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ABSTRACT

Societal Movement Restrictions and Adverse Mental Health Outcomes

During the COVID-19 pandemic, governments have struggled to find the right balance between restrictive measures to contain the spread of the virus, and the effects of these measures on people's psychological wellbeing. This paper investigates the relationship between limitations to mobility and mental health for British population during the COVID-19 pandemic, combining the use of high frequency mobility data from Google and longitudinal monthly data collected during the pandemic. We show that more time spent at home predicts a worsening of mental wellbeing even when we account for the prevalence of COVID-19 in the region and the general stringency of the lockdown. There is some heterogeneity in these effects, with young healthy people, living alone, with an active working life, showing particularly high levels of distress.

JEL Classification: I0, I14

Keywords: COVID-19, mental health, human movement, mobility restriction, stay-at-home lockdowns

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1. Introduction

The eruption of the pandemic, and the various ways in which governments across the globe have reacted to it, have generated important lessons about the extent to which our wellbeing depends on 'mobility': namely, being able to function as economic agents that interact with one another in a world where activities (e.g., production, consumption, and education), and socialisation, involve moving across the physical space. While mobility was the key to unleash the potential benefits of globalisation, 'lockdowns' – the prohibition to leave one's residence unless for carrying out a few essential services – were extensively used and continue to be in place to contain the spread of COVID-19 (i.e., the disease caused by the novel coronavirus, SARS-CoV-2) in many parts of the world to keep contagions at bay.

As a nonpharmaceutical intervention (NPI) to limit the morbidity and mortality associated with COVID-19, lockdowns have been effective in a number of settings, both in ex-ante modeling exercises (e.g., Davies et al. 2020) and in ex-post evaluations (e.g., Flaxman et al. 2020, Singh et al. 2021, and Liu et al. 2021). However, their use as a generic response to flatten the curve of new cases has been "unprecedented in scale, scope, and duration" (Sonuga-Barke and Fearon 2021, p. 1375) and deemed a "cure […] worse than the disease" (Meyerowitz-Katz et al. 2021) for aggravating the mental health of those under restrictions[1]. COVID-19 itself, of course, also causes mental distress. COVID-19-related deaths of family and friends are an adverse shock, and there is the prevailing fear of being infected (Pfefferbaum and North 2020), as well as financial insecurity brought about by the pandemic (Cheng et al. 2021). The fact that lockdowns reduce the spread of COVID-19 and the transmission of SARS-CoV-2 can improve the mental wellbeing of the population. However, while lockdowns have reduced the burden associated with the disease itself, these government measures designed to restrict mobility, such as "stay-at-home" or "shelter-in-place" orders, are strongly associated with adverse impacts on wellbeing, especially on mental health (e.g., Silverio-Murillo et al. 2021 and Brodeur et al. 2021).

A priori, it is not clear which impact on mental health – a positive one associated with reduced prevalence of COVID-19 or a negative one associated with physical isolation – is larger in magnitude,

[1] The so-called "Great Barrington Declaration" – signed by a number of prominent scientists and academics – has advocated for "focused protection" instead, where the most vulnerable to COVID-19 are "shielded" from the virus.

nor is clear if the net effect 'switches' from benefiting to harming society when restrictions lasts beyond certain time spans. Part of the problem is that information on mental health is typically collected retrospectively through ad hoc surveys. Hence one learns about the effect of current restrictions with a lag, which can vary from weeks, as is the case in the UK which has been collecting monthly information on a representative panel of households, to months, as most other countries include health-related questions only in annual surveys. This delay, in turn, sheds light on the problem only when it has already grown, with possibly tragic consequences with regards to self-harm, suicides, and domestic violence, to name a few.

This study investigates the relationship between mobility restrictions and mental wellbeing in the UK, using high quality longitudinal data collected monthly or bi-monthly during the pandemic.

Unfortunately, there is no lead indicator of mobility in current surveys. However, a leading indicator of mobility can be constructed from information on the movement of people collected by Google from internet-connected devices with the "location history" setting turned on. In this paper we combine data on mobility sourced from Google's publicly available Community Mobility Reports with monthly data on mental health to measure the effect of mobility on mental health. In doing so, we are able to add to the growing literature that examines this issue (e.g., Gloster et al. 2020 and Prati and Macini 2021). Particularly for the United Kingdom, we note the previous work investigating changes in mental health during the pandemic, such as Banks and Xu (2020), Davillas and Jones (2021 and 2021a), Daly et al. (2020), Fancourt et al. (2020), Johnston et al (2020), Pierce et al (2020), Proto and Quintana-Domque (2020), O'Connor et al. (2021), Etheridge and Spantig (2020), Banks et al. (2021), Cheng et al. (2021), and Serrano-Alarcon et al (2021). Most of these studies analyse changes in mental health during the COVID-19 pandemic using survey data and focus on the impact of observable characteristics of individuals in mitigating the effects on mental well-being.

However, these studies collectively only provide insight specifically to the understanding of mental health behaviour during the COVID-19 pandemic. This leaves an absence to understand the relationship between mental health and mobility behaviour within a UK context. Overall, this has received limited attention within a social science perspective relative to the UK (Burdett et al., 2021;

Ellwardt & Präg, 2021; Serrano-Alarcón et al., 2022). Whereas, other approaches within broader social science and economics focus on macro-based and cultural indicators relative to mobility which include the understanding of labour, employment and mobility across differing occupations (Brodeur et al., 2021). This leaves current social science research with a smaller focus to truly understand the relationship between mobility and mental health, and in particular reference to an absence of understanding within the context of the UK (Burdett et al., 2021; Ellwardt & Präg, 2021; Serrano-Alarcón et al., 2022).

This is an important area of research that has been partially developed by studies within health sciences, showing that there is an important relationship between mobility behaviours and mental health outcomes (Anderson, 2018; Buckee et al., 2020; Park & Kim, 2021). However, most of these studies do not include very detailed individuals' pre-pandemic traits and do not model the existence of common time-invariant characteristics across regions, individuals and time.

Our findings are applicable across a number of research areas within health inclusive of vulnerable sub-populations within society which include: the unemployed, physically disabled and older, isolated age groups. Here, our study innovates with respect to the existing literature by analyzing the relationship between mental health and mobility during the COVID-19 pandemic combining the use of high-quality longitudinal data including information on mental health, with high frequency data from Google mobility reports providing information about mobility in several different types of contexts within the UK. We use individual, region and wave fixed effects, in order to disentangle the specific effects of restrictions in mobility on mental well-being.

Towards these ends, we adopted mental health data from the UK Understanding Society longitudinal database. An important advantage of this monthly survey is that the Understanding Society study allows us to track a strongly validated measure of mental wellbeing: the short-form, 12-item General Health Questionnaire (GHQ-12) "Caseness score" (Anjara et al. 2020). Previous studies (e.g., Brodeur et al. 2021) have proxied for mental wellbeing using Google Trends data, which has information on searches performed on Google. We model variations in GHQ Caseness score across various territories in the UK as a function of the percentage change in the time spent at home, which

Google provides through its Community Mobility Reports. The use of this variable improves on previous studies (e.g., Silverio-Murillo et al. 2021), which relied on an event-study approach using the date lockdowns took effect as triggers.

In our study, we are also able to control for the severity of COVID-19 in the region by including the number of COVID-19 cases per 1,000 people. This allows us to account for the changes in mental health associated with the prevalence of COVID-19 within a region, similar to how Brodeur et al. 2021 used lagged COVID-19-related deaths.

Our results come from regressing region-level GHQ Caseness scores against the percentage change in the time spent at home, along with a set of socioeconomic and demographic control variables as well as geographic, time, and individual fixed effects. We show that more time spent at home predicts a worsening of mental wellbeing after accounting for the prevalence of COVID-19 in the region and the general stringency of the lockdown. In terms of the magnitude, a one-standard-deviation decrease in residential mobility results in an increase of 0.087 standard deviations in GHQ Caseness score (indicating worse mental health). There is some evidence of heterogeneity in the extent to which mental wellbeing responds to the amount of time spent at home. In particular, it appears that older people, men, and those with partners are less affected, as well as those people living in rural areas, those who own their houses outright (i.e., not paying off a mortgage), those who were not working, and those who were less healthy.

2. Data and Descriptive Statistics

2.1 Understanding Society (UK Household Longitudinal Study)

We use data from the UK Household Longitudinal Study (UKHLS), now known as *Understanding Society.* UKHLS surveyed approximately 40,000 households living in the United Kingdom in Wave 1. The survey contains a wide range of questions on social, economic, and behavioural issues. Interviewed individuals lived in 12 Government Office Regions across the UK (NUTS level 1: nine English regions,[2]

[2] East of England, East Midlands, London, North East, North West, South East, South West, West Midlands, and Yorkshire and the Humber.

Scotland, Wales, and Northern Ireland). Data collection started in 2009–2010 for Wave 1; ten waves are currently available. Wave 10 (pre-COVID-19) consists of individuals surveyed during the period 2018–2019.

On April 2020, selected respondents of the UKHLS were invited to take part in the first wave of a new COVID-19 special survey, which consisted of important questions on the impact of the pandemic on the wellbeing of individuals, families, and wider communities, including information about caring responsibilities and family life, employment and financial situation, financial wellbeing, home schooling, and mental wellbeing. Participants were asked to complete one survey per month until July 2020, followed by a survey every two months from September 2020 in order to track changes in their circumstances and environments. There were 17,452 individuals who completed a full post-COVID-19 survey in April 2020 (Institute for Social and Economic Research, 2020). Table S1 presents basic descriptive statistics of the estimation sample.

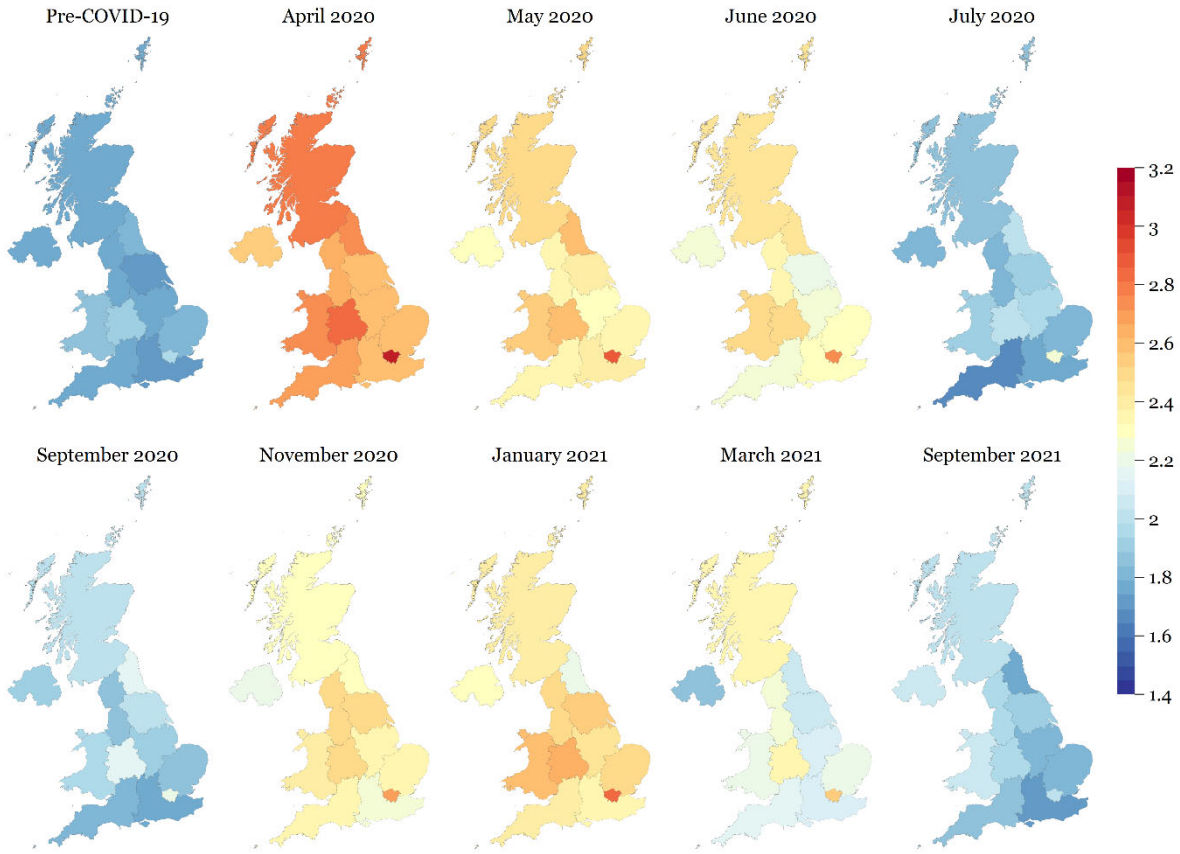
Our analysis is based on Wave 10 of the regular UKHLS and the nine waves[3] of the UKHLS COVID-19 special survey. The final estimation sample consists of 110,008 (individual×wave) observations, with 19,763 individuals from 13,295 households. Thus, the analysis below covers the period of the initial lockdown as well as the series of repeated lockdowns all the way until one and a half year into the pandemic – from March 2020 to September 2021.

Mental health was measured in UKHLS using the General Health Questionnaire (GHQ) Caseness score (Goldberg, 1972; Goldberg, 1992). The GHQ is regarded as one of the most reliable indicators of psychological distress or "disutility" (Argyle, 1989; Clark and Oswald, 1994). The GHQ Caseness score is constructed from responses to 12 questions covering feelings of strain, depression, inability to cope, anxiety-based insomnia and lack of confidence (see the Appendix for details). The twelve answers are summed up into a GHQ Caseness score that indicates the level of mental distress, resulting in a scale from 0 (the least distressed) to 12 (the most distressed).

[3] April, May, June, July, September, and November 2020, and January, March, and September 2021.

Figure 1 displays a choropleth map of regional GHQ Caseness average in the UK. London's residents experienced the worst subjective wellbeing for the entire duration of the dataset, including during the pre-pandemic period. Immediately after the declaration of the pandemic in March 2020, we observe a radical decline in people's mental wellbeing. April 2020 is clearly the worst month. Generally, mental wellbeing showed an improvement as summer approached, which brought with it an easing of lockdown restrictions; this was followed by a deterioration again in winter with lockdowns reinstated. These panels in Figure 1 portend the main results of the more sophisticated analysis in Section 4 – that increased mobility restrictions due to the lockdowns likely resulted in poorer mental health.

Figure 1. Mental health (GHQ Caseness score) across UK regions over time.



In Figure 2, we show how subjective wellbeing (measured as GHQ Caseness score) evolves over time for different socioeconomic and demographic groups identified in the data. Notably, females, children, young adults, single households, and those with a long-term illness have tracked much worse than other groups. Those who are renting are also experiencing slightly worse mental health. Nearly all

of these groups experienced improving mental wellbeing between April 2020 and June 2020, which may reflect adaptation to the “new normal”, public and private policies that have improved individual and social wellbeing, or indeed the easing of lockdown measures. There is a notable deterioration of wellbeing around the time the second lockdown starts in England (November 2020), but mental health also improves as the country transitions away from the day it took effect – similar to the evolution after the initial lockdown in March 2020.

Figure 2. Mental health across different groups over time

2.2 Google's Community Mobility Reports

The impact of the series of lockdowns in the UK on mobility is measured using movement information collected by Google from internet-connected devices with the "location history" setting turned on. The information is anonymised and a person cannot be identified in the datasets, which are called the Community Mobility Reports.[4] These reports are provided by Google to the public partly to assist the public in crafting policies that can help limit the spread of SARS-CoV-2. For our analysis, we focus on the mobility measure relating to time spent in residential places, i.e., changes in length of stay at home compared to the pre-COVID-19 baseline which is the median value of the corresponding day of the week between the 3rd January to 6th February. While the Google Mobility Reports measure is on a refined geographical level (i.e.,#Nomenclature of territorial units for statistics (NUTS) level 3), the location information of the Understanding Society survey participants is only available on the NUTS level 1 (or major socio-economic regions). Thus, in order to merge the two datasets, we aggregate the NUTS level 3 mobility to the 12 Government Office Regions by taking the average mobility measure weighted by the population of the subregions. Figure S1 shows the average monthly changes in residential mobility across the 12 regions in the UK. We observe that London dwellers had the largest decrease in mobility at the beginning of the pandemic (i.e., April 2020), as the duration of staying home increases by approximately 30% compared to the January 2020 baseline. For subsequent analysis, we calculate, for each participant, the average mobility change in the past 7 (or 14) days from the date when the survey was conducted.

2.3 COVID Statistics and Government Stringency

We use data on cases and death from COVID-19 from the UK Health Security Agency, which are reported up to the level of the 12 regions: North East, North West, Yorkshire and the Humber, East Midlands, West Midlands, East of England, London, South East, South West, Wales, Scotland, and

[4] For more information, see Google's website for the Community Mobility Reports: https://www.google.com/covid19/mobility/.

Northern Ireland. This information is used together with the population to calculate the reported case per thousand people at the region level.

We use the COVID-19 Stringency Index from the Oxford Coronavirus Government Response Tracker (OxCGRT) to proxy the strictness of lockdown policies implemented by the government (Hale et a., 2021). The stringency index is a composite measure constructed from nine policy indicators (e.g., workplace closures; restrictions on public gatherings; closures of public transport; stay-at-home requirements) and is reported at the UK country levels (England, Scotland, Wales, and Northern Ireland). Similar to the mobility measure, we calculate the past 7-day (or 14-day) average of COVID-19 case statistics and stringency index from the date when the survey was conducted.

3. Estimation Strategy

We model mental health – measured using the GHQ Caseness score – as a function of the change in the duration spent at home, socioeconomic and demographic characteristics, mental health stock before the pandemic, COVID-19 prevalence in the community, time-invariant region and individual fixed effects, as well as period fixed effects. More explicitly, we estimate variations of the following regression equation:

$$GHQ_{it} = \alpha + \beta(\Delta home)_{rt} + \boldsymbol{\gamma}'\mathbf{X}_{it} + \varepsilon_{it},$$

where i and t are individual and wave indexes, respectively, $(\Delta home)_{rt}$ is the past 7-day average of the percentage change in time spent at home compared to the pre-pandemic baseline period in region r at the time of survey t, $\mathbf{X}_{it}$ is a vector of control variables as described previously, and ε_{it} is the error term. The parameters α, β, and vector of parameters $\boldsymbol{\gamma}$ are estimated via generalised least squares. For statistical inference, the standard errors are clustered at the individual level (although clustering by region and wave does not change our conclusions). The parameter of interest is β, which quantifies the relationship between the GHQ Caseness score and the change in the duration of time spent at home.

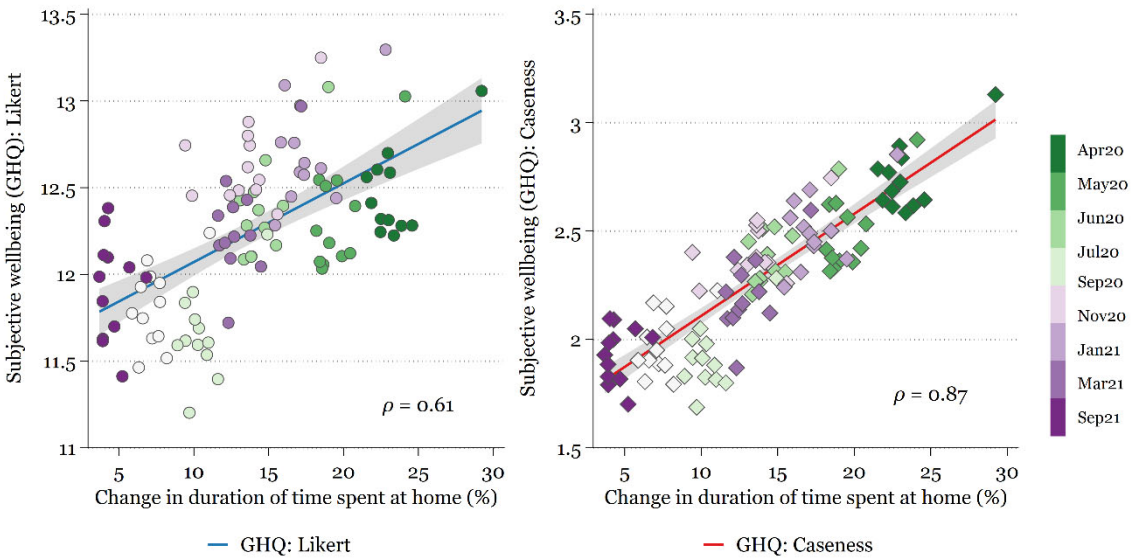
To demonstrate the stability of the estimated coefficient, we progressively expand the set of control variables entering $\mathbf{X}_{it}$. After the bivariate regression between GHQ and change in home time,

we first include a set of socioeconomic and demographic characteristics, such as gender, marital status, educational attainment, household composition (having children of various ages), home-ownership status (or renting), urban area, and employment status. Information on marital status, educational attainment, urban area, and home-ownership status are from the pre-COVID-19 wave. Second, we include a measure of mental health stock using pre-COVID-19 GHQ Caseness score as a proxy, and we control for whether the individual has a long-standing (or chronic) illness. Third, we include the prevalence of COVID-19 in the community by including the number of cases per 1,000 people as well as an index of the stringency of the lockdown. Finally, we include various fixed effects in the regression: region-specific, individual-specific, and wave-specific fixed effects. These are intended to capture unspecific features or characteristics of individuals, regions, and the survey waves that are non-varying. As an extension, we explore the heterogeneity of the relationship by interacting the change in home duration with the control variables.

4. Results

We find a very strong correlation between movement reduction and average mental health outcomes (prevalence in mental health issues). Figure 3 presents the linear fit between the mobility measure and mental health outcomes aggregated by regions and survey waves (averages). The correlation coefficients of regional-level mobility change and mental health are 0.61 and 0.87 for the two derivative measures of mental health (GHQ in a Likert scale, which ranges from 0 to 36, and GHQ Caseness score, which ranges from 0 to 12; in both cases, higher values correspond to worse mental health), respectively.

Figure 3. Mental health and mobility.

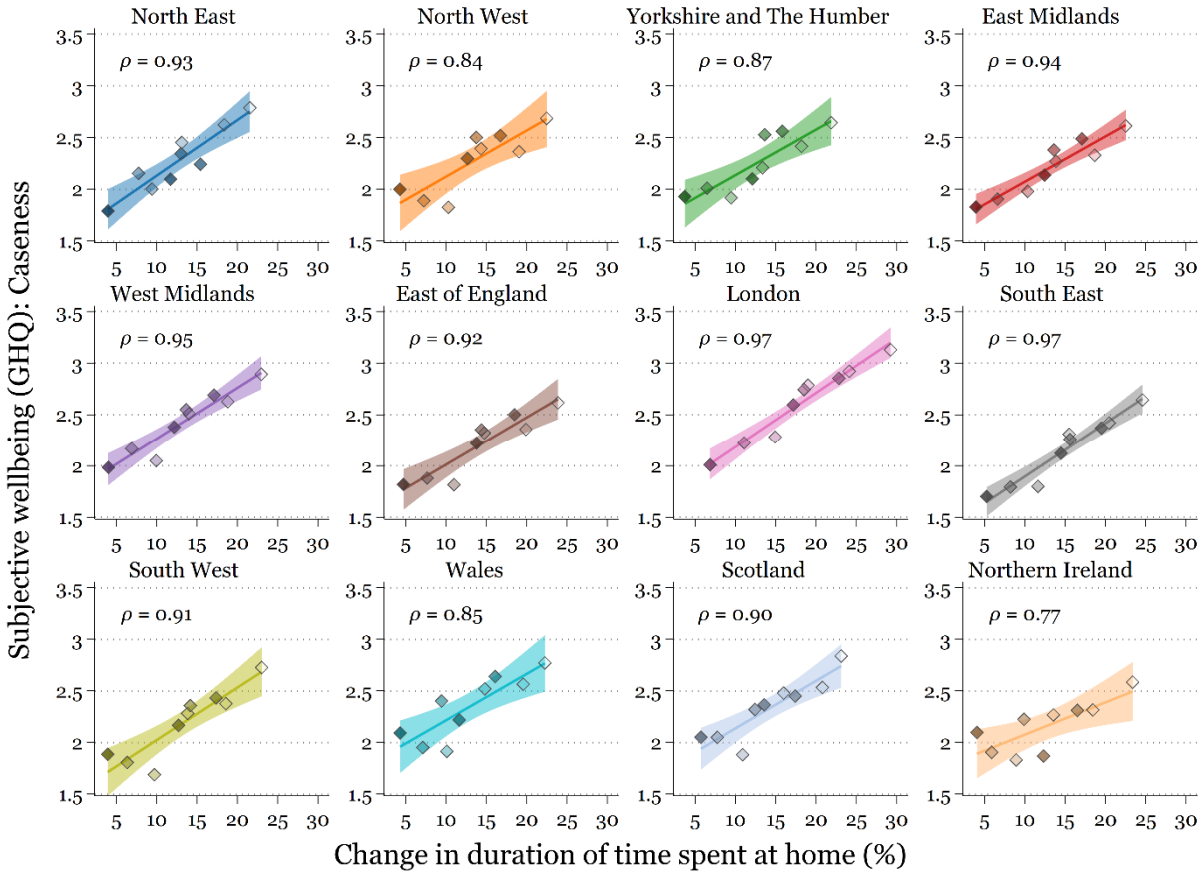


Notes. Mobility and GHQ measures are monthly averages (9-wave) for each 12 regions. Marker colours represent the nine COVID-19 survey waves with earlier waves appear in green and later waves appear in purple. Shaded areas represent 95% confidence intervals of the linear fit.

The largest change in the duration spent at home is experienced in the earlier parts of the pandemic (April and May 2020, for instance, have the darker shades of green, which appear toward the right of each panel). This period is also associated with poorer mental health. A decrease in mobility at the societal level is also strongly associated with poorer mental health across all 12 regions. In Figure 4, each dot represent the monthly average within each region, with the change in time spent at home (the horizontal axis) representing the deviation from the baseline at January 2020. Darker colours represent later waves.

Like in Figure 1, residents of London display the strongest relationship ($\rho = 0.97$) between the lockdown restrictions and mental health. For instance, people who lived in London experienced the most radical change in the duration spent at home – about 30% at its most extreme (in April 2020), which is associated with the worst average GHQ Caseness score in Figure 3. Visually, the other regions are fairly similar to each other, with correlation ranging from 0.77 (Northern Ireland) to 0.95 (West Midlands).

Fig 4. Relationship between GHQ Caseness score and mobility within region.



Notes. Mental health (GHQ) is averaged over each survey wave. Markers with darker colour represent later waves. Shaded areas represent 95% confidence intervals of the linear fit.

In Table 1, we show the main regression results using individual level observations using GHQ Caseness score as the outcome variable. As a benchmark, we begin with a bivariate model (Column 1) and subsequently include COVID test results and socio-demographic variables (Column 2), pre-existing mental health or long-term illness history (Column 3), COVID-19 prevalence and government stringency level in the last seven days (Column 4), region fixed effects (Column 5), wave fixed effects (Column 6), and individual fixed effects (Column 7). The estimated relationship between movement reduction and mental health deterioration is statistically significant at least at the 5% level. The main results are also robust to all specifications including the alternative derivative measure of mental health (i.e., Likert; Table S2), using the past-14 days average for mobility, COVID-19 cases, and stringency

measures (Table S3), and clustering standard errors at the region or region and survey wave levels (Table S4).[5]

Table 1. Movement restrictions worsen mental wellbeing

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Change in duration of time spent at home (%)	0.046*** (0.00131)	0.047*** (0.00135)	0.047*** (0.00136)	0.046*** (0.00186)	0.047*** (0.00188)	0.037** (0.0128)	0.040** (0.0126)
COVID-19 positive		0.21*** (0.0343)	0.20*** (0.0337)	0.13*** (0.0348)	0.14*** (0.0349)	0.13*** (0.0354)	0.11** (0.0384)
Age		-0.018*** (0.00202)	-0.014*** (0.00187)	-0.015*** (0.00187)	-0.015*** (0.00187)	-0.015*** (0.00187)	
Female		0.74*** (0.0406)	0.56*** (0.0367)	0.55*** (0.0367)	0.56*** (0.0367)	0.56*** (0.0367)	
Marital status							
Married/civil partnership		-0.31*** (0.0679)	-0.19** (0.0622)	-0.18** (0.0622)	-0.18** (0.0621)	-0.18** (0.0621)	
Separated/divorced/widowed		0.0074 (0.0847)	-0.014 (0.0752)	0.0017 (0.0752)	-0.0029 (0.0753)	-0.0047 (0.0753)	
Living with partner		-0.29*** (0.0457)	-0.21*** (0.0440)	-0.21*** (0.0440)	-0.21*** (0.0440)	-0.21*** (0.0440)	-0.16** (0.0558)
Education							
No qualification		-0.24* (0.114)	-0.32** (0.0979)	-0.31** (0.0979)	-0.32** (0.0979)	-0.31** (0.0978)	
Other qualification		-0.11 (0.0924)	-0.14† (0.0801)	-0.13† (0.0801)	-0.13 (0.0802)	-0.13 (0.0802)	
A level		-0.016 (0.0667)	0.0050 (0.0596)	0.0023 (0.0596)	-0.00077 (0.0596)	-0.00088 (0.0596)	
Other higher degree		0.077 (0.0733)	0.093 (0.0652)	0.095 (0.0652)	0.092 (0.0652)	0.092 (0.0652)	
Degree		0.18** (0.0596)	0.19*** (0.0535)	0.19*** (0.0535)	0.20*** (0.0538)	0.20*** (0.0538)	
Live in rural area		-0.070 (0.0451)	-0.043 (0.0405)	-0.044 (0.0406)	-0.046 (0.0420)	-0.047 (0.0420)	
Housing status							
Mortgage		0.27*** (0.0531)	0.12** (0.0481)	0.11* (0.0481)	0.12* (0.0481)	0.12* (0.0481)	
Renting		0.76*** (0.0698)	0.33*** (0.0617)	0.33*** (0.0617)	0.34*** (0.0619)	0.34*** (0.0619)	
Employment							
Unemployed		0.54*** (0.0473)	0.37*** (0.0450)	0.37*** (0.0451)	0.37*** (0.0451)	0.37*** (0.0451)	0.43*** (0.0663)
Self-employed		0.21*** (0.0603)	0.22*** (0.0569)	0.22*** (0.0570)	0.22*** (0.0570)	0.22*** (0.0571)	0.048 (0.0927)
Household composition							
Aged 0-4		0.024 (0.0511)	0.074 (0.0493)	0.074 (0.0492)	0.075 (0.0492)	0.075 (0.0492)	
Aged 5-15		0.062* (0.0291)	0.062* (0.0273)	0.063* (0.0273)	0.062* (0.0273)	0.063* (0.0273)	
Aged 70 or older		-0.10* (0.0433)	-0.071† (0.0412)	-0.071† (0.0412)	-0.070† (0.0412)	-0.071† (0.0413)	
Pre-COVID GHQ (Caseness score)			0.38*** (0.00825)	0.38*** (0.00825)	0.38*** (0.00825)	0.38*** (0.00825)	
Long-standing illness or impairment			0.48*** (0.0414)	0.49*** (0.0414)	0.49*** (0.0414)	0.49*** (0.0414)	
Case per 1,000 people				0.34***	0.33***	0.22†	0.27*

[5] We obtain robust and qualitatively similar results when we 1) cluster the standard errors at the household level, 2) use a subsample of individuals who completed all nine COVID-19 waves (40.5% of the full sample) or 3) exclude those pre-COVID wave information were not from the latest pre-COVID wave (wave 10 in 2019; 5.72% of the full sample).

				(0.0443)	(0.0445)	(0.131)	(0.128)
Stringency index				0.0014*	0.0013*	0.0019	0.0014
				(0.000600)	(0.000605)	(0.00220)	(0.00216)
Constant	1.73***	2.01***	1.17***	1.08***	1.12***	1.31***	2.05**
	(0.0277)	(0.125)	(0.115)	(0.117)	(0.152)	(0.300)	(0.669)
Region FE	No	No	No	No	Yes	Yes	Yes
Wave FE	No	No	No	No	No	Yes	Yes
Individual FE	No	No	No	No	No	No	Yes
Observations	117134	111450	109865	109865	109865	109865	117062
Individuals (cluster)	18617	17454	17141	17141	17141	17141	18609
R^2-*within*	0.016	0.017	0.016	0.018	0.018	0.019	0.019
R^2-*between*	0.005	0.077	0.258	0.259	0.259	0.259	0.001
R^2-*overall*	0.007	0.056	0.182	0.183	0.183	0.184	0.002
Prob. > *F.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes: GLS regressions. Dependent variable: Mental wellbeing (GHQ Caseness score). Reference group: *Male, Single, Not living with a partner, GCSE, Live in Urban area, Owned outright,* and *Employed.* Standard errors (clustered at individual level) in parentheses. † $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$.

A 10-percentage-point increase in time spent staying at home (compared to pre-pandemic baseline January 2020) is associated with an average increase of 0.37–0.47 in GHQ Caseness score (which has a standard deviation of 3.35). In standardized terms, a one standard deviation decrease in residential mobility is associated with a 0.066–0.084 standard deviations increase in the GHQ Caseness score. The relationship holds true for GHQ in a Likert scale, albeit slightly weaker (Table S2). In general, the relationship between the change in the time spent at home and mental distress is positive – that is, a stay-at-home order predicts worse mental wellbeing.

Other independent variables' effects on mental wellbeing follow the literature in the field. Mental health seems to improve for older people and those who live with a partner, while women report on average worse mental health. Mental health also increases for those who are employed and have no pre-existing health conditions. Unsurprisingly, increases in the number of COVID-19 cases and the stringency of restrictive measures worsen mental wellbeing.

In the following two tables (Tables 2 and 3), we interact the change in home duration with a number of different individual characteristics to examine heterogeneity over groups. Recall from Figure 2 that some groups experienced deeper declines in mental wellbeing. Interacting the change in home duration with these variables allows us to demonstrate the kind of person that might be more adversely impacted by mobility restrictions, at least in terms of their impact on mental health. The set of control variables for these regressions with interaction terms are the same as those in Table 1.

In Table 2, the own-effect of the change in mobility is consistently positive, although lacking in statistical significance when we interact it with the gender of the respondent (Column 2). The interaction with the female variable, however, shows that women suffered more than men over the period. Older respondents and those who were partnered were more resilient (Columns 1, 3, and 4). Finally, more educated individuals suffered more (Column 5).

Table 2. Interactions with age, gender, marital status, living with partner, and educational attainment

Subjective wellbeing (GHQ): Caseness score	(1) *Age*	(2) *Gender*	(3) *Marital status*	(4) *Living with partner*	(5) *Education*
Δ home duration	0.072***	0.022†	0.042**	0.037**	0.032*
	(0.0135)	(0.0129)	(0.0130)	(0.0129)	(0.0131)
Age*Δ home duration	-0.00070***				
	(0.0000852)				
Female*Δ home duration		0.023***			
		(0.00262)			
Married/civil partnership*Δ home duration			-0.0078*		
			(0.00350)		
Separated/divorced/widowed*Δ home duration			-0.0086†		
			(0.00463)		
Living with partner*Δ home duration				-0.0013	
				(0.00305)	
No qualification*Δ home duration					-0.013†
					(0.00659)
Other qualification*Δ home duration					-0.0096
					(0.00590)
A level*Δ home duration					0.0054
					(0.00436)
Other higher degree*Δ home duration					0.0018
					(0.00474)
Degree*Δ home duration					0.0075†
					(0.00386)
Age	-0.0042†	-0.015***	-0.015***	-0.015***	-0.015***
	(0.00223)	(0.00187)	(0.00187)	(0.00187)	(0.00187)
Female	0.56***	0.21***	0.56***	0.56***	0.55***
	(0.0367)	(0.0523)	(0.0367)	(0.0367)	(0.0367)
Marital status					
Married/civil partnership	-0.18**	-0.18**	-0.066	-0.18**	-0.18**
	(0.0621)	(0.0622)	(0.0804)	(0.0621)	(0.0621)
Separated/divorced/widowed	-0.00031	-0.0046	0.12	-0.0047	-0.0047
	(0.0753)	(0.0753)	(0.102)	(0.0753)	(0.0753)
Living with partner	-0.21***	-0.21***	-0.21***	-0.20**	-0.21***
	(0.0440)	(0.0440)	(0.0440)	(0.0619)	(0.0440)
Education					
No qualification	-0.32**	-0.31**	-0.31**	-0.31**	-0.13
	(0.0978)	(0.0978)	(0.0978)	(0.0978)	(0.137)
Other qualification	-0.13	-0.13	-0.13	-0.13	0.0089
	(0.0803)	(0.0803)	(0.0802)	(0.0802)	(0.118)
A level	0.00072	-0.0021	-0.00023	-0.00082	-0.080
	(0.0596)	(0.0596)	(0.0596)	(0.0596)	(0.0864)
Other higher degree	0.093	0.091	0.092	0.092	0.065
	(0.0652)	(0.0652)	(0.0652)	(0.0652)	(0.0935)
Degree	0.20***	0.20***	0.20***	0.20***	0.084

	(0.0538)	(0.0539)	(0.0538)	(0.0538)	(0.0772)
Constant	0.53†	1.31***	1.01***	1.08***	1.29***
	(0.307)	(0.301)	(0.303)	(0.301)	(0.305)
Control	Yes	Yes	Yes	Yes	Yes
Region fixed-effects	Yes	Yes	Yes	Yes	Yes
Wave fixed-effects	Yes	Yes	Yes	Yes	Yes
N	109865	109865	109865	109865	109865
N (cluster)	17141	17141	17141	17141	17141
R^2-*within*	0.020	0.020	0.019	0.019	0.019
R^2-*between*	0.259	0.259	0.259	0.259	0.259
R^2-*overall*	0.184	0.184	0.184	0.184	0.184
Prob. > *F.*	0.000	0.000	0.000	0.000	0.000

Notes: Control variables include *COVID positive*, *living in rural areas*, *housing status*, *employment*, *household composition*, *pre-COVID mental health*, *long-term illness*, *COVID case statistics*, and *stringency index*. Reference group: *Male, Single, Not living with a partner,* and *GCSE.* Standard errors (clustered at individual level) in parentheses. † $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$.

For ease of interpretation, we also graphically represent the estimation results of Table 2 in Figure 5. For almost the entire range of the percentage change in time spent at home, women are worse off than men. The gradient is also consistent for the interaction with age: the larger the change in home duration, the worse off people are, but that this relationship is much stronger for younger people than for older people.

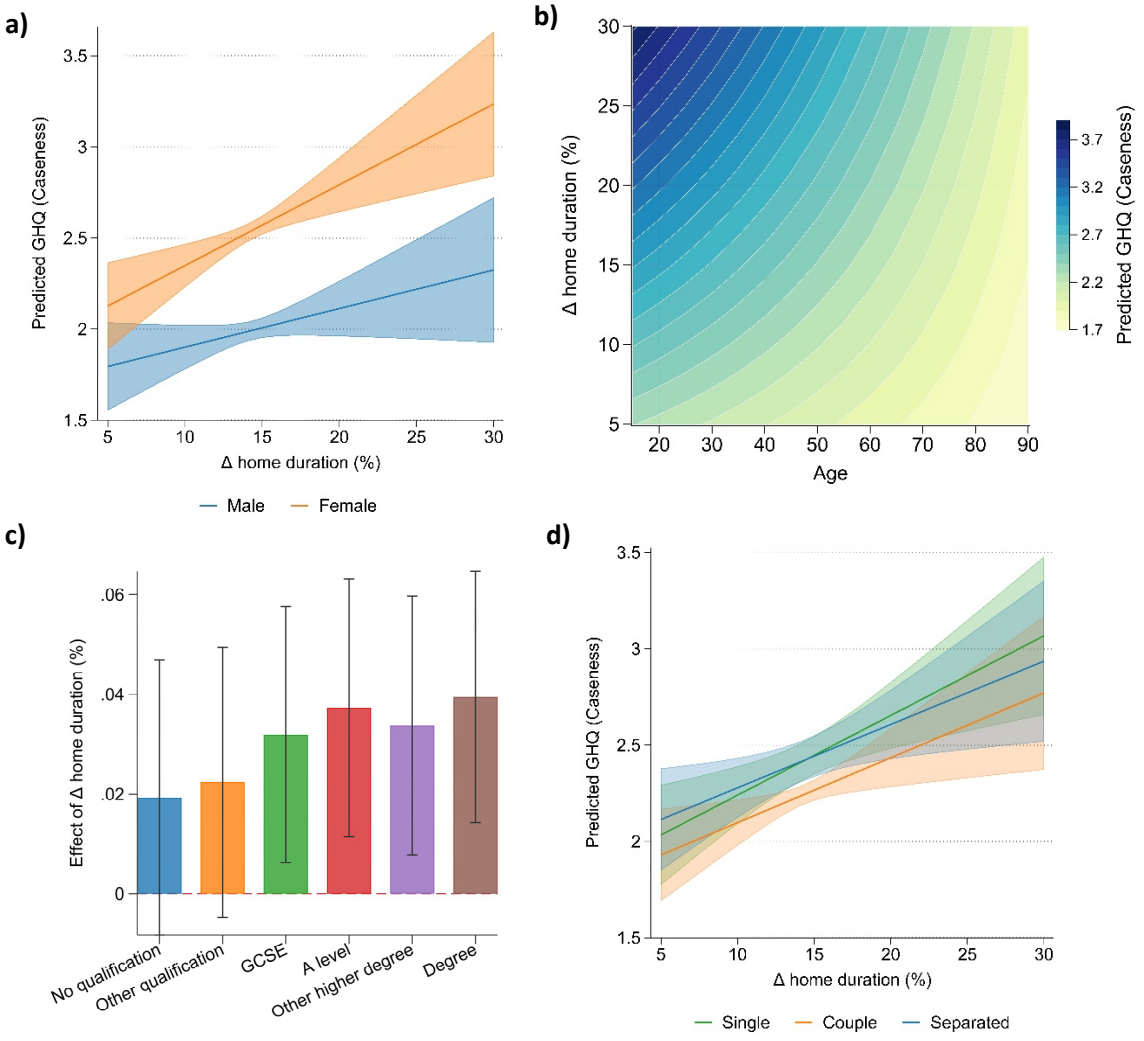


Figure 5. Heterogenous effect. a) Gender, **b**) Age, **c**) Education, **d**) Marital status. Error bars (panel c) and shared area (panel a and d) represent 95% confidence intervals.

In Table 3, we continue with the interactions of the change in time spent at home with the following independent variables: living in an urban area, home ownership, employment status, a measure of pre-existing mental health (pre-COVID), and an indicator for having a long-term illness. Those living in urban areas, the unemployed, and those who had a long-term illness before COVID-19 started are less affected by the change in mobility. Similarly, individuals with better pre-pandemic mental health suffered more by restrictions to mobility.

Table 3. Interactions with urbanity, home ownership, employment status, and other health conditions

Subjective wellbeing (GHQ): Caseness score	(6) *Live in rural area*	(7) *Home ownership*	(8) *Employment status*	(9) *Pre-existing mental health*	(10) *Long-term illness*
Δ home duration	0.037**	0.031*	0.040**	0.040**	0.043***
	(0.0128)	(0.0129)	(0.0128)	(0.0128)	(0.0128)
Live in rural area*Δ home duration	-0.0081**				
	(0.00301)				
Mortgage*Δ home duration		0.014***			
		(0.00287)			
Renting*Δ home duration		0.0012			
		(0.00408)			
Unemployed*Δ home duration			-0.012***		
			(0.00280)		
Self-employed*Δ home duration			0.0041		
			(0.00479)		
Pre-COVID GHQ (Caseness score)*Δ home duration				-0.0014*	
				(0.000566)	
Long-standing illness*Δ home duration					-0.018***
					(0.00289)
Live in rural area	0.070	-0.047	-0.047	-0.046	-0.046
	(0.0589)	(0.0420)	(0.0420)	(0.0420)	(0.0420)
Mortgage	0.12*	-0.090	0.12*	0.12*	0.12*
	(0.0481)	(0.0627)	(0.0481)	(0.0481)	(0.0481)
Renting	0.34***	0.32***	0.34***	0.34***	0.34***
	(0.0619)	(0.0873)	(0.0618)	(0.0618)	(0.0618)
Unemployed	0.37***	0.37***	0.53***	0.37***	0.37***
	(0.0451)	(0.0451)	(0.0599)	(0.0451)	(0.0451)
Self-employed	0.22***	0.22***	0.16†	0.22***	0.22***
	(0.0571)	(0.0571)	(0.0889)	(0.0570)	(0.0571)
Pre-COVID GHQ (Caseness)	0.38***	0.38***	0.38***	0.40***	0.38***
	(0.00825)	(0.00825)	(0.00825)	(0.0121)	(0.00825)
Long-standing illness or impairment	0.48***	0.48***	0.48***	0.48***	0.75***
	(0.0414)	(0.0414)	(0.0414)	(0.0414)	(0.0587)
Constant	1.08***	1.17***	1.03***	1.04***	0.99***
	(0.301)	(0.302)	(0.301)	(0.300)	(0.300)
Control	Yes	Yes	Yes	Yes	Yes
Region fixed-effects	Yes	Yes	Yes	Yes	Yes
Wave fixed-effects	Yes	Yes	Yes	Yes	Yes
N	109865	109865	109865	109865	109865
N (cluster)	17141	17141	17141	17141	17141
R^2-*within*	0.019	0.020	0.019	0.019	0.020
R^2-*between*	0.259	0.259	0.259	0.259	0.259
R^2-*overall*	0.184	0.184	0.184	0.184	0.184
Prob. > *F.*	0.000	0.000	0.000	0.000	0.000

Notes: Control variables include *COVID positive*, *age*, *gender*, *marital status, living with partner, education, household composition*, *COVID case statistics*, and *stringency index.* Standard errors (clustered at individual level) in parentheses. † $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$.

Similar to Figure 5, we also graphically represent these results in Figure 6. Those who are paying off a mortgage and renting – perhaps because of increased financial pressure – show a larger deterioration in their mental health than those who own their domicile (Figure 6a). The self-employed are also more adversely affected than those who are employed, and the unemployed are hardly affected

at all (Figure 6b). Across the range of the change in home duration, the effect of restrictions to mobility on mental health is less for those who have previous mental health issues or long-term illness (Figure 6c and 6d).

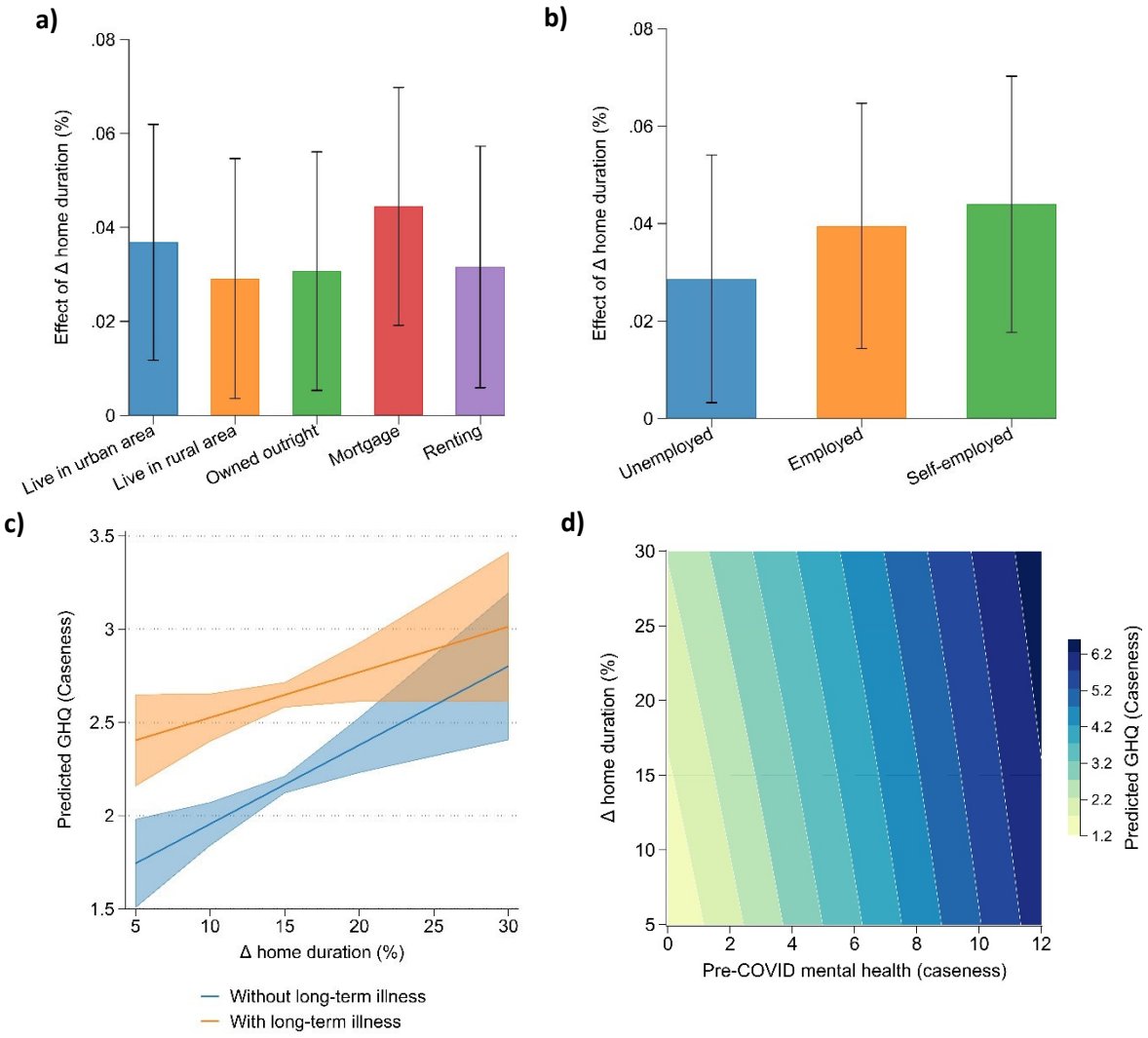


Figure 6. Heterogenous effect2. a) Home ownership and living area, **b**) Employment status during COVID-19, **c**) Long-standing illness or impairment, **d**) Pre-existing mental health issue. Error bars (in panel a and b) and shared area (panel c) represent 95% confidence intervals.

In Figure 7, we graphically represent the estimated coefficients on three-way interactions of mobility, gender, and age group (Figure 7a) and mobility, gender, and an indicator for having a child aged 5–15 in the household (Figure 7b). Younger women are more adversely affected than younger men, although the size of the differential declines as we move to older age groups. In addition, having

a child in the household amplifies the negative relationship between mental health and being female during periods of increased mobility restrictions.

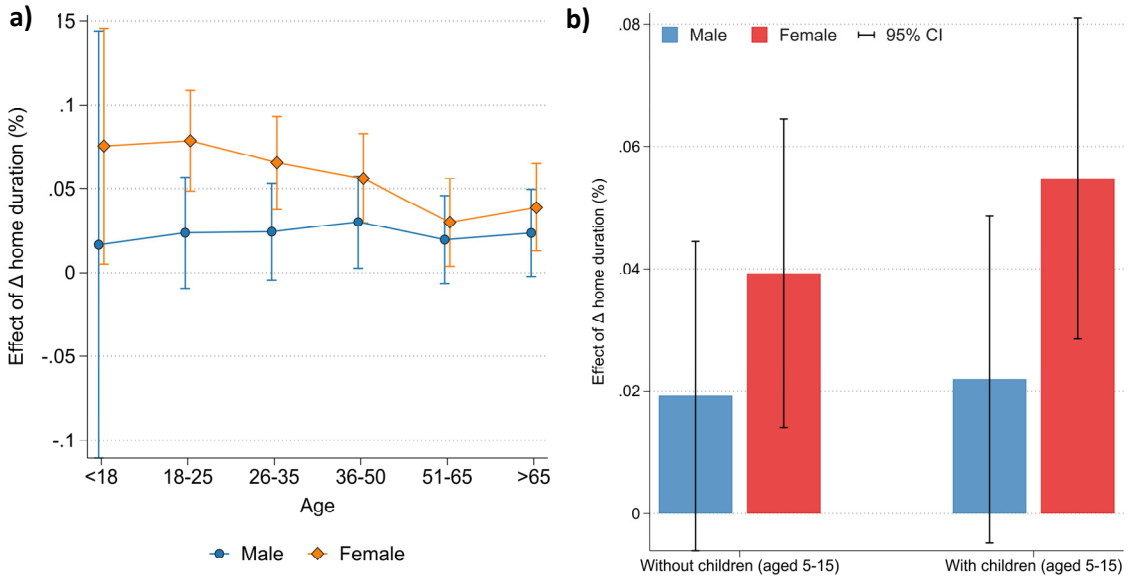


Figure 7. Three-way interaction of mobility, sex, and age group (a) and mobility, sex, and having a child aged 5–15 in the household (b). Error bars represent 95% confidence intervals.

These estimates show how change in average human movement impact the *average* mental health outcome. The main limitation of this approach is that, especially when we interpret interaction effects, the underlying assumption is that the movement change is of the same magnitude for the whole population. This is unlikely to be the case, as older people or people with long term illnesses were less mobile, even before the pandemic started. Therefore, caution should be used when interpreting these estimates, as this type of measurement error could create attenuation bias in the results, which could overestimate the effects for groups of individuals whose movement change is less than the population average, and underestimate the effects for those whose mobility was higher.

However, the negative impact of lack of mobility may arise from several sources, apart from restrictions to individuals' movement. For example, it is possible that the lack of mobility in the society, which is in turn reflected in decrease in available services and overall social interaction, may have a negative impact on individual wellbeing, in addition to the effects due to the restrictions on the individual mobility.

5. Discussion

The results of this study have considerable implications for the management of the current and future pandemics. Since the start of the pandemic, evidence on the adverse impact of lockdowns on subjective wellbeing has accumulated in the scientific literature, including the current manuscript. Although the evidence that lockdowns suppress the transmission of the disease is clear, it must be balanced against the real costs associated with mental health deterioration when physical human contact is limited via mobility restrictions.

In our study, we combined a robust measure of mental health – the GHQ Caseness score – with data from Google on mobility restrictions to track how mental wellbeing evolved during periods of lockdown and easing of restrictions in the UK. We demonstrated that the decline in mental health is significant, and that certain groups experienced significantly sharper deteriorations in mental health than others. Particularly noteworthy are the gender-based differences: women suffer more from mobility restrictions than men, and this is especially pronounced if there are small children in the household, perhaps reflecting the increased burden of domestic or at-home childcare faced by women when schools revert to remote learning. Household that are relatively more financially insecure are also at risk for further mental health distress, as well as those who are not partnered who may not have someone with whom to share the burdens of lockdown.

From a policy perspective – when lockdowns are unavoidable – it makes sense to attempt to limit the decline in mental health for the population under lockdown. Governments can invest in capacity to manage deteriorating mental health via increased funding for psychological support and counselling through telemedicine or online consultations, as well as the increased guarantee of job security and the provision of financial aid when people are unable to work. Schools can remain open for as long as possible to allow parents to both work at home without having to attend to childcare and to lessen the disruption in student learning, which may have longer-term impacts over the life course of the child and the mental wellbeing of the parents.

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Appendix

The General Health Questionnaire

List of questions

The next questions are about how you have been feeling over the last few weeks.

1. Have you recently been able to concentrate on whatever you're doing?
2. Have you recently lost much sleep over worry?
3. Have you recently felt that you were playing a useful part in things?
4. Have you recently felt capable of making decisions about things?
5. Have you recently felt constantly under strain?
6. Have you recently felt you couldn't overcome your difficulties?
7. Have you recently been able to enjoy your normal day-to-day activities?
8. Have you recently been able to face up to problems?
9. Have you recently been feeling unhappy or depressed?
10. Have you recently been losing confidence in yourself?
11. Have you recently been thinking of yourself as a worthless person?
12. Have you recently been feeling reasonably happy, all things considered?

Possible answers are : Not at all; No more than usual; Rather more than usual; Much more than usual

The GHQ Caseness score ranges from 0 to 12 and is constructed summing the number of times the individual places herself/himself in the most distressed category.

Supplementary Information

Figure S1. Mobility changes of the 12 UK regions from February 2020 to September 2021.

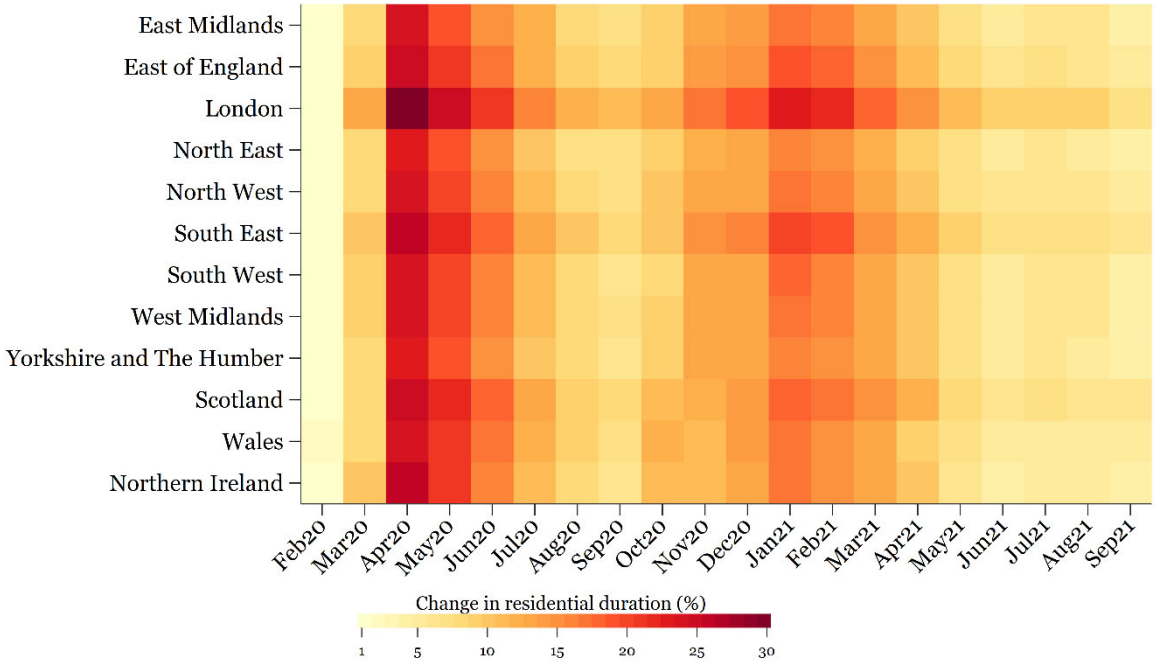

Figure S2. Government stringency level (OxCGRT) of UK countries from February 2020 to September 2021.

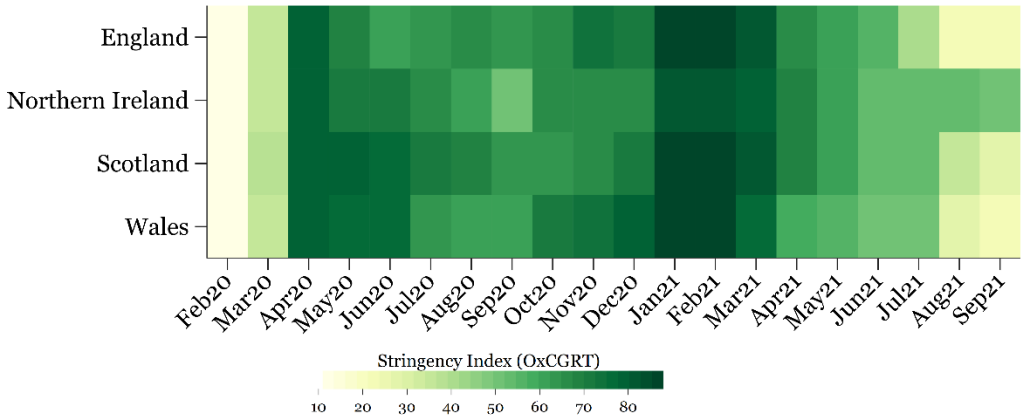

Table S1. Sample descriptive statistics

	Observation					*Individual*				
	N_{obs}	Mean/%	SD	Min	Max	N_{ind}	Mean/%	SD	Min	Max
Mental wellbeing (GHQ): Likert	117950	12.23	5.93	0	36	18625	12.46	5.24	0	36
Mental wellbeing (GHQ): Caseness	117950	2.30	3.35	0	12	18625	2.44	2.84	0	12
COVID-19 positive	122826	14.93%				19763	12.67%			
Age	122826	53.27	16.50	15	114	19763	50.27	17.15	15	114
Gender	122812					19761				
Male		41.40%					41.92%			
Female		58.60%					58.08%			
Marital status	120489					19208				
Single		23.38%					26.87%			
Married/civil partnership		61.22%					58.73%			
Separated/divorced/widowed		15.40%					14.40%			
Living with partner	122825	69.96%				19763	69.47%			
Education	120512					19247				
No qualification		4.20%					4.31%			
Other qualification		6.76%					6.70%			
GCSE		17.84%					18.34%			
A level		20.58%					21.27%			
Other higher degree		13.97%					13.57%			
Degree		36.66%					35.82%			
Living area	121347					19416				
Urban		73.92%					74.91%			
Rural		26.08%					25.09%			
Housing status	118468					18819				
Owned outright		41.86%					37.36%			
Mortgage		40.41%					42.31%			
Renting		17.73%					20.34%			
Employment	121128					18713				
Unemployed		41.49%					38.67%			
Employed		48.96%					51.42%			
Self-employed		9.55%					9.91%			
Household composition										
Aged 0-4	122825	0.10	0.35	0	2	19763	0.12	0.39	0	2
Aged 5-15	122825	0.32	0.69	0	3	19763	0.39	0.75	0	3
Aged 70 or older	122825	0.15	0.37	0	2	19763	0.15	0.39	0	2
Pre-COVID GHQ (Likert)	119195	11.22	5.44	0	36	18928	11.37	5.56	0	36
Long-standing illness or impairment	121208	0.35	0.48	0	1	19391	0.33	0.47	0	1

Notes: Mental wellbeing and COVID-19 positive indicator were averaged across all waves for summary statistics on the individual level.

Table S2. Mental wellbeing (GHQ): Likert

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Change in duration of time spent at home (%)	0.040***	0.044***	0.043***	0.032***	0.032***	0.068**	0.080***
	(0.00220)	(0.00226)	(0.00226)	(0.00309)	(0.00312)	(0.0206)	(0.0203)
COVID-19 positive		0.51***	0.48***	0.24***	0.25***	0.18**	0.17**
		(0.0572)	(0.0561)	(0.0580)	(0.0582)	(0.0590)	(0.0639)
Age		-0.038***	-0.029***	-0.032***	-0.032***	-0.033***	
		(0.00371)	(0.00328)	(0.00329)	(0.00329)	(0.00330)	
Female		1.32***	0.84***	0.84***	0.84***	0.83***	
		(0.0750)	(0.0642)	(0.0642)	(0.0642)	(0.0642)	
Marital status							
Married/civil partnership		-0.54***	-0.28**	-0.25*	-0.24*	-0.24*	
		(0.123)	(0.108)	(0.108)	(0.108)	(0.108)	
Separated/divorced/widowed		0.018	-0.026	0.022	0.026	0.037	
		(0.155)	(0.131)	(0.131)	(0.131)	(0.131)	
Living with partner		-0.48***	-0.35***	-0.35***	-0.35***	-0.34***	-0.23*
		(0.0803)	(0.0762)	(0.0761)	(0.0762)	(0.0763)	(0.0935)
Education							
No qualification		-0.081	-0.30†	-0.29†	-0.29†	-0.28	
		(0.214)	(0.173)	(0.173)	(0.173)	(0.173)	
Other qualification		-0.11	-0.14	-0.13	-0.13	-0.13	
		(0.173)	(0.142)	(0.142)	(0.143)	(0.143)	
A level		-0.038	0.051	0.041	0.036	0.034	
		(0.123)	(0.104)	(0.104)	(0.104)	(0.104)	
Other higher degree		0.076	0.18	0.19†	0.18	0.18	
		(0.134)	(0.113)	(0.113)	(0.113)	(0.113)	
Degree		0.040	0.19*	0.19*	0.19*	0.18*	
		(0.109)	(0.0932)	(0.0932)	(0.0938)	(0.0938)	
Live in rural area		-0.21**	-0.12†	-0.13†	-0.11	-0.11	
		(0.0830)	(0.0707)	(0.0707)	(0.0732)	(0.0732)	
Housing status							
Mortgage		0.61***	0.23**	0.20*	0.20*	0.20*	
		(0.0969)	(0.0834)	(0.0835)	(0.0835)	(0.0835)	
Renting		1.63***	0.66***	0.64***	0.64***	0.64***	
		(0.128)	(0.107)	(0.107)	(0.107)	(0.107)	
Employment							
Unemployed		0.92***	0.64***	0.64***	0.63***	0.63***	0.77***
		(0.0866)	(0.0802)	(0.0806)	(0.0806)	(0.0807)	(0.117)
Self-employed		0.25*	0.31**	0.31**	0.31**	0.30**	0.062
		(0.112)	(0.103)	(0.103)	(0.103)	(0.103)	(0.163)
Household composition							
Aged 0-4		-0.037	0.058	0.063	0.066	0.075	
		(0.0899)	(0.0839)	(0.0836)	(0.0837)	(0.0838)	
Aged 5-15		0.045	0.024	0.031	0.030	0.034	
		(0.0525)	(0.0478)	(0.0477)	(0.0477)	(0.0477)	
Aged 70 or older		-0.19**	-0.13†	-0.13†	-0.13†	-0.11	
		(0.0748)	(0.0698)	(0.0696)	(0.0697)	(0.0699)	
Pre-COVID GHQ (Likert)			0.47***	0.47***	0.47***	0.47***	
			(0.00820)	(0.00821)	(0.00822)	(0.00822)	
Long-standing illness or impairment			0.70***	0.72***	0.72***	0.72***	
			(0.0717)	(0.0717)	(0.0719)	(0.0719)	
Case per 1,000 people				1.00***	1.00***	0.23	0.34†
				(0.0720)	(0.0723)	(0.211)	(0.207)
Stringency index				0.0092***	0.0092***	0.0026	0.0015
				(0.000973)	(0.000980)	(0.00359)	(0.00352)
Constant	11.8***	12.7***	7.04***	6.63***	6.66***	6.33***	11.6***
	(0.0483)	(0.230)	(0.218)	(0.220)	(0.278)	(0.503)	(1.126)
Region FE	No	No	No	No	Yes	Yes	Yes
Wave FE	No	No	No	No	No	Yes	Yes
Individual FE	No	No	No	No	No	No	Yes
Observations	117134	111450	109865	109865	109865	109865	117062
Individuals (cluster)	18617	17454	17141	17141	17141	17141	18609
R^2-*within*	0.004	0.007	0.007	0.010	0.010	0.013	0.013
R^2-*between*	0.002	0.082	0.332	0.332	0.333	0.333	0.000
R^2-*overall*	0.002	0.063	0.254	0.255	0.255	0.256	0.001
Prob. > *F.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes: GLS regressions. Reference group: *Male, Single, Not living with a partner, Live in Urban area, Owned outright, Employed.* Standard errors (clustered at individual level) in parentheses. † $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$.

Table S3. Using past 14 days average instead of 7 days, for GHQ Caseness score

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Change in duration of time spent at home (%)	0.044***	0.045***	0.045***	0.044***	0.044***	0.036**	0.043**
	(0.00126)	(0.00130)	(0.00131)	(0.00176)	(0.00178)	(0.0134)	(0.0133)
COVID-19 positive		0.21***	0.20***	0.13***	0.14***	0.13***	
		(0.0343)	(0.0338)	(0.0348)	(0.0349)	(0.0354)	
Age		-0.018***	-0.014***	-0.015***	-0.015***	-0.015***	
		(0.00202)	(0.00187)	(0.00187)	(0.00187)	(0.00187)	
Female		0.74***	0.55***	0.55***	0.55***	0.55***	
		(0.0406)	(0.0367)	(0.0367)	(0.0367)	(0.0367)	
Marital status							
Married/civil partnership		-0.32***	-0.19**	-0.18**	-0.18**	-0.18**	
		(0.0679)	(0.0622)	(0.0622)	(0.0621)	(0.0621)	
Separated/divorced/widowed		0.0066	-0.014	0.00051	-0.0036	-0.0052	
		(0.0847)	(0.0752)	(0.0752)	(0.0753)	(0.0753)	
Living with partner		-0.29***	-0.21***	-0.21***	-0.21***	-0.21***	-0.16**
		(0.0457)	(0.0440)	(0.0440)	(0.0440)	(0.0440)	(0.0558)
Education							
No qualification		-0.24*	-0.32**	-0.31**	-0.32**	-0.31**	
		(0.114)	(0.0979)	(0.0979)	(0.0979)	(0.0978)	
Other qualification		-0.11	-0.14†	-0.13†	-0.13	-0.13	
		(0.0924)	(0.0801)	(0.0801)	(0.0802)	(0.0802)	
A level		-0.015	0.0053	0.0025	-0.00064	-0.00082	
		(0.0667)	(0.0596)	(0.0596)	(0.0596)	(0.0596)	
Other higher degree		0.077	0.094	0.095	0.092	0.092	
		(0.0733)	(0.0652)	(0.0652)	(0.0652)	(0.0652)	
Degree		0.18**	0.19***	0.19***	0.20***	0.20***	
		(0.0596)	(0.0535)	(0.0535)	(0.0538)	(0.0538)	
Live in rural area		-0.071	-0.044	-0.046	-0.046	-0.046	
		(0.0451)	(0.0405)	(0.0406)	(0.0420)	(0.0420)	
Housing status							
Mortgage		0.27***	0.12**	0.12*	0.12*	0.12*	
		(0.0531)	(0.0481)	(0.0481)	(0.0481)	(0.0481)	
Renting		0.76***	0.33***	0.33***	0.34***	0.34***	
		(0.0698)	(0.0617)	(0.0617)	(0.0619)	(0.0619)	
Employment							
Unemployed		0.54***	0.37***	0.37***	0.37***	0.37***	0.43***
		(0.0473)	(0.0450)	(0.0451)	(0.0451)	(0.0451)	(0.0663)
Self-employed		0.21***	0.22***	0.22***	0.22***	0.22***	0.049
		(0.0603)	(0.0569)	(0.0570)	(0.0570)	(0.0571)	(0.0927)
Household composition							
Aged 0-4		0.024	0.073	0.074	0.075	0.075	
		(0.0511)	(0.0493)	(0.0492)	(0.0492)	(0.0492)	
Aged 5-15		0.061*	0.062*	0.063*	0.062*	0.063*	
		(0.0291)	(0.0273)	(0.0273)	(0.0273)	(0.0273)	
Aged 70 or older		-0.10*	-0.072†	-0.071†	-0.070†	-0.071†	
		(0.0433)	(0.0412)	(0.0412)	(0.0412)	(0.0413)	
Pre-COVID GHQ (caseness)			0.38***	0.38***	0.38***	0.38***	
			(0.00825)	(0.00825)	(0.00825)	(0.00825)	
Long-standing illness or impairment			0.48***	0.49***	0.49***	0.49***	
			(0.0414)	(0.0414)	(0.0414)	(0.0414)	
Case per 1,000 people				0.31***	0.31***	0.19†	0.24*
				(0.0390)	(0.0391)	(0.108)	(0.105)
Stringency index				0.0014*	0.0013*	0.0014	0.00078
				(0.000579)	(0.000583)	(0.00227)	(0.00222)
Constant	1.74***	2.03***	1.18***	1.10***	1.14***	1.34***	2.00**
	(0.0275)	(0.125)	(0.115)	(0.117)	(0.152)	(0.313)	(0.675)
Region FE	No	No	No	No	Yes	Yes	Yes
Wave FE	No	No	No	No	No	Yes	Yes
Individual FE	No	No	No	No	No	No	Yes
Observations	117134	111450	109865	109865	109865	109865	117062
Individuals (cluster)	18617	17454	17141	17141	17141	17141	18609
R^2-*within*	0.015	0.017	0.017	0.018	0.018	0.019	0.019
R^2-*between*	0.005	0.078	0.258	0.258	0.259	0.259	0.001
R^2-*overall*	0.007	0.057	0.183	0.183	0.184	0.184	0.002
Prob. > *F.*	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes: GLS regressions. Reference group: *Male, Single, Not living with a partner, Live in Urban area, Owned outright,* and *Employed.* Standard errors (clustered at individual level) in parentheses. † $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$.

Table S4. SE cluster at region level and region*wave; DV=caseness

SE cluster level	Region				Region*Wave			
Dep. Var.	Caseness		Likert		Caseness		Likert	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Change in duration of time spent at home (%)	0.037**	0.040*	0.068**	0.080*	0.037***	0.040***	0.068***	0.080***
	(0.0115)	(0.0156)	(0.0217)	(0.0298)	(0.0110)	(0.0118)	(0.0205)	(0.0221)
COVID-19 positive	0.13***	0.11**	0.18***	0.17**	0.13***	0.11***	0.18***	0.17***
	(0.0241)	(0.0255)	(0.0373)	(0.0426)	(0.0278)	(0.0297)	(0.0453)	(0.0484)
Age	-0.015***		-0.033***		-0.015***		-0.033***	
	(0.00186)		(0.00325)		(0.00216)		(0.00340)	
Female	0.56***		0.83***		0.56***		0.83***	
	(0.0409)		(0.0558)		(0.0536)		(0.0879)	
Marital status								
Married/civil partnership	-0.18*		-0.24*		-0.18**		-0.24*	
	(0.0732)		(0.117)		(0.0615)		(0.111)	
Separated/divorced/widowed	-0.0047		0.037		-0.0047		0.037	
	(0.0757)		(0.123)		(0.0663)		(0.113)	
Living with partner	-0.21***	-0.16**	-0.34***	-0.23*	-0.21***	-0.16**	-0.34***	-0.23*
	(0.0501)	(0.0495)	(0.0646)	(0.0840)	(0.0438)	(0.0531)	(0.0719)	(0.0927)
Education								
No qualification	-0.31**		-0.28		-0.31***		-0.28†	
	(0.111)		(0.207)		(0.0933)		(0.163)	
Other qualification	-0.13*		-0.13		-0.13†		-0.13	
	(0.0637)		(0.139)		(0.0779)		(0.140)	
A level	-0.00088		0.034		-0.00088		0.034	
	(0.0606)		(0.100)		(0.0621)		(0.106)	
Other higher degree	0.092†		0.18*		0.092		0.18	
	(0.0500)		(0.0880)		(0.0714)		(0.128)	
Degree	0.20***		0.18*		0.20***		0.18†	
	(0.0502)		(0.0937)		(0.0556)		(0.0955)	
Live in rural area	-0.047		-0.11		-0.047		-0.11	
	(0.0535)		(0.0963)		(0.0470)		(0.0778)	
Housing status								
Mortgage	0.12*		0.20*		0.12*		0.20*	
	(0.0490)		(0.0778)		(0.0513)		(0.0918)	
Renting	0.34***		0.64***		0.34***		0.64***	
	(0.0581)		(0.117)		(0.0735)		(0.129)	
Employment								
Unemployed	0.37***	0.43***	0.63***	0.77***	0.37***	0.43***	0.63***	0.77***
	(0.0516)	(0.0824)	(0.0948)	(0.132)	(0.0414)	(0.0600)	(0.0751)	(0.107)
Self-employed	0.22***	0.048	0.30**	0.062	0.22***	0.048	0.30**	0.062
	(0.0661)	(0.0997)	(0.103)	(0.160)	(0.0537)	(0.0791)	(0.0921)	(0.137)
Household composition								
Aged 0-4	0.075		0.075		0.075		0.075	
	(0.0705)		(0.125)		(0.0521)		(0.0854)	
Aged 5-15	0.063*		0.034		0.063*		0.034	
	(0.0284)		(0.0433)		(0.0313)		(0.0512)	
Aged 70 or older	-0.071		-0.11		-0.071		-0.11	
	(0.0468)		(0.0656)		(0.0456)		(0.0801)	
Pre-COVID GHQ	0.38***		0.47***		0.38***		0.47***	
	(0.00983)		(0.00745)		(0.0101)		(0.00949)	
Long-standing illness or impairment	0.49***		0.72***		0.49***		0.72***	
	(0.0585)		(0.0908)		(0.0487)		(0.0826)	
Case per 1,000 people	0.22†	0.27†	0.23	0.34	0.22†	0.27*	0.23	0.34
	(0.117)	(0.124)	(0.199)	(0.218)	(0.119)	(0.126)	(0.212)	(0.222)
Stringency index	0.0019	0.0014	0.0026	0.0015	0.0019	0.0014	0.0026	0.0015
	(0.00217)	(0.00274)	(0.00387)	(0.00485)	(0.00197)	(0.00223)	(0.00332)	(0.00374)
Constant	1.31***	2.05***	6.33***	11.6***	1.31***	2.05***	6.33***	11.6***
	(0.248)	(0.433)	(0.441)	(0.669)	(0.249)	(0.496)	(0.455)	(0.866)
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wave FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE	No	Yes	No	Yes	No	Yes	No	Yes
Observations	109865	117062	109865	117062	109865	117062	109865	117062
Individuals (cluster)	12	12	12	12	108	108	108	108
R^2-*within*	0.019	0.019	0.013	0.013	0.019	0.020	0.013	0.013
R^2-*between*	0.259	0.001	0.333	0.000	0.259	0.001	0.333	0.000
R^2-*overall*	0.184	0.002	0.256	0.001	0.184	0.003	0.256	0.001

Notes: GLS regressions. Reference group: *Male, Single, Not living with a partner, Live in Urban area, Owned outright, Employed.* Standard errors in parentheses. † $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$.