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Policy stringency and mental health during the COVID-19 pandemic: a longitudinal analysis of data from 15 countries

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Summary

Background To date, public health policies implemented during the COVID-19 pandemic have been evaluated on the basis of their ability to reduce transmission and minimise economic harm. We aimed to assess the association between COVID-19 policy restrictions and mental health during the COVID-19 pandemic.

Methods In this longitudinal analysis, we combined daily policy stringency data from the Oxford COVID-19 Government Response Tracker with psychological distress scores and life evaluations captured in the Imperial College London-YouGov COVID-19 Behaviour Tracker Global Survey in fortnightly cross-sections from samples of 15 countries between April 27, 2020, and June 28, 2021. The mental health questions provided a sample size of 432 642 valid responses, with an average of 14 918 responses every 2 weeks. To investigate how policy stringency was associated with mental health, we considered two potential mediators: observed physical distancing and perceptions of the government's handling of the pandemic. Countries were grouped on the basis of their response to the COVID-19 pandemic as those pursuing an elimination strategy (countries that aimed to eliminate community transmission of SARS-CoV-2 within their borders) or those pursuing a mitigation strategy (countries that aimed to control SARS-CoV-2 transmission). Using a combined dataset of country-level and individual-level data, we estimated linear regression models with country-fixed effects (ie, dummy variables representing the countries in our sample) and with individual and contextual covariates. Additionally, we analysed data from a sample of Nordic countries, to compare Sweden (that pursued a mitigation strategy) to other Nordic countries (that adopted a near-elimination strategy).

Findings Controlling for individual and contextual variables, higher policy stringency was associated with higher mean psychological distress scores and lower life evaluations (standardised coefficients $\beta=0\cdot014$ [95% CI $0\cdot005$ to $0\cdot023$] for psychological distress; $\beta=-0\cdot010$ [$-0\cdot015$ to $-0\cdot004$] for life evaluation). Pandemic intensity (number of deaths per 100 000 inhabitants) was also associated with higher mean psychological distress scores and lower life evaluations (standardised coefficients $\beta=0\cdot016$ [$0\cdot008$ to $0\cdot025$] for psychological distress; $\beta=-0\cdot010$ [$-0\cdot017$ to $-0\cdot004$] for life evaluation). The negative association between policy stringency and mental health was mediated by observed physical distancing and perceptions of the government's handling of the pandemic. We observed that countries pursuing an elimination strategy used different policy timings and intensities compared with countries pursuing a mitigation strategy. The containment policies of countries pursuing elimination strategies were on average less stringent, and fewer deaths were observed.

Interpretation Changes in mental health measures during the first 15 months of the COVID-19 pandemic were small. More stringent COVID-19 policies were associated with poorer mental health. Elimination strategies minimised transmission and deaths, while restricting mental health effects.

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Introduction

There has been substantial variation in how governments and communities around the world have responded to the COVID-19 pandemic. The broad range of policy responses observed has received substantial attention. To date, strategies have been primarily evaluated on the basis of their ability to reduce infection rates and minimise economic loss.[1] However, the association between governmental COVID-19 restrictions and short-term mental health of populations remains unclear.

One hypothesis is that stricter COVID-19 policy restrictions might be associated with poorer mental health, at least in part because numerous policies have mandated lockdowns and physical distancing, which can impede social connection. Stay at home requirements, school and workplace closures, and bans on social gatherings preclude meaningful opportunities for social contact. Previous studies underscore the importance of social connection for mental health,[2–4] suggesting that policies that restrict social contact might be associated with poor mental health.

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Research in context

Evidence before this study

We searched PubMed for articles published in English between Jan 1, 2020, and Jan 19, 2022, using the search terms "COVID" or "coronavirus" and "policy" and "mental health" or "psychological distress" or "life satisfaction". Our search identified 2120 articles, of which 56 assessed the association between COVID-19 governmental policies and mental health. Previous studies were limited by the use of small subsets of countries, population subgroups, restricted time frames, and insufficient controls (eg, deaths and vaccination rates), raising questions about their generalisability. Few studies examined potential mediators of stringency effects on mental health. Thus, we aimed to investigate how policy stringency was associated with mental health during the first 15 months of the COVID-19 pandemic.

Added value of this study

This study shows that stricter COVID-19 policies and pandemic intensity (ie, number of daily cases or deaths) were associated with worse mental health between April, 2020 and June, 2021. The negative association between policy stringency and mental health was small and mediated by following physical distancing guidelines and perceptions about the handling of the pandemic by governments. We also compared countries that aimed to eliminate community transmission of COVID-19 within their borders (elimination strategy) with countries that aimed to control rather than eliminate the virus (mitigation strategy). Fewer deaths were recorded in countries that pursued an elimination strategy than in countries that pursued a mitigation strategy, with more precisely targeted, and on average, less stringent policies. Equivalent or better mental health trajectories were observed in countries that pursued elimination strategies than countries that pursued mitigation strategies.

Implications of all the available evidence

Our findings align with existing research documenting a small and negative association between COVID-19 policy stringency and mental health. However, because greater policy stringency was associated with fewer COVID-19 cases and deaths, especially when enacted early and in addition to widespread testing and contract tracing, in countries where the aim was to eliminate rather than mitigate COVID-19, fewer deaths were reported with comparable stringency, without increasing mental health costs.

Data from European studies suggest that wellbeing declined during COVID-19 restrictions.[5–7] However, not all analyses controlled for important confounders such as local infection and mortality rates. Inclusion of such factors is crucial because people are more likely to physically distance themselves in response to their own assessment of risk of exposure to the virus. Therefore, the marginal effect of government policies on mental health might be overestimated when such factors are not considered. Furthermore, few analyses have investigated the pathways through which policy stringency might be associated with poorer mental health, such as reduced social contact and other changes to daily life due to physical distancing requirements.

Another hypothesis is that more stringent policies might be associated with better mental health because tighter restrictions ease concerns about contracting the virus, and indicate that governments are engaged. Higher stringency could bolster support for national leadership because people might perceive that leaders are cognisant of a threat, and ready and capable of a response.[8,9] COVID-19 restrictions could therefore reduce psychological distress and improve life satisfaction if people feel that measures will protect them.[9] Consistent with these hypotheses, some studies indicate that stricter COVID-19 restrictions might be associated with improved mental health, and that this association might be due, in part, to evaluations of how governments are managing the threat of the pandemic.[10,11]

Considering competing hypotheses and existing data, we aimed to assess how variation in COVID-19 policy restrictions has been associated with several key facets of mental health, including anxiety, depression,[12] and wellbeing,[13,14] during the pandemic. Additionally, we grouped countries on the basis of their general approach to the pandemic to compare differences between these groups with regard to number of deaths, COVID-19 cases, and mental health trends during the first 15 months of the pandemic.

Methods

Data sources and participants

In this longitudinal analysis, we used data on two separate measures of mental health obtained from the Imperial College London-YouGov COVID-19 Behaviour Tracker Global Survey and data on government response stringency during the pandemic obtained from the Oxford COVID-19 Government Response Tracker (OxCGRT).[15] The Imperial College London-YouGov COVID-19 Behaviour Tracker Global Survey has captured data from cross-sectional, nationally representative samples from April 1, 2020 onwards. For 15 countries, data collection continued in 2021, reaching around 15 000 adults (aged ≥18 years) every 2 weeks, with approximately 474 000 respondents up to June 28, 2021. Invitations to participate are sent every 2 weeks to a randomly selected and stratified sample of YouGov online research panel participants to ensure that respondents are nationally representative of age, sex,

For the **Imperial College London-YouGov COVID-19 Behaviour Tracker Global Survey** see https://www.imperial.ac.uk/centre-for-health-policy/our-work/our-response-to-covid-19/covid-19-behaviour-tracker/

and subnational regions for each country. Post-stratification weights are provided by YouGov with the database to correct for small deviations from the sampling plan. We used data collected between April 27, 2020 (when the mental health questions were added to the survey) and June 28, 2021, except when otherwise noted: Australia, Canada, Denmark, Finland (data analysed until late January, 2021), France, Germany, Italy, Japan, the Netherlands (data analysed until early February, 2021), Norway, Singapore, South Korea, Spain, Sweden, and the UK. The mental health questions provided a sample size of 432 642 valid responses, with an average of 14 918 responses every 2 weeks. We stopped pooling the data in June 28, 2021, when the majority of individuals in our sample were not fully vaccinated and vaccination passports had rarely been implemented.

The OxCGRT is a database that provides an objective measure of the degree and reach of 24 specific COVID-19 policy indicators. We used daily OxCGRT data from the same 15 countries for which we obtained mental health data.

The Imperial College London-YouGov COVID-19 Behaviour Tracker Global Survey was approved by the ethical review boards of Imperial College London (ICREC 20IC6020) and Columbia University (IRB-AAAT2959) and all respondents completed written informed consent documents online. Since all data used were publicly available, previously collected, and not traceable to individuals, the Central University Research Ethics Committee of the University of Oxford deemed this study exempt from ethical review.

Procedures

The first mental health measure used was the four-item Patient Health Questionnaire (PHQ-4),[12] which captures psychological distress. The PHQ-4 includes two items that measure depression used in the PHQ-8 and two items that measure anxiety used in the 7-item Generalised Anxiety Disorder (GAD-7) scale. Each item is rated on a 4-point Likert scale, ranging from 0 (not at all) to 3 (nearly every day); we used the average of the four items, rescaled to the 1–4 range. The second mental health measure was life evaluation (a key component of wellbeing)[13] measured using the Cantril Ladder question.[14] The question asks participants to evaluate their current life as a whole on an imaginary ladder with ten steps. At the bottom of the ladder is step 0, which represents the worst possible life, and at the top is step 10, which represents the best possible life.

We used an adjusted version of the Stringency Index created by OxCGRT as our key objective measure of government response stringency during the pandemic, considering eight containment policies (school closures, workplace closures, cancellation of public events, restrictions on gatherings, public transportation closures, stay at home requirements, restrictions to domestic travel, and international travel restrictions), rescaled to the 0–1 range (appendix p 4).

See Online for appendix

Furthermore, we investigated a possible cumulative effect of COVID-19 policy stringency by considering the total number of days populations were under high stringency policies, restarting the count after policy stringency was reduced (ie, consecutive days). We also evaluated a potential recovery effect by including the number of days during which stringency was reduced to lower levels since the beginning of the pandemic (also considering consecutive days).

On the basis of previous research,[16,17] we defined countries pursuing an elimination strategy as countries that adopted national policies that aimed to eradicate community transmission of SARS-CoV-2 within their borders. For our analyses, inclusion of countries in the WHO Western Pacific Region was used as a prepandemic proxy measure of policy strategy. Outbreaks of severe acute respiratory syndrome have been observed in these countries in the past 20 years, thus it is reasonable to expect that such countries were more prepared for outbreaks and were more likely to pursue elimination strategies in response to the COVID-19 pandemic. Four members of the WHO Western Pacific Region were included in our sample: Australia, Japan, Singapore, and South Korea. All other countries were classified as those pursuing a mitigation strategy, meaning that they aimed to mitigate the effects of SARS-CoV-2 rather than eliminate community transmission. However, countries labelled as pursuing an elimination strategy or mitigation strategy on the basis of WHO Western Pacific Region membership differed with regard to various characteristics in addition to COVID-19 responses, introducing potential confounders. To address this concern, we considered an additional definition of countries that adopted a mitigation strategy and countries pursuing a near-elimination strategy on the basis of COVID-19 pandemic response among a more homogeneous group of countries included in our sample (Sweden, Denmark, Finland, and Norway; referred to as the Nordic sample hereafter). Since the onset of the pandemic, Sweden pursued a mitigation strategy[18] in contrast to strategies adopted in Denmark, Finland, and Norway, where near elimination approaches were adopted (appendix pp 10–12). This grouping of Nordic countries allowed comparison of different pandemic strategies across nations with similar demographic, institutional, and health-care characteristics.

To assess the association between policy stringency and mental health, we controlled for a number of variables that were likely to be associated with our predictor and outcome variables. These variables were pandemic intensity, vaccination rates, individual cross-sectional controls, and a linear time trend. We used two measures of national pandemic intensity: a 7-day moving average of the number of deaths per 100 000 population and a

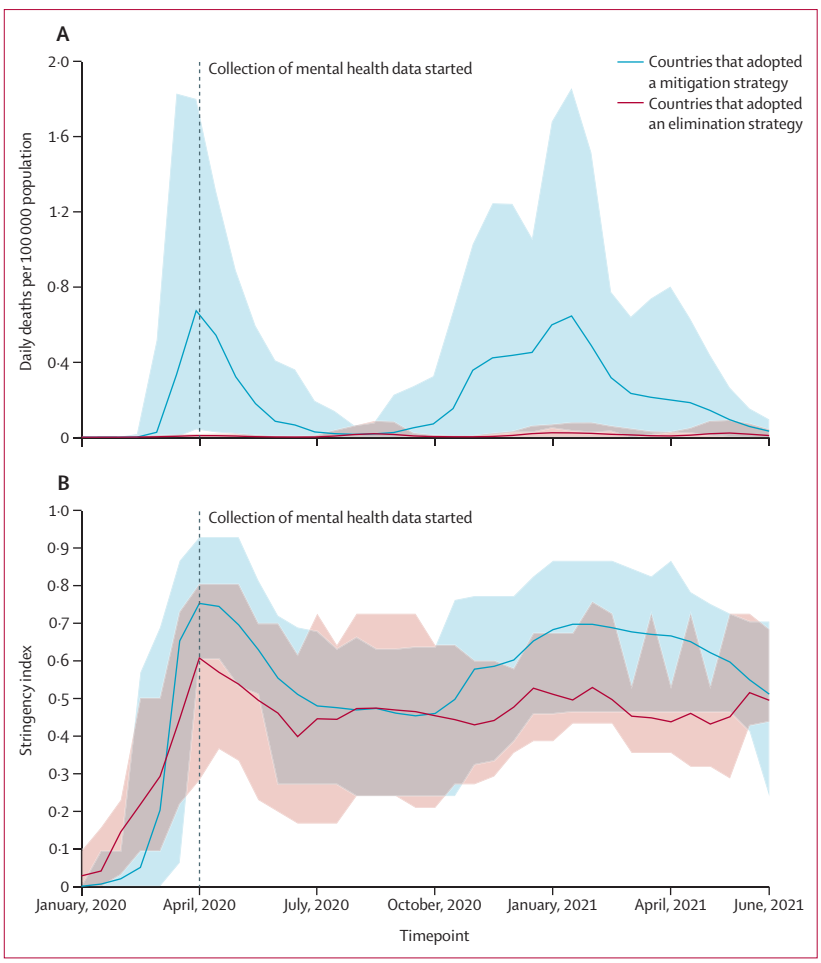

Figure 1: **Comparison of pandemic intensity (A) and policy stringency (B) between April 27, 2020, and June 28, 2021, in 15 countries adopting mitigation and elimination strategies**

Data for 11 countries that followed a mitigation strategy and four countries that followed an elimination strategy. Lines represent mean 2-weekly values averaged over all countries in each strategy grouping. Shaded areas represent the range between minimum and maximum daily country means. Pandemic intensity was measured by by the number of daily deaths per 100 000 population.

7-day moving average of the number of cases per 100 000 population. We controlled for national vaccination rates as measured by the proportion of the population vaccinated with at least one dose of a COVID-19 vaccine.[19] To reduce error variance in all models and confounding in the mediation models, we included demographic controls likely to be associated with mental health: age, sex, working status, number of people in the household, having children in the household, and self-reported chronic illness or mental health conditions. We explored two potential pathways through which COVID-19 policies might be associated with mental health: adherence to physical distancing and evaluations of government performance in handling the COVID-19 pandemic. In each survey, respondents were asked seven questions about the extent to which they had maintained physical distance from others due to COVID-19 (appendix p 4). Respondents were also asked to rate how the government had been handling the pandemic on a 4-point scale ranging from 1 (very badly) to 4 (very well).

Statistical analysis

We focused on how changes in policy stringency were associated with two facets of mental health (psychological distress and life evaluations) over a 15-month period. This approach offers a nuanced investigation of how generally small and stepwise changes in COVID-19 policy are associated with mental health within countries over many months. We did not adopt an analytical strategy aiming to assess mental health changes after a single major policy event, such as the sudden lockdowns early in the pandemic, where associations would typically be evaluated by an interrupted time-series design.[20] This would not be informative for the 15 countries in our sample, since collection of mental health data began after containment policies had started to evolve gradually and COVID-19 had already caused substantial damage to public health. Although large cumulative changes in within-country stringency were observed in the 15-month period, stringency typically evolved in small increments across fortnights. To assess these associations, we merged two sources of data: (1) country-level data containing daily values on policy stringency, COVID-19 cases, deaths, and vaccination rates, and (2) survey data from all 2-weekly surveys (pooled cross-sections), with individual survey responses identified by date of response and country. Using the single combined dataset, we estimated linear regression models with country-fixed effects (ie, dummy variables representing the countries in our sample). These fixed-effects controlled for all variance between countries, allowing us to estimate changes over time within the same country. Central to our analysis, within-country variability over time was evaluated with time-varying covariates, such as the stringency index and pandemic intensity. Cross-sectional variability among individuals in the same country was partly captured by individual-level controls. To account for the dependency across individual observations in the same country and over time, we clustered SEs at the country level. We evaluated unstandardised regression coefficients (β) in all models and standardised coefficients only for some illustrative results.

For life evaluations, we also used pre-pandemic (2019) data from the World Happiness Report[21] and compared the mean difference between countries adopting mitigation and elimination strategies in 2019 ($M_{elim-mit2019}$) and in the first 15 months of the pandemic ($M_{elim-mitAfter2019}$), using a 2 (time: 2019 *vs* first 15 months of the pandemic) ×2 (strategy: elimination *vs* mitigation) ANOVA to determine the significance of the interaction term.

To assess the robustness of the findings, we included both cases and deaths per 100 000 population as covariates in the same model; winsorised (ie, replacing extreme values by the 99th percentile of the variable

distribution) cases and deaths per 100 000 population to account for potential outliers; used different imputation methods for missing variables, specifically multiple imputation and a sensitivity analysis with alternative imputation schemes; used models with post-stratification survey weights; did tests of linearity in the stringency coefficients against quadratic and piecewise nonlinear forms; used fortnight fixed-effects rather than the linear trend to capture more precisely global events that might be linked to mental health; and used pseudo-panels rather than the pooled cross-sections dataset (appendix pp 4–6).

We compared policy stringency and pandemic intensity across mitigator and eliminator groupings (and across Nordic mitigator and near-eliminator groupings) using linear regression models with dummy variables representing country groupings. Potential heterogeneous associations across country groupings were evaluated in models including interaction terms between the predictor of interest and a dummy variable indicating the country grouping. The comparison of four Nordic countries can be considered as a quasi-natural experiment,[6] with Denmark, Finland, and Norway providing a well matched set of controls against which to evaluate the consequences of the Swedish mitigation policy experiment.

The study was reported in accordance with the STROBE guidelines (appendix pp 7–9). Data analysis and management were conducted in Stata (version 17.0).

Role of the funding source

There was no funding source for this study.

Results

Differences in COVID-19 containment strategies, timing of policy adoption, and mortality rates were observed between countries that pursued a mitigation strategy and an elimination strategy (figure 1). Because early and targeted action resulted in lower levels of virus circulation, average policy stringency was lower in countries that pursued elimination strategies than countries that pursued mitigation strategies in the 15-country sample (β=–0·112 [95% CI –0·223 to –0·001]) and the Nordic countries subset (β=–0·113 [–0·222 to –0·004]; appendix p 10). Countries pursuing an elimination strategy also had fewer daily deaths (per 100 000 population) in the 15-country sample (β=–0·202 [–0·284 to –0·119]; appendix p 14) and the Nordic subset (β=-–0·231 [–0·287 to –0·175]). Thus, the COVID-19 policies implemented by countries pursuing an elimination strategy and near-elimination strategy, particularly higher levels of contact tracing (figure 2; appendix p 11), might have allowed these countries to avoid a trade-off between policy stringency and COVID-19 deaths.

Figure 3 shows that mean psychological distress and life evaluations were relatively stable among countries

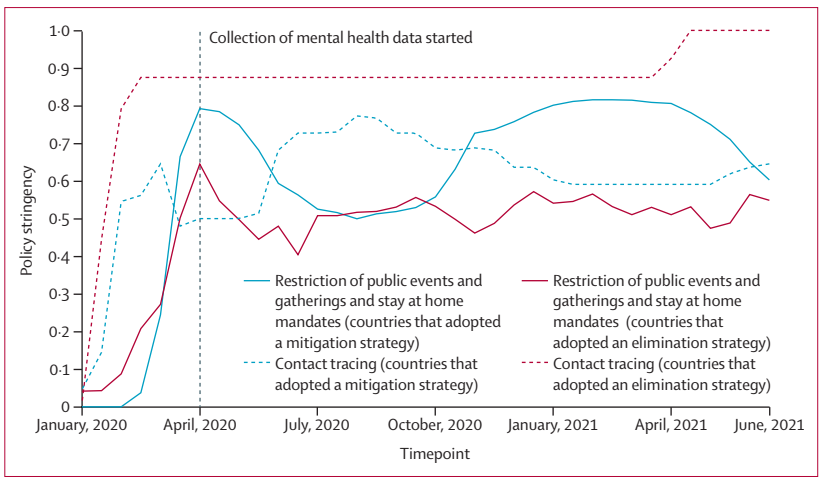

Figure 2: **Policy strength of selected policy indices in countries adopting mitigation and elimination strategies between April 27, 2020, and June 28, 2021**

Data for 11 countries that followed a mitigation strategy and four countries that followed an elimination strategy. Lines represent mean fortnightly values averaged over all countries in each strategy grouping.

that pursued mitigation and elimination strategies (appendix p 13). This stability contrasted with the variation observed in daily deaths (pandemic intensity) and policy stringency (appendix p 10).

When considering unadjusted mean mental health measures, psychological distress increased over time in countries that followed a mitigation strategy, and decreased over time in countries that followed an elimination strategy. Similarly, life evaluations deteriorated over time in countries that followed a mitigation strategy, but this decrease was not significant among countries pursuing an elimination strategy (appendix pp 17–18). In Nordic countries, life evaluations remained stable in countries that adopted a near-elimination strategy over time, whereas a significant decrease in life evaluations was observed in countries that followed a mitigation strategy (appendix pp 17–18). Thus, although a difference in mean life evaluations[21] was observed in 2019 between countries that followed a mitigation strategy and countries that followed an elimination strategy ($M_{elim\text{-}mit2019}$=–0·79, Cohen's *d*=0·38), this difference decreased during the first 15 months of the pandemic ($M_{elim\text{-}mitAfter2019}$=–0·49, Cohen's *d*=0·24, p<0·0001) among the 15-country sample (figure 3) and remained stable for the Nordic country subset ($M_{nearelim\text{-}mit2019}$=0·24, d=0·13, $M_{nearelim\text{-}mitAfter2019}$=0·25, d=0·12, p=0·8768; appendix p 13).

Controlling for demographic and contextual covariates and country-fixed effects, but not any measure of pandemic intensity, the association between policy stringency and psychological distress was positive and significant (β=0·142 [95% CI 0·091 to 0·193]; model 1), indicating that a shift in containment policies from 0·17 (minimum stringency observed) to 0·93 (maximum stringency observed) was associated with a 0·11-unit increase in distress (table). Models 2 and 3 showed a

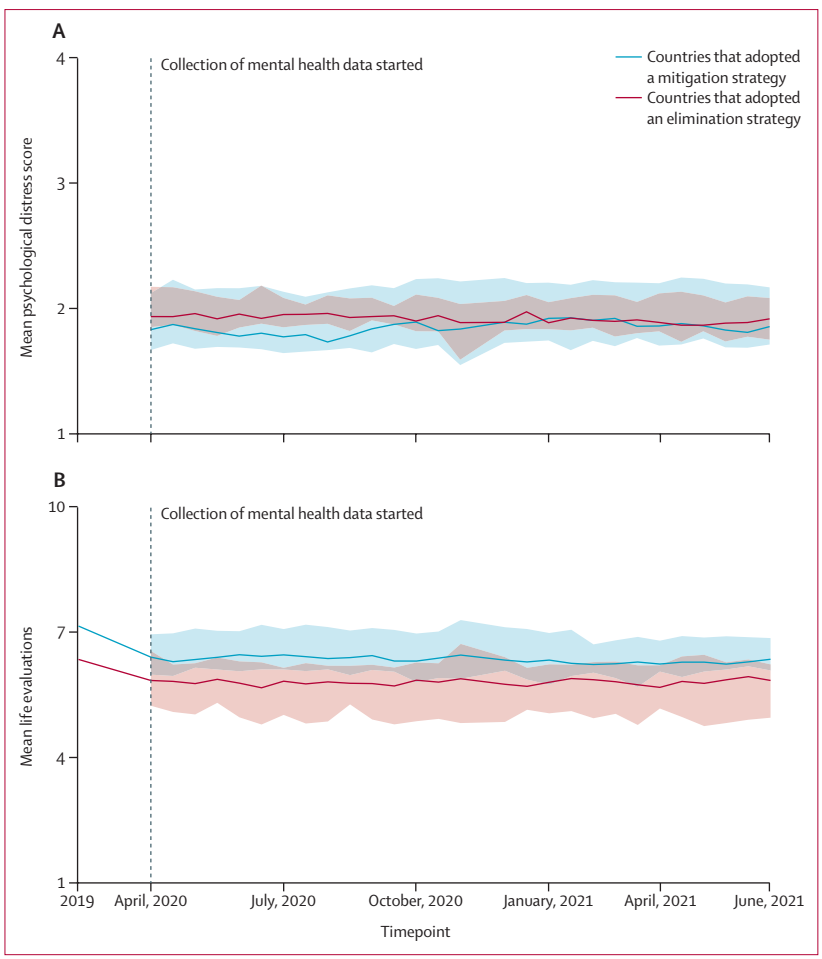

Figure 3: **Psychological distress (A) and life evaluations (B) reported in countries adopting mitigation and elimination strategies between April 27, 2020, and June 28, 2021**

Data for 11 countries that followed a mitigation strategy and four countries that followed an elimination strategy. Lines represent mean fortnightly values averaged over all countries in each strategy grouping. Shaded areas around the lines represent the range between minimum and maximum observed country means. Pre-pandemic (2019) country mean of life evaluations were retrieved from the World Happiness Report.[21]

negative association between mental health and the moving average of daily deaths and daily cases per 100 000 inhabitants. This finding indicates that people reported higher levels of psychological distress when pandemic intensity was higher. The coefficient for the stringency index, which decreased when pandemic intensity was added as a control, remained positive and significant when controlling for daily deaths (β=0·088 [0·024 to 0·151]) or cases per 100 000 population (β=0·110 [0·064 to 0·155]). The association between policy stringency and psychological distress did not differ significantly between countries that followed a mitigation strategy and those that followed an elimination strategy, nor between countries that followed a mitigation strategy or near-elimination strategy within the Nordic subset (appendix pp 22–23).

Similar results were observed for life evaluations (Cantril Ladder question). In model 4 (pandemic intensity not included as a covariate), a negative association was observed between policy stringency and life evaluations (β=–0·222 [95% CI –0·312 to –0·131]; table), indicating that more severe containment policies were associated with lower life evaluations. This association remained significant after including the moving average of daily deaths (β=–0·136 [–0·214 to –0·058]) and cases per 100 000 population (β=–0·161 [–0·235 to –0·087]; table). A regression analysis including an interaction between stringency and eliminator status showed that the association between policy stringency and life evaluations was weaker for countries that adopted an elimination strategy, although this interaction was significant in only some model specifications (appendix pp 22–23).

Standardised coefficients are shown in figure 4. The standardised association between policy stringency and psychological distress was small in substantive terms (β=0·014 [95% CI 0·005 to 0·023]) and similar in magnitude to the contemporaneous association between psychological distress and pandemic intensity (ie, daily deaths per 100 000 population; β=0·016 [0·008 to 0·025]). Similarly, the standardised association between policy stringency and life evaluations was also small (β=–0·010 [–0·015 to –0·004]) and similar to the coefficient of daily deaths per 100 000 population (β=–0·010 [–0·017 to –0·004]).

Findings from the quasi-natural experiment considering only the Nordic subsample were similar to those for the 15-country sample (appendix p 24). We also explored the association between individual policies and mental health. In a model controlling for pandemic intensity, restrictions on gatherings, stay at home requirements, and international travel restrictions were associated with greater psychological distress and lower life evaluations, whereas the remaining policies (ie, school, workplace, and public transport closures, cancellation of public events, and restrictions to domestic travel) were not (appendix pp 25–27).

No significant association was identified between mental health and the number of consecutive accumulated days under high or low policy stringency, controlling for current containment policies (appendix p 28), suggesting a contemporaneous effect of such policies rather than a cumulative one. Additionally, we investigated whether the association between policy stringency and mental health varied across different demographic subgroups. The association between stringency and psychological distress was stronger for women than for men. For life evaluations, a more nuanced pattern emerged, in which the association with stringency was conditional on age for women but not for men. Specifically, the negative association between stringency and life evaluation was more marked for women older than 60 years and women aged 30–60 years, than for younger women (appendix pp 29–32).

	Psychological distress*			Life evaluations		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	Coefficient (95% CI); p value	Coefficient (95% CI); p value	Coefficient (95% CI); p value	Coefficient (95% CI); p value	Coefficient (95% CI); p value	Coefficient (95% CI); p value
Containment policies						
Stringency index†	0·142 (0·091 to 0·193); 0·0001	0·088 (0·024 to 0·151); 0·0107	0·110 (0·064 to 0·155); 0·0002	–0·222 (–0·312 to –0·131); 0·0001	–0·136 (–0·214 to –0·058); 0·0022	–0·161 (–0·235 to –0·087); 0·0004
Pandemic intensity						
Daily COVID–19 deaths per 100 000 population	··	0·047 (0·022 to 0·071); 0·0014	··	··	–0·073 (–0·119 to –0·028); 0·0041	··
Daily COVID–19 cases per 100 000 population	··	··	0·001 (0·001 to 0·001); 0·0002	··	··	–0·002 (–0·003 to –0·001); 0·0004
Model specifications						
Model fit (R^2)‡	0·1551	0·1552	0·1553	0·1416	0·1416	0·1417
Sample size, n	432 642	432 642	432 642	432 642	432 642	432 642

Coefficients were estimated using linear regression models in a combined dataset with country-level variables and survey responses from all fortnightly survey waves (pooled cross-sections). All models had intercepts and included as covariates: individual controls (age, sex, working status, number of people in the household, having children in the household, and self-reported chronic illness or mental health conditions), contextual controls (proportion of the population vaccinated against COVID-19), a linear time term, and country-fixed effects (ie, dummy variables representing countries). Models 2 and 5 included daily COVID-19 deaths per 100 000 population and models 3 and 6 included daily COVID-19 cases per 100 000 population. The estimates for coefficients of all covariates are included in the appendix (p 20). *Rescaled to the 1–4 range. †Rescaled to the 0–1 range. ‡R^2 represents the proportion of total variability of the dependent variable explained by the model and was calculated using simple instead of multiple imputations; changes in R^2 values from model 1 to 2 and 3 and model 4 to 5 and 6 were smaller than 0·001 due to the large within-country cross-sectional variance (not explained by pandemic intensity or stringency) compared with variance over time; the pseudo-panel models (appendix p 35) indicate that the time-varying covariates used explain 0·7–1·7% of variability over time.

Table: **Associations between psychological distress, life evaluations, and policy stringency**

The statistical significance of the main findings remained unchanged with robustness checks (appendix pp 33–40).

The negative association between policy stringency and mental health could be partly due to two potential mediators: self-reported physical distancing and evaluations of how well the government is handling the pandemic. Specifically, higher policy stringency was associated with greater physical distancing (β=1·848 [95% CI 1·566 to 2·130]) and lower government evaluations (β=–0·291 [–0·531 to –0·052]). Higher stringency was indirectly associated with higher psychological distress scores and lower life evaluations through physical distancing (indirect association 0·122 [95% CI 0·089 to 0·161] for psychological distress; –0·111 [–0·165 to –0·059] for life evaluations) and through government evaluations (indirect association 0·033 [0·011 to 0·057] for psychological distress; –0·104 [–0·180 to –0·033] for life evaluations). Indirect associations and related robustness checks are detailed in the appendix (pp 41–66).

Stringency might also be indirectly associated with future mental health by reducing future deaths (figure 4; appendix pp 67–70). For both psychological distress and life evaluations, the negative association between policy stringency and future mental health became smaller with time because greater stringency reduced deaths. The effects of stringency on reduced deaths (as estimated by Hale and colleagues[22]) were much larger than those observed for mental health (figure 4).

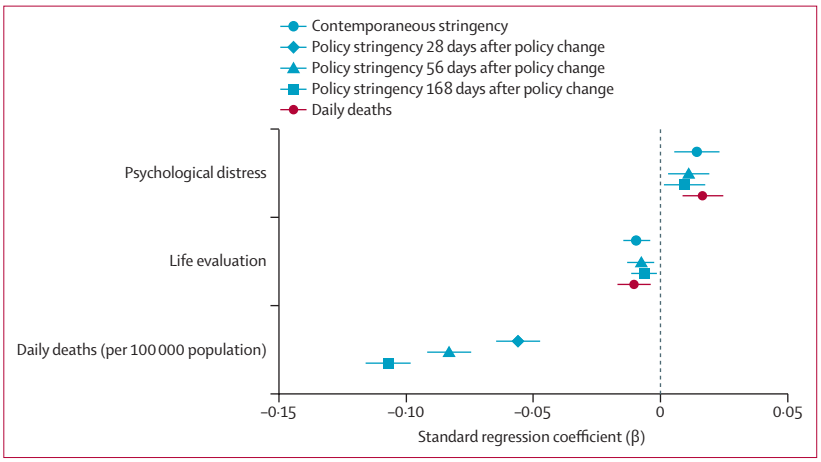

Figure 4: **Standardised associations between policy stringency and mental health scores**
Estimates of the effects of stringency on the logarithm of daily deaths are based on Hale et al.[22] Estimates of associations of policy stringency on mental health 56 and 168 days after policy change are based on a combination of estimates from Hale et al[22] and our own estimates (appendix pp 67–70). The indirect association was larger when daily deaths rates were higher and the potential for future reductions in mortality was larger. For a representative example of the magnitude of the indirect associations, we considered a scenario with daily deaths at the average of peaks for countries that adopted a mitigation strategy in our sample (0·868 daily deaths per 100 000 population) at the time of stringency change. Standard errors for non-contemporaneous associations scenarios were derived from contemporaneous effects. Horizontal lines show 95% CIs.

Discussion

Our findings indicate that greater policy stringency and pandemic intensity are both associated with worse mental health and to a similar degree. Most findings were robust for different subgroups of countries and

model specifications. Countries following an elimination strategy achieved lower pandemic intensity without the need for higher policy stringency as a result of faster and more widespread testing and contact tracing.

We also found evidence consistent with two mediating pathways. First, stringency was positively correlated with physical distancing, which, in turn, was associated with worse mental health. Second, stronger policy responses were associated with poor evaluations of the government's handling of the pandemic and, in turn, with worse mental health.

Findings for the within-country changes in policies were statistically robust but small in magnitude, consistent with previous research.[23] During the study period, moving from the minimum to maximum observed stringency was associated with a 0·07 reduction in life satisfaction, which is less than a fifth as large as the effect of unemployment.[16] Furthermore, extending the length of stringent policy periods does not seem to be associated with worse mental health beyond the initial association, but is associated with a continual decrease in deaths. If stringent policies are completely effective at reducing deaths and, as we have shown, if the mental health correlates of pandemic intensity are similar or larger in magnitude than those of stringency, then stringency should recoup its negative association with mental health by reducing mortality caused by the pandemic. However, because policies are unevenly designed and accepted, heightened stringency is likely to produce outcomes that differ by country. Our estimates of this dynamic association suggest the effect of policy stringency on mortality might help offset the detrimental contemporaneous effect of stringency on future psychological distress and life evaluations. However, more research is needed on these dynamics.

Comparisons between countries with elimination versus mitigation strategies showed that a trade-off between mental health and saving lives is not necessary. Mental health is negatively associated with both pandemic intensity and the level of policy stringency, thus mental health might be supported by COVID-19 management strategies that minimise deaths and illness without increasing average policy stringency.[1] Notably, the findings remained unchanged in different country groupings.[16,17] Countries that pursued an elimination strategy (identified by WHO Western Pacific Region membership) might have had better COVID-19 outcomes than countries that followed a mitigation strategy due to other differences beyond their COVID-19 policy strategies, therefore, we compared Sweden with the other Nordic countries in our sample, allowing us to examine whether the findings were consistent among countries with many similarities, such as demographic, institutional, and health-care characteristics, but different COVID-19 strategies. Findings from the Nordic subset were consistent with those for the larger dataset.

Our study has some limitations. Observed cross-sectional data and mental health data were not available before April, 2020, when the pandemic began. As such, we could not explore how mental health changed during early implementation of COVID-19 policies. More broadly, our findings are limited to the specific time, policies, sample of countries, and nature of the pandemic studied. We decided not to analyse data after the majority of the populations studied had been vaccinated or after the emergence of variants that have since affected many countries. We thus cannot account for the consequences of subsequent changes in the virus, which themselves were enabled by widespread community transmission.

There are uncertainties about the representativeness of surveys completed during COVID-19. Although samples were recruited and stratified to reflect the broader national population with regard to a number of key characteristics (eg, age, sex), respondents were those who were able and willing to report on their perceptions and experiences of COVID-19. Considering that people who had severe illness and individuals in vulnerable or marginalised communities were not able to respond, our data might be skewed towards individuals with better mental health and therefore present an inflated estimate of mental health. Alternatively, individuals who were most worried about the pandemic might be more likely to respond to a relevant survey, providing a possible bias in the other direction.

Other limitations of our analysis warrant consideration. First, the mental health measures used might not capture momentary emotional reactions. We used a short version of the PHQ-4 scale which, although validated, reliable, and widely used, has lower specificity and sensitivity than the full version.[24] Similarly, questions capturing the extent to which people observed government-issued physical distancing guidelines might have provided an imprecise proxy for strained social connections. People might have found creative channels to remain connected with others during the pandemic that did not include behaviours discouraged by government restrictions (eg, physically distanced walks or online social events held using videoconferencing software). Although the stringency index captures the most common containment policies expected to affect mental health, some country-specific measures might have been overlooked. Additionally, death counts and cases are likely to be underestimated, and possibly to different degrees, across countries.

Although associations do not prove causation, our findings are consistent with the idea that greater policy stringency could lead to poorer mental health. This interpretation is supported by a range of relevant controls (fixed-effects controlling for time-invariant

confounders and vaccination and pandemic intensity as time-varying covariates) and robustness checks (including the use of fortnight-fixed effects, controlling for any events that could affect all countries simultaneously—eg, the surge of a new variant). Additionally, although it is certainly possible to find pathways of reverse causality for the two proposed mediators (physical distancing and evaluations of the government's pandemic response), this direction of causality is much less likely to be driving the observed association between policy stringency and mental health. We also observed convergent findings from the quasi-natural experiment of the Nordic subset of countries, which enabled us to assess the efficacy and impact of distinct pandemic response strategies.

This analysis provides the most comprehensive assessment of policy stringency and mental health trajectories to date using nationally representative samples in 15 countries from April, 2020, to June, 2021. Findings could inform responses to subsequent waves of COVID-19 and future epidemics and pandemics.

COVID-19 has forced governments to make numerous difficult decisions. Our results suggest that that timely use of testing and contact tracing, as part of an elimination strategy, can minimise deaths without requiring greater average policy stringency. COVID-19 policy stringency is associated with lower mental health to the extent that people heed physical distancing protocols, possibly because these protocols impede familiar and meaningful forms of social connection. Governments could prioritise policies that reduce virus transmission but impose fewer restrictions on daily life (eg, restricting domestic travel across regions within a country rather than restricting gatherings). Even in settings where governments were slow to respond and have consequently brought in restrictive policies such as stay-at-home orders, mental health has gradually declined only slightly, implying that policy makers should be largely reassured by people's aggregate capacity to cope. Considering the importance of mental health for individuals and society,[25,26] this study offers evidence-based insight for governments to consider as they navigate the remainder of this pandemic and similar future challenges.

Contributors

LBA, RG, AP, and JFH conceptualised the study, and were involved in methodology, writing of the original draft, data visualisation, data validation, reviewing and editing the manuscript, project administration, and study supervision. RG, AP, JFH, and BA were responsible for data curation and formal analysis. RG and BA analysed the data. BA contributed to the data visualisation. J-EDN and SPJ contributed to study conceptualisation. SPJ was responsible for survey resources and contributed to data collection and methodology. J-EDN contributed to the data visualisation. All authors contributed comments to the paper. RG and BA had access to the raw data. The corresponding author had final responsibility to submit for publication. RG and BA had full access to and verified the data.

Declaration of interests

We declare no competing interests.

Data sharing

All data files and code required to reproduce these analyses are publicly available on the Open Science Framework.

For **data files and codes** see https://osf.io/ncdj9/?view_only=34548fac9b124b548f44b9f4fb887b46

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