Study 1

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A Critical Period for Pandemic Adaptation: The Evolution of Depressive Symptomatology in a Representative Sample of Adults Across a 17-Month Period During COVID-19

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Abstract

This 17-month longitudinal study on a representative sample of 4,361 Norwegian adults employs an observational ABAB design across six repeated assessments and three pandemic waves to systematically investigate the evolution of depressive symptomatology across *all* modifications of social distancing protocols (SDPs) from their onset to termination. Using Latent Change Score Models to analyze 26,166 observations, the study empirically corroborates that critical fluctuations in depressive symptomatology within and across individuals occur during the first three months of the pandemic, after which symptom profiles are predominantly consolidated throughout the pandemic period. Contrary to established belief, female sex, young age, lower education and preexisting psychiatric diagnosis only served as adequate predictors of the initial shocks to symptomatology observed during the onset of the pandemic, and did not adequately predict subsequent change observed in symptoms within and across individuals. Population-level analyses demonstrated that symptom levels strongly covaried with the presence and strictness of SDPs and were unrelated to COVID-19 incidence rates. Upon predominant termination of SDPs, population-level symptoms began declining, while large heterogeneity was present across the adult population. Detrimental long-term adversities were revealed by 10% of the adults. These individuals displayed chaotic adaptation to the pandemic and its SDPs, exhibiting substantial increases in clinical levels of symptomatology ensuing partial re-opening of society and through the remainder of the pandemic, with these deleterious symptoms projected to remain heightened ahead. Frequency of quarantine exposure was incrementally tied with increases in contemporaneously experienced and long-term depressive adversities, with information obtainment through unmonitored sources further associated with contemporaneous and long-term states of heightened symptomatology.

Keywords: Depression, Longitudinal Study, Latent Change Score Model, COVID-19 Pandemic, General Adult Population

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General Scientific Summary

- Pandemic adaptation, whether health-promoting or detrimental, occurs during its first three months. While symptoms levels decline for most adults ensuing predominant termination of social distancing protocols, 10% of adults do not recover from the perturbations experienced in depressive symptomatology.
- Previously identified key predictors only served as adequate predictors of the initial heightened symptom reactions observed during the onset of the pandemic, rendering the individuals demonstrating deleterious change patterns as concurrently unidentified and a major priority of investigation for future research.

A Critical Period for Pandemic Adaptation: The Evolution of Depressive Symptomatology in a Representative Sample of Adults Across a 17-Month Period During COVID-19

Depressive symptom expression is considered relevant during pandemics, with previous findings revealing that periods involving financial crises, acute events, and drastic perturbations to daily life often precede the initiation and maintenance of its course (Herrman et al., 2019; Paykel, 2003). The onset of the SARS-CoV-2 pandemic and its accompanying social distancing protocols (SDPs) have been associated with the manifestation of depressive symptoms across countries (e.g., Daly et al., 2020; Ebrahimi et al., 2021b; Ettman et al., 2021; Liu et al., 2021). A recent review of the pandemic's global mental health burden further expanded the literature by substantiating the consequences of longer periods of increased symptomatology, identifying 53.2 million additional cases of major depressive disorder (i.e., an increase of 27.6%) in 2020 as related to the SARS-CoV-2 pandemic (Santomauro et al., 2021).

The key feature of a depressive condition involves the prolonged constellation and experience of its symptoms (American Psychiatric Association, 2013). As such, longer periods of sustained symptomatology can lead to long-term adversities, including the development of depressive disorders (American Psychiatric Association, 2013; Santomauro et al., 2021). Monitoring the temporal evolvement of symptoms thus forms the cornerstone of early warning signs aimed at detecting deteriorations in the mental health of the general population. Ensuing the terminus of 2020 however, little is known about population-level patterns of change in depressive symptomatology, with knowledge remaining exiguous concerning the contextual characteristics associated with change in depressive symptom expression across the COVID-19 pandemic. Notably, the rapid contextual alterations that accompany societal infection rates and the modifications in the pandemic's mitigation

protocols may be of relevance for changes in depressive symptoms. Moreover, the extent to whether individual differences are present in such symptom endorsement and change patterns across the pandemic's waves remains uninvestigated. Such investigations may corroborate the critical periods at which individuals are most vulnerable toward transitioning into detrimental depressive states, with previous scholars arguing that periods of increased variability in symptom expression may serve as an early warning sign of forthcoming critical changes in psychological states (e.g., Hayes & Andrews, 2020).

The present longitudinal investigation of the adult population includes six repeated assessments spanning over 17 months and three pandemic waves to investigate patterns of change in depressive symptomatology in connection with contemporaneous COVID-19 incidence rates, key demographic characteristics and two ubiquitous factors during the present pandemic and across infectious disease periods, namely exposure to quarantine and information obtainment behavior. Moreover, through strict control procedures implemented in the study design with respect to the timing of measurement and the contemporaneously implemented SDPs at each assessment, the study outlines how such social distancing protocols are associated with (a) population-level changes in depressive symptoms across the pandemic period, from the onset to the predominant termination of protocols; (b) the projected long-term path of symptoms; in addition to (c) individual differences in symptom change revealing the contextual contingencies and the specific time-points at which critical transitions may occur with respect to experience of deleterious depressive symptomatology in periods of infectious disease.

Methods

This study is part of The Norwegian COVID-19, Mental Health and Adherence Project (MAP-19), ethically approved by The Regional Committee for Medical and Health Research Ethics (REK; reference: 125510).

Study Design

The study period encompasses the onset of the pandemic and the introduction of SDPs in Norway, including repeated measurements across *all* subsequent modifications of national distancing protocols, in addition to assessment of the population following the predominant termination distancing protocols after the third wave of the COVID-19 pandemic in Norway.

The design criteria of the study included (a) undertaking measurements ensuing *each* respective modification of national SDPs, with (b) all assessments initiating in an interval between two to four weeks following the modification of protocols. The former criterion was implemented to investigate within-person changes in symptom levels in relation to modifications in the strictness and leniency of pandemic distancing protocols, with the participants serving as their own controls, laying the foundations of an observational ABAB design where protocols similar in severity were implemented, discontinued, re-implemented, and so forth. The second design criterion was incorporated with considerations of the respective constructs assessed at each measurement occasion, where the preponderance of constructs (e.g., assessment of depressive symptoms) encompassed of validated instruments querying about symptom levels during the past two to four weeks. Additional design principles included (c) controlling for expectation effects through a stopping rule terminating data collection if novel information was provided concerning forthcoming modifications of SDPs during assessment periods. Finally, (d) across all assessments (i.e., following modifications of pandemic distancing protocols), these modified changes had to be present for a minimum of two weeks prior to assessment, and (e) remain constant during the assessment period. In sum, the study was designed to carefully incorporate and control for both embodied reactions to protocol changes, in addition to expectations concerning changes in protocols across its 17-month period.

Population, Recruitment, and Procedure

The target population included (a) any adult individual (i.e., age >= 18 years), (b) residing in Norway and thus exposed to identical sets of national SDPs. Participation granted a chance to win a pair of headphones (Bose QuietComfort 35 II). The sampling procedure involved recruiting a proportional number of participants from each region of Norway with respect to the region's population size, yielding a geographically representative sample.

Data collection lasted for 17 months, starting in March 2020 and ending in August 2021. The first assessment was between March 31 and April 7, 2020 (i.e., T1; N = 10 061). Upon initial recruitment, participants responded to an online survey disseminated to a random selection of Norwegian adults through a Facebook Business algorithm, in addition to systematic dissemination of the survey via national, regional, and local information platforms (i.e., television, radio, and newspapers; see Ebrahimi et al., 2021b, for details). The second through sixth assessments were between June 22 and July 13, 2020 (T2; N = 4,967), November 19 to December 2, 2020 (T3; N = 5,283), January 23 and February 2, 2021 (T4; N = 4607), May 8 to May 25, 2021 (T5; N = 4,228), and July 4 and August 1, 2021 (T6; N = 3,231).

Stratification of Sample

The proportion of all demographic characteristics of the sampled individuals were investigated and contrasted with their known occurrence rates in the population. Characteristics unrepresentative of the Norwegian adult population were poststratified to be proportional to their known rate to yield a representative sample of the Norwegian adult population (see Supplementary Document 2). The final stratified and representative sample used in the present study consisted of 4,361 adults, with the coverage at each wave being 4,361 (T1), 2,151 (T2), 2,239 (T3), 1,963 (T4), 1,811 (T5), 1,405 (T6).

Modifications in Pandemic Distancing Protocols

A list of the nationally implemented SDPs present at T1 to T6 is presented in Supplementary Document 1. All implementations and modifications of protocols remained constant for a minimum of two weeks prior to each assessment period (study design criterion (d), with the stopping rule (criterion e) further ensuring that SDPs remained unmodified during each assessment. Prior to and during T1, a period of intensive SDPs (i.e., social distancing protocols) was present. In all analyses and plots of this study, T1 is coded as month 0 (i.e., onset) of the study. The intensive SDPs at T1 included isolation upon infection, quarantine upon contact with those infected, restrictions on social gatherings, prohibitions of public activities and events, closing of universities and schools, and visitation and domestic travel restrictions. T2 (coded as month 3 of the study) represented a period where the preponderance of SDPs was lightened in severity and other protocols discontinued (e.g., domestic travel restrictions removed, schools re-opened, public activities events were allowed with up to 200 individuals).

Prior to and during T3 (i.e., ≈ month 8 of the study), similar sets of distancing protocols as those instated at T1 were re-implemented. These instated set of protocols were increased in severity (i.e., stronger restrictions on social contact) prior to and during T4 (i.e., ≈ month 10 of the study). SDPs were reduced in severity the weeks prior to the fifth assessment (T5 ≈ month 14 of the study). The protocols present during this data collection period (T5) allowed for greater social interaction, restaurant visits and other public activities, and alcohol sale. For the weeks prior to and during the final data collection (T6 ≈ month 16 and 17 of the study), many distancing protocols were terminated, with few exceptions remaining in practice (e.g., restricting flow between cohorts at different tables at restaurants and night clubs). Prior and during assessment periods T2 and T6 (i.e., month 3 and 16-17), the reduced severity and predominant discontinuation of distancing protocols allowed for near-normal social contact.

Measurement

Demographic Variables

Participants reported their age in years, sex, education, and presence of preexisting psychiatric diagnosis. Females were coded as 0 (males: 1). Age was coded into four categories (i.e., 0: 18-30 years; 1: 31-44 years; 2: 45-64 years; and 3: 65+). Education levels consisted of four categories (i.e., 0: Compulsory School; 1: Upper Secondary High School; 2: Student; 3: Any University Degree). Presence of preexisting psychiatric diagnosis was coded as 1 (absence: 0).

Depressive Symptoms

Depressive symptomatology was measured using the Patient Health Questionnaire (PHQ-9; Kroenke et al., 2001), consisting of nine items scored on a four-point Likert-scale (0–3; 0 = Not at all, 3 = Nearly every day). A formal translation of the PHQ-9 available from The Norwegian Association for Cognitive Therapy was used, detailed in Supplementary Document 2. Scores range from 0 to 27, with higher scores indicating greater depression severity. Clinically meaningful changes in symptoms were determined following normed guidelines (Kroenke et al., 2010) through changes in PHQ-scores in increments of 5, as per the validated criteria of transition from insignificant to mild depressive symptoms for scores above 5; from the mild into the moderate region with scores above 10; and moderate to severe regions of expressed symptomatology ensuing further increments in units of 5 (i.e., scores above 15). Internal consistency was excellent across all assessment waves (Cronbach's α of .88 at T1 and .91 at T2, T3, T4, T5, and T6). Longitudinal measurement invariance tests of the PHQ-9 were further conducted (see Supplementary Document 2), supporting its appropriateness for the evaluation of mean level changes in the present study.

Exposure to Quarantine

At the final assessment (T6) of the study, participants were queried about the number of times they had been exposed to quarantine since the onset of the pandemic. Quarantine was defined as mandated stay at home orders for a minimum duration of 10 days as a result of contact with an infected person, suspicion of infection, or as governed by the rules applying following domestic or cross-border travel. Frequency of quarantine exposure was coded into six categories (0: Zero times; 1: Once; 2: Twice; 3: Three times; 4: Four times; 5: Five or more times).

Information Obtainment Preferences

Participants reported their preferred source for information obtainment, measured through querying their favored platform in obtaining information about the pandemic. All source-verified platforms encompassing of source-checked and recognized national, regional, and local newspapers, television, and radio channels were coded as 0 (Source-verified information platform preference), while unmonitored information obtainment sources consisting of social media platforms (e.g., Instagram, Snapchat, TikTok), online forums and blogs, and preference for information obtainment from friends, family and peers was coded as 1 (Unmonitored information platform preference).

COVID-19 Incidence

Weekly COVID-19 incidence rates were retrieved from the Norwegian Public Health database of infectious disease and matched with the response date of each participant. The mean weekly incidence rate was 1151.08 at T1, 99.77 (T2), 3445.02 (T3), 2097.17 (T4), 2584.14 (T5), and 1346.42 (T6).

Statistical Analyses

Statistical analyses were performed using R (Version 4.1.0; R Core Team, 2021).

Latent Change Score Model

A Latent Change Score Model (LCSM; e.g., McArdle, 2001) was used to model change in depressive symptomatology across the 17-month study period. The LCSM is a type of Structural Equation Model (SEM) that models changes in the latent level of a construct over time. Because it captures latent change, it accounts for measurement error in observed scores, reducing bias and augmenting the power of detecting true effects (Grimm et al., 2016). The LCSM can also be construed as a type of dynamical systems model which focuses on time-dependent change, allowing examinations of when critical changes occur across an investigation period (Grimm et al., 2016). As the LCSM framework concerns within-person and time-dependent change, it is a powerful technique for modeling responses to distancing protocols across the pandemic period.

First, the unconditional LCSM shown in Figure 1 was fit, modeling the initial level (denoted as η_{t1}) of depressive symptomatology at T1, and the latent change scores between each pair of adjacent assessments (denoted as $\delta\eta_{t2}$, $\delta\eta_{t3}$, $\delta\eta_{t4}$, $\delta\eta_{t5}$, and $\delta\eta_{t6}$, respectively, where $\delta\eta_{t2}$ represents change from T1 to T2, $\delta\eta_{t3}$ change from T2 to T3, etc.). The residual variances (i.e., σ_{ε}^{2}) were held equal over time to identify the model. This represents the variance of measurement error contributing to the observed repeated measures of depression which is removed from the latent true scores and latent change scores. The LCSM was specified using the 'lavaan' package in R (Rosseel, 2012). Model fit was assessed using common guidelines, including the χ^2 goodness-of-fit index, Root Mean Square Error of Approximation (RMSEA), Tucker-Lewis Index (TLI), Comparative Fit Index (CFI), and the Standardized Root Mean Squared Residual (SRMR). Good model fit was defined as RMSEA ≤ 0.05, TLI ≥ 0.95, CFI ≥ 0.95, and SRMR ≤ 0.05 (e.g., Hu & Bentler, 1999).

A conditional LCSM was subsequently fit including the following predictors: demographic variables (i.e., age, sex, education, and preexisting psychiatric diagnosis),

weekly COVID-19 incidence rates, quarantine exposure, and information obtainment preference, revealing the extent these variables were associated with perturbations in the change patterns of depressive symptomatology across the study period. A path diagram revealing the specification of the conditional LCSM is provided in Figure 2, depicting all exogenous variables predicting the latent true score at T1 (η_{t1}) and each subsequent latent change score ($\delta\eta_{t2-t6}$)[1].

Missing Data Diagnostics

Full Information Maximum Likelihood (FIML) was used to estimate models on the full dataset, including individuals with incomplete data. FIML is considered the state of art approach in scenarios with missing data, decreasing bias and increasing statistical power (Enders, 2010). FIML assumes missing data are Missing At Random (MAR), the veracity of which was thoroughly investigated through two sets of complementary analyses, including t-tests of differences between completers and non-completers at each assessment wave, and a tree-based machine learning classification approach that attempted to predict patterns of attrition at each wave above chance from the available demographic variables in the study. While it is impossible to empirically verify the MAR assumption, this extensive series of analyses suggested no problematic patterns of missingness with respect to the analytical assumptions of the present study. Further details of this procedure may be found in Supplementary Document 2.

Sensitivity Analyses

A sensitivity analysis was conducted to on an attrition-controlled sample (i.e., solely among the individuals who had provided full data across all assessments) to more robustly inspect the change patterns of depressive symptoms.

[1] The interested reader is referred to Supplementary Document 2 for an expanded explanation of specified LCSM models.

Three additional analyses were conducted to examine specificity of findings for depression; 1) investigating each specific symptom of depression to examine whether the overall change profiles observed for depression also represented the change patterns of its key identifiers (i.e., anhedonia and depressed mood); 2) contrasting depressive symptomatology with other internalizing domains (i.e., anxiety); and 3) inspecting whether identified detrimental depressive symptom profiles more prominently predicted outcomes related to depression than other problem domains. The results of these specificity analyses are detailed in Supplementary Document 2.

Results

Participant age ranged from 18 to 87 years (M_{age} = 37.46), with 2152 (49.64%) of the subjects being female (compared to 49.46% females in the population), and 1543 (35.38%) having a university degree (compared to 35.60% in the population). The percentage of participants with preexisting mental health conditions was 19.01%, representative of the known rate of psychological disorders in the Norwegian adult population ([16.66, 25.00]; Norwegian Institute of Public Health, 2016). The quota of participants sampled from each region of Norway was further proportional to each respective region size, yielding a geographically representative sample of Norway. The demographic composition of participants was stable across the 17-month period of the study, with no particular subgroup revealing influentially disproportional attrition rates across the study period. Specifically, at the final assessment of the study, 45.00% of the participants were female, 38.44% had a university degree, 18.76% reporting a psychiatric diagnosis, and age ranged from 18 to 86 years (M_{age} = 39.71).

Sensitivity analyses were conducted on the subset of participants who had provided full data across all assessment waves, thus fully functioning as their own controls with respect to changes and fluctuations across waves and modifications in distancing protocols. These

sensitivity analyses replicated the findings from the main sample, revealing identical change profiles and temporal patterns across all analyses described below, with the correlation between the vectors containing the parameter estimates from this attrition-controlled sample and the main sample yielding $r = .996$, robustly replicating the main findings.

Model Fit

Model fit was excellent for both the unconditional LCSM (i.e., Figure 1), with $\chi^2(9) = 48.48$ ($p < .001$), *RMSEA* = 0.032 (90% CI: [0.023, 0.041]), *CFI* = 0.994, *TLI* = 0.990, and *SRMR* = 0.026, and the conditional LCSM (i.e., Figure 2), with $\chi^2(99) = 398.61$ ($p < .001$), *RMSEA* = 0.027 (90% CI: [0.024, 0.030]), *CFI* = 0.965, *TLI* = 0.947, and *SRMR* = 0.046.

Population-Level Symptom Changes Across the Pandemic Period

Figure 3 displays the mean-level change of depressive symptomatology for the general adult population across the three waves of the COVID-19 pandemic, with each breaking point in the curve representing the assessment time-point of symptom levels. The time axis begins at the end of March, 2020 (month = 0), advancing one unit per month duration of the pandemic from that point. As depicted in Figure 3, depressive symptom expression and severity strongly co-varied with SDPs, with their presence and increased strictness associated with subsequent increases in depressive symptomatology. Additional inspections of this using complementary information on SDP stringency (cf. Supplementary Document 2) revealed a high correlation ($r = .74$) between SDP stringency and symptom levels. Initial shocks were revealed in the general adult population, experiencing high symptomatology following the introduction of strict SDPs at T1 (cf. end of March, 2020; month 0 in Figure 3). Depressive symptoms subsequently subsided ensuing partial discontinuation of SDPs at T2 (3 months later, end of June 2020; month 3). Following gradual re-introduction of pandemic protocols up to the implementation of strict SDPs at T3 (mid-November 2020; month 8), population-wide symptom levels heightened substantially, further maintaining high levels at T4 (end of

January 2021; month 10) where protocols increased in severity. Although the implemented protocols at T5 (May 2021; month ≈ 14) were reduced in severity, population-wide symptom levels remained heightened ensuing a 6-month period of intensive SDPs prior to T5, compared the three-month mark at which such SDPs had been in place before the partial discontinuation of protocols which took place at T2. The predominant termination of all distancing measures at T6 (July to August 2021; month 16 and 17) was associated with symptom levels subsiding and being at their lowest. Weekly incidence rates of SARS-CoV-2 were controlled for and unrelated to changes in depressive symptoms at all time-points (i.e., *ps* = [.174, .936]; Table 1).

Individual-Level Change Profiles of Symptomatology Across the Pandemic Period

Figure 4 exhibits the individual change profiles of symptoms across the study period. Each line presents a single subject, with the path of each line representing *within-person level and change* in depressive states for each individual. The orange line in Figure 4 represents the previously revealed population-level (i.e., mean level across subjects) symptom changes. To aid visualization, individual change profiles of a random subset of 200 individuals are displayed (see Supplementary Figure S1 for figures with all participants).

These analyses reveal that the preponderance of within-person change in depressive symptomatology occurs during the first three months of the pandemic's onset (i.e., variance of $\delta\eta_{t2} = 39.58$, $SD = 6.30$). This period is represented by chaotic symptom patterns within and across individuals, as further reflected by the major presence of fluctuating and intersecting lines between month 0 and 3 in Figure 4. After the first three months, individuals portray a consolidated symptom profile (i.e., stable patterns reflecting minimal change), prevailingly maintaining their relative severity of depression across the remainder of the pandemic period (i.e., variances of $\delta\eta_{t3-t6} = [0.36, 2.44]$, between 15 to 110 times lower than the variance of $\delta\eta_{t2} = 39.58$). This was further reflected through rank-order stability analyses, revealing high

correlations ($r > .96$) between all latent status factors ensuing T2, while correlations between the latent status factor at T1 with all other status factors was below .19 (Supplementary Document 2). These predominantly stable symptom profiles exhibit minor fluctuations onward after month 3 of the pandemic, which co-vary with the strictness of implemented SDPs.

These results reveal a critical shift in depressive symptom change profiles occurring during the first three months of the pandemic, greatly de-stabilizing individuals from their own initial mental health state (i.e., differences between origin at month 0 and destination at month 3), prior to each individual stabilizing in a predominantly settled pattern after the third month of pandemic and the first major change (i.e., reduction) which occurred in the SDPs. While some mean-level change still occurs over time after month 3 (i.e., with this change ensuing each novel modification of SDPs), individuals maintain their rank order (i.e., their relative position in the distribution of depression. This is further revealed by the limited variability in latent changes from T3 forward and the predominant absence of intersecting lines after this point in Figure 4.

Notably, upon the partial discontinuation of SDPs at month 3, 438 of 4,361 (10.04%) of the adults deviated from the mean trend (i.e., decrease in symptomatology), exhibiting clinically impairing symptom increases (i.e., within-person increases ≥ 5). These individuals maintained this heightened state of symptomatology across the pandemic period and did not reveal any reduction in symptoms ensuing the predominant termination of distancing protocols at the final assessment of the study.

Predictors and Additional Perturbators of Symptom Change Patterns

Table 1 displays the results of the conditional LCSM, revealing the factors functioning as additional perturbators toward (or conversely as protective factors against) deleterious depressive change profiles. The effect of each predictor on change in depressive symptoms,

while controlling for all other predictors in the model, is displayed in Figures 5, 6 and Supplementary Figure S2.

All demographic predictors were significantly associated with initial levels of depressive symptoms (η_{t1}, $ps < .001$) and changes in symptomatology from T1 to T2 (i.e., during first three months of the pandemic; $\delta\eta_{t2}$, $ps < .001$), after which the divergences in patterns of change between subgroups of demographic variables largely sustained with no significant changes occurring at consecutive *adjacent* time-points (i.e., change scores). The exception for this pattern was age groups, continuing to reveal adjacent change until T3 ($p = .002$). Specifically, both older age (Figure 5) and higher education level (Supplementary Figure S2) were incrementally associated with lower initial depressive symptom levels and the least adverse patterns of change. An exception was that subjects aged above 65 portrayed increased depressive symptoms. Female sex (Supplementary Figure S2) and the presence of a preexisting psychiatric diagnosis at T1 (Figure 5) were associated with heightened symptomatology at onset, before these subgroups of individuals displayed decreases in symptom levels across the pandemic period, assimilating the symptom levels of their counterparts (i.e., males and those without a psychiatric diagnosis at T1, respectively) at the final assessment. Additional frequency analyses of these findings revealed that 29% and 31% of those with a preexisting psychiatric diagnosis at the onset of the study maintained this diagnostic status by T2 and reported being under psychiatric treatment at T6, respectively.

Number of times exposed to quarantine (Figure 6) across the pandemic period was incrementally tied to increased deleterious depressive symptom expression. Naturally, no differences were found at onset, as few subjects had been exposed to quarantine at T1. As the pandemic progressed, additive exposure to quarantine was incrementally associated with increased symptoms with significant divergences in patterns of changes occurring at T3, after which the differential symptom profiles sustained. These elevations were maintained at

termination of the study, suggesting long-term and additive effects of quarantine exposure with respect to depressive symptomatology.

Subjects engaged in information obtainment through source-verified platforms (Figure 6) displayed the least deleterious change patterns compared to their counterparts (i.e., those using unmonitored information platforms). No initial differences between these types of information obtainment strategies were observed, with differences emerging during the third month of the study (at T2), disrupting the initially indifferent change profiles between these subgroups of individuals and pushing those relying on unmonitored sources toward heightened detrimental symptom experience.

Overall, the predictors explained a substantial proportion of the variation in the initial reactions to the pandemic (i.e., η_{t1}, $R^2 = .37$) and some change between T1 to T2 (i.e., $\delta\eta_{t2}$, $R^2 = .17$), but captured less variation in change after the first three months of the pandemic (i.e., in $\delta\eta_{t3-t6}$, $R^2s = [.02, .10]$).

Specificity of Findings for Depression

As detailed in Supplementary Document 2, the present results were found to be specific for depressive symptomatology as contrasted with other psychopathological domains.

First, symptom-specific analyses revealed the core symptoms of the depressive domain (i.e., anhedonia and depressed mood) to show identical change patterns as the overall depressive change patterns across all time-points.

Second, in contrasting depressive to anxious change profiles, key differences emerged such as (a) anxious levels being highest during the onset of the pandemic (T1) while depressive symptom levels were highest upon the re-introduction of strict distancing measures; and (b) anxious symptom fluctuation being significantly related to infection rates while this was not the case for depression. Overall, anxious symptomatology showed greater reactivity to infection rates, while depressive symptoms were more strongly related to SDPs.

Finally, treatment-seeking behavior across different psychological domains at the final wave of the study was investigated among the aforementioned subgroup of individuals who exhibited clinically impairing increases in depressive symptoms (i.e., 10.04% of the sample). This analysis revealed that these individuals sought treatment for depression between 1.65 to 14.30 more frequently than any other psychological problem domain (e.g., 2.15 more frequently than for anxiety, and 14.30 times more often than for obsessive-compulsive problems).

Discussion

Population-Level Patterns of Change Across the Pandemic Period and Modifications in Social Distancing Protocols

This investigation identifies strong initial reactions associated with the invasive protocols instated at the onset of the pandemic (e.g., Daly et al., 2020; Liu et al., 2021). Contemporaneous weekly COVID-19 incidence was controlled for, displaying no significant connection to the observed changes in depressive symptomatology at any time-point. Presence and increased intensity of distancing protocols were associated with heightened symptomatology, while leniency in such protocols were associated with subsequent reductions in symptomatology. This finding was robustly observed throughout the full pandemic period across *each* repetitive modification of SDPs. Once distancing protocols were predominantly discontinued, population symptom levels of depression began to decline.

Notably, symptom declination ensuing a period with strict SDPs was associated with SDP-length. Longer periods of strictly implemented SDPs were tied to longer periods of deleterious depressive symptom expression after the SDPs were lightened. This finding is in line with the etiological explanations of depressive problems, describing how prolonged constellation of symptoms for longer periods carry over across time through increased connectivity between symptoms (e.g., American Psychiatric Association, 2013; Ebrahimi et

al., 2021a). The findings point toward additive risk of long-term exposure to such socially isolating and mobility restricting protocols.

Additional Predictors of Population-Level Depressive Change Patterns

Consistent with previous findings (e.g., Bjelland et al., 2008; Nolen-Hoeksema, 2001), this study identified that females, younger age groups, and those with lower education levels revealed higher symptom levels than their counterparts at the onset of the pandemic. While female sex and lower education are risk factors for increased symptomatology also in non-pandemic periods (e.g., Bjelland et al., 2008; Nolen-Hoeksema, 2001), the substantial reduction in magnitude of differences in symptom expression between age groups ensuing the first wave of the pandemic is notable. One plausible explanation for this pattern concerns the larger extent of disruption to routine social contact experienced among younger adults during lockdown periods compared to their older aged counterparts. While the distancing protocols accompanying the pandemic impacted the population as a whole, higher age is a factor known to be associated with reductions in social activity (e.g., Marcum, 2013), indicating that younger adults may have experienced more extensive perturbations to their daily social life during the first and initial lockdown of the pandemic. Additionally, while all age groups decreased markedly in depressive symptom levels upon the first partial re-opening of society, the oldest age group revealed augmented symptomatology at this time-point. This divergent reaction to the first re-opening may be related to infection fears, which has been related to increased depressive symptomatology (e.g., Sakib et al., 2021), possibly explained by the increased risk of mortality and severe illness following SARS-CoV-2 infection for the oldest age group (e.g., Ho et al., 2020; Semenzato et al., 2021). This further seems likely as no vaccines had been rolled out at this time-point.

The initial magnified gap in depressive symptom experience subsided between males and females as the pandemic progressed. One explanation for this initially larger gap may

reflect differences in stress response among males and females, with scholars theorizing that males to a greater extent cope with difficulties through isolation while females seek social support (e.g., Peterson et al., 2006; Taylor et al., 2000). These findings seem to reflect that females to a larger extent were impacted by the perturbations to social support networks accompanying distancing protocols at the onset of the pandemic.

The present results reveal how multiple and additive exposure to quarantine is associated with incremental increases in depressive symptoms. Akin the contemporaneously experiences of heightened symptomatology tied with quarantine exposure, these deleterious symptom profiles were maintained at the end of the pandemic period, unveiling that exposure to such invasive and routine disrupting mitigation procedures seem to be associated with long-term adversities.

At the onset of the pandemic, reliance on different information obtainment platforms was not associated with differences in depressive symptomatology. As the pandemic progressed, divergences emerged tying reliance on unmonitored information sources to deleterious symptom profiles. This may relate to the increased presence of false information and fear-arousing content present at such platforms, previously linked to central depressive symptoms including hopelessness and pessimism (e.g., Amundsen et al., 2021; Bendau et al., 2021b).

Individual-Level Change Profiles: Critical Transition and Stabilization

Longitudinal investigations of individual change profiles are imperative in identifying how and when critical fluctuations in depressive symptomatology occur, providing the literature with a focus area to further investigate how transitions from healthy states to deleterious depressive states may materialize. This study allocates this critical change period to be situated within the first three months of the pandemic, where major changes to daily life were occurring for all individuals, necessitating adjustments to a novel unprecedented

situation (Cheng et al., 2021). As revealed from the individual change profiles (cf. Figure 4 and Supplementary Figure S1), these critical transitions were present on the individual level across the whole data set, reflecting that individuals substantially changed from their own initial levels prior to consolidation into a symptom expression state that predominantly remained stable across the remaining pandemic period. This finding is in line with complex systems perspectives on mental health, theorizing that ensuing influential perturbations to daily life, a period of drastic variability may emerge prior to stabilization into a novel state or return to one's previous state (e.g., Hayes & Andrews, 2020), the latter of which may be thought of as resiliency.

Importantly, this stabilization (i.e., consolidation) of symptoms occurring at the three-month mark of the pandemic can neither be exclusively described as favorable or deleterious, as heterogenous patterns of stabilization emerged across individual. The present findings granularly reveal the contours of the long-term adversities that may be expected ahead, demonstrating that large differences are to be expected across individuals regarding long-term experience of symptomatology. While reduction of protocols were associated with decreases in depressive symptomatology for many individuals, a sizable proportion of individuals deviate from this trend, revealing unexpected and opposite patterns with associated increases in symptomatology following the lightening and even predominant removal of distancing protocols. Approximately 10% of all adults exhibited this detrimental pattern, characterized by critical increase in symptom levels from a predominantly asymptomatic state to subsequent consolidation of symptoms in a detrimental and heightened state. Importantly, these changes could not be strongly predicted by the presence of psychiatric diagnosis or any of the key demographics previously found to be associated with depressive symptoms at the onset of the pandemic (e.g., Ebrahimi et al., 2021b; Fancourt et al., 2021). Thus, contrary to established belief, the individuals who seem to have experienced critical shifts in symptom expression

during the pandemic are not merely those with a preexisting diagnosis, females, younger aged individuals, and those with low education. These variables performed poorly in predicting the observed heterogeneities in change patterns, and solely revealed satisfactory explanations of the variation that occurred at the onset of the pandemic. Accordingly, the present findings indicate that there seems to have been a slight shift in those struggling with detrimental depressive symptomatology during the pandemic period, with this shift indicated to have occurred during the first three months of the pandemic.

Specifically, the present study revealed that those with preexisting psychiatric diagnoses at the onset of the study over time nearly equated the symptom levels of their counterparts (i.e., those without a diagnoses) by the end of the pandemic period. Only 29% and 31% of those with a preexisting psychiatric diagnosis at the onset of the study maintained this diagnostic status by T2 and reported being under psychiatric treatment at the final assessment of the study in August 2021, respectively. These findings combined with the depressive change patterns (Figure 5) comparing those with and without diagnoses at the onset of the study seem to indicate that the many individuals with such preexisting adversities may have somewhat benefited from the lockdown phase of the pandemic. This corresponds to another empirical study identifying that those with a psychiatric diagnosis revealed greater reductions in symptomatology over time during the pandemic (Bendau et al., 2021a), and a qualitative study identifying that for some individuals, lockdown was perceived as a relief from external pressures and provided time to contain and process mental symptoms through rest and self-care activities (Gillard et al., 2021). Given the contextual contingencies tied to mental health problems, individuals with such preexisting conditions thus may have gained an opportunity to attenuate old maladaptive patterns and establish new ones in a period encompassing of major changes in daily life.

Future Directions

Future work would do well to consider four unresolved issues. First, efforts to identify additional and more granular factors connected to the perturbations during the first three months of the pandemic is a top priority for research. Second, understanding the heterogeneous underpinnings and critical shifts in symptom expression which pushed subgroups of individuals into maladaptive depressive states is a pivotal priority to intervene and mitigate the adverse long-term consequences for those affected by this shift in symptom expression. Third, given the simultaneous exposure to the pandemic and its SDPs, the greater initial resiliency of older adults is an important area of investigation for future studies. Finally, follow-up studies employing growth mixture models may provide assistance in identifying the divergent individual patterns of change in symptomatology and the subgroups of individuals that are concurrently experiencing and projected to experience further long-term adversities. Such efforts may also be enhanced through network analytic studies aiding identification of the multifactorial processes involved in the emergence of such detrimental depressive states.

Strengths and Limitations

Strengths of this study include its large and representative sample, controlling for contemporaneous COVID-19 incidence rates, the simultaneous unveiling of population-level and individual change patterns, approach to missing data, the additional sensitivity analyses on an attrition-controlled subsample, and the use of validated and well-established measures. The longitudinal design and assessment of the same individuals across a 17-month pandemic period further allowed subjects to serve as their own controls, robustly revealing within-person change in depressive states in periods of infectious disease. Importantly, a major strength includes the stringent design in systematically and proactively controlling for and undertaking assessments at *each* respective modification of social distancing protocols from

the onset of the pandemic. This study further includes several limitations. Although the preponderance of participants were randomly obtained and stratified to represent the population demographics, the online procedure may favor particular subgroups of individuals above others (e.g., older aged adults more knowledgeable of technology). Major efforts were however taken reduce such biases through additional recruitment of participants across a variety of platforms more accessible to the elderly population. Another limitation concerns the modeling of quarantine as a time-invariant variable, which retrospectively assessed the number of times the individual were exposed to quarantine across the full pandemic period. The use of self-report measures serves as another limitation of this study, precluding diagnostic assessments of the participants.

Conclusion

This study found initial shocks (heightened symptom levels) to be associated with the onset of pandemic SDPs, with depressive symptomatology further associated with the strictness of SDPs across the pandemic period before subsiding upon predominant discontinuation of distancing protocols. Longer periods of continuous presence of protocols were associated with prolonged sustenance of deleterious symptomatology, suggesting that careful considerations are warranted by public health officials concerning the implementation length of distancing protocols. While most individuals revealed similar patterns as the population, the opposite pattern was exhibited by a large subgroup who substantially increased in deleterious symptom levels ensuing the first partial re-opening of society. These individuals maintained their heightened depressive states across the full pandemic period and are projected to sustaining them ahead, not portraying any sizable changes ensuing the revealed major increase in symptom levels after the third month of the pandemic. Traditional demographic covariates only adequately predicted the initial reaction to the pandemic, and not the subsequent changes occurring throughout the pandemic period, rendering the individuals

demonstrating deleterious symptom profiles as concurrently unidentified and a major priority of investigation for future research. In general, the results demonstrate that adaptation to the pandemic, whether favorable or maladaptive, occurred within its first three months across all individuals, after which individuals' symptomatology consolidated in a stable pattern that was predominantly maintained for the remainder of the pandemic period. These results suggest that the course of depressive symptomatology for adults heavily depends on their initial reaction and adaptive flexibility to the pandemic and its implemented SDPs, highlighting the critical importance of monitoring symptomatology during the first months of pandemics as a risk period.

Figure Captions

Figure 1

The Unconditional Latent Change Score (LCS) Model

Note. Error variances (σ^2) are constrained to be equal. The covariances between η_{t1} and the latent change scores $\delta\eta_{t2-t6}$ are omitted from the figure to aid visualization.

Figure 2

The Conditional Latent Change Score (LCS) Model

Note. For visualization purposes, the covariances between η_{t1} and the latent change scores $\delta\eta_{t2-t6}$, the estimated parameter labels of the exogenous variables, in addition the regression estimates from the exogenous variables to η_{t1} and $\delta\eta_{t2-t6}$ are omitted from the path diagram. Edu: Education; Diag: Psychiatric diagnosis; Info: Information obtainment; Quar: Number of times exposed to quarantine; COV19 Inf $\text{Rate}_{t1\text{-}t6}$: Placeholder for the six time-variant weekly COVID-19 incidence rates.

Figure 3

The Evolution of Depressive Symptomatology Across Three Waves of the COVID-19 Pandemic From March 31, 2020, to August 1, 2021

Note. The dashed lines represent the 95% confidence intervals. Symptom change patterns were modelled upon all modifications in national social distancing protocols across the pandemic period. Each month is coded in units of 30 days ensuing the starting point March 31, 2020, coded as 0. The blue line depicts the complementary Oxford COVID-19 Stringency Index.

Figure 4

Individual Change Profiles in Depressive Symptomatology Across Three Pandemic Waves and all Modifications in Pandemic Distancing Protocols Through a 17-Month Period

Figure 5

Change Patterns of Depressive Symptomatology Across the 17-Month Period of the Study as Predicted by Age and Preexisting Psychiatric Diagnosis, Controlling for All Other Variables in the Model

Figure 6

Change Patterns of Depressive Symptomatology Across the 17-Month Period of the Study as Predicted by Number of Times Exposed to Quarantine and Information Obtainment Preferences, Controlling for All Other Variables in the Model

Supplementary Figure S1

The Individual Change Profiles of Depressive Symptomatology of all Participants Throughout the Study Period in Segments of 400 Subjects Across 11 Subfigures

Supplementary Figure S2

Change Patterns of Depressive Symptomatology Across the 17-Month Period of The Study as Predicted by Biological Sex and Education level, Controlling for All Other Variables in the Model

Supplementary Figure S3

Symptom-Level Analyses

Supplementary Document 1

Tables S1-S6. Social distancing protocols (SDPs) present across each assessment of the study (i.e., T1-T6).

Supplementary Document 2

Missing data diagnostics, sensitivity and specificity analyses, rank-order stability, and an expanded explanation of the latent change score model.

Supplementary Document 3

Performance of machine learning models in predicting attrition at each assessment wave.

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Table 1

The Results of the Conditional Latent Change Score Model (LCSM)

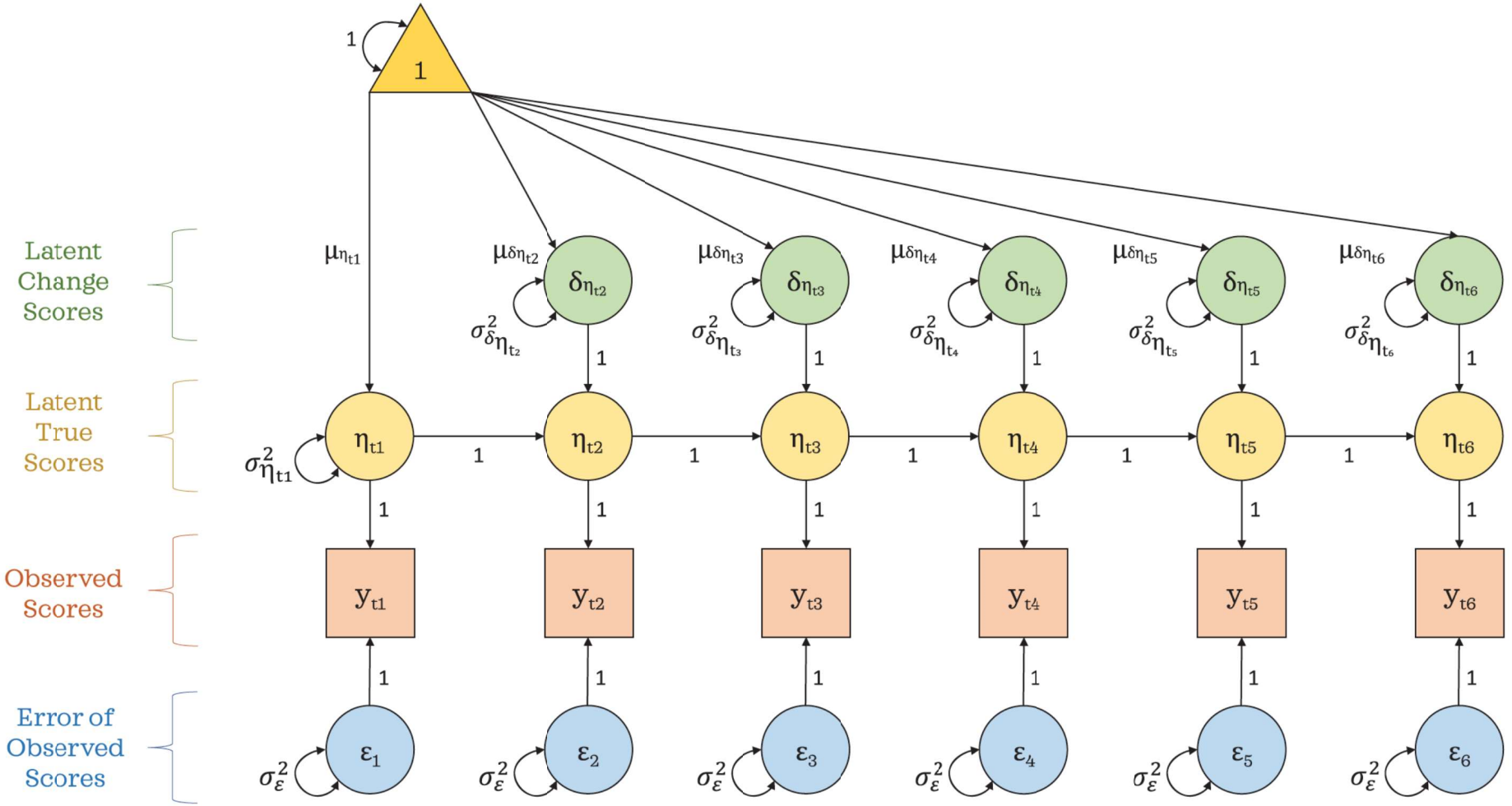
	Estimate	***SE***	***z***	***p***
1. Intercepts				
η_{t1}	9.49	0.20	47.37	< .001*
$\delta\eta_{t2}$	-2.89	0.33	-8.70	< .001*
$\delta\eta_{t3}$	1.41	0.23	6.22	< .001*
$\delta\eta_{t4}$	0.13	0.21	0.59	.558
$\delta\eta_{t5}$	-0.50	0.24	-2.14	.032*
$\delta\eta_{t6}$	-0.83	0.25	-3.28	.001*
2. Variances				
η_{t1}	18.68	0.58	32.00	< .001*
$\delta\eta_{t2}$	39.58	1.29	30.72	< .001*
$\delta\eta_{t3}$	2.44	0.42	5.82	< .001*
$\delta\eta_{t4}$	0.36	0.32	1.15	.252
$\delta\eta_{t5}$	2.08	0.36	5.75	< .001*
$\delta\eta_{t6}$	1.51	0.50	3.02	.002*
3. Covariances				
$\eta_{t1} \sim\sim \delta\eta_{t2}$	-16.74	0.74	-22.58	< .001*
$\eta_{t1} \sim\sim \delta\eta_{t3}$	-0.02	0.35	-0.06	.949
$\eta_{t1} \sim\sim \delta\eta_{t4}$	0.10	0.33	0.31	.758
$\eta_{t1} \sim\sim \delta\eta_{t5}$	-1.12	0.38	-2.94	.003*
$\eta_{t1} \sim\sim \delta\eta_{t6}$	-1.19	0.41	-2.93	.003*
4. Regression estimates				
4.1. Predictors of η_{t1}				
Age	-1.38	0.08	-16.47	< .001*
Sex	-1.43	0.17	-8.32	< .001*
Education	-0.70	0.08	-8.92	< .001*
Psychiatric diagnosis	6.00	0.20	30.40	< .001*
Quarantine exposure	0.11	0.10	1.08	.280
Info. platform preference	-0.12	0.32	-0.36	.716
C19 incidence rate$_{t1}$[a]	0.05	0.06	0.85	.397
4.2. Predictors of $\delta\eta_{t2}$				
Age	1.16	0.14	8.25	< .001*
Sex	1.26	0.29	4.36	< .001*
Education	0.61	0.13	4.62	< .001*
Psychiatric diagnosis	-5.21	0.33	-15.75	< .001*
Quarantine exposure	0.14	0.15	0.95	.344
Info. platform preference	1.04	0.46	2.27	.023*
C19 incidence rate$_{t2}$[a]	0.16	0.12	1.36	.174
4.3. Predictors of $\delta\eta_{t3}$				
Age	-0.30	0.10	-3.13	.002*
Sex	-0.18	0.20	-0.92	.359

Education	-0.09	0.09	-0.96	.338
Psychiatric diagnosis	0.33	0.23	1.44	.149
Quarantine exposure	0.20	0.09	2.13	.033*
Info. platform preference	0.16	0.28	0.56	.575
C19 incidence rate$_{t3}$[a]	-0.00	0.08	-0.10	.922
4.4. Predictors of $\delta\eta_{t4}$				
Age	0.15	0.09	1.68	.093
Sex	-0.16	0.19	-0.82	.413
Education	-0.06	0.09	-0.70	.485
Psychiatric diagnosis	-0.31	0.22	-1.41	.160
Quarantine exposure	0.03	0.08	0.41	.681
Info. platform preference	0.18	0.30	0.59	.555
C19 incidence rate$_{t4}$[a]	0.02	0.07	0.27	.784
4.5. Predictors of $\delta\eta_{t5}$				
Age	0.02	0.10	0.22	.826
Sex	0.23	0.21	1.09	.276
Education	0.06	0.10	0.66	.509
Psychiatric diagnosis	0.28	0.24	1.15	.248
Quarantine exposure	-0.09	0.09	-1.10	.270
Info. platform preference	0.22	0.33	0.07	.946
C19 incidence rate$_{t5}$[a]	0.00	0.08	0.08	.936
4.6. Predictors of $\delta\eta_{t6}$				
Age	0.10	0.11	0.94	.347
Sex	-0.15	0.23	0.64	.523
Education	0.04	0.10	0.38	.707
Psychiatric diagnosis	-0.47	0.27	-1.74	.083
Quarantine exposure	-0.15	0.08	-1.91	.056
Info. platform preference	-0.74	0.34	-2.18	.030*
C19 incidence rate$_{t6}$[a]	-0.02	0.09	-0.23	.819

Note. η_{t1} = Latent intercept at T1 (March 2020); $\delta\eta_{t2}$ = Latent change from T1 to T2 (March to July, 2020); $\delta\eta_{t3}$ = Latent change from T2 to T3 (July to December, 2020); $\delta\eta_{t4}$ = Latent change from T3 to T4 (December 2020 to February, 2021); $\delta\eta_{t5}$ = Latent change from T4 to T5 (February to May, 2021); $\delta\eta_{t6}$ = Latent change from T5 to T6 (May to August, 2021). [a] Standardized weekly incidence rates of COVID-19 matched with the response dates of each participant.

Figure 1

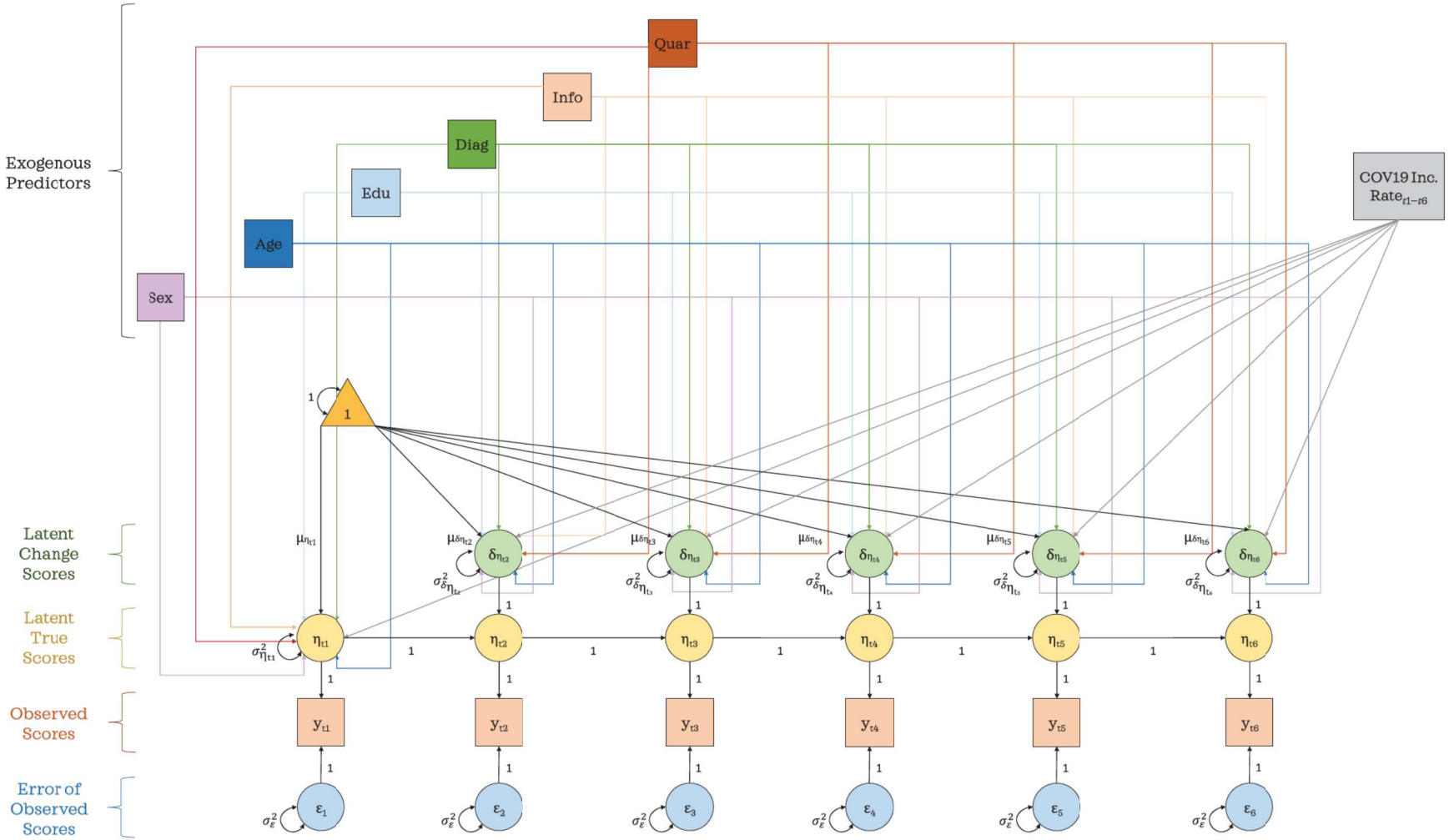
The Unconditional Latent Change Score (LCS) Model



Note. Error variances (σ^2) are constrained to be equal. The covariances between η_{t1} and the latent change scores $\delta\eta_{t2-t6}$ are omitted from the figure to aid visualization.

Figure 2

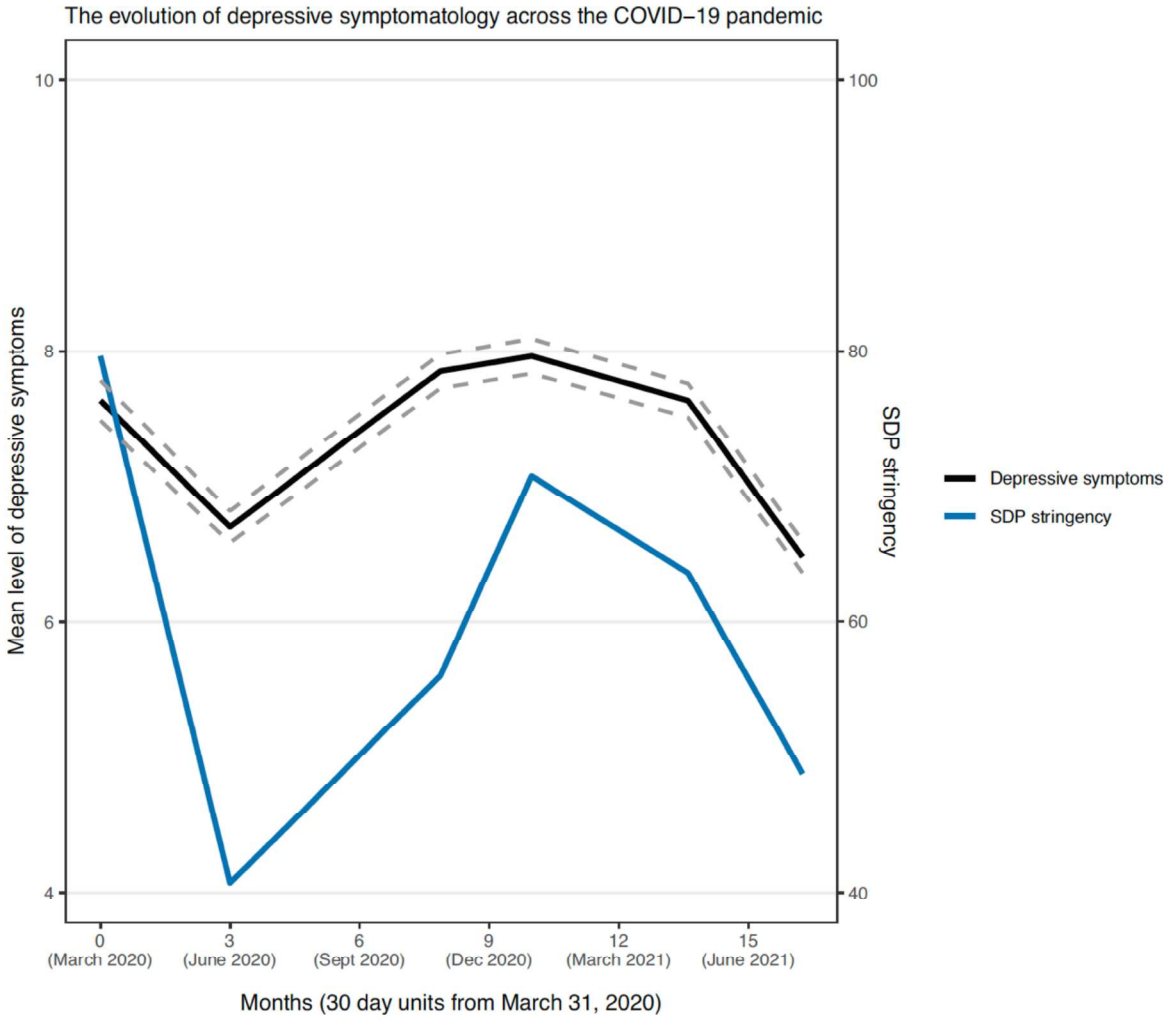
The Conditional Latent Change Score (LCS) Model



Note. For visualization purposes, the covariances between η_{t1} and the latent change scores $\delta\eta_{t2-t6}$, the estimated parameter labels of the exogenous variables, in addition the regression estimates from the exogenous variables to η_{t1} and $\delta\eta_{t2-t6}$ are omitted from the path diagram. Edu: Education; Diag: Psychiatric diagnosis; Info: Information obtainment; Quar: Number of times exposed to quarantine; COV19 Inf Rate$_{t1\text{-}t6}$: Placeholder for the six time-variant weekly COVID-19 incidence rates.

Figure 3

The Evolution of Depressive Symptomatology Across Three Waves of the COVID-19 Pandemic From March 31, 2020, to August 1, 2021



Note. The dashed lines represent the 95% confidence intervals. Symptom change patterns were modeled upon all modifications in national social distancing protocols across the pandemic period. Each month is coded in units of 30 days ensuing the starting point March 31, 2020, coded as 0. The blue line depicts the complementary Oxford COVID-19 Stringency Index.

Figure 4

Individual Change Profiles in Depressive Symptomatology Across Three Pandemic Waves and All Modifications in Pandemic Distancing Protocols Through a 17-Month Period

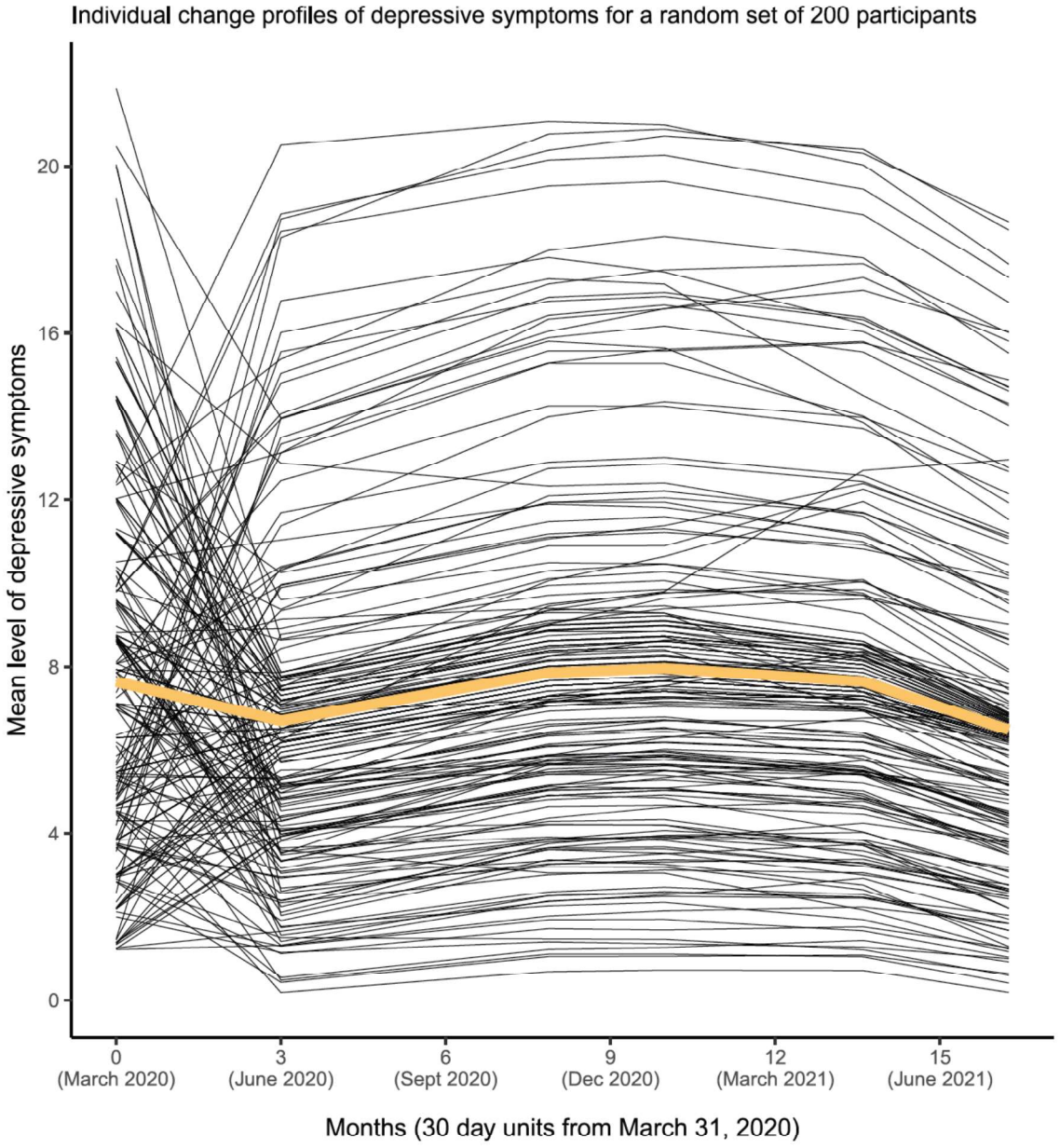


Figure 5

Change Patterns of Depressive Symptomatology Across the 17-Month Period of the Study As Predicted by Age and Preexisting Psychiatric Diagnosis, Controlling for All Other Variables in the Model

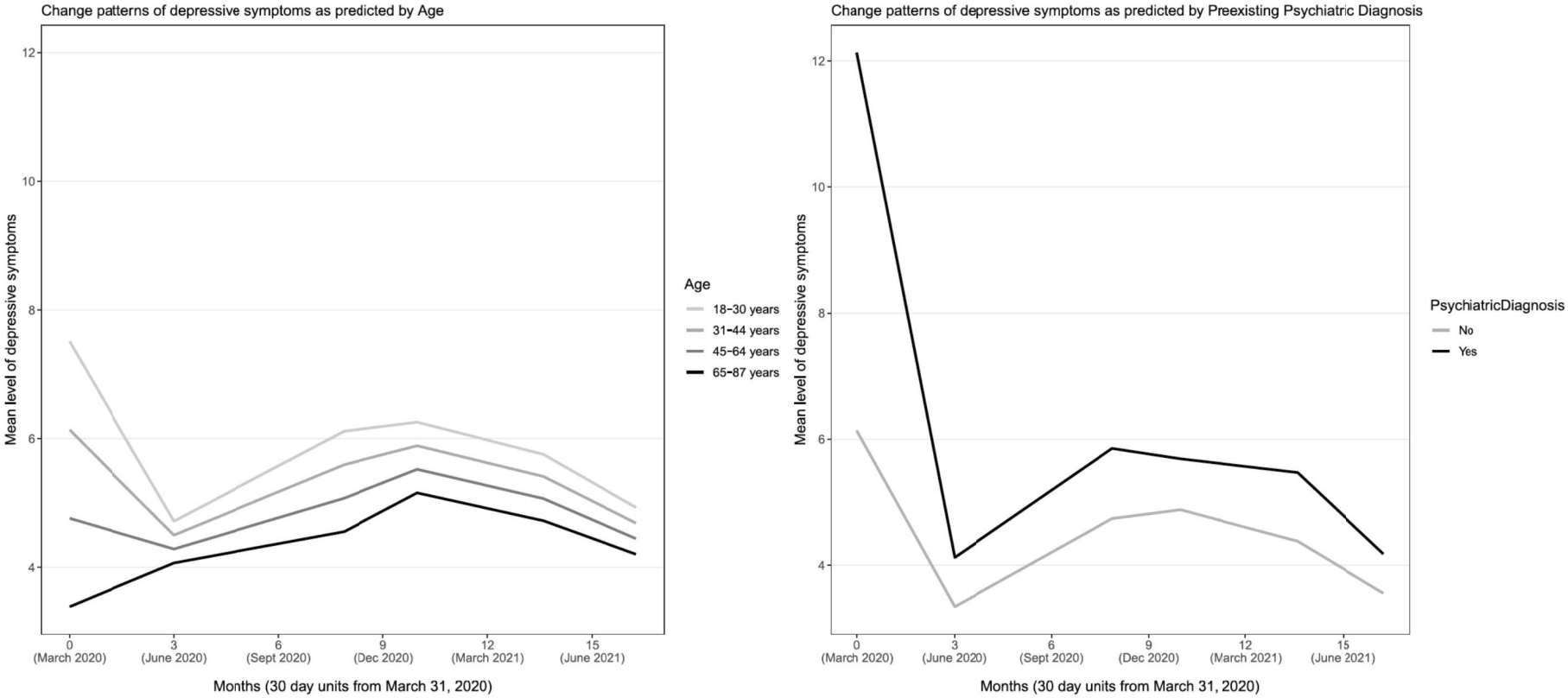
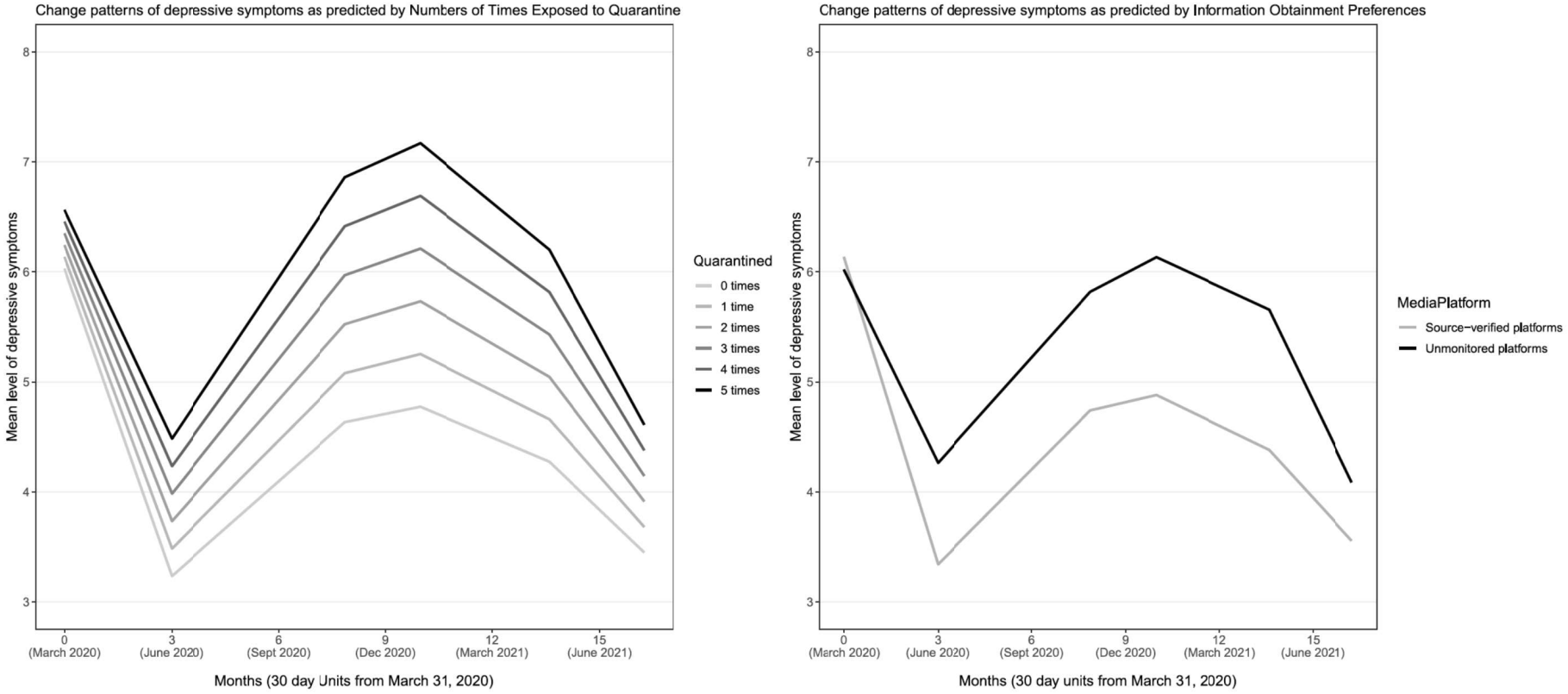


Figure 6

Change Patterns of Depressive Symptomatology Across the 17-Month Period of the Study As Predicted by Number of Times Exposed to Quarantine and Information Obtainment Preferences, Controlling for All Other Variables in the Model



Supplementary Document 1: Social Distancing Protocols Across the 17-Month Study Period: T1 to T6

(Article 1)

Supplementary Document 1: Social Distancing Protocols Across the 17-Month Study Period: T1 to T6

Supplementary Table S1

All nationally implemented social distancing protocols (SDPs) actively in place in Norway during the first wave of data collection (T1; between March 31 to April 7, 2020). No new information was given about modifications of SDPs during the measurement period, controlling for expectation effects. All SDPs were stable and unchanged for the weeks prior to and during data collection

Protocol
1. Individuals who have been in contact with an infected person are quarantined for 14 days following initial contact with the infected person.
2. Anyone suspecting having coronavirus symptoms or is confirmed to have the virus must be in isolation.
3. Social and physical distancing: individuals are disallowed from being in groups with more than five peers and must maintain at least two meters distance from others.
4. Closing of schools, kindergartens, and universities.
5. Closing of all businesses in the catering, food, and beverage industry. The exception of the rule involves eateries that may facilitate visitors to have at least a one-meter distance from each other.
6. Closure of all additional businesses with increased risk of infectious spread. This includes any business involving human contact, with the exception of essential stores (e.g., grocery stores, pharmacies).
7. Individuals returning to Norway receive an automatic quarantine duration of 14 days.
8. Cancellation of cultural events (e.g., concerts), closing of gyms and physical work-out centers.
9. Health personnel disallowed from leaving the country.
10. All hospitals and health institutions must introduce access control and stop regular visitation routines.
11. Ban on traveling to and staying overnight at one's leisure property outside the individuals residing municipality.
12. Border control: The borders are closed with regards to visitors from other countries.

Supplementary Table S2

All nationally implemented social distancing protocols (SDPs) actively in place in Norway during the second wave of data collection (T2; between June 22 to July 13, 2020). No new information was given about modifications of SDPs during the measurement period, controlling for expectation effects. As with T1, all SDPs were stable and unchanged for the weeks prior to and during data collection

Protocol
1. Individuals who have been in contact with an infected person are quarantined for 10 days following initial contact with the infected person.
2. Anyone suspecting having coronavirus symptoms or is confirmed to have the virus must be in isolation.
3. Social and physical distancing: individuals are disallowed from being in groups with more than twenty peers and must maintain at least a one-meter distance from others.
4. Universities and colleges are closed (Elementary and high school have re-opened)
5. Individuals visiting or returning to Norway receive an automatic quarantine duration of 10 days.
6. Public events must not exceed more than 200 individuals. In this case, they may be allowed if events can maintain the one-meter distance rule and meet the requirement of infection control protocols.
7. Re-opening of direct contact health service providers (e.g., psychologists and physiotherapists) provided they meet the requirement of infection control protocols.
8. Re-opening of one-to-one contact services (e.g., hair salons), gyms, and the catering and beverage industry may provided they meet the requirement of infection control protocols (as well as the maintenance of a one-meter distance for gyms and the catering and beverage industry).
9. All hospitals and health institutions must introduce access control and stop regular visitation routines.

Supplementary Table S3

All nationally implemented social distancing protocols (SDPs) actively in place in Norway during the third wave of data collection (T3; November 19 to December 2, 2020). No new information was given about modifications of SDPs during the measurement period, controlling for expectation effects. All SDPs were stable and unchanged for the weeks prior to and during data collection

Protocol
1. Individuals who have been in contact with an infected person are quarantined for 10 days following initial contact with the infected person.
2. Anyone suspecting having coronavirus symptoms or is confirmed to have the virus must be in isolation
3. Social and physical distancing: Recommended to avoid social contact. Individuals are disallowed from being in groups with more than five peers and must maintain at least 1 meter distance from others.
4. Masks are mandatory indoors, in public transportation areas, crowded places, and anywhere where it is not possible to maintain at least a one-meter distance.
5. Mandatory home-office wherever possible and particularly in areas with high transmission rates.
6. All universities, schools, and colleges must employ digital teaching where possible, reducing teaching and other activities that contribute to increased mobility, including pressure on public transport.
7. Individuals visiting or returning to Norway receive an automatic quarantine duration of 10 days. Extended restrictions for quarantine and travel to Norway, including but not limited to mandatory quarantine duty and presentation of a certificate of a negative COVID-19 test. Individuals, including tourists and visitors, who do not have their own residence or employer in Norway must stay in a quarantine hotel and get tested during the quarantine period.
8. Public events must not exceed more than 50 individuals.
9. National prohibition on serving alcohol after midnight. Restaurants with a license to sell alcohol disallowed from admitting new guests after 22:00
10. Avoid non-essential domestic travel. It is allowed to travel to leisure properties if one can travel without contact with other people.
11. All hospitals and health institutions must introduce access control and stop regular visitation routines.

Supplementary Table S4

All nationally implemented social distancing protocols (SDPs) actively in place in Norway during the fourth wave of data collection (T4; January 23 to February 2, 2021). No new information was given about modifications of SDPs during the measurement period, controlling for expectation effects. All SDPs were stable and unchanged for the weeks prior to and during data collection

Protocol
1. Temporary full stop of social contact: Avoid hosting guests in your home. Wait at least 14 days to make private visits.
2. Ensuing the 14 days, everyone should limit social contact to the greatest extent possible. It is recommended that meetings with other individuals, if any, take place outdoors, for individuals to avoid visits including more than five peers.
3. All organized leisure activities, sporting activities, cultural events and indoor faith community gatherings are to be halted and postponed.
4. Children in day-care facilities and primary schools must be organized in cohorts and can only receive visits from members of their own cohort.
5. Avoid all non-essential travel domestically and abroad. Stays in cabins with individuals from the same household continue to be permitted provided they take place in accordance with all applicable local and national rules and guidelines.
6. Re-recommendation of working from home.
7. Reclosing of universities, colleges and several types of schools: All teaching and planned events at universities, university colleges and vocational training schools must take place digitally.
8. All shopping centers and stores must introduce limits on the number of customers permitted inside to enable distancing and to control access to the premises.
9. The elite tiers of sports are recommended to postpone all league matches for a minimum period of two weeks.
10. Cultural events such as performances, courses, conferences, religious and life stance ceremonies shall be postponed if they gather attendees from multiple municipalities.
11. A maximum of ten individuals may attend private gatherings outside their own home, such as a birthday celebration in a rented premises with implemented transmission control. If the private gathering is taking place outdoors, the limit is 20 attendees.
12. There is a limit of ten individuals for indoor sporting events, cultural events, seminars, life stance community gatherings, ceremonies, etc., in addition to a limit of 200 individuals where everyone in the audience is seated in fixed seating. Up to 50 individuals are

permitted to attend funerals, even if the seating is not fixed.

13. A maximum of 200 people may attend outdoor events, while the limit is 600 people for events at which all members of the audience are seated in fixed seating.

14. Prohibitions on serving alcohol in the food, beverage, and catering industry.

Supplementary Table S5

All nationally implemented social distancing protocols (SDPs) actively in place in Norway during the fifth wave of data collection (T5; May 8 to May 25, 2021). No new information was given about modifications of SDPs during the measurement period, controlling for expectation effects. All SDPs were stable and unchanged for the weeks prior to and during data collection

Protocol
1. Individuals who have been in contact with an infected person are quarantined for 10 days following initial contact with the infected person.
2. Anyone suspecting having coronavirus symptoms or is confirmed to have the virus must be in isolation.
3. Social and physical distancing: A maximum of 10 individuals for inside events. A maximum of 20 individuals if the event is outside. Recommended to maintain a one-meter distance from others and maintain good hand hygiene.
4. Re-opening of schools, workplaces and universities: Students and employees are allowed to be on campus, in reading halls, and the library. Large-scale physical lectures are not recommended.
5. Children and young adults under 20 can engage in physical and in leisure activities. Adults can participate in organized physical activities in groups of 10 or smaller if possible to maintain a one-meter distance. Physical activities outside are allowed up to 20 adults.
6. Public events allowed up to 100 individuals with fixed seating, 200 individuals if event is outside, and 600 individuals when divided in cohorts of 200 with fixed seating.
7. Domestic travel allowed, but events gathering individuals from different municipalities recommended to be delayed.
8. Re-opening of alcohol sale: Allowed to serve alcohol but only accompanied with food. Serving alcohol is prohibited after 10 pm. Entrance prohibition after 10 pm.

Supplementary Table S6

All nationally implemented social distancing protocols (SDPs) during the COVID-19 pandemic in Norway actively in place during the sixth wave of data collection (T6; July 4 to August 1, 2021). No new information was given about modifications of SDPs during the measurement period, controlling for expectation effects. All SDPs were stable and unchanged for the weeks prior to and during data collection

Protocol
1. Social gathering in one's own home is allowed with up to (unvaccinated) 20 peers. Vaccinated peers do not count in the peer limit. Thus, private social gatherings may surpass the 20-person limit if guests are vaccinated.
2. No longer a one-meter rule for vaccinated individuals. The one-meter distance rule now only applies for unvaccinated individuals. Vaccinated individuals are exempt from the one-meter rule when having social contact with other vaccinated peers.
3. Discontinuation of quarantine upon contact with or share of housing with an infected individual.
4. Full opening of all schools, universities, kindergartens, and workplaces without restrictions. Universities no longer need to have digital solutions and may also include large-scale physical lectures.
5. No more travel domestic travel restrictions: Domestic travel allowed within and across all municipalities.
6. No more international travel restrictions: There is no longer a quarantine requirement for individuals returning or visiting Norway upon documenting vaccination, previous infection, or negative test.
7. Individuals allowed to travel internationally outside the country. Vacations outside of Norway are allowed, while not necessarily recommended.
8. No restrictions for children with respect to physical and in leisure activities. Adults can participate in organized physical activities up to groups of 40 individuals. There is no longer a requirement to maintain a one-meter distance.
9. Public events allowed up to 1000 individuals if the event is inside with fixed seating and 400 without fixed seating, 2000 individuals if event is outside with fixed seating, 800 individuals outside without fixed seating.
10. Night clubs reopened on top of all other services in the catering and beverage industry. Alcohol sale is no longer only limited to food servings and serving time is no longer restricted.
11. All professional sports activities can be conducted as normal again both indoors and outdoors.

Supplementary Document 2: Additional Analyses

(Article 1)

Supplementary Document 2: Additional Analyses

Diagnostic Analyses of Missing Data Patterns

Missing data patterns in the present study were investigated through two series of systematic analyses. The first set of analyses focused on whether the missing values on the outcome itself (i.e., depression) at each specific assessment wave where missing data was present (i.e., T2-T6) was related to the participants' initial values of the outcome. This series of independent samples t-tests (Table S7) revealed no differences in initial depressive levels between completers and non-completers at any assessment wave of the study.

Table S7

Differences in Initial Levels of Depression Between Completers and Non-Completers at Each Wave of the Study

Assessment wave	*M (SD)*	*t*	*p*
T2		-1.08	.283
Completers	7.54 (6.02)		
Non-completers	7.73 (6.06)		
T3		1.12	.264
Completers	7.73 (6.14)		
Non-completers	7.53 (5.94)		
T4		-0.19	.849
Completers	7.62 (6.06)		
Non-completers	7.65 (6.02)		
T5		-1.32	.186
Completers	7.49 (5.94)		
Non-completers	7.74 (6.11)		
T6		-1.13	.261
Completers	7.49 (6.06)		
Non-completers	7.71 (6.03)		

Additionally, another series of analysis was conducted to thoroughly investigate overall patterns of attrition at each assessment wave as related to the wide range of demographic variables available in the data set through the employment of decision tree-based machine learning classification approach, referred to as Classification and Regression Trees (CART). This involved inspection of variables such as age, biological sex, education,

psychiatric illness, ethnicity, employment status, relationship status, living situation, region of residency, urban versus rural residency, in addition previous depressive levels and potentially relevant cognitive-affective such as worry about losing one's job.

In this series of analyses, attrition at each wave was used as the target (i.e., criterion or outcome) variable, while the aforementioned variables were used as features (i.e., predictors). This machine learning technique examines whether and the degree to which the mentioned features can meaningfully predict patterns of missingness above and beyond chance (i.e., always guessing "Yes" on whether data is missing or not) at each assessment wave. The results from these machine learning models in predicting attrition at each assessment wave can be found in Supplementary Document 3, with the left panel of the figures portraying classification performance as per the Receiver Operating Curve (ROC), and the right panel revealing the extent to which features, if any, improved model performance. Note that the CART model is likely to identify predictors that to any degree can predict attrition, while the extent to whether this is meaningful depends on the models' predictive ability and performance (i.e., AUC and predictive ability above chance).

The CART models revealed no discriminative ability in predicting completers versus non-completers across any assessment wave, with Area Under the ROC Curve (AUC) ranging from 0.50 to 0.55 (mean AUC: 0.52). Additionally, these models did not for any of the assessment waves (i.e., T2-T6) predict attrition meaningfully better than chance, with mean improvements in Accuracy above chance across waves being 1.41% (range: [0.00, 4.40]).

Overall, while it is not possible to verify whether data are Missing at Random (MAR) or Missing Not At Random (MNAR; Enders, 2010, p. 6 and p. 8), this extensive series of analyses strengthen the case that no influential pattern of missingness exist in the present study among its measured variables and as dependent on previous values of the outcome,

increasing the plausibility that the assumption of MAR underlying the studies FIML-based analyses are reasonable.

Formal Translation of the Patient Health Questionnaire-9

A formal translation of the PHQ-9 available from The Norwegian Association for Cognitive Therapy was used, detailed in Supplementary Document 2. This instrument was translated through a translation-backtranslation procedure, first from English to Norwegian by a Norwegian clinical psychologist and researcher, prior to independent backtranslation by a native English-speaking MD practicing as a psychiatrist in Norway who spoke Norwegian fluently. The psychometric properties of this translated instrument were found to correspond to its English version in Norwegian samples (e.g., Wisting et al., 2021).

Post-Stratification of Sample

The demographic characteristics of the subjects were compared to their occurrence rates in the Norwegian adult population. In cases where assessments must be conducted within a specific time-period that cannot be flexibly extended to ensure proportionate participants in each stratum, poststratification of participants can be conducted to match the ratio of subgroups to that of the target population. Such procedures are relevant in public health studies in minimizing the risk of prevalence estimates being disproportionately driven by certain demographic groups (e.g., females) above others. As such, characteristics unrepresentative of the Norwegian adult population were poststratified to be proportional to their known rate to yield a representative sample of the Norwegian adult population.

Specificity of Findings for Depression

Three series of analyses were conducted to assess the specificity of the findings for depressive symptomatology. First, symptom-level patterns of change were investigated to assess the specificity of the results for the core symptoms of depression. Second, supplementary analyses on anxious change profiles were conducted using a validated

Norwegian translation of the GAD-7 instrument (Johnson et al., 2019) to compare depressive change profiles and its predictors to anxious change profiles. Finally, we tested whether the identified subgroup of individuals revealing detrimental depressive symptom profiles (i.e., 10% of adults in the sample; cf. Results section) could specifically and more dominantly be tied to outcomes related to depression above other psychopathological domains (e.g., anxiety, obsessive-compulsive problems). This was done through investigating psychiatric treatment seeking at the last wave of the study. Psychiatric treatment seeking at the last wave of the study was measured with a categorical question querying participants about whether they were seeking treatment at the final wave of the study and the specific psychological problem domain they were seeking treatment for. The response options on this item included the following categories: 0: Not seeking any psychological treatment; 1: Treatment related to anxiety; 2: Treatment related to depressive symptoms; 3: Treatment related to loneliness; 4: Treatment related to stress and trauma-related problems; 5: Treatment for loss and/or grief; 6: Treatment for obsessive-compulsive problems; and 7: Treatment for other psychological problems.

Symptom-Level Analyses and Patterns of Change

First, nine additional analyses were conducted to investigate the patterns of change for each specific symptom of depression. Model fit for each of these nine symptom-specific Latent Change Score Models can be found in Table S8, with the population-level and individual-level changes in each symptom over the study period provided in Supplementary Figure S3. The two symptoms that were identical (i.e., displayed significant and identical change patterns with the same direction at the exact same time-points; $\delta\eta_{t2}$, $\delta\eta_{t3}$, $\delta\eta_{t5}$ and $\delta\eta_{t6}$) to the overall depressive change patterns were its main identifiers (i.e., core symptoms; American Psychiatric Association, 2013), namely anhedonia and depressed mood.

Ensuing these key identifiers, lethargy was the symptom that partially assimilated the overall change patterns of depression, with significant change occurring at 3 of 5 time-points for this symptom, but not all change occurring in the same direction. Of particular note, while anhedonia and depressed mood increased during the intensive social distancing period after the Christmas holidays and early new year period at T4, lethargy decreased. Significant change in worthlessness occurred only 2 of 5 time-points, depicting a divergent pattern of change than depression and its two key identifiers, through worthlessness first revealing significant elevations well into the second wave of the pandemic (around November-December 2020).

Overall, no significant change patterns occurred for suicidal ideation, except for a slight decrease in the prevalence of such thoughts occurring upon predominant termination of the social distancing protocols at T6. Change patterns of psychomotor impairment/agitation were also different than the overall depressive change patterns, predominantly decreasing across the study period. Finally, significant change in appetite, sleep, and concentration problems solely occurred 3 of 5 time-points. In sum, only the two main identifiers (i.e., core criteria; American Psychiatric Association, 2013) of depression revealed identical and significant change patterns as the main analysis on the depression construct, highlighting the specificity of the results for key depressive symptoms including anhedonia and depressed mood.

Table S8

Model fit for the Each of the Nine Symptom-Specific Latent Change Score Models (LCSM)

Item number (Symptom)	χ^2 (df), *p*	*RMSEA* [90% CI]	*CFI*	*TLI*	*SRMR*
PHQ-1 (Anhedonia)	39.09 (9), $p < .001$	0.028 [0.019, 0.037]	0.990	0.984	0.026
PHQ-2 (Depressed Mood)	46.58 (9), $p < .001$	0.031 [0.023, 0.040]	0.989	0.982	0.028
PHQ-3 (Sleep disruption)	29.74 (9), $p < .001$	0.023 [0.014, 0.032]	0.994	0.991	0.020
PHQ-4 (Lethargy)	21.23 (9), $p = .012$	0.018 [0.008, 0.028]	0.996	0.994	0.016
PHQ-5 (Appetite change)	18.79 (9), $p = .027$	0.016 [0.005, 0.026]	0.997	0.995	0.015
PHQ-6 (Worthlessness)	22.06 (9), $p = .009$	0.018 [0.009, 0.028]	0.997	0.995	0.018
PHQ-7 (Concentration diff.)	19.43 (9), $p = .022$	0.016 [0.006, 0.026]	0.997	0.996	0.018
PHQ-8 (Psychomotor change)	58.19 (9), $p < .001$	0.035 [0.027, 0.044]	0.982	0.971	0.027
PHQ-9 (Suicidal ideation)	34.07 (9), $p < .001$	0.025 [0.017, 0.035]	0.995	0.992	0.024

Contrasting Depressive and Anxious Change Profiles

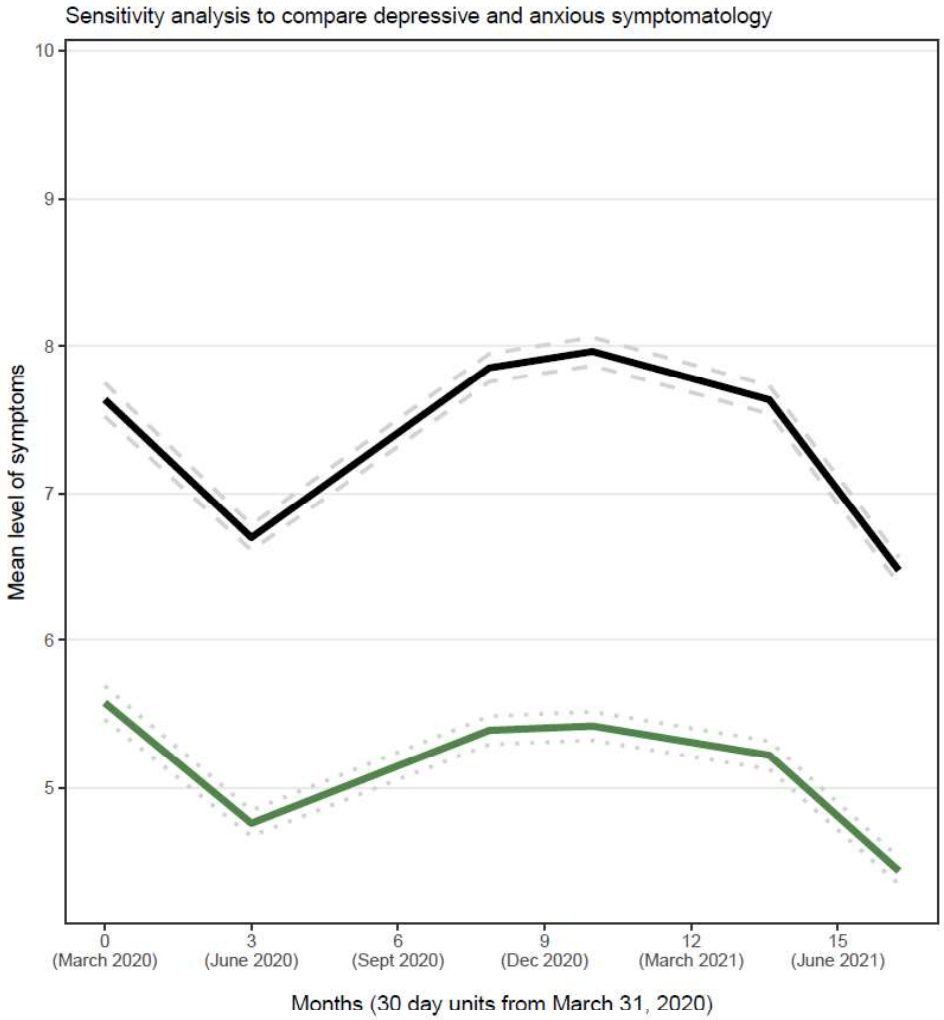
Anxious change profiles were estimated to compare depressive change profiles and its predictors to anxiety. The correlation between depression (PHQ-9) and anxiety (GAD-7) across all six time-points is provided in Table S9 below. The analyses on anxiety followed the same procedures as described for depression (cf. Statistical analyses section). The fit metrics for the anxiety models were χ^2 (10) = 58.31 ($p < .001$), *RMSEA* = 0.033 (90% CI: [0.025, 0.042]), *CFI* = 0.992, *TLI* = 0.988, *SRMR* = 0.029 for the unconditional LCSM), and χ^2 (96) = 396.54 ($p < .001$), *RMSEA* = 0.027 (90% CI: [0.024, 0.030]), *CFI* = 0.961, *TLI* = 0.942, and *SRMR* = 0.045 for the conditional LCSM.

Supplementary Figures S4 and S5 (below) depicts the change profiles of anxious symptomatology across the study period along with depressive symptomatology, stringency of social distancing protocols (SDPs) and weekly infection rates (cf. COVID-19 incidence section; Methods section). Key differences were identified between evolution of anxious versus depressive symptomatology and their predictors. In contrast with depression, ensuing an initial heightening in symptoms occurring for both symptom domains, anxiety both fluctuated less and revealed several notable differences in fluctuation patterns than depression. Specifically, the standardized estimates of change were -0.42 vs. -0.35 (at $\delta\eta_{t2}$), 0.86 vs. 0.46 ($\delta\eta_{t3}$), 0.20 vs. -0.00 ($\delta\eta_{t4}$), -0.35 vs. -0.16 ($\delta\eta_{t5}$), and -0.64 vs. -2.29 ($\delta\eta_{t6}$) for depression versus anxiety, respectively. In contrast with depression, no significant decrease in anxious symptomatology was observed at T5 during the reduction of SDPs ($p = .425$). Anxious symptoms levels were further highest during the first stringent SDP period (T1), while depression was highest during the re-introduction of strict distancing measures and further increase in their stringency at T3 and T4. Importantly, while infection rates did not significantly predict depressive symptomatology at any time-point during the study period, higher infection rates predicted heightened anxiety at both T1 and T4 ($ps < .05$). One possible explanation relates to concerns about viral spread, which has been tied increase in anxiousness during the present pandemic (e.g., Wheaton et al., 2021). Depression on the other hand has been more strongly tied to loneliness during the present pandemic and previously mechanistically demonstrated to be predicted by the prolonged states of social isolation (Elmer et al., 2020), corresponding to the findings of the present study in identifying fluctuations in depressive symptoms more strongly being tied to the changes in SDPs than anxiety. Finally, while quarantine manifested itself as an early (i.e., T3) predictor of deleterious depressive symptom profiles, this was not significantly tied to anxiety ($p = .13$). In summary, depressive symptom profiles were more strongly tied to fluctuations in SDP

stringency, the socially isolating incidence of quarantine, and further unrelated to infection rates, while anxiety symptoms in contrast was related to infection rates and revealed lesser fluctuations to SDPs. Accordingly, while the pandemic and its accompanying SDPs also were tied to fluctuations in anxious symptoms, these were less tied (and at times, i.e., T5, disconnected) to the changes in SDPs relative to depression, with anxious symptoms further uniquely being predicted by infection rates in contrast to depression.

Figure S4

Sensitivity Analysis Comparing Depressive and Anxious Symptomatology Across Three Waves of the COVID-19 Pandemic From March 31, 2020, to August 1, 2021



N*ote*. The green line represents anxiety symptoms, while the black line represents depressive symptoms, with the dotted and dashed lines representing the 95% confidence intervals, respectively.

Table S9

Correlation Between Depression (PHQ-9) and Anxiety (GAD-7) at Each of the six Assessment Waves of the Study

T1	T2	T3	T4	T5	T6
0.784	0.795	0.831	0.817	0.832	0.809

Specificity of Findings in Relation to Treatment Seeking Behavior

As a third and final step in investigating the specificity of findings for depression compared to anxiety and other psychiatric problem domains, we investigated self-reported treatment seeking-behavior at the last assessment of the study (T6) among the individuals revealing deleterious depressive symptom change profiles during the study (i.e., 438 individuals; 10.04% of the sample; cf. Results section). Being in treatment for depressive problems specifically was compared and contrasted with being treatment related to all other available measured psychiatric problem domains. Overall, the individuals identified to have deleterious depressive symptom profiles through the pandemic period were in treatment for depression between 1.65 to 14.30 more frequently compared to any other problem domain. Particularly, treatment seeking for depression (i.e., 24.16%) was 2.15 times more frequent than for anxiety (11.24%), 14.30 times higher for depression than for obsessive-compulsive problems (1.69%), 14.30 times higher than for loneliness (1.69%), 1.65 times higher than stress and trauma-related problems (14.61%), 10.74 times higher for loss and/or grief (2.25%), and 3.31 times higher than 'other' reasons for treatment seeking (7.30%). Accordingly, the individuals revealing deleterious depressive change patterns were approximately 2 to 14 times more frequently in treatment for depression than any other internalizing problem domains, in addition to between 3 to 10 more often in treatment for other problem domains.

Additional Inspection of the Link Between Social Distancing Protocols and Depressive Symptomatology

The investigation of social distancing protocol (SDP) modifications in relation to depressive symptomatology is a key feature built into the study design (cf. study design criterion a to e; cf., Methods section). Nonetheless, additional analyses using information from complimentary sources were conducted to augment the study design in further examining the link between SDPs and depressive symptomatology. In addition to conducted statistical examination of the connection between one of the most frequently used and ubiquitous SDPs (i.e., quarantine exposure; cf. Results section) in the main analysis of the study, further inspections were conducted on overall SDP stringency levels at each assessment.

First, depressive symptom evolution was plotted along with an internationally validated stringency index of social distancing protocols (i.e., extracting the country-specific SDP stringency for Norway at the six assessment waves of the study) and weekly infection rates across the study period. This is illustrated in Supplementary Figure S5 below. Second, additional statistical examinations were conducted, inspecting the correlation between the extracted stringency of SDPs and the mean level of depressive symptoms at each wave of the study. This was done through using the Oxford COVID-19 Stringency Index (Hale et al., 2020), which was used as an additional and complimentary objective measure of overall strictness of SDPs. The Oxford COVID-19 Stringency Index is based on nine metrics, yielding a final stringency score ranging from 0 (no protocols present) to 100 (strictest response possible). The nine metrics utilized by the Stringency Index in calculating and providing SDP strictness estimates include: 1) workplace closures; 2) school closures; 3) cancellation of public events; 4) closures of public transport; 5) stay-at-home requirements; 6) restrictions on public gatherings; 7) public information campaigns; 8) restrictions on internal

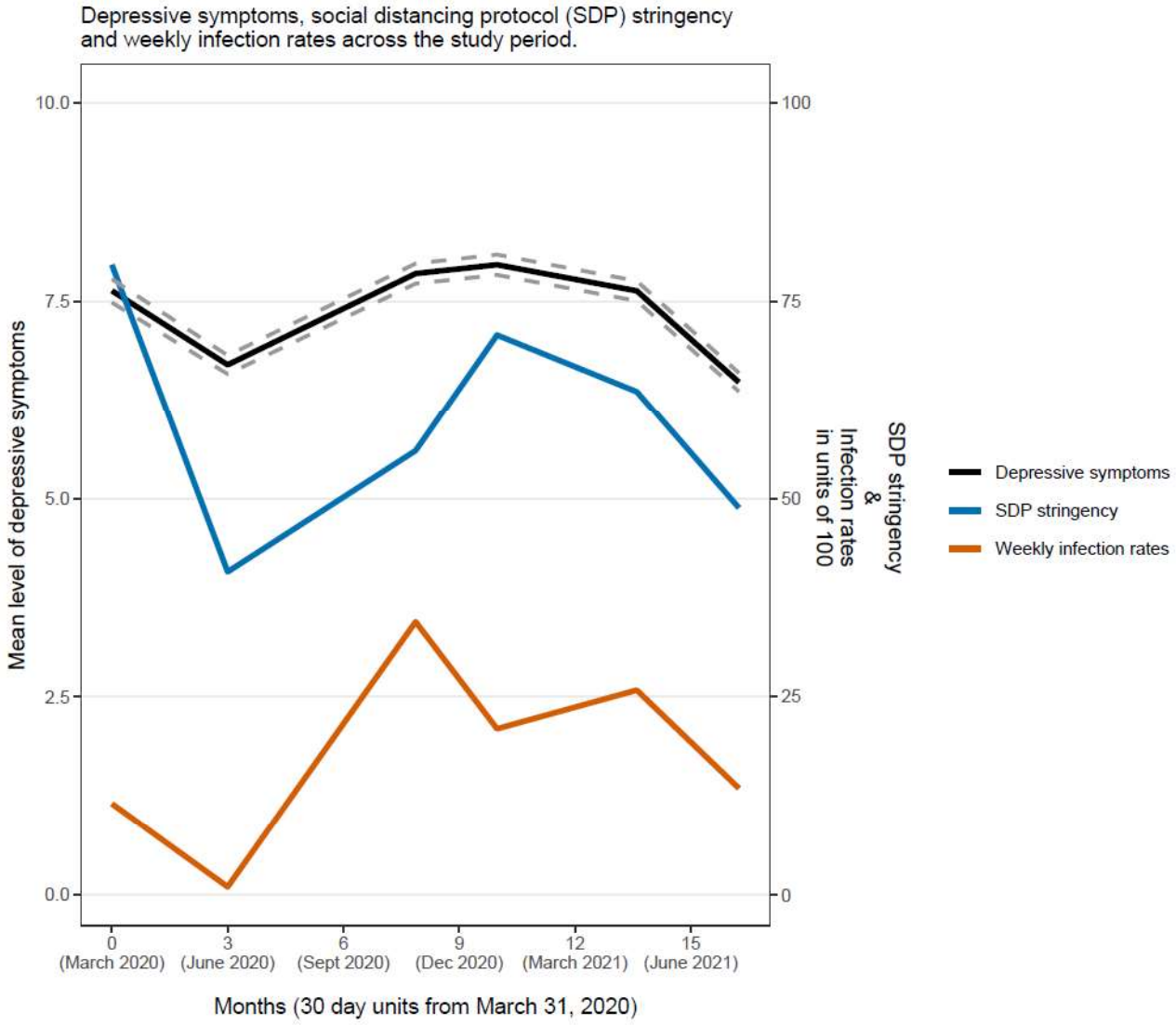
movements; and 9) international travel controls. In contrast with the national protocols which the present study implemented in its design and investigated over time, this internationally adaptable index does not account for the length implemented protocols into stringency severity. Overall, the stringency scores calculated for Norway at each wave of the present study by the Oxford COVID-19 Stringency Index were 79.63 (T1), 40.74 (T2), 56.02 (T3), 70.76 (T4), 63.61 (T5), 48.79 (T6). The index matched well with the national SDPs which the present study was designed to incorporate, revealing a near-identical profile in increase and decrease of SDP strictness.

The results incorporating this additional stringency index revealed a strong correlation (r = .74) between SDP stringency levels and mean level of symptoms across the study period. Notably, infection rates and SDP stringency were not strongly tied together (r = .29). This is further depicted in Supplementary Figure 5 below, with infection rates and SDP stringency revealing opposite patterns over longer periods during the pandemic, specifically at T3 to T4, and T4 to T5, where depressive symptom expression mimicked the SDP stringency trajectories as opposed to infection rates. These results are further in line with main statistical analyses revealing no relationship between infection rates and depressive symptoms as demonstrated in Table 1 and elaborated in the Results section of this study.

In sum, strong correlations were revealed between the complimentary and statistical measures of global SDP stringency and depressive symptoms, with depressive symptom expression further revealed to be statistically unrelated to infection rates as opposed to for anxious symptomatology where infection rates were deemed relevant.

Figure S5

Depressive Symptomatology Along With SDP Stringency and Weekly Infection Rates During the Study Period



Note. The left Y-axis reveals the mean level of depressive symptoms, while the right Y-axis portrays SDP stringency levels (0-100) and weekly infection rates in units of 100 at each wave of the study.

Expanded Explanation of the Latent Change Score Models

The latent change score model (LCSM) assesses and analyses individual differences in change over time, represented as latent *change scores* between adjacent occasions of measurement. First, an *unconditional* LCSM is fit to the data. This refers to as a model without any predictors which investigates whether and the extent to which any meaningful change exists in the outcome of interest (i.e., here change in depressive symptoms over time). In this model, first the initial latent (i.e., measurement error free) level of depressive symptoms is estimated at the onset of the study (T1). This is denoted as $\boldsymbol{\eta_{t1}}$, yielding the latent initial levels of depressive symptoms at T1 in the sample. The average initial level is represented by the term in $\boldsymbol{\mu\eta_{t1}}$ (cf. denoted in Figures 1 and 2, through regression on the constant **1**). The individual differences (i.e., variance) around this latent intercept are estimated by $\boldsymbol{\sigma^2\eta_{t1}}$, providing information about the extent to which individuals differed from the sample intercept on initial levels of depressive symptoms at T1. The latent true score (i.e., $\boldsymbol{\eta_{t1}}$; latent intercept in this context) is a measurement error free representation of the level of depressive symptoms at T1 as reflected by the observed score (i.e., $\boldsymbol{y_{t1}}$), with the error term for the score denoted as $\boldsymbol{\varepsilon_1}$.

Just as the latent measurement-error free level of depressive symptom at T1 is denoted $\boldsymbol{\eta_{t1}}$, latent levels of depressive symptoms at each consecutive time-point (i.e., T2 to T6) are denoted as $\boldsymbol{\eta_{t2}}$ to $\boldsymbol{\eta_{t6}}$. The observed scores (i.e., $\boldsymbol{y_{t2}}$ to $\boldsymbol{y_{t6}}$) reflect these latent variables plus error (i.e., $\boldsymbol{\varepsilon_2}$ to $\boldsymbol{\varepsilon_6}$). Note that separating the true and error variance in the observed scores to obtain measurement error-free latent levels of depression requires a sufficient number of time points and appropriate constraints on the error variance (equality over time).

The primary focus in LCSM is on how latent levels of the construct change over time, as represented by a second layer of latent variables representing *time-dependent changes*,

which are denoted as $\boldsymbol{\delta\eta_{t2}}$, $\boldsymbol{\delta\eta_{t3}}$, $\boldsymbol{\delta\eta_{t4}}$, $\boldsymbol{\delta\eta_{t5}}$, and $\boldsymbol{\delta\eta_{t6}}$, representing the change at time-points T2 to T6, respectively. Because these represent change in the latent variables (i.e., $\boldsymbol{\eta_{t1}}$ to $\boldsymbol{\eta_{t6}}$), these *latent change scores* are likewise free of free of measurement error. As depicted in Figures 1 and 2, these latent *change* scores capture change between each pair of adjacent assessments (i.e., T1 to T2; T2 to T3; T3 to T4; T4 to T5; and T5 to T6) and are denoted as $\boldsymbol{\delta\eta_{t2}}$, $\boldsymbol{\delta\eta_{t3}}$, $\boldsymbol{\delta\eta_{t4}}$, $\boldsymbol{\delta\eta_{t5}}$, and $\boldsymbol{\delta\eta_{t6}}$, respectively. Just as $\boldsymbol{\mu\eta_{t1}}$ and $\boldsymbol{\sigma^2\eta_{t1}}$ represent the mean and variance of the initial level of the construct (i.e., $\boldsymbol{\eta_{t1}}$), $\boldsymbol{\mu\delta\eta_{t2}}$ to $\boldsymbol{\mu\delta\eta_{t6}}$ and $\boldsymbol{\sigma^2\delta\eta_{t2}}$ to $\boldsymbol{\sigma^2\delta\eta_{t6}}$ capture the means and variances of the latent change scores. Note that covariances between initial status and latent changes are typically also included in an unconditional LCSM. Sometimes a third layer of latent variables is added to an LCSM to impose a parametric growth function on the latent change scores; however, in this application the pattern of change did not follow a simple function and interest focused on the specific time adjacent changes that were observed as pandemic protocols shifted.

The above-mentioned details form the core elements of the model which investigates *patterns of change* in depressive symptoms across the studies 17-month period and 6 assessment waves. With the change model in-place, *predictors* of change patterns can be brought in, expanding the model into a *conditional* LCSM (cf. Figure 2). These predictors each respectively predict the latent initial level of depressive symptoms (i.e., $\boldsymbol{\eta_{t1}}$) in addition to the latent change occurring at each time-point (i.e., $\boldsymbol{\delta\eta_{t2}}$, $\boldsymbol{\delta\eta_{t3}}$, $\boldsymbol{\delta\eta_{t4}}$, $\boldsymbol{\delta\eta_{t5}}$, and $\boldsymbol{\delta\eta_{t6}}$). The conditional LCSM model thus informs about *whether* and *the extent* to which each predictor can explain differences in initial levels (i.e., $\boldsymbol{\eta_{t1}}$) of depressive symptoms and the subsequent change patterns (i.e., $\boldsymbol{\delta\eta_{t2}}$, $\boldsymbol{\delta\eta_{t3}}$, $\boldsymbol{\delta\eta_{t4}}$, $\boldsymbol{\delta\eta_{t5}}$, and $\boldsymbol{\delta\eta_{t6}}$), *while controlling for* all other variables in the model.

For readers interested in more detailed mathematical overviews of LCSMs and its variants, McArdle (2001) and Grimm et al. (2016) may serve as suitable starting points, further encompassed with additional useful references.

Rank-Order Stability Analysis

The full correlation matrix showing the rank-order stability across all assessments (i.e., T1-T6) of the present study can be found in Table S10 below.

Table S10

Correlation Matrix Between the Latent Status Factors at Each of the six Assessment Waves of the Study

	η_{t1}	η_{t2}	η_{t3}	η_{t4}	η_{t5}	η_{t6}
η_{t1}	1.000					
η_{t2}	0.195	1.000				
η_{t3}	0.196	0.993	1.000			
η_{t4}	0.195	0.990	0.999	1.000		
η_{t5}	0.161	0.978	0.992	0.995	1.000	
η_{t6}	0.089	0.966	0.981	0.985	0.996	1.000

Longitudinal Measurement Invariance Inspection of the PHQ-9

The present investigation uses the sum-score of the PHQ-9 as its unit of analysis in modelling latent change given its well-established cut-off criteria validated in the general population which the study uses to identify subgroups of individuals revealing *clinically significant* increases in depressive symptomatology (i.e., Kroenke et al., 2001). As sum-scores implicitly make the assumption of equivalent measurement over time, in addition to the assumption of equal weighting of the items, longitudinal measurement invariance tests were conducted to examine the appropriateness of these assumptions and the use of sum-scores for the present study.

Measurement invariance test are highly sensitive large sample sizes, with high-powered studies prone to over-rejection of models due to trivial differences particularly

related to item intercepts (i.e., scalar invariance testing). As such, next to conventional evaluations of model fit (i.e., Hu & Bentler, 1999), the use of ΔCFI has been advocated as a criterion for model comparisons in cases with large sample sizes (Cheung & Rensvold, 2002). Accordingly, model comparisons were conducted using Cheung & Rensvold's (2002) criteria where a ΔCFI of -.01 or more suggests that the less parsimonious model (i.e., model with fewer constraints) should be preferred, while smaller changes suggests that the more parsimonious model (i.e., model with more constraints) should be chosen. We further used ΔBIC to complement the above-mentioned criteria.

First, a configural invariance model was conducted to assess appropriateness of the construct in relation to its nine indicators and that the same factor structure applies across assessment waves. This model yielded good fit to the data, with χ^2 (1227) = 3616.33 ($p <$ .001), RMSEA = 0.023 (90% CI: [0.022, 0.024]), CFI = 0.965, TLI = 0.960, SRMR = 0.042, and BIC = 235038.080.

Ensuingly, a metric invariance model was conducted to test whether the items were invariant in how representative they are of the construct across assessment waves. This model also portrayed good fit to the data, with χ^2 (1267) = 3703.19 ($p <$ .001), RMSEA = 0.023 (90% CI: [0.022, 0.024]), CFI = 0.965, TLI = 0.960, SRMR = 0.041, and BIC = 234813.699. ΔCFI (Metric – Configural) was 0.000, revealing that metric (i.e., weak invariance) holds and thus that items do not vary in how representative they are of the construct (i.e., the factor) across different time-points. In other words, the different indicators do not become more or less representative of depression at different occasions. ΔBIC (Metric - Configural) was equal to -224 and supported this conclusion.

Finally, a scalar invariance model was conducted, testing whether the mean levels of the underlying items vary across time-points. This model revealed excellent fit to the data, with χ^2 (1307) = 4148.88 ($p <$ .001), RMSEA = 0.024 (90% CI: [0.024, 0.025]), CFI = 0.959,

TLI = 0.955, SRMR = 0.045, and BIC = 234989.204. Model evaluation through ΔCFI supported that full scalar invariance holds, with ΔCFI (Scalar – Metric) = -0.006. ΔBIC (Scalar - Metric) was equal to 175 and thus not in agreement with ΔCFI. Accordingly, as a sensitivity analysis, modification indices were utilized to inspect whether a partial invariance model would be deemed more acceptable by all evaluation metrics. These indices highlighted the intercept constraints on item one (i.e., anhedonia), which were subsequently freed estimate a partial scalar invariance model. This model demonstrated better fit to the data, χ^2 (1302) = 4003.09 ($p < .001$), RMSEA = 0.024 (90% CI: [0.023, 0.025]), CFI = 0.961, TLI = 0.957, SRMR = 0.044, and BIC = 234860.001. As with the full scalar invariance model, ΔCFI supported that partial scalar invariance holds, with ΔCFI ($\text{Scalar}_{partial}$ – Metric) = -0.004. ΔBIC (Scalar - Metric) also approached zero, being equal to 46, a negligible difference given the scale. Accordingly, item intercepts were inspected to check whether the differences captured by the BIC were meaningful. Inspection of item intercepts indicated that the intercept differences for item one across assessment waves may be trivial (i.e., largest differences was 0.17 on a 4-point scale, between T1 and T6). Accordingly, to test whether these intercept differences were actually meaningful, the factor scores from the partial scalar invariance model at each assessment wave were correlated with a) the corresponding the factor scores yielded from the full scalar invariance model above (i.e., with explicit invariance assumptions) and b) the sum-scores means (i.e., with implicit invariance assumptions). Correlations between the full scalar invariance factor scores with the sum-scores are also provided, with all mentioned correlations reported in Table S11 below.

Table S11

Correlation Between Factor Scores From the Partial Scalar Invariance model, the Full Scalar Invariance Model, and Sum-Scores

Time-point	Partial scalar invariance and full scalar invariance factor scores	Partial scalar invariance factor scores and sum-scores	Full scalar invariance factor scores and sum-scores
T1	.9999	.9941	.9941
T2	.9999	.9911	.9911
T3	.9999	. 9901	.9900
T4	.9999	.9918	.9916
T5	.9999	.9908	.9907
T6	.9999	.9906	.9907

Finally, the correlation between the means of the factor scores from the partial scalar invariance model and corresponding sum-scores means were investigated *across time* to demonstrate the stability in mean trends between the sum-scores and partial invariance scores, yielding a correlation of r = .9890). This same analysis comparing the correlation of the factor scores from the full scalar invariance model and sum-score means across time yielded a correlation of r = .9957.

All correlations were close to unity (i.e., between .9890 to .9999), revealing no meaningful differences between the factor scores from either invariance model (i.e., full scalar invariance or partial scalar invariance) and the sum-scores, providing support that the assumption of equivalent measurement holds and that sum-scores may appropriately be used to evaluate mean level changes in the present study.

In sum, all invariance models fit well to the data, with ΔCFI supporting a full scalar invariance model, while ΔBIC indicated possible differences in intercepts of item one. Inspections of these intercepts and correlations between score estimates indicated these differences were trivial in magnitude and supported the use of sum scores in the LCSMs.

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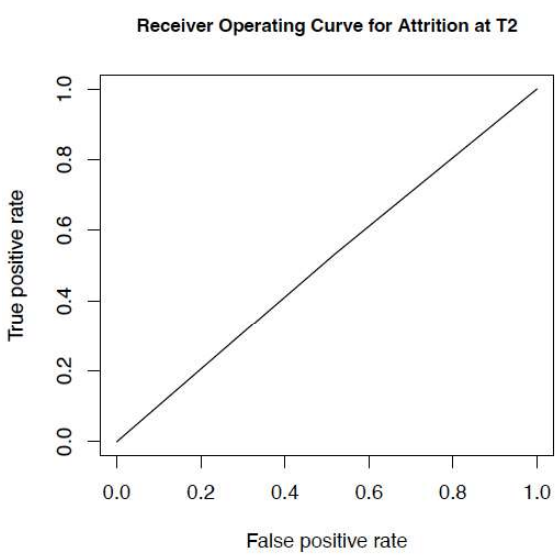
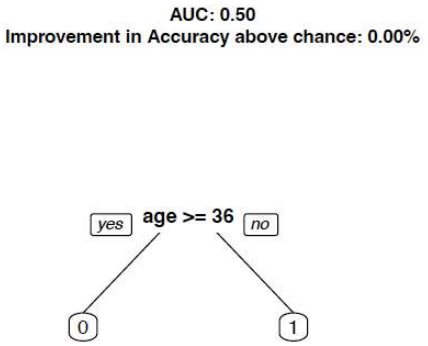
Supplementary Document 3: Classification and Regression Trees (CART) to Inspect Attrition

(Article 1)

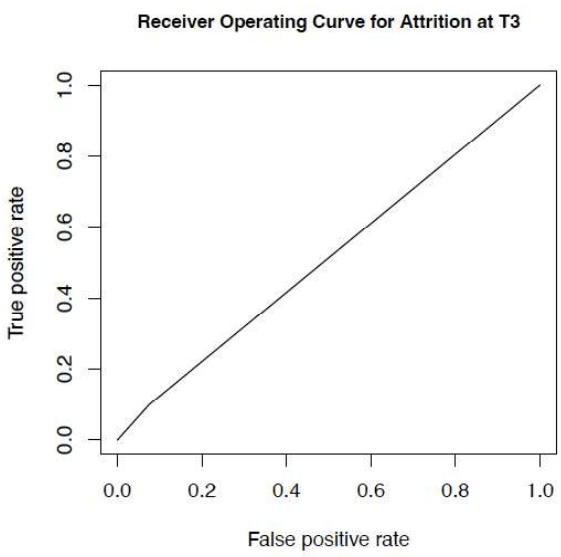
Supplementary Document 3: Classification and Regression Trees (CART) to Inspect Attrition

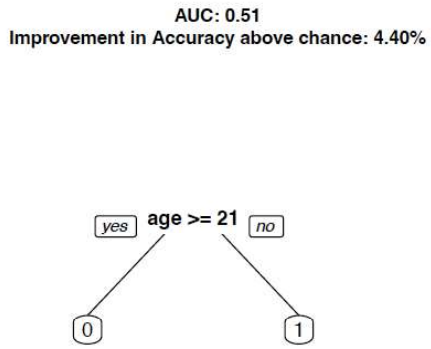
T2



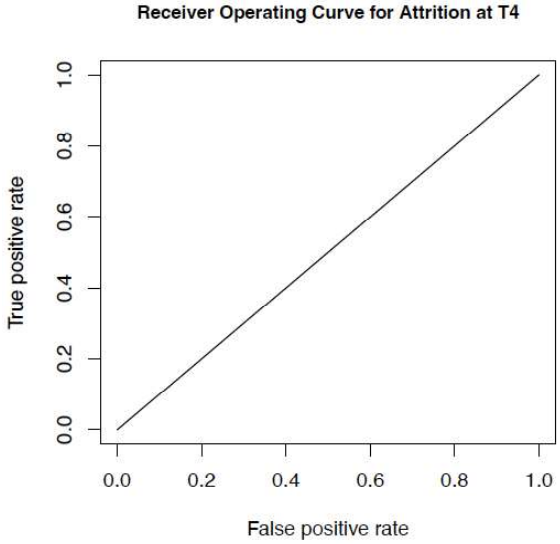


T3



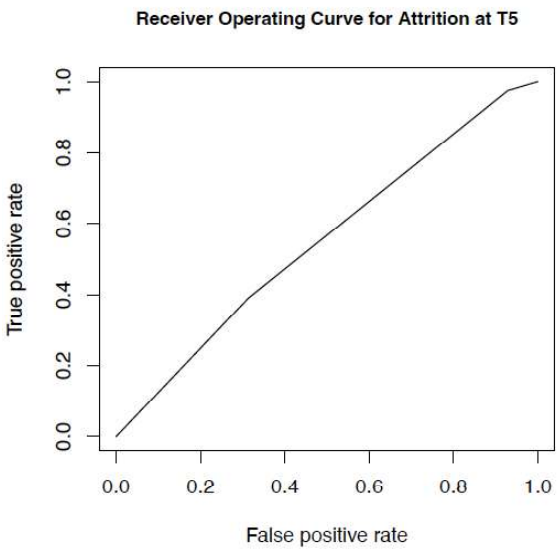


T4

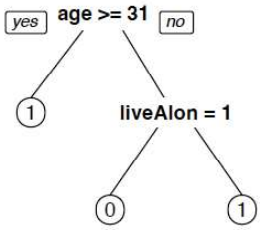


AUC: 0.50
Improvement in Accuracy above chance: 0.00%

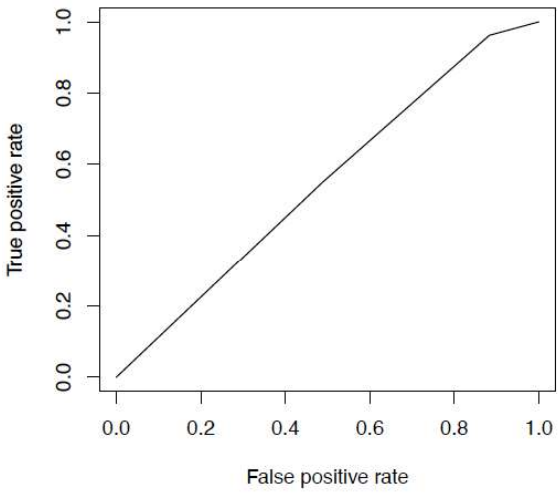
T5

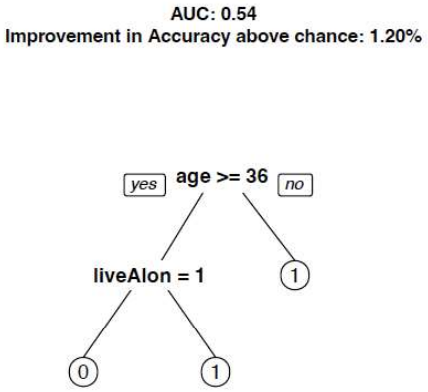


AUC: 0.55
Improvement in Accuracy above chance: 1.47%



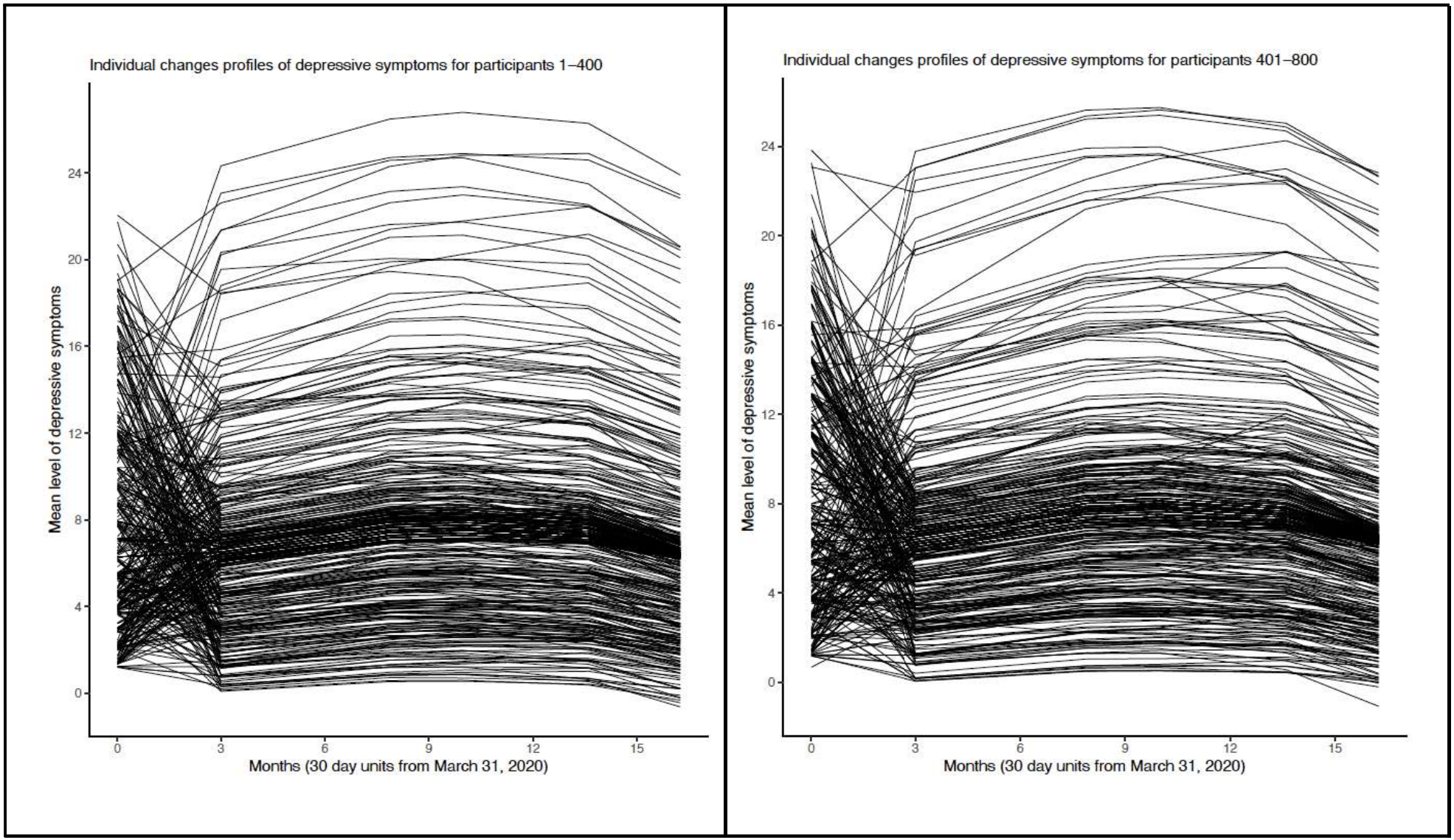
T6

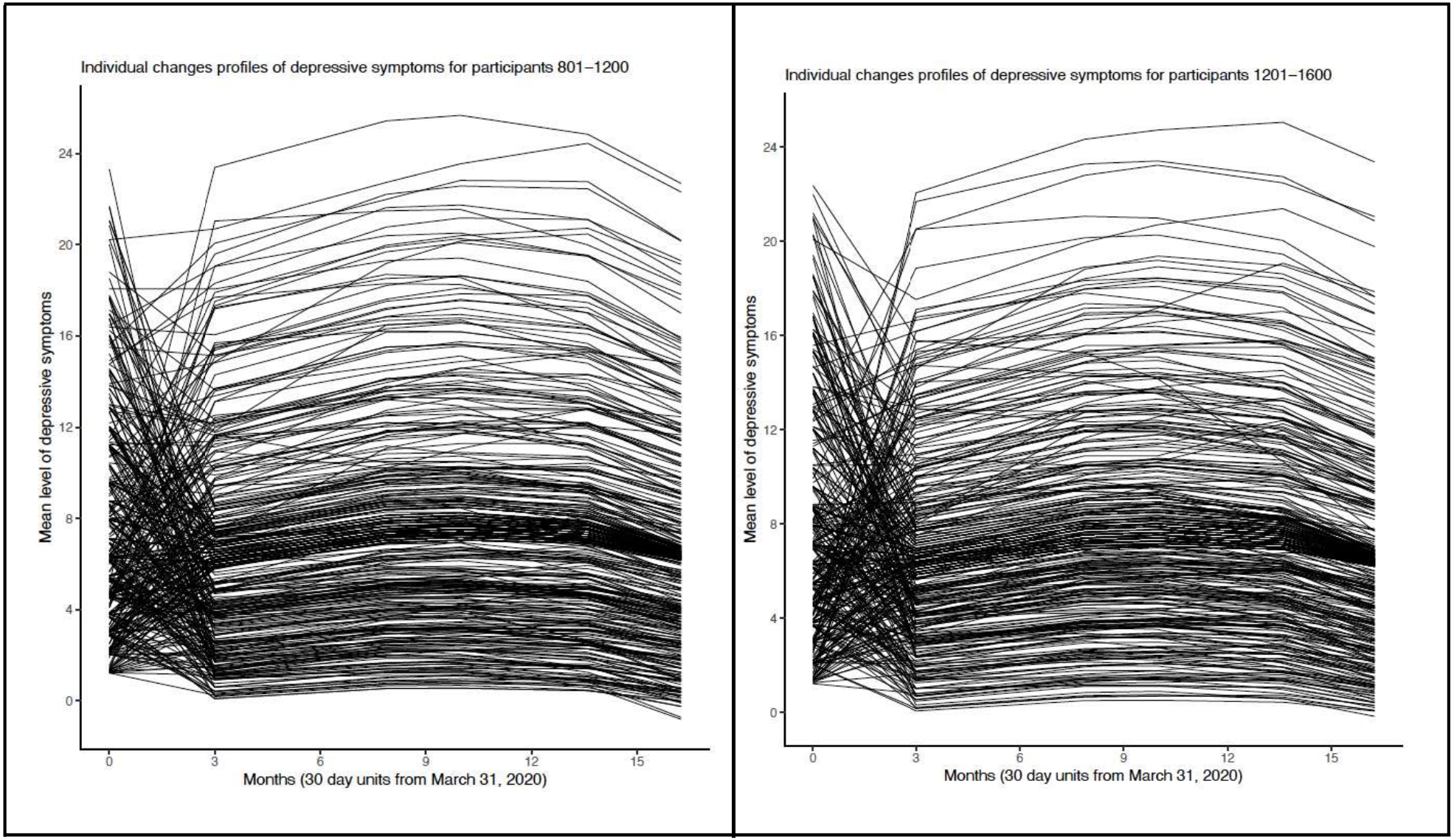

Receiver Operating Curve for Attrition at T6
True positive rate
False positive rate
0.0
0.2
0.4
0.6
0.8
1.0

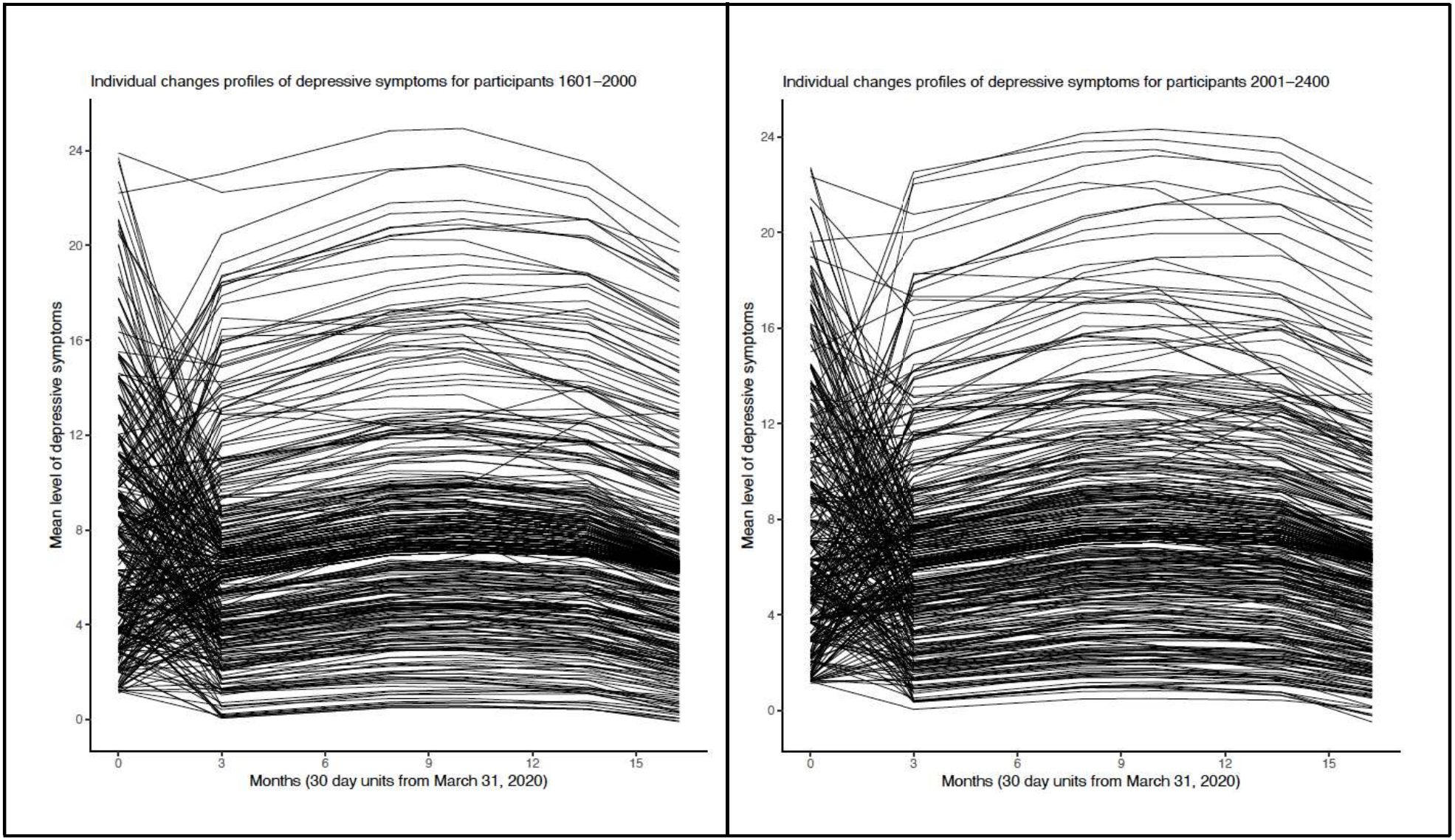

AUC: 0.54
Improvement in Accuracy above chance: 1.20%
yes
age >= 36
no
liveAlon = 1
1
0
1

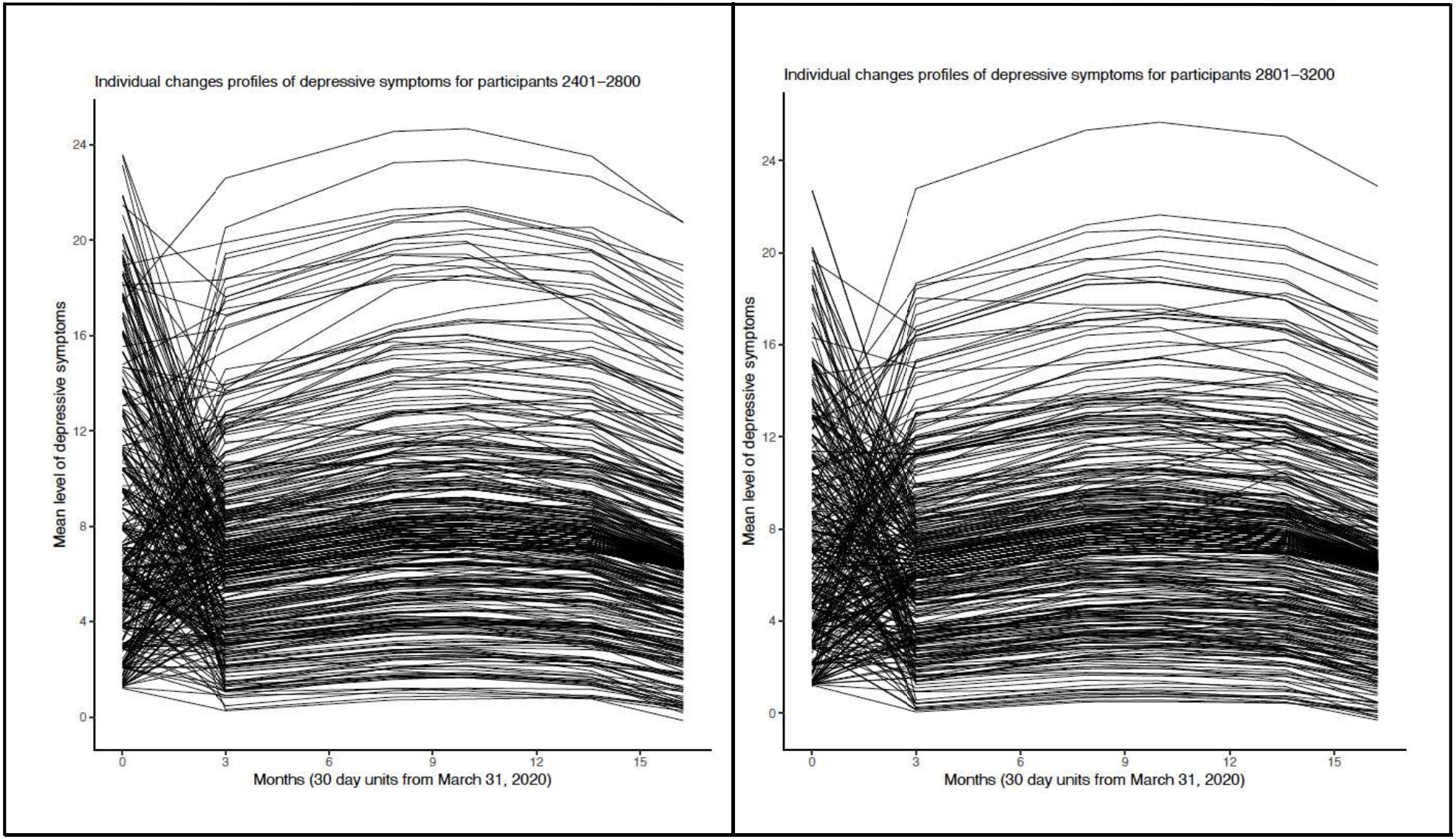
Supplementary Figures S1: Individual Change Profiles of all Participants in the Sample

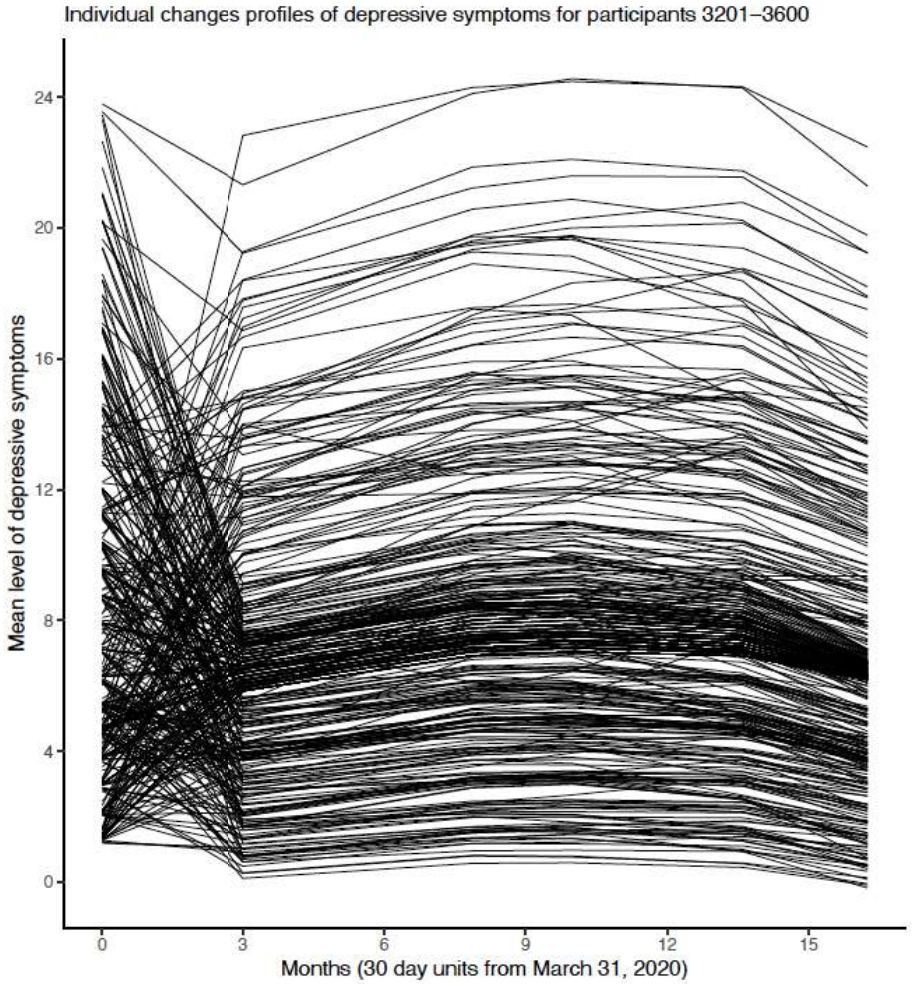
(Article 1)

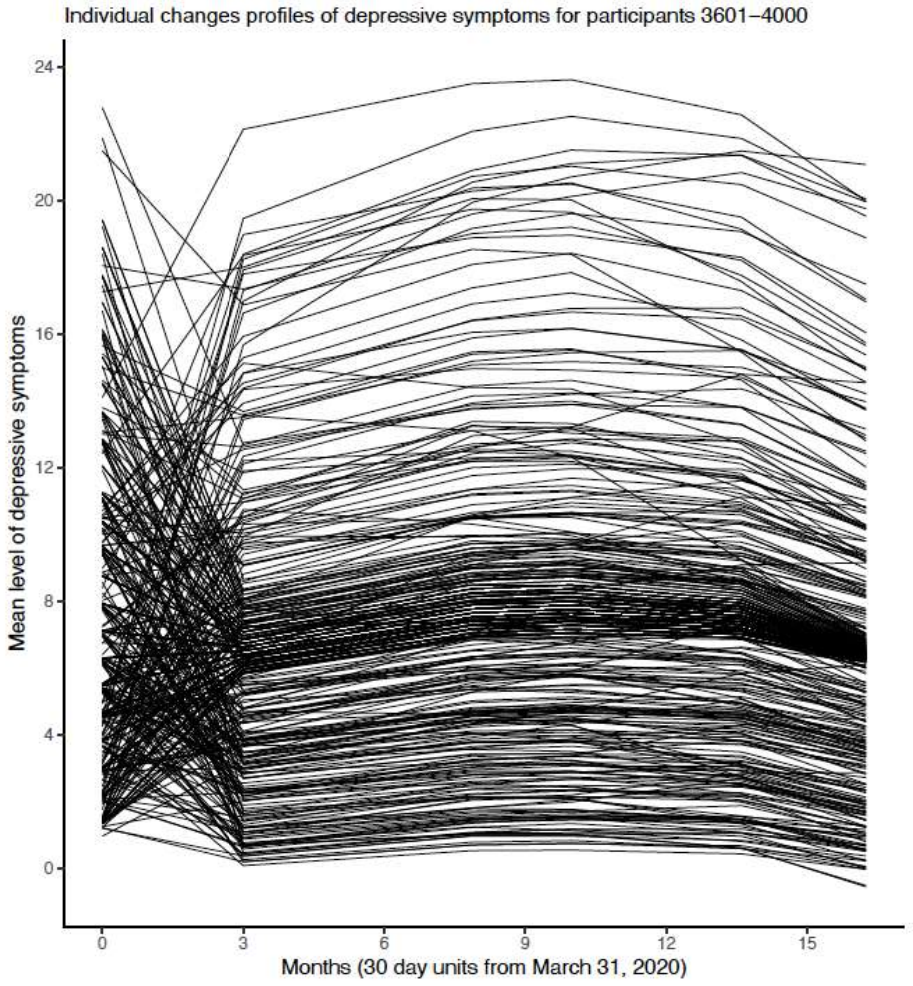

Individual changes profiles of depressive symptoms for participants 1–400
Mean level of depressive symptoms
0
4
8
12
16
20
24
0
3
6
9
12
15
Months (30 day units from March 31, 2020)
Individual changes profiles of depressive symptoms for participants 401–800
Mean level of depressive symptoms
0
4
8
12
16
20
24
0
3
6
9
12
15
Months (30 day units from March 31, 2020)

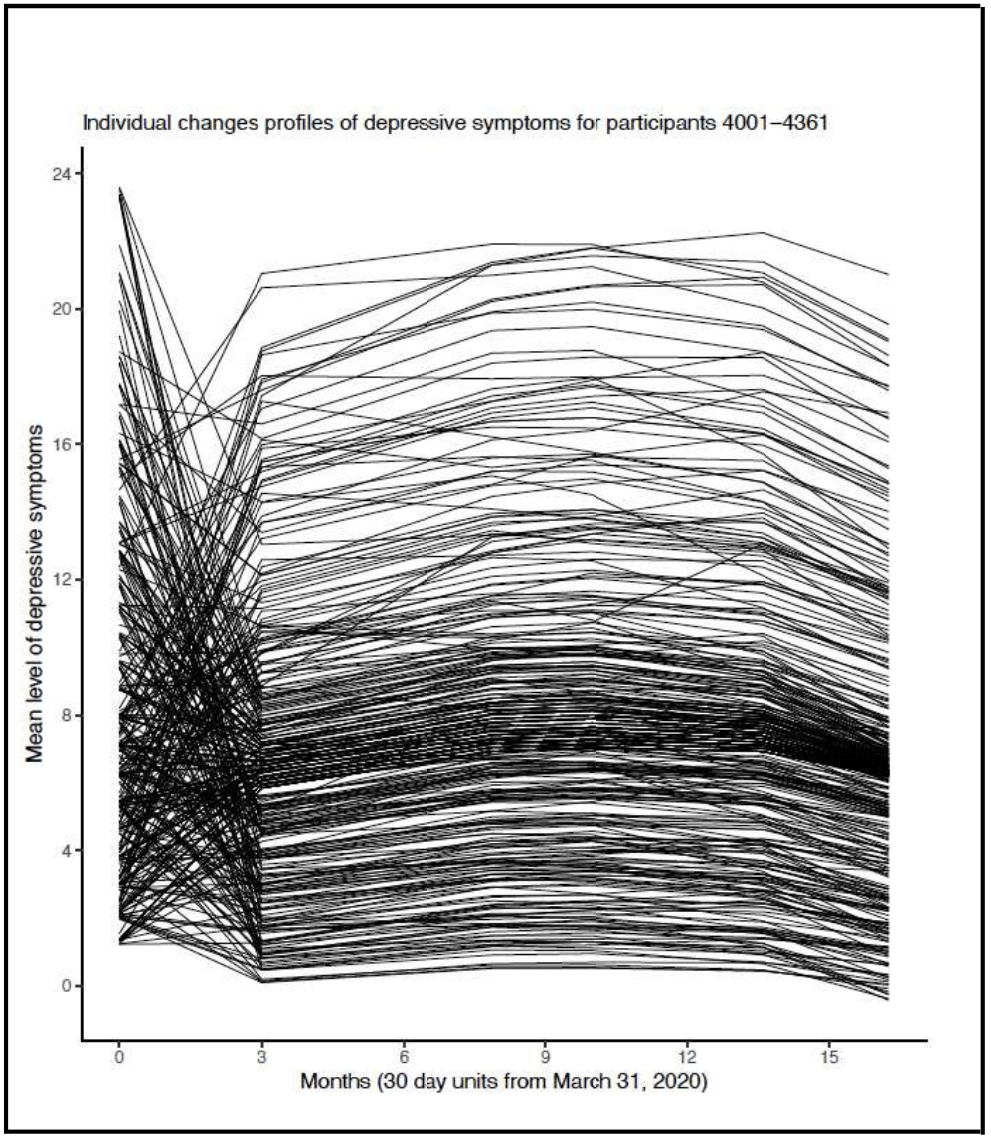

Individual changes profiles of depressive symptoms for participants 801–1200
Mean level of depressive symptoms
0
4
8
12
16
20
24
0
3
6
9
12
15
Months (30 day units from March 31, 2020)
Individual changes profiles of depressive symptoms for participants 1201–1600
Mean level of depressive symptoms
0
4
8
12
16
20
24
0
3
6
9
12
15
Months (30 day units from March 31, 2020)


Individual changes profiles of depressive symptoms for participants 1601–2000
Mean level of depressive symptoms
0
4
8
12
16
20
24
0
3
6
9
12
15
Months (30 day units from March 31, 2020)
Individual changes profiles of depressive symptoms for participants 2001–2400
Mean level of depressive symptoms
0
4
8
12
16
20
24
0
3
6
9
12
15
Months (30 day units from March 31, 2020)


Individual changes profiles of depressive symptoms for participants 2401–2800
Mean level of depressive symptoms
0
4
8
12
16
20
24
0
3
6
9
12
15
Months (30 day units from March 31, 2020)
Individual changes profiles of depressive symptoms for participants 2801–3200
Mean level of depressive symptoms
0
4
8
12
16
20
24
0
3
6
9
12
15
Months (30 day units from March 31, 2020)

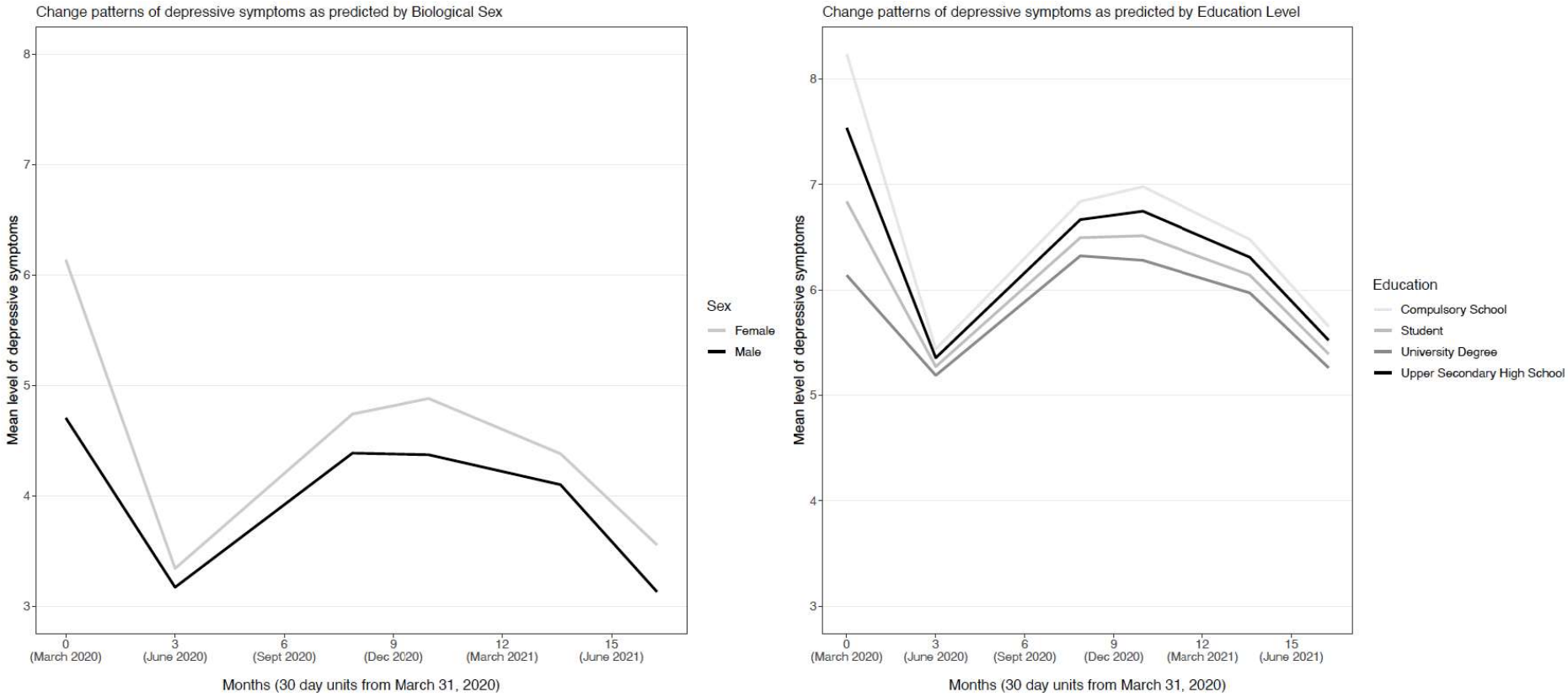

Individual changes profiles of depressive symptoms for participants 3201–3600
Mean level of depressive symptoms
0
4
8
12
16
20
24
0
3
6
9
12
15
Months (30 day units from March 31, 2020)


Individual changes profiles of depressive symptoms for participants 3601–4000
Mean level of depressive symptoms
0
4
8
12
16
20
24
0
3
6
9
12
15
Months (30 day units from March 31, 2020)


Individual changes profiles of depressive symptoms for participants 4001–4361
Mean level of depressive symptoms
24
20
16
12
8
4
0
0
3
6
9
12
15
Months (30 day units from March 31, 2020)

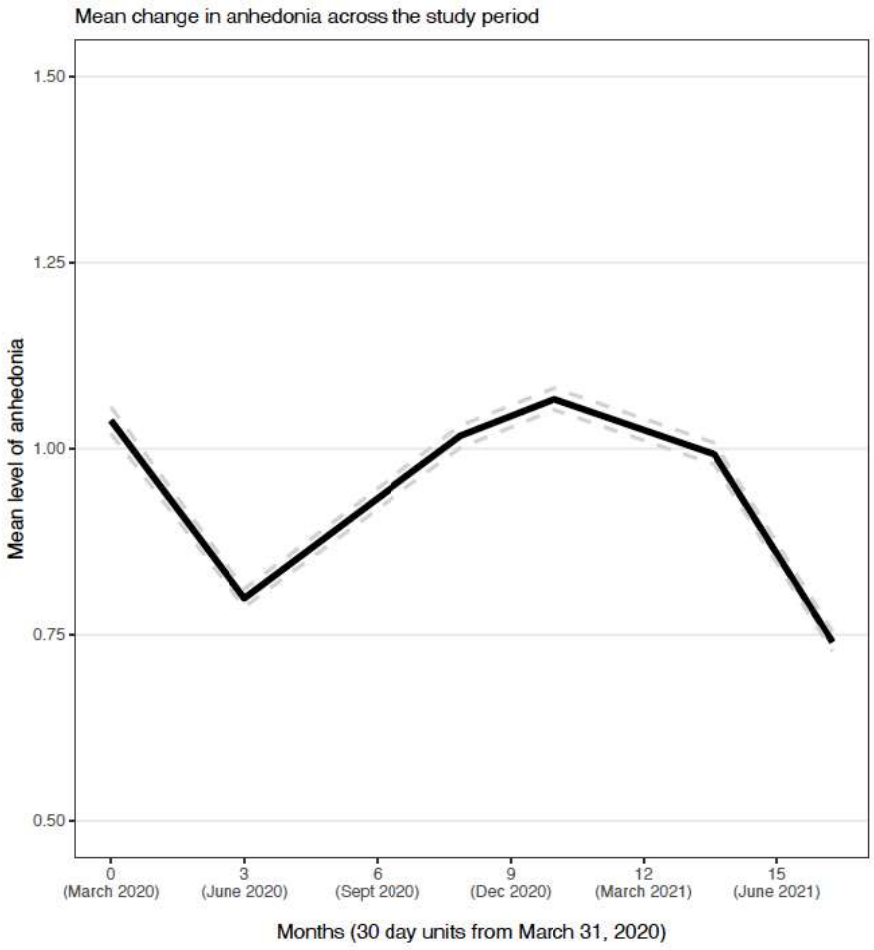
Supplementary Figure S2: Change Patterns of Depressive Symptoms as Predicted by Biological Sex and Education Level

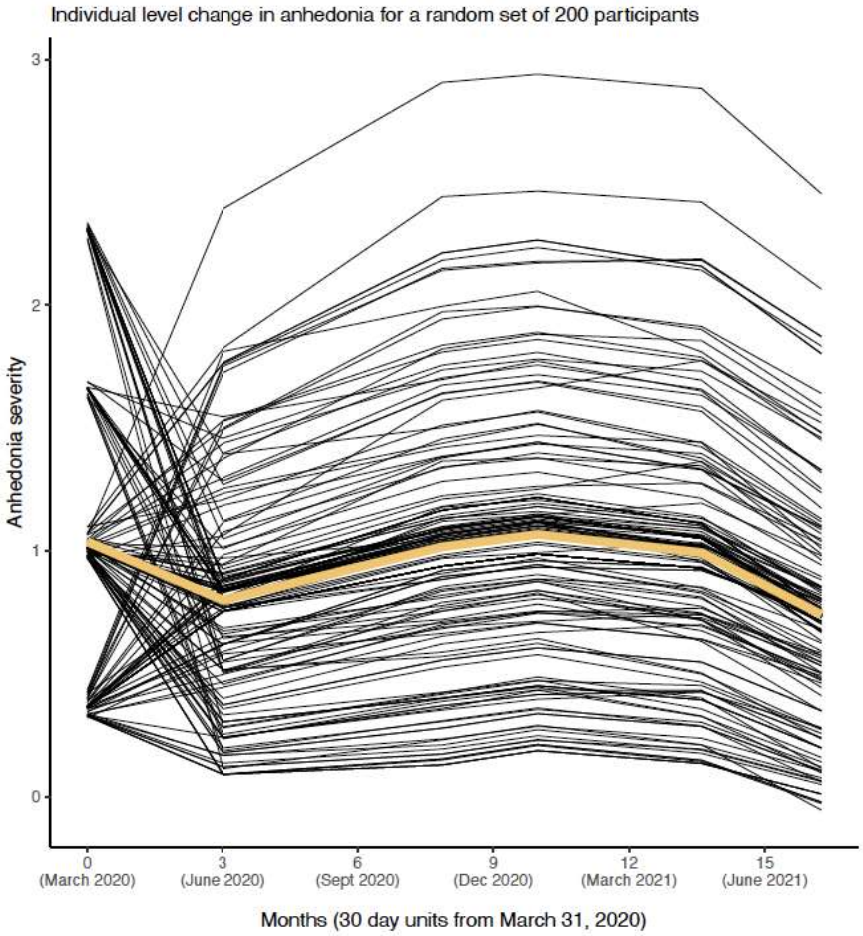
(Article 1)

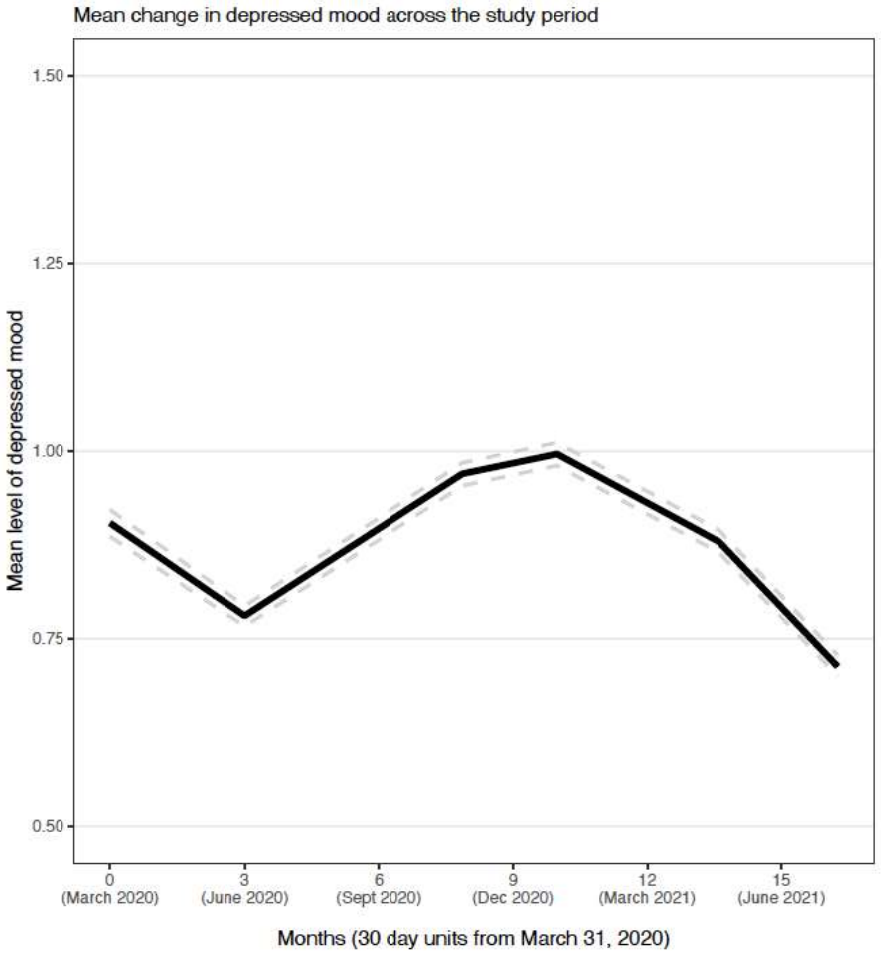

Change patterns of depressive symptoms as predicted by Biological Sex
Mean level of depressive symptoms
8
7
6
5
4
3
0
(March 2020)
3
(June 2020)
6
(Sept 2020)
9
(Dec 2020)
12
(March 2021)
15
(June 2021)
Months (30 day units from March 31, 2020)
Sex
Female
Male
Change patterns of depressive symptoms as predicted by Education Level
Mean level of depressive symptoms
8
7
6
5
4
3
0
(March 2020)
3
(June 2020)
6
(Sept 2020)
9
(Dec 2020)
12
(March 2021)
15
(June 2021)
Months (30 day units from March 31, 2020)
Education
Compulsory School
Student
University Degree
Upper Secondary High School

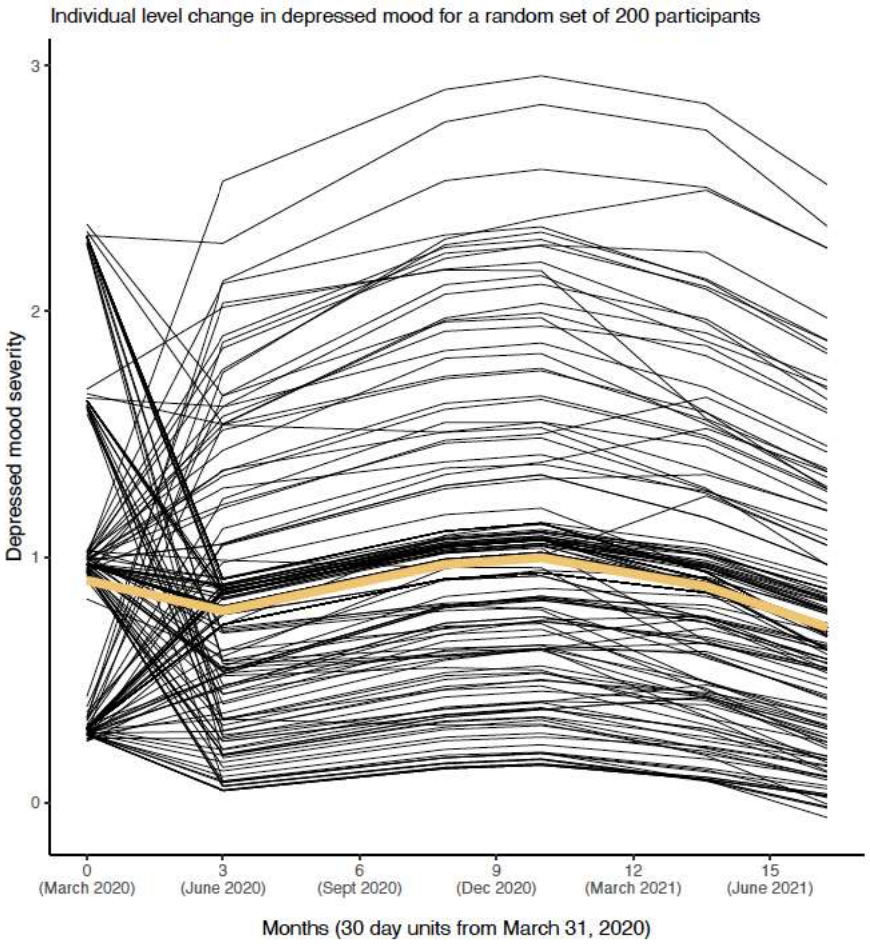
Supplementary Figures S3: Symptom-Specific Patterns of Change

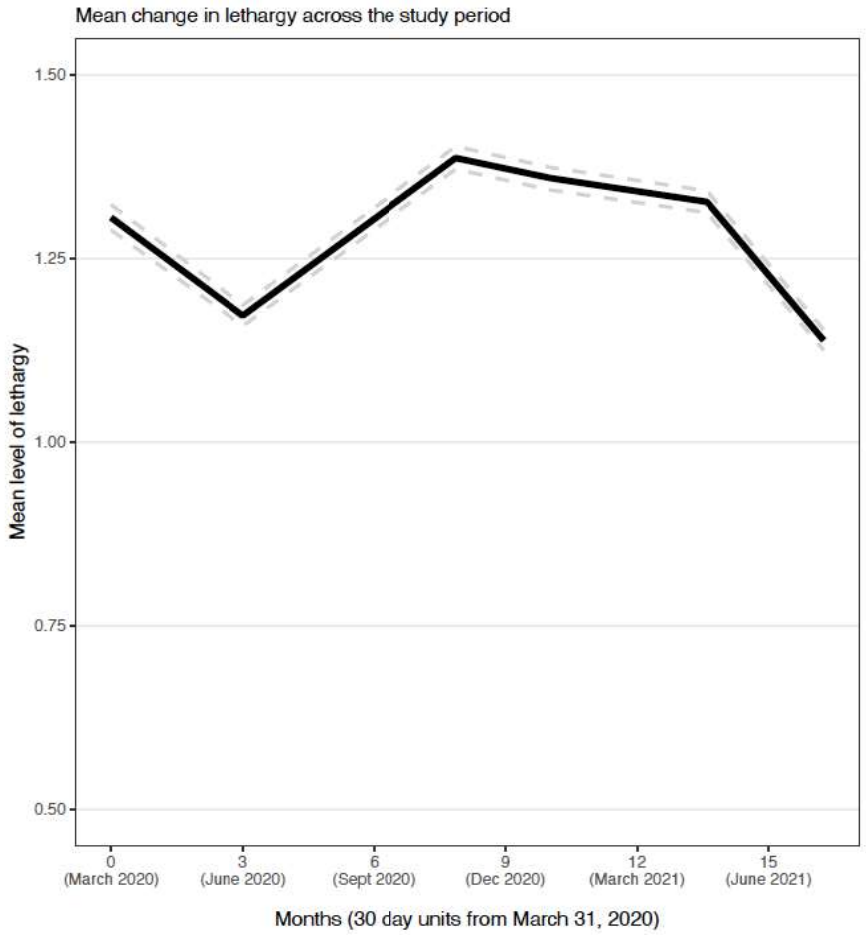
(Article 1)

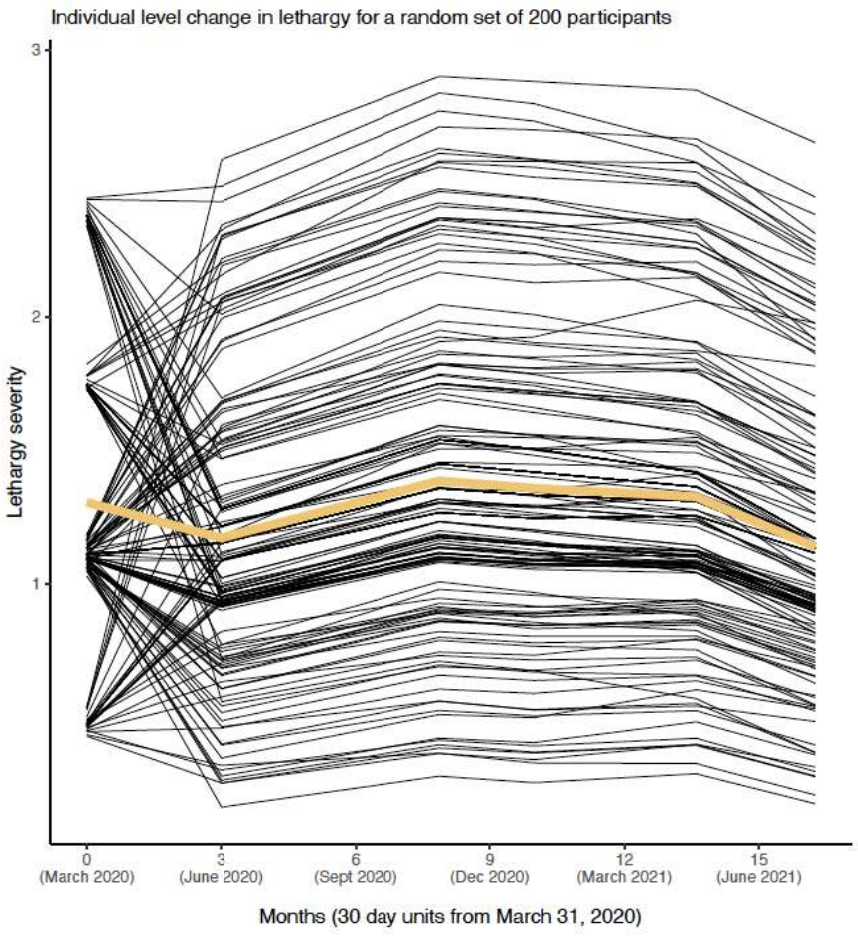

Mean change in anhedonia across the study period
Mean level of anhedonia
1.50
1.25
1.00
0.75
0.50
0 (March 2020)
3 (June 2020)
6 (Sept 2020)
9 (Dec 2020)
12 (March 2021)
15 (June 2021)
Months (30 day units from March 31, 2020)

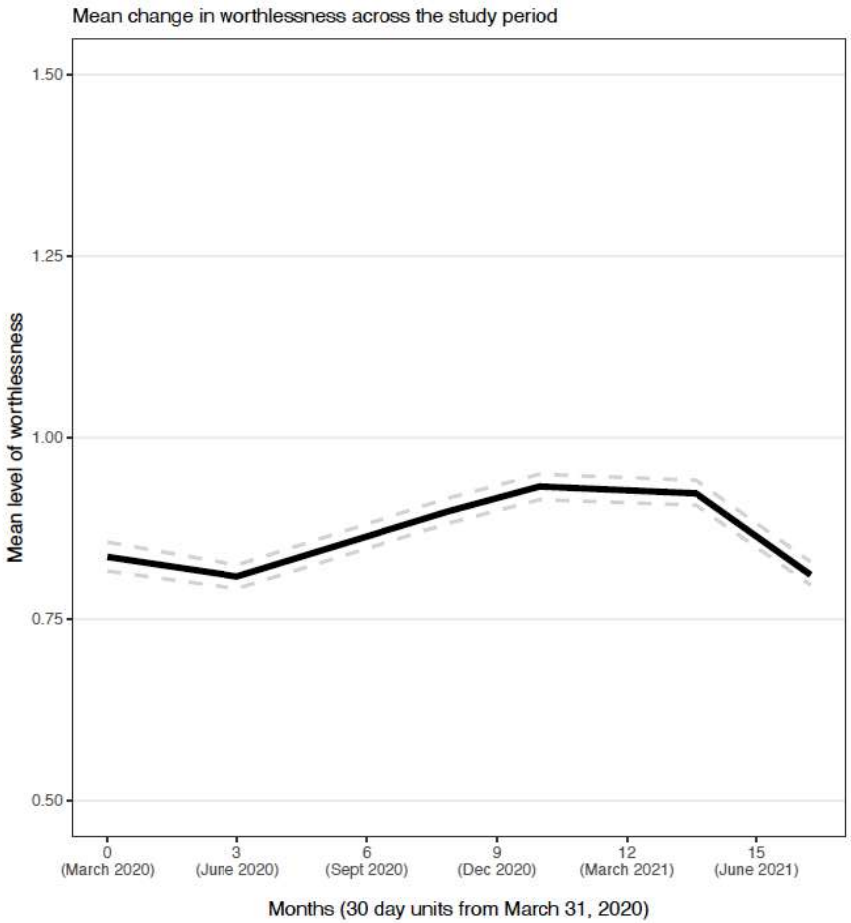

Individual level change in anhedonia for a random set of 200 participants
Anhedonia severity
3
2
1
0
0 (March 2020)
3 (June 2020)
6 (Sept 2020)
9 (Dec 2020)
12 (March 2021)
15 (June 2021)
Months (30 day units from March 31, 2020)

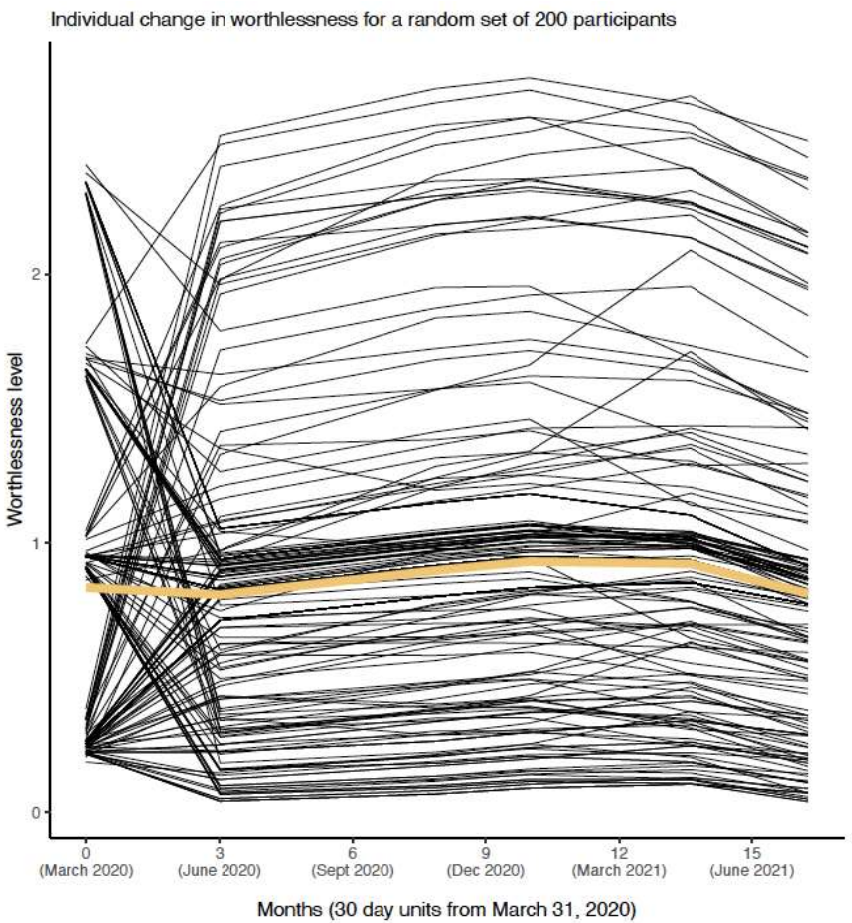

Mean change in depressed mood across the study period
Mean level of depressed mood
1.50
1.25
1.00
0.75
0.50
0 (March 2020)
3 (June 2020)
6 (Sept 2020)
9 (Dec 2020)
12 (March 2021)
15 (June 2021)
Months (30 day units from March 31, 2020)

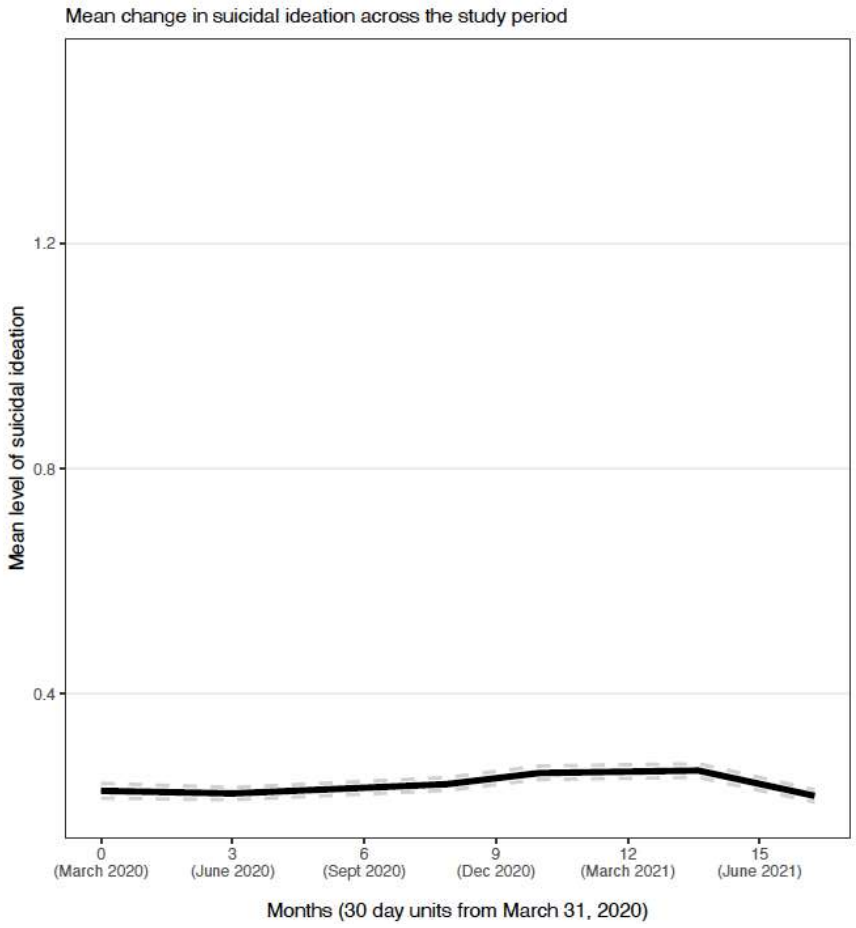

Individual level change in depressed mood for a random set of 200 participants
Depressed mood severity
3
2
1
0
0 (March 2020)
3 (June 2020)
6 (Sept 2020)
9 (Dec 2020)
12 (March 2021)
15 (June 2021)
Months (30 day units from March 31, 2020)

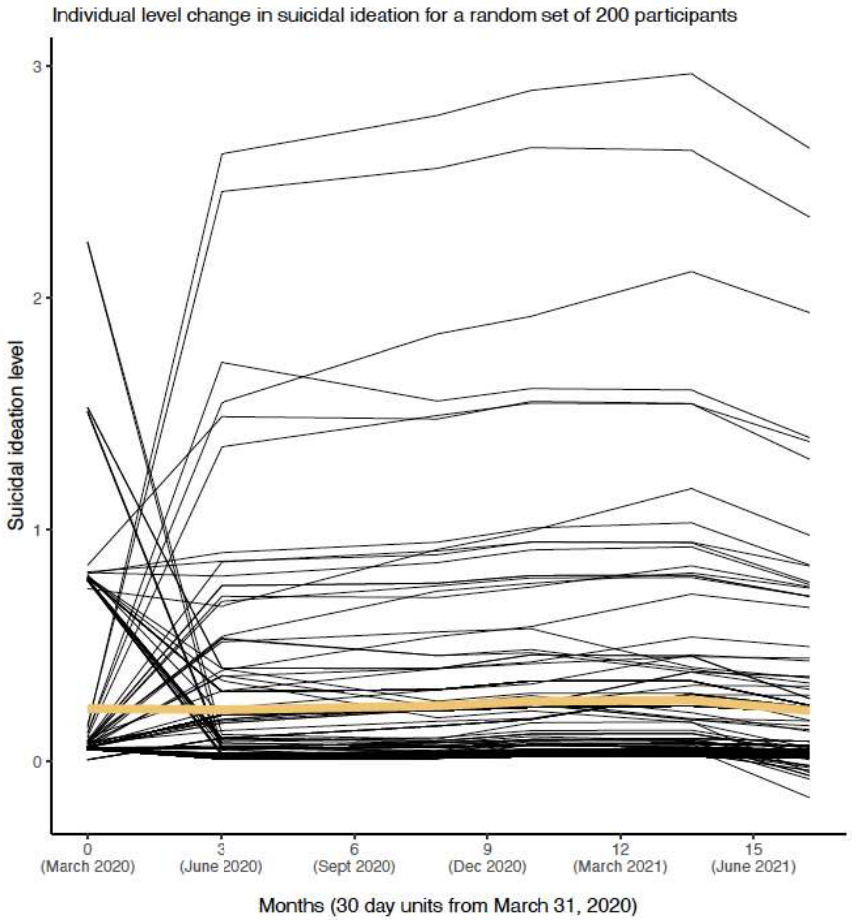

Mean change in lethargy across the study period
Mean level of lethargy
1.50
1.25
1.00
0.75
0.50
0
(March 2020)
3
(June 2020)
6
(Sept 2020)
9
(Dec 2020)
12
(March 2021)
15
(June 2021)
Months (30 day units from March 31, 2020)

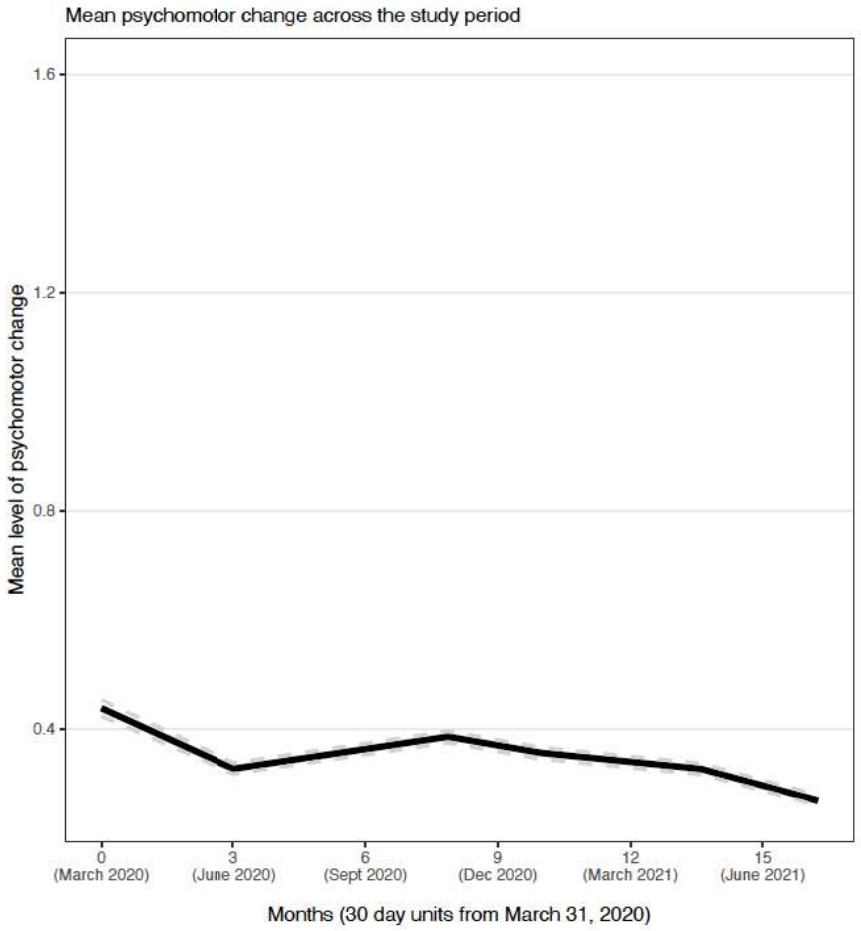

Individual level change in lethargy for a random set of 200 participants
Lethargy severity
3
2
1
0
(March 2020)
3
(June 2020)
6
(Sept 2020)
9
(Dec 2020)
12
(March 2021)
15
(June 2021)
Months (30 day units from March 31, 2020)

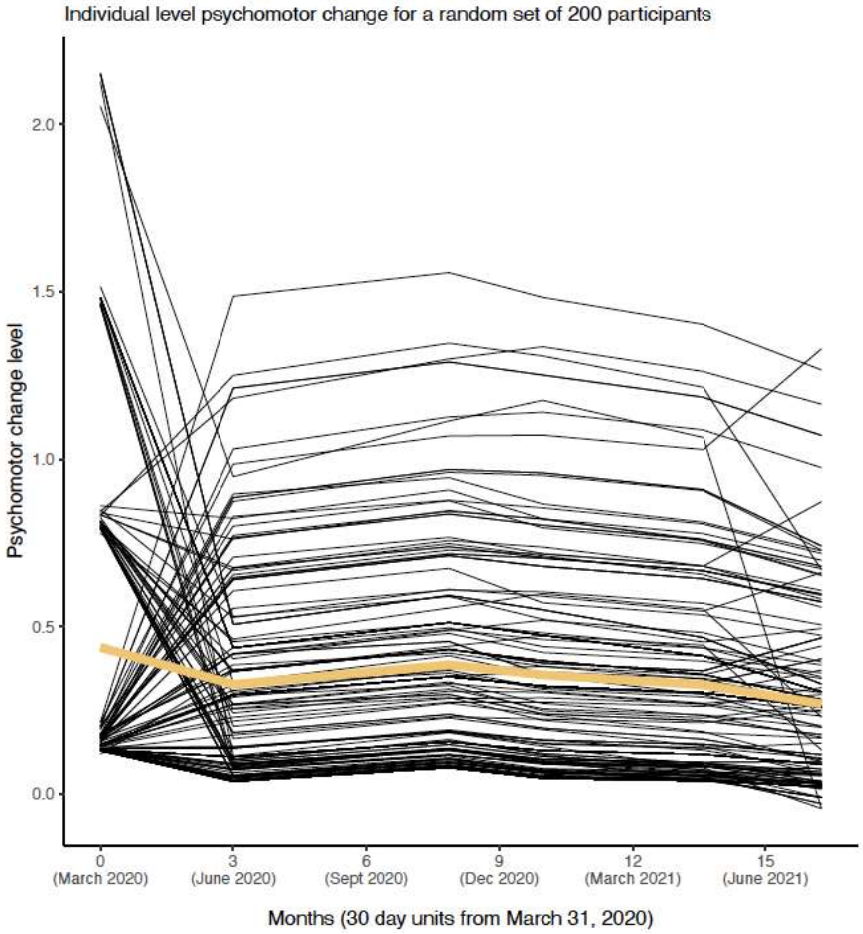

Mean change in worthlessness across the study period
Mean level of worthlessness
1.50
1.25
1.00
0.75
0.50
0 (March 2020)
3 (June 2020)
6 (Sept 2020)
9 (Dec 2020)
12 (March 2021)
15 (June 2021)
Months (30 day units from March 31, 2020)

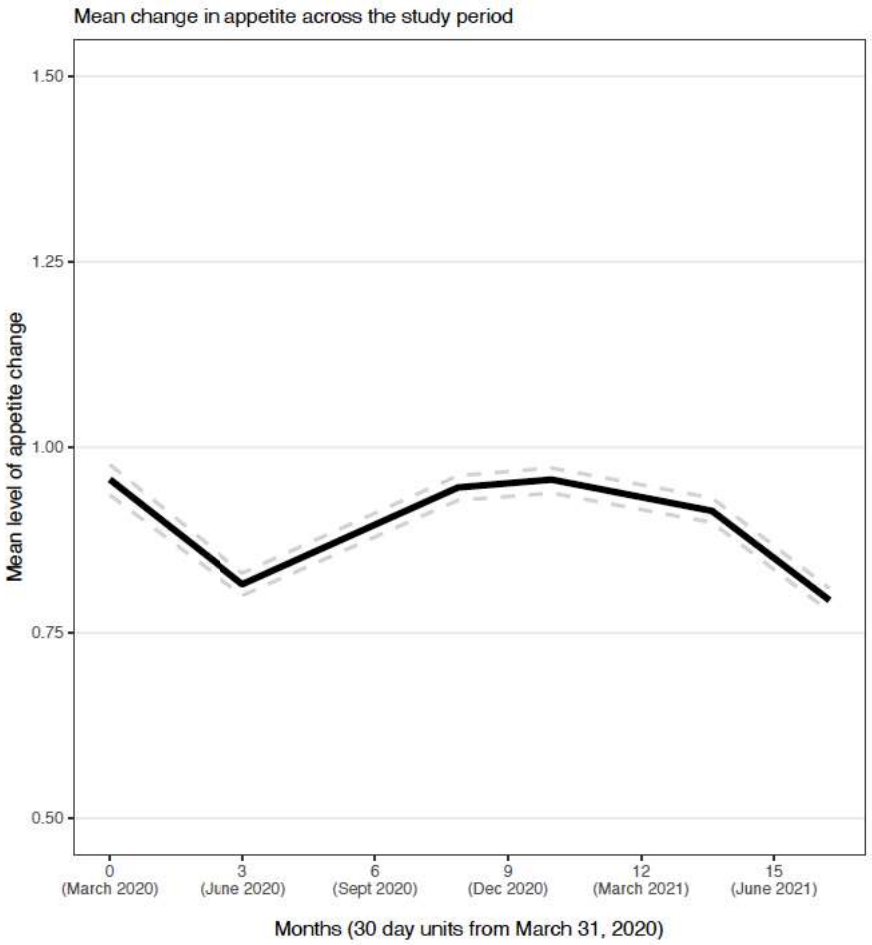

Individual change in worthlessness for a random set of 200 participants
Worthlessness level
2
1
0
0 (March 2020)
3 (June 2020)
6 (Sept 2020)
9 (Dec 2020)
12 (March 2021)
15 (June 2021)
Months (30 day units from March 31, 2020)

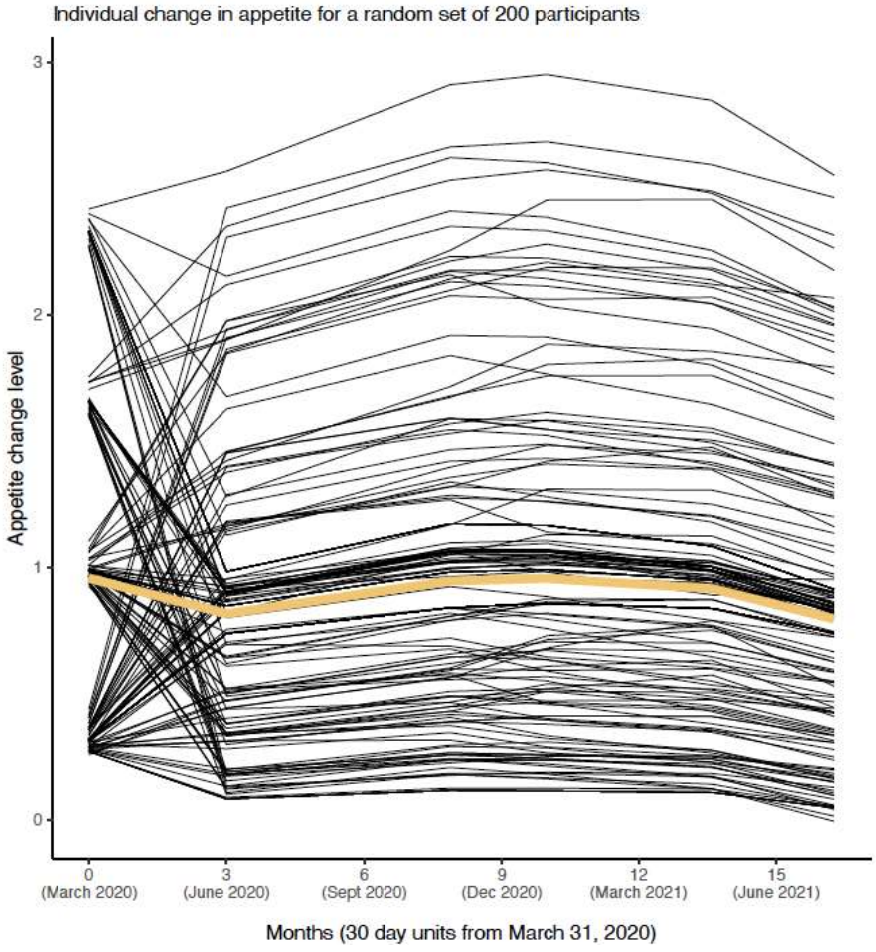

Mean change in suicidal ideation across the study period
Mean level of suicidal ideation
1.2
0.8
0.4
0
(March 2020)
3
(June 2020)
6
(Sept 2020)
9
(Dec 2020)
12
(March 2021)
15
(June 2021)
Months (30 day units from March 31, 2020)

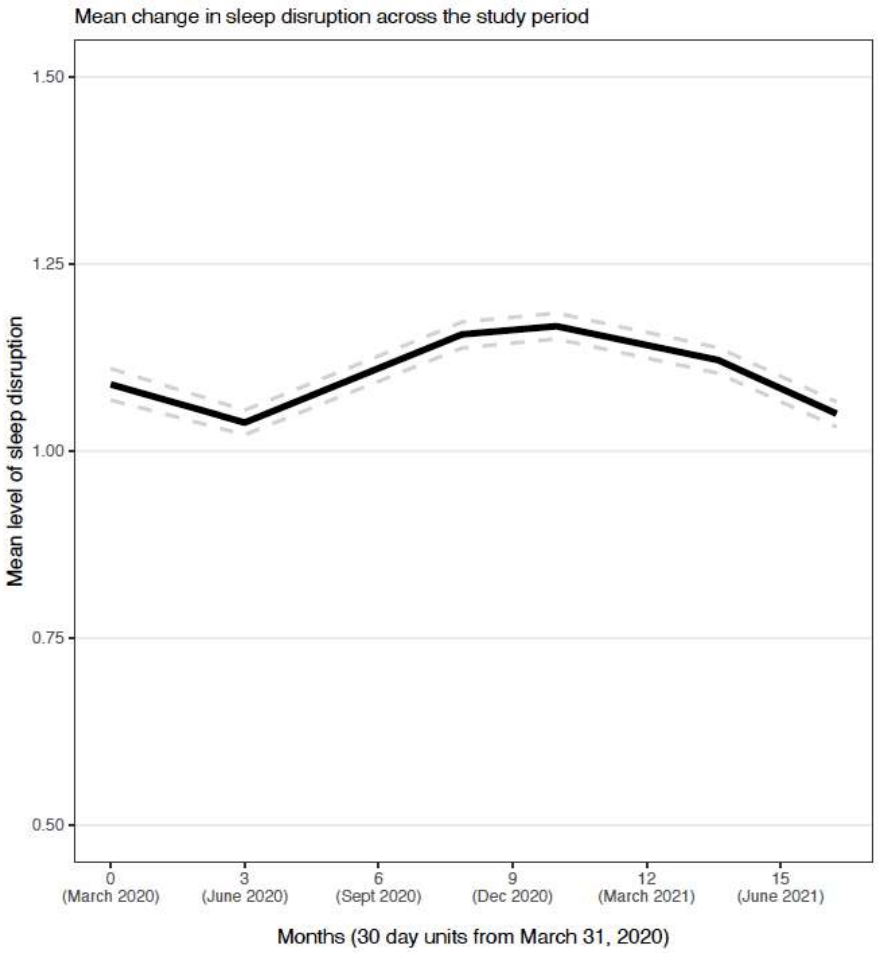

Individual level change in suicidal ideation for a random set of 200 participants
Suicidal ideation level
3
2
1
0
0
(March 2020)
3
(June 2020)
6
(Sept 2020)
9
(Dec 2020)
12
(March 2021)
15
(June 2021)
Months (30 day units from March 31, 2020)

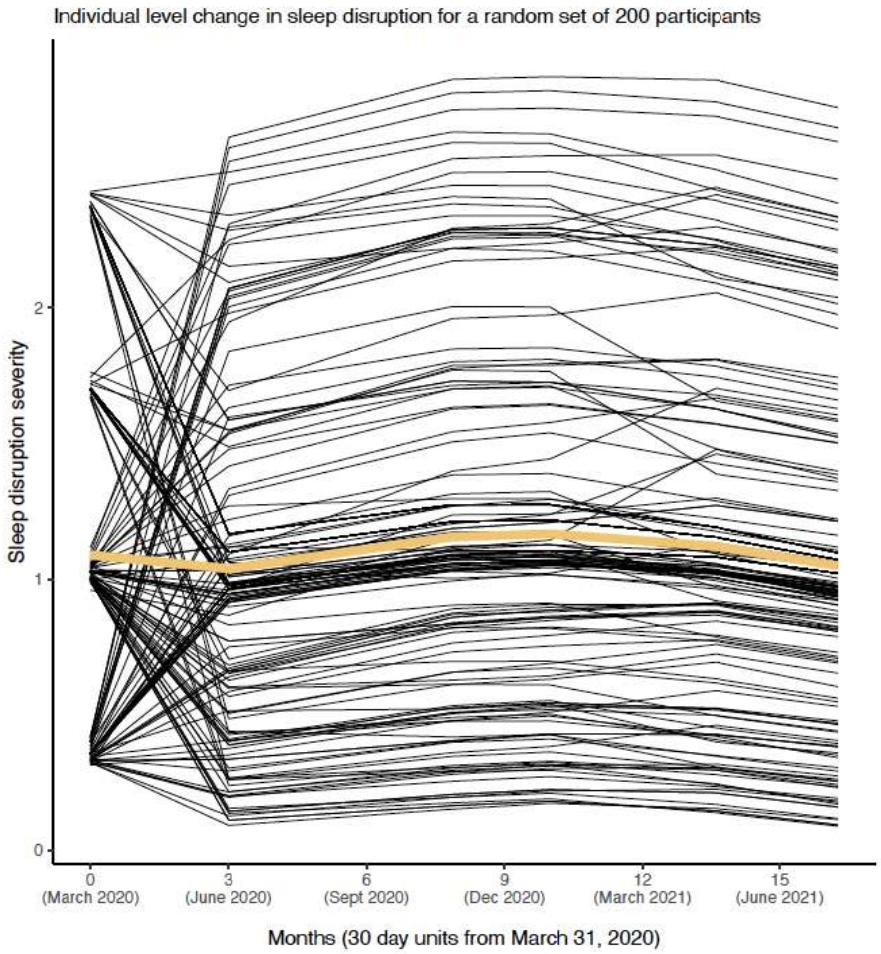

Mean psychomotor change across the study period
Mean level of psychomotor change
1.6
1.2
0.8
0.4
0
(March 2020)
3
(June 2020)
6
(Sept 2020)
9
(Dec 2020)
12
(March 2021)
15
(June 2021)
Months (30 day units from March 31, 2020)

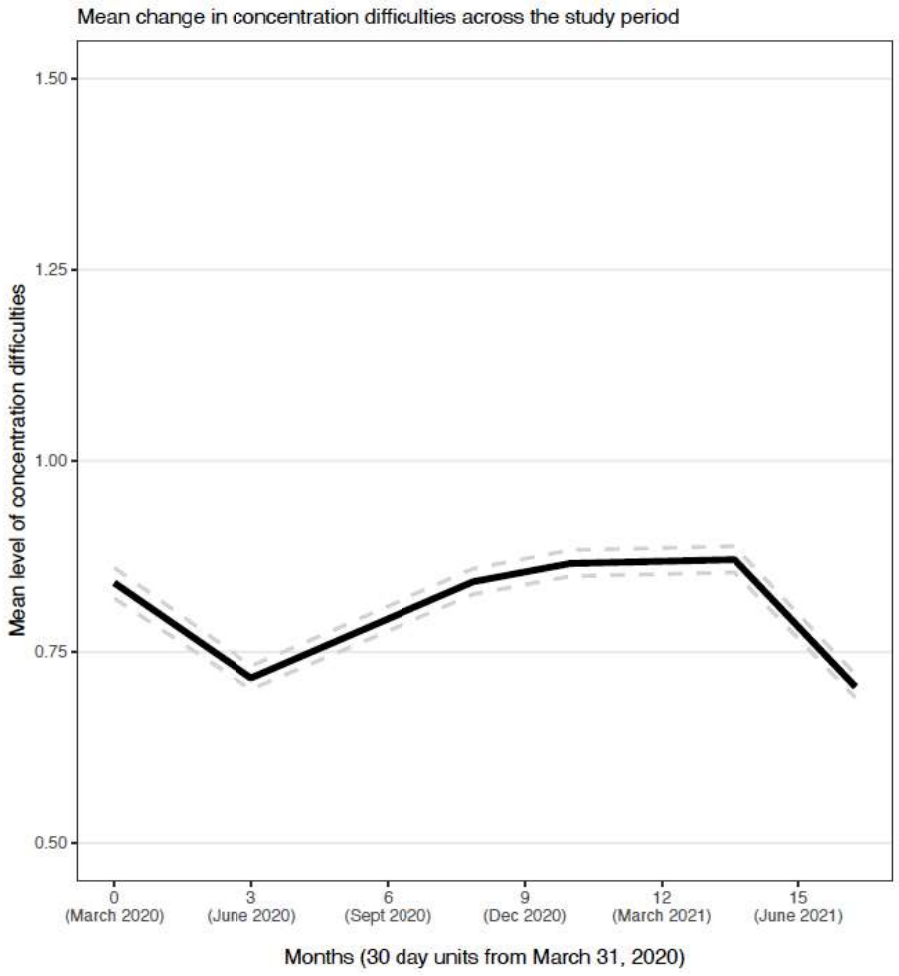

Individual level psychomotor change for a random set of 200 participants
Psychomotor change level
2.0
1.5
1.0
0.5
0.0
0
(March 2020)
3
(June 2020)
6
(Sept 2020)
9
(Dec 2020)
12
(March 2021)
15
(June 2021)
Months (30 day units from March 31, 2020)

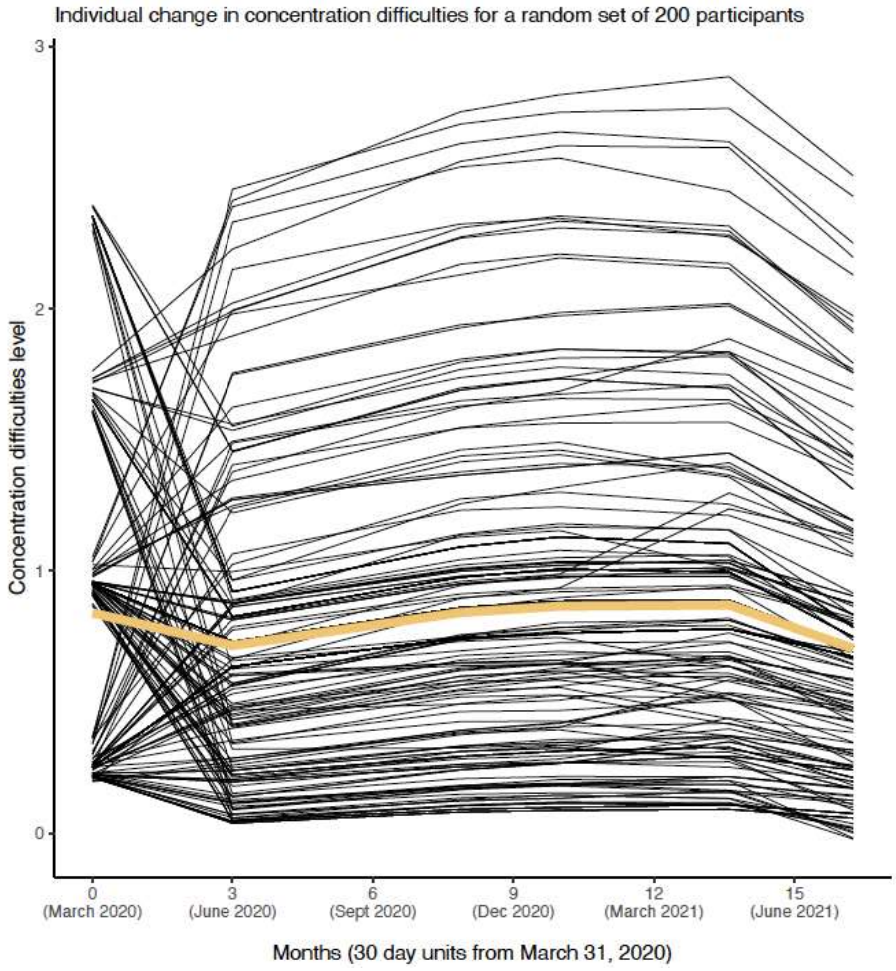

Mean change in appetite across the study period
Mean level of appetite change
1.50
1.25
1.00
0.75
0.50
0 (March 2020)
3 (June 2020)
6 (Sept 2020)
9 (Dec 2020)
12 (March 2021)
15 (June 2021)
Months (30 day units from March 31, 2020)


Individual change in appetite for a random set of 200 participants
Appetite change level
3
2
1
0
0 (March 2020)
3 (June 2020)
6 (Sept 2020)
9 (Dec 2020)
12 (March 2021)
15 (June 2021)
Months (30 day units from March 31, 2020)


Mean change in sleep disruption across the study period
Mean level of sleep disruption
1.50
1.25
1.00
0.75
0.50
0
(March 2020)
3
(June 2020)
6
(Sept 2020)
9
(Dec 2020)
12
(March 2021)
15
(June 2021)
Months (30 day units from March 31, 2020)


Individual level change in sleep disruption for a random set of 200 participants
Sleep disruption severity
2
1
0
0
(March 2020)
3
(June 2020)
6
(Sept 2020)
9
(Dec 2020)
12
(March 2021)
15
(June 2021)
Months (30 day units from March 31, 2020)


Mean change in concentration difficulties across the study period
Mean level of concentration difficulties
1.50
1.25
1.00
0.75
0.50
0 (March 2020)
3 (June 2020)
6 (Sept 2020)
9 (Dec 2020)
12 (March 2021)
15 (June 2021)
Months (30 day units from March 31, 2020)


Individual change in concentration difficulties for a random set of 200 participants
Concentration difficulties level
3
2
1
0
0 (March 2020)
3 (June 2020)
6 (Sept 2020)
9 (Dec 2020)
12 (March 2021)
15 (June 2021)
Months (30 day units from March 31, 2020)