Mental health inequalities increase as a function of COVID-19 pandemic severity levels

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ABSTRACT

Rationale: Current evidence suggests that mental health across the globe has suffered significantly during the COVID-19 global pandemic, and that disadvantaged communities are suffering these impacts more acutely. Lower income, female gender, and younger age have all been associated with worse psychopathology during COVID-19.

Objective and methods: The goal of this study was to determine whether these disparities are more pronounced in places where the pandemic is more severe. We analyzed self-report data and objective metrics from a large global sample ($N = 11,227$) in order to test the hypothesis that country-level severity of COVID-19 moderates the relationship between the target demographic variables (Subjective SES, gender and age) and psychopathology indicators.

Results: Severity of the pandemic emerged as a significant moderator of the relationship between these demographic variables and mental health outcomes. This pattern was extremely consistent for Subjective SES and gender, but slightly more nuanced for age.

Conclusion: Overall, we interpreted our data as suggesting that mental health disparities are greater in countries with more severe COVID-19 outbreaks. These findings are critical for understanding the ways that the ongoing pandemic is affecting global mental health, and contribute to the broader literature surrounding collective trauma.

1. Introduction

The COVID-19 global pandemic has brought the world to a halt in unprecedented fashion. Since the initial outbreak in Wuhan, China, in December 2019 (Chen et al., 2020), the virus has wreaked havoc across the world. International unemployment levels have risen dramatically (Kawohl and Nordt, 2020), civil unrest has spread across the globe (Galea and Abdalla, 2020), and strict quarantine laws and policies have been enacted in numerous countries in an effort to slow the spread of SARS-CoV-2, the deadly disease that causes COVID-19 (Nussbaumer-Streit et al., 2020). There have also been psychological impacts—recent research has suggested that stress, anxiety, and depression all over the world have risen significantly since the pandemic began (Salari et al., 2020). Broadly speaking, the negative impacts of COVID-19 have been disproportionately felt in lower-income and minority communities (e.g., Elgar et al., 2020; Shadmi et al., 2020; Tai et al.,), and emerging research suggests that the same is true for mental health (e.g., Flentje et al., 2020). In the present work, we investigate the relationship between three demographic variables—subjective socioeconomic status (SES), gender and age—and the mental health consequences of COVID-19 in a global sample. Importantly, our study is the first to examine if the severity of outbreak may exacerbate these relationships.

2. Mental health during COVID-19

The global pandemic has resulted in social isolation, chronic threat, economic uncertainty, and disruption of daily routines (Salari et al., 2020), all of which can be expected to exacerbate existing psychological

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difficulties. Indeed, alarming levels of broad subsyndromal mental health concerns have been noted both in healthcare workers and in the general public (Rajkumar, 2020). Czeisler et al. (2020) recently found that 30.9 % of a US sample met criteria for anxiety or depressive disorder, 26.3 % met criteria for a traumatic-disorder related to the pandemic, 13.3 % reported having increased substance use to cope with the pandemic, and 10.7 % reported having considered suicide in the past 10 days. Overall rates of depression and anxiety have increased significantly since this same period in 2019 (CDC, National Center for Health Statistics). It is imperative that we improve our understanding of the ways that this global societal event has impacted mental health in order to help address global suffering and mitigate the inevitable consequences.

COVID-19 appears to be disproportionately affecting disadvantaged communities (e.g., Clark et al., 2020; Donnelly and Farina, 2021; Pareek et al., 2020). Past collective traumas and public health emergencies have provided evidence that socially disadvantaged groups (e.g. low-income populations, racial minorities) experience worse psychological outcomes than their socially advantaged counterparts (Purtle, 2012). Evidence from this event is still emerging, but a recent meta-analysis involving eight countries found that female gender, younger age group (≤40 years), presence of chronic/psychiatric illnesses, unemployment, student status, and frequent exposure to social media/news concerning COVID-19 were all risk factors for increases mental distress (Xiong et al., 2020a). Further investigations have found higher levels of depressive symptomatology in socially vulnerable groups (racial minorities, women, unemployed; Flentje et al., 2020), and highlighted a much greater riser in depression and anxiety among sexual and gender minority groups compared to the general population since the pandemic began (Flentje et al., 2020). Clearly the mental health burden of COVID-19 has not been evenly distributed, but it remains an open question how these disparities change as the severity of the pandemic increases.

3. The role of demographic factors

Despite the large amount of research on general demographic factors that influence psychological responses to COVID-19, comparatively less research has focused on the specific impact of socio-economic status. A justifiably thorough emphasis has been placed on the role of unemployment (see Blustein et al., 2020), and numerous studies have highlighted the general health disparities related to income levels (e.g., Oronce et al., 2020; Raifman and Raifman, 2020). A much smaller group of studies have examined the impact of income inequality on mental health. One investigation of an Austrian population by Pieh et al. (2020) found evidence that levels of depression and anxiety had increased more dramatically in lower income populations since the pandemic began. A separate study found that lower SES was a risk factor for greater stress, depression and anxiety in an Indian population (Kajdy et al., 2020). As the external stressors created by a pandemic (e.g., health risk, unstable economies) increase, factors like healthcare and job security may become increasingly relevant to people with low SES, thus negatively impacting mental health. Despite the importance of understanding these patterns, to our knowledge, no study has looked at the differential impact of SES on the mental health detriments of COVID-19 on a global scale.

Gender is another important factor in mental health outcomes during the COVID-19 pandemic, with women consistently reporting greater distress (e.g., Flentje et al., 2020). While considerable research suggests that women are more likely to survive an infection from SARS-CoV-2 than men (e.g., Banerjee et al., 2020; Sharma et al., 2020), many of the most insidious impacts of this event are social and cultural in nature. Investigations across multiple countries have shown that women during the pandemic are more likely to report experiencing depression, anxiety, posttraumatic stress, insomnia, subjective distress, and adjustment disorder (Lai et al., 2020; Rossi et al., 2020; Xiong et al., 2020a). These

differences are perhaps not surprising considering women on average earn less money (O'Reilly et al., 2015) are more likely to work in healthcare (Boniol et al., 2019), and are more likely to provide childcare (Craig & Mullan, 2011), all of which could be expected to impose a greater burden during a pandemic. Indeed, a recent review found that COVID-19 uniquely exacerbates the general stress and health risks that women regularly experience (Connor et al., 2020). Given stay-at-home orders and fear of infection, these burdens could reasonably be expected to worsen as the pandemic becomes more severe, presumably increasing stress and mental health concerns among women. Nevertheless, it remains unclear if the between-country severity of COVID-19 further exacerbates these mental health disparities between women and men.

Finally, our study explores how age moderates the relationship between the severity of the outbreak and mental health. Many studies have focused on age in a similar manner to gender in the sense that younger age is often broadly construed as a risk factor for negative psychological outcomes associated with COVID-19 (e.g., Banks and Xu, 2020; Varma et al., 2021; Xiong et al., 2020a). Predicting how age will interact with country severity is perhaps not quite as straightforward, however. For instance, older people are far more likely to die or suffer serious health consequences from a SARS-CoV-2 infection (e.g., Jordan et al., 2020; Lloyd-Sherlock et al., 2020), so the associated fear, social consequences, and added precautions could feasibly bode poorly for mental health. While the relationship between younger age and worse mental health outcomes appears robust, it may very well diminish or even reverse as country severity increases. Conversely, younger individuals may also be more likely to have their lives significantly altered, or may be less financially resilient to the economic consequences of the pandemic. Ultimately, it is difficult to predict how the relationship between age and psychopathology changes as a function of pandemic severity. That being said, given the vastly different resources and coping strategies that are potentially employed by different generations in response to a stressor such as COVID-19 (see Kotta et al., 2021), it is important to understand whether age plays a moderating role in mental health outcomes as the pandemic becomes more severe.

4. The current research

Understanding how large-scale traumatic events impact mental health is a matter of global importance that can potentially inform future responses to such catastrophes. Previous research into collective trauma has largely been limited in that it has necessarily focused on the ways that single events impact people in a specific area (e.g., Krieg, 2009; Maffly-Kipp et al., 2020; Updegraff, Silver & Holleman, 2008). Thus, our understanding of the ways in which people across groups and cultures respond to traumatic events is often limited by the nature of a specific disaster. The COVID-19 pandemic, however, has had an unprecedented global impact, creating the opportunity to empirically investigate how responses to a single source of trauma vary based on a number of variables in different cultures around the world. Given the established detrimental impact that the pandemic has had on mental health, (e.g., Rajkumar, 2020), we chose to use this opportunity to examine how three demographic factors—Subjective SES, gender and age—influenced mental health outcomes across the world in the context of a single collective trauma. We chose to investigate these relationships in regards to relative pandemic severity in order to gauge the extent to which the pandemic was responsible for increasing mental health disparities.

In order to explore the relationship between the above demographic variables, mental health outcomes, and pandemic severity, we administered a self-report survey to a large international sample. Based on the existing evidence, we predicted that there would be greater mental health disparities between high and low SES individuals, and between women and men, in countries where COVID-19 is more severe. In other words, we expected that self-reported socioeconomic status would moderate the relationship between objective country-level severity of

COVID-19 and mental health outcomes. Due to the potential competing predictions for how age would factor into this relationship, we treated age as exploratory and refrained from making specific predictions.

5. Methods

5.1. Participants

A total of 11,227 people from 30 countries participated in the study as part of a broader research project (see Eisenbeck et al., under review). Participant's age ranged between 18 and 85 ($M = 35.36$, $SD = 13.26$) and a majority of the sample was female (69.9 %). The majority of participants were also categorized as "middle income" (66.3 %). However, given our robust sample size, we were still able to recruit over 1300 participants for each level of Subjective SES ($n = 2,179$, for low SES; $n = 7,739$, for middle SES; $n = 1,309$, for high SES).

5.2. Materials and procedure

This data was part of a larger international project assessing the psychological impacts of the COVID-19 pandemic between March and June 2020. We recruited investigators through ResearchGate announcements, and selected those who were willing to adapt our surveys into the local languages and recruit at least 250 participants from their country. Adaptations of materials followed currently recommended best practices (see Beaton et al., 2020). Investigators then recruited participants through email invitations and social media announcements (Facebook and Instagram). Though overall data collection occurred during a four-month period (March–June of 2020), each country completed their data collection within a three-week window. All participation was voluntary and anonymous.

5.2.1. Demographic data

General demographic data was collected via self-report, including gender, and age.

5.2.2. Socioeconomic status

We chose to use a subjective measure of socioeconomic status in order to obtain a single standardized metric across all of the countries in our sample (many of which use different currencies). Previous research has demonstrated that subjective SES is a robust indicator of economic status that accounts for factors beyond simple monetary income (e.g., Anderson et al., 2020). In order to gauge subjective SES participants responded to the item: "My economic status is: (*higher than average; average; lower than average*).

5.2.3. Psychopathology indicators

Participants completed local versions of the Depression, Anxiety and Stress Scale (DASS-21; Brown et al., 1997). They responded to 21 items describing negative emotional states experienced during the past week. The DASS-21 contains three subscales (depression, stress and anxiety), and total scores indicate general psychological distress. These three separate scales are based upon the tripartite model of anxiety and depression (Clark & Watson; 1991). The scale has demonstrated good psychometrics properties (see Brown et al., 1997); the individual sub-scales tend to show strong convergent and discriminant validity with other similar measures of anxiety and depression (e.g., Bener et al., 2016; Norton, 2007). Alpha values in our samples ranged from 0.90 to 0.95. Responses were made along a 1 (*did not apply to me at all*) to 4 (*applied to me very much*) scale.

5.2.4. Country-level variables

We categorized countries based on publicly available data (worldmeters.info) involving COVID-19 infection rates. We assigned countries with less than 100 reported infections per million inhabitants a severity level of 1, countries with between 100 and 2000 infections per million

inhabitants a severity level of 2, and countries with greater than 2000 cases per million inhabitants a severity level of 3. This severity index was based off of the specific window of time in which data was collected in each individual country.

We obtained GDP per capita for each country from the official World Bank national accounts database (worldbank.org).

5.3. Data Analysis

We performed all statistical analyses using SPSS (Version 25). Missing data in the formal questionnaires was less than 0.1 %, (missing completely at random) and was replaced with the expectation maximization algorithm. Missing data on demographic variables was less than 0.2 % and was not replaced. We did not remove possible outliers. We evaluated the effects of country on study variables with analysis of variance and Cramer's *V*.

We employed Multilevel modeling (MLM) to assess the influence of both individual (socioeconomic status, age, gender) and country-level variables (severity index and GDP) on markers of psychopathology (general psychological distress, depression, stress and anxiety). All of these variables, with the exception of gender, were treated as continuous. In all four analyses, we implemented a restricted likelihood method. The null models served as baseline models with random intercepts to help us determine whether MLM was warranted. Full models incorporated all individual and country-level variables. We chose to treat both subjective SES and the severity index, which are ordinal variables, as continuous. Likelihood-ratio tests indicated that treating subjective SES and country-level severity as continuous in the model was a more parsimonious option than treating them as categorical, without a significant loss of information. Furthermore, follow-up analyses showed that our primary results did not meaningfully change when treating these variables as categorical. It's important to note that there is some debate over the proper treatment of ordinal variables in an MLM model, but our approach was ultimately informed by previous literature (Long and Freese, 2006, pg. 421; Pasta, 2009, pg. 3).

To determine the adequacy of the MLM method, we compared nested models with basic models by chi square difference tests (maximum likelihood method). All variables were standardized. We probed significant interactions detected in the analyses with simple slopes analyses between the predictor and the outcome variables at different levels of the moderating variables. For continuous moderator variables like age, we tested relationships at low (-1 SD: 18–22), mean (0 SD: 23–49) and high (1 SD: 50–85) levels of the moderator variable.

6. Results

We observed significant differences based on age, $F(1, 29) = 80.74$, $p < .001$, $\eta_p^2 = 0.174$, economic status, $F(1, 29) = 18.16$, $p < .001$, $\eta_p^2 = 0.045$, and gender, Cramer's $V = 0.334$, $p < .001$, between countries. Also, countries differed in their level of psychological distress, $F(1, 29) = 22.19$, $p < .001$, $\eta_p^2 = 0.054$, depression, $F(1, 29) = 21.80$, $p < .053$, $\eta_p^2 = 0.054$, anxiety, $F(1, 29) = 24.17$, $p < .001$, $\eta_p^2 = 0.059$, and stress, $F(1, 29) = 24.63$, $p < .001$, $\eta_p^2 = 0.060$. In all countries, most people reported having medium socio-economic status (from 50.2 % to 86.1 %, see Table 1). Participants with the highest levels of psychological distress were from Bangladesh and the UK, and participants with the lowest levels were from Germany and Nigeria. A total of eight countries were classified as having low severity pandemic index, 14 as medium and eight as high.

6.1. Predictors of psychological distress, depression, anxiety, and stress

All four null models (psychological distress: 2LL = 31340.321; depression: 2LL = 31349.215; anxiety: 2LL = 31286.590; stress: 2LL = 31285.004) showed that the effect of country was significant on participant's psychological distress (Wald $Z = 3.62$, $p < .001$, ICC = 0.055),

Table 1
Mean scores of the study variables per country.

Country	n	Severity index	Gender %		Age		Socio-economic status %			Psychological distress			
			F	M	M (SD)	Range	High	Medium	Low	Total	Depression	Anxiety	Stress
Argentina	145	2	72.4	27.6	36.32 (11.07)	18–63	9.0	72.4	18.6	29.30 (27.06)	8.21 (8.91)	5.70 (6.89)	12.29 (8.97)
Algeria	253	1	67.6	37.6	32.28 (10.18)	18–69	24.9	69.2	5.9	27.03 (24.47)	9.61 (9.63)	7.92 (8.95)	11.76 (10.55)
Australia	53	2	84.9	15.1	44.77 (11.11)	18–73	54.7	41.5	3.8	26.34 (20.56)	8.11 (9.16)	7.01 (8.24)	11.92 (9.71)
Bangladesh	344	1	39.8	60.2	25.35 (7.41)	18–78	7.6	86.0	6.4	40.94 (25.87)	7.85 (8.11)	4.98 (5.77)	13.51 (10.05)
Brazil	298	2	73.5	26.5	38.33 (13.17)	18–77	28.5	62.1	9.4	28.87 (24.80)	13.30 (9.24)	12.63 (9.14)	15.01 (9.61)
Canada	332	2	48.5	51.5	36.87 (13.74)	18–84	25.4	62.7	11.4	28.00 (23.72)	11.23 (10.08)	5.66 (6.89)	11.97 (10.12)
Colombia	115	2	87.8	12.2	40.31 (12.17)	20–70	7.8	73.0	19.1	31.47 (26.13)	10.13 (9.72)	5.98 (7.15)	11.89 (9.43)
Egypt	285	1	70.5	29.5	37.19 (11.02)	18–70	33.7	58.2	8.1	30.04 (25.24)	9.97 (9.87)	7.03 (8.61)	14.70 (10.56)
France	465	3	76.8	23.2	43.64 (11.54)	18–81	20.6	69.0	10.3	27.49 (23.93)	10.47 (9.70)	7.35 (8.13)	12.22 (10.07)
Germany	281	3	69.4	30.6	40.84 (15.27)	18–79	40.6	50.2	9.3	16.29 (17.61)	9.86 (9.77)	4.98 (6.81)	12.65 (10.66)
Hungary	262	2	88.9	10.7	37.42 (12.43)	18–71	27.1	64.5	8.4	29.35 (21.84)	5.51 (6.86)	2.49 (4.87)	8.29 (8.47)
India	596	1	56.5	43.3	26.71 (7.95)	18–85	11.4	81.9	6.7	19.24 (20.19)	8.35 (8.57)	6.55 (7.34)	14.45 (9.53)
Indonesia	277	1	73.3	26.7	24.83 (9.85)	18–59	9.4	84.1	6.5	26.62 (21.09)	6.29 (7.40)	6.13 (7.00)	6.82 (7.56)
Italy	511	3	75.3	24.3	34.53 (14.67)	18–80	8	78.1	13.9	28.27 (18.44)	7.42 (7.42)	7.15 (6.98)	12.06 (8.79)
Lebanon	294	2	64.6	35.4	28.74 (11.96)	18–69	20.7	73.1	6.1	35.46 (25.79)	10.53 (7.52)	5.29 (6.04)	12.90 (8.21)
Mexico	648	2	79.2	20.8	41.45 (13.39)	18–80	43.7	16.0	40.3	26.38 (23.11)	12.50 (10.69)	8.31 (8.37)	14.65 (10.01)
New Zealand	43	2	74.4	25.6	45.34 (13.00)	20–74	46.5	51.2	2.3	26.37 (18.29)	7.65 (8.49)	5.79 (7.44)	12.94 (9.49)
Nigeria	435	1	31.5	68.5	33.34 (8.67)	19–64	7.1	79.3	13.6	17.10 (21.23)	8.70 (8.28)	4.60 (5.53)	13.07 (8.30)
Pakistan	420	1	61.4	38.6	20.59 (10.31)	18–80	30.7	64.3	5.0	34.61 (25.32)	5.53 (7.49)	5.00 (7.24)	6.57 (8.04)
Poland	275	2	79.6	20.4	33.73 (12.70)	19–82	25.8	69.1	5.1	34.74 (27.33)	11.42 (9.20)	9.96 (8.77)	13.23 (9.13)
Portugal	483	3	72.0	28.0	39.01 (12.27)	18–75	9.9	82.4	7.7	25.09 (21.16)	10.94 (10.67)	7.88 (9.29)	15.92 (10.62)
Romania	546	2	70.7	29.3	32.87 (11.65)	18–69	16.5	78.0	5.5	25.18 (22.89)	7.14 (7.14)	4.95 (6.87)	13.00 (9.57)
Russia	307	2	89.3	10.4	44.62 (11.06)	19–79	13.4	75.9	10.7	29.38 (21.78)	8.21 (8.46)	5.92 (7.24)	11.05 (9.60)
Slovenia	1271	2	82.6	16.7	34.58 (13.70)	18–81	12.0	78.6	9.4	28.84 (24.81)	9.09 (8.27)	6.31 (7.05)	13.99 (9.51)
Spain	640	3	71.6	23.9	36.26 (11.78)	18–73	8.7	77.0	14.5	26.19 (22.02)	9.82 (9.95)	5.40 (7.06)	13.62 (10.47)
Sweden	278	3	84.5	15.1	41.84 (12.34)	18–75	43.5	51.4	5.0	22.71 (18.18)	8.75 (8.01)	3.22 (4.57)	10.74 (8.33)
Thailand	405	1	33.1	64.7	34.39 (10.85)	18–70	14.2	75.1	10.6	18.50 (19.37)	5.21 (6.91)	4.67 (6.04)	8.62 (7.83)
Turkey	302	2	60.9	39.1	27.35 (8.67)	18–61	12.3	70.5	17.2	34.76 (25.46)	12.52 (10.12)	8.25 (7.87)	13.99 (10.19)
United Kingdom	382	3	86.6	12.8	42.02 (15.18)	18–76	20.9	62.8	16.2	36.88 (27.51)	12.52 (10.51)	8.09 (9.04)	16.27 (10.92)
United States	281	3	76.9	23.1	44.81 (15.83)	18–77	28.5	54.1	17.4	28.11 (24.79)	9.85 (10.18)	5.68 (6.94)	12.58 (10.40)

Note. Severity index: 1 = less than 100 infected per million inhabitants; 2 = between 100 and 2000 per million inhabitants; 3 = more than 2000 infected. Depression: normal: 0–9, mild: 10–13, moderate: 14–20, severe: 21–27, extremely severe: 28+; Anxiety: normal: 0–7, mild: 8–9, moderate: 10–14, severe: 15–19, extremely severe: 20+; Stress: normal: 0–14, mild: 15–18, moderate: 19–25, severe: 26–33, extremely severe: 34+; General psychological distress: no cutoff values are available.

depression (Wald $Z = 3.61$, $p < .001$, ICC = 0.053), anxiety (Wald $Z = 3.62$, $p < .001$, ICC = 0.064), and stress (Wald $Z = 3.63$, $p < .001$, ICC = 0.056). ICCs showed that between 5.3 and 6.4 % of the variance of different markers of psychopathology was explained by variables at the country level. Accordingly, we assessed the full models, incorporating both individual-level and country-level variables. All complete models were significantly better than the null models (see Table 3).

Our analyses indicated that participants' depression, anxiety and distress levels, as well as their total scores of psychological distress (depression, anxiety and distress combined), were related to age, and gender and economic status. Older participants and males tended to report lower levels of markers of psychopathology as compared to

younger participants and females, respectively. Country-level variables (GDP and severity of the pandemic) were not directly linked to depression, anxiety, stress and general psychological distress. The main effects of each individual difference variable on each psychopathology indicator are reported in Table 2, and models with the full-interaction terms are reported in Table 3.

Assessment of individual-level interactions showed significant moderating effects of age on the relationship between gender and markers of psychopathology. Though women reported higher levels of psychopathology markers overall, this difference was more pronounced among younger individuals (compared to middle aged and older individuals). This moderation pattern was observed in all four outcome variables, namely total psychological distress, depression, anxiety and stress (see Table 4).

The effect of age on all markers of psychological distress seemed to be stronger when the economic status of the person was lower (see Table 4). This suggests that, for people with lower economic status, younger age is a higher risk factor for showing markers of psychopathology than for their more affluent counterparts.

In the cross-level interactions, GDP did not moderate the relationship between any of the individual characteristics and markers of psychological distress, $p > .05$. Severity index of the COVID-19 pandemic, however, had a significant impact on the relationship between individual-level variables and measures of psychopathology (see Table 5).

We found significant moderating effects of severity index on the relationship between depression and age, as well as the relationship between anxiety and age. The effect of age seemed to be the lowest on depression at medium levels of severity but showed similar tendencies at low and high severity levels. As for the anxiety levels, the strongest relationships between anxiety and age were detected at low levels of severity as compared to medium and high levels. Although the severity index did not significantly moderate the relationship between general psychological distress and age, we observed more pronounced relationships between age and psychological distress at low and high severity levels. We similarly observed a stronger relationship between age and stress at high severity levels, though again the moderation was not significant. Overall, in case of all outcome variables, effect of age was the lowest at medium levels of severity (see Table 5).

Our results indicate a clear effect of severity index on the relationship

Table 2
Main effects of multilevel models predicting markers of psychopathology.

	Psychological distress B (SE)	Depression B (SE)	Anxiety B (SE)	Stress B (SE)
Individual-level variables				
Gender (female)	.230 (.021)***	.148 (.021)***	.187 (.021)***	.278 (.021)***
Age	-.143 (.010)***	-.139 (.010)***	-.104 (.010)***	-.138 (.010)***
Economic status	.055 (.009) ***	.068 (.009)***	.057 (.009)***	.026 (.009)*
Country-level variables				
Severity index	.037 (.065)	.043 (.065)	-.058 (.059)	.095 (.063)
GDP	-.046 (.057)	-.016 (.058)	-.077 (.053)	-.038 (.056)
Covariance parameters				
Residual variance	.908***	.913***	.918***	.905***
Intercept variance	.047***	.048***	.039***	.044***
−2 log likelihood	30529.847	30585.527	30632.653	30487.626
χ^2 (df) difference with null model (ML)	806.068 (8)***	759.249 (8)***	649.679 (8)***	792.980 (8)***

Note: *$p < .05$; **$p < .01$; ***$p < .001$. All p values are two-tailed. Females are coded as 1 and Males are coded as 2.

Table 3
Multilevel models predicting markers of psychopathology.

	Psychological distress B (SE)	Depression B (SE)	Anxiety B (SE)	Stress B (SE)
Individual-level variables				
Gender (female)	.235 (.021)***	.146 (.021)***	.190 (.021)***	.288 (.021)***
Age	-.214 (.012)***	-.211 (.012)***	-.159 (.012)***	-.201 (.011)***
Economic status	.052 (.009) ***	.065 (.009)***	.054 (.009)***	.023 (.009)*
Country-level variables				
Severity index	.048 (.069)	.051 (.069)	-.047 (.062)	.104 (.069)
GDP	-.029 (.061)	.003 (.061)	-.065 (.055)	-.024 (.061)
Individual-level interactions				
Age^X Gender	.075 (.010)***	.069 (.010)***	.058 (.011)***	.074 (.010)***
Age^X Economic status	-.046 (.009)***	-.051 (.009)***	-.033 (.010)**	-.038 (.009)***
Gender^X Economic status	.004 (.009)	.010 (.009)	.001 (.009)	.001 (.009)
Cross-level interactions				
Severity index^X Age	.032 (.020)	.043 (.020)*	.051 (.020)*	.002 (.020)
Severity index^X Gender	-.082 (.016)***	-.064 (.015)***	-.075 (.016)***	-.082 (.016)***
Severity index^X Economic status	.037 (.017)*	.042 (.017)*	.039 (.017)*	.020 (.017)
GDP^X Age	-.014 (.018)	-.023 (.018)	-.009 (.018)*	-.006 (.018)
GDP^X Gender	.031 (.017)	.035 (.017)*	.030 (.017)	.019 (.017)
GDP^X Economic status	.008 (.015)	.007 (.015)	.007 (.015)	.007 (.015)
Covariance parameters				
Residual variance	.893***	.899***	.909***	.891***
Intercept variance	.054***	.054***	.041***	.054***
−2 log likelihood	30396.385	30463.201	30572.473	30369.904
χ^2 (df) difference with null model (ML)	1036.748 (15)***	978.723 (15)***	807.626 (15)***	1007.958 (15)***

Note. *$p < .05$; **$p < .01$; ***$p < .001$. All p values are two-tailed.

between economic status and global psychological distress, depression and anxiety. At the lowest severity level of the outbreak, participants' global psychological distress, depression and anxiety were not related to their economic status. These relationships were significant at medium and high levels of severity, and were in fact strongest at high levels. The effects of economic status on stress seemed to follow a similar pattern, but the main interaction term was not significant, $p > .05$ (see Tables 3 and 4). Overall these results indicate that, as severity levels increase, the adverse effects of low economic status on psychopathology become more pronounced.

7. Discussion

Our results suggest that, as the severity of COVID-19 increases between countries, the existing mental health disparities targeted by this research increase. Mental health outcomes overall were worse for women (vs. men), younger people (vs. older people), and individuals with lower (vs. higher) subjective economic status. Nevertheless, these demographic differences in indicators of psychopathology were the most pronounced in countries where the coronavirus outbreak was the most severe. This pattern was most clear in regards to SES and gender. We interpreted our findings to suggest that the COVID-19 pandemic may be

Table 4
Simple slopes of the moderating effects of age/economic status with individual predictors on markers of psychopathology.

Outcome	Moderator	Predictor
	Age	*Gender*
General psychological distress	Low	.166 (.023) ***
	Medium	.115 (.011) ***
	High	.110 (.023) ***
Depression	Low	.135 (.023) ***
	Medium	.077 (.011) ***
	High	.066 (.024) ***
Anxiety	Low	.094 (.023) ***
	Medium	.054 (.011) ***
	High	.081 (.024) ***
Stress	Low	.204 (.023) ***
	Medium	.166 (.011) ***
	High	.142 (.023) ***
Outcome	**Moderator**	**Predictor**
	Economic status	*Age*
General psychological distress	Low	-.247 (.033) ***
	Medium	-.202 (.014) ***
	High	-.064 (.014) ***
Depression	Low	-.265 (.033) ***
	Medium	-.196 (.014) ***
	High	-.055 (.014) ***
Anxiety	Low	-.194 (.034) ***-
	Medium	-.203 (.014) ***
	High	-.064 (.014) ***
Stress	Low	-.202 (.034) ***
	Medium	-.152 (.014) ***
	High	-.055 (.014) ***

Note. $*p < .05$; $**p < .01$; $***p < .001$. All *p* values are two-tailed.

Table 5
Simple slopes of the moderating effect of the severity index with individual predictors on markers of psychopathology.

Outcome	Moderator	Individual predictors (separate analyses)		
	Severity index	Age	Gender	Economic status
General psychological distress	Low	-.206 (.028) ***	.075 (.017) ***	-.032 (.020)
	Medium	-.138 (.012) ***	.123 (.015) ***	.055 (.013) ***
	High	-.191 (.020) ***	.169 (.019) ***	.155 (.017) ***
Depression	Low	-.188 (.028) ***	.068 (.017) ***	-.026 (.020)
	Medium	-.143 (.012) ***	.062 (.015) ***	.078 (.013) ***
	High	-.180 (.020) ***	.114 (.019) ***	.154 (.017) ***
Anxiety	Low	-.235 (.028) ***	.044 (.017) ***	-.020 (.020)
	Medium	-.107 (.012) ***	.106 (.015) ***	.064 (.013) ***
	High	-.122 (.020) ***	.134 (.019) ***	.155 (.017) ***
Stress	Low	-.143 (.028) ***	.086 (.016) ***	-.039 (.020) *
	Medium	-.120 (.012) ***	.158 (.015) ***	.038 (.013) **
	High	-.203 (.020) ***	.200 (.019) ***	.114 (.017) ***

Note. No significant overall moderating effect of severity index was detected on the relationships of age and general psychological distress; age and stress; and economic status and stress. $*p < .05$; $**p < .01$; $***p < .001$. All *p* values are two-tailed.

further perpetuating societal inequalities in mental health across the world.

Our results are perhaps not altogether surprising. Women (e.g., Simon, 2002) and lower-income individuals (Gresenz et al., 2001) tend to report poorer mental health in general, and emerging research thus far has indicated that the same trend is occurring during the COVID-19 pandemic (e.g., Flentje et al., 2020; Zheng et al., 2021). Our data corroborate these patterns quite clearly, and further demonstrate that these disparities are greater in places where the pandemic is more severe. Though the cross-sectional nature of our design does limit our interpretations, these disparities could reflect factors such as increased childcare burden on women, or decreased job security for low SES individuals. Similar investigations may help to contextualize these data. For example, our findings complement research from the same time period showing that subjective judgments of COVID-19 threat (along with factors like gender and financial insecurity) correspond to worse mental health outcomes (Wilson et al., 2020; Zheng et al., 2021). Taken together with these studies, our results can more confidently be interpreted as evidence that mental health disparities increase as the pandemic worsens.

While collective traumas may theoretically impact all people equally, it certainly makes sense that members of advantaged groups would be better able to protect themselves against the potential deleterious impacts. Indeed, previous research has suggested that socially disadvantaged groups suffer more acute psychologically impacts of past collective traumas than socially advantaged groups (Purtle, 2012). In the case of a viral pandemic, these groups may have less access to critical resources, live in conditions that are more optimal for the spread of contagions, and face greater systemic and interpersonal bias when seeking medical treatment. Emerging research from the COVID-19 pandemic suggests that mental health inequalities are being exacerbated in a similar fashion (e.g., Di Gessa et al., 2021; Gibson et al., 2021). While many factors have likely contributed to the observed pattern of results, they ultimately confirm and extend previous research on collective trauma and social inequality.

Our findings involving age, however, are slightly less straightforward to interpret. Some previous studies have found young age to be a risk factor for mental health outcomes during COVID-19 (e.g., Banks and Xu, 2020). However, as we previously outlined, older age is a major risk factor for health outcomes (Lloyd-Sherlock et al., 2020), which provides reason for competing predictions about how this relationship would change as a function of country severity. We observed inconsistent effects for age in our sample. For example, while the negative relationship between age and stress was most extreme at high levels of severity, the negative relationship between age and anxiety was the most extreme at low levels of severity. One speculative explanation for this pattern is that health anxiety in young individuals is contributing to distress in younger individuals. Another possibility is that, while more concrete factors like employment disproportionately stress younger individuals when the pandemic is severe, older individuals are actually better equipped to manage abstract and existential threats of a global pandemic before it has become severe. Finally, it may be that there is something qualitatively different about the countries with low level severity in our sample. For example, most countries in the low severity index were African and Asian countries. These countries tend to have higher levels of youth unemployment (Tai et al.,), which could contribute to increased anxiety even with low infection rates.

7.1. Limitations

It is important to note several limitations of this research. First, though we had a large global sample, our sample ultimately had unequal group sizes in regards to country, SES, and gender. The majority of our sample subjectively reported having an "average" level of income, which does limit the interpretation of our results as it calls into question how representative the low-SES and high-SES categories were in each

country. We believe that the large sample size partially mitigates this concern, but we still urge caution in the interpretation of our results. Second, we relied on a severity index that separated countries into three groups (low, middle and high severity), based on infections per one million inhabitants. While this is an objective measure, it may overlook factors like health-care access, under-reporting, within-country distributions of the outbreak, and other qualitative factors of the pandemic that are difficult to capture with a single metric. Though this may be the best metric available as a single number for statistical analysis, it should not be interpreted as the final measure of country-level COVID-19 severity. Third, we relied on a normative sample. Although we asked participants to report on psychopathology constructs, we did not specifically seek a population with diagnoses of mental illness. Fourth, the cross-sectional nature of this study does not rule out the possibility that other country-level differences (besides severity) were driving the observed effects. Finally, our data relied largely on self-report. In particular, our decision to use subjective SES raises questions about whether objective income measures would demonstrate the same pattern. We believe that they would, and that our use of a subjective measure ultimately takes more factors into account than the objective quantity of money earned. However, we cannot rule out the possibility that some psychological bias relating to subjective perceptions of socioeconomic status impacted our results. Future research should seek to rule out this possibility.

8. Conclusion

Overall, the current research is an important contribution to the growing body of literature that highlights the ways that the current global pandemic is disproportionately impacting the mental health of disadvantaged groups. While previous research has shown that lower SES, younger age, and female gender are risk factors for worse mental health outcomes from COVID-19, we utilize a large global sample to demonstrate that these disparities tend to become more pronounced as country-level pandemic severity increases. These findings help to paint a clear and urgent picture of how this societal event is interacting with existing inequalities to impose unequal systemic burdens to global mental health.

Author statement

Joseph Maffly-Kipp: Manuscript writing, Editing, Revision, Reporting of results. Nikolett Eisenbeck: Study Design, Data Collection, Data Analysis, Reporting of Results, Revision. David Carreno: Study Design, Data Collection, Revision. Joshua Hicks: Editing, Revision, Reporting of results, Supervision of Project.

Data availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

References

Anderson, R.M., Heesterbeek, H., Klinkenberg, D., Hollingsworth, T.D., 2020. How will country-based mitigation measures influence the course of the COVID-19 epidemic? Lancet 395 (10228), 931–934.
Banerjee, A., Pasea, L., Harris, S., Gonzalez-Izquierdo, A., Torralbo, A., Shallcross, L., Noursadeghi, M., Pillay, D., Sebire, N., Holmes, C., Pagel, C., Wong, W.K., Langenberg, C., Williams, B., Denaxas, S., Hemingway, H., 2020. Estimating excess 1-year mortality associated with the COVID-19 pandemic according to underlying conditions and age: a population-based cohort study. Lancet 395 (10238), 1715–1725.

Banks, J., Xu, X., 2020. The Mental Health Effects of the First Two Months of Lockdown and Social Distancing during the Covid-19 Pandemic in the UK (Working Paper W20/16). IFS Working Papers).
Blustein, D.L., Duffy, R., Ferreira, J.A., Cohen-Scali, V., Cinamon, R.G., Allan, B.A., 2020. Unemployment in the time of COVID-19: a research agenda. J. Vocat. Behav. 119, 103436.
Brown, T.A., Chorpita, B.F., Korotitsch, W., Barlow, D.H., 1997. Psychometric properties of the depression anxiety stress scales (DASS) in clinical samples. Behav. Res. Ther. 35 (1), 79–89.
Chen, N., Zhou, M., Dong, X., Qu, J., Gong, F., Han, Y., et al., 2020. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. Lancet 395 (10223), 507–513.
Clark, E., Fredricks, K., Woc-Colburn, L., Bottazzi, M.E., Weatherhead, J., 2020. Disproportionate impact of the COVID-19 pandemic on immigrant communities in the United States. PLoS Neglected Trop. Dis. 14 (7), e0008484.
Connor, J., Madhavan, S., Mokashi, M., Amanuel, H., Johnson, N.R., Pace, L.E., Bartz, D., 2020. Health risks and outcomes that disproportionately affect women during the Covid-19 pandemic: a review. Soc. Sci. Med. 113364.
Czeisler, M.É., Lane, R.I., Petrosky, E., Wiley, J.F., Christensen, A., Njai, R., Weaver, M. D., Robbins, R., Facer-Childs, E.R., Barger, L.K., Czeisler, C.A., Howard, M.E., Rajaratnam, S.M.W., 2020. Mental health, substance use, and suicidal ideation during the COVID-19 pandemic—United States, June 24–30, 2020. MMWR (Morb. Mortal. Wkly. Rep.) 69 (32), 1049–1057.
Di Gessa, G., Maddock, J., Green, M.J., Thompson, E.J., McElroy, E., Davies, H.L., Mundy, J., Stevenson, A.J., Kwong, A.S.F., Griffith, G.J., Katikireddi, S.V., Niedzwiedz, C.L., Ploubidis, G.B., Fitzsimons, E., Henderson, M., Silverwood, R.J., Chaturvedi, N., Breen, G., Steves, C.J., Steptoe, A., Porteous, D.J., Patalay, P., 2021. Mental Health Inequalities in Healthcare, Economic, and Housing Disruption during COVID-19: an Investigation in 12 Longitudinal Studies.
Donnelly, R., Farina, M.P., 2021. How do state policies shape experiences of household income shocks and mental health during the COVID-19 pandemic? Soc. Sci. Med. 269, 113557.
Eisenbeck, N., Carreno, D. F., Wong, P. T. P., Hicks, J. A., García, A. M. R.-R., Puga, J., Greville, J., Testoni, I., Biancalani, G., López, A. C. C., Villareal, S., Leontiev, D. A., Enea, V., Schultz, C., Jansen, J., Sanchez-Ruiz, M.-J., Yıldırım, M., Arslan, G., Cruz, J. F. A, et al.. (Under Review). Clinical Psychological Science.
Elgar, F.J., Stefaniak, A., Wohl, M.J., 2020. The trouble with trust: time-series analysis of social capital, income inequality, and COVID-19 deaths in 84 countries. Soc. Sci. Med. 263, 113365.
Flentje, A., Obedin-Maliver, J., Lubensky, M.E., Dastur, Z., Neilands, T., Lunn, M.R., 2020. Depression and anxiety changes among sexual and gender minority people coinciding with onset of COVID-19 pandemic. J. Gen. Intern. Med. 35 (9), 2788–2790.
Galea, S., Abdalla, S.M., 2020. COVID-19 pandemic, unemployment, and civil unrest: underlying deep racial and socioeconomic divides. J. Am. Med. Assoc. 324 (3), 227–228.
Gibson, B., Schneider, J., Talamonti, D., Forshaw, M., 2021. The impact of inequality on mental health outcomes during the COVID-19 pandemic: a systematic review. Canadian Psychology/Psychologie canadienne 62 (1), 101–126.
Gresenz, C.R., Sturm, R., Tang, L., 2001. Income and Mental Health: Unraveling Community and Individual Level Relationships.
Jordan, R.E., Adab, P., Cheng, K.K., 2020. Covid-19: Risk Factors for Severe Disease and Death.
Kajdy, A., Feduniw, S., Ajdacka, U., Modzelewski, J., Baranowska, B., Sys, D., Pokropek, A., Pawlicka, P., Kaźmierczak, M., Rabijewski, M., Jasiak, H., Lewandowska, R., Borowski, D., Kwiatkowski, S., Poon, L.C., 2020. Risk factors for anxiety and depression among pregnant women during the COVID-19 pandemic. Medicine 99 (30).
Kawohl, W., Nordt, C., 2020. COVID-19, unemployment, and suicide. The Lancet Psychiatry 7 (5), 389–390.
Kotta, I., Szabo, K., Marschalkó, E.E., Jancso-Farcas, S., Kalcza-Janosi, K., 2021. The moderation effect of generation on the relationship between psychological flexibility and covid-19 preventive behaviour among females. J. Int. Wom. Stud. 22 (3), 176–187.
Lai, J., Ma, S., Wang, Y., Cai, Z., Hu, J., Wei, N., Wu, J., Du, H., Chen, T., Li, R., Tan, H., Kang, L., Yao, L., Huang, M., Wang, H., Wang, G., Liu, Z., Hu, S., 2020. Factors associated with mental health outcomes among health care workers exposed to coronavirus disease 2019. JAMA Network Open 3 (3), e203976.
Lloyd-Sherlock, P., Ebrahim, S., Geffen, L., McKee, M., 2020. Bearing the Brunt of Covid-19: Older People in Low and Middle Income Countries.
Long, J.S., Freese, J., 2006. Regression Models for Categorical Dependent Variables Using Stata, vol. 7. Stata press.
Nussbaumer-Streit, B., Mayr, V., Dobrescu, A.I., Chapman, A., Persad, E., Klerings, I., Wagner, G., Siebert, U., Ledinger, D., Zachariah, C., Gartlehner, G., 2020. Quarantine alone or in combination with other public health measures to control COVID-19: a rapid review. Cochrane Database Syst. Rev. 9.
Oronce, C.I.A., Scannell, C.A., Kawachi, I., Tsugawa, Y., 2020. Association between state-level income inequality and COVID-19 cases and mortality in the USA. J. Gen. Intern. Med. 35 (9), 2791–2793.
O'Reilly, J., Smith, M., Deakin, S., Burchell, B., 2015. Equal Pay as a Moving Target: international perspectives on forty-years of addressing the gender pay gap. Camb. J. Econ. 39 (2), 299–317.
Pareek, M., Bangash, M.N., Pareek, N., Pan, D., Sze, S., Minhas, J.S., Hanif, W., Khunti, K., 2020. Ethnicity and COVID-19: an urgent public health research priority. Lancet 395 (10234), 1421–1422.

Pasta, D.J., 2009, March. Learning when to be discrete: continuous vs. categorical predictors. In: SAS Global Forum, vol. 248.

Pieh, C., Budimir, S., Probst, T., 2020. The effect of age, gender, income, work, and physical activity on mental health during coronavirus disease (COVID-19) lockdown in Austria. J. Psychosom. Res. 136, 110186.

Purtle, J., 2012. Racial and ethnic disparities in post-disaster mental health: examining the evidence through a lens of social justice. Wash. & Lee J. Civil Rts. & Soc. Just. 19, 31.

Raifman, M.A., Raifman, J.R., 2020. Disparities in the population at risk of severe illness from COVID-19 by race/ethnicity and income. Am. J. Prev. Med. 59 (1), 137–139.

Rossi, R., Socci, V., Talevi, D., Mensi, S., Niolu, C., Pacitti, F., Di Marco, A., Rossi, A., Siracusano, A., Di Lorenzo, G., 2020. COVID-19 pandemic and lockdown measures impact on mental health among the general population in Italy. Front. Psychiatr. 11.

Salari, N., Hosseinian-Far, A., Jalali, R., Vaisi-Raygani, A., Rasoulpoor, S., Mohammadi, M., Rasoulpoor, S., Khaledi-Paveh, B., 2020. Prevalence of stress, anxiety, depression among the general population during the COVID-19 pandemic: a systematic review and meta-analysis. Glob. Health 16 (1), 57.

Shadmi, E., Chen, Y., Dourado, I., Faran-Perach, I., Furler, J., Hangoma, P., Hanvoravongchai, P., Obando, C., Petrosyan, V., Rao, K.D., Ruano, A.L., Shi, L., de Souza, L.E., Spitzer-Shohat, S., Sturgiss, E., Suphanchaimat, R., Uribe, M.V., Willems, S., 2020. Health equity and COVID-19: global perspectives. Int. J. Equity Health 19 (1), 104.

Sharma, G., Volgman, A.S., Michos, E.D., 2020. Sex differences in mortality from COVID-19 pandemic: are men vulnerable and women protected? JACC (J. Am. Coll. Cardiol.): Case Reports 2 (9), 1407–1410.

Simon, R.W., 2002. Revisiting the relationships among gender, marital status, and mental health. Am. J. Sociol. 107 (4), 1065–1096.

Tai, D. B. G., Shah, A., Doubeni, C. A., Sia, I. G., & Wieland, M. L. (n.d.). The disproportionate impact of COVID-19 on racial and ethnic minorities in the United States. Clin. Infect. Dis..

Varma, P., Junge, M., Meaklim, H., Jackson, M.L., 2021. Younger people are more vulnerable to stress, anxiety and depression during COVID-19 pandemic: a global cross-sectional survey. Prog. Neuro Psychopharmacol. Biol. Psychiatr. 109, 110236.

Wilson, J.M., Lee, J., Fitzgerald, H.N., Oosterhoff, B., Sevi, B., Shook, N.J., 2020. Job insecurity and financial concern during the COVID-19 pandemic are associated with worse mental health. J. Occup. Environ. Med. 62 (9), 686–691.

Xiong, J., Lipsitz, O., Nasri, F., Lui, L.M.W., Gill, H., Phan, L., Chen-Li, D., Iacobucci, M., Ho, R., Majeed, A., McIntyre, R.S., 2020a. Impact of COVID-19 pandemic on mental health in the general population: a systematic review. J. Affect. Disord. 277, 55–64.

Zheng, J., Morstead, T., Sin, N., Klaiber, P., Umberson, D., Kamble, S., DeLongis, A., 2021. Psychological distress in North America during COVID-19: the role of pandemic-related stressors. Soc. Sci. Med. 270, 113687.