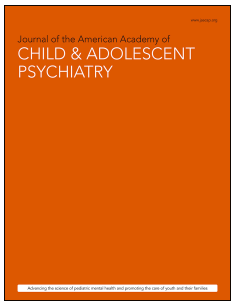
# Journal Pre-proof




Collaborative Outcomes Study on Health and Functioning During Infection Times (COH-FIT): Global and Risk-Group Stratified Course of Well-Being and Mental Health During the COVID-19 Pandemic in Adolescents

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# Collaborative Outcomes Study on Health and Functioning During Infection Times (COH-FIT): Global and Risk-Group Stratified Course of Well-Being and Mental Health During the COVID-19 Pandemic in Adolescents

RH = COH-FIT Adolescents: Risk Factors

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Editorial
DEI
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## ABSTRACT

**Objective.** To identify the COVID-19 impact on well-being/mental health, coping strategies and risk factors in adolescent worldwide.

**Method.** Anonymous online multi-national/language survey in the general population (representative/weighted non-representative samples, 14-17years), measuring change in well-being (WHO-5/range=0-100) and psychopathology (validated composite P-score/range=0-100), WHO-5 <50 and <29, pre- versus during COVID-19 pandemic (26/04/2020-26/06/2022). Coping strategies, nine a-priori defined individual/cumulative risk factors were measured. $\chi^2$, penalized cubic splines, linear regression, and correlation analyses were conducted.

**Results.** Analyzing 8,115 of 8,762 initiated surveys (representative=75.1%), the pre-pandemic WHO-5 and P-score remained stable during the study (excluding relevant recall bias/drift), but worsened intra-pandemic by 5.55±17.13 (standard deviation) and 6.74±16.06 points, respectively (effect size d=0.27 and d=0.28). The proportion of adolescents with WHO-5 scores suggesting depression screening (<50) and major depression (<29) increased from 9% to 17% and 2% to 6%. WHO-5 worsened (descending magnitude, with cumulative effect) in adolescents with a mental or physical disorder, female gender, and with school closure. Results were similar for P-score, with the exception of school closure (not significant) and living in a low-income country, as well as not living in a large city (significant). Changes were significantly but minimally related to COVID-19 deaths/restrictions, returning to near-pre-pandemic values after >2 years. The three most subjectively effective coping strategies were internet use, exercise/walking, and social contacts.


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**Conclusion.** Overall, well-being/mental health worsened (small effect sizes) during early stages of COVID-19, especially in vulnerable subpopulations. Identified at-risk groups, association with pandemic-related measures, and coping strategies can inform individual behaviours and global public health strategies.

**Study preregistration information:** Physical and mental health impact of COVID-19 on children, adolescents, and their families: The Collaborative Outcomes study on Health and Functioning during Infection Times - Children and Adolescents (COH-FIT-C&A); https://doi.org/10.1016/j.jad.2021.09.090

**Diversity & Inclusion Statement:** We worked to ensure sex and gender balance in the recruitment of human participants. We worked to ensure race, ethnic, and/or other types of diversity in the recruitment of human participants. We worked to ensure that the study questionnaires were prepared in an inclusive way. The author list of this paper includes contributors from the location and/or community where the research was conducted who participated in the data collection, design, analysis, and/or interpretation of the work. We actively worked to promote inclusion of historically underrepresented racial and/or ethnic groups in science in our author group. We actively worked to promote sex and gender balance in our author group. One or more of the authors of this paper self-identifies as a member of one or more historically underrepresented racial and/or ethnic groups in science.

**Key words:** COVID-19; pandemic; survey; WHO-5; p-factor; well-being; mental health; Psychiatry; Adolescents

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## INTRODUCTION

Since the beginning of the COVID-19 pandemic, many studies have measured the impact of the pandemic and related restrictions on the mental health of children and adolescents[1]. Meta-analytic evidence shows overall a slight deterioration in some measures of psychopathology from the pre-pandemic to intra-pandemic times[2]. However, findings were mixed, likely owing to high cross-study heterogeneity, without clear patterns across psychopathology measures.

Many studies of the COVID-19 impact on children and adolescents have multiple limitations, namely focusing on the assessment of isolated domains of psychopathology, with an emphasis on internalising behaviors, reliance on small samples, reflecting the practical challenges of recruiting larger samples during the pandemic, or restricting data collection to one country/location/language or population subgroup. Moreover, studies considered one single time point with a cross-sectional design, or did not account for variation in death rate, severity of the COVID-19 pandemic in specific geographic areas, and restriction measures over time. High cross-study heterogeneity regarding design, setting, assessment tools, timing of baseline and follow-up assessment, and time between baseline and follow-up assessments, limits the generalizability of findings of individual studies, posing methodological barriers to evidence synthesis efforts. Finally, studies focused on psychopathology only, neglecting coping strategies.

The Collaborative Outcomes study on Health and Functioning during Infection Times (COH-FIT, www.coh-fit.com) is an international survey study, conducted in 30 languages in representative/weighted non-representative samples, in adults, adolescents, and children[3,4]. COH-FIT has been measuring well-being and the psychopathology factor (P-score), a validated composite mental health measure[5], in the general population across all continents since April-26-2020, including a retrospectively recalled pre-pandemic assessment, comprehensive

multidimensional factors relevant for well-being and mental health. Here, we report globally in adolescents findings of the two co-primary outcomes, well-being and the P-score, hypothesizing reduced well-being and increased psychopathology globally, with increased impairment in vulnerable subgroups and a relationship to death rates and stringency measures over time, and with cumulative effects across multiple risk factors. We also assessed subjectively most effective coping strategies for dealing with the impact of the pandemic.

## METHOD

COH-FIT has been approved by local authors' institutional ethics committees, as per protocol[3,4].

### Outcomes

The two co-primary outcomes were the pre- versus intra-pandemic change of wellbeing (World Health Organization, WHO-5[6]), and composite psychopathology "P-score", a validated 5-dimensional measure composed of anxiety, depressive, post-traumatic, psychotic, and psychophysiologic (stress, sleep problems, and concentration problems) symptoms[5]. As in adults, in COH-FIT-Adolescents, anxiety items were extracted from the Generalized Anxiety Disorder 7 (GAD-7)[7], depression, sleep, and concentration items from the Patient Health Questionnaire 9 (PHQ-9)[8], post-traumatic items from the post-traumatic stress disorder (PTSD) Checklist for DSM-5 (PCL-5)[9], stress items from the WHO-5 wellbeing scale[6], and psychotic items from the Prodromal Questionnaire-16 (PQ-16)[10]. Obsessive-compulsive and manic symptoms did not meet our threshold for external validation in adults, and so were not included in the P-score (both in adults and adolescents)[5]. Participants were asked to answer each item in relation to the period "during the last two weeks", and, "during the last two weeks of your regular life" before the

pandemic. Symptoms were rated on a 0-100 visual analogue scale for both outcomes, with higher values indicating better wellbeing (WHO-5) and poorer mental health (P-score). We also computed the proportion of subjects with WHO-5 <50 (indication for testing for depression), and <29 (indicative of major depression)[6], pre- and intra-pandemic.

We further asked participants to rate how important ("very", "somewhat", "not") the following coping strategies were: exercise, internet use, direct social contact, hobby, information about the COVID-19 pandemic, media, social media, work, studying/learning, pet, physical intimacy, prescribed medications, religion/meditation/spirituality, gaming, substance use, or other strategies. The list of coping strategies has been identified a-priori based on authors' clinical experience, diverse cultural background and a targeted review of the literature [11–13].

We tested for the presence of recall bias for retrospectively recalled pre-pandemic ratings over the time of data collection, performing polynomial regression analyses to assess linear or quadratic relationships.

**At-risk groups**

We previously identified a priori 12 literature-based risk factors for poor well-being/mental health in adults, namely present/past COVID-19 infection, age ≤30, female sex, being unemployed, healthcare worker employment, mental disorder diagnosis, physical disorder diagnosis, first-generation immigrant status, large city location, low-income country location, obesity, and having lost someone due to COVID-19[14,15] (Table S1, available online). For adolescents, we used 9 risk factors, excluding four adult risk factors and including an additional one of school closures. We excluded age considering adolescents as one homogeneous age group, employment status and being a healthcare worker, as minors typically do not work in

developed countries, and being obese, as growth charts and not body mass index thresholds better describe overweight/underweight status in minors. In country-income analyses, we only retained data from those countries where at least 100 analyzable surveys were available.

**COVID-19 deaths and restrictions**

Time-/region-specific COVID-19 daily deaths were extracted from the Johns Hopkins University repository (https://coronavirus.jhu.edu/data)We also included the Oxford stringency index which provides a daily rating for different countries indicating the severity of government-imposed restrictions (0-100) at the time of survey completion based on nine comprehensive metrics, e.g. school closures, facial coverings) (https://covidtracker.bsg.ox.ac.uk/). All reporting followed a Consensus-Based Checklist for Reporting of Survey Studies (CROSS)[16] (eChecklist).

**Translations and P-score validation**

COH-FIT translations have been validated in adults[5]. The P-score in COH-FIT-Adolescents followed the same structure and was based on the same items as the validated P-score in adults. Since validated questionnaires in adults have not been validated in minors, any concurrent validation would not have been informative, due to lack of validity of the external validator. Hence, we only performed internal psychometric validation of P-score in adolescents.

For internal validation, we performed confirmatory factor analysis (CFA) testing the fit of a model with the same second-order P-score and first-order depression, anxiety, post-traumatic, psychotic, and psycho-physiologic domains validated in adults[5]. In addition, we assessed the fit of three plausible alternative candidate models: a (1) unidimensional model (2) correlated five-

factor model, and (3) bifactor model[17] with all factors uncorrelated. Criteria for adequate model fit were: comparative fit index (CFI)>0.95, root mean square error of approximation (RMSEA)<.06, and standardized root mean square residual (SRMR) <.08[18]. We also computed Bayesian Information Criterion (BIC) which is suitable for the direct comparison of non-nested models (e.g. bifactor vs. correlated-factors), where lower BIC is indicative of better fit. Mean-adjusted maximum likelihood was used to estimate parameters with robust standard errors and Satorra-Bentler scaled test statistics to account for any non-normality[19] Sampling weights were applied to all CFA analyses. Overall and individual internal domain reliabilities were estimated with coefficient ω[20].

Equivalence of P-scale measurement across different survey languages and countries, as well as across gender, was tested in a hierarchical manner[21], assessing model fit after applying increasingly restrictive equality constraints across groups. Specifically, we modelled identical factor structures across groups (configural invariance), equal factor loadings (metric invariance) and equal item intercepts (scalar invariance), which is generally considered sufficient for valid measurement of latent means for any subsequent hypothesis testing [17]. To maximise reliability of estimates we excluded any subgroups with N<200 (e.g. non-binary gender or countries with minimal survey administration). Using Chen's 2007[22] guidelines, a change in the following fit indices was used as indicative of nonvariance: CFI < -.01 *and* either RMSEA >.015 or SRMR>.03 (loadings)/SRMR>.01(intercepts). We did not use chi-square to assess invariance, given this is excessively sensitive to negligible changes in fit for large sample sizes [22].

All analyses were conducted in *R*[23] using the *MICE*[24], *ggplot2*[25], *MVN*[26], *psych*[27] and *lavaan*[28] packages.

**Data analysis**

COH-FIT-Adolescents items were identical to COH-FIT-Adult items[5]. Missing item data were imputed using multivariate chained equations with predictive mean matching[29] for continuous and logistic regression for categorical values as described in Supplement 1, available online. Outliers were identified using a high threshold of |z|=5.0, winsoring them to the next highest non-outlying value. Non-representative samples were weighted for sex according to representative distribution in each country.

To examine changes in outcomes across pre- vs. intra-pandemic time periods, we performed mixed-effects linear regression with country as a random-effect. We allowed regression slopes for time to vary across countries given that the impact of time across different nations is likely varied. McNemar's $\chi^2$ test was also used to compare change in the proportion of WHO-5 <50 and <29 scores during pre- vs. intra-pandemic time periods. Finally, we examined whether the presence of multiple concomitant risk factors was associated with worse outcomes by regression analyses on WHO-5/P-score using a cumulative risk score (0-9). This risk score was derived by summing the number of at risk groups to which each participant belonged as identified *a priori*.

Descriptive trends in the wellbeing and P-score changes over time were explored with cubic regression splines. This approach fits a series of smoothed local piecewise regressions analyses across different time intervals[30] and may be particularly sensitive to revealing sudden temporal

changes that might occur with COVID-related events such as policy changes. These analyses were performed in the whole sample using ten equally-spaced spline intervals, together with COVID-19 deaths and restrictions. This analytic approach was applied to provide descriptive data on possible trends with no inferential analyses conducted.

We conducted a correlation analysis among co-primary outcomes. We conducted correlation and smoothed regression analyses to measure the association of outcomes with COVID-19 deaths, stringency, and time since pandemic start. STATA [31]was used for regression analyses for cumulative risk factors and correlation analyses, and R for all other analyses.

**Sample weights**

While the majority of the sample was obtained through representative sampling via survey organisations, around 25% of the data were acquired through non-probabilistic sampling. On average, this non-probabilistic subsample had a higher female:male respondent ratio (Table 1). Post-stratification adjustment weights were used to provide a representative distribution of sex within each country based on national population statistics. In the adult COHFIT survey population, we also weighted for age, education and employment status (data under review). Here, we weighted only for sex, as (i) employment and education classifications are not relevant to an adolescent sample, and (ii) the age-band used to define adolescents (14-17 years) is already narrow, and population figures frequently report age statistics using age-bands that extend beyond the adolescent age range (commonly 15-19 years).

## RESULTS

**Survey sample**

Surveys were administered between 27-Apr-2020 and 11-Jun-2022, yielding 8,762 surveys. Excluding 642 participants completing <50% of items and 5 respondents without obtainable stringency index information, data from 8,115 adolescents (representative=75.1%, age=15.6 (range=14-17 years), females=49.4%, males=50.1%, non-binary=0.4%, transgender/intersex= 0.1%.) suitable for regression analyses were analysed.

**Data Screening**

Missing data was ≤1% for all items except immigration status (9%), helping others (5%) and receiving a positive COVID test (57%). For detailed participant characteristics, see Table 1. Patterns of missingness were explored across all included variables with the Anderson-Darling rank test[26]. This was significant (median T = 18.64, median p <.001), suggesting that data was not 'missing completely at random' , but can be considered 'missing at random' (i.e., it missingness is contingent on the observed data) which means that imputation is supported. (Supplement 1, available online). For the CFA, assessment of multivariate normality with Mardia's coefficient showed significant skew (z=17398.01, p<.001) and kurtosis (z=273.81, p<.001), so scaled CFA test statistics [19] and robust standard errors were used in parameter estimation to account for non-normality.

**Recall bias analysis**

A longer interval between pandemic start and survey completion was linearly associated with higher pre-pandemic well-being ratings (β=.077, p<0.001) (Figure S1, available online). A quadratic association with P-scores was also observed (β=-0.02, p<0.001), with Figure S2

(available online) suggesting a general decrease in ratings across time but with a transient increase in Jan 2022. Variation in pre-pandemic scores across time nevertheless appeared to be minimal, suggesting little substantive recall bias/drift. Regression slopes estimating pre vs. during pandemic are in Figure S3, available online.

**P-score factor structure**

The second-order, bifactor and correlated factors model all met established thresholds for model fit (Table S2, available online), and item-factor loadings were high suggesting good convergent validity (Figure S4, available online). The unidimensional model did not demonstrate adequate fit (Table S2, available online) and is not considered further. A comparison of BIC values across the three adequate fitting models, found that BIC was lowest (indicating a better fit) for the correlated factor model, and this model was therefore selected for further measurement invariance tests. Factor correlations for this model were high ($r$ =0.60-0.84), suggesting a strong degree of commonality across subdomains.

**P-score reliability, measurement invariance, and association with WHO-5**

Reliability assessed with coefficient omega was high both for an overall composite P-score (ω=0.96) and the five subdomains (ω=0.83-0.93). Measurement invariance results in Table S3 (available online ) indicate the correlated factor model exhibits no meaningful decrement in model fit using Chen's criteria when factor structure, loadings and intercepts were constrained to be equal across different countries, survey languages and gender groups. Correlations of P-scores with the WHO-5 (Table S4, available online) showed significant associations for both the overall (r=-0.49) and domain scores (r=-0.24 to -0.53).

**Change in wellbeing**

Weighted mixed-effects regression analyses indicated an overall decrease (worsening) in WHO-5 wellbeing during the pandemic of 8.37 (95% CI 6.50-10.23) points ($t(16.79)=8.83$, $p<0.001$) from a pre-pandemic baseline of 75.78 (a standardized mean difference (SMD) of 0.40). The random-effects intercept term showed that there was considerable variation in the magnitude of wellbeing changes across countries (SD=5.01) (Figure S3a, available online). Follow-up individual country-wide comparisons (Table 2) indicated significant worsening in all assessed countries, except Canada, Russia, USA, and Taiwan.The proportion of individuals scoring WHO-5<50 increased from 9% pre-pandemic to 17% intra-pandemic (McNemar's $\chi^2=153.24$, N=8115, $p<0.001$), with the proportion scoring WHO-5<29 increasing from 2% pre-pandemic to 6% intra-pandemic (McNemar's $\chi^2=153.24$, N=8115, $p<0.001$).

**Changes in P-score**

The P-score increased (worsened) by 10.33 (95% CI 8.05, 12.61) points ($t(17.46)=8.88$, $p<.001$) from the pre-pandemic baseline of 31.54 (SMD=0.42), with notable variation in the size of P-score change (SD=6.05) across countries (Figure S3b, available online). Individual country-wide comparisons (Table 2) indicated significant worsening of psychopathology in the majority of countries except Canada and USA. Additionally, P-scores increased in 45% by ≥20%, 39% by ≥30%, 34% by ≥40%, and 30% by ≥50%.

Correlations of P-score total and domain scores with wellbeing can also be seen in Table S4 (available online).

**Change trajectories in well-being, P-score, COVID-19 deaths and restrictions**

Figure 1 shows regression splines fitted to WHO-5 scores [$F(8.3, 8106)=14.74$, $p<0.001$] and P-scores [$F(8.9, 8106)=14.16$, $p<0.001$] across time, along with stringency and death data rescaled to a similar metric to each outcome to facilitate visual comparison. Both outcomes appeared to worsen in the beginning stage of the survey collection period early in the pandemic, returning to near-pre-pandemic levels over time, as evident from the shape of the cubic spline model (Figure 1). There was a significant, albeit very small, association between WHO-5 change and COVID pandemic-related deaths ($r=-0.05$, $p<0.001$, and stringency index $r=-0.09$, $p<0.001$). P-score changes were significantly correlated, albeit with modest effect, with the stringency index ($r=0.04$, $p=0.001$) but not with COVID-pandemic related deaths ($r=-0.01$, $p=0.299$).

**Risk factors and wellbeing**

The following risk factors were significantly associated with larger WHO-5 intra-pandemic worsening in adolescents: having a mental disorder, having a physical disorder, female gender, and with school closures (Figure 2, Table S5, available online). Associations were non-significant for country income, immigrant status, COVID-19 related loss, COVID-19 infection, or urbanicity. The presence of more concomitant risk factors was associated with larger WHO-5 worsening ($B=-0.79$, $SE=0.18$, $p<0.001$). Results from representative samples only are in Table S6, available online.

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### Risk factors and P-score

The following risk factors were significantly associated with larger P-score worsening pre- vs intra-pandemic in adolescents; having a mental disorder, having a physical disorder, female gender, living in a low-income country, and not living in a large city (Figure 2, Table S5, available online). Associations were non-significant for school closure, immigrant status, COVID-19 related loss, or COVID-19 infection. A greater number of concomitant risk factors was associated with larger P-score worsening (B=1.198, SE=0.161, $p<0.001$). Results from representative samples only are in Table S6, available online.

### Coping strategies

The coping strategies most frequently rated as "very important" were internet use=57.0%, exercise/walking=51.4%, direct social contacts=50.4%, followed by social media use/remote interactions=49.8%, media use=47.2%, hobby=45.4%, gaming=38.8%, COVID-19 pandemic information=38.8%, spending time with a pet=38.3%, studying/learning=37.3%, work=24.5%, prescribed medications=23.9%, physical intimacy=21.8%, religion/meditation/spirituality=21.2%, other strategies=14.5%, and substance use=9.6% (Figure 3, Table S7, available online).

## DISCUSSION

To our knowledge, this is the first multi-language study to assess changes in wellbeing and overall psychopathology, as well as coping strategies, from pre- to intra-Covid-19 pandemic in a transcontinental, predominantly representative, sample of adolescents. We found that during the COVID-19 pandemic, well-being and mental health of adolescents worsened, albeit with a small

effect size, yet heterogeneously across one or multiple risk factor subgroups and countries. COVID-19-related deaths and restriction stringency association with well-being and psychopathology were statistically significant but negligible. The three most subjectively important coping strategies were internet use, exercise/walking, and direct social contacts. Notably, well-being and composite psychopathology returned to near-pre-pandemic values after >2 years of the pandemic.

COH-FIT overcomes many limitations of previous studies on this topic according to recent meta-analytic evidence based on 51 studies[2]. First, previous studies were mostly (94%) based on convenience samples. Notably, early in the pandemic, Pierce et al. warned against the bias introduced by the exclusive use of convenience samples in mental health surveys. By contrast, COH-FIT relied mainly (75%) on representative sampling. Second, previous studies focused mainly on the assessment of isolated domains of psychopathology, with an emphasis on internalising behaviors, while COH-FIT successfully assessed wellbeing as well as a composite index of general psychopathology. Third, previous studies were mainly based on one/few countries. COH-FIT, being a multicontinental study, provides a unique overview of changes in wellbeing and psychopathology worldwide. Notably, we found an overall worsening of wellbeing and psychopathology across many countries, consistent with other data in adolescents and adults[32], this was not the case for selected countries. Adolescents' well-being did not worsen in Canada, Russia, USA, Taiwan, and no significant changes in general psychopathology were reported in Canada and USA. While it is possible that measures and policies applied in these countries were particularly effective in containing the impact of the pandemic in adolescents wellbeing and mental health, it is also possible that other reasons were responsible for our not detecting significant changes in these countries, such as time of data collection or other

unmeasured factors. Fourth, previous studies generally focused on psychopathology, while an important aim of COH-FIT was to also explore coping strategies, which is crucial to inform individual and mental health professional behaviors and public health policies on directly actionable measures, such as facilitating internet access, exercise/walking, and direct social contacts. The findings on physical exercise resonate with a large-scale umbrella review showing benefits of physical activity on psychosocial outcomes in youth[33]. Our findings underscore that, with cautions to restrict virus spread, (outdoor) exercise, safe direct social contact and internet access should be facilitated, including for those adolescents unlikely to afford it. Fifth, previous evidence generally failed to account for variation in local death rates, severity of the COVID-19 pandemic, and governmental restrictions. We found that psychopathology and wellbeing were correlated with the stringency index, and wellbeing was also correlated with COVID-19-related deaths. However, these correlations were small, and we were likely limited by the small number of deaths in adolescents. Sixth, previous surveys investigated relatively small samples, or were set in one country, with sample sizes ranging for instance in studies reporting on anxiety symptoms from 184-11,774 (one country only). Overcoming the logistic challenges of initiating research studies and recruiting samples during the pandemic, our large sample size (N=8,115) collected as early as April-26-2020 allowed us not only to detect average pre- to intra-pandemic group level changes, starting in the earliest pandemic times, but also to assess the impact on specific adolescent subgroups. Indeed, while the worsening, at the group level, in wellbeing and psychopathology is consistent with previous findings in youth, and the small effect size would suggest that these changes were overall of limited clinical/public health importance, wellbeing and psychopathology worsened more substantially in specific subgroups. Having a mental health disorder, having a physical disorder, and female gender increased the negative impact of the

pandemic both regarding wellbeing and psychopathology, consistent with effects in adults, and suggesting that these populations should be considered when allocating resources and initiatives to protect mental health and wellbeing by clinicians and governmental policies[3435]. The timing and extent of school closures during the pandemic has been discussed controversially[36]. Our results suggest that school closures may mainly affect wellbeing, but that effect may not be a strong risk factor for worsening of psychopathology. By contrast, not living in a big city was associate with worsening in psychopathology. While worse housing conditions with less access to green areas, and higher cost of living, increasing job/financial insecurities, might be expected to worsen psychopathology in adults, adolescents may particularly value living in big cities in terms of peer support and social connectedness. Importantly, having multiple risk factors increased the pandemic's impact on well-being and mental health, suggesting that clinical care as well as public health prevention, promotion and interventions should prioritize individuals with specific and, especially, multiple risk factors, aiming to provide targeted assistance and reduce risk factors globally.

While the duration of the studied effects of the pandemic on mental health in youth has been limited to a few months (e.g., <1 year for studies of anxiety symptoms), our continuous data collection for >2 years allowed us to explore assess temporal trends. Overall, our findings point to a return to near-pre-pandemic values after >2 years. As our findings are based on repeated cross-sectional rather than longitudinal data, they should be considered exploratory. Nevertheless, the pattern of change we observed is consistent with longitudinal data from a large scale meta-analysis pooling studies in adults and youth and showing a U shape relationship between time in the COVID-19 pandemic and anxiety/depressive symptom severity[32] . Overall, these data provide reassurance regarding the mental health impact of the pandemic, at least in the

medium-term and at the general population level. Nevertheless, efforts are needed to identify less resilient/fortunate/resourceful subgroups and helping them to recover from the impact of the pandemic too.

Results from this study should be interpreted considering its limitations, including the cross-sectional design at the individual level paired with retrospective recall to allow for calculation of pre- to intra-pandemic status. However, we did not detect a relevant drift in the retrospective recall of the pre-pandemic WHO-5 or P-factor during the study period. Moreover, accounting for severity of COVID-19 infections was not possible because we did not collect information on need for hospitalization for COVID-19, intensive care unit, intubation, or other proxy measures of severity. Also, country-level data were limited by small sample sizes that may have reduced the power to find significant differences between responses regarding pre-and intra-pandemic times in some isolated countries. With regard to the structure of the P-scale, while the correlated factors model had the most favourable fit indices, such indices can be biased by model features such as complexity, sample size and other factors and second order and bifactor should not be rejected. Nevertheless, all these models commonly support the existence of five distinct but highly related dimensions (albeit with different inferences on how they are related), which supports the computation of either an overall P-score dimension or five separate subdomains. This P-score, however, did not measure externalizing symptoms. Finally, we did not conduct analyses on specific risk factors within each country, as dedicated reports will be focusing on them.

Despite these limitations, the COH-FIT study provides unique data to inform individuals, clinicians and public health/intervention policies aimed at preventing/decreasing the impact of this and possible future pandemics on the wellbeing and mental health in adolescents.

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## References


1. Cortese S, Sabe M, Solmi M. Editorial Perspective: COVID-19-related publications on young people's mental health – what have been the key trends so far and what should come next? *J Child Psychol Psychiatry*. Published online December 1, 2022. doi:10.1111/JCPP.13615
2. Newlove-Delgado T, Russell AE, Mathews F, et al. Annual Research Review: The impact of Covid-19 on psychopathology in children and young people worldwide: systematic review of studies with pre- and within-pandemic data. *Journal of Child Psychology and Psychiatry*. 2023;64(4):611-640. doi:https://doi.org/10.1111/jcpp.13716
3. Solmi M, Estradé A, Thompson T, et al. The collaborative outcomes study on health and functioning during infection times in adults (COH-FIT-Adults): Design and methods of an international online survey targeting physical and mental health effects of the COVID-19 pandemic. *J Affect Disord*. 2022;299:393-407.
4. Solmi M, Estradé A, Thompson T, et al. Physical and mental health impact of COVID-19 on children, adolescents, and their families: The Collaborative Outcomes study on Health and Functioning during Infection Times - Children and Adolescents (COH-FIT-C&A). *J Affect Disord*. 2022;299:367-376.
5. Solmi M, Thompson T, Estradé A, et al. Validation of the collaborative outcomes study on health and functioning during infection times (COH-FIT) questionnaire for adults. *J Affect Disord*. Published online December 28, 2022. doi:10.1016/j.jad.2022.12.022
6. Topp CW, Østergaard SD, Søndergaard S, Bech P. The WHO-5 Well-Being Index: A Systematic Review of the Literature. *Psychother Psychosom*. 2015;84(3):167-176. doi:10.1159/000376585
7. Spitzer RL, Kroenke K, Williams JBW, Löwe B. A brief measure for assessing generalized anxiety disorder: The GAD-7. *Arch Intern Med*. 2006;166(10):1092-1097. doi:10.1001/archinte.166.10.1092
8. Kroenke K, Spitzer RL, Williams JBW. The PHQ-9: Validity of a brief depression severity measure. *J Gen Intern Med*. 2001;16(9):606-613. doi:10.1046/j.1525-1497.2001.016009606.x
9. Blevins CA, Weathers FW, Davis MT, Witte TK, Domino JL. The Posttraumatic Stress Disorder Checklist for DSM-5 (PCL-5): Development and Initial Psychometric Evaluation. *J Trauma Stress*. 2015;28(6):489-498. doi:10.1002/jts.22059
10. Ising HK, Veling W, Loewy RL, et al. The validity of the 16-item version of the Prodromal Questionnaire (PQ-16) to screen for ultra high risk of developing psychosis in the general help-seeking population. *Schizophr Bull*. 2012;38(6):1288-1296. doi:10.1093/schbul/sbs068
11. Ashdown-Franks G, Firth J, Carney R, et al. Exercise as Medicine for Mental and Substance Use Disorders: A Meta-review of the Benefits for Neuropsychiatric and Cognitive Outcomes. *Sports Medicine*. 2020;50(1):151-170. doi:10.1007/s40279-019-01187-6

12. Solmi M, Veronese N, Galvano D, et al. Factors Associated With Loneliness: An Umbrella Review Of Observational Studies. *J Affect Disord*. 2020;271:131-138. doi:10.1016/j.jad.2020.03.075
13. Rosmarin DH, Kaufman CC, Ford SF, et al. The neuroscience of spirituality, religion, and mental health: A systematic review and synthesis. *J Psychiatr Res*. 2022;156:100-113. doi:10.1016/j.jpsychires.2022.10.003
14. Dragioti E, Li H, Tsitsas G, et al. A large-scale meta-analytic atlas of mental health problems prevalence during the COVID-19 early pandemic. *J Med Virol*. 2021;n/a(n/a). doi:https://doi.org/10.1002/jmv.27549
15. Salazar de Pablo G, Vaquerizo-Serrano J, Catalan A, et al. Impact of coronavirus syndromes on physical and mental health of health care workers: Systematic review and meta-analysis. *J Affect Disord*. 2020;275:48-57. doi:10.1016/j.jad.2020.06.022
16. Sharma A, Minh Duc NT, Luu Lam Thang T, et al. A Consensus-Based Checklist for Reporting of Survey Studies (CROSS). *J Gen Intern Med*. 2021;36(10):3179-3187. doi:10.1007/s11606-021-06737-1
17. Brown TA. Confirmatory Factor Analysis for Applied Research Methodology in the Social Sciences. Published online 2015.
18. Hu L, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Struct Equ Modeling*. 1999;6(1):1-55. doi:10.1080/10705519909540118
19. Satorra A, Bentler PM. Ensuring positiveness of the scaled difference chi-square test statistic. *Psychometrika*. 2010;75(2):243-248. doi:10.1007/s11336-009-9135-y
20. Raykov T. Estimation of congeneric scale reliability using covariance structure analysis with nonlinear constraints. *British Journal of Mathematical and Statistical Psychology*. 2001;54(2):315-323. doi:https://doi.org/10.1348/000711001159582
21. Vandenberg RJ, Lance CE. A Review and Synthesis of the Measurement Invariance Literature: Suggestions, Practices, and Recommendations for Organizational Research. *Organ Res Methods*. 2000;3(1):4-69. doi:10.1177/109442810031002
22. Chen FF. Sensitivity of goodness of fit indexes to lack of measurement invariance. *Structural Equation Modeling*. 2007;14(3):464-504. doi:10.1080/10705510701301834
23. R Foundation for Statistical Computing, Vienna AustriaU https://www. R project. org/. R Core Team (2019). R: A language and environment for statistical computing.
24. van Buuren S, Groothuis-Oudshoorn K. mice: Multivariate Imputation by Chained Equations in R. *Journal of Statistical Software; Vol 1, Issue 3 (2011)* . Published online December 12, 2011.
25. Wickham H. *Ggplot2: Elegant Graphics for Data Analysis*. 2nd ed. (Springer., ed.).; 2016.
26. Korkmaz S, Goksuluk D, Zararsiz G. *MVN: An R Package for Assessing Multivariate Normality*. http://www.biosoft.hacettepe.edu.tr/MVN/.
27. Revelle W, Revelle MW. Package 'psych.' *The comprehensive R archive network*. 2015;337:338.
28. Rosseel Y. Lavaan: An R package for structural equation modeling. *J Stat Softw*. 2012;48(1):1-36. doi:10.18637/jss.v048.i02

29. Buuren S van, Groothuis-Oudshoorn K. mice: Multivariate imputation by chained equations in R . *Journal of statistical software* . Published online 2010:1-68.
30. Hastie TJ. Generalized Additive Models. In: Hastie TJ, Chambers JM, eds. *Statistical Models in S*. Wadsworth & Brooks/Cole Advanced Books & Software; 1992.
31. StataCorp. Stata Statistical Software: Release 18. College Station, TX: StataCorp LLC. Published online 2023.
32. Salanti G, Peter N, Tonia T, et al. The Impact of the COVID-19 Pandemic and Associated Control Measures on the Mental Health of the General Population. *Ann Intern Med*. 2022;175(11):1560-1571. doi:10.7326/M22-1507
33. Purgato M, Cadorin C, Prina E, et al. Umbrella Systematic Review and Meta-analysis: Physical Activity as an Effective Therapeutic Strategy for Improving Psychosocial Outcomes in Children and Adolescents. *J Am Acad Child Adolesc Psychiatry*. Published online 2023. doi:https://doi.org/10.1016/j.jaac.2023.04.017
34. Collaborators GBD 2019 MD. Global, regional, and national burden of 12 mental disorders in 204 countries and territories, 1990-2019: a systematic analysis for the Global Burden of Disease Study 2019. *Lancet Psychiatry*. 2022;9(2):137-150. doi:10.1016/S2215-0366(21)00395-3
35. Arrondo G, Solmi M, Dragioti E, et al. Associations between mental and physical conditions in children and adolescents: An umbrella review. *Neurosci Biobehav Rev*. 2022;137:104662. doi:https://doi.org/10.1016/j.neubiorev.2022.104662
36. Christie H, Hiscox L V, Halligan SL, Creswell C. Examining harmful impacts of the COVID-19 pandemic and school closures on parents and carers in the United Kingdom: A rapid review. *JCPP Advances*. 2022;2(3):e12095. doi:https://doi.org/10.1002/jcv2.12095

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**Table 1. Basic participant characteristics for overall, representative and non-representative samples**

| | | Overall | | Representative | | Non-probability | |
|---|---|---|---|---|---|---|---|
| **Variable** | | **Freq** | **Percent** | **Freq** | **Percent** | **Freq** | **Percent** |
| Representativeness of the sample | non-probability | 2,019 | 24.9 | 0 | 0.0 | 2,019 | 100.0 |
| | representative | 6,096 | 75.1 | 6,096 | 100.0 | 0 | 0.0 |
| Age | 14 | 1,669 | 20.6 | 1,332 | 21.9 | 337 | 16.7 |
| | 15 | 2,196 | 27.1 | 1,689 | 27.7 | 507 | 25.1 |
| | 16 | 1,977 | 24.4 | 1,404 | 23.0 | 573 | 28.4 |
| | 17 | 2,273 | 28.0 | 1,671 | 27.4 | 602 | 29.8 |
| Gender | Male | 4,066 | 50.1 | 3,215 | 52.7 | 851 | 42.1 |
| | Female | 4,006 | 49.4 | 2,852 | 46.8 | 1,154 | 57.2 |
| | Non-binary | 32 | 0.4 | 24 | 0.4 | 8 | 0.4 |
| | Transgender or intersex | 11 | 0.1 | 5 | 0.1 | 6 | 0.3 |
| Ethnicity | White | 5,782 | 71.3 | 5,121 | 84.0 | 661 | 32.7 |
| | African/African-descent | 420 | 5.2 | 128 | 2.1 | 292 | 14.5 |
| | Hispanic | 375 | 4.6 | 323 | 5.3 | 52 | 2.6 |
| | Asian | 1,002 | 12.3 | 117 | 1.9 | 885 | 43.8 |
| | Mixed | 465 | 5.7 | 370 | 6.1 | 95 | 4.7 |
| | Other | 71 | 0.9 | 37 | 0.6 | 34 | 1.7 |
| Country economy | High income | 5,907 | 72.8 | 5,207 | 85.4 | 700 | 34.7 |
| | Middle income | 1,478 | 18.2 | 889 | 14.6 | 589 | 29.2 |
| | Low income | 730 | 9.0 | 0 | 0.0 | 730 | 36.2 |
| Stringency | 0-24 | 726 | 8.9 | 456 | 7.5 | 270 | 13.4 |
| | 25-49 | 1,932 | 23.8 | 1,591 | 26.1 | 341 | 16.9 |
| | 50-74 | 3,803 | 46.9 | 2,944 | 48.3 | 859 | 42.5 |
| | 75-100 | 1,654 | 20.4 | 1,105 | 18.1 | 549 | 27.2 |
| Migrant status | No | 6,902 | 85.1 | 5,327 | 87.4 | 1,575 | 78.0 |
| | Yes | 521 | 6.4 | 481 | 7.9 | 40 | 2.0 |
| | Not reported | 692 | 8.5 | 288 | 4.7 | 404 | 20.0 |
| SES | 0-24 | 399 | 4.9 | 168 | 2.8 | 231 | 11.4 |
| | 25-49 | 1,012 | 12.5 | 615 | 10.1 | 397 | 19.7 |
| | 50-74 | 4,643 | 57.2 | 3,576 | 58.7 | 1,067 | 52.8 |
| | 75-100 | 2,061 | 25.4 | 1,737 | 28.5 | 324 | 16.0 |
| Urbanicity | Village/rural | 1,545 | 19.0 | 1,145 | 18.8 | 400 | 19.8 |
| | Small city/town (10,000-100.000 population) | 2,391 | 29.5 | 1,813 | 29.7 | 578 | 28.6 |
| | Medium city/town (100,000-500.000 population) | 1,798 | 22.2 | 1,318 | 21.6 | 480 | 23.8 |

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| | | Overall | | Representative | | Non-probability | |
|---|---|---|---|---|---|---|---|
| **Variable** | | **Freq** | **Percent** | **Freq** | **Percent** | **Freq** | **Percent** |
| | Large city/town (over 500.000 population) | 2,381 | 29.3 | 1,820 | 29.9 | 561 | 27.8 |
| COVID-19-related loss | No | 7,431 | 91.6 | 5,540 | 90.9 | 1,891 | 93.7 |
| | Yes | 669 | 8.2 | 556 | 9.1 | 113 | 5.6 |
| | Not reported | 15 | 0.2 | 0 | 0.0 | 15 | 0.7 |
| Month of data collection | Apr-2020 | 130 | 1.6 | 2 | 0.0 | 128 | 6.3 |
| | Jun-2020 | 493 | 6.1 | 285 | 4.7 | 208 | 10.3 |
| | Aug-2020 | 432 | 5.3 | 5 | 0.1 | 427 | 21.1 |
| | Oct-2020 | 2,463 | 30.4 | 1,884 | 30.9 | 579 | 28.7 |
| | Dec-2020 | 431 | 5.3 | 365 | 6.0 | 66 | 3.3 |
| | Feb-2021 | 330 | 4.1 | 272 | 4.5 | 58 | 2.9 |
| | Apr-2021 | 519 | 6.4 | 428 | 7.0 | 91 | 4.5 |
| | Jun-2021 | 394 | 4.9 | 263 | 4.3 | 131 | 6.5 |
| | Aug-2021 | 434 | 5.3 | 284 | 4.7 | 150 | 7.4 |
| | Oct-2021 | 95 | 1.2 | 1 | 0.0 | 94 | 4.7 |
| | Dec-2021 | 39 | 0.5 | 0 | 0.0 | 39 | 1.9 |
| | Feb-2022 | 522 | 6.4 | 510 | 8.4 | 12 | 0.6 |
| | Apr-2022 | 1,648 | 20.3 | 1,612 | 26.4 | 36 | 1.8 |
| | Jun-2022 | 185 | 2.3 | 185 | 3.0 | 0 | 0.0 |

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**Table 2. Changes in wellbeing and psychopathology across countries with N> 100 respondents, in descending order of magnitude.**

| Country | | Pre | | During | | Weighted change | |
|---|---|---|---|---|---|---|---|
| | N | M | SD | M | SD | M | p |
| **WHO-5** | | | | | | | |
| Uruguay | 286 | 69.44 | 17.85 | 57.83 | 21.64 | 10.91 | <.001 |
| Uganda | 320 | 57.47 | 18.08 | 48.32 | 17.27 | 9.13 | <.001 |
| Thailand | 155 | 75.22 | 19.14 | 66.16 | 22.45 | 8.54 | <.001 |
| Germany | 813 | 76.51 | 18.83 | 68.48 | 22.77 | 7.97 | <.001 |
| Czech Republic | 112 | 66.67 | 19.82 | 57.74 | 24.59 | 7.81 | 0.009 |
| Switzerland | 133 | 69.67 | 19.18 | 61.56 | 21.77 | 7.64 | 0.003 |
| Poland | 182 | 78.54 | 16.86 | 71.17 | 20.48 | 7.36 | <.001 |
| Greece | 283 | 75.91 | 20.86 | 68.69 | 22.51 | 7.21 | <.001 |
| Austria | 562 | 75.92 | 18.84 | 69.14 | 23.25 | 6.77 | <.001 |
| France | 263 | 80.77 | 17.26 | 74.93 | 20.75 | 5.96 | <.001 |
| Brazil | 632 | 78.37 | 18.57 | 72.70 | 21.20 | 5.70 | <.001 |
| United Kingdom | 467 | 76.24 | 19.11 | 70.55 | 22.19 | 5.63 | <.001 |
| Italy | 625 | 79.02 | 16.38 | 74.20 | 19.18 | 4.83 | <.001 |
| Spain | 1,358 | 79.99 | 16.39 | 75.43 | 18.62 | 4.60 | <.001 |
| Bangladesh | 410 | 69.19 | 20.88 | 65.15 | 19.49 | 4.05 | 0.005 |
| Canada | 225 | 75.45 | 17.35 | 73.06 | 19.88 | 2.40 | 0.174 |
| Russia | 257 | 83.33 | 15.79 | 82.22 | 16.32 | 1.11 | 0.433 |
| United States of America | 511 | 77.82 | 18.45 | 77.11 | 18.56 | 0.75 | 0.515 |
| Taiwan | 340 | 72.85 | 22.09 | 72.48 | 22.20 | 0.02 | 0.993 |
| **P-score** | | | | | | | |
| Uruguay | 286 | 30.61 | 18.64 | 48.98 | 22.45 | -17.53 | <.001 |
| Bangladesh | 410 | 36.41 | 21.03 | 50.44 | 22.88 | -14.88 | <.001 |
| Thailand | 155 | 23.84 | 19.60 | 36.30 | 22.50 | -12.43 | <.001 |
| Switzerland | 133 | 27.37 | 18.58 | 39.46 | 24.50 | -11.80 | <.001 |
| Czech Republic | 112 | 32.65 | 20.01 | 44.55 | 22.79 | -10.09 | <.001 |
| Austria | 562 | 26.86 | 20.18 | 35.04 | 23.27 | -8.08 | <.001 |
| Uganda | 320 | 32.87 | 20.14 | 40.45 | 19.40 | -7.56 | <.001 |
| Taiwan | 340 | 17.87 | 17.65 | 25.54 | 20.89 | -7.47 | <.001 |
| Greece | 283 | 33.27 | 22.49 | 40.48 | 22.61 | -7.21 | <.001 |
| Poland | 182 | 31.66 | 20.94 | 38.77 | 23.78 | -7.11 | 0.003 |
| Germany | 813 | 26.44 | 20.89 | 32.83 | 23.35 | -6.24 | <.001 |
| Italy | 625 | 31.67 | 22.60 | 37.73 | 24.66 | -6.08 | <.001 |
| France | 263 | 23.31 | 22.81 | 28.76 | 24.56 | -5.62 | 0.007 |
| Brazil | 632 | 43.65 | 22.20 | 48.67 | 23.56 | -5.06 | <.001 |
| United Kingdom | 467 | 25.43 | 21.96 | 30.25 | 24.42 | -4.83 | 0.002 |
| Russia | 257 | 21.37 | 20.03 | 26.09 | 22.04 | -4.72 | 0.011 |
| Spain | 1,358 | 31.91 | 23.63 | 35.32 | 24.46 | -3.49 | <.001 |
| Canada | 225 | 33.39 | 23.26 | 36.76 | 25.54 | -3.37 | 0.144 |
| United States of America | 511 | 50.58 | 28.53 | 52.59 | 28.85 | -2.10 | 0.242 |

*Note: M, mean; N, sample size; SD, standard deviation*

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**Figure 1. Trajectory of change in outcomes of WHO-5 well-being score (A) and composite psychopathology P-score (B), stringency and daily death rate**

Note: Stringency and daily death rate rescaled to same metric as outcomes to facilitate comparison.

**Figure 2. Forest plot of changes in well-being and psychopathology across risk factors in adolescents during versus before COVID-19 pandemic**

*Note: Although non-overlapping confidence lines (each corresponding to the group's SE) is commonly used as a rough proxy for indicating significant differences across two groups, the precise 95% confidence interval relating to a comparison between two groups is actually sqrt(2)*SE, rather than 2*SE (as suggested by the two drawn lines) – being just under 30% smaller (e.g. https://www.jvascsurg.org/article/S0741-5214(02)00030-7/pdf). Visually reducing the standard error lines by about 30% would give a better indicator of whether the difference between two groups has reached statistical significance. *, p<0.05, significant difference with versus without risk factor; ** p<0.001, significant difference with versus without risk factor.*

**Figure 3. Most important coping strategies during COVID-19 pandemic in adolescents**

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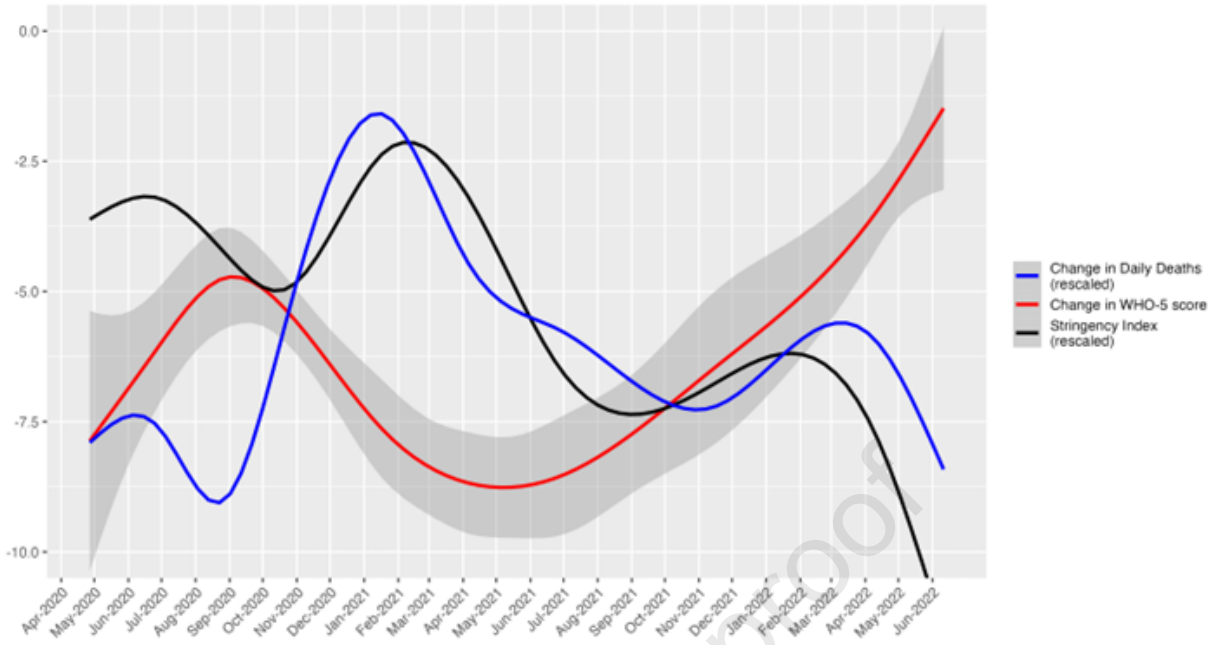


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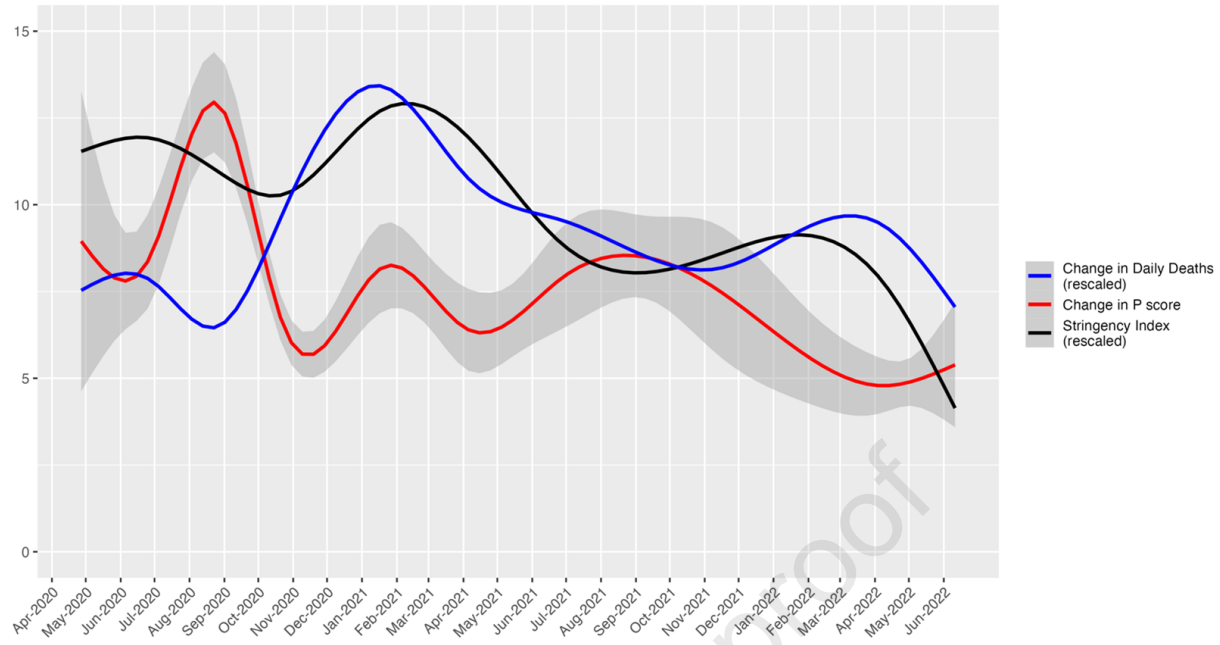


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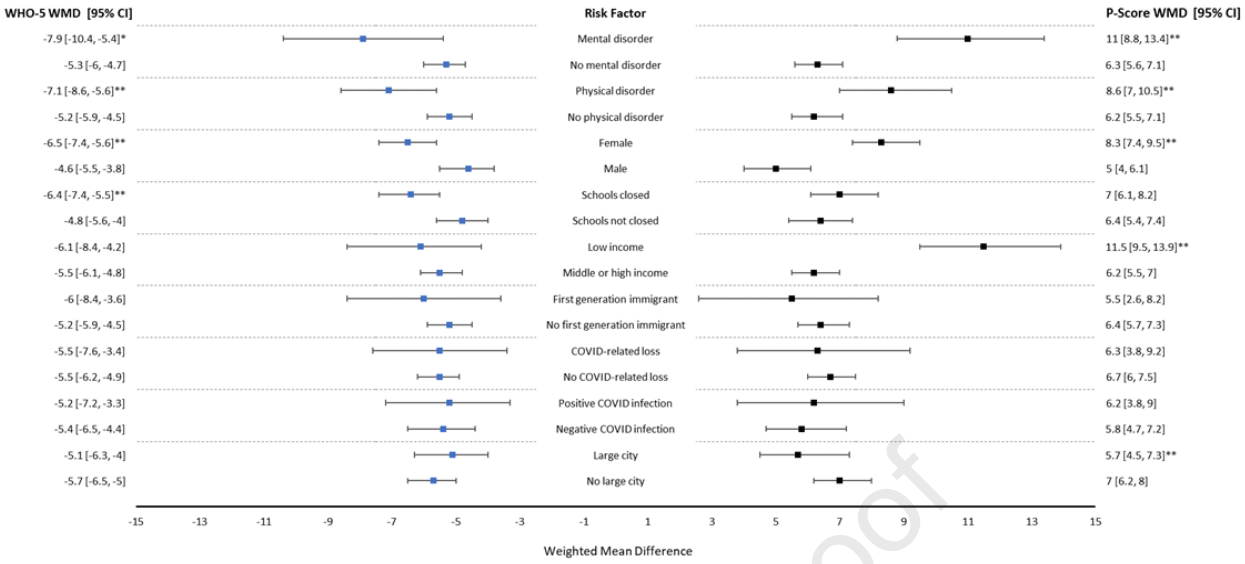


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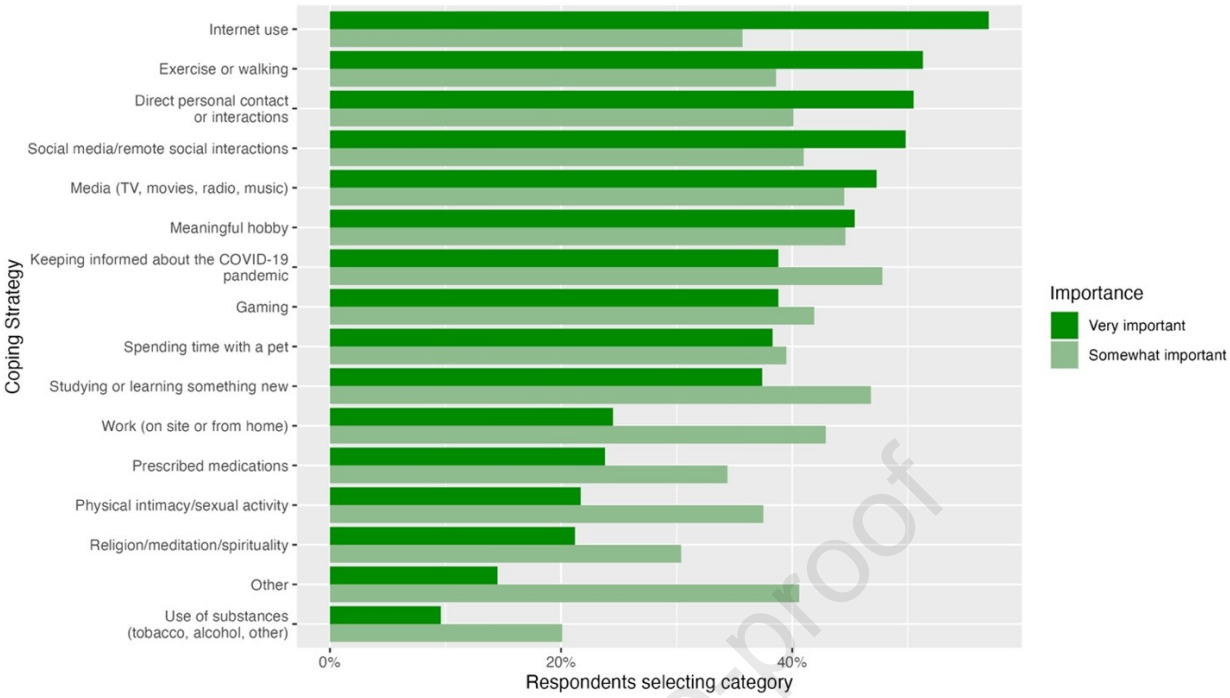


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