Série des Documents de Travail

n° 2021-07

# Heterogeneous Mental Health Development During the COVID-19 Pandemic in the United Kingdom*

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**Abstract**

**Aim** The COVID-19 pandemic and the mitigation measures by governments have upended the economic and social lives of many, leading to widespread psychological distress. However, how distress developed during the pandemic and who was most affected is poorly understood. We explore heterogeneity in trajectories of psychological distress during the first six months of the pandemic in the United Kingdom and relate this heterogeneity to socio-demographic and health factors.

*Data availability statement: The data analyzed in this study are publicly available (University of Essex and Institute for Social and Economic Research, 2020) and a replication package can be found on-line (Ellwardt and Präg, 2021).

The Understanding Society COVID-19 study is funded by the Economic and Social Research Council and the Health Foundation. Fieldwork for the survey is carried out by Ipsos MORI and Kantar. Understanding Society is an initiative funded by the Economic and Social Research Council and various Government Departments, with scientific leadership by the Institute for Social and Economic Research, University of Essex. The research data are distributed by the UK Data Service.

**Subjects and Methods** We analyze six waves of longitudinal, nationally representative survey data from the UK Household Longitudinal Study ($N = 15{,}218$), covering the first lockdown in 2020. First, latent class mixture modelling (LCCM) is used to identify trajectories of psychological distress. Second, associations of the trajectories with covariates are tested with multinomial logistic regressions.

**Results** We find four different trajectories of distress: continuously low, continuously moderate, temporarily elevated, and continuously elevated distress. One-fifth of the population experienced severely elevated risks of distress. Long-term exposure was highest among younger people, women, those who lost income, and those with previous health conditions or COVID-19 symptoms.

**Conclusion** Given the threat of persistent stress on health, policy measures should be sensitized to the unintended yet far-reaching consequences of non-pharmaceutical interventions.

# Introduction

The COVID-19 pandemic has challenged the routines of everyday life on an unprecedented scale and for many caused worries about aspects such as threats to physical health and financial security, along with the distressing experience of social isolation. However, there is considerable variation in the prevalence of psychological distress (Fancourt *et al.*, 2021; Giuntella *et al.*, 2021; Holmes *et al.*, 2020; McGinty *et al.*, 2020; Niedzwiedz *et al.*, 2021; O'Connor *et al.*, 2021; Pierce *et al.*, 2020), both across social groups and across countries.

During the pandemic, average mental health deteriorated for the whole population, and research has examined variation in this deterioration across subpopulations (Chandola *et al.*, 2021; Niedzwiedz *et al.*, 2021; Proto and Quintana-Domeque, 2021). These subpopulations are typically segmented ex ante in line with theoretical expectations by discrete socio-demographic characteristics, such as social class, ethnicity, or gender. We argue that the development of the individuals' mental health during the COVID-19 pandemic was heterogeneous. Further, we argue that much of the socio-demographics predictors examined in previous research of this heterogeneity might not

be as deterministic as that research assumes: Several distinct developments are feasible that do not unanimously pertain to specific socio-demographic subpopulations and thereby remain hidden in explanatory analyses. We contribute to previous research by using data-driven exploration, in which we compare and classify individuals based on their mental health development over time, and inspect socio-demographic profiles ex post. The aim of the present study was, first, to detect the number and prevalence of psychological distress trajectories over the first six months of the COVID-19 pandemic, and second, to relate these trajectories to individuals' socio-demographic and health characteristics.

People vary both in their susceptibility to pandemic-induced stressors (Chandola *et al.*, 2021) and their ability to successfully cope with them. This results in different trajectories of psychological distress. For example, while some individuals suffer from increasing psychological distress from the onset (linear growth), others are affected at first and distress levels off again later (inverted u-curve), and others remain resilient to the external stressor altogether. Similarly, the economic recession associated with the pandemic was v-shaped for high-wage workers, and was much deeper and ongoing for low-wage workers (Chetty *et al.*, 2020; Witteveen and Velthorst, 2020). We expect mental health to follow heterogeneous developments which are associated with individual characteristics.

The UK government announced on March 23, 2020 that residents must stay at home and some businesses have to close, one of the longest and harshest government measures of the pandemic. This lockdown was gradually eased until July 4 when most businesses were allowed to open again. Ignoring the existence of simultaneous yet distinct trajectories in coping with the lockdown likely obscures important differences across subpopulations. Previous research has shown, for example, that disadvantaged social groups are more vulnerable to stressors, have worse mental and physical health, and are less resilient to adverse life events than advantaged groups (Thoits, 2010). Likewise, the unique case of the lockdown imposed increased informal care responsibilities on women (Schmid *et al.*, 2021) and heightened risks of loneliness for people living alone (Elmer *et al.*, 2020; van Tilburg *et al.*, 2021).

Trajectories were retrieved from a time series of mental health data cover-

ing the period before, during, and after the first lockdown in the UK. In our analyses we, first, employed latent class mixture modelling (LCCM) (Collins and Lanza, 2010) to estimate trajectories of change in psychological distress. This data-reduction technique classifies individuals within a population and probabilistically assigns them into latent classes. Each class represents a distinct subpopulation of individuals with highly similar trajectories. Second, using multinomial logistic regression, we examined factors associated with the different trajectories.

## Data and Methods

We analyze data from the Understanding Society COVID-19 Study (Platt *et al.*, 2020; University of Essex and Institute for Social and Economic Research, 2020). The UK Household Longitudinal Study "Understanding Society" is a long-running, nationally representative panel survey that annually interviews those members 16 years or older of participating households. During the COVID-19 pandemic, additional monthly online and phone interviews were conducted in April, May, June, July, and September. The University of Essex Ethics Committee approved the data collection and informed consent was obtained from all participants. No ethics approval was necessary for this secondary data analysis. The analytical sample is restricted to 15,218 participants with information on psychological distress for a minimum of three waves. This is to ensure high certainty in the participants' assignment to the different trajectories.

Psychological distress is measured with the General Health Questionnaire (GHQ-12) (Goldberg, 1972). Participants are presented with twelve questions (e.g. "Have you recently been feeling unhappy or depressed?"), and those who respond "Much more than usual" or "Rather more than usual" receive a score of 1, while those responding "No more than usual" or "Not at all" receive a score of 0 (the so-called "caseness" scoring). Summated scores of four or more (out of twelve) are usually considered as distressed. As done in previous research (Niedzwiedz *et al.*, 2021), we dichotomized scores accordingly into presence (1) versus absence (0) of psychological distress in every of the six measurement waves.

Covariates included dummy variables for the countries Scotland, Wales, and Northern Ireland (England was the reference category), age (24 years and younger, 25–44 years, 45–64 years, 65 years and older), gender (female = 1 vs. male = 0), race (Non-White = 1 vs. White = 0), living with partner (yes = 1 vs. no = 0), socio-economic status (working class, intermediate, salariat), monthly earnings log-transformed and mean-imputed, a dummy variable indicating an income loss of 15 per cent or more during the pandemic, and two dummy variables to adjust for missing values in the previous earnings variables. Other socio-demographic covariates regarded sharing the household with one or more children aged under 19 years, being a single parent (composed from the aforementioned partner and child variables), being employed or self-employed (all: yes = 1 vs. no = 1). Health covariates concerned having had symptoms of COVID-19 and mentioning any diagnosed health conditions (both: yes = 1 vs. no = 0). All covariates stemmed from baseline of the COVID-19 study module, April 2020. Descriptive statistics of the covariates are presented in Table 1.

Table 1: Descriptive statistics

| | Proportion/Mean | *SD* | Min. | Max. |
|---|---|---|---|---|
| Age groups: | | | | |
| 24 years and younger | 0.04 | | 0 | 1 |
| 25–44 years | 0.25 | | 0 | 1 |
| 45–64 years | 0.45 | | 0 | 1 |
| 65 years and older | 0.26 | | 0 | 1 |
| Female (*ref.* male) | 0.58 | | 0 | 1 |
| Non-white (*ref.* white) | 0.1 | | 0 | 1 |
| Living with partner | 0.75 | | 0 | 1 |
| Child(ren) in household | 0.32 | | 0 | 1 |
| Single parent | 0.05 | | 0 | 1 |
| Worked pre-COVID | 0.65 | | 0 | 1 |
| Reported COVID-19 symptoms | 0.17 | | 0 | 1 |
| No health conditions | 0.49 | | 0 | 1 |
| Social class: | | | | |
| Working class | 0.27 | | 0 | 1 |
| Intermediate | 0.24 | | 0 | 1 |
| Salariat | 0.49 | | 0 | 1 |
| Earnings pre-COVID (log)[a] | 7.28 | 1.81 | 0 | 10 |
| Lost earnings[a] | 0.33 | | 0 | 1 |

*Notes:* Based on individuals with complete information on all covariates at baseline ($N$ = 13,389). *SD*: Standard deviation. [a] Mean-imputed.

Because we had no a priori expectations of specific distributions, we opted for an explorative approach to determine number and prevalence of trajectories, using the six repeated measurements of psychological distress. Mixture models for the clustering of longitudinal data series identify latent subpopulations that share similar trajectories (Van der Nest *et al.*, 2020). These trajectories, which are highly comparable within subpopulations, are deemed mutually exclusive between subpopulations. To determine the number of distinct trajectories, we first estimated a set of models for a varying number of $k$ trajectories, starting with $k = 1$, and sequentially increasing $k$ by one, until the model fit leveled off or deteriorated.

Second, we proceeded with the model with the best fit to investigate associations of covariates with each of the k trajectories. Specifically, a participant's trajectory with the highest probability served as the categorical outcome in a multinomial logit model. The sample in this model was reduced to participants with complete covariates. We show average marginal effects (AME's), which reflect the average change in a trajectory's probability when a covariate increases by one unit. The statistical analysis was performed in Stata 16.1 using the plugin 'traj' (version May 17, 2020) for estimating group-based trajectory models (Jones and Nagin, 2013).

## Data availability

The data analyzed in this study are available from the UK Data Service (University of Essex and Institute for Social and Economic Research, 2020) and a replication package for all analyses shown is available online (Ellwardt and Präg, 2021).

## Ethics statement

The UK Household Longitudinal Study was approved by the University of Essex Ethics Committee. No additional ethical approval was necessary for this secondary data analysis. All necessary participant consent has been obtained and the appropriate institutional forms have been archived.

# Results

Development of psychological distress followed four distinct trajectories, as revealed by the latent class mixture models. The four-trajectory solution yielded the best model fit to the data according to the log-likelihood based statistics (Van der Nest *et al.*, 2020), i.e. the lowest value for the Bayes Information Criterion, as seen in Table 2. The five-trajectory solution was also well-fitted, but split the largest class further into two mostly overlapping trajectories. The model with four trajectories was therefore more parsimonious and plausible in its interpretation.

Table 2: Fit statistics and class prevalence for models with $k$ latent trajectories

| No. trajectories ($k$) | BIC | AIC | LL | % trajectory 1 | % trajectory 2 | % trajectory 3 | % trajectory 4 | % trajectory 5 |
|---|---|---|---|---|---|---|---|---|
| 1 | -43576.5 | -43561.3 | -43557.3 | 100 | | | | |
| 2 | -35392.4 | -35369.5 | -35363.5 | 72 | 28 | | | |
| 3 | -34840.9 | -34798.9 | -34787.9 | 46 | 35 | 18 | | |
| 4 | -34628.5 | -34567.5 | -34551.5 | 22 | 58 | 6 | 13 | |
| 5 | -34643.6 | -34563.5 | -34542.5 | 38 | 22 | 7 | 19 | 14 |

*Notes:* AIC, BIC: Akaike, Bayesian Information Criterion. LL: Log-Likelihood. Based on individuals with at least three completed waves on psychological distress ($N$ = 15,218).

The four psychological distress trajectories are visualized in Figure 1. *Continuously low* (trajectory 2): The largest class included 57.9% of the participants whose likelihood of psychological distress was permanently low and mostly close to zero. *Continuously moderate* (trajectory 1): The second-largest class comprised 22.4% of participants. Their likelihood of psychological distress was roughly one third at the start and hardly changed throughout the entire observation period. *Continuously elevated* (trajectory 4): The third-largest group comprised of 13.4% of the participants, who had a high likelihood of psychological distress at all times, with half or more of the individuals reporting distress. Yet, in this trajectory, mental health covaried with the lockdown of society. The likelihood of distress reached a near-maximum and slowly declined at the end of the observation period, however, without returning to its initial level.

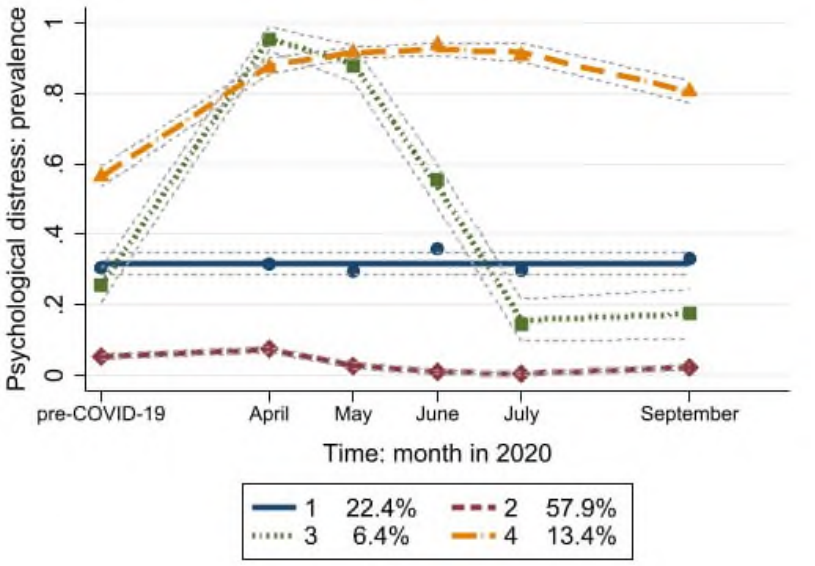


Figure 1: Four latent trajectories of psychological distress

*Notes:* (1) continuously moderate, (2) continuously low, (3) temporarily elevated, and (4) continuously elevated. Error bounds represent 95% CIs. $N = 15{,}218$.

*Temporarily elevated* (trajectory 3): The last and smallest group with 6.4% of participants started out with a moderate likelihood of distress, comparable to those in trajectory 1. Crucially, nearly everyone in this trajectory experienced a rapid increase of psychological distress at the beginning of the pandemic, indicated by the near-maximum prevalence close to 100%. This extreme elevation was of temporal nature, as the prevalence of distress quickly dropped back to original levels after the lockdown. Taking trajectories 3 and 4 together, about one fifth of the population experienced a significant and severe elevation of psychological distress during lockdown.

Socio-demographic and health variables are associated with being on the four trajectories. For this part of the analysis, individuals were discretely assigned to the latent trajectory with the highest posterior probability. Higher means of this probability in a trajectory indicate greater certainty in the assignment procedure. Mean probabilities ranged from .64 for trajectory 3 to .88 for trajectory 2. The assigned trajectories served as the outcome in a multinomial logistic regression model. The association of the covariates

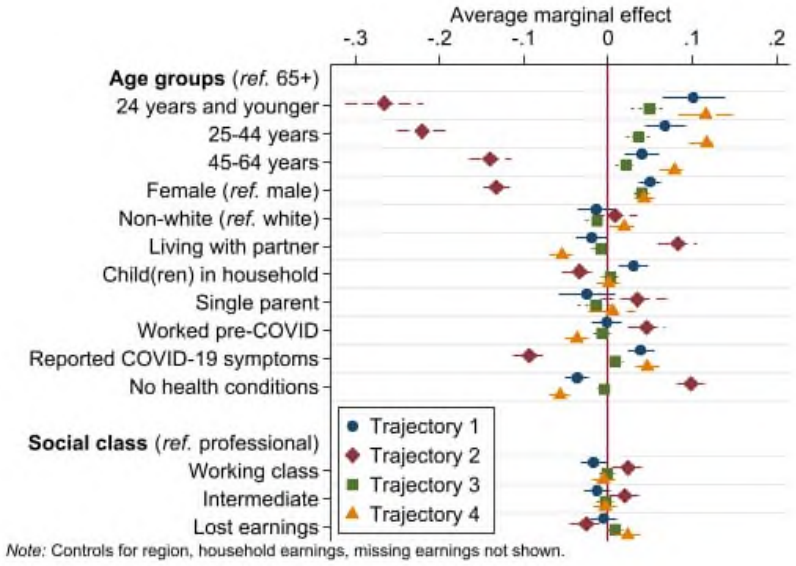


Figure 2: Average marginal effects of following the four trajectories

*Notes:* Average change in a trajectory's probability when a covariate increases by one unit, from multinomial model with the trajectories of psychological distress as the outcome: (1) continuously moderate, (2) continuously low, (3) temporarily elevated, and (4) continuously elevated. Error bars represent 95% confidence intervals. $N$ =13,389.

with each of the four trajectories are expressed as average marginal effects (AMEs) shown in Figure 2. AME's reflect the average change in a trajectory's probability when a covariate increases by one unit.

The following focuses on changes in mental health, thus on individuals with temporarily and continuously elevated stress levels in trajectories 3 and 4. Female and younger (under 65 years of age) individuals were exposed to significantly heightened risks of experiencing both temporarily and continuously elevated distress. Furthermore, the risk for continued distress was highest for individuals who lived without a partner, had work before the lockdown, reported COVID-19 symptoms, mentioned pre-pandemic health conditions, and lost substantial income during the course of the pandemic. For the latter sub-populations, the initial probability of 13.4% in trajectory 4 shifted upwards by another 2.9 to 5.7 percentage points (e.g. income loss was associated with a total risk of 19.1%). This implied a moderate to strong impact of these covariates on developing continuously elevated psychological distress.

# Discussion

The unparalleled shock of the COVID-19 pandemic has provoked a natural stress test for entire societies. We took a perspective similar to those of policy makers and stakeholders by describing which trajectories of psychological distress occurred in the United Kingdom. We next described the most affected subpopulation in terms of socio-demographic profiles, rather than single out presumably vulnerable subpopulations for inspection a priori.

In contrast to Proto and Quintana-Domeque (2021), we did not find an average increase in psychological distress for the whole UK sample. However, their study covered changes between pre-COVID-19 and April 2020 only, i.e. the first two measurements in our study design. This snapshot could not capture short-term hiccups in distress that smoothed out after the lockdown, as identified in trajectory 3. But even though in our study the majority proved resilient, one out of five individuals suffered from psychological distress. For two thirds of these cases, distress endured until after the lifting of the lockdown. This vulnerable group was not solely defined by the usual risk factors

of poor health. These findings closely resemble previous findings from the UK, where one out of four individuals reported depressive symptoms and one out of five individuals suffered from anxiety (O'Connor *et al.*, 2021). Using the same data as in our study and group-based latent growth mixture models on depressive symptoms, an outcome closely related to our measure of psychological distress, Iob *et al.* (2020) found three latent trajectories. These included low (60%), moderate (29%) and severe (11%) depressive symptoms during lockdown. As in previous research, in our study risks were greater for those younger, female (Banks and Xu, 2020), individuals living without a partner (Fancourt *et al.*, 2021; Pierce *et al.*, 2020), individuals with COVID-19-related symptoms (Chandola *et al.*, 2021; Niedzwiedz *et al.*, 2020; Li and Wang, 2020), and those who lost income (Bu *et al.*, 2020b,a; Wright *et al.*, 2021). Crucially, individuals who fail to buffer the long-term exposure of distress are vulnerable to a variety of negative health outcomes, including poor physical health, morbidity, and mortality (Barry *et al.*, 2020; Thoits, 2010). More dramatically, chronic psychological stress has been related to lower immunity and, as a result, higher susceptibility of the common cold, influenza, infectious diseases and upper respiratory illness (Cohen *et al.*, 1991). This means that measures aimed at mitigating the COVID-19 pandemic might promote risk factors for catching the coronavirus, if these measures trigger stress among the broader public, and thereby backfire on a large scale. Reducing distress should therefore be key in policy-making aiming to safeguard public health, and even more so during repeated lockdowns that change temporarily elevated into continued stressors.

A limitation of the present study was the use of self-reported psychological distress and the coverage of the first lockdown only. Future research could investigate the course of mental health for a longer time period, preferably spanning over several lockdowns. It would be interesting to see whether individuals from the lowly and moderately stressed group eventually experience disaster fatigue with a delayed onset of severe distress, or whether continuously distressed individuals undergo adaptive processes during the pandemic. Moreover, the development of psychological distress may be investigated in combination with correlated health variables, such as drinking behavior, through modelling joint trajectories.

The heterogeneity in the development of mental health during the pandemic emphasizes peoples' idiosyncrasy in responses to extreme changes. Likewise, policy-makers will need to be careful in identifying and supporting groups at risk. Addressed health risks should not merely prioritize physical outcomes directly related to the COVID-19 disease, but include longer-term consequences in the domain of mental and social well-being of the general public (Holmes *et al.*, 2020).

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