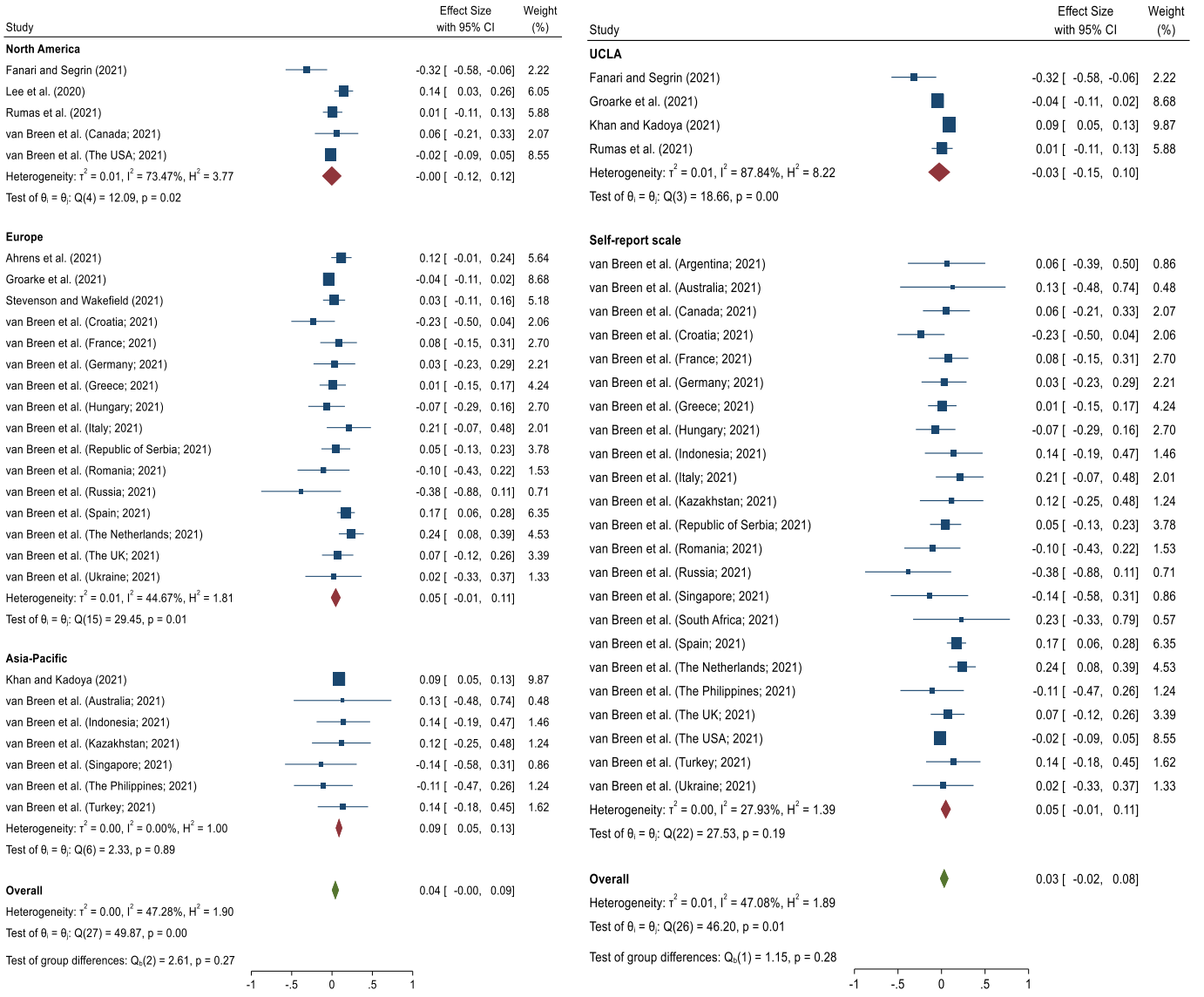



**Fig. 14.** The LOR of loneliness across regions and measures.

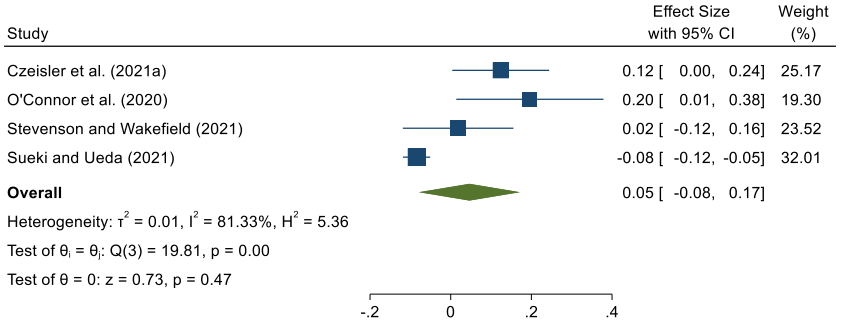
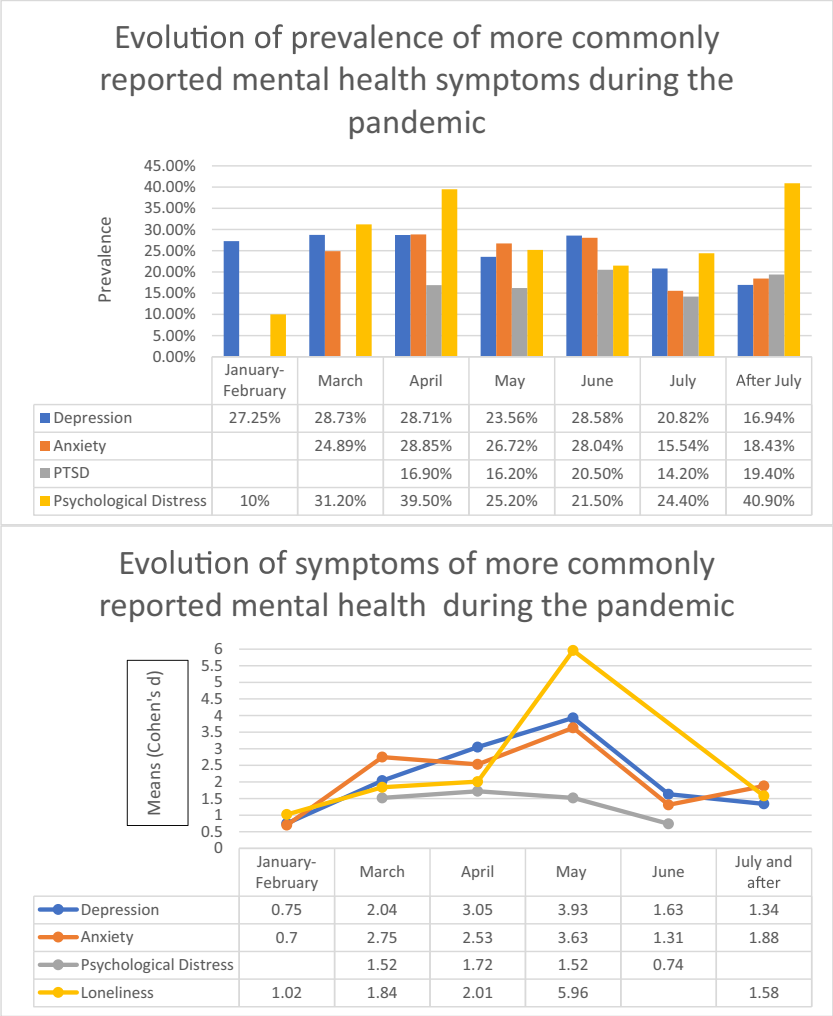



**Fig. 15.** Changes in suicidal ideation from the baseline to the follow-up.

observed in these disorders in May 2020. However, as of June 2020, the results showed a decrease in mental health disorders. This month also coincides with the end of the first wave in North America and Europe, with an initial recovery of the global economy and with the lifting of isolation and containment measures related to the pandemic (Bailey et al., 2021; Demirgüç-Kunt et al., 2021; Ligo et al., 2021). Despite this decrease, the prevalence of mental health problems remains higher during the pandemic compared to pre-pandemic times (Prati and Mancini, 2021; Robinson et al., 2022).

The regions with the highest prevalence of symptoms of mental health problems are North America for anxiety, depression, and PTSD, Latin America for psychological distress, and Europe for insomnia. The lack of social protection in the United States created situations of panic and anxiety, and showed significant social precariousness of vulnerable




| | January-February | March | April | May | June | July | After July |
|---|---|---|---|---|---|---|---|
| Depression | 27.25% | 28.73% | 28.71% | 23.56% | 28.58% | 20.82% | 16.94% |
| Anxiety | | 24.89% | 28.85% | 26.72% | 28.04% | 15.54% | 18.43% |
| PTSD | | | 16.90% | 16.20% | 20.50% | 14.20% | 19.40% |
| Psychological Distress | 10% | 31.20% | 39.50% | 25.20% | 21.50% | 24.40% | 40.90% |

| | January-February | March | April | May | June | July and after |
|---|---|---|---|---|---|---|
| Depression | 0.75 | 2.04 | 3.05 | 3.93 | 1.63 | 1.34 |
| Anxiety | 0.7 | 2.75 | 2.53 | 3.63 | 1.31 | 1.88 |
| Psychological Distress | | 1.52 | 1.72 | 1.52 | 0.74 | |
| Loneliness | 1.02 | 1.84 | 2.01 | 5.96 | | 1.58 |

**Fig. 16.** Evolution of most reported mental health problems during the COVID-19 pandemic.

communities during the COVID-19 pandemic (Parolin et al., 2020; van Dorn et al., 2020). Massive job losses, not being able to feed oneself, and not being able to pay the rent, demonstrated the fragility of the American social protection system. In addition to that, North America became the epicenter of the pandemic and had the highest COVID-19 death toll (Kim et al., 2020; Parolin et al., 2020; van Dorn et al., 2020; Weinberger et al., 2020). As for Latin America, the included studies were conducted in Argentina, Brazil, and Colombia, and although they are among the most developed countries in the region, their social security remains fragile (Blofield et al., 2020; Brunoni et al., 2021). Only half of the population has social security (Blofield et al., 2020; Blofield and Filgueira, 2020). In addition, these countries (and particularly Brazil) have been greatly affected by the consequences of the pandemic, in terms of health (number of cases and deaths), social and economic terms (Blofield et al., 2020; Neiva et al., 2020).

We were only able to assess gender as a moderator for anxiety and depression. Being a female is associated with a higher prevalence of anxiety and depression symptoms. In addition to social (e.g., experiences of violence), societal (e.g., gender roles), and biological (e.g., hormonal changes) reasons (Albert, 2015; Kuehner, 2017), which are often cited in scientific literature to explain why women often have higher rates of depression and anxiety. The pandemic has also shown significant gender disparities(Connor et al., 2020; Gausman and Langer, 2020). During the pandemic, women were more likely to lose their jobs, take unpaid leaves of absence to care for children, continue to work while caring for children, and be exhausted from various household and professional tasks(Connor et al., 2020; Gausman and Langer, 2020). In addition, women were more likely to provide care to family members facing difficult situations during the pandemic, including child health (Johnston et al., 2020; Power, 2020). They were also more likely to be in caregiving professions (nurses, nursing assistants, orderlies) (Nordhues et al., 2021). All these factors may explain the higher prevalence of depression and anxiety in women.

However, results indicated differences according to age, for only anxiety, which tended to decrease with age. This reflects the concern of active population during the COVID-19 pandemic, including younger people, university students, parents with young children and adolescents, and working professionals (Cénat and Dalexis, 2020; Guan et al., 2020; Patrick et al., 2020; Savage et al., 2020). More studies need to be conducted, because elderly people were perceived to be more at risk of being infected and to experience the worst symptoms or die from COVID-19 (Gerst-Emerson and Jayawardhana, 2015).

The results also showed significant differences in prevalence, depending on the questionnaires used to assess the symptoms of the different disorders. This observation holds true for anxiety, depression, psychological distress, PTSD, insomnia, substance abuse, and loneliness. These observations are always double-edged, because the question is whether certain measures exaggerate the screening of symptoms (too sensitive and not specific enough) or conversely, whether other measures do not screen enough symptoms (too specific and not sensitive

enough) (Reitsma et al., 2005). These results should make researchers aware of choice of measure in future studies of populations affected by the COVID-19 pandemic and other health and social challenges.

### 4.1. Limitations and implications

Despite its importance in examining the evolution of mental health problems during the COVID-19 pandemic, this study contains certain limitations. First, the quality assessment of the articles, considering a score of 6 out of 9, led to the removal of 52 articles in the selection process. This reduced the ability to study certain moderators (e.g., gender, region) for each mental health problem explored, such as psychological distress, PTSD, insomnia, substance abuse. The removal of those articles also reduced the number of articles conducted in China. Second, the lack of longitudinal studies in some parts of the world, such as Africa, the Caribbean, India, the Middle East, and the very few articles in Latin America and Asia did not allow for a deeper exploration of issues related to geographic factors for all disorders. This lack of data also prevented the examination of geographical aspects, exploring them by gender, measures used, among others. Similarly, the lack of data regarding ethnicity, race, sexual orientation, migration status, and gender prevented considering these issues as potential risk factors for individual mental health problems during the pandemic. In addition, while at the beginning of the pandemic there were many publications addressing mental health issues, from July 2020 and onwards fewer studies were published, even in those published up to August 2021.The significant heterogeneity observed is also an important limitation to this study. Moreover, despite the exploration of different moderators, the heterogeneity remained. Other moderators could have been explored, such as risk and protective factors associated with the pandemic and the participants (e.g., past traumas, social support, resilience, social isolation), but too few studies reported that information in a consistent manner to be able to analyze them. Also, the lack of studies using structured interviews for diagnosis and the use of self-reported measures should prevent us from using the term “disorder”, but only consider the term “symptom”. Finally, no longitudinal studies were conducted with samples of children and adolescents, precluding separate analyses for this group with particular needs.

## 5. Conclusions

Despite the aforementioned limitations, this meta-analysis on the evolution of mental health problems during COVID-19 is of major importance. It shows the evolution of clinically elevated symptoms of anxiety, depression, PTSD, psychological distress, insomnia, and substance abuse during the COVID-19 pandemic. It reveals how the evolution of mental health problems is related to the evolution of the pandemic as well as the social, economic and health problems that accompany it. It shows differences between regions of the world, gender, age, measures used among others. Future studies should systematically report data on gender, age groups, education level, ethnicity, sexual orientation, and migration status to allow for better comparison. They will also help identify groups that are more at risk of experiencing mental health problems. Additional studies also need to be conducted in certain parts of the world such as India, Africa, the Middle East, and the Caribbean, to better understand the long-term impacts of the COVID-19 pandemic on the mental health of diverse populations. This study confirms that globally, the mental health of populations has been affected by the COVID-19 pandemic.

## CRediT authorship contribution statement

Dr. Cénat and M. Farahi had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. *Concept and design*: Cénat, Farahi, Dalexis, Darius, Labelle. Acquisition and extraction of data: all the authors. Statistical analysis: Cénat and Farahi. Interpretation of data: All the authors. Drafting of the manuscript: Cénat, Farahi, Dalexis, Darius, and Labelle. Critical revision of the manuscript for important intellectual content: All the authors. Administrative, technical, or material support: Darius and Cénat. Supervision: Cénat and Darius.

## Declaration of competing interest

None reported.

## Acknowledgments

The Vulnerability, Trauma, Resilience and Research Laboratory (V-TRaC Lab) received funding from the Faculty of Social Sciences at the University of Ottawa RE 151066.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jad.2022.07.011.

## References

Ahmed, F., Zhao, F., Faraz, N.A., Qin, Y.J., 2021. How inclusive leadership paves way for psychological well-being of employees during trauma and crisis: a three-wave longitudinal mediation study. J. Adv. Nurs. 77, 819–831.

Ahrens, K.F., Neumann, R.J., Kollmann, B., Brokelmann, J., Von Werthern, N.M., Malyshau, A., Weichert, D., Lutz, B., Fiebach, C.J., Wessa, M., Kalisch, R., Plichta, M. M., Lieb, K., Tüscher, O., Reif, A., 2021. Impact of COVID-19 Lockdown on Mental Health in Germany: Longitudinal Observation of Different Mental Health Trajectories and Protective Factors. https://doi.org/10.1038/s41398-021-01508-2.

Albert, P.R., 2015. Why is depression more prevalent in women? J. Psychiatry Neurosci. 40, 219. https://doi.org/10.1503/JPN.150205.

Amanzio, M., Canessa, N., Bartoli, M., Cipriani, G.E., Palermo, S., Cappa, S.F., 2021. Lockdown effects on healthy cognitive aging during the COVID-19 pandemic: a longitudinal study. Front. Psychol. 12, 685180.

Andersen, A.J., Mary-Krause, M., Bustamante, J.J.H., Héron, M., El Aarbaoui, T., Melchior, M., 2021. Symptoms of anxiety/depression during the COVID-19 pandemic and associated lockdown in the community: longitudinal data from the TEMPO cohort in France. BMC Psychiatry 21, 381.

Andrade, C., 2020. Mean difference, standardized mean difference (SMD), and their use in meta-analysis: as simple as it gets. J. Clin. Psychiatry 81 (5), 11349.

Bailey, D., Crescenzi, R., Roller, E., Anguelovski, I., Datta, A., Harrison, J., 2021. In: Regions in Covid-19 Recovery, 55, pp. 1955–1965. https://doi.org/10.1080/00343404.2021.2003768 doi:10.1080/00343404.2021.2003768.

Batterham, P.J., Calear, A.L., McCallum, S.M., Morse, A.R., Banfield, M., Farrer, L.M., Gulliver, A., Cherbuin, N., Rodney Harris, R.M., Shou, Y., Dawel, A., 2021. Trajectories of depression and anxiety symptoms during the COVID-19 pandemic in a representative australian adult cohort. Med. J. Aust. 214, 462–468. https://doi.org/10.5694/MJA2.51043.

Baumann, B.M., Cooper, R.J., Medak, A.J., Lim, S., Chinnock, B., Frazier, R., Roberts, B. W., Epel, E.S., Rodriguez, R.M., 2021. Emergency physician stressors, concerns, and behavioral changes during COVID-19: a longitudinal study. Acad. Emerg. Med. 28, 314–324.

Bel, G., Gasulla, Ó., Mazaira-Font, F.A., 2021. The effect of health and economic costs on governments’ policy responses to COVID-19 crisis under incomplete information. Public Adm. Rev. 81, 1131–1146. https://doi.org/10.1111/PUAR.13394.

Bendau, A., Plag, J., Kunas, S., Wyka, S., Ströhle, A., Petzold, M.B., 2021. Longitudinal changes in anxiety and psychological distress, and associated risk and protective factors during the first three months of the COVID-19 pandemic in Germany. Brain Behav. 11, e01964.

Bhuiyan, N., Puzia, M., Stecher, C., Huberty, J., 2021. Associations between rural or urban status, health outcomes and behaviors, and COVID-19 perceptions among meditation app users: longitudinal survey study. JMIR mHealth uHealth 9. https://doi.org/10.2196/26037.

Blofield, M., Filgueira, F., 2020. COVID19 and Latin America: Social Impact, Policies and a Fiscal Case for an Emergency Social Protection Floor, Policies and a Fiscal Case for an Emergency Social Protection Floor. Buenos Aires.

Blofield, M., Hoffmann, B., Llanos, M., 2020. In: Assessing the Political and Social Impact of the COVID-19 Crisis in Latin America, 3 3, p. 12.

van Breen, J.A., Kutlaca, M., Koç, Y., Jeronimus, B.F., Reitsema, A.M., Jovanović, V., Agostini, M., Bélanger, J.J., Gützkow, B., Kreienkamp, J., Abakoumkin, G., Khaiyom, J.H.A., Ahmedi, V., Akkas, H., Almenara, C.A., Atta, M., Bagci, S.C., Basel, S., Berisha Kida, E., Bernardo, A.B.I., Buttrick, N.R., Chobthamkit, P., Choi, H. S., Cristea, M., Csaba, S., Damnjanovic, K., Danyliuk, I., Dash, A., Di Santo, D., Douglas, K.M., Enea, V., Faller, D.G., Fitzsimons, G., Gheorghiu, A., Gómez, Á., Hamaidia, A., Han, Q., Helmy, M., Hudiyana, J., Jiang, D.Y., Kamenov, Ž., Kende, A., Keng, S.L., Kieu, T.T.T., Kovyazina, K., Kozytska, I., Krause, J., Kruglanski, A.W., Kurapov, A., Lantos, N.A., Lemay, E.P., Lesmana, C.B.J., Louis, W.R., Lueders, A.,

Malik, N.I., Martinez, A., McCabe, K., Mehulić, J., Milla, M.N., Mohammed, I., Molinario, E., Moyano, M., Muhammad, H., Mula, S., Muluk, H., Myroniuk, S., Najafi, R., Nisa, C.F., Nyúl, B., O'Keefe, P.A., Olivas Osuna, J.J., Osin, E.N., Park, J., Pica, G., Pierro, A., Rees, J., Resta, E., Rullo, M., Ryan, M.K., Samekin, A., Santtila, P., Sasin, E., Schumpe, B.M., Selim, H.A., Stanton, M.V., Sultana, S., Sutton, R.M., Tseliou, E., Utsugi, A., van Lissa, C.J., van Veen, K., Vázquez, A., Wollast, R., Wai-Lan Yeung, V., Zand, S., Žeželj, I.L., Zheng, B., Zick, A., Zúñiga, C., Leander, N.P., vanDellen, M.R., 2021. Lockdown lives: a longitudinal study of inter-relationships among feelings of loneliness, social contacts, and solidarity during the COVID-19 lockdown in early 2020. Pers. Soc. Psychol. Bull. https://doi.org/10.1177/01461672211036602.

Brooks, S.K., Dunn, R., Amlôt, R., Greenberg, N., James Rubin, G., 2016. Social and occupational factors associated with psychological distress and disorder among disaster responders: a systematic review. BMC Psychol. 41 (4), 1–13. https://doi.org/10.1186/S40359-016-0120-9, 2016.

Brunoni, A.R., Suen, P.J.C., Bacchi, P.S., Razza, L.B., Klein, I., Dos Santos, L.A., De Souza Santos, I., Valiengo, L.D.C.L., Gallucci-Neto, J., Moreno, M.L., Pinto, B.S., Félix, L.D. C.S., De Sousa, J.P., Viana, M.C., Forte, P.M., Cardoso, M.C.D.A.O., Bittencourt, M.S., Pelosof, R., De Siqueira, L.L., Fatori, D., Bellini, H., Bueno, P.V.S., Passos, I.C., Nunes, M.A., Salum, G.A., Bauermeister, S., Smoller, J., Lotufo, P.A., Benseñor, I.M., 2021. Prevalence and risk factors of psychiatric symptoms and diagnoses before and during the COVID-19 pandemic: findings from the ELSA-Brasil COVID-19 mental health cohort. Psychol. Med. 1–12 https://doi.org/10.1017/S0033291721001719.

Buheji, M., Da Costa Cunha, K., Beka, G., Mavrić, B., Souza, De, Leandro do Carmo, Y., da Costa Silva, S.S., Hanafi, M., Chetia Yein, T., 2020. The Extent of COVID-19 Pandemic Socio-Economic Impact on Global Poverty. A Global Integrative Multidisciplinary Review. https://doi.org/10.5923/j.economics.20201004.02.

Casali, N., Feraco, T., Meneghetti, C., 2021. Character strengths sustain mental health and post-traumatic growth during the COVID-19 pandemic. A longitudinal analysis. Psychol. Health 1–17.

Cénat, J.M., Blais-Rochette, C., Kokou-Kpolou, C.K., Noorishad, P.-G., Mukunzi, J.N., McIntee, S.-E., Dalexis, R.D., Goulet, M.-A., Labelle, P., 2021. Prevalence of symptoms of depression, anxiety, insomnia, posttraumatic stress disorder, and psychological distress among populations affected by the COVID-19 pandemic: a systematic review and meta-analysis. Psychiatry Res. 295, 113599 https://doi.org/10.1016/j.psychres.2020.113599.

Cénat, J.M., Dalexis, R.D., 2020. The complex trauma Spectrum during the COVID-19 pandemic: a threat for children and adolescents' physical and mental health. Psychiatry Res. 293 https://doi.org/10.1016/j.psychres.2020.113473.

Cénat, J.M., Dalexis, R.D., Kokou-Kpolou, C.K., Mukunzi, J.N., Rousseau, C., 2020a. Social inequalities and collateral damages of the COVID-19 pandemic: when basic needs challenge mental health care. Int. J. Public Health 2020. https://doi.org/10.1007/s00038-020-01426-y.

Cénat, J.M., Felix, N., Blais-Rochette, C., Rousseau, C., Bukaka, J., Derivois, D., Noorishad, P.-G., Birangui, J.-P., 2020b. Prevalence of mental health problems in populations affected by ebola virus disease: a systematic review and meta-analysis. Psychiatry Res. 289, 113033 https://doi.org/10.1016/j.psychres.2020.113033.

Chen, W., Ju, Y., Liu, B., Huang, M., Yang, A., Zhou, Y., Wang, M., Liao, M., Shu, K., Liu, J., Zhang, Y., 2021. Negative appraisals of the COVID-19 social impact associated with the improvement of depression and anxiety in patients after COVID-19 recovery. Front. Psychiatry 12, 585537.

Cheng, Z., Mendolia, S., Paloyo, A.R., Savage, D.A., Tani, M., 2021. Working parents, financial insecurity, and childcare: mental health in the time of COVID-19 in the UK. Rev. Econ. Househ. 19, 123–144. https://doi.org/10.1007/S11150-020-09538-3/TABLES/15.

Chew, Q.H., Chia, F.L.A., Ng, W.K., Lee, W.C.I., Tan, P.L.L., Wong, C.S., Puah, S.H., Shelat, V.G., Seah, E.J.D., Huey, C.W.T., Phua, E.J., Sim, K., 2020. Perceived stress, stigma, traumatic stress levels and coping responses amongst residents in training across multiple specialties during COVID-19 pandemic—a longitudinal study. Int. J. Environ. Res. Public Health 17, 6572. https://doi.org/10.3390/IJERPH17186572, 2020, Vol. 17, Page 6572.

Chu, Y.-H.I., Alam, P., Larson, H.J., Lin, L., 2020. Social consequences of mass quarantine during epidemics: a systematic review with implications for the COVID-19 response. J. Travel Med. 27, 7. https://doi.org/10.1093/JTM/TAAA192.

Connor, J., Madhavan, S., Mokashi, M., Amanuel, H., Johnson, N.R., Pace, L.E., Bartz, D., 2020. Health risks and outcomes that disproportionately affect women during the Covid-19 pandemic: a review. Soc. Sci. Med. 266, 113364 https://doi.org/10.1016/J.SOCSCIMED.2020.113364.

Cousijn, J., Kuhns, L., Larsen, H., Kroon, E., 2020. For Better or for Worse? A Pre-post Exploration of the Impact of the COVID-19 Lockdown on Cannabis Users. https://doi.org/10.1111/add.15387.

Czeisler, M., Lane, R.I., Wiley, J.F., Czeisler, C.A., Howard, M.E., Rajaratnam, S.M.W., 2021a. Follow-up survey of US adult reports of mental health, substance use, and suicidal ideation during the COVID-19 pandemic, september 2020. JAMA Netw. Open 4, e2037665.

Czeisler, M., Wiley, J.F., Facer-Childs, E.R., Robbins, R., Weaver, M.D., Barger, L.K., Czeisler, C.A., Howard, M.E., Rajaratnam, S.M.W., 2021b. Mental health, substance use, and suicidal ideation during a prolonged COVID-19-related lockdown in a region with low SARS-CoV-2 prevalence. J. Psychiatr. Res. 140, 533–544.

Dalkner, N., Wagner-Skacel, J., Ratzenhofer, M., Fellendorf, F., Lenger, M., Maget, A., Tmava-Berisha, A., Pilz, R., Queissner, R., Hamm, C., Bengesser, S., Platzer, M., Birner, A., Reininghaus, E., 2021. Psychological symptoms during and after austrian first lockdown in individuals with bipolar disorder? A follow-up control-group investigation. Int. J. Bipolar Disord. 9, 16.

Daly, M., Robinson, E., 2021. Longitudinal changes in psychological distress in the UK from 2019 to september 2020 during the COVID-19 pandemic: evidence from a large nationally representative study. Psychiatry Res. 300, 113920 https://doi.org/10.1016/J.PSYCHRES.2021.113920.

Daly, M., Sutin, A.R., Robinson, E., 2021. Depression reported by US adults in 2017–2018 and march and april 2020. J. Affect. Disord. 278, 131–135.

Demirgüç-Kunt, A., Lokshin, M., Torre, I., 2021. Opening-up trajectories and economic recovery: lessons after the first wave of the COVID-19 pandemic. CESifo Econ. Stud. 67, 332–369. https://doi.org/10.1093/CESIFO/IFAB010.

van Dorn, A., Cooney, R.E., Sabin, M.L., 2020. COVID-19 exacerbating inequalities in the US. Lancet. https://doi.org/10.1016/S0140-6736(20)30893-X.

Fanari, A., Segrin, C., 2021. Longitudinal effects of U.S. students' reentry shock on psychological health after returning home during the COVID-19 global pandemic. Int. J. Intercult. Relat. 82, 298–310. https://doi.org/10.1016/j.ijintrel.2021.04.013.

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. Lancet Psychiatry 8, 141–149.

Fenollar-Cortés, J., Jiménez, Ó., Ruiz-García, A., Resurrección, D.M., 2021. Gender differences in psychological impact of the confinement during the COVID-19 outbreak in Spain: a longitudinal study. Front. Psychol. 12, 682860.

Gausman, J., Langer, A., 2020. In: Sex and Gender Disparities in the COVID-19 Pandemic, 29, pp. 465–466. https://doi.org/10.1089/JWH.2020.8472. https://home.liebertpub.com/jwh.

Gerst-Emerson, K., Jayawardhana, J., 2015. Loneliness as a public health issue: the impact of loneliness on health care utilization among older adults. Am. J. Public Health 105, 1013–1019. https://doi.org/10.2105/AJPH.2014.302427.

González-Sanguino, C., Ausín, B., Castellanos, M.A., Saiz, J., Muñoz, M., 2021. Mental health consequences of the Covid-19 outbreak in Spain. A longitudinal study of the alarm situation and return to the new normality. Prog. Neuro-Psychopharmacol. Biol. Psychiatry 107, 110219.

Groarke, J.M., McGlinchey, E., McKenna-Plumley, P.E., Berry, E., Graham-Wisener, L., Armour, C., 2021. Examining temporal interactions between loneliness and depressive symptoms and the mediating role of emotion regulation difficulties among UK residents during the COVID-19 lockdown: longitudinal results from the COVID-19 psychological wellbeing study. J. Affect. Disord. 285, 1–9.

Guan, H., Okely, A.D., Aguilar-Farias, N., del Pozo Cruz, B., Draper, C.E., El Hamdouchi, A., Florindo, A.A., Jáuregui, A., Katzmarzyk, P.T., Kontsevaya, A., Löf, M., Park, W., Reilly, J.J., Sharma, D., Tremblay, M.S., Veldman, S.L.C., 2020. Promoting healthy movement behaviours among children during the COVID-19 pandemic. Lancet Child Adolesc. Health 4, 416–418. https://doi.org/10.1016/S2352-4642(20)30131-0/ATTACHMENT/A0706737-DDFD-49C0-8C7C-B5B5D6B1A050/MMC1.PDF.

Gulliver, A., Banfield, M., Batterham, P.J., Calear, A.L., Farrer, L.M., Dawel, A., McCallum, S., Murray, K., Morse, A.R., 2021. Effects of previous exposure to psychotherapeutic strategies on depression and anxiety symptoms during the COVID-19 pandemic. BJPsych Open 7, e38.

Han, J., Zhou, F., Zhang, L., Su, Y., Mao, L., 2021. Psychological symptoms of cancer survivors during the COVID-19 outbreak: a longitudinal study. Psychooncology 30, 378–384.

Haug, N., Geyrhofer, L., Londei, A., Dervic, E., Desvars-Larrive, A., Loreto, V., Pinior, B., Thurner, S., Klimek, P., 2020. Ranking the effectiveness of worldwide COVID-19 government interventions. Nat. Hum. Behav. 4, 1303–1312. https://doi.org/10.1038/s41562-020-01009-0, 2020 412.

Healthcare Improvement Scotland (n.d.) Search filters. https://www.sign.ac.uk/what-we-do/methodology/search-filters/.

Helliwell, J.A., Bolton, W.S., Burke, J.R., Tiernan, J.P., Jayne, D.G., Chapman, S.J., 2020. Global academic response to COVID-19: cross-sectional study. Learn. Publ. 33, 385–393. https://doi.org/10.1002/LEAP.1317.

Hennigan et al., n.d., K. Hennigan M. Mcgovern R. Plunkett S. Costello C. Mcdonald B. Hallahan, n.d. A Longitudinal Evaluation of the Impact of the COVID-19 Pandemic on Patients With Pre-existing Anxiety Disorders. doi:10.1017/ipm.2021.32.

Iob, E., Frank, P., Steptoe, A., Fancourt, D., 2020. Levels of severity of depressive symptoms among at-risk groups in the UK during the COVID-19 pandemic. JAMA Netw. Open 3, e2026064.

Iovino, E.A., Caemmerer, J., Chafouleas, S.M., 2021. Psychological distress and burden among family caregivers of children with and without developmental disabilities six months into the COVID-19 pandemic. Res. Dev. Disabil. 114, 103983.

Johansson, F., Côté, P., Hogg-Johnson, S., Rudman, A., Holm, L.W., Grotle, M., Jensen, I., Sundberg, T., Edlund, K., Skillgate, E., 2021. Depression, anxiety and stress among swedish university students before and during six months of the COVID-19 pandemic: a cohort study. Scand. J. Public Health 49, 741–749.

John Hopkins University, 2021. Coronavirus COVID-19 (2019-nCoV) [WWW document]. URL. John Hopkins Univ. https://gisanddata.maps.arcgis.com/apps/opsdashboard/index.html#/bda7594740fd40299423467b48e9ecf6. (Accessed 1 December 2021).

Johnston, R.M., Mohammed, A., Van Der Linden, C., 2020. Evidence of exacerbated gender inequality in child care obligations in Canada and Australia during the COVID-19 pandemic. Polit. Gend. 16, 1131–1141. https://doi.org/10.1017/S1743923X20000574.

Jüni, P., Rothenbühler, M., Bobos, P., Thorpe, K.E., Da Costa, B.R., Fisman, D.N., Slutsky, A.S., Gesink, D., 2020. Impact of climate and public health interventions on the COVID-19 pandemic: a prospective cohort study. CMAJ 192, E566–E573. https://doi.org/10.1503/CMAJ.200920/-/DC1.

Kamerlin, S.C.L., Kasson, P.M., 2020. Managing coronavirus disease 2019 spread with voluntary public health measures: Sweden as a case study for pandemic control. Clin. Infect. Dis. 71, 3174–3181. https://doi.org/10.1093/CID/CIAA864.

Kim, C.S., Lynch, J.B., Cohen, S., Neme, S., Staiger, T.O., Evans, L., Pergam, S.A., Liu, C., Bryson-Cahn, C., Dellit, T.H., 2020. One academic health System's early (and

Ongoing) experience responding to COVID-19: recommendations from the initial epicenter of the pandemic in the United States. Acad. Med. 95, 1146–1148. https://doi.org/10.1097/ACM.0000000000003410.
Kim, H.H.Soo, Ryu, J., 2021. Social distancing attitudes, national context, and health outcomes during the COVID-19 pandemic: findings from a global survey. Prev. Med. (Baltim) 148, 106544. https://doi.org/10.1016/J.YPMED.2021.106544.
Kimura, M., Kimura, K., Ojima, T., 2021. Relationships between changes due to COVID-19 pandemic and the depressive and anxiety symptoms among mothers of infants and/or preschoolers: a prospective follow-up study from pre-COVID-19 Japan. BMJ Open 11, 44826. https://doi.org/10.1136/bmjopen-2020-044826.
Kuehner, C., 2017. Why is depression more common among women than among men? Lancet Psychiatry 4, 146–158. https://doi.org/10.1016/S2215-0366(16)30263-2.
Kulbin, K., Kask, K., Uriko, K., 2021. Depression, anxiety, perceived and post-traumatic stress, and the use of alcohol during the COVID-19 pandemic in Estonia from spring to autumn in 2020: a longitudinal study. Trames 3, 279–294. https://doi.org/10.3176/tr.2021.3.01.
Kyzar, E.J., Purpura, L.J., Shah, J., Cantos, A., Nordvig, A.S., Yin, M.T., 2021. Anxiety, depression, insomnia, and trauma-related symptoms following COVID-19 infection at long-term follow-up. Brain Behav. Immun. Health 16, 100315.
Lalonde, K., 2020. COVID-19 Literature Searching [WWW Document]. Med. Libr. Assoc.
Lee, C.M., Cadigan, J.M., Rhew, I.C., 2020. Increases in loneliness among young adults during the COVID-19 pandemic and association with increases in mental health problems. J. Adolesc. Health 67, 714–717.
Levay, P., Finnegan, A., 2021. The NICE COVID-19 Search Strategy for Ovid MEDLINE and Embase: Developing and Maintaining a Strategy to Support Rapid Guidelines. medRxiv. https://doi.org/10.1101/2021.06.11.21258749, 2021.06.11.21258749.
Li, L., Smith, H.E., Atun, R., Tudor Car, L., 2019. Search strategies to identify observational studies in MEDLINE and embase. Cochrane Database Syst. Rev. 2019 https://doi.org/10.1002/14651858.MR000041.PUB2/MEDIA/CDSR/MR000041/IMAGE_N/NMR000041-AFIG-FIG 01.PNG.
Ligo, A.K., Mahoney, E., Cegan, J., Trump, B.D., Jin, A.S., Kitsak, M., Keenan, J., Linkov, I., 2021. Relationship Among State Reopening Policies, Health Outcomes and Economic Recovery Through First Wave of the COVID-19 Pandemic in the U.S, 2020, Vol. 17, Page 6572.
López Steinmetz, L.C., Fong, S.B., Godoy, J.C., 2021. Longitudinal evidence on mental health changes of college students with and without mental disorder background during the Argentina's lengthy mandatory quarantine. Prog. Neuro-Psychopharmacol. Biol. Psychiatry 110, 110308.
López-Morales, H., Del Valle, M.V., Canet-Juric, L., Andrés, M.L., Galli, J.I., Poó, F., Urquijo, S., 2021. Mental health of pregnant women during the COVID-19 pandemic: a longitudinal study. Psychiatry Res. 295, 113567.
Marroquín, B., Vine, V., Morgan, R., 2020. Mental health during the COVID-19 pandemic: effects of stay-at-home policies, social distancing behavior, and social resources. Psychiatry Res. 293, 113419.
Mergel, E., Schützwohl, M., 2021. COVID-19 and the trajectory of participation, inclusion, and psychological well-being among adults with and without mental disorders - a follow-up study from Germany. Psychiatr. Prax. 48, 265–268. https://doi.org/10.1055/A-1480-6761.
Messiah, S.E., Uppuluri, M., Xie, L., Schellinger, J.N., Mathew, M.S., Ofori, A., Kukreja, S., Schneider, B., Dunn, S.H., Tavakkoli, A., Almandoz, J.P., 2021. Substance use, mental health, and weight-related behaviors during the COVID-19 pandemic among metabolic and bariatric surgery patients. Obes. Surg. 31, 3738–3748.
Moya, A., Serneels, P., Desrosiers, A., Reyes, V., Torres, M.J., Lieberman, A., 2021. The COVID-19 pandemic and maternal mental health in a fragile and conflict-affected setting in Tumaco, Colombia: a cohort study. Lancet Glob. Health 9, e1068–e1076. https://doi.org/10.1016/S2214-109X(21)00217-5.
Neiva, M.B., Carvalho, I., Filho, E.D.S.C., Barbosa-Junior, F., Bernardi, F.A., Sanches, T.L. M., de Oliveira, L.L., Lima, V.C., Miyoshi, N.S.B., Alves, D., 2020. Brazil: the emerging epicenter of COVID-19 pandemic. Rev. Soc. Bras. Med. Trop. 53, 1–8. https://doi.org/10.1590/0037-8682-0550-2020.
Ng, L.C., Stevenson, A., Kalapurakkel, S.S., Hanlon, C., Seedat, S., Harerimana, B., Chiliza, B., Koenen, K.C., 2020. National and regional prevalence of posttraumatic stress disorder in sub-saharan Africa: a systematic review and meta-analysis. PLoS Med. 17, e1003090 https://doi.org/10.1371/journal.pmed.1003090.
Niedzwiedz et al., n.d., C.L. Niedzwiedz M. Benzeval K. Hainey A.H. Leyland S.V. Katikireddi, n.d. Psychological Distress Among People With Probable COVID-19 Infection: Analysis of the UK Household Longitudinal Study. doi:10.1192/bjo.2021.63.
Nisticò, V., Bertelli, S., Tedesco, R., Anselmetti, S., Priori, A., Gambini, O., Demartini, B., 2021. The psychological impact of COVID-19-related lockdown measures among a sample of italian patients with eating disorders: a preliminary longitudinal study. Eat. Weight Disord. 26, 2771–2777.
Nordhues, H.C., Bhagra, A., Stroud, N.N., Vencill, J.A., Kuhle, C.L., 2021. COVID-19 gender disparities and mitigation recommendations: a narrative review. Mayo Clin. Proc. 96, 1907–1920. https://doi.org/10.1016/J.MAYOCP.2021.04.009.
Nussbaumer-Streit, B., Mayr, V., Dobrescu, A.I., Chapman, A., Persad, E., Klerings, I., Wagner, G., Siebert, U., Ledinger, D., Zachariah, C., Gartlehner, G., 2020. Quarantine alone or in combination with other public health measures to control COVID-19: a rapid review. Cochrane Database Syst. Rev. 2020 https://doi.org/10.1002/14651858.CD013574.PUB2/MEDIA/CDSR/CD013574/IMAGE_N/NCD013574-FIG-01.PNG.
O'Connor, R.C., Wetherall, K., Cleare, S., McClelland, H., Melson, A.J., Niedzwiedz, C.L., O'Carroll, R.E., O'Connor, D.B., Platt, S., Scowcroft, E., Watson, B., Zortea, T., Ferguson, E., Robb, K.A., 2020. Mental health and well-being during the COVID-19 pandemic: longitudinal analyses of adults in the UK COVID-19 Mental Health & Wellbeing study. Br. J. Psychiatry 1–8.
Osaghae, I., Nguyen, L.K., Chung, T.H., Moffitt, O., Le, Y.L., Suh, M.B., Prasad, P.N., Thomas, E.J., Gordon, C.D., Hwang, K.O., 2021. Prevalence and factors associated with mental health symptoms in adults undergoing Covid-19 testing. J. Prim. Care Community Health 12, 21501327211027100.
Page, M.J., McKenzie, J.E., Bossuyt, P.M., Boutron, I., Hoffmann, T.C., Mulrow, C.D., Shamseer, L., Tetzlaff, J.M., Akl, E.A., Brennan, S.E., Chou, R., Glanville, J., Grimshaw, J.M., Hróbjartsson, A., Lalu, M.M., Li, T., Loder, E.W., Mayo-Wilson, E., McDonald, S., McGuinness, L.A., Stewart, L.A., Thomas, J., Tricco, A.C., Welch, V.A., Whiting, P., Moher, D., 2021. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 372. https://doi.org/10.1136/BMJ.N71.
Pappa, S., Ntella, V., Giannakas, T., Giannakoulis, V.G., Papoutsi, E., Katsaounou, P., 2020. Prevalence of depression, anxiety, and insomnia among healthcare workers during the COVID-19 pandemic: a systematic review and meta-analysis. Brain Behav. Immun. https://doi.org/10.1016/j.bbi.2020.05.026.
Parker, C., Shalev, D., Hsu, I., Shenoy, A., Cheung, S., Nash, S., Wiener, I., Fedoronko, D., Allen, N., Shapiro, P.A., 2021. Depression, anxiety, and acute stress disorder among patients hospitalized with COVID-19: a prospective cohort study. J. Acad. Consult. Liaison Psychiatry 62, 211–219.
Parolin, Z., Curran, M., Matsudaira, J., Waldfogel, J., Wimer, C., 2020. Monthly poverty rates in the United States during the COVID-19 pandemic. Poverty Soc. Policy Work. Pap. Cent. poverty Soc. Policy. https://static1.squarespace.com/static/610831a16c95260dbd68934a/t/6113d2bae6b660706a69aad1/1628689082609/COVID-Projecting-Poverty-Monthly-CPSP-2020.pdf.
Patrick, S.W., Henkhaus, L.E., Zickafoose, J.S., Lovell, K., Halvorson, A., Loch, S., Letterie, M., Davis, M.M., 2020. Well-being of parents and children during the COVID-19 pandemic: a National Survey. Pediatrics 146, e2020016824. https://doi.org/10.1542/PEDS.2020-016824/79686.
Pizzonia, K.L., Koscinski, B., Suhr, J.A., Accorso, C., Allan, D.M., Allan, N.P., 2021. Insomnia During the COVID-19 Pandemic: The Role of Depression and COVID-19-related Risk Factors. https://doi.org/10.1080/16506073.2021.1879241.
Power, K., 2020. In: The COVID-19 Pandemic has Increased the Care Burden of Women and Families, 16, pp. 67–73. https://doi.org/10.1080/15487733.2020.1776561.
Prati, G., Mancini, A.D., 2021. The psychological impact of COVID-19 pandemic lockdowns: a review and meta-analysis of longitudinal studies and natural experiments. Psychol. Med. 51, 201–211. https://doi.org/10.1017/S0033291721000015.
Primc, K., Slabe-Erker, R., 2020. The success of public health measures in Europe during the COVID-19 pandemic. Sustainability 12, 4321. https://doi.org/10.3390/SU12104321, 2020, Vol. 12, Page 4321.
Quaglieri, A., Lausi, G., Fraschetti, A., Burrai, J., Barchielli, B., Pizzo, A., Cordellieri, P., De Gennaro, L., Gorgoni, M., Ferlazzo, F., Sdoia, S., Zivi, P., Giannini, A.M., Mari, E., 2021. "Stay at home" in Italy during the COVID-19 outbreak: a longitudinal study on individual well-being among different age groups. Brain Sci. 11.
Racine, N., McArthur, B.A., Cooke, J.E., Eirich, R., Zhu, J., Madigan, S., 2021. Global prevalence of depressive and anxiety symptoms in children and adolescents during COVID-19: a meta-analysis. JAMA Pediatr. 175, 1142–1150. https://doi.org/10.1001/JAMAPEDIATRICS.2021.2482.
Raifman, J., Bor, J., Venkataramani, A., 2021. Association between receipt of unemployment insurance and food insecurity among people who lost employment during the COVID-19 pandemic in the United States. JAMA Netw. Open 4. https://doi.org/10.1001/JAMANETWORKOPEN.2020.35884 e2035884-e2035884.
Reitsma, J.B., Glas, A.S., Rutjes, A.W.S., Scholten, R.J.P.M., Bossuyt, P.M., Zwinderman, A.H., 2005. Bivariate analysis of sensitivity and specificity produces informative summary measures in diagnostic reviews. J. Clin. Epidemiol. 58, 982–990. https://doi.org/10.1016/J.JCLINEPI.2005.02.022.
Riehm, K.E., Holingue, C., Smail, E.J., Kapteyn, A., Bennett, D., Thrul, J., Kreuter, F., McGinty, E.E., Kalb, L.G., Veldhuis, C.B., Johnson, R.M., Fallin, M.D., Stuart, E.A., 2021. Trajectories of mental distress among U.S. adults during the COVID-19 pandemic. Ann. Behav. Med. 55, 93–102. https://doi.org/10.1093/ABM/KAAA126.
Ripoll, J., Contreras-Martos, S., Esteva, M., Soler, A., Serrano-Ripoll, M.J., 2021. Mental health and psychological wellbeing during the COVID-19 lockdown: a longitudinal study in the Balearic Islands (Spain). J. Clin. Med. 10.
Robinson, E., Sutin, A.R., Daly, M., Jones, A., 2022. A systematic review and meta-analysis of longitudinal cohort studies comparing mental health before versus during the COVID-19 pandemic in 2020. J. Affect. Disord. 296, 567–576. https://doi.org/10.1016/J.JAD.2021.09.098.
Ruggieri, S., Ingoglia, S., Bonfanti, R.C., Lo Coco, G., 2021. The role of online social comparison as a protective factor for psychological wellbeing: a longitudinal study during the COVID-19 quarantine. Personal. Individ. Differ. 171, 110486.
Rumas, R., Shamblaw, A.L., Jagtap, S., Best, M.W., 2021. Predictors and consequences of loneliness during the COVID-19 pandemic. Psychiatry Res. 300, 113934 https://doi.org/10.1016/j.psychres.2021.113934.
Russell, B.S., Hutchison, M., Park, C.L., Fendrich, Michael, Finkelstein-Fox, L., 2021. Short-term impacts of COVID-19 on family caregivers: emotion regulation, coping, and mental health. J. Clin. Psychol. https://doi.org/10.1002/jclp.23228, 2020 412.
Saidur, M., Khan, R., Kadoya, Y., Lohman, M.C., Fortuna, K., 2021. Loneliness during the COVID-19 pandemic: a comparison between older and younger people pandemic: a comparison between. Environ. Res. Public Health 18. https://doi.org/10.3390/ijerph18157871.
Santabárbara, J., Bueno-Notivol, J., Lipnicki, D.M., Olaya, B., Pérez-Moreno, M., Gracia-García, P., Idoiaga-Mondragon, N., Ozamiz-Etxebarria, N., 2021. Prevalence of anxiety in health care professionals during the COVID-19 pandemic: a rapid systematic review (on published articles in Medline) with meta-analysis. Prog.

Neuro-Psychopharmacol. Biol. Psychiatry 107, 110244. https://doi.org/10.1016/J.PNPBP.2021.110244.
Savage, M.J., James, R., Magistro, D., Donaldson, J., Healy, L.C., Nevill, M., Hennis, P.J., 2020. Mental health and movement behaviour during the COVID-19 pandemic in UK university students: prospective cohort study. Ment. Health Phys. Act. 19, 100357 https://doi.org/10.1016/J.MHPA.2020.100357.
Shevlin, M., Butter, S., McBride, O., Murphy, J., Gibson-Miller, J., Hartman, T.K., Levita, L., Mason, L., Martinez, A.P., McKay, R., Va Stocks, T., Bennett, K., Hyland, P., Bentall, R.P., 2021a. 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. https://doi.org/10.1017/S0033291721001665.
Shevlin, M., Butter, S., McBride, O., Murphy, J., Gibson-Miller, J., Hartman, T.K., Levita, L., Mason, L., Martinez, A.P., McKay, R., Va Stocks, T., Bennett, K., Hyland, P., Bentall, R.P., 2021b. Refuting the myth of a 'tsunami' of mental ill-health in populations affected by COVID-19: evidence that response to the pandemic is heterogeneous, not homogeneous. Psychol. Med. 1–9 https://doi.org/10.1017/S0033291721001665.
Shuster, A., O'Brien, M., Luo, Y., Berner, L.A., Perl, O., Heflin, M., Kulkarni, K., Chung, D., Na, S., Fiore, V.G., Gu, X., 2021. Emotional adaptation during a crisis: decline in anxiety and depression after the initial weeks of COVID-19 in the United States. Transl. Psychiatry 11. https://doi.org/10.1038/s41398-021-01552-y.
Sideli, L., Lo Coco, G., Bonfanti, R.C., Borsarini, B., Fortunato, L., Sechi, C., Micali, N., 2021. Effects of COVID-19 lockdown on eating disorders and obesity: a systematic review and meta-analysis. Eur. Eat. Disord. Rev. 29, 826–841. https://doi.org/10.1002/ERV.2861.
Soldevila-Domenech, N., Forcano, L., Boronat, A., Lorenzo, T., Piera, I., Puig-Pijoan, A., Mateus, J., de Echevarri, González, Gómez, J.M., Knezevic, I., Soteras, A., Fauria, K., Pizarro, N., Molinuevo, J.L., de la Torre, R., Imim, P.S.G.F., Bbrc, F., 2021. Effects of COVID-19 home confinement on mental health in individuals with increased risk of Alzheimer's disease. J. Alzheimers Dis. 79, 1015–1021.
Somma, A., Krueger, R.F., Markon, K.E., Gialdi, G., Colanino, M., Ferlito, D., Liotta, C., Frau, C., Fossati, A., 2021. A longitudinal study on clinically relevant self-reported depression, anxiety and acute stress features among italian community-dwelling adults during the COVID-19 related lockdown: evidence of a predictive role for baseline dysfunctional personality dime. J. Affect. Disord. 282, 364–371. https://doi.org/10.1016/j.jad.2020.12.165.
Stevenson, C., Wakefield, J.R.H., 2021. Financial distress and suicidal behaviour during COVID-19: family identification attenuates the negative relationship between COVID-related financial distress and mental ill-health. J. Health Psychol. 26, 2665–2675. https://doi.org/10.1177/13591053211014597.
Sueki, H., Ueda, M., 2021. Short-term effect of the COVID-19 pandemic on suicidal ideation: a prospective cohort study. Crisis: The Journal of Crisis Intervention and Suicide Prevention. https://doi.org/10.1027/0227-5910/a000797 (Advance online publication).
Thekkumpurath, P., Venkateswaran, C., Kumar, M., Bennett, M.I., 2008. Screening for psychological distress in palliative care: a systematic review. J. Pain Symptom Manag. 36, 520–528. https://doi.org/10.1016/j.jpainsymman.2007.11.010.
Vlake, J.H., Van Bommel, J., Hellemons, M.E., Wils, E.J., Bienvenu, O.J., Schut, A.F.C., Klijn, E., Van Bavel, M.P., Gommers, D., Van Genderen, M.E., 2021. Psychologic distress and quality of life after ICU treatment for Coronavirus Disease 2019: a multicenter, Observational Cohort Study. Crit. Care Explor. 3, e0497.
Wade, D.F., Moon, Z., Windgassen, S.S., Harrison, A.M., Morris, L., Weinman, J.A., 2016. Non-pharmacological interventions to reduce ICU-related psychological distress: a systematic review. Minerva Anestesiol. 82, 465–478.
Weinberger, D.M., Chen, J., Cohen, T., Crawford, F.W., Mostashari, F., Olson, D., Pitzer, V.E., Reich, N.G., Russi, M., Simonsen, L., Watkins, A., Viboud, C., 2020. Estimation of excess deaths associated with the COVID-19 pandemic in the United States, march to may 2020. JAMA Intern. Med. 180, 1336–1344. https://doi.org/10.1001/JAMAINTERNMED.2020.3391.
Wells, G., Shea, B., O'Connell, D., Peterson, J., 2000. The Newcastle-Ottawa Scale (NOS) for assessing the quality of nonrandomised studies in meta-analyses. Ottawa, Ottawa Hosp. Res. Inst. https://web.archive.org/web/20210716121605id_/http://www3.med.unipmn.it/dispense_ebm/2009-2010/Corso%20Perfezionamento%20EBM_Faggiano/NOS_oxford.pdf.
Yates, K., Lång, U., Cederlöf, M., Boland, F., Taylor, P., Cannon, M., McNicholas, F., Devylder, J., Kelleher, I., 2019. Association of Psychotic Experiences with Subsequent Risk of suicidal ideation, suicide attempts, and suicide deaths: a systematic review and meta-analysis of longitudinal population studies. JAMA Psychiatry 76, 180–189. https://doi.org/10.1001/JAMAPSYCHIATRY.2018.3514.
Yocum, A.K., Zhai, Y., McInnis, M.G., Han, P., 2021. Covid-19 pandemic and lockdown impacts: a description in a longitudinal study of bipolar disorder. J. Affect. Disord. 282, 1226–1233.
Zhao, Y.J., Jin, Y., Rao, W.W., Li, W., Zhao, N., Cheung, T., Ng, C.H., Wang, Y.Y., Zhang, Q.E., Xiang, Y.T., 2021. The prevalence of psychiatric comorbidities during the SARS and COVID-19 epidemics: a systematic review and meta-analysis of observational studies. J. Affect. Disord. 287, 145–157. https://doi.org/10.1016/j.jad.2021.03.016.
Zheng, J., Morstead, T., Sin, N., Klaiber, P., Umberson, D., Kamble, S., DeLongis, A., 2021. Psychological distress in North America during COVID-19: the role of pandemic-related stressors. Soc Sci Med 270, 113687.
Zhou, Y., Ding, H., Zhang, Y., Zhang, B., Guo, Y., Cheung, T., Hall, B.J., Shi, T., Xiang, Y. T., Tang, Y., 2021. Prevalence of poor psychiatric status and sleep quality among frontline healthcare workers during and after the COVID-19 outbreak: a longitudinal study. Transl. Psychiatry 11, 223.