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Review article

Government response moderates the mental health impact of COVID-19: A systematic review and meta-analysis of depression outcomes across countries

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A R T I C L E I N F O

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A B S T R A C T

Background: The COVID-19 pandemic represents a public health, economic and mental health crisis. We hypothesized that timely government implementation of stringent measures to reduce viral transmission would benefit mental health, as evidenced by reduced rates of depressive symptoms (i.e., Patient Health Questionnaire [PHQ]-9≥10, PHQ-2≥3).

Methods: The systematic review herein (PROSPERO CRD42020200647) evaluated to what extent differences in government-imposed stringency and timeliness of response to COVID-19 moderate the prevalence of depressive symptoms across 33 countries (k=114, N=640,037). We included data from six lower-middle-income countries, nine upper-middle-income countries, and 18 higher-income countries. Government-imposed stringency and timeliness in response were operationalized using the Oxford COVID-19 Government Response ("Stringency") Index.

Results: The overall proportion of study participants with clinically significant depressive symptoms was 21.39% (95% CI 19.37–23.47). The prevalence of clinically significant depressive symptoms was significantly lower in countries wherein governments implemented stringent policies promptly. The moderating effect of government response remained significant after including the national frequency of COVID cases at the time of study commencement, Healthcare Access and Quality index, and the inclusion of COVID patients in the study.

Limitations: Factors that may have confounded our results include, for example, differences in lockdown duration, lack of study participant and outcome assessor blinding, and retrospective assessment of depressive symptom severity.

Conclusions: Governments that enacted stringent measures to contain the spread of COVID-19 benefited not only the physical, but also the mental health of their population.

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1. Introduction

The current threat of the COVID-19 pandemic to mental health is unprecedented in scale and scope (Xiong et al., 2020). In addition to being a public health crisis, COVID-19 is also a mental health and economic crisis. The prevalence and severity of depression and other mental disorders have increased during the pandemic across geopolitical, cultural, and sociodemographic strata (De Sousa et al., 2020; Moser et al., 2020; Nyashanu et al., 2020; Petterson et al., 2020). Furthermore, government responses to contain infection have significantly reduced economic activities in most world regions, with the externality of significant gross domestic product contraction and increased extreme poverty in low-income countries (Franco et al.et , 2020; Nyashanu et al., 2020; OECD, 2020).

Financial insecurity and unemployment predispose and portend poor mental health outcomes (Ibrahim et al., 2019; Reeves et al., 2014). For example, we recently predicted that suicide mortality will increase by 3-8% in the USA and 5-27% in Canada per year, between 2020 and 2021, as a result of heightened unemployment rates, which are attributable to COVID-19-related lockdown measures (McIntyre and Lee, 2020a, 2020b). School closures, travel restrictions, sudden shifts to working from home, social gathering bans, and other disruptions to social life and day-to-day routines additionally contribute to the mental health burden experienced by individuals under lockdown (Hou et al., 2020a, 2020b; IASC Reference Group on Mental Health and Psychosocial Support in Emergency Settings, 2020; Walker et al., 2020). Individuals working in healthcare settings may be additionally distressed by the risk of being exposed, and/or exposing others, to COVID-19 infection (Chirico et al., 2021; K. Lin et al., 2020).

It can be conjectured that the uncertainty emanating and surrounding events of COVID-19 are independently hazardous to general well-being and mental health. In keeping with that view, interventions that reduce uncertainty may protect mental health. For example, results from a recent study indicate that, during the COVID-19 pandemic, widespread face mask usage in the community may mitigate population level rates of psychological distress by providing assurance: by wearing a mask, individuals are protecting their own health and the health of others and, by extension, are being protected by others in the community who are also wearing masks (C. Wang et al., 2020). In addition to the public health, economic and mental health crisis that has played out during COVID-19, malignant uncertainty also exists across many aspects, including but not limited to, accurate information surrounding the risk of COVID-19 to the general population, availability of proven therapeutics, evidence-based vaccines, and return to work (Holmes et al., 2020; World Health Organization, 2020). We hypothesized that the timely implementation of stringent containment measures may mitigate depressive symptom risk by exacting certainty (and reducing helplessness) at the general population level.

We evaluated the impact of the COVID-19 pandemic and government response on measures of depressive symptom presence and severity based on published studies. Our systematic review included studies that evaluated measures of depressive symptom severity in the general population during the COVID-19 pandemic. Studies were pooled across countries to characterize how differences in the stringency and timeliness of government response to COVID-19 moderate the risk for clinically significant depressive symptoms.

2. Methods

We conducted a meta-analytic and systematic review concordant with recommendations from the Cochrane Handbook for Systematic Reviews of Interventions and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement (Higgins JPT, Thomas J, Chandler J, Cumpston M, Li T, Page MJ, Welch VA, 2019; Moher et al., 2009). Our study protocol, including our Patient, Intervention, Comparison and Outcome (PICO) (strategy, was registered in the International Prospective Register of Systematic Reviews (PROSPERO CRD42020200647) (Lee et al., 2020).

2.1. Inclusion and exclusion criteria

We included studies that evaluated measures of depressive symptom severity in the general population during the COVID-19 pandemic. The COVID-19 pandemic was operationalized as January 1, 2020 to the present time of manuscript writing. We included studies reporting the number or proportion of study participants meeting criteria for clinically significant depressive symptoms. Our preliminary search identified the Patient Health Questionnaire (PHQ) as the most commonly reported standardized depression metric in the extant COVID-19 literature. Moreover, studies using the PHQ consistently used the same cut-off score to detect moderate-to-severe depressive symptoms (i.e., PHQ-9≥10, PHQ-2≥3). To reduce heterogeneity among included studies and minimize the potential confounding effect of differences between depression metrics and scoring methods, we delimited our inclusion criteria to studies reporting categorical depression outcomes using the PHQ.

Studies reporting outcomes for a single country were eligible; those including study participants from more than one country but reporting outcomes separately for each country were also eligible. Studies that explicitly pooled outcomes across multiple countries were ineligible. Study authors, sample sizes, site locations, and enrollment periods were screened to identify duplicate study samples.

2.2. Systematic search strategy and study selection

We searched Ovid MEDLINE/PubMed from inception to September 16, 2020 for relevant publications without language restrictions. The following medical search headings and keywords were used: (Coronavirus Infections/ or Severe Acute Respiratory Syndrome/ or Pandemics/ or "COVID" or "COVID-19" or "coronavirus" or "SARS-CoV-2") and (Mood Disorders/ or depressi* or Depressive Disorder, Major/ or "patient health questionnaire" or "PHQ"). Results were limited to articles published in 2019 or 2020. The complete search strategy and results for the Ovid MEDLINE/PubMed search are listed in Table S1.

The titles and abstracts were reviewed for eligibility (by author YL); full texts of potentially eligible articles were subsequently reviewed in duplicate independently (by authors DC, LMWL, and YL) using Covidence (Veritas Health Innovation, 2021). Any discrepancies in determining eligibility were resolved by consensus (between authors DC, LMWL, and YL).

2.3. Data extraction

The primary outcome measure was the proportion of study participants with clinically significant depressive symptoms. The most commonly used and validated cut-off score of ≥10 on the PHQ-9 (and ≥3 on the PHQ-2) is commensurate with moderate-to-severe severity (Y. Lee et al., 2020a). We assessed the presence of moderate-to-severe symptoms, rather than mild symptoms, as most evidence-based clinical practice guidelines recommend pharmacological interventions and manual-based psychotherapy for patients with moderate-to-severe symptoms. We additionally extracted the following information using a standardized assessment form: full citation, country sampled, sample size, data collection method, recruitment strategy, depression metric and cut-off score(s), proportion of study participants that tested positive for COVID-19, inclusion of inpatients being treated for COVID-19, and study period.

The stringency of government response was operationalized using the Oxford COVID-19 Government Response Index, which ranges from 0 to 100 (least to most stringent government response). At the time of manuscript writing (September 17, 2020), daily index values were available for individual countries from January 1, 2020 to September

16, 2020. Countries were rated on an ordinal scale to capture, 1) whether or not a given policy was enforced and 2) how stringently or comprehensively each policy was implemented. Countries without any publicly available information about a particular policy were assumed to have abstained from its implementation. Eight containment-, two economic support-, and three health-related policies were evaluated. Containment-related policies included school, workplace, and public transportation closures; public event cancellations; public gathering, national travel, international travel restrictions or controls; and stay-at-home requirements. Economic policies included income support and debt relief for households. Health policies included public education campaigns, COVID-19 testing, and contact tracing (Hale et al., 2020).

The timeliness of government intervention was operationalized using the earliest date a country reached a value of 20 or greater on the Oxford COVID-19 Government Response Index, henceforth referred to as the "stringency index." A cut-off value of 20 was chosen following a preliminary analysis evaluating weekly changes in global mean stringency index. The largest increase in global mean stringency index (i.e., of 20 index points) was observed between the weeks of March 8-14 and March 15-21. The stringency indices have been plotted for each country included in our analysis for reference (Figure S1).

The Healthcare Access and Quality (HAQ) index measured national ratings of personal access to high quality healthcare (GBD 2016 Healthcare Access and Quality Collaborators, 2018). The index ranges from 0-100; a higher score identifies a country with greater access to high quality healthcare. Countries were ranked in descending order by Human Development Index (United Nations Publications, 2020). Countries were categorized using World Bank classifications of income groups (World Bank, 2020).

2.4. Assessment of bias

We adapted the Risk of Bias in Non-randomized Studies of Interventions (ROBINS-I) tool and recommended signalling questions to evaluate risk of biases (Sterne et al., 2016) The ROBINS-I tool uses "intervention" to refer to exposure groups in observational studies. In our risk of bias assessments, we considered the intervention to be the COVID-19 pandemic. We rated each study as low, moderate, or serious on each domain of biasbias : 1) confounding, 2) participant selection, 3) intervention classification, 4) missing data, 5) outcome measurement, and 6) reporting. Bias due to deviations from intended interventions was not assessed as all included studies were conducted during the COVID-19 pandemic, implying that there was no deviation from the intervention.

2.5. Statistical analysis

A meta-analysis of proportions was conducted using the *meta::metaprop* function on R, version 4.0.2 (R Core Team, 2020). We evaluated the moderating effects of the Government Response Index, as well as other covariates, using the *meta::metareg* function. A restricted maximum likelihood model pooled proportion data and estimated between-study variance (Nyaga et al., 2014). Exact binomial confidence intervals (CI) were calculated for individual studies and 95% CI of pooled estimates were calculated using the Wald method (Molenberghs et al., 2007). Pooled estimates were Freeman-Tukey double arcsine—-transformed (Freeman and Tukey, 1950).

Cochrane's Q and I^2 tests quantified heterogeneity, between studies and between countries, as being small, moderate, or large (i.e., $I^2 = 25\%$, 50%, or 75%, respectively) (Higgins JPT, Thomas J, Chandler J, Cumpston M, Li T, Page MJ, Welch VA, 2019). We assessed publication bias using Egger's and Begg's tests using the *meta::metabias* function (Begg and Mazumdar, 1994; Egger et al., 1997). We used the trim and fill method (*metafor::trimfill*) to correct for publication bias (Duval and Tweedie, 2000). The *metafor::forest* and *meta::funnel* functions created forest and funnel plots (Balduzzi et al., 2019; Viechtbauer, 2010).

3. Results

Our database and manual literature searches identified 799 unique records. The full texts of 446 articles were assessed for eligibility. A total of 114 articles reporting categorical depression outcomes using the PHQ were included in the present meta-analysis (Fig. 1).

We included studies originating in 33 countries, including 18 high-income regions (i.e., Austria, Canada, France, Germany, Greece, Hong Kong Special Administrative Region of the People's Republic of China, Italy, Ireland, Israel, Norway, Poland, Saudi Arabia, South Korea, Spain, Sweden, Switzerland, United Kingdom, USA), nine upper-middle-income countries (i.e., Albania, Bosnia and Herzegovina, Brazil, China, Ecuador, Iran, Jordan, Mexico, Turkey), and six lower-middle-income countries (i.e., Bangladesh, India, Kenya, Nepal, Pakistan, Vietnam). We did not identify any eligible studies from a low-income country. The included studies are summarized in Table S2.

Twenty-six studies used the 2-item PHQ, whereas 88 studies used the 9-item PHQ. Nine studies did not report the cut-off score used to define clinically significant depressive symptoms. All other studies used standard cut-off scores for clinically significant symptom severity (i.e., 10 on PHQ-9, 3 on PHQ-2) (Manea et al., 2012).

3.1. Global prevalence of clinically significant depressive symptoms during COVID-19

The proportion of study participants meeting criteria for clinically significant depressive symptoms was pooled across 33 countries (k=114, N=640,037). An estimated 21.39% (95% CI 19.37–23.47) of individuals globally had clinically significant depressive symptoms during the COVID-19 pandemic (Fig. 2).

We compared the prevalence of clinically significant depressive symptoms across countries using the Human Development Index. The United Nations Development Programme operationalized very high, high, medium, and low Human Development Index values using the thresholds $\geq$0.892, 0.750, 0.634, 0.507, respectively. Depressive symptom prevalence was higher in countries with a very high Human Development Index (23.52%, 95% CI 20.37–26.82, k=53) and lower in countries with a medium (19.58%, 95% CI 6.67–37.12, k=4) or low Human Development Index (16.69%, 95%CI 1.17–44.44, k=4), relative to countries with a high Human Development Index (20.06%, 95% CI 17.67–22.56, k=64).

3.2. Government response to COVID-19 moderates depressive symptom prevalence

Studies were pooled by countries and subgrouped by when their governments implemented stringent COVID-19 containment policies (i.e., stringency index of 20 or greater). The prevalence of clinically significant depressive symptoms was significantly lower in countries where governments implemented stringent policies more promptly (Fig. 3). The moderating effect of government response was significant after including the national frequency of COVID cases at the time of study commencement, Healthcare Access and Quality index, and the inclusion of COVID patients in the study (Table 1). The moderating effect of government response date was significant after removing studies from China in sensitivity analysis (Figure S2).

3.3. Assessment of bias

Study quality was assessed using the revised ROBINS-I tool and the results are summarized in Table 2. Thirty of 114 studies were assessed as having a moderate overall risk of bias and 84 were rated as having a serious risk of bias. Only eight studies tested study participants for COVID and reported depressive symptom data separately for those with and without COVID; 29 studies asked participants if they had been tested for COVID and reported the percentage of participants who had self-

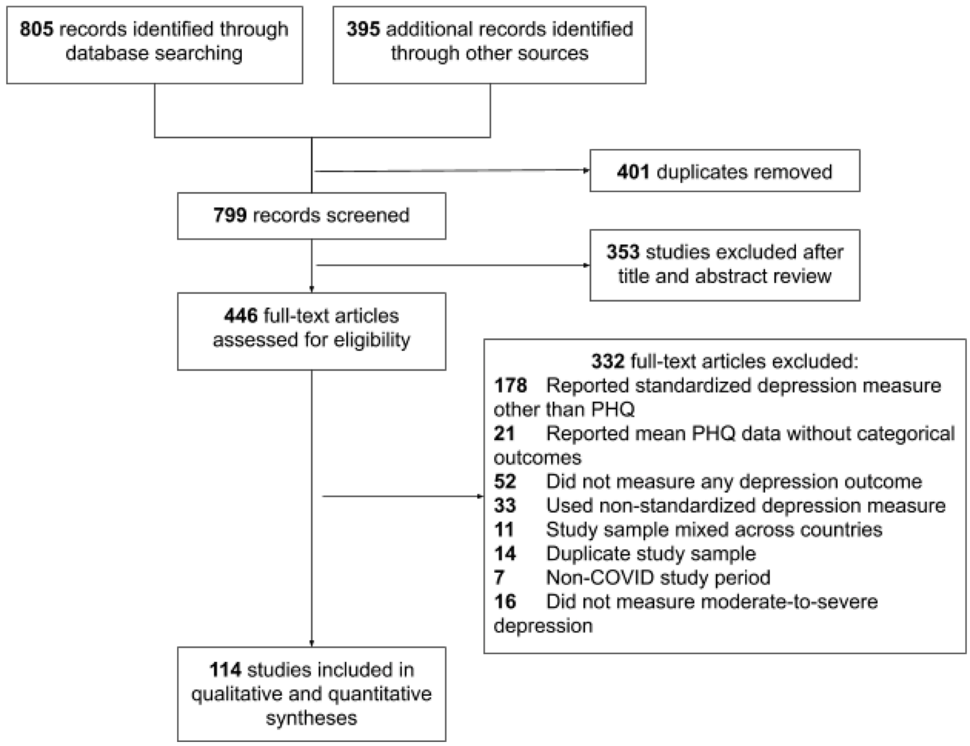

Fig. 1. Articles identified through database and manual searches were reviewed for eligibility for inclusion in the present meta-analysis. Articles reporting depression outcomes, using the Patient Health Questionnaire, during the COVID-19 pandemic were included. Studies were pooled by country. We evaluated how the stringency of government response to COVID-19 moderated differences across countries in depression outcomes.

reported a positive COVID test without stratifying depressive symptom data by COVID status. All but three studies assessed at least one confounding variable, such as socio-demographic characteristics (e.g., age, sex, education, income), pre-COVID depression-related data (e.g., mean PHQ score, psychiatric history), and COVID exposure or risk of exposure (e.g., number of cases in participant's municipality or province).

Trim and fill did not add any studies (Figure S3). The funnel plot was symmetric and the Egger's and Begg's tests were not significant (Egger's: slope=0.470, p=0.885; Begg's: p=0.105).

4. Discussion

Our systematic review compared the timeliness of government response to COVID-19 across 33 countries and its impact on clinically significant depressive symptoms spanning high-, middle-, and low-income countries. We observed a global depressive symptom prevalence of 21.4% during the COVID-19 pandemic, which is higher than what was observed before the COVID-19 pandemic. For example, a meta-analysis evaluating depression prevalence across 30 countries between 1994 and 2014 reported an aggregate point prevalence of 12.9% (95% CI: 11.1–15.1%, k=90, n=1,112,573) (Lim et al., 2018). Moreover, depressive symptom prevalence was higher in countries with higher Human Development Index values, which contrasts the observation of lower depression prevalence in more developed countries before the COVID-19 pandemic (i.e., 9.8% for very high, 19.2% for high, 29.2% for medium, 11.5% for low Human Development Index) (Lim et al., 2018). Our results replicate accumulating studies reporting increases in depression prevalence during the pandemic.

Moreover, in our meta-analysis, countries that waited to implement stringent lockdown measures evinced a higher prevalence of clinically significant depressive symptoms when compared to countries that implemented stringent lockdown measures sooner. The foregoing moderating effect was significant after adjusting for the total number of COVID-19 cases, access to high-quality healthcare, and the inclusion of COVID-19 patients as study participants. Our findings replicate and extend literature indicating that a rapid public health response is a critical determinant of protecting the mental wellbeing of the general population (Felton, 2002; Kinsman, 2012).

Governments that enacted stringent measures to contain the spread of COVID-19 not only benefited the physical health of their population, but also their mental health, in our meta-analysis. During the 1918 pandemic, swift and timely implementation of social gathering bans and quarantine measures predicted lower mortality rates; American cities that implemented delayed lockdown measures after death rates began to accelerate suffered the highest mortality rates (Bootsma and Ferguson, 2007; Markel et al., 2007). We hypothesized that, in addition to increasing infection-mortality rates, delays in implementing stringent containment measures would result in greater psychiatric morbidity during the present public health crisis.

A swift and stringent government response may reduce mental and emotional distress by augmenting certainty and resilience against uncertainty. Similarly, greater trust in the government and the national public health response has been associated with lower depressive symptom severity (O'Hara et al., 2020; Tee et al., 2020). Uncertainty is malignant: chronic and unpredictable stress provokes psychological distress and begets anxiety and depressive disorders (Bakioglu et al., 2020).

The COVID-19 pandemic can be conceptualized as a pandemic of uncertainty (e.g., infectious disease risk, economic security, and social life). Individuals are additionally struggling to identify trustworthy sources of information (Larson, 2018; Moran, 2020; World Health Organization, 2020). Vulnerable subpopulations (e.g., immigrant or ethnic communities, low literacy or educational attainment) may additionally lack critical health information from government sources (Le et al., 2020). Thus, public health interventions that reduce entropy and exact certitude (i.e., mitigate helplessness) can be hypothesized to reassure

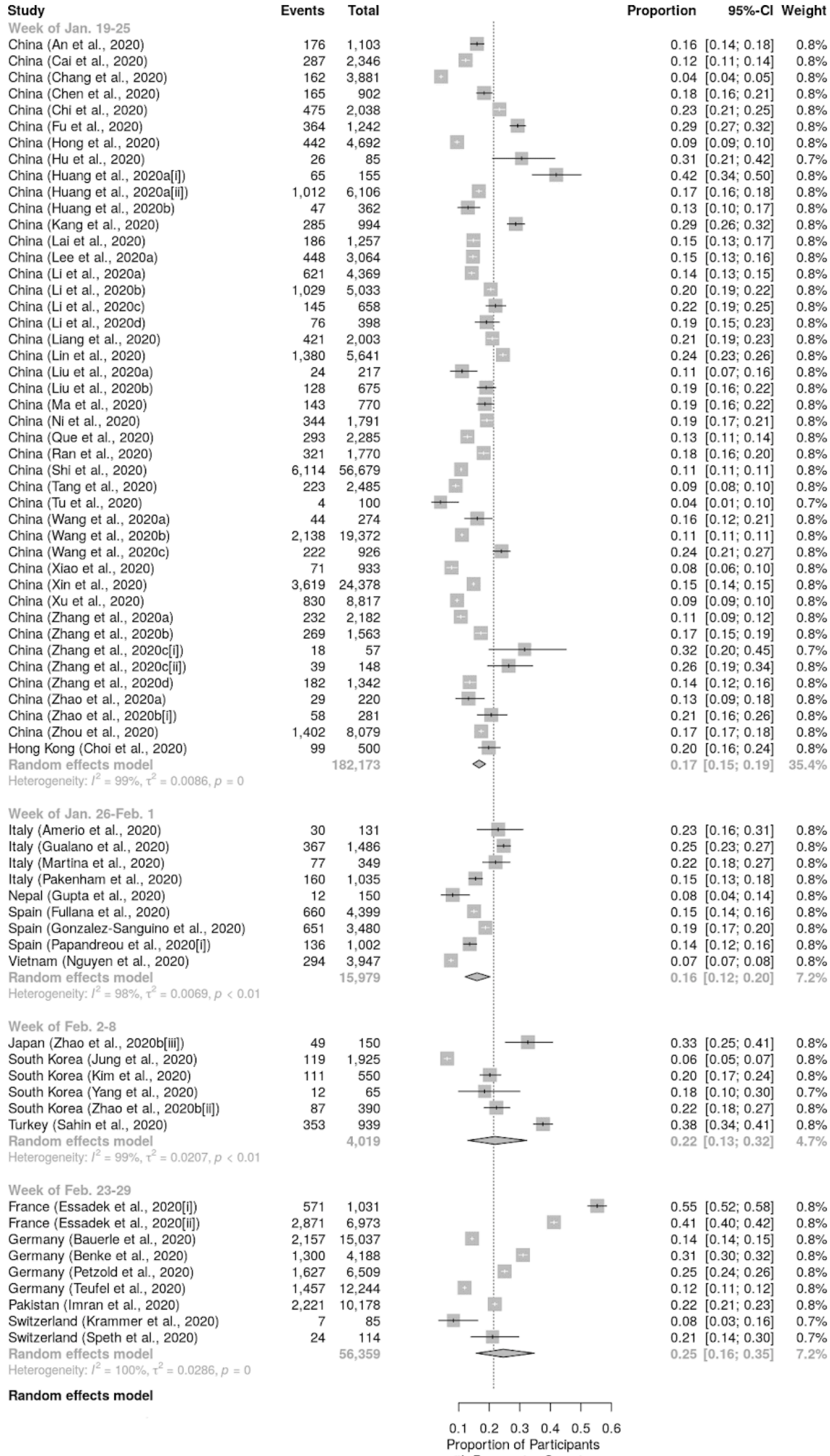

Fig. 2. Forest plot of mean proportion of study participants meeting criteria for clinically significant depressive symptoms using the Patient Health Questionnaire.

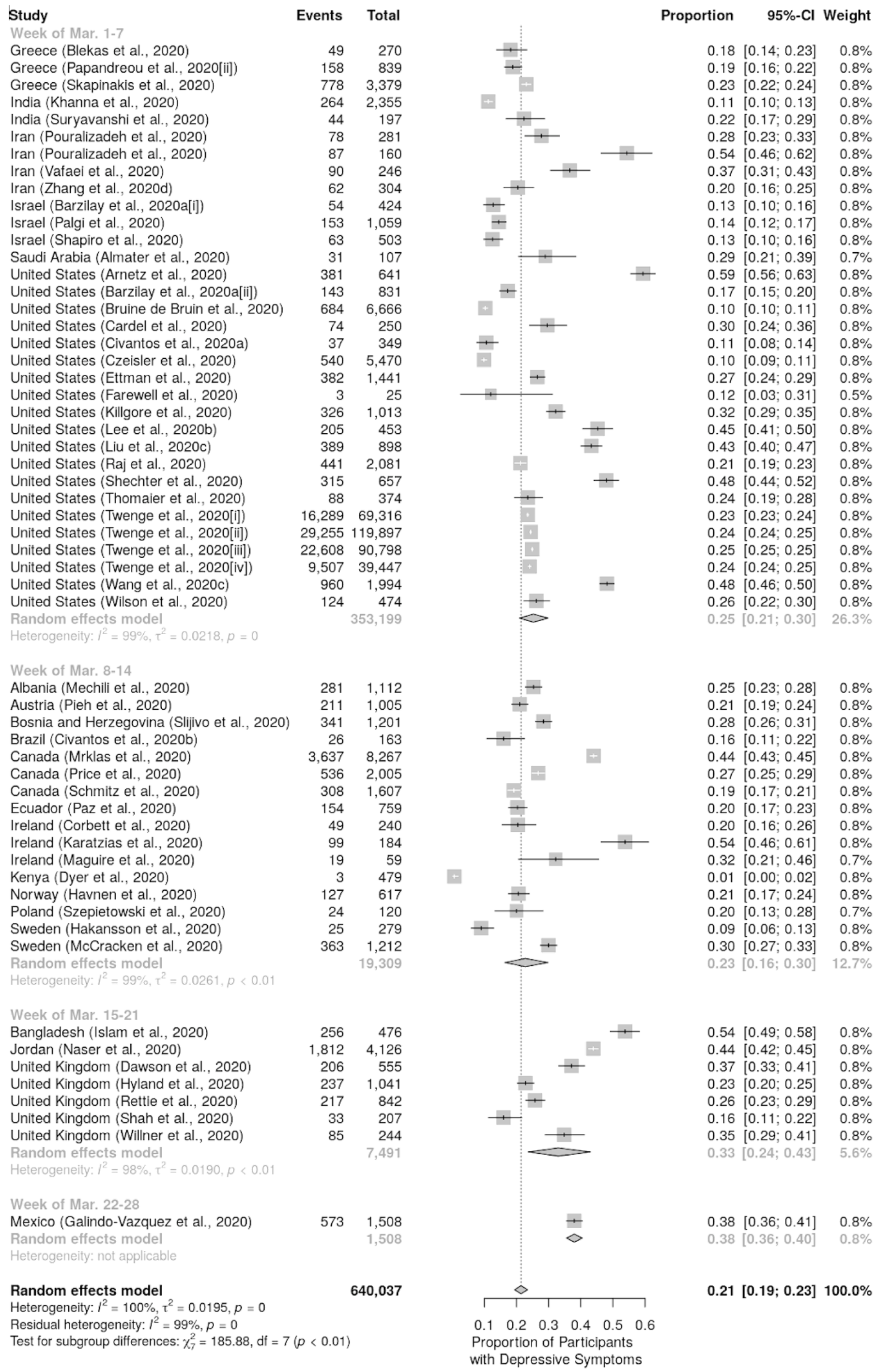

Fig. 2. (*continued*).

citizens and support their mental wellbeing (C. Wang et al., 2020).

However, there exist individuals, within the plurality of the populace, who have not benefited from stringent containment measures (Adam et al., 2021; Amerio et al., 2020b; Mukherjee, 2020; Yi et al., 2020). For example, aggregate community mobility data indicate that high income-earners with greater job security and flexibility were better able to shelter in place than were low income-earners (Bonaccorsi et al., 2020; Srivastava, 2020; Valentino-DeVries et al., 2020). Inadequate workplace support (e.g., lack of personal protective equipment, awareness of mental health needs) may additionally detriment mental wellbeing (Giorgi et al., 2020; Kang et al., 2020a; Pollock et al., 2020; Y.-X. Wang et al., 2020). Moreover, the negative externalities of stringent lockdown policies disproportionately affect vulnerable populations (e.g., health insurance loss due to unemployment, intimate partner violence, low-income households, migrant workers, racialized communities) (Hamadani et al., 2020; Noel et al., 2020; Raj et al., 2020; Simmons-Duffin, 2020).

Similar inequities exist on a global level: a cross-sectional study of 37,696 households in 30 African countries reported that 52% of households in urban areas had access to safe drinking water, sanitation, and electricity, whereas only 12% of households in rural regions had access to the foregoing basic resources (Egger et al., 2020). Only 12% of urban households and 2% of rural households with access to basic resources reported having a stable income source and telephone access

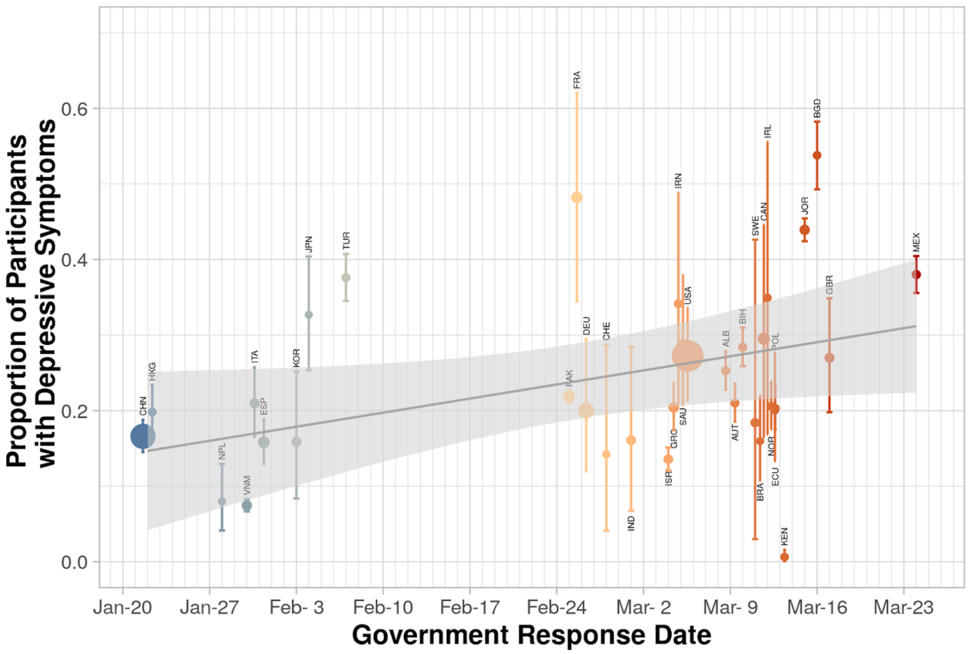

Fig. 3. The prevalence of clinically significant depressive symptoms was lower in countries wherein governments implemented stringent lockdown measures at an earlier date. Point size is proportionate to sample size. ***Abbreviations***: CHN, China; HKG, Hong Kong; ITA, Italy; NPL, Nepal; ESP, Spain; VNM, Vietnam; JPN, Japan; KOR, South Korea; TUR, Turkey; FRA, France; DEU, Germany; PAK, Pakistan; CHE, Switzerland; GRC, Greece; IND, India; IRN, Iran; ISR, Israel; SAU, Saudi Arabia; USA, United States; ALB, Albania; AUT, Austria; BIH, Bosnia and Herzegovina; BRA, Brazil; CAN, Canada; ECU, Ecuador; IRL, Ireland; KEN, Kenya; NOR, Norway; POL, Poland; SWE, Sweden; BGD, Bangladesh; JOR, Jordan; GBR, United Kingdom; MEX, Mexico.

Table 1

Meta-analytic regression results. Studies were pooled by country and subgrouped by date of government response. *k=125*, Q_M=66.47, *df*=7, *p*<0.001; Q_E=9485.92, *df*=117, *p*<0.001; R^2=33.61%.

Moderator	β	SE	p
Intercept	-57.62	13.60	<0.0001
Government response date[a]	0.003	0.001	<0.0001
Study included COVID patients[b]	0.147	0.042	<0.001
National COVID case frequency (ln-transformed)[c]	0.020	0.005	<0.0001
Human Development Index ranking[d]	0.104	0.034	0.002
Healthcare Access and Quality index (ln-transformed)[e]	0.365	0.119	0.002
Median stringency index[f]	-0.001	0.001	0.218
Lockdown duration[g]	0.0002	0.001	0.759

[a] To compare countries with earlier vs. later lockdown dates, we identified the earliest date in which the country exceeded a stringency index of 20 (denoting a stringent government response to COVID-19).

[b] Studies that included patients who had tested positive for COVID-19 were compared to studies that explicitly excluded patients with COVID-19 or did not report whether study participants had been tested for COVID-19.

[c] For each study, we identified the cumulative count of COVID cases in their country on the first day of the study period; the national case frequency was then ln-transformed.

[d] The United Nations Development Programme ranked countries by Human Development Index in descending order.

[e] The most recent (2016) estimates were extracted for each study and ln-transformed.

[f] The median stringency index was computed for each study for all dates preceding the start date of study.

[g] We estimated the duration of the lockdown in days (up until the study start date) by counting the number of days wherein the stringency index met or exceeded 20.

(Egger et al., 2020). The United Nations' Global Report on Food Crises estimates that the economic impact of COVID-19 will push an additional 130 million individuals in low- and middle-income countries into acute food insecurity in 2020 ("United Nations World Food Programme, 2020 - Global Report on Food Crises," 2020).

4.1. Limitations

We were unable to assess the potential confounding effect of the length of study period as several included studies did not report the study end date or length of the study period. We were also unable to assess differences in duration of lockdown measures across countries and how these differences may moderate depression prevalence. Most of the included studies used convenience or snowball sampling to recruit study participants, rather than a stratified or random sampling method typically used to derive nationally representative study populations, limiting the generalizability of our results. We evaluated the point prevalence of depression, rather than the incidence of new-onset depression, as pre-COVID-19 data were not reported by the vast majority of included studies. Most studies used a well-established cut-off score using a validated and standardized metric of depressive symptom severity with sensitivity and specificity to detect clinical cases of depression; notwithstanding, individuals meeting or exceeding the threshold for moderate-to-severe depressive symptom severity may not meet clinical diagnostic criteria for major depressive disorder. Moreover, our results may be confounded by the lack of study participant and outcome assessor blinding, as well as the retrospective assessment of depressive symptom severity.

Table 2
Risk of bias was assessed using the ROBIN-I tool.

Author	Citation	Confounding	Participant Selection	Intervention Classification	Missing Data	Outcome Measurement	Reporting	Overall Risk-of bias Rating
Almater	(Almater et al., 2020)	Moderate	Moderate	Serious	Low	Moderate	Low	**Serious**
Amerio	(Amerio et al., 2020a)	Low	Moderate	Serious	Low	Moderate	Low	**Serious**
An	(An et al., 2020)	Moderate	Moderate	Serious	Low	Moderate	Low	**Serious**
Arnetz	(Arnetz et al., 2020)	Moderate	Moderate	Serious	Moderate	Moderate	Moderate	**Serious**
Barzilay	(Barzilay et al., 2020)	Moderate	Moderate	Moderate	Low	Moderate	Moderate	**Moderate**
Bauerle	(Bauerle et al., 2020)	Low	Moderate	Serious	Low	Moderate	Low	**Serious**
Benke	(Benke et al., 2020)	Low	Moderate	Serious	Low	Moderate	Serious	**Serious**
Blekas	(Blekas et al., 2020)	Moderate	Moderate	Serious	Moderate	Moderate	Low	**Serious**
Bruine de Bruin	(Bruine de Bruin, 2020)	Moderate	Moderate	Moderate	Low	Moderate	Low	**Moderate**
Cai	(Cai et al., 2020)	Serious	Moderate	Serious	Low	Moderate	Low	**Serious**
Cardel	(Cardel et al., 2020)	Moderate	Moderate	Serious	Low	Moderate	Low	**Serious**
Chang	(Chang et al., 2020)	Moderate	Moderate	Serious	Low	Moderate	Low	**Serious**
Chen	(Chen et al., 2020)	Low	Moderate	Moderate	Low	Moderate	Low	**Moderate**
Chi	(Chi et al., 2020)	Moderate	Moderate	Serious	Low	Moderate	Moderate	**Serious**
Choi	(Choi et al., 2020)	Moderate	Moderate	Serious	Low	Moderate	Low	**Serious**
Civantos	(Civantos et al., 2020b)	Moderate	Moderate	Serious	Low	Moderate	Low	**Serious**
Civantos	(Civantos et al., 2020a)	Moderate	Moderate	Serious	Low	Moderate	Low	**Serious**
Corbett	(Corbett et al., 2020)	Moderate	Moderate	Serious	Moderate	Moderate	Serious	**Serious**
Czeisler	(Czeisler et al., 2020)	Moderate	Low	Serious	Low	Moderate	Low	**Serious**
Dawson	(Dawson and Golijani-Moghaddam, 2020)	Moderate	Moderate	Moderate	Low	Moderate	Low	**Moderate**
Dyer	(Dyer et al., 2020)	Moderate	Moderate	Serious	Moderate	Moderate	Low	**Serious**
Essadek	(Essadek and Rabeyron, 2020)	Low	Moderate	Low	Low	Moderate	Low	**Moderate**
Ettman	(Ettman et al., 2020)	Low	Low	Serious	Low	Moderate	Moderate	**Serious**
Farewell	(Farewell et al., 2020)	Moderate	Moderate	Serious	Moderate	Moderate	Low	**Serious**
Fu	(Fu et al., 2020)	Low	Moderate	Serious	Moderate	Moderate	Low	**Serious**
Fullana	(Fullana et al., 2020)	Moderate	Moderate	Moderate	Low	Moderate	Moderate	**Moderate**
Galindo-Vazquez	(Galindo-Vázquez et al., 2020)	Low	Moderate	Serious	Moderate	Moderate	Low	**Serious**
Gonzalez-Sanguino	(Gonzalez-Sanguino et al., 2020)	Moderate	Moderate	Serious	Moderate	Moderate	Low	**Serious**
Gualano	(Gualano et al., 2020)	Moderate	Moderate	Serious	Low	Moderate	Low	**Serious**
Gupta	(Gupta et al., 2020)	Moderate	Moderate	Serious	Low	Moderate	Low	**Serious**
Hakansson	(Håkansson et al., 2020)	Moderate	Moderate	Serious	Moderate	Moderate	Low	**Serious**
Havnen	(Havnen et al., 2020)	Low	Moderate	Serious	Low	Moderate	Low	**Serious**
Hong	(Hong et al., 2020)	Serious	Moderate	Serious	Low	Moderate	Low	**Serious**
Hu	(Hu et al., 2020)	Moderate	Moderate	Moderate	Low	Moderate	Low	**Moderate**
Huang	(J. Huang et al., 2020)	Low	Moderate	Low	Low	Moderate	Low	**Moderate**
Huang	(S. Huang et al., 2020)	Moderate	Serious	Moderate	Low	Moderate	Moderate	**Serious**
Hyland	(Hyland et al., 2020)	Moderate	Moderate	Moderate	Low	Moderate	Moderate	**Serious**
Imran	((Imran et al., 2020)	Moderate	Moderate	Serious	Moderate	Moderate	Low	**Serious**
Islam	(Islam et al., 2020)	Moderate	Moderate	Serious	Low	Moderate	Low	**Serious**
Jung	(Jung et al., 2020)	Low	Low	Low	Low	Moderate	Low	**Moderate**
Kang	(Kang et al., 2020b)	Moderate	Moderate	Moderate	Low	Moderate	Low	**Moderate**
Karatzias	(Karatzias et al., 2020)	Moderate	Low	Serious	Low	Moderate	Low	**Serious**
Khanna	(Khanna et al., 2020)	Moderate	Moderate	Serious	Low	Moderate	Low	**Serious**
Killgore	(Killgore et al., 2020)	Moderate	Moderate	Serious	Moderate	Moderate	Low	**Serious**
Kim	(Kim et al., 2020)	Moderate	Moderate	Serious	Low	Moderate	Low	**Serious**
Krammer	(Krammer et al., 2020)	Moderate	Moderate	Moderate	Low	Moderate	Low	**Moderate**
Lai	(Lai et al., 2020)	Moderate	Moderate	Serious	Low	Moderate	Low	**Serious**
Lee	(Y. Lee et al., 2020b)	Moderate	Moderate	Serious	Low	Moderate	Low	**Serious**
Lee	(S. A. Lee et al., 2020)	Moderate	Moderate	Moderate	Low	Moderate	Low	**Moderate**
Liang	(Liang et al., 2020)	Moderate	Moderate	Serious	Low	Moderate	Low	**Serious**
Li	(J. Li et al., 2020)	Moderate	Moderate	Serious	Low	Moderate	Low	**Serious**
Li	(G. Li et al., 2020)	Moderate	Moderate	Serious	Low	Moderate	Low	**Serious**
Li	(Juanjuan et al., 2020)	Low	Moderate	Moderate	Low	Moderate	Low	**Moderate**
Li	(X. Li et al., 2020)	Low	Moderate	Serious	Low	Moderate	Low	**Serious**
Lin	(L.-Y. Lin et al., 2020)	Moderate	Moderate	Low	Low	Moderate	Low	**Serious**
Liu	(J. Liu et al., 2020)	Moderate	Moderate	Serious	Low	Moderate	Low	**Serious**
Liu	(C. H. Liu et al., 2020)	Moderate	Moderate	Serious	Low	Moderate	Low	**Serious**
Liu	(D. Liu et al., 2020)	Low	Moderate	Low	Low	Moderate	Moderate	**Moderate**
Ma	(Ma et al., 2020)	Moderate	Moderate	Moderate	Low	Moderate	Low	**Moderate**
Maguire	(Maguire and O'Shea, 2020)	Moderate	Moderate	Serious	Moderate	Moderate	Moderate	**Serious**
Martina	(Martina et al., 2020)	Moderate	Moderate	Moderate	Low	Moderate	Low	**Moderate**
McCracken	(McCracken et al., 2020)	Low	Moderate	Low	Low	Moderate	Low	**Moderate**
Mechili	(Mechili et al., 2020)	Moderate	Moderate	Serious	Low	Moderate	Low	**Serious**
Mrklas	(Mrklas et al., 2020)	Moderate	Moderate	Serious	Low	Moderate	Moderate	**Serious**
Naser	(Naser et al., 2020)	Moderate	Moderate	Serious	Low	Moderate	Low	**Serious**
Nguyen	(Nguyen et al., 2020)	Moderate	Moderate	Moderate	Low	Moderate	Low	**Moderate**
Ni	(Ni et al., 2020)	Moderate	Moderate	Serious	Low	Moderate	Low	**Serious**
Pakenham	(Pakenham et al., 2020)	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	**Moderate**

(*continued on next page*)

Table 2 (*continued*)

Author	Citation	Confounding	Participant Selection	Intervention Classification	Missing Data	Outcome Measurement	Reporting	Overall Risk-of bias Rating
Palgi	(Palgi et al., 2020)	Moderate	Moderate	Serious	Low	Moderate	Low	**Serious**
Papandreou	(Papandreou et al., 2020)	Moderate	Moderate	Serious	Low	Moderate	Serious	**Serious**
Pouralizadeh	(Pouralizadeh et al., 2020)	Low	Moderate	Low	Low	Moderate	Low	**Moderate**
Paz	(Paz et al., 2020)	Moderate	Moderate	Moderate	Low	Moderate	Low	**Moderate**
Petzold	(Petzold et al., 2020)	Moderate	Moderate	Moderate	Low	Moderate	Low	**Moderate**
Pieh	(Pieh et al., 2020)	Moderate	Moderate	Serious	Low	Moderate	Low	**Serious**
Price	(Price, 2020)	Moderate	Moderate	Serious	Low	Moderate	Low	**Serious**
Que	(Que et al., 2020)	Moderate	Moderate	Serious	Low	Moderate	Low	**Serious**
Raj	(Raj et al., 2020)	Low	Moderate	Serious	Low	Moderate	Low	**Serious**
Ran	(Ran et al., 2020)	Moderate	Serious	Serious	Low	Moderate	Low	**Serious**
Rettie	(Rettie and Daniels, 2020)	Low	Moderate	Moderate	Low	Moderate	Low	**Moderate**
Sahin	(Şahin et al., 2020)	Moderate	Moderate	Moderate	Low	Moderate	Low	**Moderate**
Schmitz	(Schmitz et al., 2020)	Moderate	Moderate	Serious	Low	Moderate	Low	**Serious**
Shah	(Shah et al., 2020)	Moderate	Moderate	Serious	Moderate	Moderate	Moderate	**Serious**
Shapiro	(Shapiro et al., 2020)	Moderate	Moderate	Serious	Moderate	Moderate	Low	**Serious**
Shechter	(Shechter et al., 2020)	Low	Moderate	Serious	Low	Moderate	Low	**Serious**
Shi	(Shi et al., 2020)	Moderate	Moderate	Moderate	Low	Moderate	Low	**Moderate**
Skapinakis	(Skapinakis et al., 2020)	Low	Moderate	Moderate	Low	Moderate	Low	**Moderate**
Sljivo	(Sljivo, 2020)	Moderate	Serious	Moderate	Low	Moderate	Low	**Serious**
Speth	(Speth et al., 2020)	Moderate	Moderate	Moderate	Low	Moderate	Low	**Moderate**
Suryavanshi	(Suryavanshi et al., 2020)	Low	Moderate	Serious	Low	Moderate	Low	**Serious**
Szepietowski	(Szepietowski et al., 2020)	Low	Moderate	Serious	Moderate	Moderate	Serious	**Serious**
Tang	(Tang et al., 2020)	Moderate	Moderate	Serious	Low	Moderate	Low	**Serious**
Teufel	(Teufel et al., 2020)	Moderate	Moderate	Serious	Moderate	Moderate	Low	**Serious**
Thomaier	(Thomaier et al., 2020)	Moderate	Moderate	Serious	Low	Moderate	Serious	**Serious**
Tu	(Tu et al., 2020)	Moderate	Moderate	Serious	Moderate	Moderate	Low	**Serious**
Twenge	(Twenge and Joiner, 2020)	Moderate	Low	Serious	Low	Moderate	Low	**Serious**
Vafaei	(Vafaei et al., 2020)	Moderate	Moderate	Serious	Moderate	Moderate	Low	**Serious**
Wang	(L.-Q. Wang et al., 2020)	Moderate	Moderate	Serious	Low	Moderate	Moderate	**Serious**
Wang	(X. Wang et al., 2020)	Moderate	Moderate	Serious	Low	Moderate	Low	**Serious**
Wang	(S. Wang et al., 2020)	Moderate	Moderate	Serious	Low	Moderate	Low	**Serious**
Wang	(Q. Wang et al., 2020)	Serious	Moderate	Serious	Low	Moderate	Low	**Serious**
Willner	(Willner et al., 2020)	Moderate	Moderate	Serious	Low	Moderate	Moderate	**Serious**
Wilson	(Wilson et al., 2020)	Moderate	Moderate	Moderate	Low	Moderate	Low	**Moderate**
Xiao	(Xiao et al., 2020)	Moderate	Moderate	Serious	Low	Moderate	Low	**Serious**
Xin	(Xin et al., 2020)	Moderate	Serious	Moderate	Low	Low	Low	**Serious**
Xu	(Xiaoming et al., 2020)	Low	Moderate	Serious	Low	Moderate	Low	**Serious**
Yang	(Yang et al., 2020)	Moderate	Serious	Moderate	Low	Low	Low	**Serious**
Zhang	(W.-R. Zhang et al., 2020)	Moderate	Serious	Serious	Low	Moderate	Low	**Serious**
Zhang	(Zhang et al., 2021)	Moderate	Serious	Serious	Low	Low	Low	**Serious**
Zhang	(J. Zhang et al., 2020)	Moderate	Low	Low	Low	Low	Low	**Moderate**
Zhang	(S. X. Zhang et al., 2020)	Moderate	Serious	Moderate	Moderate	Moderate	Serious	**Serious**
Zhang	(W. Zhang et al., 2020)	Moderate	Serious	Serious	Low	Moderate	Moderate	**Serious**
Zhao	(R. Zhao et al., 2020)	Moderate	Serious	Serious	Low	Moderate	Low	**Serious**
Zhao	(B. Zhao et al., 2020)	Moderate	Moderate	Moderate	Low	Moderate	Low	**Moderate**
Zhou	(Zhou et al., 2020)	Moderate	Low	Serious	Low	Low	Low	**Serious**

A study that measured and included in its analysis at least one confounding variable was rated as having a low risk of confounding bias; a study that measured but did not include in its analysis at least one confounding variable was rated as having a moderate risk of confounding bias. A study was considered to have moderate risk of selection bias if it excluded individuals with a history of psychiatric diagnoses or was delimited to a particular demographic (e.g., college students, elderly, healthcare workers). A study was assessed as having a low risk of selection bias if it recruited a nationally representative sample. Studies that reported COVID diagnoses (self-reported or as assessed by study personnel) and subgrouped participants by COVID status were rated as having a low risk of bias on the intervention classification domain. Studies that did not report their results separately for participants who had tested positive and participants who had tested negative (or were not tested) received a moderate rating. Studies that did not ask participants about COVID diagnoses were judged as having a serious risk of intervention classification bias.
A study received a low risk of missing data bias unless it failed to report the study start date, study end date or duration, or the cut-off score used to identify cases with clinically significant depressive symptoms (in which case it received a moderate rating). A study received a serious risk of outcome measurement bias if it used different scales or modes of scale administration between study subpopulations or a moderate rating if participants or outcome assessors were unblinded to study outcomes of interest. Non-refereed publications and studies that omitted analyses mentioned in their methods were rated as having moderate risk of reporting bias. Studies that failed to report the analysis sample size were rated as having a serious risk of reporting bias.

5. Conclusions

Taken together, our results underscore the need for governments formulating policy interventions to include the mental health community and representatives of vulnerable populations during the development process. A future study should evaluate how the duration of stringent lockdown measures moderate the incidence of depression due to COVID-19 using nationally representative data.

MeSH keywords: Depression; Depressive Disorder; Public Health; Population Health; Social Medicine; Global Health; Public Policy; Pandemics; Coronavirus Infections; Pandemics / prevention & control*; Humans; Meta-Analysis; Systematic Reviews

Supplementary concepts: COVID-19; severe acute respiratory syndrome coronavirus 2

Summary

The COVID-19 pandemic represents a public health, economic and mental health crisis. We hypothesized that timely government implementation of stringent measures to reduce viral transmission would benefit mental health, as evidenced by reduced rates of depressive symptoms (i.e., Patient Health Questionnaire [PHQ]-9≥10, PHQ-2≥3). The systematic review herein (PROSPERO CRD42020200647) evaluated to what extent differences in the government-imposed stringency

and timeliness of response to COVID-19 moderate the prevalence of depressive symptoms across 33 countries (k=114, N=640,037). We included data from six lower-middle-income countries, nine upper-middle-income countries, and 18 higher-income countries.

The overall proportion of study participants with clinically significant depressive symptoms was 21.39% (95% CI 19.37–23.47). The prevalence of clinically significant depressive symptoms was significantly lower in countries wherein governments implemented stringent policies promptly. The moderating effect of government response remained significant after including the national frequency of COVID cases at the time of study commencement, Healthcare Access and Quality index, and the inclusion of COVID patients in the study. Government-imposed stringency and timeliness in response were operationalized using the Oxford COVID-19 Government Response ("Stringency") Index.

The World Health Organization defines health as physical and mental health, as well as social wellbeing. Governments that enacted stringent measures to contain the spread of COVID-19 benefited, not only the physical health, but also mental health of their population.

Author statement

All authors have approved the final manuscript and note that this is our original work. The article is not under review with any other journal or publication. The authors' conflicts of interest have been provided.

Author contributions

YL conceptualized the Article. YL, LMWL, DC-L reviewed articles and collected data. YL ran the analysis. YL and LMWL wrote the first draft of the Article and revised it based on feedback from co-authors. All authors reviewed and approved the Article.

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Data sharing

Data collected for the meta-analysis, including individual study data and a data dictionary defining each field in the set, will be made available to others upon publication of the meta-analysis herein. The standardized data collection form and individual study data used in the analysis herein will be published online via a public repository (Mendeley DOI). The study protocol is available online (PROSPERO CRD42020200647).

Declaration of Competing Interest

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jad.2021.04.050.

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