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The COVID-19 pandemic and its impact on inequality of opportunity in psychological distress in the UK*

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Abstract

We use data from Wave 9 of UK Household Longitudinal Study (UKHLS) and the April 2020 Wave of the UKHLS COVID-19 survey to compare measures of *ex ante* inequality of opportunity (IOp) in psychological distress, as measured by the General Health Questionnaire (GHQ), before (Wave 9) and at the initial peak (April 2020) of the pandemic. Based on a Caseness measure, the prevalence of psychological distress increases from 18.3% to 28.3% between Wave 9 and April 2020. Also, there is a systematic increase in total inequality in the Likert GHQ-12 score. However, measures of IOp have not increased. Specifically, the proportion of total inequality attributed to circumstances has declined, consistent with the notion that the pandemic is, to some extent, a leveller as far as psychological distress is considered. A Shapley-Shorrocks decomposition analysis shows that in the pre-COVID-19 period the largest contributors to IOp were financial strain, employment status and housing conditions. In contrast, in April 2020, these factors decline in their shares and age and gender now account for a larger share. The contribution of working in an industry related to the COVID-19 response plays a small role at Wave 9, but more than triples its share in April 2020. Household composition and parental occupation also increase their shares during the pandemic.

Keywords: COVID-19; inequality of opportunity; GHQ; mental health; psychological distress.

JEL codes: C1, D63, I12, I14.

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1 Introduction

Has the experience of the COVID-19 pandemic in the UK had a greater impact on psychological distress among those in more disadvantaged circumstances and hence widened inequality of opportunity (IOp)? The UK Household Longitudinal Study (UKHLS), Understanding Society, has launched a COVID-19 survey to examine the impact of the coronavirus pandemic on UKHLS participants. The release of these data provides an opportunity to address this question. This new survey is being sent to adult UKHLS participants once a month with the first release collected in April 2020 (Institute for Social and Economic Research, 2020). Our aim is to use data from UKHLS Wave 9 along with the April 2020 release of the COVID-19 web survey to compare measures of *ex ante* IOp in mental health, as measured by the General Health Questionnaire (GHQ) that captures twelve indicators of psychological distress. This allows us to compare inequalities in the distribution of GHQ before and at the peak of (the first phase of) the response to coronavirus in the UK.

COVID-19 originated in the city of Wuhan, China, in December 2019 and spread rapidly to become a global pandemic. Wednesday 29 January saw the first two patients test positive for COVID-19 in the UK. On 11 March the UK Government announced its first package of financial support for those affected and on the same day the World Health Organisation (WHO) declared a global pandemic. The following week saw the announcement of a much larger financial package in the UK. The closure of pubs, restaurants, gyms and other social venues was announced on Friday 20 March and then on 23 March a national lockdown was announced. This lockdown included the shielding on 1.5 million vulnerable people and the public as a whole were instructed to begin socially isolating and expected to stay at home. The exceptions to this were for essential workers and for non-essential workers who were not able to work from home, shopping for essentials such as food and medical supplies, medical reasons, providing help to the vulnerable, and taking exercise once a day.

By the end of April 2020, when our new data were collected, the UK appeared to be at the peak of the first phase of the pandemic. The direct impact of COVID-19 on health and wellbeing had caused 20,283 COVID-19 registered deaths in England and Wales up to 17 April. The pandemic highlighted existing socioeconomic inequalities in health and appears to have amplified the gradients in health by age, sex, ethnicity, income and wealth, education and housing. For example, the end of April coincided with the publication of evidence from the Office for National Statistics (2020a) that revealed a stark social gradient in the mortality rates associated with COVID-19. Comparisons of data up to 17 April 2020 showed substantial socio-geographic variation in death rates across local authorities in England and Wales[1].

[1] Specifically, the most deprived London boroughs had the highest COVID-19 age-standardised death rates with Newham at 144.3 deaths per 100,000, Brent at 141.5 and Hackney at 127.4 compared to an average of 36.2 per 100,000 in England and Wales as a whole.

The nature of the economic and policy response to COVID-19 has created specific gradients in both exposure to the disease itself and in exposure to the economic impact of the lockdown. These new or amplified facets of the socioeconomic gradient include, for example, those working in essential occupations (for example, in health and social care and other public services), financial and employment hardship, the presence of children in households and living in multigenerational households or as lone parents. Moreover, other facets include the influence of housing and neighbourhood environment on people's ability to self-isolate.

Beyond the direct impact of COVID-19, the population as a whole has been exposed to the policy response to the pandemic. Lockdown, social distancing, self-isolation, the economic impact of shut-down of parts of the economy and the focusing of resources within the health and social care systems on coping with the pandemic may all have had an indirect impact on psychological distress and the mental health of the population (e.g., Haiyang *et al.,* 2020). Given the characteristics of the policy and institutional responses outlined above, the burden of this psychological distress may have been unequally distributed within the population. This is what we seek to explore in this paper.

To measure the impact of the UK response to the pandemic in terms of health equity we adopt an approach based on the notion of equality of opportunity; a key concept in recent social choice theory and normative economics (e.g., Ramos and Van de Gaer, 2016; Roemer and Trannoy, 2016). A growing literature has addressed the measurement of IOp in health (e.g., Carrieri and Jones, 2018; Carrieri *et al.*, 2020; Davillas and Jones, 2020; Fajardo-Gonzalez, 2016; Garcia-Gomez *et al.*, 2015; Jusot *et al.*, 2013; Li Donni *et al.*, 2014; Rosa Dias, 2009, 2010; Trannoy *et al.*, 2010). Here we follow Davillas and Jones (2020) and adapt their approach to the measurement of *ex ante* IOp in psychological distress.

We compare the magnitude of IOp in the GHQ measure of psychological distress before (at Wave 9) and at the peak of the initial phase of coronavirus (April 2020). The results show a substantial and systematic worsening of the levels of GHQ post-COVID. This applies to nearly all of the individual elements of GHQ and to overall GHQ scores. For example, the prevalence of psychological distress based on the GHQ-12 Caseness scoring, increases from 18.3% to 28.3%. In addition, there is a statistically significant increase in total inequality in the Likert GHQ-12 score between Wave 9 and April 2020. However, we find lower levels of IOp in April 2020, suggesting that the proportion of total inequality attributed to observed circumstances has not increased with COVID-19. A Shapley-Shorrocks decomposition analysis allows us to explore the contribution of specific circumstances. At Wave 9 the largest contributors to IOp were financial strain, employment status and housing conditions. In contrast, during the peak of the pandemic (April 2020), these factors decline in their shares and age and gender account for a larger share. The contribution of working in industries related to the response to COVID-19 plays a small role at Wave 9 (0.74%), but more than triples its share in April

2020 (3.28%). Household composition and parental occupation have also increased their shares during the pandemic.

2 Methods

2.1 Measuring ex ante IOp in psychological distress

Roemer (1998) defines a 'responsibility cut' that partitions all factors influencing individual attainment between a category of *effort factors*, for which individuals should be held partly responsible, and a category of *circumstance factors*, which are judged to be a source of unfair differences in outcomes[2]. The Roemer framework applied to an individual's mental health can be expressed as:

$$h_i = f(C_i, E(C_i, v_i), u_i) \tag{1}$$

where h is the specific mental health outcome of interest, C are observed circumstances, and E is a vector of effort variables (which need not be observed in our reduced form *ex ante* approach). The specification includes unobserved error terms to reflect that observed realisations of mental health outcomes are random[3]; specifically, v captures random variation in effort that is independent of C, while u captures random variation in outcomes that is independent of C and E. Then, assuming additive separability and linearity of $f(.)$ and $E(.)$, a linear reduced form can be derived:

$$h_i = C_i\psi + \varepsilon_i \tag{2}$$

where the coefficients ψ reflect the total contribution of circumstances and include both the direct contribution of circumstances and their indirect contribution through their influence on efforts[4].

We follow Davillas and Jones (2020) and adopt an approach based on *ex ante* compensation and utilitarian reward that focuses on inequality in the distribution of mean outcomes across social types, as defined by their observed circumstances. In practice, the mean-based direct parametric approach to measure *ex ante* IOp is based on using predictions of $E(h_i|C_i)$ from the reduced form regression (2) as the counterfactual outcome:

$$\widetilde{h_\iota} = C_i\hat{\psi} \tag{3}$$

[2] The concept of equality of opportunity draws on two ethical principles: compensation and reward (e.g., Fleurbaey and Schokkaert, 2012). There are two broad perspectives on the definition and measurement of IOp: the *ex ante* and the *ex post* approaches. The *ex ante* approach defines equality of opportunity if all individuals face the same opportunity set, prior to their efforts and outcomes being realised; then, individuals have equal opportunities if there are no differences in expected outcomes across types who have different circumstances. The expectation over outcomes within types can be based on a simple mean (utilitarian reward) or with some degree of inequality aversion within types.

[3] This has been labelled as 'luck' in the IOp literature (e.g., Lefranc et al., 2009).

[4] A feature of this approach is that the distribution of effort within each type constitutes a circumstance in itself. The model therefore assumes that effort is a function of circumstances, with circumstances being pre-determined.

These predicted outcomes are the same for all individuals with identical circumstances and all of the variation in $\tilde{h}$ is attributable to differences in their observed circumstances (Ferreira and Gignoux, 2011; Wendelspeiss Chávez Juárez and Soloaga, 2014)[5]. The level of IOp can be estimated using a suitable inequality measure, I(.), applied to the vector of counterfactual outcomes $\tilde{h}$:

$$\theta_I = \mathrm{I}(\tilde{h}) \tag{4}$$

The level of IOp relative to overall inequality can be expressed as a percentage share of total inequality:

$$\theta_S = \frac{\mathrm{I}(\tilde{h})}{I(h)}.100 \tag{5}$$

We present results for three sets of mental health outcomes, all derived from the GHQ. IOp in these measures is compared between UKHLS Wave 9 and the COVID-19 April 2020 web survey.

The first set of outcomes are indicators for each of the twelve questions that comprise the GHQ questionnaire (see Appendix A for full details). These collapse the responses to the twelve dimensions of GHQ into so-called "Caseness" binary indicators. To measure $\mathrm{I}(\tilde{h})$, we apply the dissimilarity index to each of them[6]. These indicators allow us to explore inequalities in each of the GHQ dimensions and, thus, identify which of the dimensions of physiological distress were most affected by the response to the pandemic.

The second outcome is the level of GHQ-12 measured on a continuous Likert scale that sums the 12 components of the GHQ. *Ex ante* IOp studies have argued that the mean logarithmic deviation (MLD) or the variance are relevant inequality indexes to be used for continuous outcomes, depending on the nature of the outcome variable (e.g., Davillas and Jones, 2020; Ferreira and Gignoux, 2011, 2013; Wendelspeiss Chávez Juárez and Soloaga, 2014). As the Likert GHQ-12 score is not a ratio-scaled variable, the variance of $\tilde{h}$ is used as our main inequality measure $\mathrm{I}(\tilde{h})$. Then the IOp share, θ_S, is measured by the share of the total variance in our continuous mental health measure that is attributed to observed circumstances.

The third outcome is an indicator based on dichotomising the overall GHQ-12 index, which is constructed by the Caseness scoring method, using appropriate thresholds. To measure IOp the dissimilarity index is applied to this indicator.

As discussed above, for the level of GHQ-12 Likert score, which is a continuous non-ratio scale measure, we use the variance as our inequality measure with:

$$\mathrm{I}(.) = \frac{1}{n}\sum_{i=1}^{n}\left(\tilde{h_i} - \bar{h}\right)^2 \tag{6}$$

[5] Given that some of our mental health outcomes are binary variables, a probit model is used to estimate the conditional probability function, on our set of circumstances, and the relevant counterfactual predictions are obtained (analogously to, equations 2 and 3).

[6] Dissimilarity indexes have been used by the World Bank to compute the Human Opportunity Index (Paes de Barros *et al.*, 2009).

where the predicted conditional means $\tilde{h}$ are estimated using linear regression models. For our binary outcomes, we use the dissimilarity index (Paes de Barros *et al.*, 2007; Wendelspeiss Chávez Juárez and Soloaga, 2014):

$$\mathrm{I}(.) = \frac{2}{n\bar{h}} \sum_{i=1}^{n} \left| \widetilde{h_i} - \bar{h} \right| \tag{7}$$

where the predicted sample proportions $\widetilde{h_i}$ are estimated using probit models.

2.2 Decomposing IOp

We use a Shapley-Shorrocks decomposition to measure the contribution of the measured circumstance variables (C) to overall IOp (Davillas and Jones, 2020; Shorrocks, 2013; Wendelspeiss Chávez Juárez and Soloaga, 2014). This is implemented by computing the inequality index for all permutations of the circumstances and then averaging the marginal contribution of each circumstance. This Shapley-Shorrocks decomposition is path independent and exactly additive (Wendelspeiss Chávez Juárez and Soloaga, 2014). The decomposition is applied to the variance share for the overall Likert GHQ-12 score and to dissimilarity indices for the binary indicator of experiencing distress (based on the overall Caseness GHQ-12 index) both before and during the response to the pandemic.

3 Data

The individual level data on outcomes and circumstances come from *Understanding Society (UKHLS)*, a longitudinal, nationally representative study of the UK. The UKHLS is a large, national representative panel survey, based on a two-stage stratified random sample of the household population. For this study we use the General Population Sample (GPS) of the UKHLS, a representative sample for the residential population living in private households in the UK at the first wave in 2009-10[7]. As far as possible, individuals from the first wave are retained as part of the sample so long as they live in the UK. Other individuals joining their households are included while they live with the original sample member.

Circumstances are assumed to be predetermined and, thus, are measured using variables drawn from Waves 1-8 of UKHLS. Our baseline outcomes, taken from the GHQ, are measured at UKHLS Wave 9, which collected data between January 2017 and May 2019 prior to the onset of the pandemic. The GHQ is a widely used measure of non-psychotic psychological distress.

Our potential maximum sample contains 20,848 individuals with valid GHQ measures at Wave 9 that provided information on circumstances from previous waves (mainly Wave 8 for the time-varying circumstances and waves 1-8 for the time-invariant measures). We restrict our analysis to adults aged 20 and above, as there are concerns for the validity of GHQ-12 for adolescents (e.g., Tait *et al.*, 2002). This results in a

[7] As a survey of those living in private households UKHLS does not include those living in care homes, an important group in terms of the direct impact of COVID-19.

potential sample of 19,830 adults. Excluding missing values on all variables used in our analysis further restricts our working sample to 15,083 individuals (hereafter, called the Wave 9 sample). Given the much lower response rate at the UKHLS COVID-19 April web survey, we also re-estimate our baseline analysis further restricting our sample to those who responded to the COVID-19 survey (Wave 9-COVID-19 sample) and employing sample weights that we have created (see below for details).

During April 2020, selected participants from the UKHLS survey have been approached to complete a short web-survey that focuses on the impact of the COVID-19 pandemic. It is possible to link data from this web survey to previous UKHLS waves. Responses to the twelve questions that make up the GHQ are used as our outcomes from the COVID-19 web survey. The questionnaire's wording is identical to that at UKHLS Wave 9 (see Appendix A).

For the needs of this study, we focus on the GPS respondents of UKHLS Wave 9 who are followed and give valid responses to all the GHQ-12 questions at the April 2020 COVID-19 survey and have valid data on all the circumstance variables used in our analysis (based on UKHLS Waves 1-8). This results in a working sample of 7,789 respondents for our COVID-19 survey sample (April 2020 COVID-19 sample). The fieldwork was completed on 30 April 2020 and data were made available from the UK Data Service in the end of May 2020.

To ensure that the results are nationally representative we use the Wave 9 cross sectional survey weights supplied with the UKHLS for the analysis of the baseline data at Wave 9 (Wave 9 sample). To allow for unit non-response at the April wave of the Covid-19 survey, the selection of respondents who responded to both UKHLS Wave 9 and the COVID-19 April survey, and item non-response for the GHQ questions, we constructed our own longitudinal weights. Specifically, we estimated a stepwise probit model for the probability of responding in the COVID-19 April 2020 GHQ questionnaire among those in the Wave 9 sample, using their observed circumstances as predictors. The predicted probabilities from this model are used to compute inverse probability weights that are then used to adjust the UKHLS base weights. These longitudinal weights are used for all analyses of the Wave 9-COVID-19 sample and our COVID-19 April 2020 sample.

The main UKHLS survey adopted a push-to-web mixed-mode design from Wave 8. The use of different survey modes may affect how respondents' answer the same questions. We conduct a sensitivity analysis to explore whether the observed differences in the inequalities in GHQ before and after the COVID-19 response may be an artefact of the mixed mode at Wave 9 as opposed to the web-based mode that was used in the COVID-19 April 2020 survey and conclude that this is not likely to be a problem (see Appendix C).

Policy context and psychological distress outcomes (h)

Our analysis compares the level of IOp in the distribution of GHQ before and during the response to the pandemic. The GHQ instrument has been used to measure socioeconomic inequalities in mental health and, for example, the impact of the global financial crisis of 2008 on psychological distress (e.g., Maheswaran *et al.*, 2015; Thomson *et al.*, 2018). The Likert-scaled GHQ-12 is a widely used measure of non-psychotic psychological distress with excellent psychometric properties (Bowling, 1991; Goldberg *et al.*, 1997). Following the literature, we have also used a combined GHQ-12 index that is based on the Caseness scoring as an additional outcome (e.g., Maheswaran, *et al.*, 2015). In addition we use the questions on all twelve dimensions of the GHQ are used as separate outcomes in our analysis. The wording of the GHQ questions in the UKHLS Wave 9 questionnaire and the COVID-19 questionnaire is identical (shown in Appendix A). A full description of the mental health outcomes used in our analysis is given in Appendix A.

Circumstances (C)

All of the circumstances are measured using data from before the onset of the pandemic. Specially, we use data from the UKHLS Wave 8 (mainly) for the time-varying circumstances and Waves 1-8 for the time-invariant variables. The choice of our circumstance variables embodies ethical judgments, defining illegitimate sources of mental health inequality that are regarded as unfair. For the choice of circumstance variables, we follow the recent literature on health equity, along with the UK policy and legal context (e.g., Carrieri and Jones, 2018; Carrieri *et al.*, 2020; Davillas and Jones, 2020; Jusot *et al.*, 2013; Rosa Dias, 2009, 2010).

To provide additional insights into the possible impact of the pandemic, we broaden the list of circumstances beyond those that have typically been used in this literature to capture factors that are specific to the policy debate concerning the adverse consequences of COVID-19 for social inequality. These include working in industries that are more relevant for or affected by the pandemic, individuals' employment status the presence of children in households and living in multigenerational households or as lone parents, and housing tenure. Moreover, the influence of housing conditions on people's ability to self-isolate the neighbourhood environment and any pre-existing financial strain problems are also factors to be considered. A full description of the circumstance variables is provided in Appendix B.

4 Results

4.1 The distribution of GHQ before and during the pandemic

Summary statistics for the GHQ outcomes are presented in Table 1 and for our measures of circumstances in Table B.1 in Appendix B; the latter show that the weighted means for the baseline circumstances variables used in our analysis are well balanced between our full GPS sample and the restricted COVID-19 sample. Table 1 (Panel A) shows that the baseline levels for each of the elements of the GHQ and for the combined Likert and Caseness scores are very similar between the full GPS sample at

Wave 9 and the COVID-19 respondents measured at Wave 9 (columns [a] and [b]). This provides further evidence that there are limited differences between our weighted COVID-19 sample and the full GPS sample.

Table 1: Summary statistics for the GHQ at UKHLS Wave 9 and in April 2020.

	Wave 9 Full sample [a]	**Wave 9** COVID-19 sample [b]	**April 2020** COVID-19 sample [c]	**Difference between b and c [p-values]**
Panel A: Sample proportions and means				
GHQ-12 elements				
Concentration†	0.162	0.163	0.279	0.000
Sleep†	0.155	0.150	0.240	0.000
Role†	0.143	0.137	0.272	0.000
Decisions†	0.094	0.091	0.132	0.000
Strain†	0.219	0.228	0.283	0.000
Overcoming difficulties†	0.137	0.138	0.148	0.039
Enjoy activities†	0.166	0.171	0.457	0.000
Face up problems†	0.100	0.103	0.131	0.000
Depressed†	0.190	0.197	0.277	0.000
Confidence†	0.154	0.158	0.164	0.286
Worthlessness†	0.086	0.090	0.098	0.052
Happiness†	0.145	0.153	0.234	0.000
GHQ-12 Likert‡‡	11.25	11.31	12.48	0.000
GHQ-12 Caseness ≥4‡‡‡	0.184	0.183	0.283	0.000
Panel B: Overall inequality measure (variance)				
GHQ-12 Likert‡‡	30.49	32.29	37.69	0.000
Sample size	15,083	7,789	7,789	

Notes: Results in the first column use the UKHLS wave 9 sample weights while, those in the second and third columns are weighted by using our own longitudinal weights.
† For each of the GHQ dimensions, the two categories indicating the most depressed states are coded as one and the remaining two categories, that reflect better mental health, are coded as zero (dichotomous variables).
‡‡ Continuous GHQ-12 measure based on the overall score across all 12 dimensions using the Likert scoring (ranging between zero and 36).
‡‡‡ Dichotomous variable taking the value of one if the overall GHQ-12 Caseness score ≥4 and zero otherwise.

Given that all measures are coded to reflect worse psychological distress, the comparison of columns [b] and [c] in Table 1 (Panel A), along with the associated p-values, shows a substantial and statistically significant worsening of levels of psychological distress during the pandemic. This applies to nearly all of the individual elements of GHQ and to the aggregated Likert and Caseness scores. For example, the aggregate Caseness score, for the proportion of respondents above the threshold value for psychological distress, increases from 0.183 to 0.283. So, on this measure, just under 20% of the sample were experiencing psychological distress at Wave 9, but by April 2020, almost 30% of the same sample of individuals were experiencing distress. Panel B of Table 1 compares total absolute inequality, measured by the variance if the Likert GHQ-12 score, between Wave 9 and during the peak of the first wave of the pandemic (April 2020). There is a systematic increase in total inequality from 32.29 to 37.69. Figure A.1 in Appendix A shows the change in the shape of the, kernel smoothed,

density function for GHQ-12 between Wave 9 and April 2020, with a flattening of the density and greater mass in the right-hand tail of the distribution.

Our analysis so far shows an increase in the total inequality in GHQ during the pandemic, but does the same hold for IOp? To assess this, Table 2 presents the dissimilarity indices for IOp in each of the twelve elements of the GHQ. The baseline results for the full sample at Wave 9 all lie between 0.202 and 0.319 and are statistically significant, while for the restricted Wave 9 sample (conditional on responding to the COVID-19 GHQ questionnaire) they range between 0.220 and 0.361. Strikingly, within the COVID-19 sample, the estimated dissimilarity indices are smaller for all twelve elements of the GHQ in April 2020. In some cases, there is a substantial reduction in IOp; the estimates lie between 0.091 and 0.321. This indicates that the proportion of total inequality attributed to our observed circumstances factors has declined during the pandemic.

Table 2: Measures of IOp (Dissimilarity Indices) for each element of the GHQ at UKHLS Wave 9 and in April 2020.

	Wave 9 Full sample	**Wave 9** COVID-19 sample	**April 2020** COVID-19 sample
GHQ-12 elements	θ_I	θ_I	θ_I
Concentration	0.206*** (0.006)	0.254*** (0.013)	0.222*** (0.013)
Sleep	0.232*** (0.007)	0.250*** (0.013)	0.230*** (0.013)
Role	0.236*** (0.007)	0.265*** (0.013)	0.171*** (0.012)
Decisions	0.242*** (0.006)	0.280*** (0.011)	0.249*** (0.011)
Strain	0.212*** (0.007)	0.231*** (0.013)	0.210*** (0.013)
Overcoming difficulties	0.262*** (0.007)	0.311*** (0.014)	0.255*** (0.013)
Enjoy activities	0.202*** (0.006)	0.232*** (0.013)	0.091*** (0.013)
Face up problems	0.256*** (0.006)	0.301*** (0.013)	0.270*** (0.012)
Depressed	0.204*** (0.007)	0.220*** (0.014)	0.169*** (0.013)
Confidence	0.241*** (0.007)	0.276*** (0.014)	0.270*** (0.013)
Worthlessness	0.319*** (0.006)	0.361*** (0.012)	0.321*** (0.012)
Happiness	0.237*** (0.007)	0.275*** (0.014)	0.156*** (0.012)

Notes: Results in the first column use the UKHLS wave 9 sample weights while those in the second and third columns are weighted by using our own longitudinal weights. Bootstrapped standard errors with 500 replications are presented in parenthesis.
***$p < 0.01$.

Table 3 presents the measures for IOp in the variance share for the GHQ-12 measure and the dissimilarity index for the GHQ-12 Caseness score. The baseline results for the full sample at Wave 9 are statistically significant with circumstances accounting for 10.7% for the total variation in GHQ-12, and a dissimilarity index of 0.234 for the Caseness score. The corresponding results when the Wave 9 sample is restricted to those who responded to the COVID-19 survey are comparable, with values of 13.45% and 0.263, respectively. As with the dissimilarity indices for the elements of GHQ, these values fall to 11.23% and 0.197 in April 2020, showing that circumstances account for a smaller share of total inequality and suggesting that relative IOp may have declined during the peak of the pandemic.

Table 3: Measures of IOp for levels of GHQ-12 (Likert scoring) and for dichotomous distress indicators at UKHLS Wave 9 and in April 2020.

	Wave 9 Full sample		**Wave 9** COVID-19 sample		**April 2020** COVID-19 sample	
	θ_I	θ_S	θ_I	θ_S	θ_I	θ_S
GHQ-12 Likert						
Variance share	-	10.70*** (0.224)		13.45*** (0.555)		11.23*** (0.407)
GHQ-12 Caseness≥4						
Dissimilarity index	0.234*** (0.008)	-	0.263*** (0.013)		0.197*** (0.014)	

Notes: Results in the first column use the UKHLS wave 9 sample weights while those in the second and third columns are weighted by using our own longitudinal weights. Bootstrapped standard errors with 500 replications are presented in parenthesis.
***$p < 0.01$.

4.2 Decomposition analysis

Table 4 (Panel A) presents the Shapley-Shorrocks decomposition of the variance share for GHQ-12. Our results are grouped by categories of circumstance variables showing the contributions of age and gender, ethnicity, education, housing conditions, household composition, employment status, industry, financial strain, neighbourhood and parental occupation. At the baseline in Wave 9, for both the full sample and the COVID-19 sample, the largest contributions to IOp are those attributed to financial strain (34.53%), housing conditions (17.16%) and employment status (17.03%). In contrast, during the peak (of the first wave) of the pandemic (April 2020) these three factors decline in their shares, most notably for financial strain that drops to 19.62%, and demographic factors (age and gender) account for the largest share, increasing their share from 12.24% to 29.38%. The contribution of working in an industry relevant to the response to the pandemic plays a small role at Wave 9 (0.74%) but more than triples its share in April 2020 (3.28%). Household composition and parental occupation also show an increase in their shares. The share of ethnicity decreases from 3.40% to 1.12%. Table 4 (Panel B) presents the corresponding Shapley-Shorrocks decomposition results for the dissimilarity indices for the GHQ-12 Caseness score; these results echo those in Panel A, described above.

Table 4: Decomposition of IOp at UKHLS Wave 9 and in April 2020.

	Wave 9 Full sample	**Wave 9** COVID-19 sample	**April 2020** COVID-19 sample
PANEL A			
GHQ-12 (Variance share)	**%**	**%**	**%**
Age and gender	11.32	12.24	29.38
Ethnicity	0.29	3.40	1.12
Education/qualifications	0.84	1.34	1.39
Housing conditions	17.67	17.16	15.09
Household composition	4.10	6.06	8.83
Employment status	23.02	17.03	13.47
COVID19-related industry	0.53	0.74	3.28
Financial strain	36.00	34.53	19.62
Neighbourhood characteristics	4.42	4.83	4.63
Parental occupational status	1.81	2.67	3.19
Total	100.00	100.00	100.00
PANEL B			
GHQ Caseness (dissimilarity index)	%	%	%
Age and gender	15.38	17.01	32.18
Ethnicity	0.99	2.82	1.00
Education/qualifications	1.74	2.95	4.37
Housing conditions	24.56	20.29	16.46
Household composition	6.03	7.91	7.09
Employment status	17.55	14.28	12.04
COVID19-related industry	1.02	1.35	6.38
Financial strain	24.45	22.56	11.11
Neighbourhood characteristics	4.73	6.92	3.62
Parental occupational status	3.53	3.91	5.76
Total	100.00	100.00	100.00
Notes: Results show percentage contributions. Results in the first column use the UKHLS wave 9 sample weights while those in the second and third columns are weighted by using our own longitudinal weights.			

5 Conclusion

The UK population as a whole has been exposed to the policy responses to the COVID-19 pandemic. Measures taken include a lockdown, social distancing and self-isolation. Their economic impact has been substantial and resources within the health and social care systems have been diverted to the pandemic. Given evidence that the impact of the pandemic on physical health and mortality has been more severe for those in disadvantaged circumstances (e.g., Office for National Statistics, 2020a) it might reasonably be expected that the impact on psychological distress and the mental health of the population may also have been unequally distributed within the population. To measure the impact of the pandemic on equity in mental health we adopt an approach based on *ex ante* equality of opportunity.

In line with the evidence on physical health, our results show a substantial worsening of the overall levels of GHQ during the peak (of the first wave) of the pandemic. This applies to nearly all of the individual elements of GHQ-12 and to overall GHQ-12 scores. In addition, there is a statistically significant increase in total inequality in the Likert GHQ-12 score between Wave 9 and April 2020. Nevertheless, inequality of opportunity does not seem to have increased. Within the COVID-19 sample we find lower levels of IOp in April 2020, suggesting that the proportion of total inequality attributed to observed circumstances has not increased with COVID-19. Our results suggest that, with respect to psychological distress, the greater total inequality that is evident, is broadly diffused across the population. This is consistent with the notion that the pandemic is, to some extent, a leveller.

The Shapley-Shorrocks decomposition analysis of the shares of inequality that are attributable to observed circumstances shows that during the peak of the pandemic, key socioeconomic factors – financial strain, housing conditions and employment status – declined in their share of IOp and that age and gender now accounts for a larger share which may reflect the fact that the direct burden of COVID-19 is concentrated among the elderly. Working in industries related to the response to COVID-19, household composition and parental occupation have increased their shares of IOp in psychological distress during the pandemic.

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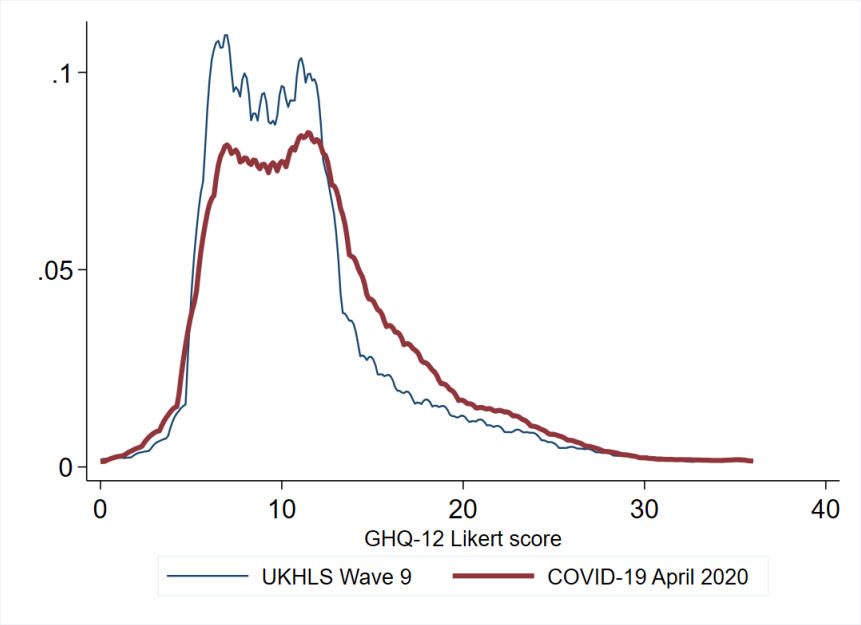
Appendices

Appendix A: GHQ Module Variables in UKHLS

Questions on all twelve dimensions of the GHQ are used as separate outcomes in our analysis. The wording of the GHQ questions in the UKHLS Wave 9 questionnaire and the COVID-19 questionnaire is identical, as shown below. The twelve dimensions of GHQ span concentration, loss of sleep, playing a useful role, ability to make decisions, coping under strain, overcoming difficulties, enjoying activities, facing problems, feeling depressed or unhappy, confidence, feeling worthless, and general happiness. Responses to the twelve dimensions are answered on a four-category scale ('not at all', 'no more than usual', 'rather more than usual' and 'much more than usual'). For each of the GHQ dimensions, the two categories indicating the most depressed states are coded as one and the remaining two categories, that reflect better mental health, are coded as zero (the Caseness scoring).

We also use a single continuous index that combines all twelve dimensions (GHQ-12). To create this index, we use a Likert scoring method that sums all twelve dimensions, which are scored from zero to three to reflect the four categories of each of the dimensions. This results in a single continuous GHQ-12 index, ranging from 0 (least distressed) to 36 (most distressed). This allows us to treat GHQ-12 as a pseudo-continuous measure in our analysis (e.g., Davillas *et al.*, 2016). The density functions for GHQ-12 at Wave 9 and in April 2020 are shown in Figure A.1.

Figure A.1: Distribution of GHQ-12 Likert score at UKHLS Wave 9 and in April 2020



Following the literature, we have also used a combined GHQ-12 index that is based on the Caseness scoring as an additional outcome (e.g., Maheswaran, *et al.*, 2015). As the resulting GHQ index is characterised by spikes, the Caseness scoring GHQ-12 index is typically dichotomised to create an indicator for distress; in line with the literature (Maheswaran, *et al.*, 2015), Caseness GHQ-12 ≥ 4 is used as the threshold to define our dichotomous variable. We present analysis of IOp in all GHQ-related outcomes at UKHLS Wave 9 and in the COVID-19 survey at April 2020.

Wording of the GHQ questions:

ghqa [GHQ: concentration]
Universe: Ask all.
The next questions are about how you have been feeling over the last few weeks. Have you recently been able to concentrate on whatever you're doing?
1. Better than usual
2. Same as usual
3. Less than usual
4. Much less than usual

ghqb [GHQ: loss of sleep]
Universe: Ask all.
Have you recently lost much sleep over worry?
1. Not at all
2. No more than usual
3. Rather more than usual
4. Much more than usual

ghqc [GHQ: playing a useful role]
Universe: Ask all.
Have you recently felt that you were playing a useful part in things?
1. More so than usual
2. Same as usual
3. Less so than usual
4. Much less than usual

ghqd [GHQ: capable of making decisions]
Universe: Ask all.
Have you recently felt capable of making decisions about things?
1. More so than usual
2. Same as usual
3. Less so than usual
4. Much less capable

ghqe [GHQ: constantly under strain]
Universe: Ask all.
Have you recently felt constantly under strain?
1. Not at all
2. No more than usual
3. Rather more than usual
4. Much more than usual

ghqf [GHQ: problem overcoming difficulties]
Universe: Ask all.
Have you recently felt you couldn't overcome your difficulties?
1. Not at all
2. No more than usual
3. Rather more than usual
4. Much more than usual

ghqg [GHQ: enjoy day-to-day activities]
Universe: Ask all.
Have you recently been able to enjoy your normal day-to-day activities?
1. More so than usual
2. Same as usual
3. Less so than usual
4. Much less than usual

ghqh [GHQ: ability to face problems]
Universe: Ask all.
Have you recently been able to face up to problems?
1. More so than usual
2. Same as usual
3. Less able than usual
4. Much less able

ghqi [GHQ: unhappy or depressed]
Universe: Ask all.
Have you recently been feeling unhappy or depressed?
1. Not at all
2. No more than usual
3. Rather more than usual
4. Much more than usual

ghqj [GHQ: losing confidence]
Universe: Ask all.
Have you recently been losing confidence in yourself?
1. Not at all
2. No more than usual
3. Rather more than usual
4. Much more than usual

ghqk [GHQ: believe worthless]
Universe: Ask all.
Have you recently been thinking of yourself as a worthless person?
1. Not at all
2. No more than usual
3. Rather more than usual
4. Much more than usual

ghql [GHQ: general happiness]
Universe: Ask all.
Have you recently been feeling reasonably happy, all things considered?
1. More so than usual
2. About the same as usual
3. Less so than usual
4. Much less than usual

Appendix B: Description of the circumstance variables

Sex and age are included in our list of circumstances as they are protected characteristics under the UK Equality Act of 2010 (NHS England, 2017). Beyond this, for example, Alon *et al.* (2020) argue the impact of COVID-19 may have a specific impact on gender: social distancing may have differential effects on the sectors and occupations where women are more likely to work, school closures and limited access to child care affecting working mothers offset by a shift to more flexible working and changes in social norms with respect to child care. Specifically, we create four age group indicators based on UKHLS wave 9 data (20-34 age group; 35-49 age group; 50-64 age group and those 65 and above) for males and females (giving eight age-sex dummies).

Race is also protected under the Equality Act and the impact of COVID-19 on those of black, Asian and minority ethnic (BAME) groups has been a particular focus of concern in public policy and debate in the UK and elsewhere (e.g., Office for National Statistics, 2020b). We have included indicators for white (reference group), black, Asian and mixed (including the other ethnic groups), following the ethnic breakdown from the Office for National Statistics (2020b).

Socioeconomic status (SES) in childhood is regarded as an important source of IOp in health in the literature (e.g., Davillas and Jones, 2020; Jusot et al., 2013; Rosa Dias, 2009, 2010). We measure parental occupational status to proxy childhood SES. Two categorical variables (one for each parent) are used to capture the occupational status of the respondent's mother and father when the respondent was aged 14: not working (reference category), four occupation skill levels and a category for missing data. To construct these variables the occupational skill levels are based on the skill level structure of the Standard Occupational Classification 2010. Given that parental occupation is a time-invariant variable, information from all nine UKHLS waves is used for those included in our sample (as it is collected when respondents first enroll in the survey). As in Davillas and Jones (2020), individuals' own education is included as a circumstance. Educational attainment is measured using indicators for five levels of qualification: no qualification (reference), basic qualification, O-Level or equivalent qualification, A-Level/post-secondary, and degree.

Additional factors that have been identified as a source of concern in context of impact of COVID-19 are included as described below. These are considered as predetermined circumstances in our analysis and are based on information collected from UKHLS Wave 8 (unless otherwise stated); this is before the collection of our GHQ outcomes at Wave 9 and the COVID-19 questionnaire. We measure housing tenure in a four-category variable: own outright (reference category), own with mortgage, rent socially and private renters. Rental and mortgage costs have been considered as an important financial concern, with the UK Government undertaking initiatives to support those experiencing financial difficulties meeting mortgage and rental costs. Housing space is capturing by

the ratio of the number of bedrooms to household size and by the number of other rooms in the home (apart from bedrooms, bathrooms, and kitchen); inequalities in housing space are an important factor affecting people's ability to self-isolate.

Household composition is captured by a four-category variable: single person household, lone parent household, multi-occupancy households, while all other household types are treated as the reference category. Single adult households as well as multigenerational and multi-occupancy household are particularly vulnerable to the COVID-19 pandemic and lockdown. The presence of children in the household, imposing home-schooling and additional child care responsibilities during the lockdown, is captured by a dummy indicator taking the value of one in the presence of one or more children in household and zero otherwise.

Job status is included as a categorical variable: self-employed, employee (reference), unemployed, retired and other. We have also included five dummy variables indicating whether respondent's occupation is in broad industrial sectors that are most relevant to the response to COVID-19: health services, the food industry, retail, transportation, education and sports. Respondents' financial strain prior to COVID-19 is captured by a three-category financial wellbeing measure: living comfortably/doing alright (reference group), just getting by, and facing difficulties. Finally, two dummy variables are used to capture neighbourhood-level characteristics that may be relevant for the response to COVID-19[8]. Specifically, we include an indicator for respondents considering their neighbourhood as having poor/fair medical facilities and zero if very good/excellent. An indicator for poor/fair leisure facilities is also included.

Summary statistics for the circumstance variables are shown in Table B.1.

[8] Unlike all other time-varying circumstance variables (collected at UKHLS Wave 8), the neighbourhood-level characteristics are measured at UKHLS Wave 6.

Table B.1: Summary statistics for circumstance variables.

	Wave 9 Full sample	**April 2020** COVID-19 sample
Circumstances	**Mean**	**Mean**
Males: age group 20-34 (reference)	0.082	0.079
Males: age group 35-49	0.118	0.126
Males: age group 50-64	0.138	0.140
Males: age group 65+	0.128	0.123
Females: age group 20-34	0.097	0.094
Females: age group 35-49	0.142	0.151
Females: age group 50-64	0.151	0.153
Females: age group 65+	0.143	0.134
White (reference)	0.961	0.955
Mixed	0.012	0.012
Asian	0.020	0.021
Black	0.008	0.011
Degree (reference)	0.295	0.301
A-Level/post-secondary	0.334	0.326
O-Level/equivalent	0.189	0.187
Basic qualification	0.093	0.092
No qualification	0.090	0.094
Own house outright (reference)	0.361	0.352
Mortgage	0.357	0.365
Social rent	0.169	0.177
Private rent	0.114	0.106
Beds to household size ratio	1.346	1.331
Number of other rooms	1.916	1.915
Singe person household	0.180	0.171
Lone parent household	0.029	0.031
Multioccupancy household	0.409	0.422
Other household composition (reference)	0.382	0.376
Number of children in household	0.278	0.287
Self-employed	0.078	0.081
Employee (reference)	0.506	0.517
Unemployed	0.032	0.033
Retired	0.276	0.259
Other employment status	0.108	0.111
Health and social care sector	0.053	0.054
Food industry	0.028	0.027
Retail industry	0.055	0.058
Transportation industry	0.023	0.025
Education and sports industry	0.084	0.087
Financial strain: Comfort/all right	0.752	0.745
Financial strain: Getting by	0.187	0.196
Financial strain: Difficulties	0.061	0.059
Neighbourhood: poor/fair medical facilities	0.259	0.256
Neighbourhood: poor/fair leisure facilities	0.500	0.510
Father: Skill level 4 (reference)	0.095	0.097
Father: Skill level 3	0.073	0.076
Father: Skill level 2	0.256	0.254
Father: Skill level 1	0.131	0.134
Father unemployed	0.350	0.346
Missing data	0.096	0.093
Mother: Skill level 4 (reference)	0.153	0.154
Mother: Skill level 3	0.349	0.348
Mother; Skill level 2	0.211	0.216
Mother: Skill level 1	0.077	0.076
Mother unemployed	0.050	0.052
Missing data	0.159	0.154
Notes: Weighted using the UKHLS Wave 9 sample weights (first column) and our own longitudinal weights (second column).		

Appendix C: Sensitivity analysis on the interview mode for UKHLS Wave 9.

The use of different modes during a survey may affect how respondents answer the same questions. Specifically, at UKHLS Wave 9, when our pre-COVID-19 GHQ data were collected, about 60% of households were initially invited to complete the questionnaire online and, then, followed up in other modes if they had not completed online. A further 20% of the households were initially approached for a face-to-face interview but then given the opportunity to complete online if they had not completed the face-to-face interview. The remaining 20% were only approached for a face-to-face interview (ring-fenced face-to-face sample). As a result of these initiatives, about 54% of the respondents have responded online to our GHQ questions at Wave 9, with the remaining sample using a face-to-face interview mode.

We conducted sensitivity analyses to explore whether the observed differences in the inequalities in GHQ-12 before and after the COVID-19 response may be an artefact of the mixed modes in UKHLS Wave 9 as opposed to the web-based COVID-19 April 2020 Wave. First, we exclude from our UKHLS Wave 9 analysis the ring-fenced face-to-face sample, as it is a sample of respondents who only offered the traditional face-to-face questionnaire mode. Second, we restricted our Wave 9 sample to those respondents who actually conducted their interview by any web-based mode. We found limited differences between these results (Tables C.1-C.4) and our base case inequality and decomposition results in Tables 2-5 (Wave 9 Full sample, first column) suggesting that the mixed-mode effects have limited impact in our inequality results before the COVID-19 pandemic.

Table C.1: Measures of IOp (Dissimilarity Indices) for each element of the GHQ at UKHLS Wave 9: Sensitivity analysis on the interview mode.

	Wave 9 Web-based mode only	**Wave 9** Without the ring-fenced face-to-face sample
GHQ-12 elements	θ_I	θ_I
Concentration	0.215*** (0.009)	0.210*** (0.008)
Sleep	0.230*** (0.008)	0.237*** (0.008)
Role	0.253*** (0.009)	0.240*** (0.008)
Decisions	0.266*** (0.007)	0.245*** (0.007)
Strain	0.205*** (0.010)	0.217*** (0.008)
Overcoming difficulties	0.286*** (0.010)	0.266*** (0.008)
Enjoy activities	0.197*** (0.010)	0.204*** (0.008)
Face up problems	0.273*** (0.008)	0.255*** (0.007)
Depressed	0.201*** (0.010)	0.204*** (0.008)
Confidence	0.262*** (0.010)	0.242*** (0.008)
Worthlessness	0.334*** (0.010)	0.321*** (0.007)
Happiness	0.243*** (0.009)	0.240*** (0.008)
Sample size	8,419	12,160
Notes: Results are weighted using UKHLS Wave 9 sample weights. Bootstrapped standard errors with 500 replications are presented in parenthesis. ***p < 0.01.		

Table C.2: Measures of IOp for levels of GHQ-12 (Likert scoring) and for dichotomous distress indicators at UKHLS Wave 9: Sensitivity analysis on the interview mode.

	Wave 9 Online mode only		**Wave 9** Without the ring-fenced face-to-face sample	
	θ_I	θ_S	θ_I	θ_S
GHQ-12 Likert				
Variance share	-	10.9*** (0.40)		10.9*** (0.32)
GHQ-12 Caseness >4				
Dissimilarity index	0.236*** (0.010)	-	0.234*** (0.009)	
Notes: Results are weighted using UKHLS Wave 9 sample weights. Bootstrapped standard errors with 500 replications are presented in parenthesis. ***p < 0.01.				

Table C.3: Decomposition of IOp (variance share) for levels of GHQ-12 (Likert scoring) at UKHLS Wave 9: Sensitivity analysis on the interview mode.

	Wave 9 Online mode only	**Wave 9** Without the ring-fenced face-to-face sample
Factors (grouped)	%	%
Age and gender	11.21	11.69
Ethnicity	0.72	0.36
Education/qualifications	0.49	0.75
Housing conditions	21.13	20.10
Household composition	4.92	4.12
Employment status	19.00	21.13
COVID19-related industry	1.09	0.58
Financial strain	34.29	35.17
Neighbourhood characteristics	4.96	4.31
Parental occupational status	2.20	1.79
Total	100.00	100.00
Notes: Percentage contributions are presented here. The results are weighted using UKHLS Wave 9 sample weights.		

Table C.4: Decomposition of IOp (dissimilarity indices) for dichotomous distress indicators at UKHLS wave 9: Sensitivity analysis on the interview mode.

	Wave 9 Full sample	**Wave 9** Excluding the ring-fenced face-to-face sample
Factors (grouped)	**%**	**%**
GHQ-12 Caseness >4		
Age and gender	18.30	15.23
Ethnicity	2.30	1.22
Education/qualifications	1.03	1.65
Housing conditions	21.74	24.87
Household composition	6.28	6.62
Employment status	14.48	15.95
COVID19-related industry	1.72	0.83
Financial strain	22.14	24.27
Neighbourhood characteristics	6.92	5.30
Parental occupational status	5.09	4.07
Total	100.00	100.00
Notes: Percentage contributions are presented here. The results are weighted using UKHLS Wave 9 sample weights.		