

Factors Associated with Acute and Persistent Psychological Disturbances During the COVID-19 Pandemic

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Abstract

Background: The emergence of Corona virus disease (COVID-19) and wide-spread counter-measures, such as quarantine and social distancing, can have a significant impact on mental health of individuals.

Methods: This online study anonymously screened 13,332 individuals worldwide for acute psychological symptoms related to Corona virus disease 2019 (COVID-19) pandemic from March 29th to April 14th, 2020. A total of n=12,817 responses were considered valid. n=1077 participants from Europe were screened a second time during May 15th to May 30th to longitudinally ascertain the persistence of psychological effects.

Results: Female gender, pre-existing psychiatric condition, and prior exposure to trauma were identified as notable factors associated with increased acute psychological symptoms during COVID-19. The same factors, in addition to, being related to someone who demised due to COVID-19 and using social media more than usual predicted persistence of psychological disturbances. Optimism, ability to share concerns with family and friends like usual, positive prediction about COVID-19, and daily exercise predicted fewer acute and persistent psychological symptoms.

Conclusions: Females, psychiatric patients, and individuals with previous exposure to trauma are at increased risk of being persistently psychologically affected by COVID-19.

Background

The emergence of novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in December 2019 and the global spread of corona virus disease 2019 (COVID-19) has transpired as the most severe and publicized human crisis in recent history. As of August 1, 2020, the global burden of COVID-19 has exceeded 17 million cases worldwide.¹

Quarantine, isolation, and social distancing have been recommended by the World Health Organization (WHO), Center for Disease Control (CDC), and health officials worldwide to combat the spread of COVID-19.^{2,3} To adequately enforce implementation of these measures, one-third to half of the world remained in complete lock-down for several weeks.⁴ As a result of these extensive lock-down measures, economic markets have demonstrated alarming instability, with little indication of a timely recovery. The International Labour Organization projected that up to 25 million jobs could be affected overall.⁵

The impact of COVID-19 on mental health of the masses has emerged as a matter of enormous concern.⁶ A number of factors related to COVID-19 can adversely affect the mental health of individuals, with an even higher risk in those predisposed to psychological conditions.⁷ Being in quarantine or isolation for extended periods of time has been associated with depression, anger, anxiety, and suicide as reported following the SARS epidemic of the early 2000s.⁷ Similarly, uncertainty of economic recovery and loss of job security are important factors previously associated with neuropsychiatric perturbations.⁸⁻¹⁰

Concerns have also been raised about increase in incidents of domestic violence and ‘screen time’ of individuals during the COVID-19 pandemic,¹¹⁻¹³ which are known risk factors for the development or worsening of psychological conditions.¹⁴ Furthermore, fear and paranoia of being infected with SARS-CoV-2 and the stigma associated with manifesting symptoms such as cough or sneezing could negatively impact mental well-being.¹⁵ The fear of losing a loved one and the grief following loss are other potential disturbances to mental health accompanying disease outbreaks.^{16,17} Finally, it remains a consideration that SARS-CoV-2 may itself have neuropsychiatric manifestations as its effects on the nervous system are increasingly reported in patients who do not exhibit prominent respiratory tract symptoms.¹⁸

A number of studies from China have reported significant increases in symptoms of anxiety, distress, and risk of PTSD in students and health professionals assessed during the COVID-19 pandemic.^{13,19-25} A timely assessment on a global scale is paramount to display the mental health impact of the COVID-19 pandemic. With this data, health systems can strive to improve mental health services to reduce the long-term morbidity and mortality related to the COVID-19 crisis. Furthermore, this information could aid policymakers in improving the compliance of masses to the lock-down measures.⁷

To address this, we assembled a team of health professionals (neuroscientists, psychiatrists, psychologists, data scientists, and medical students) across all continents to develop a global study on the mental health impact of COVID-19. Our primary assessment employed a fully anonymous online survey screening individuals in multiple countries for indicators and/or risk of general psychological disturbance, post-traumatic stress disorder (PTSD), depression, and suicidal ideation. The prevalence of these conditions was then cross-analyzed with participants’ demographics, opinions/outlooks, personality traits, current house-hold conditions, previous psychiatric disease history, and factors associated with COVID-19 to identify specific risk and resilience factors. We found alarming global trends for general psychological disturbances, risk for PTSD and depression, and suicidal ideation that were specifically predicted by participant demographics, personality traits, house-hold conditions, previous psychiatric disease and/or risk factor history and prediction about COVID-19 resolution. A follow-up assessment of the European participants one month later showed persistence of these effects.

Methods (Online)

Study Design

The study comprised a primary and a follow-up assessment. The primary assessment comprised a cross-sectional electronic survey-based assessment of individuals above the age of 18 years willing to participate in the study. The anonymous survey was conducted among participants from diverse demographic groups across continents using standardized self-report scales to screen for general psychological disturbance, risk for PTSD, and symptoms of depression. Specific responses were also independently assessed to screen for suicidal ideation. The survey was available online for a period of 15

consecutive days starting 18:00 Central European Time (CET) on March 29, 2020 and concluding on 18:00 CET on April 14, 2020. The secondary assessment was performed one month after completion of the primary assessment for a period of 15 consecutive days starting 18:00 CET on May 15, 2020 and concluding 18:00 CET on May 30, 2020. The secondary assessment was limited to European participants who had filled the primary survey.

Questionnaire development

The questionnaire was developed via close consultation between a neuroscientist, a neuropsychologist, a psychiatrist, a data scientist, and a psychiatry clinic manager. The questionnaire included closed-ended questions that assessed participant characteristics and opinions, and screened for neuropsychiatric conditions through standardized and validated self-report scales. The questionnaire prototype was prepared in English (Appendix 1) and translated into 10 additional languages (Arabic, Bosnian, French, German, Greek, Italian, Persian, Polish, Spanish, and Turkish; Appendix 2). The translation was performed by bilingual native speakers and vetted by volunteers native to those countries. The feasibility of each questionnaire was confirmed using pilot studies comprised of 10 participants each. These responses were excluded from the final analysis.

The questionnaires (Appendix 1) included a section on participant demographics (age, gender, country, residential setting, educational status, current employment status) house-hold conditions (working/studying from home, home isolation conditions, pet ownership, level of social contact, social media usage, time spent exercising), COVID-19 related factors (knowing a co-worker, friend, or family member who tested positive for or demised due to COVID-19, prediction about pandemic resolution), personality traits (level of optimism, level of extroversion), previous history of psychiatric disease and/or trauma, previous exposure to human crisis, and level of satisfaction with actions of the state and employer during the current crisis. All questionnaires were rated on binary (yes/no) responses or Likert-type scales.

The other sections contained general health assessment based on WHO Self-Reporting Questionnaire-20 (SRQ), Impact of Event Scale (IES), and Beck's Depression Inventory II (BDI).^{24,26,27} These scales were chosen based on their common usage and efficacy in previously employed works studying the psychological impact of human crises, including the SARS epidemic.²⁸⁻³⁶ IES was purposefully adjusted to assess the impact of an ongoing event rather than a past event. For this purpose, the past tense was converted into the present tense in each question without changing the subject matter. This adjustment was performed in consultation with an independent neuropsychologist not involved in the study. For all scales, participants were prompted to think of and report their physical and psychological state during the preceding week. The secondary assessment was only limited to SRQ.

Data Collection

Primary assessment

Using a non-randomized referral sampling (snowball sampling) method, participants were contacted by a team of 70 globally diverse members (study authors and volunteers that have been acknowledged in the acknowledgement section) using electronic communication channels including posts on social media platforms, direct digital messaging, and personal and professional email lists. For primary assessment, the data collection procedures were repeated at least thrice during the data collection period (March 29-April 14, 2020). The data was collected exclusively online for participants under 60 years of age. For participants who were 60 or above, a special provision was allowed for assistance in recording their responses online as older adults are often not comfortable with virtual platforms.³⁷

Our data collection strategy resulted in a total of 13,332 responses during the primary assessment. Surveys completed by participants who were younger than 18 (n = 34), those with missing responses for all dependent variables (n = 112), filled the second time (n = 325), missing geographic location (n = 20), and from WHO AFRO region (n = 24) were excluded from the final analysis. When the responses were missing for individual items, the missing data were considered null and excluded from the analysis for that particular variable. The number of participants for top 12 countries and the regions encompassing the other countries is represented in the Supplementary item S1.

Follow-up assessment

For the follow-up assessments, data collection was limited to European participants only. The data collection team from Europe contacted the potential participants using the same electronic communication channels that were used for data collection during primary assessment. The data collection procedures were repeated three times during the data collection period. A total of 1,077 responses were collected from Europe during the follow-up study. Against the 6,207 responses from Europe collected during the primary assessment, this established a response rate of 17.35%.

Statistical Analysis

All statistical analyses were performed using R version v.3.6.3 and *Rstudio* (Rstudio team, 2015). All figures were produced using the packages *ggplot2* (Wickham et al., 2016) and *CGPfunctions* (Powell, 2020).

Non-adjusted analysis for SRQ, IES, and BDI scores

Mean scores with standard deviations were calculated for SRQ, IES and BDI scores from all valid responses (n = 12,817) and compared across all of the following categorical predictors via Kruskal-Wallis tests with the Chi-square function. The categorical predictors included gender, residential status, education level, employment status, being a medical professional, working remotely from home, satisfaction with employer, satisfaction with the state (government), home-isolation status, interaction with family and friends, social media usage, ability to share concerns with a mental health professional, ability to share concerns with family and friends, prior exposure to a human crisis situation, previous exposure to trauma, level of extroversion, prediction about COVID-19 resolution and one's self-determined role in the pandemic.

Multiple Regression Models for SRQ, IES, and BDI

Multiple linear and logistic regression models were built for SRQ, IES, and BDI using mean scores and cut-offs for respective categorical classification.

For linear regression, generalized linear models with the *glm* function were devised using the *lme4* package (Bates et al., 2015). The three univariate linear regression models, one each for SRQ, IES, and BDI, were fitted and corrected for multiple comparisons followed by *glm* function analyses. Following the Bonferroni correction for multiple comparisons, the p-value threshold was set to 0.017. For each linear regression model, 'age' was entered as a continuous independent predictor whereas all aforementioned predictors were entered as categorical fixed effects. Poisson family and log link function were used to model BDI and SRQ factors. In order to choose the best model (based on Akaike information criterion; AIC or Bayesian information criterion; BIC) from the set of predictors, stepwise model selection was performed from the *MASS* package (Venables et al., 2002).

Logistic regression was performed to generate odds ratios (ORs) for SRQ, IES, and BDI using the following categorization scheme; SRQ: 0 = normal (0–7 points), 1 = concern for general psychological disturbance (8–20 points); IES: 0 = normal (0–23 points), 1 = PTSD is a clinical concern (24–32 points), 2 = threshold for a probable PTSD diagnosis (33–36 points), 3 = Severe condition (high enough to induce immunosuppression) (≥ 37 points). For generating ORs, the variables were regrouped as 0 = no concern versus any type of concern (1/2/3); BDI: 0 = These ups and downs are considered normal (1–10 points), 1 = Mild mood disturbance (11–16 points), 2 = Borderline clinical depression. (17–20 points), 3 = Moderate Depression (21–30 points), 4 = Severe Depression (31–40 points), 5 = Extreme Depression (> 40 points). For generating ORs, the variables were regrouped as 0 = no concern versus any type of concern (levels 1/2/3/4/5). Cut-offs for SRQ, IES, and BDI were defined using least stringent thresholds for each of these measures from previous literature to ensure high sensitivity of the screening.^{24–28} Furthermore, separate OR analysis was performed with reference level set to 0 = absence of symptom that was compared to presence of symptom (varying severity levels of the symptom regrouped into one category). Correlations between SRQ, IES, and BDI were performed through Pearson's correlation test and illustrated as $x \sim y$ plots.

For the follow-up study, a generalized linear model with the *glm* function was fitted using the *lme4* package (Bates et al., 2015). All predictors were entered as categorical fixed effects. Poisson family and log link function were used to model the SRQ factor. An interaction effect was introduced to inspect whether the follow-up assessment and working from home, satisfaction with the employer, having a pre-existing psychiatric condition, closely knowing someone who died of COVID-19, and residence (urban or rural) had a significant effect on SRQ score progression during the primary and follow-up assessments.

All statistical analyses were performed by the analysis team comprising MP, SG, PR, and AJ in consultation with ZB.

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Results

Primary Assessment

A total of 12,817 valid responses were divided across USA (1864), Iran (1198), Pakistan (1173), Poland (1110), Italy (1096), Spain (972), Bosnia and Herzegovina (885), Turkey (539), Canada (538), Germany (534), Switzerland (489) and France (337). The remaining countries were grouped according to WHO regions, i.e. European region EURO (784), East Mediterranean region EMRO (459), Western Pacific region WPRO (326), South East Asian region SEARO (259), and region of the Americas PAHO (254). Over-all, a prominent psychological impact of COVID-19 is evident worldwide with highest SRQ scores (indicating general psychological disturbance) in Bosnia and Herzegovina, Canada, Pakistan, and USA; and highest IES (indicating risk of PTSD) and BDI (indicating risk of depression) scores in Canada, Pakistan, and USA (Main Item 1).

There was a slight disproportion in valid responses over-all, with higher numbers from those participants who were female (72.36%), residing in urban areas (82.87%), with advanced educational qualification, i.e., bachelor's degree or higher (75%), working/studying remotely from home (64.4%), and currently under home-isolation with a partner/family (83.06%). Also, of notable prevalence were factors, such as expressing satisfaction with COVID-19-related employer response (33.91%), being somewhat satisfied with COVID-19-related state response (37.08%), and spending less than 15 minutes on daily physical exercise (48.99%). A majority of participants also reported increased social media usage (65.15%), less-than-usual or minimal interaction with family and friends (70%), and feeling a sense of control in protecting themselves and others during the COVID-19 pandemic (80.86%). Details of participant demographics, household conditions, history of psychiatric conditions and exposure to trauma/crisis, personality traits, and COVID-19 related factors and opinions are presented in Supplementary Item S2.

Unadjusted Analysis of Risk and Resilience Factors for General Psychological Disturbance (SRQ), PTSD Risk (IES), and Depression (BDI)

Unadjusted analyses of SRQ, IES, and BDI scores between different participant demographics/characteristics showed significantly ($p < 0.017$) greater prevalence of psychological symptoms in participants who were female, unemployed, working remotely from home, dissatisfied with

the response of their employer/state to COVID-19, home-isolated alone, with a pet, interacting with friends/family less than usual, using social media more than usual, and in those with less-than-usual ability to share concerns with friends/family. Significantly ($p < 0.017$) higher scores on SRQ, IES, and BDI were also seen in participants who self-reported as being pessimist or introvert, not feeling in control during COVID-19, and having an overall negative prediction about COVID-19 resolution. Means and standard deviations for all comparisons are presented in Main Item 2.

Adjusted Analysis of Risk and Resilience Factors for General Psychological Disturbance (SRQ), PTSD Risk (IES), and Depression (BDI)

Adjusted analysis using different general linear models for each of the questionnaires is reported in Main Item 3. Across all three questionnaires, we found the following relevant risk factors for general psychological disturbance, PTSD, and depression: psychiatric condition that worsened during the COVID-19 pandemic (SRQ mean-coefficient: 0.36, 95% CI: [0.33, 0.39]; IES mean-coefficient: 7.36 95% CI: [6.26, 8.46]; BDI mean-coefficient: 0.38, 95% CI: [0.36, 0.40]), previous exposure to trauma (SRQ mean-coefficient: 0.19, 95% CI: [0.16, 0.22]; IES mean-coefficient: 4.08 95% CI: [3.14, 5.03]; BDI mean-coefficient: 0.20, 95% CI: [0.17, 0.22]) and working remotely from home (SRQ mean-coefficient: 0.07, 95% CI: [0.05, 0.10]; IES mean-coefficient: 1.91, 95% CI: [1.01, 2.82]; BDI mean-coefficient: 0.03, 95% CI: [0.01, 0.05]).

Moreover, significant gender differences were observed, with higher risk in women versus men for general psychological disturbances (SRQ mean-coefficient: 0.23, 95% CI: [0.20, 0.26]), PTSD (IES mean-coefficient: 4.99, 95% CI: [4.03, 5.95]), and depression (BDI mean-coefficient: 0.19, 95% CI: [0.17, 0.21]).

Having an optimistic attitude, positive prediction about COVID-19, and being able to share concerns with family/friends decreased SRQ, IES, and BDI scores, indicating the protective effect of these factors for general psychological disturbance, PTSD and depression (as shown in Main Items 3 and 4). Furthermore, daily physical activity/sport decreased both SRQ (mean-coefficient: -0.19, 95% CI: [-0.23, -0.15]) and BDI (mean-coefficient: -0.15, 95% CI: [-0.18, -0.12]) scores, with greater protective effect with higher duration of the physical activity/sport (exercise ≥ 1 hour more effective in decreasing SRQ and BDI scores compared to exercise > 15 minutes but < 1 hour). In addition, healthcare professionals reported significantly lower BDI scores, suggesting this status to have a protective effect against depression (mean-coefficient: -0.09, 95% CI: [-0.12, -0.06]).

The logistic regression analyses performed after classifying SRQ, IES, and BDI scores into categorical cut-offs confirmed the primary results from the linear regression models (Supplementary Item S3). An individual with pre-existing psychiatric condition that worsened during COVID-19 showed 7-times higher odds of being depressed (OR: 7.10, 95% CI: [6.03, 8.35]), 1.6 times higher odds of having PTSD (OR: 1.60, 95% CI: [1.38, 1.84]) and twice higher odds of having general psychological disturbance (OR: 2.64, 95% CI: [1.99, 3.48]). As expected, individuals with previous trauma exposure exhibited greater ORs than their counterpart for these conditions according to BDI (OR: 1.61, 95% CI: [1.46, 1.76]) and SRQ (OR: 2.62, 95% CI: [2.08, 3.30]). Still, an optimistic attitude and the opportunity to share concerns with family/friends like usual served as a protective factor for general psychological disturbance according to SRQ (OR: 0.51,

95% CI: [0.43, 0.62] and OR: 0.19, 95% CI: [0.15, 0.23] and depression according to BDI (OR: 0.23, 95% CI: [0.20, 0.26] and OR: 0.39, 95% CI: [0.33, 0.45] respectively.

For the ease of understanding, the association of participant-related predictors with categorical classifications for general psychological disturbance (SRQ), PTSD (IES), and depression (BDI) are indicated through box-plots in Supplementary Item S4. Owning a pet, pre-existing psychiatric condition, previous exposure to trauma, considering oneself an introvert, and working remotely from home were associated with decreased %age of responses in the unaffected ('normal') category based on SRQ, IES, as well as BDI, suggesting these as risk factors. Contrastingly, a majority of responses from health professionals landed in the unaffected ('normal') category for BDI, indicating that working as a health professional is a resilience factor against depression during the COVID-19 pandemic.

Correlation between Scales

The continuous scores of all responses on SRQ, BDI, and IES were also analyzed by Pearson's correlations using all possible combinations on $x \sim y$ plotting (SRQ vs. IES, IES vs. BDI, BDI vs. SRQ). All combinations yielded significant correlations with the strongest correlation ($R = 0.79$) between BDI and SRQ (Supplementary Item S5).

Follow-up Study

The demographic distribution of the participants included in the follow-up study of European participants was similar to the primary assessment with higher numbers from those participants who were female (74.57%), working/studying remotely from home (56.95%), and currently under home-isolation with a partner/family (65.30%). A majority of participants also reported increased social media usage (61.94%), less-than-usual or minimal interaction with family and friends (65.30%), and feeling a sense of control in protecting themselves and others during the COVID-19 pandemic (61.85%).

Unadjusted analyses of SRQ scores between different participant demographics/characteristics showed significantly ($p < 0.05$) higher prevalence of psychological symptoms in participants who were female, medical or healthcare professionals, dissatisfied with the response of their employer/state to COVID-19, interacting with friends/family less than usual, using social media more than usual, and in those with less-than-usual ability to share concerns with friends/family. Significantly ($p < 0.05$), higher scores on SRQ were also seen in participants with pre-existing psychiatric conditions, previous exposure to traumatic experiences, and who self-reported as being pessimist or introvert. Means and standard deviations for all comparisons are presented in the Supplementary item S6.

Adjusted analysis using generalized linear model for the SRQ questionnaire is reported in Main Item 5. The following factors were independently associated with increased SRQ scores on the follow-up assessment: psychiatric condition that worsened during the COVID-19 pandemic (SRQ mean-coefficient: 0.41, 95% CI: [0.33, 0.48]; previous exposure to trauma, before and after 17 years old (0.13, 95% CI: [0.06, 0.19], and 0.14, 95% CI: [0.08, 0.19]), and being home alone (0.22, 95% CI: [0.12, 0.31]). In addition, an increased social media usage, working from home, and death of family member due to COVID-19 significantly increased SRQ scores (SRQ mean-coefficient 0.19, 95% CI: [0.07, 0.32]), 0.17, 95% CI: [0.12, 0.23]), and 0.17, 95% CI: [0.07, 0.26]). Moreover, significant gender differences were observed, with higher

scores in women versus men (0.27, 95% CI: [0.22, 0.32]). Having an optimistic attitude and feeling a sense of control in protecting themselves and others during the COVID-19 pandemic decreased SRQ scores in the follow-up study, indicating the protective effect of these factors against persistent general psychological disturbance (SRQ mean-coefficient - 0.26, 95% CI: [-0.32, -0.20]), -0.25, 95% CI: [0.12, 0.23]). Furthermore, participants that were satisfied with the employer/state response to COVID-19, and were able to share concerns with family/friends had lower scores (-0.21, 95% CI: [-0.27, -0.15])/ 0.17, 95% CI: [-0.23,-0.11]), and - 0.10, 95% CI: [-0.19, -0.02]). Furthermore, daily physical activity/sport significantly decreased SRQ score (mean-coefficient: -0.29, 95% CI: [-0.37, -0.22]) with greater protective effect with higher duration of the physical activity/sport (exercise \geq 1 hour more effective in decreasing SRQ score compared to exercise > 15 minutes but < 1 hour).

Finally, by including interaction terms in our regression model, we found that there was a different relationship between residence and SRQ score changes between the primary and the follow-up assessments. Notably, the SRQ scores increased in people living in urban areas compared to those living in rural (mean coefficient of interaction between acute/persistent and residence type: 0.27, 95% CI [0.13, 0.41]). Both people working and not working from home shown a difference between the two phases (mean coefficient of interaction between acute/persistent and working from home: -0.27, 95% CI [-0.41, -0.12]). Moreover, people who reported worsening of pre-existing psychiatric condition during the primary assessment reported lower SRQ scores in the follow-up study, whereas, those with no pre-existing psychiatric condition or a psychiatric condition that did not worsen showed an increase of SRQ scores in the follow-up assessment (mean coefficient of interaction between acute/persistent and psychiatric condition: -0.45, 95% CI [-0.64, -0.28]).

Discussion

This study highlights a significant impact of COVID-19 pandemic on mental health worldwide and provides unprecedented evidence for persistence of these effects in a large population sub-set of European participants.

In addition to reporting prevalence, a major aim of this study was to identify specific risk and resilience factors for psychological perturbations during the current COVID-19 crisis. Worsening of a pre-existing psychiatric condition, female gender, exposure to trauma before age 17, and working remotely predicted higher risk of general psychological disturbance, PTSD, depression, and increased concerns about physical health and appearance. Additionally, considering oneself an introvert was associated with heightened risk of general psychological disturbance and depression; being unemployed, living alone, and limited interaction with family and friends also increased the risk for depression. An overall protective effect against all major psychological perturbations was observed for the following factors; increasing age, considering oneself an optimist, positive prediction about COVID-19 outcome, ability to share concerns with family and friends like usual, daily physical exercise/sport for 15 minutes or more, and being satisfied with the actions of employer/state in response to COVID-19.

To ensure that the psychological symptoms assessed in this study are related to COVID-19 pandemic, the participants were repeatedly prompted to consider COVID-19 and their feelings during the preceding one week while filling in the survey. Furthermore, the phrase 'this crisis' was present in all the screening questions, for example, 'I am unable to sleep well during this crisis'. We would like to further highlight the difference in the proportion (22%) of participants who reported pre-existing psychiatric conditions versus the ones who report general psychological disturbance (43%) assessed through SRQ indicating an impact of COVID-19 pandemic (Supplementary Item S8). Furthermore, we compared the prevalence of depression in all of our featured countries based on different BDI cut offs for depression versus the recent-most available statistics from WHO (2017) and notice a remarkable difference (Supplementary Item S9).

To the best of our knowledge, this study is the first worldwide assessment of the mental health effects of COVID-19. Previous studies on the psychological impact of COVID-19 have been mostly from China^{13, 19-25,39} The largest of these studies (n = 52,730) that surveyed voluntary public participants, reported symptoms of psychological distress in almost one-third of the participants according to the peri-traumatic distress index.⁴⁰ Another notable study, on health professionals (n = 1,255), revealed depression, anxiety, and symptoms of general distress in almost half of participants, and sleep disturbances in almost 8%.¹³ One-third of the participants in a Chinese study on college students (n = 7,143) in the Hubei province reported symptoms of anxiety.²⁵ Some of our observations are supportive of findings in these studies, such as female gender, living alone, and negative prediction about COVID-19 outcome arising as risk factors for psychological perturbations. However, our study identifies several unique risk and resilience factors that were not investigated previously.

Parallels can also be drawn between our study and existing research on the psychological effects of the SARS and other previous epidemics. These studies reported PTSD, anxiety, distress, anger, and confusion as major sequelae of the epidemic and quarantine measures.^{35,41-43} It has previously been reported, however, that very few studies investigated specific risk or protective factors⁷ for these mental health disturbances. One notable study showed longer quarantine duration, boredom, financial instability, stigma, inadequate resources and information deficit to exacerbate the negative psychological impact from the SARS outbreak. In noteworthy contrast to our work, the study was performed several months after the epidemic had occurred.⁴⁴

Identification of specific risk and resilience factors is an essential first step for developing strategies to mitigate the negative psychological impact of COVID-19 at a regional and global level. For example, selective vulnerability of females indicated in this study warrants further investigation for both the contributing factors and the resulting implications of such increased risk. These include social factors such as increased reporting of domestic violence in relation to COVID-19⁴⁵, possible caregiver stress, and the impact of changes in roles and responsibilities secondary to the current health emergency. Furthermore, increased risk of psychological perturbations in individuals with pre-existing psychiatric conditions and/or trauma exposure necessitates the initiation and/or expansion of mental health support

systems available remotely.⁴⁰ Emerging evidence now supports the efficacy of web- and social-media based interventions in promoting mental health of masses focusing on paradigms based on mindfulness, positive psychology, and exercise.⁴⁶⁻⁴⁸ Such interventions could be developed at the governmental and institutional levels and delivered to the masses via main-stream and social media. Indeed, media outlets could also play a major role in promoting optimism and a positive attitude towards COVID-19 resolution, both of which were identified in our study as important resilience factors. Furthermore, the association between remote working with increased psychological symptoms calls for optimization of the work-from-home settings and a greater emphasis on the general well-being of employees. This is further corroborated by the observation that participant satisfaction with the employer-response to the COVID-19 pandemic is associated with reduced psychological symptoms in this study.

This research has several strengths. This study employed the 2nd largest sample size to date in examining the mental health impact of COVID-19, and the number of participants well exceeds previous studies on the SARS epidemic. The only study with a larger sample size⁴⁰ employed a single scale for screening psychological disturbances. The administered measures in our study allowed for simultaneous screening of multiple psychiatric co-morbidities and the findings can provide invaluable insight to global health systems. The availability of the questionnaire in 11 different languages is a notable and unprecedented effort to provide the study as much generalizability as possible. Furthermore, the timing of this study is an important strength. The primary assessment was performed from March 29-April 14, 2020. This timing coincides with the peak of COVID-19 pandemic in North America and Europe—a time period when almost one-half of the world remained in complete lock-down.⁴ The follow-up assessment was performed with a targeted approach in European after a one month interval when the situation had improved considerably in Europe. This longitudinal assessment is a considerable strength of the study. Finally, while cultural and linguistic factors are known to possibly impact psychological outcome measures when translations are utilized, the significant correlation between SRQ, IES, and BDI scores in this study cross-validates the assessment of psychological symptoms and confirms that COVID-19 pandemic is globally affecting the overall mental health of individuals.

The study also has potential limitations that warrant consideration when interpreting the results. First, the study employed a non-randomized sampling strategy. While this method has certain disadvantages, we hope that our results will catalyze the development of more studies on this essential topic that could be conducted by global outlets such as WHO and the European Union (EU) on a world- or continent-wide scale. Second, the data collection was exclusively done in an online format that may exclude those less-versed in web-usage, such as illiterate, disadvantaged, underdeveloped, or rural populations. We tried to reduce this bias by translating the study questionnaire into native/official languages for each of the featured countries. The third considerable limitation is the use of self-reporting scales rather than clinical verification. However, the anonymous nature of the survey and widespread social distancing measures preclude such verification. Additionally, it is not possible to adjust for the confounding effect of non-COVID-19-related individual crisis situations on participant responses. We tried to reduce this effect by

formatting survey questions in such a way that would prompt participants to consider their mental state over the preceding week, rather than current mood.

Utilizing the 'feedback' feature in our online questionnaire, several participants expressed that participation in the survey helped them focus on their mental health. Furthermore, a number of participants reported eating more than usual for comfort or out of boredom. This feedback could aid in efforts to develop mental health screens specific to COVID-19 pandemic.⁴⁹

Conclusions

In conclusion, this effort highlights a significant impact of the COVID-19 pandemic at a regional and worldwide level on the mental health of individuals and elucidates prominent associations with their demographics, history of psychiatric disease risk factors, house-hold conditions, personality traits, and attitude towards COVID-19. These results could serve to inform health professionals and policymakers across the globe, aiding in dynamic optimization of mental health services during and following the COVID-19 pandemic, and reducing its long-term morbidity and mortality.

Abbreviations

COVID-19: Corona virus disease 2019

SARS-CoV-2: Severe acute respiratory syndrome-Corona virus-2

CDC: Center for disease control

WHO: World health organization

SRQ: Self report questionnaire

IES: Impact of event scale

BDI: Beck's depression inventory

PTSD: Post-traumatic stress disorder

CI: Confidence interval

SARS: Severe acute respiratory syndrome

Declarations

Ethical approval and consent to participate:

Written informed consent was obtained from each participant to allow anonymous recording and analysis of their answers. The data was collected in a completely anonymous fashion without recording any personal identifiers. This strategy ensured that the confidentiality of the participants was maintained throughout all phases of the study. The study procedures were reviewed and approved by University of Zurich Research Office for Scientific Integrity and Cantonal Ethics Commission for the canton of Zurich (Switzerland; Appendix 3), Nencki Institute of Experimental Biology, Warsaw (Poland; Appendix 4), Faculty of Medicine, and University of Tuzla, Tuzla (Bosnia and Herzegovina; Appendix 5).

Consent for publication:

Not applicable.

Availability of data and materials:

All data presented in the main and supplementary items are deposited on the repository below and are available for verification upon request.

https://osf.io/3vupe/?view_only=80f71b6f0c8d49b08573ea12eab10d33

Competing interests:

The authors declare no competing interests.

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Author contributions:

MP and SG contributed in conceptualization, questionnaire development, data collection, data mining, data analysis, visualization, review and editing. RN contributed in data collection, manuscript writing, review and editing. BS, SL, KA, AD, AB, LH, SE, HJ, LRP, VW, BA, MB, and DS contributed in questionnaire translation, data collection, data mining, review, editing, and project co-ordination. PR contributed in data analysis and visualization. ZA contributed in data collection, manuscript writing, review, and editing. ZB contributed in data analysis. ZH and SUQ contributed in data collection and project co-ordination. AMS contributed in data collection, project administration, and editing. AJ contributed in conceptualization, questionnaire development, study approval, data collection, data analysis, data visualization, manuscript writing, review, editing, project administration and supervision. All authors have reviewed and approved the final draft.

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Figures

Main Item 1

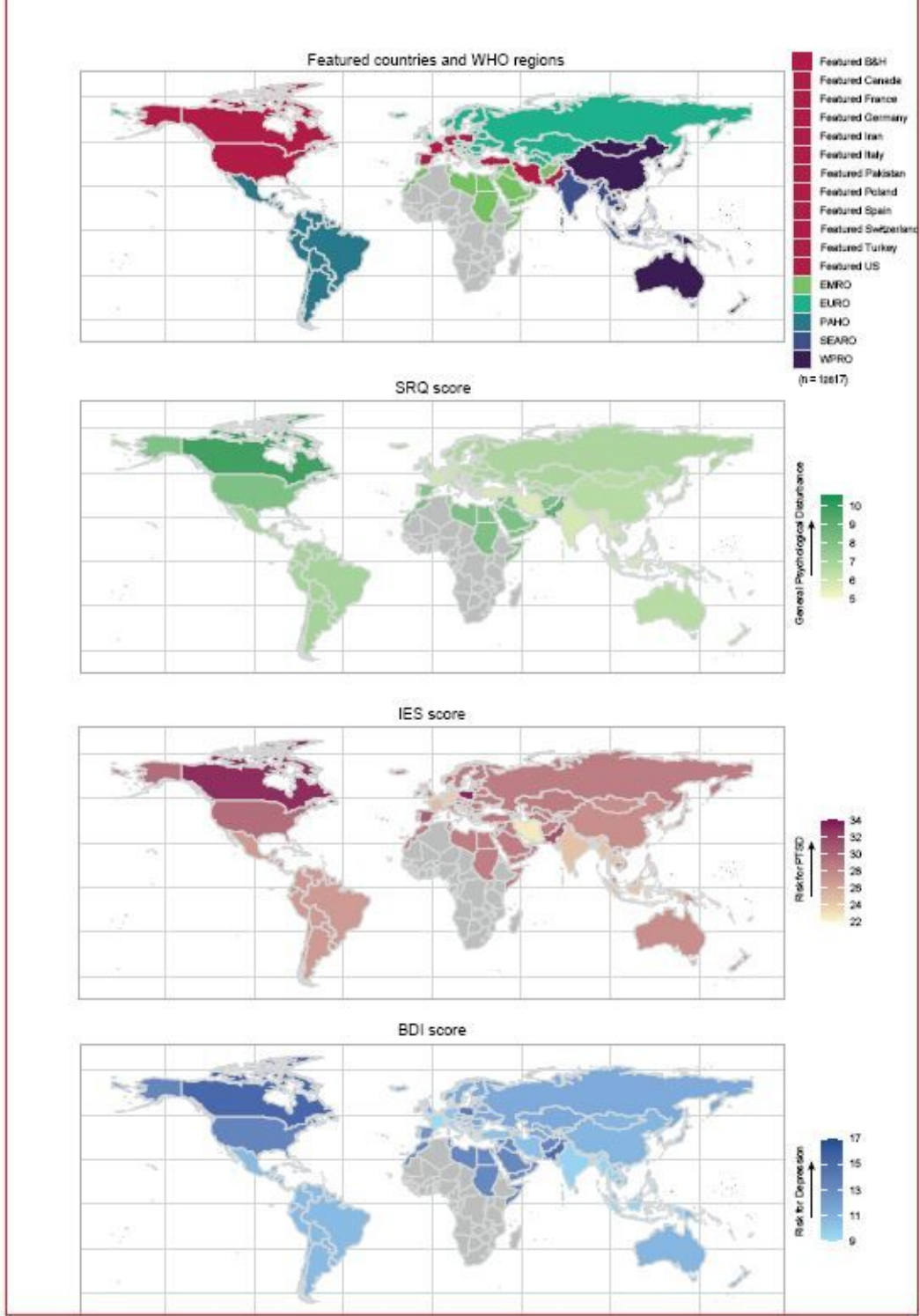


Figure 1

Geodemographic representation of global mental health burden. First map presents featured countries (red) and remaining countries divided according to WHO regions. Remaining maps present mean scores from SRQ, IES and BDI respectively. The means were calculated separately for each of the featured countries, and for each of the WHO regions. Total number of responders is 12,817, distributed as follows: USA (1864), Iran (1198), Pakistan (1173), Poland (1110), Italy (1096), Spain (972), Bosnia and

Herzegovina (885), Turkey (539), Canada (538), Germany (534), Switzerland (489), France (337), and in remaining countries from WHO regions: WHO European region EURO (784), WHO East Mediterranean region EMRO (459), WHO Western Pacific region WPRO (326), WHO South East Asia region SEARO (259) and WHO region of the Americas PAHO (254). First panel: featured top 12 countries (in red) and remaining countries divided according to WHO regions; Second panel: mean scores for Self-Reporting Questionnaire (SRQ) indicating general psychological disturbance; Third panel: mean scores for Impact of Event Scale (IES) indicating risk for post-traumatic stress disorder (PTSD); Fourth panel: mean scores for Beck's Depression Inventory (BDI) indicating risk for depression. All mean scores were calculated separately for the featured top 12 countries and WHO regions. Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.

Predictors		SRQ	IES	BDI
Gender	Male	5.29 ± 4.64	23.57 ± 14.06	9.17 ± 9.07
	Female	7.62 ± 5.05	30.22 ± 14.16	12.88 ± 10.05
	Non-binary	9.98 ± 5.87	34.18 ± 16.81	18.58 ± 11.78
	Not disclosed	7.09 ± 5.32	27.78 ± 15.8	13.11 ± 10.61
		0.88 ± 5.08	20.07 ± 14.58	11.74 ± 9.6
Residence	Rural	7.08 ± 5.06	28.63 ± 14.43	12.04 ± 10.04
	Urban	7.05 ± 5.09	27.64 ± 14.58	12.56 ± 10.51
Education	Compulsory	7.05 ± 5.07	26.87 ± 14.42	11.84 ± 9.81
	Advanced	6.35 ± 4.84	26.54 ± 14.05	10.3 ± 9.02
Work Status	Private employed	6.63 ± 5.17	28.22 ± 14.71	11.02 ± 9.56
	Public employed	6.3 ± 4.81	27.59 ± 14.42	10.67 ± 9.32
	Freelancer	8.14 ± 5.26	29.9 ± 15.07	13.96 ± 11.12
	Unemployed	7.89 ± 5.09	26.61 ± 14.44	12.12 ± 10.04
Medical or healthcare professional	No	6.5 ± 4.87	20.61 ± 14.05	10.76 ± 9.19
	Yes	8.63 ± 5.01	27.6 ± 14.88	11.7 ± 10.1
Remotely working from home	No	7.25 ± 5.08	29.04 ± 14.22	12.15 ± 9.91
	Yes	8.7 ± 5.22	32.39 ± 15.24	15.18 ± 11.31
Opinion about employer response to COVID-19	Somewhat satisfied	7.64 ± 5.01	29.8 ± 14.18	12.71 ± 9.76
	Satisfied	5.92 ± 4.83	26.42 ± 14.15	9.83 ± 8.99
Opinion about state response to COVID-19	Not satisfied	7.18 ± 5.14	30.83 ± 14.76	13.74 ± 10.66
	Somewhat satisfied	7.08 ± 4.86	28.55 ± 13.88	11.89 ± 9.42
Home Isolation	Satisfied	6.25 ± 5	26.31 ± 14.48	10.37 ± 9.61
	Not isolated	5.29 ± 4.58	25.2 ± 14.68	9.44 ± 9.01
Individual home isolation	Individual home isolation	7.88 ± 5.37	30.04 ± 15.15	13.25 ± 10.58
	Home isolation with family or partner	7.14 ± 5.05	28.7 ± 14.34	12.1 ± 9.97
Presence of pet at home	No pet at home	6.81 ± 5	27.82 ± 14.37	11.55 ± 9.55
	Pet at home	7.48 ± 5.16	29.74 ± 14.57	12.85 ± 10.16
Interaction with family or friends	Less than usual	7.57 ± 5.02	29.77 ± 14.18	12.62 ± 9.87
	Minimal interaction	7.14 ± 4.89	26.89 ± 14.38	12.74 ± 9.42
	Like usual	6.41 ± 4.89	27.45 ± 14.69	10.89 ± 9.42
Use of social media	Less than usual	7.61 ± 5.37	29.89 ± 16.06	13.47 ± 11.42
	Like usual	5.58 ± 4.7	25.28 ± 14.2	10.17 ± 9.33
	More than usual	7.84 ± 5.07	29.89 ± 14.22	12.69 ± 10.03
Time dedicated to physical exercise	Less than 15 minutes	7.7 ± 5.17	29.33 ± 14.82	13.22 ± 10.61
	More than 15 minutes	6.65 ± 4.9	26.26 ± 13.91	11.08 ± 9.04
	More than 1 hour	5.72 ± 4.15	26.56 ± 14.3	10.06 ± 9.27
Close person positive for COVID-19	No	6.97 ± 5.09	28.25 ± 14.55	12 ± 10.07
	Yes	7.28 ± 5.02	29.43 ± 14.16	12.01 ± 9.71
	Close person demised due to COVID-19	No	7.04 ± 5.08	28.53 ± 14.52
Psychiatric Condition	Yes	7.07 ± 4.95	28.71 ± 13.67	11.76 ± 9.81
	No psychiatric condition	6.21 ± 4.7	26.8 ± 13.88	10.34 ± 8.83
	No change in pre-existing psychiatric condition	6.18 ± 4.31	25.74 ± 13.14	10.63 ± 8.53
Ability to share concerns with health professional	Worsening of pre-existing psychiatric condition	12.2 ± 4.12	40.57 ± 12.84	22.53 ± 10.75
	No	8.44 ± 5.16	31.79 ± 14.46	14.5 ± 10.74
	Yes	7.52 ± 5.11	30.09 ± 14.87	12.88 ± 10.35
Ability to share concerns with family or friends	No	9.32 ± 5.89	31.59 ± 16.29	17.87 ± 13.25
	Less than usual	9.78 ± 4.99	34.88 ± 14.23	17.06 ± 10.6
	Like usual	5.95 ± 4.59	26.37 ± 13.67	9.78 ± 8.35
Previous exposure to crisis	No	7.05 ± 5.02	26.52 ± 14.21	11.99 ± 9.92
	Yes	7.03 ± 5.2	26.79 ± 15.12	12.11 ± 10.15
Previous exposure to traumatic experiences	No	6.21 ± 4.75	26.4 ± 14.05	10.46 ± 9.07
	Yes	8.03 ± 5.3	31.48 ± 14.8	13.99 ± 10.87
	Yes (before the age of 17)	7.81 ± 5.1	29.57 ± 13.87	12.92 ± 10.44
Personality	Extrovert	6.36 ± 4.89	27.49 ± 14.36	10.42 ± 9.09
	Introvert	7.66 ± 5.16	29.05 ± 14.42	13.16 ± 10.45
Personality	Pessimist	9.89 ± 4.98	34.89 ± 14.46	18.41 ± 11.23
	Optimist	5.57 ± 4.62	25.81 ± 13.81	8.86 ± 7.92
	Realist	7.23 ± 4.98	28.86 ± 14.24	12.81 ± 9.95
Prediction about COVID-19 outcomes/resolution	It might be the end of human race	10 ± 5.42	36.41 ± 16.48	21.88 ± 13.95
	It will resolve after many months or years	7.81 ± 5.2	30.62 ± 14.92	13.64 ± 10.68
	It will resolve in the summer but not within a month	6.76 ± 4.93	27.94 ± 13.93	11.25 ± 9.41
	It will resolve within a month	6.36 ± 5.21	26.63 ± 14.6	10.62 ± 9.7
Self-opinion in COVID-19 pandemic	It is not in my control at all	10.11 ± 5.39	34.77 ± 18.5	18.65 ± 13.7
	It is not in my control but I can take precautions to protect myself	7.83 ± 5.3	30.39 ± 15.23	13.45 ± 10.66
	It is not in my control but I can take precautions to protect myself and also others	6.77 ± 4.96	28.03 ± 14.1	11.48 ± 9.51

Figure 2

Comparison of psychological symptoms between different participant demographics/characteristics. This table shows means ± standard deviations of participants' SRQ, IES, and BDI scores divided according to different participant demographics/ characteristics and compared through unadjusted Kruskal-Wallis tests. Significant differences (p-value threshold set to <0.017 after multiple-comparisons

correction) in mean scores are highlighted as bold. Each bold association indicates difference in categories reported in the predictors column vertically.

Main Item 3

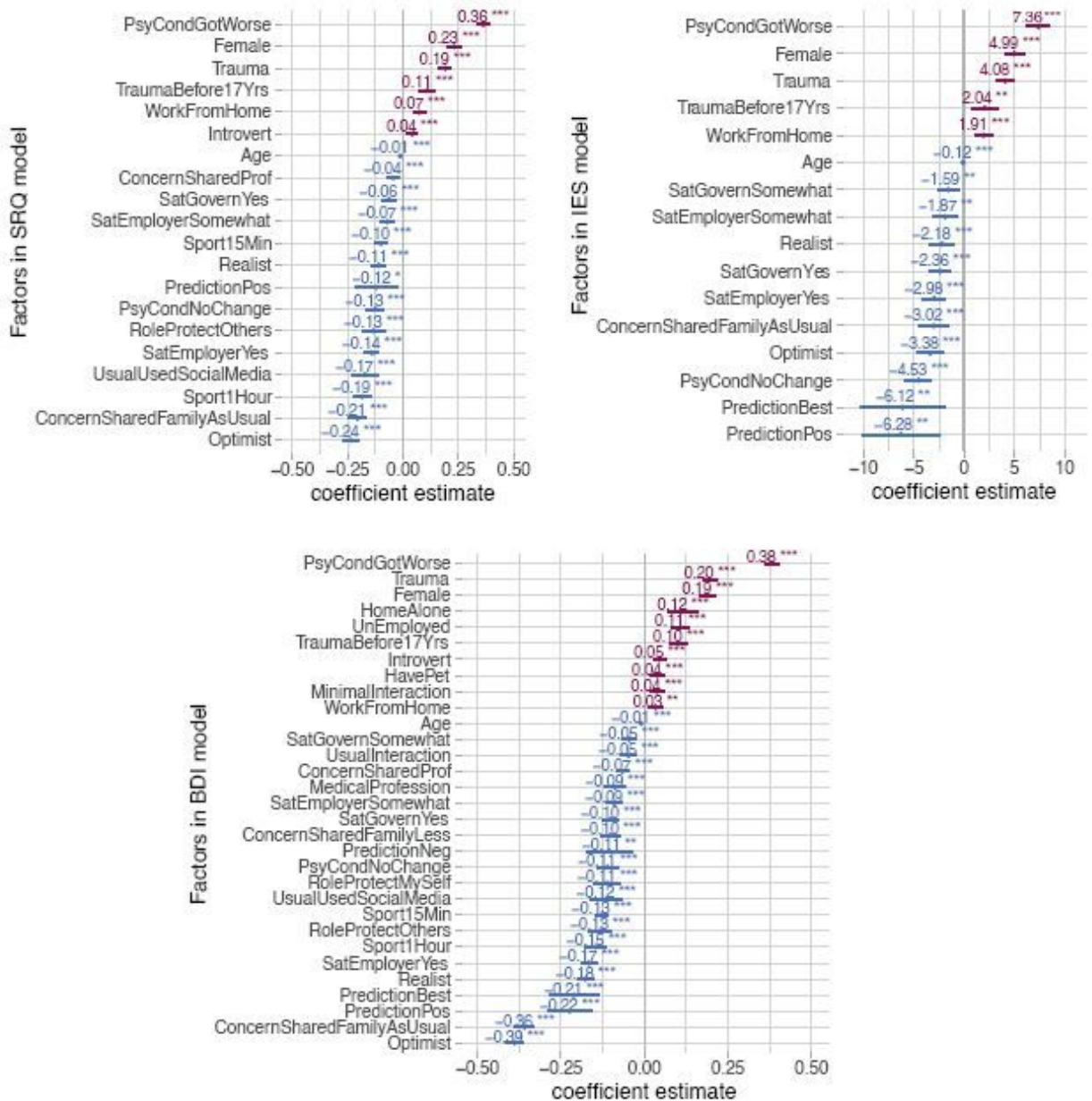


Figure 3

Risk and resilience factors for general psychological disturbance (SRQ), risk for PTSD (IES), and depression (BDI). These forest-plots show the mean estimates and the 95% confidence intervals (CI) for adjusted coefficients significantly affecting SRQ, IES and BDI scores respectively generated through multiple regression models. Only predictors that survived Bonferroni correction for multiple comparisons

($p < 0.017$) are listed. Risk associations (i.e. increase in scores) are shown in red while resilience associations (i.e. decrease in scores) are in blue.

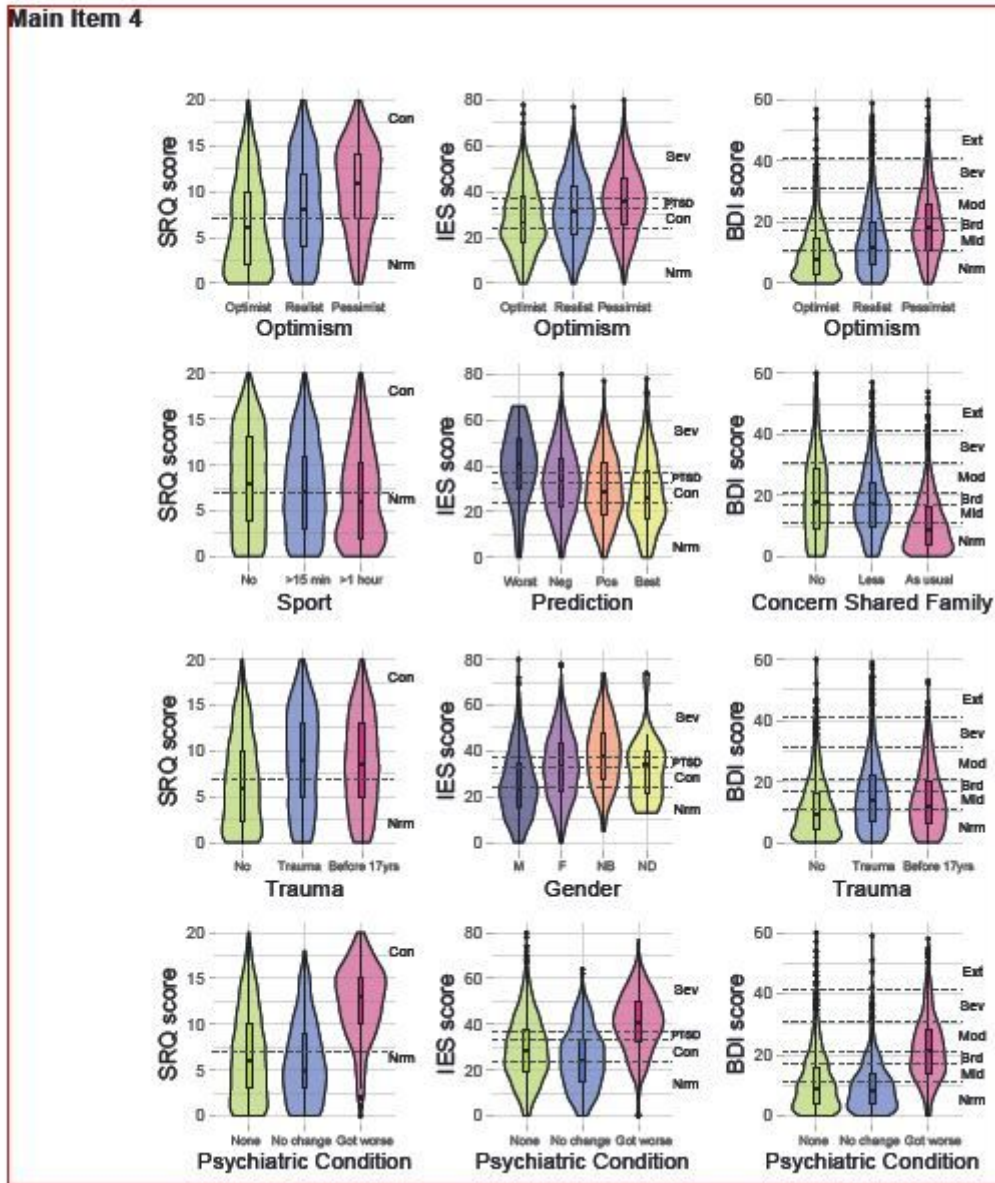


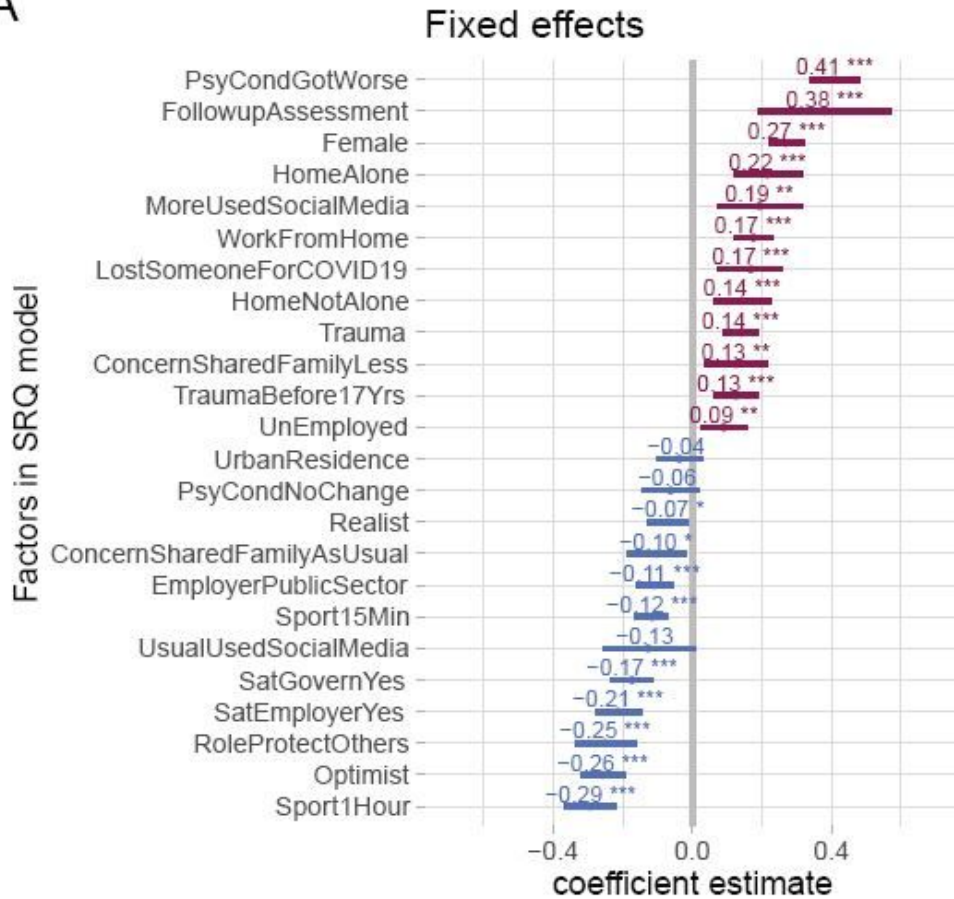
Figure 4

Violin plots indicating the effects of selected predictors on general psychological disturbance (SRQ), risk for PTSD (IES), and depression (BDI). These plots provide a relation between the participant scores on SRQ, IES, and BDI; and participant characteristics (previous history of a psychiatric condition, past exposure to trauma, prediction about COVID-19 resolution, and level of optimism, gender and daily physical activity/sport adjusted for confounding variables through multiple regression models. Boxplots display the distribution of the selected predictors with the visualization of five summary statistics (minimum, maximum, median, first quartile, third quartile), and all outliers individually. Violin plots added behind the boxplots visualize the probability density of selected predictors. Parallel to the x-axis, dashed lines present cut-offs for the scales used- For BDI: Ext - "Extreme", 40 + points, Extreme Depression; Sev -

“Severe”, 31-40 points, Severe Depression; Mod- “Moderate”, 21-30 points, Moderate Depression; Brd - “Borderline”, 17-20 points, Borderline clinical depression; Mld - “Mild”, 11-16 points, Mild mood disturbance; Nrm - “Normal”, 1-10 points, Considered normal For SRQ: Con - “Concern”, 8-20 points, Clinical concern for General Psychological Disturbance; Nrm - “Normal”, 0-7 points For IES: Sev- “Severe”, 37+ points, symptoms high enough to suppress the immune system; PTSD - “Post Traumatic Stress Disorder”, 34-36 points; Con - “Clinical Concern for possible PTSD”, 24-33 points, Nrm - “Normal”, 0-23 points

Main Item 5

A



B

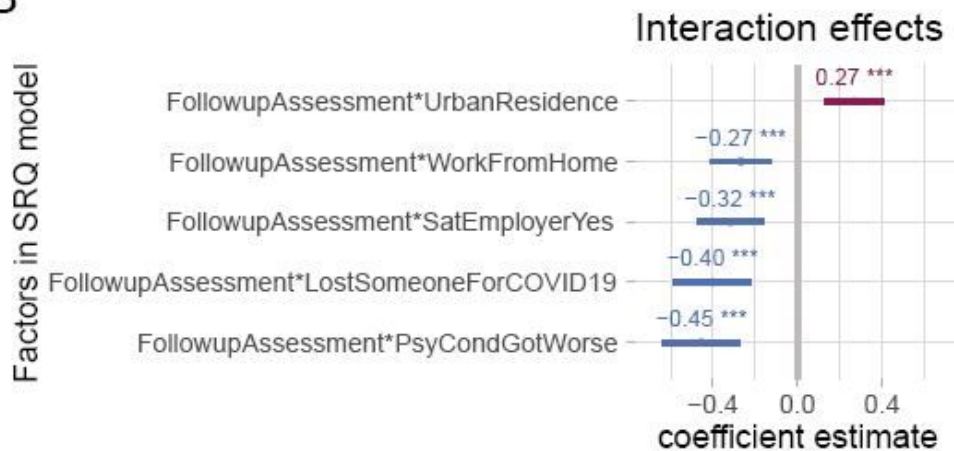


Figure 5

Factors associated with persistent general psychological disturbance on follow-up assessment. These forest-plots show the mean estimates and the 95% confidence intervals (CI) for adjusted coefficients affecting SRQ generated through multiple regression. Panel a shows fixed predictor for SRQ scores during the follow-up assessment. Panel b indicates interaction terms included in our regression model, indicating a significant difference between the fixed effects and SRQ scores during the first phase of the data collection and the follow-up assessment. Factors increasing SRQ score are shown in red and factors decreasing SRQ scores are shown in blue.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Plomeckaetal.Appendix1QuestionnaireinEnglish.pdf](#)
- [Plomeckaetal.Appendix3ZurichCantonalEthicsCommission.pdf](#)
- [Plomeckaetal.Appendix5MedicalFacultyofTuzlaApproval.pdf](#)
- [Plomeckaetal.Appendix4NenckiInstituteapprovalletter.pdf](#)
- [Plomeckaetal.SupplementaryItems3.docx](#)
- [Plomeckaetal.MainItems2.pdf](#)