Mental health inequalities in healthcare, economic, and housing disruption during COVID -19: an investigation in 12 longitudinal studies

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Abstract

Background: The COVID-19 pandemic and its associated virus suppression measures have disrupted lives and livelihoods, potentially exacerbating inequalities. People already experiencing mental ill-health may have been especially vulnerable to disruptions.

Aim: Investigate associations between pre-pandemic psychological distress and disruptions during the pandemic to (1) healthcare, economic activity, and housing, (2) cumulative disruptions and 3) whether these differ by age, sex, ethnicity or education.

Methods: Data were from 59,482 participants in 12 UK longitudinal adult population surveys with data collected both prior to and during the COVID-19 pandemic. Participants self-reported disruptions since the start of the pandemic to: healthcare (medication access, procedures, or appointments); economic activity (negative changes in employment, income or working hours); and housing (change of address or household composition). Logistic regression models were used within each study to estimate associations between pre-pandemic psychological distress scores and disruption outcomes. Findings were synthesised using a random effects meta-analysis with restricted maximum likelihood.

Results: Between one to two-thirds of study participants experienced at least one disruption during the pandemic, with 2.3-33.2% experiencing disruptions in 2 or more of the 3 domains examined. One standard deviation higher pre-pandemic psychological distress was associated with: (i) increased odds of any healthcare disruptions (OR=1.30; 95% CI: 1.20 to 1.40) with fully adjusted ORs ranging from 1.33 [1.20 to 1.49] for disruptions to prescriptions or medication access and 1.24 [1.09 to 1.41] for disruption to procedures; (ii) loss of employment (OR=1.13 [1.06 to 1.21]) and income (OR=1.12 [1.06 to 1.19]) and reductions in working hours/furlough (OR=1.05 [1.00 to 1.09]); (iii) no associations with housing disruptions (OR=1.00 [0.97 to 1.03]); and (iv) increased likelihood of experiencing a disruption in at least two domains (OR=1.25 [1.18 to 1.32]) or in one domain (OR=1.11 [1.07 to 1.16]) relative to experiencing no disruption. We did not find evidence of these associations differing by sex, ethnicity, education level, or age.

Conclusion: Those suffering from psychological distress before the pandemic were more likely to experience healthcare disruptions, economic disruptions related to unemployment and loss of income, and to clusters of disruptions across multiple domains during the pandemic. Considering mental ill-health was already unequally distributed in the UK population, the pandemic may exacerbate existing mental health inequalities. Individuals with poor mental health may need additional support to manage these pandemic-associated disruptions.

Introduction

The COVID-19 pandemic and consequent mitigation measures have led to notable changes to routine healthcare delivery, economic participation, and housing circumstances in many countries. There is extensive evidence that the negative impacts of the pandemic disproportionately affect certain socio-demographic groups (e.g., socio-economically disadvantaged, ethnic minorities, younger generations, and women) (1). Individuals with poor mental health may be at particular risk of these disruptions during the pandemic, further widening pre-existing mental health inequalities in a wide range of health, social and economic outcomes (2, 3).

Mental health conditions like depression and anxiety are widespread in the population with one in six adults estimated to suffer from these conditions at any given time (4). People with prior mental health difficulties have experienced higher risk for COVID-19 related adverse outcomes including greater risk of infection, severe disease, and mortality (5). In addition, these individuals had already experienced greater risk of social and health inequalities prior to the pandemic (6, 7). Moreover, recent evidence suggests they are less likely to be vaccinated, further increasing the risk of infection-related adverse outcomes for this group (8). There has been less investigation of whether non-infection related outcomes of the pandemic - such as healthcare, economic and housing disruptions – have been differentially experienced by those with prior mental ill-health. Evidence from previous disruptive events, such as economic recessions, highlights greater negative consequences for those with mental ill-health (9).

This study investigates the extent to which pre-pandemic psychological distress (symptoms of anxiety and depression) was associated with experiences of healthcare, economic, and housing disruptions in the UK during the COVID-19 pandemic. We examine whether this association differs between socio-demographic groups based on sex, age, ethnicity, and socio-economic position. We also examine the prevalence of, and mental health impacts on, cumulative disruptions, as people who face adverse disruptions in multiple domains are likely to have poorer longer-term outcomes. We use data from over 59,000 participants across 12 UK population-based longitudinal studies with rich pre-pandemic socio-demographic and health measures as well as detailed information about disruptions during the pandemic.

Methods

Participants

Data were drawn from 12 UK population studies which conducted surveys both before and during the COVID-19 pandemic. Details of the design, sample frames, current age range, timing of the most recent pre-pandemic and COVID-19 surveys, response rates, and analytical sample size are available in Table 1. Demographic and socio-economic characteristics of each analytical sample are presented in Table S1.

Six of these were age homogenous birth cohorts (all individuals similar age): the Millennium Cohort Study (MCS; 10); the Avon Longitudinal Study of Parents and Children (ALSPAC G1; 11); Next Steps (NS, formerly known as the Longitudinal Study of Young People in England; 12); the 1970 British Cohort Study (BCS; 13), the National Child Development Study (NCDS; 14); and the National Survey of Health and Development (NSHD; 15).

Six age heterogeneous studies (covering a range of age groups) were included: Understanding Society (USoc; 16); the English Longitudinal Study of Ageing (ELSA; 17); Generation Scotland: the Scottish Family Health Study (GS; 18, 19); the UK Adult Twin Registry (TWINS; 20); the Genetic Links to Anxiety and Depression study (GLAD; 21), which is a cohort of those with poor mental health; and the parents of the ALSPAC-G1 cohort (ALSPAC-G0)(22).

Analytical samples were defined within each study based on the following eligibility criteria: those who had a measure of psychological distress in a recent pre-pandemic survey, had information available for at least one outcome in a COVID-19 survey, and had valid data on a minimum set of covariates (sex, ethnicity, socio-economic position, and age). Each study was weighted to be representative of its target population, accounting for sampling design, attrition up to the most recent pre-pandemic survey, and differential non-response to the COVID-19 surveys (23-25).

Measures

Below we describe the overall approach to measuring each variable in the analysis. Full details of the questions and coding used within each cohort are available in supplementary file 1.

Exposure: Pre-pandemic psychological distress

All studies measured psychological distress in the most recent pre-pandemic survey using validated continuous scales (e.g., GHQ-12 in NS and USOC; GHQ-28 for NSHD and GS; Malaise Inventory in NCDS and BCS70; K-6 in MCS; and CES-D in ELSA). Each scale was transformed into standard deviation units (z-scores) within each cohort, and we conducted additional analyses using dichotomous variables based on established cut-offs for each measure. See Table S2 for details of each measure, including when last collected, its distribution (mean, range, and standard deviation), and the percentage with high psychological distress in each study.

Outcomes

Outcomes were disruptions, separated into three broad domains: healthcare, economic, and housing. For healthcare, we assessed reported disruptions to: prescriptions or medication

access; procedures or surgery; and appointments (e.g., with a GP or outpatient services). Any deviation from planned/existing treatment was coded as a disruption, regardless of the reason for the disruption. In the economic domain we assessed disruptions to: usual economic activity (i.e., education/training, occupations); job loss; loss of income; or any changes in working hours, including furlough. Housing disruptions included: any loss of housing or change of address; and any changes in household composition (i.e., who they live with). We generated variables indicating any disruption within each domain, and the number of domains in which disruptions had occurred: no disruptions, disruption in one domain, or disruptions in two or more domains. Where multiple survey waves had been conducted during the pandemic, we assessed disruptions reported up to and including the most recent survey.

Other variables

We examined modification by sex (female, male), ethnicity (White, non-White ethnic minority; in cohorts where possible), socio-economic position measured by highest education level (degree, no-degree) and age (16-24; 25-34; 35-44; 45-54; 55-64; 65-74; 75+). Age homogeneous cohorts were included in their corresponding age band.

The following covariates were included where relevant and available within each study: UK nation (i.e., England, Scotland, Wales, or Northern Ireland); partnership status (single or couple); presence of children in the household; housing tenure (owned/mortgage or rented/other); own occupational class (or parental occupational class for younger cohorts; four categories: managerial/professional; intermediate; routine; or never worked/not available/long-term non-employed); prior chronic conditions or illness (yes or no); and an indicator of physical disability (yes or no).

Analysis

Within each study, the association between each binary disruption outcome and standardised pre-pandemic psychological distress was examined using logistic regression. Following unadjusted associations, we adjusted for a minimal set of confounders across all studies, including, where relevant: age, sex, ethnicity, education, and UK nation (adjustment 1). Subsequently, we further adjusted for partnership status, presence of children, housing tenure, occupational class, prior chronic conditions, and physical disability (adjustment 2). Modification was assessed with stratified regressions predicting any disruption in each domain, and the minimal adjustment set (for optimal comparability across studies). As an additional sensitivity analysis, the non-stratified models predicting any disruption in each domain were repeated using established categorical cut-offs (reflecting high psychological distress symptoms) as the exposure. Details of the cut-off points used are available in Supplementary File 2.

Results from each study were then meta-analysed for each outcome for the full sample and then stratified by sex, education level, ethnicity, and age. We used a random effects meta-analysis with restricted maximum likelihood. We report heterogeneity using the I^2 statistic (26). Meta-analyses were conducted in Stata 16 (27).

Results

Descriptive Statistics

Between 7% (TWINS) and 24% (NS) of participants from the population-based cohorts and 54% of participants in GLAD (reflecting their recruitment of those with mental health difficulties) reported high psychological distress prior to the pandemic. As expected, the prevalence of psychological distress was generally higher among women, those without a degree, and younger age groups (see Supplementary Tables S3-S5 for full details). Table 2 shows the percentage of respondents who reported disruptions: this ranged from <10% (MCS, GLAD and TWINSUK) to 37% (ELSA) for healthcare; from 10% (NSHD) to 51% (USOC) for the economic domain; and from 2% (NSHD) to 36% (MCS) for housing. Between 28% (NSHD) and 77% (USOC) of study participants experienced at least one of these disruptions during the pandemic (see supplementary Table 5 for outcome descriptives by sex, ethnicity, education level and age group).

Pre-pandemic psychological distress and disruptions during the pandemic

The associations between standardised psychological distress and each outcome are illustrated in Figure 1. Table 3 shows the meta-analysed estimates for each outcome from the unadjusted, adjustment 1 and adjustment 2 models, and the heterogeneity in estimates (details of coefficients from each cohort and their weight in the meta-analysis for each outcome are available in supplementary file 3). Heterogeneity was lower in meta-analyses with greater adjustment and ranged from 0% to 66.8% across the different outcomes examined for the fully adjusted estimates.

In fully adjusted models, one standard deviation higher psychological distress was associated with increased odds of any healthcare disruptions (OR 1.30 [95% CI: 1.20-1.40]) with ORs ranging from 1.24 to 1.33 for the different healthcare outcomes examined. ORs for each study were consistently >1 for all outcomes with a few exceptions, however, a substantial range was observed. For instance, ORs were between 1.03 and 1.53 for any healthcare disruption for the population representative cohorts, but higher (OR=2.18) in GLAD, which is a convenience sample with a higher proportion of participants with prior mental health difficulties.

For economic disruptions overall, one standard deviation higher distress was associated with higher likelihood of experiencing any economic disruption (OR=1.11 [1.05-1.16]), with associations found for loss of employment (OR= 1.13 [1.06-1.21]) and income (OR=1.12

[1.06-1.19]), and a smaller effect for reductions in working hours or furlough (OR= 1.05 [1.00 -1.09]). Some study-based differences were observed here, which likely reflect age-based differences. For instance, there were no observed associations with employment loss in older studies such as ELSA and NSHD, perhaps reflecting the lower proportions working post retirement age and the likelihood of those with good mental health to be in this group.

There was no consistent evidence that prior mental health was associated with housing disruptions (OR= 1.01 (0.97, 1.05).

Prior mental health was associated with an increased likelihood of experiencing a disruption in at least two domains (OR=1.25; 95%CI: 1.18, 1.32) or in one domain (OR=1.11; 95%CI: 1.07, 1.16) relative to experiencing no disruption.

Stratified analyses

We examined effect modification in the associations between prior mental health and overall disruptions and found no evidence that associations differed by sex, education level, age or ethnicity (Table 4).

Additional analysis

We conducted an additional analysis with a pre-pandemic binary indicator of high psychological distress. This was based on measure-specific cut-off scores which indicate clinical levels of distress (see results in supplementary file 3). Overall, findings were similar to those seen with continuous measures, with the largest associations seen for healthcare disruptions followed by economic and no associations for housing. However, owing to the different distribution and meaning of the dichotomised exposure, the observed effect sizes vary. Based on this binary exposure, high psychological distress was associated with an increased likelihood of experiencing disruptions in at least two domains OR 1.46 (1.28, 1.67) compared to OR 1.18 (1.04, 1.33) in one domain.

Discussion

In our co-ordinated analysis of data from 12 UK-based longitudinal cohort studies, we found people with poor pre-pandemic mental health have experienced greater disruption to their lives across multiple domains. More specifically, (i) prior mental ill-health was associated with greater likelihood of all examined healthcare disruptions (24-33% greater odds), economic disruptions (5-13% greater odds) and not associated with housing disruptions, (ii) the impact of prior mental ill-health on these outcomes was not different by sex, education, age or ethnicity, though pre-pandemic psychological distress was generally more common among women, younger generations, ethnic minorities, and those with fewer qualifications, and (iii) prior mental ill-health was associated with greater likelihood of disruptions in

multiple domains with an 11% increased risk of disruption in one domain, and 28% greater risk of disruptions in two or three domains.

Healthcare disruptions have been widespread in the UK with numbers of treatments for non-COVID-19 illness dropping by millions compared to previous years (28). There has been a substantial decrease in the number of people attending A&E services (29), and reports of difficulties and delays accessing medication(30, 31). Reporting of healthcare disruptions ranged from around under 10% to 37% across the included studies; this wide range may reflect both true gradients by age, and differences in sampling and assessment measures used (32). Disruptions associated with prior mental ill-health included around a 24% greater odds of missed appointments and procedures and 33% greater odds of interruptions to prescriptions or medication access. Information on reasons for disruptions to healthcare access was not consistently available across studies, and could include: patients or providers cancelling appointments, individuals being unable to rebook appointments, or being faced with complexities in the requirements for rebooking appointments or changing healthcare needs. Disruptions to healthcare are problematic both due to their potential longer term adverse impacts on health outcomes and potential stress involved. Our finding that these were disproportionately faced by those with prior mental ill-health highlights the risk of widening these prior inequalities in health outcomes, both during and after the pandemic. Socio-demographic inequalities in healthcare access during the pandemic have been recorded across different data sources. Women, ethnic minorities, and those living in more deprived areas were more likely to experience healthcare disruptions (33, 34) and prior mental health might help explain some of these observed socio-demographic inequalities. Furthermore, since women, ethnic minorities, and those with less education were more likely to have experienced psychological distress before the pandemic, these mental health related disruptions to healthcare may also widen prior social inequalities in health.

The pandemic has also impacted economic activity, with large numbers of people losing jobs, being put on furlough, and experiencing drops in household incomes (35, 36). Around 20-60% of working age cohorts reported disruptions to economic activity. As expected, this was lower in retired cohorts (e.g., 10% in the NSHD cohort who are now 75 years old). Prior mental ill-health increased the likelihood of disruption by 10% to main economic activity, 13% to loss of employment, 12% to loss of income and 5% reductions in working hours or furlough. We did not examine potential positive economic outcomes such as starting a new business or increases in income or working hours. It is possible that there are differences in the ability of those with mental health difficulties to have economically benefitted or coped with additional or changed work demands during the pandemic. Younger workers, ethnic minorities, and females have been more likely to be in disrupted sectors and become unemployed or furloughed (37). Younger workers have been more likely to lose their jobs and report drops in income than older workers, reflecting their already more precarious

labour market situation (36). However, the association between prior mental health and poorer economic outcomes were not different across age and other socio-demographic groups. Again, given the socio-demographic inequalities in pre-pandemic mental health, this highlights how the pandemic may widen existing mental health and socio-demographic inequalities.

With overcrowded housing increasing risk of COVID-19 transmission, disparities in housing disruption are likely to have impacts on risk of COVID-19 infection and other poor health and economic outcomes (38). Although there have been reported changes in individuals' housing situations during the pandemic, with evidence of younger people moving themselves, and older adults having people move into their households (39), we find no associations in the risk of housing disruptions with prior mental health in this study. This might alter in the medium and longer term as consequences of the economic and health disruptions are realised, and should be monitored.

Across the included cohorts, around 25-45% of individuals reported at least one kind of disruption, with a further 2-30% across cohorts experiencing two out of three, and a smaller proportion (0.2-6.5%) experiencing all three. The heightened risk for clusters of disruptions for those with psychological distress may be largely due to the increased risk of disruptions to healthcare, economic activity and income, as that combined with no difference in risk for housing disruptions will still mean clusters of disruptions are more likely. Furthermore, adverse outcomes may cluster, for example, with housing disruption resulting from employment loss, or those with poor mental health being more likely to experience healthcare disruptions as a result of moving home and general practice (39). Multiple adverse disruptions are also potentially stressful and more predictive of poorer prognosis longer term (40). We found that those with prior mental ill-health were more likely to suffer multiple disruptions, highlighting the need for inter-agency working in supporting those with mental ill-health.

Strengths and Limitations

The analysis of longitudinal cohorts with rich pre-COVID-19 information is an important strength of this study. Although many COVID-era online studies are available, the lack of pre-pandemic information makes it difficult to untangle the directions of associations between mental health and other outcomes. This study is also strengthened by the co-ordinated investigation in multiple longitudinal studies with differing study designs, different target populations, and varying selection and attrition processes. Heterogeneity in our meta-analysed estimates were often reduced when considering models with a greater number of possible confounders, highlighting the importance of adjusting for relevant pre-pandemic characteristics as appropriate for different generations and cohorts.

Differences between studies in a range of factors including measurement of mental health and outcomes, timing of surveys, design, response rates, and differential selection into the COVID-19 sweeps are potentially responsible for large heterogeneity in estimates. However, despite this heterogeneity, the key findings are fairly consistent across most datasets. The differences might also be positively construed as allowing for replication and triangulation of findings that are robust to these intrinsic differences between studies. Furthermore, this heterogeneity can be informative, for example, by virtue of the mix of age-specific and age-range cohorts we could determine that the observed association between pre-pandemic psychological distress and disruptions does not differ by age.

Implications and conclusions

Our findings highlight that people with prior mental ill-health were more likely to suffer negative economic and healthcare consequences in the first 8-10 months of the pandemic, highlighting the need for policymakers to take this into account when provisioning current and post-pandemic health, economic and well-being support. For instance, processes for re-booking healthcare procedures or accessing economic support should ensure that people struggling with mental health difficulties do not face additional barriers to accessing resources. Primary care practitioners and pharmacists should monitor patients with known mental health difficulties to ensure they do not miss appointments, procedures or prescriptions.

Individuals with mental health difficulties are more likely to have experienced adverse healthcare, economic and housing outcomes before the pandemic (7, 9). Given the far greater frequency of these disruptions in the population during COVID-19, the impacts on those with prior mental ill-health will have been consequently larger.

Individuals with more severe mental disorders (e.g. schizophrenia, eating disorders), may have experienced even greater adversity from these disruptions, particularly in housing and economic domains. However, low prevalence of severe disorders generally leaves population-based-samples underpowered to infer about such conditions. Efforts to understand the impacts of the pandemic on those with more severe mental disorders is lacking, but needed. Current evidence suggests that they are at even greater risk of COVID-19 infection, mortality and non-vaccination uptake (5, 8).

Our findings highlight that the adverse socio-economic and health impacts of the pandemic have been disproportionately faced by those with prior mental ill-health, who are more likely to be women, those without a degree, and younger generations. The pandemic has the potential to increase social exclusion and widen existing physical health and economic inequalities amongst those with mental health problems, and mitigating this should be a

public health priority. Ongoing monitoring is needed to get a full picture of the health and socio-economic implications of the pandemic for those with mental health difficulties.

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Studies:

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Transparency declaration

PP is the guarantor of this manuscript and affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

Author Contribution Statement

Patalay, Porteous, and Chaturvedi conceptualised the study and design. Patalay, Green, Thompson, Di Gessa, McElroy, Maddock, Katikireddi, Niedzwiedz, Griffith, Kwong, and Silverwood designed the methodology. Green, Thompson, Di Gessa, McElroy, Maddock, Stevenson, Davies, Mundy, Griffith, and Kwong conducted the formal analysis. Green, Thompson, Di Gessa, McElroy, Maddock, Stevenson, Griffith, Kwong, Steves, Chaturvedi, Henderson, and Fitzsimons were responsible for data curation. Patalay, Green, Di Gessa, and Maddock wrote the original draft of the manuscript. All authors contributed to critical revision of the manuscript. Thompson, Di Gessa, Maddock contributed to data visualisation. The project was supervised by Patalay, Porteous, and Katikireddi. Funding was acquired by Patalay, Katikireddi, Breen, Porteous, Steptoe, Ploubidis, Silverwood, Steves and Chaturvedi.

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Table 1. Details of each included study

Study Population	Design and Sample Frame	2020 Age Range in years	Most recent pre-pandemic survey	Details of 2020 covid surveys (response rate)	Analytic N
Age Homogenous Cohorts					
MCS: Millennium Cohort Study	Cohort of UK children born between Sept 2000 and Jan 2002 with regular follow-up surveys from birth.	18-20	2018	Two surveys: May (26.6%) & Sep-Oct (24.2%)	3028
ALSPAC (G1): Avon Longitudinal Study of Parents and Children-Generation 1	Cohort of children born in the South-West of England between April 1991 and Dec 1992, with regular follow-up surveys from birth. (original young people)	27-29	2017-2018	Three surveys: April (19%), June (17.4%), December (26.4%)	2698
NS: Next Steps, formerly known as Longitudinal Study of Young People in England	Sample recruited via secondary schools in England at around age 13 with regular follow-up surveys thereafter.	29-31	2015	Two surveys: May (20.3%) & Sep-Oct (31.8%)	3209
BCS70: British Cohort Study 1970	Cohort of all children born in Great Britain (i.e. England, Wales & Scotland) in one week in 1970, with regular follow-up surveys from birth.	50	2016	Two surveys: May (40.4%) & Sep-Oct (43.9%)	4303
NCDS: National Child Development Study	Cohort of all children born in Great Britain (i.e. England, Wales & Scotland) in one week in 1958, with regular follow-up surveys from birth.	62	2013	Two surveys: May (57.9%) & Sep-Oct (53.9%)	5394
NSHD: National Survey of Health and Development	Cohort of all children born in Great Britain (i.e. England, Wales & Scotland) in one week in 1946, with regular follow-up surveys from birth.	74	2015	Two surveys: May (68.2%) & Sep-Oct (61.5%)	1310
Age Heterogeneous Studies					
USOC: Understanding Society: the UK Household Longitudinal Survey	A nationally representative longitudinal household panel study, based on a clustered-stratified probability sample of UK households, with all adults aged 16+ in chosen households surveyed annually.	16-96	2018-2019	Six: surveys: April (40.3%), May (33.6%), Jun (32.0%), July (31.2%), Sep (29.2%) & Nov (27.3%)	13175
ELSA: English Longitudinal Study of Aging	A nationally-representative population study of individuals aged 50+ living in England, with biennial surveys and periodic refreshing of the sample to maintain representativeness.	52-90+	2018-2019	Two surveys: Jun-July (75%) & Nov-Dec (73%)	5061
GS: Generation Scotland: the Scottish Family Health Study	A family-structured, population-based Scottish cohort, with participants aged 18-99 recruited between 2006-2011	27-100	2006-2011	Two surveys: April-Jun (21.6%) & Jul-Aug (15.6%)	3179
ALSPAC(G0): Avon Longitudinal Study of Parents and Children-Generation 0	Parents of the ALSPAC(G1) cohort described above, treated as a separate age-heterogenous study population. (original parents)	45-81	2011-2013	Three surveys: April (12.4%), June (12.2%), December (14.3%)	3212
TWINSUK: the UK	A cohort of volunteer adult twins (55%	22-96	2017-2018	Three surveys:	2855

Adult Twin Registry	monozygotic and 43% dizygotic) from around the United Kingdom who were sampled between 18-101 years of age.			April (64.3%), July (77.6%) & November (76.1%)	
Genetic Links to Anxiety and Depression (GLAD) study	Participants with depression and/or anxiety aged 16+ from the 2018 Genetic Links to Anxiety and Depression study (GLAD) were invited to take part in covid surveys as part of a new project, Covid-19 Psychiatry and Neurological Genetics study (COPING).	16-89	2018-2021 (data from GLAD)	Fortnightly data collection from April to July (20.4%), then monthly (19,7%).	12107

Table 2. Percent prevalence (and 95% confidence intervals) of any healthcare, economic, and housing disruptions during the pandemic as well as of cumulative disruptions, by study

	MCS	**ALSPAC G1**	**NS**	**BCS70**	**NCDS**	**NSHD**	**USOC**	**ELSA**	**GS**	**ALSPAC G0**	**TWINS UK**	**GLAD**
Based on data until	*Oct 2020*	*Jan 2021*	*Oct 2020*	*Oct 2020*	*Oct 2020*	*Oct 2020*	*Nov 2020*	*Dec 2020*	*Sept 2020*	*Jan 2021*	*Nov 2020*	*Jan 2021*
Any healthcare disruption	9.6 (7.9-11.5)	15.9 (14.3-17.6)	11.6 (9.4-14.3)	13.3 (11.7-15.1)	15.3 (13.9-16.8)	18.5 (14.7-22.9)	31.9 (30.8-32.9)	36.7 (34.9-38.4)	27.4 (25.9-29.0)	19.9 (18.1-21.9)	8.7* (7.7 - 9.8)	0.7 (0.6 - 0.9)
Prescription/medication access	3.3 (2.6-4.2)	NA	3.8 (2.5-5.7)	3.3 (2.6-4.3)	2.5 (1.9-3.2)	2.3 (1.3-4.2)	5.6 (5.1-6.2)	0.8 (0.5-1.3)	6.7 (5.8-7.6)	NA	2.9 (2.5- 3.4)	0.7 (0.6 - 0.9)
Procedures or surgery	1.0 (0.5-2.2)	1.6 (1.2-2.1)	1.3 (0.5-3.5)	0.8 (0.5-1.0)	2.1 (1.6 - 2.8)	2.4 (1.3-4.5)	12.3 (11.6-13.1)	21.4 (20.0-22.9)	2.9 (2.4-3.6)	2.9 (2.1-3.9)	NA	NA
Appointments	6.4 (5.1-8.1)	11.7 (10.3-13.2)	7.2 (5.6-9.1)	10.2 (8.8-11.8)	12.0 (10.7-13.2)	14.3 (10.9-18.4)	28.5 (27.5-29.5)	21.3 (19.8-22.9)	22.0 (20.6-23.5)	14.4 (12.8-16.2)	NA	NA
Any economic disruption	43.6 (40.5-46.8)	50.2 (47.6-52.9)	41.0 (37.8-44.3)	40.8 (38.4-43.2)	36.8 (35.1-38.6)	10.0 (6.7-14.8)	51.5 (50.3-52.7)	30.2 (28.5-32.0)	20.8 (19.4-22.2)	48.6 (46.2-51.1)	30.9 (29.2-32.6)	41.9 (41.0 - 42.8)
Main economic activity	35.1 (31.2-39.2)	43.3 (40.6-46.0)	7.9 (5.7-10.7)	5.9 (4.9-7.0)	6.6 (5.8-7.4)	0.9 (0.5-1.5)	n/a	4.6 (3.8-5.6)	10.3 (9.3-11.4)	46.6 (43.7-49.4)	17.6 (16.6 - 18.6)	41.0 (40.1 - 41.9)
Employment	8.3 (6.0-11.3)	6.4 (5.1-7.9)	7.4 (5.3-10.3)	5.8 (4.9-6.9)	6.3 (5.6-7.2)	0.7 (0.4-1.3)	6.1 (5.6-6.7)	1.4 (1.0-2.0)	0.2 (0.05-0.3)	12.3 (10.7-14.2)	9.3 (8.6-10.1)	6.8 (6.4 - 7.3)
Income	24.8 (22.1-27.8)	23.5 (21.4-25.8)	26.0 (23.0-29.1)	24.1 (21.9-26.4)	20.4 (18.9-22.0)	8.7 (5.4-13.6)	36.8 (35.6-38.0)	24.5 (22.9-26.1)	13.1 (11.9-14.3)	29.8 (27.5-32.2)	27.48 (26.32-28.67)	
Working hours/furlough	39.8 (33.5-46.4)	42.6 (39.9-45.4)	26.9 (24.0-30.1)	30.3 (28.3 - 32.4)	41.2 (38.2 - 43.7)	3.8 (2.6-5.5)	51.8 (50.6-53.0)	20.4 (18.9-22.0)	6.5 (5.7-7.4)	43.4 (40.5-46.5)	11.0 (10.2 - 11.9)	20.2 (19.4 - 20.9)
Any housing disruption	35.8 (32.5-39.3)	23.3 (21.6-25.2)	15.2 (12.8-18.0)	12.7 (11.3-14.1)	9.7 (8.3-10.7)	2.2 (1.3-3.7)	31.8 (30.7-33.0)	24.4 (22.8-26.1)	7.7 (6.8-8.7)	15.3 (13.9-16.8)	6.8 (6.0-7.8)	12.3 (11.8 - 12.9)
Housing loss/change	2.4 (1.7-3.4)	16.7 (15.2-18.4)	1.4 (0.8-2.4)	0.3 (0.2-0.6)	0.01 0.0-0.02)	0	4.5 (4.0-5.1)	1.8 (1.4-2.4)	0.8 (0.5-1.2)	2.1 (1.5-2.9)	2.5 (2.1-2.9)	3.8 (2.0 - 3.4)
Household composition	35.4 (32.1-38.8)	5.3 (4.4-6.4)	15.1 (12.6-17.9)	12.5 (11.2 - 14.0)	9.7 (8.8 - 10.7)	3.4 (2.0-5.6)	29.2 (28.2-30.3)	22.6 (21.1-24.2)	7.7 (6.8-8.7)	10.6 (9.5-11.8)	4.5 (4.0-5.1)	12.2 (11.6 - 12.7)
Cumulative disruptions												
No disruptions	35.1 (31.8-38.6)	46.5 (44.5-48.6)	47.2 (43.8-50.6)	45.9 (43.4 - 48.4)	49.2 (47.3-51.0)	72.0 (66.7-76.8)	23.0 (22.0-23.9)	34.7 (33.1-36.4)	52.4 (50.7-54.2)	43.4 (41.3-45.5)	60.8 (59-62.6)	52.4 (51.5 - 53.3)

Any one domain disrupted	43.0 (39.8-46.2)	40.8 (38.8-42.8)	39.0 (36.0-42.3)	42.4 (40.0-44.8)	40.5 (38.7-42.3)	25.7 (21.0-31.0)	43.9 (42.8-44.9)	42.3 (40.5-44.1)	39.7 (38.0-41.5)	43.4 (41.3-45.6	31.5 (29.8-33.2)	41.1 (40.2 - 41.9)
Two domains disrupted	20.0 (17.4-22.8)	11.7 (10.4-13.1)	12.4 (10.1-15.0)	10.8 (9.5-12.4)	9.6 (8.6-10.7)	2.3 (1.2-4.5)	27.5 (26.5-28.4)	20.0 (18.5-21.6)	7.4 (6.5-8.3)	11.7 (10.3-13.2)	6.7 (5.8-7.7)	6.5 (6.1 - 7.0)
All three domains disrupted	1.9 (1.4-2.6)	1.1 (0.7-1.6)	1.4 (0.7-2.9)	0.8 (0.6-1.2)	0.7 (0.5-0.9)	0	5.7 (5.2-6.3)	3.0 (2.4-3.7)	0.5 (0.2-0.8)	1.5 (1.0-2.1)	0.5 (0.3-0.8)	0.02 (0.01 - 0.08)

Sources: MCS (Millennium Cohort Study); ALSPAC G1 (Children of the Avon Longitudinal Study of Parents and Children); NS (Next Steps); BCS 70 (1970 British Cohort Study), NCDS (National Child Development Study); NSHD (National Survey of Health and Development); USoc (Understanding Society); ELSA (English Longitudinal Study of Ageing); GS (Generation Scotland: the Scottish Family Health Study); TWINSUK (UK Adult Twin Registry); COPING (Covid-19 Psychiatry and Neurological Genetics study), ALSPAC G0 (parents of ALSPAC). Weighted data. The detailed prevalence for each disruption can be found in the Supplementary Online file (see Supplementary Table S5). Note. TWINSUK had an additional question: "Have you experienced healthcare disruption as a result of the COVID-19 pandemic?" This data was also used to derive the 'any healthcare disruption' variable for TWINSUK.

Table 3. Meta-analysed associations between standardised psychological distress and healthcare, economic and housing disruptions

	Unadjusted		Adjustment 1		Adjustment 2	
	OR (95% CI)	I^2	OR (95%CI)	I^2	OR (95%CI)	I^2
Any Healthcare	**1.39 (1.30, 1.48)**	**67.7%**	**1.40 (1.29, 1.51)**	**79.8%**	**1.30 (1.20, 1.40)**	**65.1%**
Prescription/medication access	1.53 (1.39, 1.69)	55.5%	1.52 (1.37, 1.68)	56.7%	1.33 (1.20, 1.49)	52.3%
Procedures or surgery	1.34 (1.22, 1.46)	42.0%	1.35 (1.20, 1.52)	65.1%	1.24 (1.09, 1.41)	54.5%
Appointments	1.31 (1.22, 1.41)	65.1%	1.31 (1.19, 1.44)	81.0%	1.24 (1.14, 1.36)	66.8%
Any Economic	**1.09 (1.03, 1.16)**	**80.8%**	**1.05 (0.97, 1.13)**	**87.7%**	**1.11 (1.05, 1.16)**	**60.5%**
Main economic activity	1.06 (0.99, 1.13)	62.4%	1.03 (0.96, 1.10)	60.8%	1.10 (1.05, 1.15)	0.0%
Loss of employment	1.09 (1.00, 1.19)	58.7%	1.06 (0.99, 1.15)	44.4%	1.13 (1.06, 1.21)	12.0%
Loss of income	1.11 (1.04, 1.20)	81.3%	1.10 (1.02, 1.19)	83.4%	1.12 (1.06, 1.19)	63.3%
Change in working hours/furlough	1.07 (1.00, 1.13)	69.2%	1.01 (0.94, 1.08)	74.0%	1.05 (1.00, 1.09)	18.7%
Any Housing	**1.04 (1.00, 1.07)**	**16.0%**	**1.00 (0.97, 1.03)**	**0.0%**	**1.01 (0.97, 1.05)**	**0.0%**
Loss of housing	1.12 (1.06, 1.18)	0.0%	1.05 (0.99, 1.12)	0.0%	1.02 (0.94, 1.10)	0.0%
Household composition	1.04 (1.00, 1.08)	14.1%	1.00 (0.96, 1.03)	0.0%	1.01 (0.97, 1.05)	0.0%
Cumulative						
1 disruption vs none	1.12 (1.06, 1.16)	58.6%	1.09 (1.03,1.14)	68.4%	1.11 (1.07, 1.16)	32.1%
2+ disruptions vs none	1.28 (1.22, 1.34)	40.6%	1.23 (1.15, 1.31)	61.4%	1.25 (1.18, 1.32)	37.5%

Adjustment 1= age, sex, ethnicity, education, and UK Nation
Adjustment 2= age, sex, ethnicity, education, and UK Nation, partnership status, presence of children, housing tenure, occupational class, prior chronic conditions, and physical disability

Table 4. Meta-analysed associations between standardised psychological distress and overall healthcare, economic and housing disruptions stratified by sex, education, and age.

	Healthcare disruption		**Economic disruption**		**Housing disruption**		**1 disruption vs none**		**2+ disruptions vs none**	
	OR (95% CI)	I^2	OR (95% CI)	I^2	OR (95% CI)	I^2	OR (95% CI)	I^2	OR (95% CI)	I^2
Female	1.39 (1.28, 1.50)	72.4%	1.04 (0.96, 1.13)	84.8%	0.99 (0.96, 1.03)	0.0%	1.08 (1.02, 1.15)	70.7%	1.22 (1.13, 1.32)	67.7%
Male	1.44 (1.30, 1.60)	52.4%	1.03 (0.94, 1.14)	69.4%	1.01 (0.95, 1.07)	0.0%	1.08 (1.02, 1.14)	17.3%	1.29 (1.18, 1.40)	34.5%
Degree	1.41 (1.26,1.58)	72.0%	1.10 (1.03, 1.19)	66.9%	1.01 (0.97, 1.06)	0.0%	1.06 (0.99, 1.13)	58.8%	0.84 (0.56, 1.25)	97.9%
No degree	1.40 (1.29, 1.51)	63.5%	1.01 (0.92, 1.10)	83.3%	0.99 (0.95, 1.03)	0.0%	1.08 (0.99, 1.17)	82.0%	1.20 (1.10, 1.31)	64.8%
White	1.42 (1.28, 1.57)	82.4%	1.04 (0.93, 1.16)	90.5%	1.00 (0.96, 1.03)	0.0%	1.08 (1.00, 1.17)	80.8%	1.23 (1.12, 1.36)	79.7%
Ethnic minority	1.53 (1.17, 2.00)	54.4%	1.04 (0.85, 1.27)	59.1%	1.13 (0.97, 1.31)	22.0%	1.10 (0.93, 1.30)	32.0%	1.36 (1.12, 1.65)	27.9%
16-24 years	1.42 (1.24, 1.62)	0.0%	1.05 (0.86, 1.29)	82.5%	0.99 (0.85, 1.17)	70.3%	1.00 (0.91, 1.10)	0.0%	1.13 (0.89, 1.44)	78.0%
25-34 years	1.50 (1.16, 1.95)	52.4%	1.11 (1.01, 1.23)	28.7%	1.07 (0.97, 1.18)	0.0%	1.09 (0.94, 1.26)	54.6%	1.29 (1.15, 1.44)	0.0%
35-44 years	1.70 (1.46, 1.98)	0.0%	0.97 (0.73, 1.30)	88.1%	1.17 (0.81, 1.69)	82.3%	0.99 (0.89, 1.10)	21.2%	1.27 (0.96, 1.67)	65.2%
45-54 years	1.53 (1.39, 1.68)	22.0%	0.95 (0.86, 1.04)	58.3%	0.93 (0.87, 0.99)	0.0%	1.05 (0.94, 1.19)	66.7%	1.18 (0.97, 1.42)	77.3%
55-64 years	1.42 (1.22, 1.65)	81.5%	0.96 (0.82, 1.11)	90.3%	0.98 (0.93, 1.04)	0.0%	1.07 (1.00, 1.15)	50.5%	1.17 (1.06, 1.29)	48.1%
65-74 years	1.51 (1.13, 2.03)	91.8%	1.06 (0.90, 1.25)	76.1%	0.99 (0.91, 1.08)	0.0%	1.21 (1.12, 1.31)	18.5%	1.20 (1.03, 1.41)	42.2%
75+ years	1.51 (1.17, 1.96)	44.2%	1.01 (0.78, 1.29)	51.4%	1.02 (0.86, 1.20)	10.2%	1.31 (1.00, 1.70)	71.0%	1.48 (1.01, 2.16)	51.8%
Adjusted for age, sex, ethnicity, education, and UK Nation										

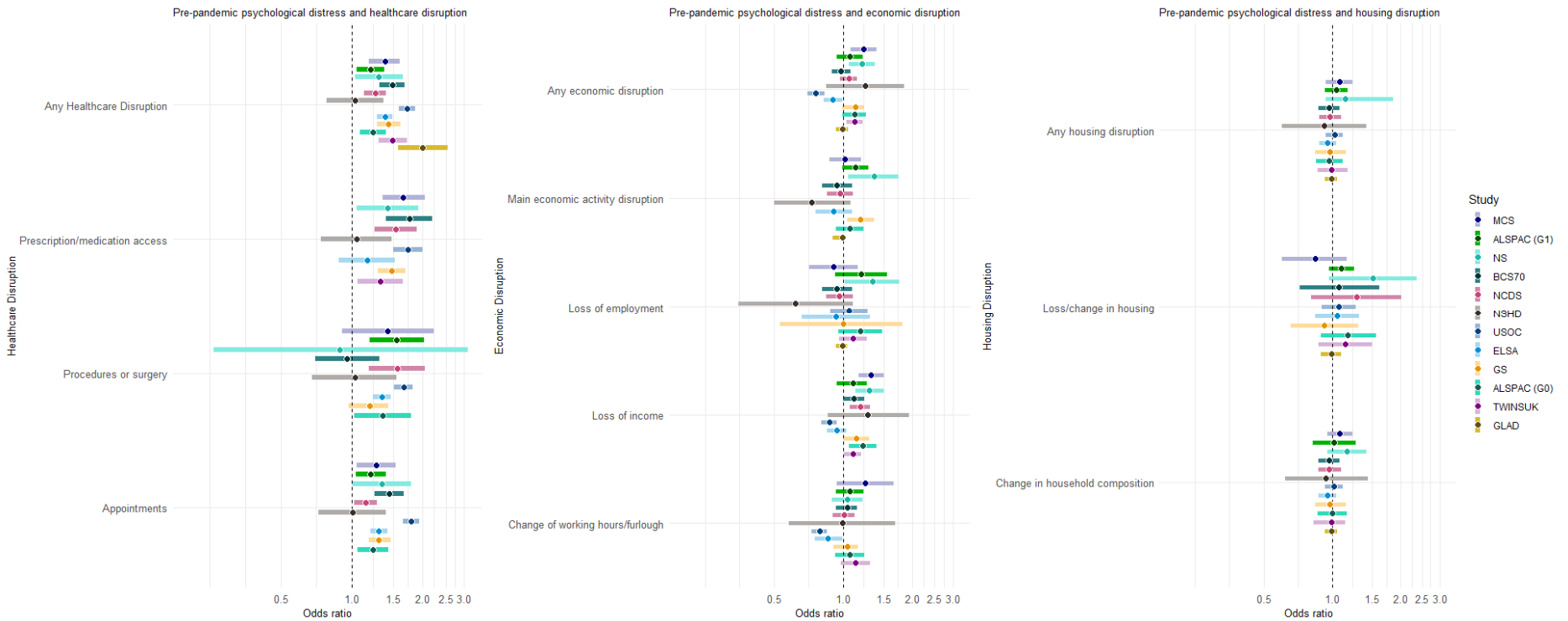


Figure 1. Odds Ratios between standardised psychological distress and each examined disruption. Models adjusted for age, sex, ethnicity, education, and U
Nation, partnership status, presence of children, housing tenure, occupational class, prior chronic conditions, and physical disability.

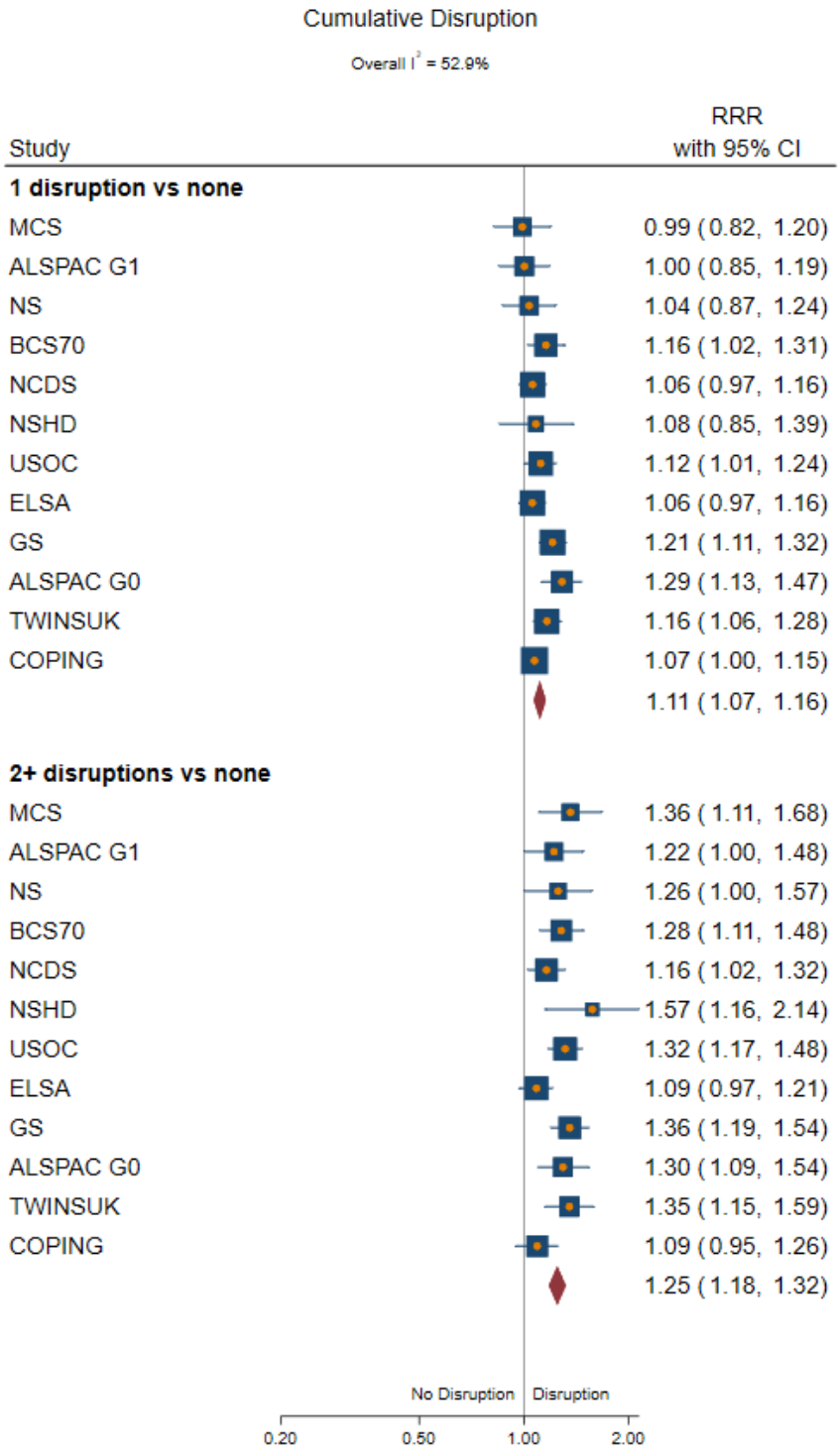
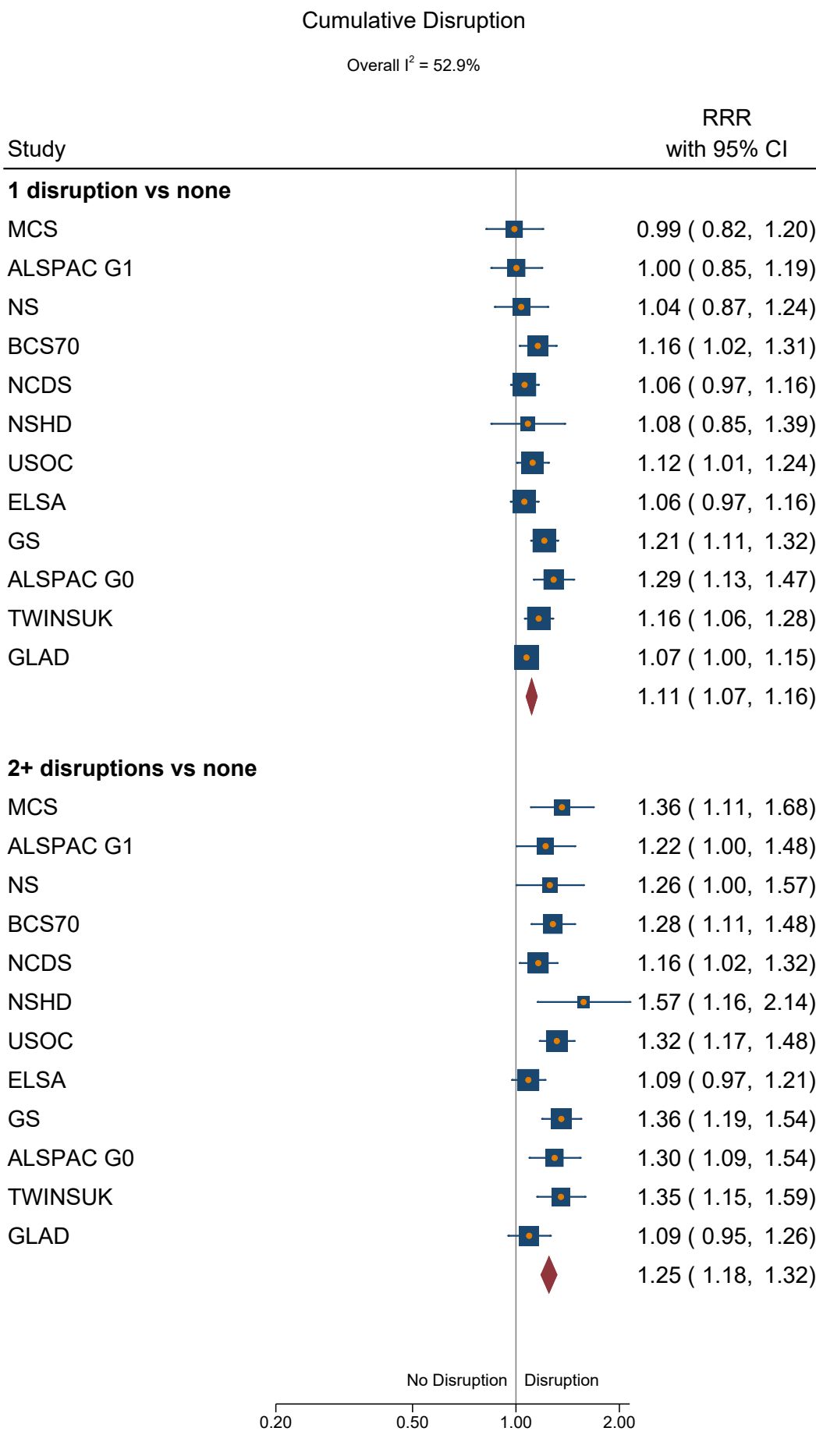
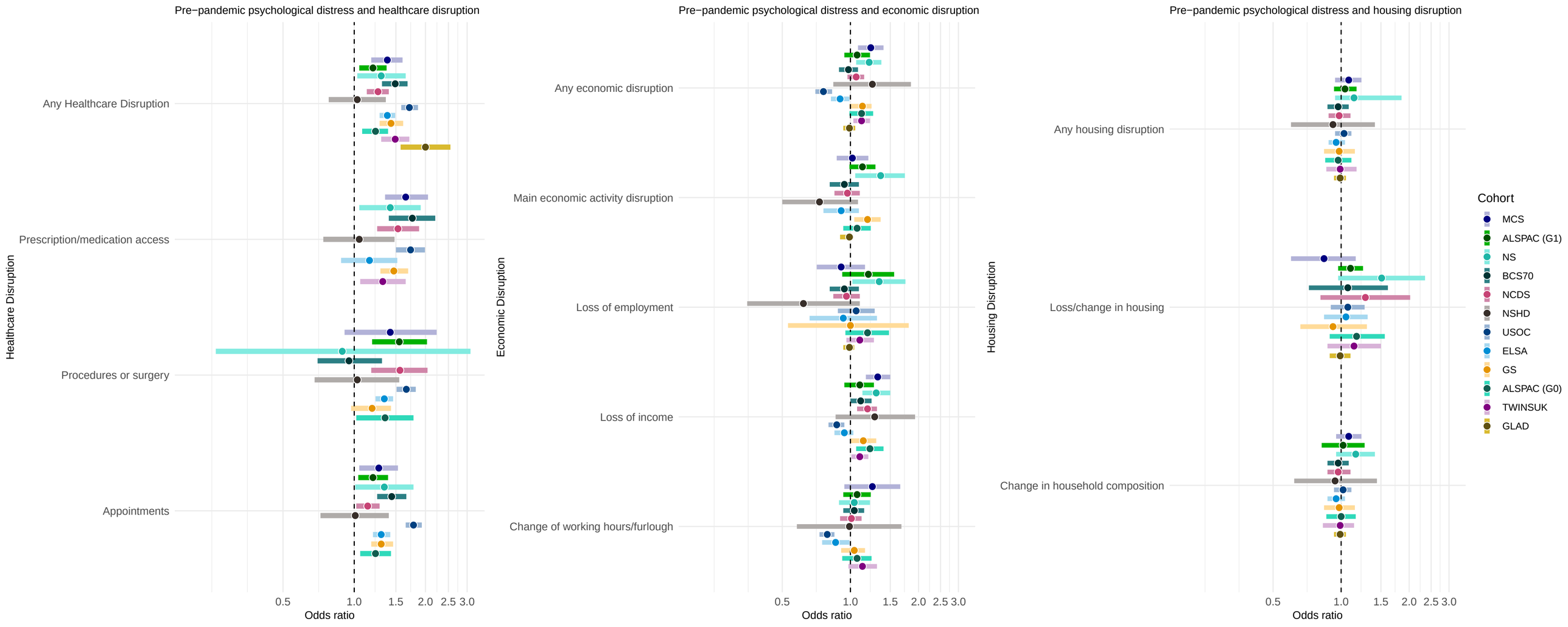


Figure 2. Associations between standardised psychological distress and cumulative disruptions. Models adjusted for age, sex, ethnicity, education, and UK Nation, partnership status, presence of children, housing tenure, occupational class, prior chronic conditions, and physical disability. RRR: Relative risk ratio.


Cumulative Disruption
Overall I² = 52.9%
Study
RRR with 95% CI
1 disruption vs none
MCS 0.99 (0.82, 1.20)
ALSPAC G1 1.00 (0.85, 1.19)
NS 1.04 (0.87, 1.24)
BCS70 1.16 (1.02, 1.31)
NCDS 1.06 (0.97, 1.16)
NSHD 1.08 (0.85, 1.39)
USOC 1.12 (1.01, 1.24)
ELSA 1.06 (0.97, 1.16)
GS 1.21 (1.11, 1.32)
ALSPAC G0 1.29 (1.13, 1.47)
TWINSUK 1.16 (1.06, 1.28)
GLAD 1.07 (1.00, 1.15)
1.11 (1.07, 1.16)
2+ disruptions vs none
MCS 1.36 (1.11, 1.68)
ALSPAC G1 1.22 (1.00, 1.48)
NS 1.26 (1.00, 1.57)
BCS70 1.28 (1.11, 1.48)
NCDS 1.16 (1.02, 1.32)
NSHD 1.57 (1.16, 2.14)
USOC 1.32 (1.17, 1.48)
ELSA 1.09 (0.97, 1.21)
GS 1.36 (1.19, 1.54)
ALSPAC G0 1.30 (1.09, 1.54)
TWINSUK 1.35 (1.15, 1.59)
GLAD 1.09 (0.95, 1.26)
1.25 (1.18, 1.32)
No Disruption
Disruption
0.20
0.50
1.00
2.00


Pre−pandemic psychological distress and healthcare disruption
Any Healthcare Disruption
Prescription/medication access
Procedures or surgery
Appointments
Healthcare Disruption
0.5
1.0
1.5
2.0
2.5
3.0
Odds ratio
Pre−pandemic psychological distress and economic disruption
Any economic disruption
Main economic activity disruption
Loss of employment
Loss of income
Change of working hours/furlough
Economic Disruption
0.5
1.0
1.5
2.0
2.5
3.0
Odds ratio
Pre−pandemic psychological distress and housing disruption
Any housing disruption
Loss/change in housing
Change in household composition
Housing Disruption
0.5
1.0
1.5
2.0
2.5
3.0
Odds ratio
Cohort
MCS
ALSPAC (G1)
NS
BCS70
NCDS
NSHD
USOC
ELSA
GS
ALSPAC (G0)
TWINSUK
GLAD