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Associations of lockdown stringency and duration with Google searches for mental health terms during the COVID-19 pandemic: A nine-country study

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ABSTRACT

Objectives: We examined the associations of lockdown stringency and duration with Google searches for four mental health concepts (i.e., "Anxiety," "Depression," "Suicide," "Mental Health") in nine countries (i.e., Hungary, India, Iran, Italy, Paraguay, Serbia, South Africa, Spain, Turkey) during the COVID-19 pandemic.

Methods: We retrieved national-level data for each country from Google Trends and the Global Panel Database of Pandemic Policies. In our primary analysis, we used data from all countries to estimate a set of multilevel regression models examining associations of overall lockdown stringency and lockdown duration with relative search volumes for each mental health term. We repeated the models after replacing overall lockdown stringency with each of the lockdown stringency components.

Results: A negative association was found between overall lockdown stringency and "Depression." Lockdown duration and the most stringent stay-at-home requirements were negatively associated with "Anxiety." Policies that recommended or required the cancelation of public events evidenced negative associations with "Depression," whereas associations between policies that required some or all levels of schooling to close and "Depression" were positive. Policies that recommended or required workplaces to close and those that enforced quarantines on non-citizens arriving from high-risk regions or closed borders entirely were negatively associated with "Suicide."

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Conclusions: Lockdown duration and some lockdown policies during the COVID-19 pandemic were generally associated with significantly lower, rather than higher, Google searches for selected mental health terms. These findings could be used alongside other evidence to develop future lockdown strategies that are sensitive to mental health issues during public health crises.

1. Introduction

The coronavirus disease 2019 (COVID-19) pandemic is a global public health crisis. To limit and control the transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), many countries around the world implemented public health measures that were particularly stringent during the early part of the COVID-19 pandemic (Cowden et al., 2021). Although these measures were considered necessary to protect the physical health of populations and reduce the burden of COVID-19 on health systems (Counted et al., 2021; Govender et al., 2020), they also precipitated a wide range of challenges (e.g., financial insecurity, social isolation, mobility restrictions) that have the potential to degrade well-being (Davis et al., 2021; De Kock et al., 2022).

During the early stages of the COVID-19 pandemic, telecommunication technologies served an important function in managing the public health crisis. Internet platforms played a key role in educating people about SARS-CoV-2 and providing up-to-date information about the COVID-19 pandemic (Vargo et al., 2021). For example, people may have used the internet to search for information about SARS-CoV-2, the status of public health measures that were in place, available treatments for COVID-19, and mental health concerns. Internet search data could be a potentially useful resource that complements and extends evidence acquired from traditional methodologies (e.g., public health surveillance studies) about the health-related implications of the COVID-19 pandemic. In light of the many ways that the COVID-19 pandemic has disrupted human life (Counted et al., 2020; Cowden et al., 2021), scholars have leveraged Google searches to explore the impact of this public health crisis on mental health. Some studies have used descriptive approaches to report broad changes in searches for mental health concepts from before to during the COVID-19 pandemic, with evidence largely supporting an increase in relevant searches. For example, several studies found an increase in searches for anxiety symptoms (Hoerger et al., 2020) and insomnia (Kirsi-Marja Zitting et al., 2021; Lippi et al., 2021) within the United States of America (USA) during the early part of the COVID-19 pandemic.

When researchers have focused more specifically on searches for mental health concepts during periods of lockdown, findings have been more mixed. In one study that included Europe and the USA, Brodeur et al. (2021) found an increase in Google searches after the start of lockdowns for terms such as "loneliness," "worry," and "sadness," but there was a decrease in searches for "stress" and "suicide." Similarly, Knipe et al.'s (2020) study involving Italy, Spain, USA, and the United Kingdom (UK) revealed that changes (or lack thereof) in Google searches for mental health terms from before to during lockdowns often varied by term. For instance, searches for "suicide" in each country tended to decrease before lockdowns were imposed and then increased after the onset of lockdowns; however, searches for "anxiety" started to rise in Spain and remained relatively stable in other countries (e.g., UK) after lockdown measures were enforced. The mixed pattern of findings that emerged in these studies could be a function of many different within and between-country factors, including the broader context of the COVID-19 pandemic (e.g., local burden of COVID-19), the timing of lockdowns, and/or the specific kinds of lockdown measures that were implemented (Lee et al., 2021). A few studies have investigated the potential impact that some of these aforementioned factors might have had on Google search patterns for mental health terms during lockdowns. For example, Foa et al. (2020) reported evidence suggesting that increases in Google searches for selected mental health terms during the early part of the COVID-19 pandemic were primarily driven by country-specific pandemic severity rather than lockdowns themselves. However, to our knowledge, no previous study has explored linkages between specific lockdown stringency measures and Google searches for mental health terms during lockdowns. Research along these lines could provide useful insight into whether Google search patterns for mental health terms during lockdowns varied based on the types of lockdown measures that were instituted.

In the present study, we examine the associations of lockdown stringency and duration with Google searches for four mental health concepts (i.e., "Anxiety," "Depression," "Suicide," "Mental Health") in nine countries (i.e., Hungary, India, Iran, Italy, Paraguay, Serbia, South Africa, Spain, Turkey) during the COVID-19 pandemic. We anticipated that lockdown duration and the different lockdown components would generally be associated with lower Google searches for the mental health terms, with some variation in the direction and magnitude of associations for specific lockdown components.

2. Methods

2.1. Data retrieval

Our analysis focuses on the terms "Anxiety," "Depression," "Suicide," and "Mental Health." We selected anxiety, depression, and suicide because they are among the leading causes of disability around the world (Abbafati et al., 2020). Although these terms represent specific mental health problems, they are especially well-suited to this study because each term is known and commonly used among the general population. We also included the term "Mental Health," as it is a broader term that people may have used, for example, when searching for general information about mental health, to gauge whether their mental health has declined, or to find out how to best support their mental health.

We performed Google Trends searches for each of these four terms in each of the nine countries that were included in this study. Google Trends is an online search tool that provides information about how searches in Google change over time. Users can look for information about specific search terms, and the website provides a graph and a downloadable datasheet of the relative search volumes for each term. Relative search volume values range from 0 to 100, with 0 representing very low search interest and 100 representing the maximum search activity for the term at any given location and period (Google, 2015). Therefore, the relative search volume provides information on how the number of searches in each time unit relates to the maximum number of searches detected in that time and location. Although the relative search volume for a term in one country is not directly comparable to the relative search volume for the same term in another country, the search volume is useful for detecting changes in an existing trend and comparing it with other trends from different locations.

Our decision to focus on Hungary, India, Iran, Italy, Paraguay, Serbia, South Africa, Spain, and Turkey was based principally on pragmatic criteria, such as contextual knowledge that the authors had about

the COVID-19 pandemic in each country. All search terms were translated into the most widely used language within each country: Hungarian (Hungary), English (India and South Africa), Persian (Iran), Italian (Italy), Spanish (Paraguay and Spain), Serbian (Serbia), and Turkish (Turkey). For this study, we downloaded country-specific data from the last five years, which took place between January 3rd, 2021 and June 13th,2021.[1] These datasheets contained one observation per date with two variables: the relative search volume of the search term and the date in a weekly format. The datasheets of the four search terms were merged according to the date and country.

Time-updated details about local government responses to the COVID-19 pandemic were collected at the national level from the Global Panel Database of Pandemic Policies (Hale et al., 2021). This database included information about eight containment and closure policies from the Oxford COVID-19 Government Response Tracker (Hale et al., 2021): school closures, workplace closures, cancelling public events, restrictions on gatherings, public transport closures, stay-at-home requirements, restrictions on internal movement, and international travel controls (see Table 1S). The stringency of these lockdown measures were captured using an ordinal rating scale, with higher values reflecting more stringent lockdown policies. We calculated time-updated overall lockdown stringency values for each country by summing values for each of the eight lockdown components. For interpretive purposes, we rescaled the overall lockdown stringency variable such that the range of possible values was 0 (no measures implemented) to 100 (maximum stringency). We also extracted information about daily COVID-19 related deaths per 100,000 people in each country between January 1st, 2020 and December 15th, 2020, a period in which lockdown measures were the most stringent worldwide.

2.2. Data analysis

To account for country-specific trends in Google searches prior to the COVID-19 pandemic, we began by predicting the relative search volume during the weeks of lockdown using pre-pandemic information. This predicted trend consists of two parts: 1) the annual trend (i.e., how Google searches change over the years), and 2) the seasonal trend (i.e., how Google searches are affected by the month and day within a given year). We used data from before January 1st, 2020 to estimate the relative search volumes for each mental health term within each country during 2020. The relative search volume was smoothed by averaging each weekly observation with the previous and following 26 weekly observations. This process homogenized the data by reducing the distance of the peaks and valleys in the 52 weeks (a full year) around a given date.

Next, we estimated a linear regression model with the yearly smoothed relative search volume as the criterion and the weekly date as a predictor, which resulted in an estimation of the annual trend before January 1st, 2020. We subtracted the predicted values of this annual trend from the weekly relative search volumes, yielding a stationary series with the seasonal residual values from 2016 to the end of 2019. This seasonal series indicates the changes in relative search volume according to the day and month, regardless of the annual trend before 2020. Then, we computed a seasonal Autoregressive Integrated Moving Average (ARIMA) model (1,0,1) (1,0,1,52)[2] to predict weekly seasonal trends for the relative search volumes during the year 2020 with the stationary series of residual values from before 2020. ARIMA is a statistical model that uses time series data to predict future values of data based on past values by regressing the variable of interest on its prior values.

Finally, we summed the predicted annual trend and the predicted seasonal trend from the ARIMA model to obtain the full predicted trend of the relative search volumes for the year 2020. This predicted trend may be partially explained by culture, geography, politics, the health care system, and other factors that played a role in how people searched for the mental health terms in Google before 2020. Thus, we used this variable to control for potential confounding between countries.

For descriptive purposes, we used time-series graphs to illustrate actual relative search volume, the predicted relative search volume, and the overall lockdown stringency value for each mental health term in each country. Both the actual and predicted relative search volumes for each observation were smoothed by month based on the average between a given observation, the two weeks that preceded it, and the two weeks that followed it.

In our primary analysis, we performed a set of two-level linear mixed models to estimate the associations of overall lockdown stringency and lockdown duration with the relative search volume for each mental health term across all observations (level 1, fixed effects) within each country (level 2, random effects) from January 1st, 2020 onwards. Separate models were computed for each mental health term, and all observations from different dates were modeled as if they were unique cases. The criterion variable for each model was the relative search volume for a given mental health term. The predictor was the continuous overall lockdown stringency value at each date. Covariates included daily COVID-19-related deaths, the number of weeks since the start of lockdown, and the predicted relative search volume for each country at each date. All within-country errors were assumed to have an autoregressive structure in which adjacent measurements are more strongly correlated than distant measurements. We computed pseudo-R to assess the change in variance based on the addition of fixed effects.

We replicated these models by replacing overall lockdown stringency with all eight components of overall lockdown stringency as categorical variables. After adjusting for the other lockdown stringency components, these models estimated the associations of each level of the different lockdown measures with the relative search volumes for each mental health term. The absence of relevant lockdown measures or restrictions served as the reference category for each lockdown component.

Finally, to compare the associations of the overall lockdown stringency with the mental health terms across the countries, we replicated the abovementioned multivariate models separately for each country. We were unable to replicate the multivariate analyses with the lockdown stringency components by country, as government authorities within a country often implemented or scaled public health measures together at certain times during the COVID-19 pandemic (Hale et al., 2021).

3. Results

Overall lockdown stringency scores by date, together with the actual and predicted weekly relative search volume for “Anxiety,” “Depression,” “Suicide,” and “Mental Health” for each of the included countries, are shown in Figs. 1–4. In most countries, the relative search volume for

[1] Collaborators from some of the countries joined this research project later than others, which is why there are differences in the dates that the Google Trends data were downloaded for each country. Given that Google Trends limits data downloads in a weekly format to a maximum of five years prior to the search date, we were unable to obtain up to six months of weekly observations in 2016 (between January 1st, 2016 and June 19th, 2016) for those countries that were added to the research project at a later date. Since our main analysis was performed with 2020 data and our pre-pandemic data spans at least 3 years and 5 months for all countries, the implications of having a different number of observations for some countries in 2016 are likely to be negligible.

[2] We computed an ARIMA model with an order of one for both the autoregressive ($p = 1$) and moving average ($q = 1$) parts of the model, and with no subtraction ($d = 0$) between the adjacent values of the data. For the seasonal component, the periods were all the weeks during a year ($m = 52$).

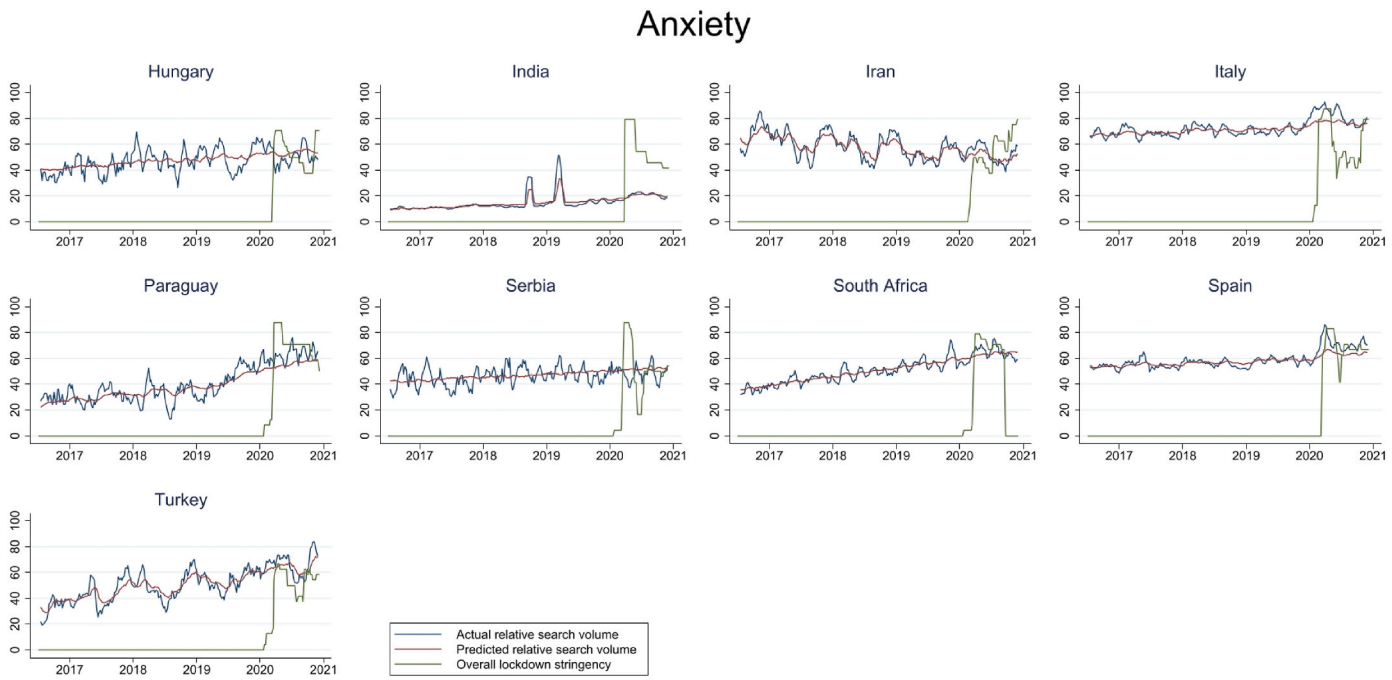

Fig. 1. Search trends for "Anxiety" before and during lockdowns in each country.

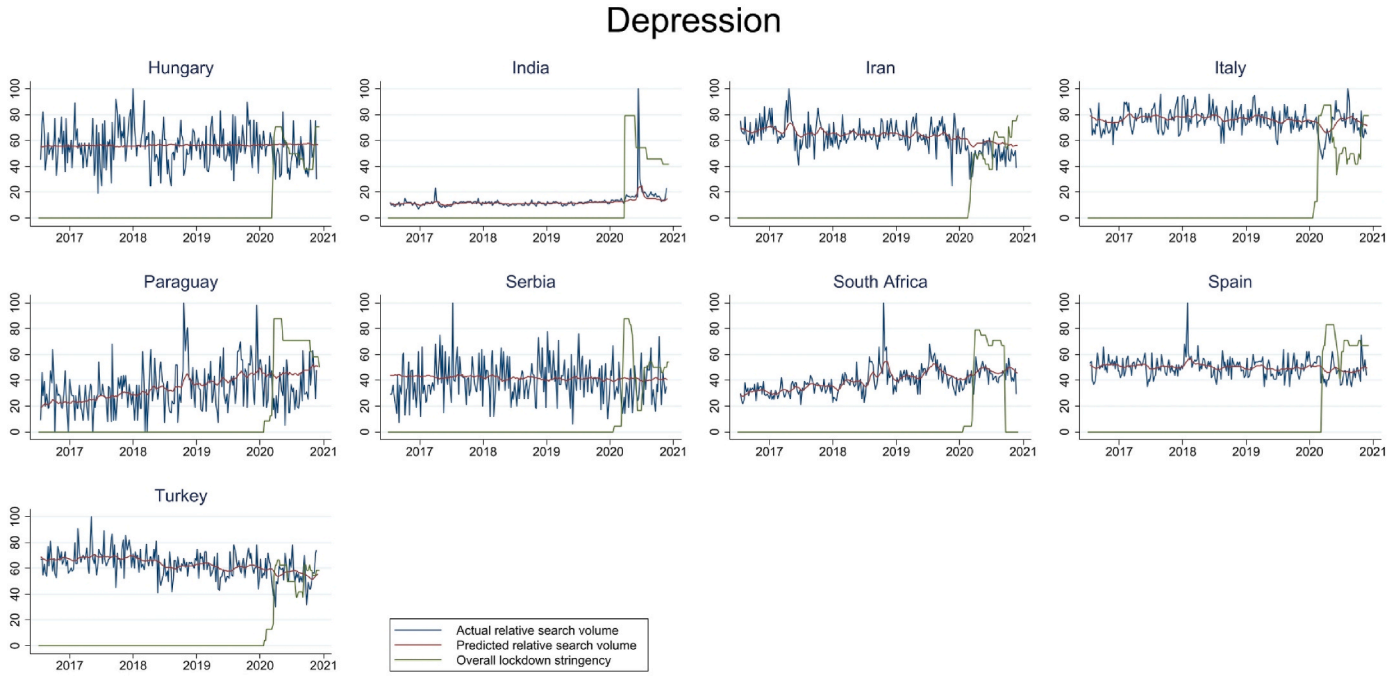

Fig. 2. Search trends for "Depression" before and during lockdowns in each country.

"Anxiety" increased weeks before lockdowns were implemented. There was a decrease in the relative search volume for "Depression" around the start of the lockdown in Iran, Italy, Spain, and Paraguay, whereas there was a slight increase in India. Turkey and Spain showed a similar pattern of decline in relative search volume for "Suicide." Searches for "Mental Health" generally did not change substantially from before to during lockdowns; however, India, Iran, Italy, Paraguay, South Africa and Spain showed a relative search volume peak for that term on October 10th, 2020, which is World Mental Health Day.

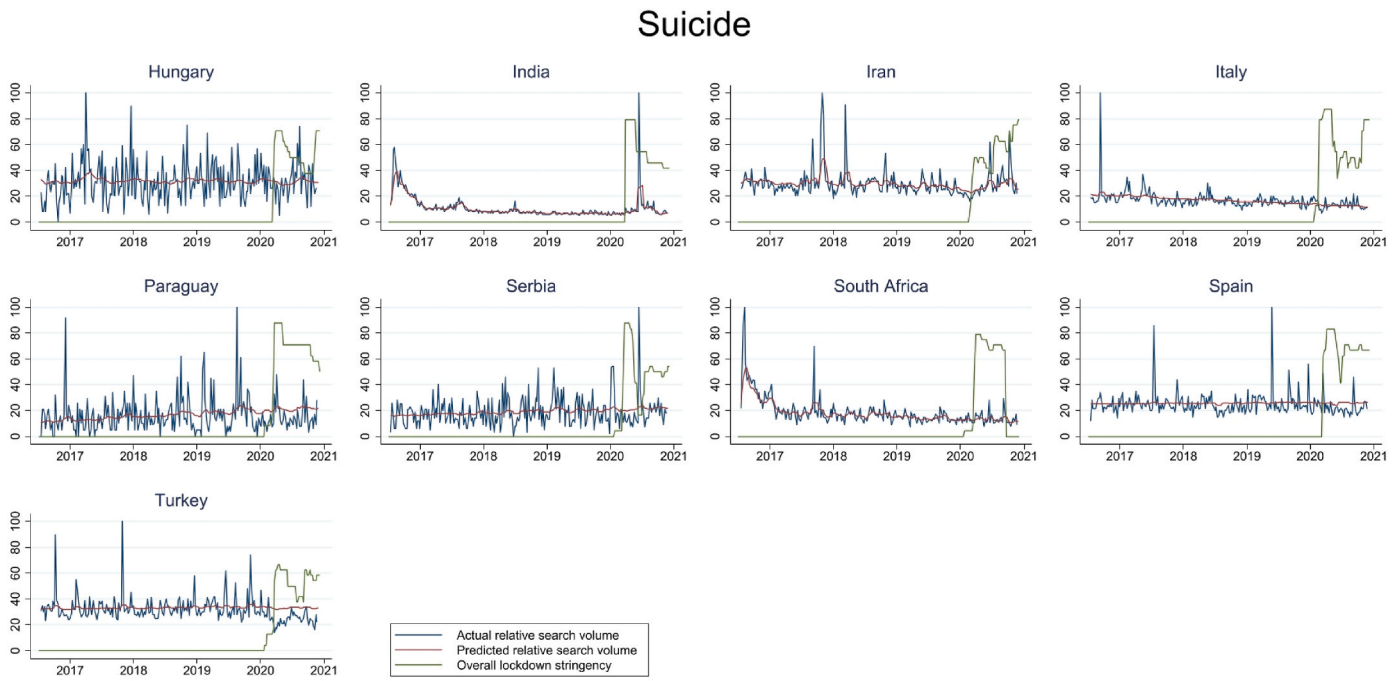

Fig. 3. Search trends for "Suicide" before and during lockdowns in each country.

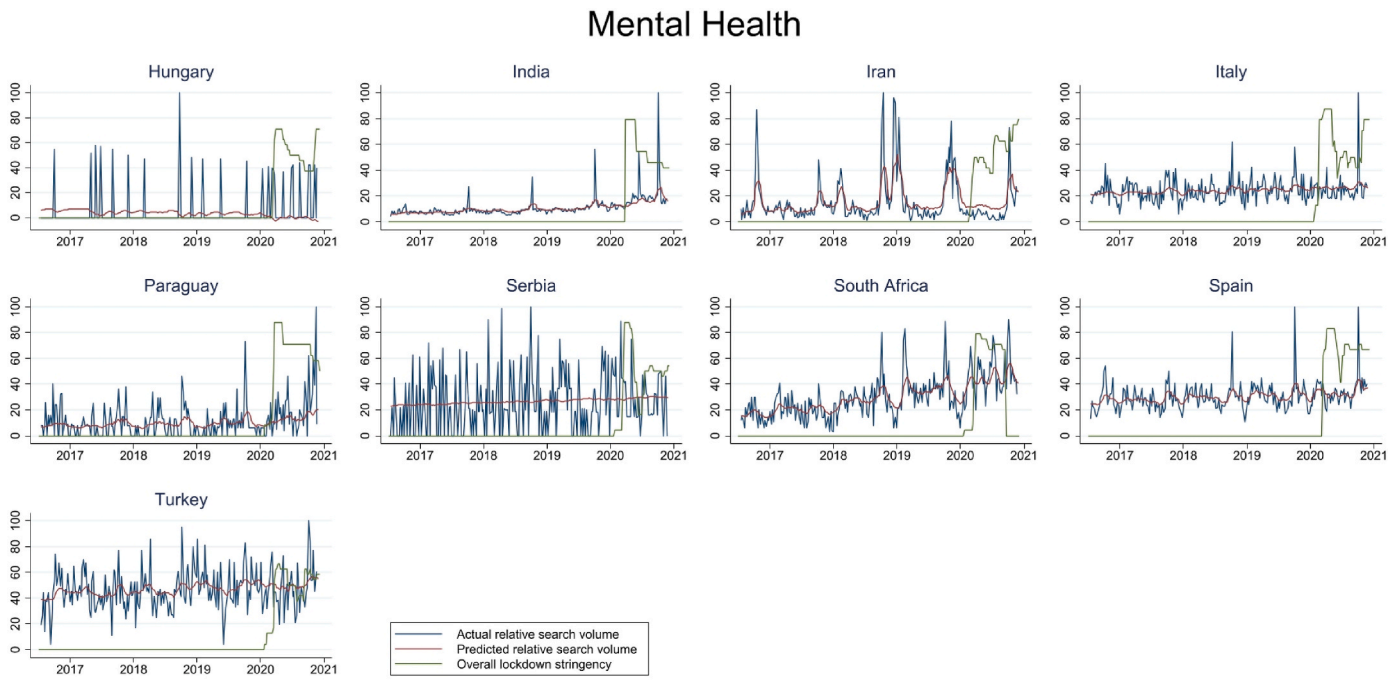

Fig. 4. Search trends "Mental Health" before and during lockdowns in each country.

The association between overall lockdown stringency and the relative search volume for the mental health terms across all countries is shown in Table 1. We found evidence of a negative association between overall lockdown stringency and the relative search volume for "Depression" (standardized beta = −0.09; 95% CI = −0.16, −0.01). There was little evidence of associations between overall lockdown stringency and relative search volumes for the other search terms. Lockdown duration evidenced a negative association with the relative search volume for "Anxiety" (standardized beta = −0.09; 95% CI = −0.17, −0.01). The change in variance due to the addition of fixed effects was greater for "Anxiety" (pseudo-R = 0.98) and "Depression" (pseudo-R = 0.68) than for "Suicide" (pseudo-R = 0.06) and "Mental Health" (pseudo-R = 0.12).

Table 2 shows the associations between each of the lockdown stringency components and the relative search volumes for the mental health terms across all countries. Evidence of a negative association was found between the most stringent stay-at-home requirements and the relative search volume for "Anxiety" (standardized beta = −0.60; 95% CI = −1.07, −0.14). Policies that recommended (standardized beta = −1.14; 95% CI = −1.93, −0.34) or required (standardized beta = −1.12; 95% CI = −1.85, −0.39) the cancellation of public events were negatively associated with the relative search volume for "Depression." On

Table 1
Associations between overall lockdown stringency and relative search volumes across all countries.

	Standardized regression coefficient (95% CI)[a]			
	Anxiety	Depression	Suicide	Mental health
Daily deaths[b]	0.21 (−0.14, 0.56)	0.06 (−0.32, 0.44)	−0.21 (−0.79, 0.37)	−0.04 (−0.43, 0.50)
Country trend[c]	0.76 (0.67, 0.86)***	0.64 (0.51, 0.78)***	0.14 (0.01, 0.28)**	0.70 (0.58, 0.81)***
Lockdown duration (weeks)[d]	−0.09 (−0.17, −0.01)**	0.06 (−0.03, 0.14)	−0.02 (−0.12, 0.16)	0.07 (−0.04, 0.19)
Overall lockdown stringency[e]	0.04 (−0.03, 0.11)	−0.09 (-0.16, −0.01)**	−0.03 (−0.14, 0.09)	−0.01 (−0.11, 0.17)

***p < .01, **p < .05, *p < .10.
[a] Standardized regression coefficients and 95% confidence intervals for the associations between overall lockdown stringency and relative search volumes for anxiety, depression, mental health and suicide with data from all countries.
[b] Daily COVID-19 related deaths per 100,000 habitants.
[c] Predicted daily relative search volume through the ARIMA model.
[d] Number of weeks since the first lockdown stringency measure was adopted in each country.
[e] Range from 0 to 100.

Table 2
Associations between lockdown stringency components and relative search volumes across all countries.

	Standardized regression coefficient (95% CI)[a]			
	Anxiety	Depression	Suicide	Mental health
Daily deaths[b]	0.26 (−0.17, 0.69)	0.25 (−0.19, 0.69)	−0.06 (−0.62, 0.50)	0.03 (−0.54, 0.61)
Country trend[c]	0.75 (0.66, 0.85)***	0.71 (0.59, 0.84) ***	0.44 (0.35, 0.53) ***	0.66 (0.55, 0.76) ***
Lockdown duration (weeks)[d]	−0.15 (−0.26, −0.03)**	0.05 (−0.08, 0.17)	−0.06 (−0.21, 0.08)	0.07 (−0.09, 0.23)
School closures[e]				
Recommended	0.08 (−0.67, 0.84)	0.70 (−0.08, 1.48) *	0.94 (−0.09, 1.97) *	−0.01 (−1.00, 0.98)
Required at some levels	0.12 (−0.60, 0.85)	0.83 (0.07, 1.59) ***	0.75 (−0.24, 1.75)	0.07 (−0.89, 1.02)
Required at all levels	0.15 (−0.57, 0.87)	0.90 (0.15, 1.64) ***	0.75 (−0.23, 1.74)	−0.15 (−1.10, 0.79)
Workplace closures[e]				
Recommended	−0.12 (−0.52, 0.28)	0.05 (−0.37, 0.47)	−0.80 (−1.34, −0.26) ***	−0.06 (−0.60, 0.48)
Required for some sectors	0.07 (−0.29, 0.44)	0.25 (−0.12, 0.63)	−0.86 (−1.33, −0.38) ***	−0.13 (−0.61, 0.34)
Required for all-but-essential sectors	0.09 (−0.34, 0.52)	0.05 (−0.38, 0.49)	−0.89 (−1.45, −0.32) ***	−0.24 (−0.80, 0.31)
Cancelling public events[e]				
Recommended	0.19 (−0.57, 0.95)	−1.14 (−1.93, −0.34) ***	0.31 (−0.73, 1.34)	−0.30 (−1.30, 0.71)
Required	0.15 (−0.54, 0.84)	−1.12 (−1.85, −0.39) ***	−0.31 (−1.25, 0.63)	−0.20 (−1.11, 0.70)
Restrictions on gatherings[e]				
Restrictions on >1000 people	−0.23 (−0.53, 0.06)	−0.02 (−0.32, 0.29)	0.22 (−0.16, 0.60)	0.25 (−0.15, 0.65)
Restrictions between 100 and 1000 people	−0.09 (−0.43, 0.26)	0.07 (−0.29, 0.43)	0.42 (−0.04, 0.87) *	0.33 (−0.13, 0.79)
Restrictions between 10 and 100 people	0.07 (−0.21, 0.35)	−0.04 (−0.34, 0.25)	0.03 (−0.34, 0.39)	0.12 (−0.25, 0.49)
Restrictions of less than 10 people	0.06 (−0.20, 0.33)	−0.04 (−0.32, 0.24)	0.06 (−0.28, 0.40)	0.22 (−0.13, 0.57)
Public transport closures[e]				
Recommended	−0.07 (−0.29, 0.15)	−0.21 (−0.45, 0.03) *	0.22 (−0.06, 0.51)	−0.15 (−0.45, 0.14)
Required	0.04 (−0.30, 0.38)	0.20 (−0.16, 0.56)	−0.27 (−0.68, 0.13)	0.23 (−0.17, 0.63)
Stay-at-home requirements[e]				
Recommended	−0.30 (−0.64, 0.03) *	−0.05 (−0.4, 0.29)	0.39 (−0.06, 0.83) *	−0.04 (−0.48, 0.40)
Required with exceptions	−0.28 (−0.64, 0.08)	0.04 (−0.33, 0.42)	0.38 (−0.09, 0.86)	0.07 (−0.41, 0.55)
Required with minimal exceptions	−0.60 (−1.07, −0.14) **	−0.04 (−0.53, 0.44)	0.36 (−0.25, 0.96)	0.07 (−0.54, 0.68)
Restrictions on internal movement[e]				
Recommended	0.08 (−0.20, 0.36)	0.27 (−0.02, 0.57) *	0.01 (−0.36, 0.39)	0.05 (−0.33, 0.43)
Required	0.18 (−0.09, 0.45)	0.01 (−0.27, 0.29)	0.04 (−0.30, 0.39)	0.06 (−0.30, 0.41)
International travel controls[e]				
Screening	−0.02 (−0.25, 0.20)	−0.20 (−0.44, 0.04)	−0.22 (−0.51, 0.07)	0.15 (−0.16, 0.45)
Quarantine arrivals from high-risk regions	0.18 (−0.14, 0.49)	0.06 (−0.27, 0.39)	−0.50 (−0.90, −0.11) **	0.21 (−0.20, 0.61)
Ban on arrivals from high-risk regions	−0.01 (−0.24, 0.22)	−0.15 (−0.38, 0.08)	−0.16 (−0.44, 0.12)	0.09 (−0.20, 0.37)
Total border closure	−0.03 (−0.29, 0.23)	−0.25 (−0.53, 0.03) *	−0.37 (−0.70, −0.03) **	0.30 (−0.05, 0.64) *

***p < .01, **p < .05, *p < .10.
[a] Standardized regression coefficients and 95% confidence intervals for the associations between different levels of each lockdown components and relative search volumes for anxiety, depression, mental health and suicide with data from all countries.
[b] Daily new COVID-19 related deaths per 100.000 habitants.
[c] Predicted daily relative search volume through the ARIMA model.
[d] Number of weeks since the first lockdown stringency measure was adopted in each country.
[e] The reference category for each lockdown component was the absence of any measure or data related to that component.

the other hand, policies that required schools to close at some (standardized beta = 0.83; 95% CI = 0.07, 1.59) or all levels (standardized beta = 0.90; 95% CI = 0.15, 1.64) yielded positive associations with the relative search volume for "Depression." Policies that recommended workplace closures (standardized beta = −0.80; 95% CI = −1.34, −0.26), required workplaces in some sectors to close (standardized beta = −0.86; 95% CI = −1.33, −0.38), or required all-but-essential workplaces to close (standardized beta = −0.89; 95% CI = −1.45, −0.32) were negatively associated with the relative search volume for "Suicide." In addition, policies that enforced quarantines on people arriving from high-risk regions (standardized beta = −0.50; 95% CI = −0.90, −0.11) or closed borders entirely (standardized beta = −0.37; 95% CI = −0.70, −0.03) were negatively associated with the relative search volume for "Suicide." There was little evidence to suggest that

Table 3
Associations between overall lockdown stringency and relative search volumes within each country.

	Standardized regression coefficient (95% CI)[a]			
	Anxiety	Depression	Suicide	Mental Health
Hungary	−0.42 (−0.70, −0.16)***	−0.20 (−0.45, 0.04)	−0.29 (−0.73, 0.14)	−0.02 (−0.40, 0.44)
India	0.04 (0.01, 0.07)**	0.10 (−0.10, 0.30)	0.18 (−0.16, 0.52)	0.06 (−0.08, 0.20)
Iran	0.27 (−0.11, 0.64)	−0.32 (−0.76, 0.12)	0.23 (−0.21, 0.68)	−0.02 (−0.51, 0.46)
Italy	0.00 (−0.20, 0.19)	−0.32 (−0.61, −0.02)**	−0.30 (−0.42, −0.17)***	−0.09 (−0.29, 0.11)
Paraguay	0.06 (−0.24, 0.36)	−0.29 (−0.57, −0.00)**	0.39 (0.07, 0.72)**	0.06 (−0.24, 0.36)
Serbia	−0.15 (−0.39, 0.09)	−0.14 (−0.37, 0.10)	−0.72 (−1.30, −0.15)**	−0.18 (−0.49, 0.44)
South Africa	0.21 (0.10, 0.32)***	0.07 (−0.01, 0.16)*	0.09 (0.00, 0.17)**	0.02 (−0.21, 0.25)
Spain	0.28 (0.06, 0.50)**	−0.11 (−0.34, 0.11)	−0.05 (−0.26, 0.16)	−0.05 (−0.20, 0.09)
Turkey	0.46 (−0.08, 0.99)*	−0.25 (−0.64, 0.13)	−0.14 (−0.32, 0.04)	−0.09 (−0.60, 0.42)

***p < .01, **p < .05, *p < .10.

[a] Standardized regression coefficients and 95% confidence intervals for the associations between overall lockdown stringency and relative search volumes for anxiety, depression, mental health and suicide within each country. All regression models adjusted for daily COVID-19 related deaths per 100,000 habitants, the predicted daily relative search volume from the ARIMA model, and the number of weeks since the first stringency measure was adopted in the respective country.

any of the lockdown stringency components were associated with the relative search volume for "Mental Health."

The associations between the overall lockdown stringency in each country and the relative search volumes for the mental health terms in each country can be found in Table 3. We did not identify a consistent pattern of results across the included countries. Hungary was the only country for which there was evidence of a negative association between overall lockdown stringency and the relative search volume for "Anxiety" (standardized beta = −0.42; 95% CI = −0.70, −0.16). Positive associations with the relative search volume for "Anxiety" were found in Spain (standardized beta = 0.28; 95% CI = 0.06, 0.50), South Africa (standardized beta = 0.21; 95% CI = 0.10, 0.32), and India (standardized beta = 0.04; 95% CI = 0.01, 0.07). Overall lockdown stringency was negatively associated with the relative search volume for "Depression" in Italy (standardized beta = −0.32; 95% CI = −0.61, −0.02) and Paraguay (standardized beta = −0.29; 95% CI = −0.57, −0.00). A positive association was found between overall lockdown stringency and the relative search volume for "Suicide" in Paraguay (standardized beta = 0.39; 95% CI = 0.07, 0.72) and South Africa (standardized beta = 0.09; 95% CI = 0.00, 0.17), whereas negative associations emerged in Serbia (standardized beta = −0.72; 95% CI = −1.30, −0.15) and Italy (standardized beta = −0.30; 95% CI = −0.42, −0.17). We found little evidence of an association between overall lockdown stringency and the relative search volume for "Mental Health" in each country.

4. Discussion

Extending previous research, this study examined the associations of lockdown stringency measures and duration with Google searches for key mental health terms (i.e., "Anxiety," "Depression," "Suicide," "Mental Health") in nine countries (i.e., Hungary, India, Iran, Italy, Paraguay, Serbia, South Africa, Spain, Turkey) during the COVID-19 pandemic. Based on data from all countries, our findings suggest that lockdown duration and some lockdown policies were generally associated with significantly lower Google searches for selected mental health terms, with some variation in the direction and magnitude of associations across lockdown components. A similar trend emerged when the associations of overall lockdown stringency with the mental health terms were estimated in each country, with some variation in the direction and magnitude of associations across countries.

Using data from all countries, we found that lockdown duration was associated with lower searches for "Anxiety." Our time-series graphs indicate that searches for "Anxiety" in most countries tended to increase shortly after SARS-CoV-2 became a global public health threat in early 2020, which is consistent with other studies that reported an increase in anxiety symptom-related searches after the onset of the COVID-19 pandemic (Hoerger et al., 2020; Kirsi-Marja Kirsi-Marja Zitting et al., 2021; Lippi et al., 2021). Given that searches for "Anxiety" increased in many of the countries before lockdowns were implemented, it is possible that searches for "Anxiety" during the early part of lockdowns were influenced principally by the severity of the COVID-19 pandemic in each country rather than the lockdowns themselves. This interpretation aligns with the findings of Foa et al. (2020), which suggested that lockdowns can lead to a reduction in negative affect that is masked by the detrimental impact of country-specific pandemic severity on subjective well-being. Over time, Google searches that included the term "Anxiety" may have declined as people adapted psychologically to the COVID-19 pandemic (Shiba et al., 2022).

Our analyses involving all countries also indicated that overall lockdown stringency was negatively associated with searches for "Depression." These findings align with previous research that found a decrease in Google searches for "Depression" in Italy, Spain, USA, United Kingdom, and globally during the COVID-19 pandemic (Knipe et al., 2020). However, this study is among the first to assess whether specific lockdown components are associated with Google searches for mental health terms. In our analyses examining associations between each lockdown component and searches for the mental health terms across all countries, we found that selected lockdown components were negatively associated with searches for at least one mental health term. Specifically, policies that imposed the most stringent stay-at-home requirements were associated with lower searches for "Anxiety," policies that recommended or required public events be canceled were associated with lower searches for "Depression," and lockdown measures that recommended or required workplaces to close as well as those that enforced quarantines on people arriving from high-risk regions or closed borders entirely were associated with lower searches for "Suicide." One potential explanation for this pattern of findings is that Google searches for some mental health terms might have declined after certain lockdown policies were implemented because subjective well-being in the general population increased. For example, Greyling et al. (2021) used Twitter posts to construct a happiness index for South Africa during the COVID-19 pandemic. They found a positive association between stay-at-home requirements and the happiness index, which they suggested might be the result of the policy reducing people's risk of contracting SARS-CoV-2 and the benefits of spending more time in the safety and comfort of one's home. An alternative yet complementary possibility is that people may have rationalized certain mental health symptoms as part of a normal coping response to the general conditions of the COVID-19 pandemic and lockdowns more specifically (Hoerger et al, 2020). If people became less concerned about certain mental health symptoms over time, they may have been less likely to search Google for information about what they were experiencing.

Compared to other lockdown measures, the only lockdown component that evidenced a positive association with any of the mental health

terms was school closures. Specifically, policies that required schools to close were associated with higher searches for "Depression." This finding could be explained by the broad impact that this public health measure had on the daily lives of school-going students, their parents, and their families more generally. On the one hand, school closures restricted students from accessing educational facilities that were a familiar and routine part of their lives, which physically distanced them from educators and peers, shifted their educational experiences from in-person to distance learning, and prevented them from engaging in structured leisure activities (e.g., school-based sports) that are facilitated by educational institutions (McGuine et al., 2022; Poulain et al., 2022; Russell et al., 2020). These kinds of swift and extensive changes may have precipitated emotional problems among school-going children, adolescents, and emerging adults, including depressive symptoms (El-Monshed et al., 2021; Fawaz and Samaha, 2021; Viner et al., 2022). During periods in which schools were closed, students with access to the internet may have conducted searches with the term "Depression" to obtain information about their emotional experiences and explore options for resolving their depressive symptoms. However, it is also possible that parents (or other caregivers) searched Google to gain a better understanding of the adverse emotional experiences their children may have been dealing with or identify ways of addressing the depressive symptoms their children were experiencing. School closures also placed additional strain on parents (and other primary caregivers), many of whom were coping with various other pandemic-related challenges that were unfolding in other areas of life around the same time. For example, some parents who transitioned to remote work during the COVID-19 pandemic were tasked with managing job demands while serving as a key facilitator of their children's distance learning (Antunes et al., 2021). Other parents became unemployed because of the economic fallout of the public health crisis, and they were burdened with finding employment to support their family while ensuring that their children's educational needs were being fulfilled at home (Kalil et al., 2020). These challenges highlight some of the difficulties that parents may have faced when school closures were implemented, which could have contributed to an elevation in depressed mood (SJ Lee et al., 2021). Parents who experienced an increase in depressive symptoms might have responded by searching Google to find information or support.

We found that the associations of overall lockdown stringency with searches for each mental health term tended to vary in direction and magnitude across the countries. These differences could be due to the unique decisions that governments made about which lockdown measures to implement, when they were instituted, and how long they were enforced. For example, some countries (e.g., South Africa) applied a very stringent lockdown at the beginning of the COVID-19 pandemic and relaxed measures over time, whereas other countries (e.g., Iran) implemented lockdown measures in scaling succession. Another potential explanation for between-country differences is that the observed associations (or lack thereof) in certain countries might have been influenced by other government policies that were applied during the COVID-19 pandemic. For instance, in Turkey, where overall lockdown stringency was not associated with searches for any of the mental health terms, the government implemented several policies designed to support economic well-being during the lockdown, such as by providing direct financial support to residents, prohibiting employers from terminating employees, and making funding available for businesses to avoid bankruptcy (Demiralp, 2020). These kinds of contextual factors could explain some of the between-country differences that emerged when the associations of overall lockdown stringency with searches for selected mental health terms were modeled for each country.

Interestingly, there was little evidence of associations between overall lockdown stringency or each of its components with searches for "Mental Health." One possible reason for this consistent pattern of findings is that the term "Mental Health" is less widely used in the general population compared to more specific mental health terms (e.g., anxiety, depression). When searching Google for information about mental health during lockdowns, people may have been more inclined to use common terms that also correspond with specific mental health problems. This theorizing is supported by trends in our time-series graphs. For example, searches for "Mental Health" in most countries did not appear to change substantively after lockdowns were imposed, but search trends for "Anxiety" and/or "Depression" in several countries (e.g., Italy, Spain) changed abruptly after lockdowns began.

4.1. Strengths and limitations

This study used two different sources of information—the Global Panel Database of Pandemic Policies and Google Trends—to provide some insight into how COVID-19 pandemic lockdown conditions in each country might be related to Google searches for key mental health concepts. The diversity of the countries that were included allowed us to explore associations between the stringency of lockdown measures and Google searches for selected mental health terms in various sociocultural contexts. However, there are several limitations of this study that ought to be considered. First, Google Trends does not provide information about the reasons people performed Google searches for the mental health terms that were of interest in this study. For example, people may have been searching for information about their symptoms or seeking guidance on how to support their mental health amid the challenges of the COVID-19 pandemic. Second, we collected data from Google Trends using terms translated to the official and most widely spoken local language of each country. Hence, data corresponding with Google searches that people may have performed in other languages were excluded from this study. Third, overall lockdown stringency values for each country were derived by summing values for the eight lockdown stringency components. As a result, two countries could obtain the same overall lockdown stringency value even if each country differed in the type and severity of the specific lockdown measures that they implemented. Therefore, we do not recommend making any direct comparisons of the findings for associations involving overall lockdown stringency between countries. Fourth, our findings for the associations between lockdown stringency components and searches for mental health terms across all countries may be explained by the policies of one or a small number of countries. For example, the highest level of stay-at-home requirements was only implemented in some countries (i.e., India, Italy, Paraguay, Serbia, Turkey), and therefore the association between the most stringent stay-at-home requirements and "Anxiety" should only be considered for countries that implemented such restrictions. Hence, associations involving specific lockdown stringency components should be interpreted with caution. Fifth, it is not possible to draw inferences about causality from our multivariate analyses because those models estimated the concurrent associations of lockdown stringency and duration with each of the four mental health terms.

5. Conclusion

In summary, this study provides further evidence demonstrating the potential for Google Trends to be leveraged as a data source for understanding how populations in different parts of the world might be affected by public health measures (including lockdowns) that are implemented in response to a global health crisis. Our findings could be used alongside other evidence (e.g., surveillance studies of mental health) to inform the development of lockdown strategies that are sensitive to the mental health needs of people living in different parts of the world during future public health crises. Additional research is needed to build on the findings of this study, such as whether the associations of lockdown measures with searches in Google for mental health terms change according to vaccination rates or the rise of new SARS-CoV-2 variants.

Author statement

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Declaration of competing interest

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Appendix A. Supplementary data

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References

Abbafati, C., Abbas, K.M., Abbasi-Kangevari, M., et al., 2020. Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. The Lancet vol. 396 (10258), 1204–1222. https://doi.org/10.1016/S0140-6736(20)30925-9. Elsevier.

Antunes, A.P., Martins, S., Magalhães, L., et al., 2021. Parenting during the COVID-19 lockdown in Portugal: Changes in Daily Routines, Co-parenting Relationships. In: Emotional Experiences, and Support Networks. Children, vol. 8, p. 1124. https://doi.org/10.3390/children8121124. Multidisciplinary Digital Publishing Institute (MDPI), 12.

Brodeur, A., Clark, A.E., Fleche, S., et al., 2021. COVID-19, lockdowns and well-being: evidence from google trends. J. Pub. Econ. vol. 193, 104346 https://doi.org/10.1016/j.jpubeco.2020.104346. North-Holland.

Counted, V., Pargament, K.I., Bechara, A.O., et al., 2020. Hope and well-being in vulnerable contexts during the COVID-19 pandemic: does religious coping matter? J. Positive Psychol. vol. 17 (1), 70–81. https://doi.org/10.1080/17439760.2020.1832247. Routledge.

Counted, V., Cowden, R.G., Ramkissoon, H., 2021. Place and post-pandemic flourishing: disruption, adjustment, and healthy behaviors. In: SpringerBriefs in Psychology. https://doi.org/10.1007/978-3-030-82580-5. New York: Springer International Publishing.

Cowden, R.G., Davis, E.B., Counted, V., et al., 2021. Suffering, mental health, and psychological well-being during the COVID-19 pandemic: a longitudinal study of U. S. adults with chronic health conditions. In: Wellbeing, Space and Society, vol. 2, 100048. https://doi.org/10.1016/j.wss.2021.100048. Elsevier.

Davis, E.B., McElroy-Heltzel, S.E., Lemke, A.W., et al., 2021. Psychological and spiritual outcomes during the COVID-19 pandemic: a prospective longitudinal study of adults with chronic disease. Health Psychol. vol. 40 (6), 347. https://doi.org/10.1037/HEA0001079. US: American Psychological Association.

De Kock, J.H., Ann Latham, H., Cowden, R.G., et al., 2022. The mental health of NHS staff during the COVID-19 pandemic: two-wave Scottish cohort study. BJ.Psych. Open vol. 8 (1). https://doi.org/10.1192/bjo.2021.1079. Cambridge University Press.

Demiralp, S., 2020. The economic impact of COVID-19 on Turkey | Middle East Institute. Available at: https://www.mei.edu/publications/economic-impact-covid-19-turkey. (Accessed 1 November 2021).

El-Monshed, A.H., El-Adl, A.A., Ali, A.S., et al., 2021. University students under lockdown, the psychosocial effects and coping strategies during COVID-19 pandemic: a cross sectional study in Egypt. In: Journal of American College Health. Taylor & Francis. https://doi.org/10.1080/07448481.2021.1891086.

Fawaz, M., Samaha, A., 2021. E-learning: depression, anxiety, and stress symptomatology among Lebanese university students during COVID-19 quarantine. Nurs. Forum 56 (1). https://doi.org/10.1111/NUF.12521. Nurs Forum: 52–57.

Foa, R., Gilbert, S., Fabian, M.O., 2020. COVID-19 and subjective well-being: separating the effects of lockdowns from the pandemic. In: SSRN Electronic Journal. Elsevier BV. https://doi.org/10.2139/ssrn.3674080.

Google, 2015. Trends help. Available at: https://support.google.com/trends#topic=6248052. (Accessed 11 November 2021).

Govender, K., Cowden, R.G., Nyamaruze, P., et al., 2020. Beyond the disease: contextualized implications of the COVID-19 pandemic for children and young people living in Eastern and Southern Africa. Front. Pub. Health vol. 8, 504. https://doi.org/10.3389/fpubh.2020.00504. Frontiers Media S.A.

Greyling, T., Rossouw, S., Adhikari, T., 2021. The good, the bad and the ugly of lockdowns during Covid-19. PLOS ONE vol. 16 (1), e0245546. https://doi.org/10.1371/JOURNAL.PONE.0245546. Public Library of Science.

Hale, T., Angrist, N., Goldszmidt, R., et al., 2021. A global panel database of pandemic policies (Oxford COVID-19 Government Response Tracker). Nat. Human Behav. vol. 5 (4), 529–538. https://doi.org/10.1038/s41562-021-01079-8. Nature Research.

Hoerger, M., Alonzi, S., Perry, L.M., et al., 2020. Impact of the COVID-19 pandemic on mental health: real-time surveillance using google trends. In: Psychological Trauma: Theory, Research, Practice, and Policy, vol. 12, pp. 1–2. https://doi.org/10.1037/tra0000872. US: Educational Publishing Foundation, 6.

Kalil, A., Mayer, S., Shah, R., 2020. Impact of the COVID-19 crisis on family dynamics in economically vulnerable households. In: SSRN Electronic Journal. Elsevier BV. https://doi.org/10.2139/ssrn.3706339.

Kirsi-Marja Zitting, K.M., Lammers-Van Der Holst, H.M., Yuan, R.K., et al., 2021. Google Trends reveals increases in internet searches for insomnia during the 2019 coronavirus disease (COVID-19) global pandemic. J. Clinical Sleep Med. vol. 17 (2), 177–184. https://doi.org/10.5664/JCSM.8810. American Academy of Sleep Medicine.

Knipe, D., Evans, H., Marchant, A., et al., 2020. Mapping population mental health concerns related to COVID-19 and the consequences of physical distancing: a Google trends analysis. In: Wellcome Open Research, vol. 5, p. 82. https://doi.org/10.12688/wellcomeopenres.15870.2. F1000 Research Limited.

Lee, S.J., Ward, K.P., Chang, O.D., et al., 2021a. Parenting activities and the transition to home-based education during the COVID-19 pandemic. In: Children and Youth Services Review, vol. 122, 105585. https://doi.org/10.1016/j.childyouth.2020.105585. Elsevier.

Lee, Y., Lui, L.M.W., Chen-Li, D., et al., 2021b. Government response moderates the mental health impact of COVID-19: a systematic review and meta-analysis of depression outcomes across countries. In: Journal of Affective Disorders. Elsevier. https://doi.org/10.1016/j.jad.2021.04.050.

Lippi, G., Henry, B.M., Sanchis-Gomar, F., 2021. Putative impact of the COVID-19 pandemic on anxiety, depression, insomnia and stress. Eur. J. Psychiat. vol. 35 (3), 200–201. https://doi.org/10.1016/J.EJPSY.2020.11.006. Elsevier.

McGuine, T.A., Biese K, M., Hetzel, S.J., et al., 2022. High school sports during the COVID-19 pandemic: the effect of sport participation on the health of adolescents. J. Athlet. Train. vol. 57 (1), 51–58. https://doi.org/10.4085/1062-6050-0121.21. Allen Press.

Poulain, T., Meigen, C., Kiess, W., Vogel, M., 2022. Wellbeing, coping with homeschooling, and leisure behavior at different COVID-19-related lockdowns: A longitudinal study in 9- to 16-year-old German children. JCPP Adv. 2 (1), e12062 https://doi.org/10.1002/jcv2.12062.

Russell, B.S., Hutchison, M., Tambling, R., et al., 2020. Initial challenges of caregiving during COVID-19: caregiver burden, mental health, and the parent–child relationship. Child Psychiat. Human Develop. vol. 51 (5), 671–682. https://doi.org/10.1007/s10578-020-01037-x. Springer.

Shiba, K., Cowden, R.G., Counted, V., et al., 2022. Associations of Home Confinement during COVID-19 Lockdown with Subsequent Health and Well-Being Among UK Adults. Human Flourishing Program, Harvard University *[Manuscript submitted for publication]*.

Vargo, D., Zhu, L., Benwell, B., et al., 2021. Digital technology use during COVID-19 pandemic: a rapid review. Human Behav. Emerging Technol. vol. 3 (1), 13–24. https://doi.org/10.1002/HBE2.242. John Wiley & Sons, Ltd.

Viner, R., Russell, S., Saulle, R., et al., 2022. School Closures during Social Lockdown and Mental Health, Health Behaviors, and Well-Being Among Children and Adolescents during the First COVID-19 Wave: a Systematic Review. JAMA Pediatrics. American Medical Association. https://doi.org/10.1001/jamapediatrics.2021.5840.