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Does caring for others affect our mental health? Evidence from the COVID-19 pandemic

Chiara Costi [a,*], Bruce Hollingsworth [b], Vincent O'Sullivan [c], Eugenio Zucchelli [d,e]

[a] *Department of Economics, Lancaster University Management School (LUMS), Lancaster University, UK*
[b] *Division of Health Research, Lancaster University, UK*
[c] *Department of Economics, University of Limerick, Ireland*
[d] *Madrid Institute for Advanced Study (MIAS) and Department of Economic Analysis, Universidad Autónoma de Madrid (UAM), Spain; IZA, Germany*
[e] *Lancaster University, UK*

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ABSTRACT

Despite a growing literature about the mental health effects of COVID-19, less is known about the psychological costs of providing informal care during the pandemic. We examined longitudinal data from the UK's Understanding Society Survey, including eight COVID surveys, to estimate fixed effects difference-in-differences models combined with matching, to explore the causal effects of COVID-19 among informal carers. While matching accounts for selection on observables into caregiving, multiple period difference-in-differences specifications allow investigation of heterogeneous mental health effects of COVID-19 by timing and duration of informal care. The estimates suggest that while mental health fluctuated following the imposition of social restrictions, informal carers who started caregiving during the pandemic show the largest mental health deterioration, especially during lockdowns. Policies to mitigate the psychological burden of caregiving might be more effective if targeted at those starting to provide care for the first time.

1. Introduction

There is increasing evidence that the COVID-19 pandemic and related social restrictions are having an effect on mental health (e.g. Banks and Xu, 2020; Le and Nguyen, 2021; Lorenz-Dant and Comas-Herrera, 2021; Muldrew et al., 2021; Zhou and Kann, 2021). Recent studies show increases in loneliness, worry and boredom (Brodeur et al., 2021) together with overall worse mental health following lockdowns (Serrano-Alarcon et al., 2022). This fast-growing literature has mainly focused either on the general population or specific sub-groups, including young adults, women, ethnic minorities, households with children, and the least educated (Anaya et al., 2021; Daly et al., 2020; Etheridge and Spantig, 2020; Niedzwiedz et al., 2021; Proto and Quintana-Domeque, 2021; Zhou and Kann, 2021). However, less is known about the effect of COVID-19 on the psychological well-being of informal carers, one of the most affected yet potentially vulnerable groups of individuals (Rodrigues et al., 2021).

Before the COVID-19 outbreak, informal care was already considered essential for the sustainability of publicly funded healthcare systems (Lorenz-Dant and Comas-Herrera, 2021) because informal care is seen as a 'cost saving' alternative to formal care, for instance saving the UK Government £132 billion annually (Carers UK, 2015). In addition, it is often preferred by care recipients when provided by relatives or friends (Carers UK, 2020). When the pandemic began, the formal healthcare sector was overwhelmed by COVID-19 and long-term care systems were heavily disrupted (Giebel et al., 2021). Since then, informal carers are viewed more as frontline healthcare workers, caring for an ever-increasing number of vulnerable individuals (Kent et al., 2020). More generally, given the fast-growing older population and the increasing prevalence of age-related illnesses (Onwumere, 2020), governments are increasingly relying on this form of assistance (Lacey et al., 2019). Thus, it would be relevant to assess whether the pandemic causally affected the mental health of such an important category of healthcare workers.

While during the pandemic governments recommended avoiding close contact with the elderly and frail, the sudden disruption of most formal care services led existing carers to provide additional care, as well as many individuals starting to provide care (Carers UK, 2020). It is

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* Corresponding author.
E-mail address: c.costi@lancaster.ac.uk (C. Costi).

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estimated that around 26% of the individuals in the UK population are currently providing some form of informal care (Onwumere et al., 2021) and 4.5 million people became informal carers after the COVID-19 outbreak (Carers UK, 2020). Since providing informal care is often associated with an increase in psychological distress (Adelman et al., 2014), it is plausible that the pandemic harmed the mental health of informal carers, especially among those who started providing care during the pandemic. New carers might have been concerned about infecting care recipients or have experienced greater psychological distress by suddenly having greater health-related responsibilities by providing care (Irani et al., 2021; Kent et al., 2020; Lorenz-Dant and Comas-Herrera, 2021; Muldrew et al., 2021).

Our objective is to identify potential causal effects of COVID-19 and related social restrictions on the mental health of informal carers. We examined detailed data on mental health and informal care drawn from the UK Household Longitudinal Study (Understanding Society), collected between 2016 and March 2021. Our empirical approach relies on two difference-in-differences (DD) specifications, a standard two-way fixed effects model as well as a multi-period fixed effects DD model. The former DD model explores the causal effect of the COVID-19 pandemic on the mental health of informal carers while the latter is based on recent advancements in the quasi-experimental literature (Callaway and Sant'Anna, 2021) investigating heterogeneous effects driven by timing and duration of caregiving. We also employ propensity score matching to pre-process the data to make treated and control groups (i.e. informal carers vs non-carers) more comparable by accounting for selection into informal caregiving through observable characteristics. We employed the 12-item General Health Questionnaire (Goldberg et al., 1997), a psychometrically validated and widely used index of psychological distress as our measure of mental health.

Our results show that new carers - those who started providing informal care after the COVID-19 outbreak - experienced a significant mental health deterioration especially when lockdown and social restrictions were in place. Specifically, their mental health deteriorated by around 0.37 points on the GHQ scale at the start of the pandemic (April 2020), 0.27 points during the second national lockdown (November 2020) and 0.25 points during the third national lockdown (January 2021), while it seems unaffected when social restrictions were lifted. These estimates are comparable to the mental health deterioration associated with major life events such as divorce and unemployment (Clark and Georgellis, 2013). Existing carers appear to have coped relatively well during the pandemic, mostly showing changes in mental health that are not statistically significant.

This paper offers several contributions to the growing literature on the mental health effects of the COVID-19 pandemic as well as to the broader literature on the determinants of the mental health of (informal) carers. First, we employ a quasi-experimental approach to provide causal evidence on the mental health burden suffered by informal carers during the COVID-19 pandemic. Despite a rapidly increasing number of studies of mental health effects among healthcare workers, whether the pandemic had a causal impact on the mental health of informal carers remains an open empirical question. Second, our empirical approach is to estimate standard as well as multiple period difference-in-differences models combined with matching. This simultaneously accounts for several important issues in identifying causal effects, including observed self-selection into treatment (via matching) and individual-level unobserved heterogeneity (via fixed effects). In addition, the difference-in-differences approach with multiple time periods recently proposed by Callaway and Sant'Anna (2021) allows estimation of the mental health effect of COVID-19 on multiple groups of informal carers during different periods and by duration of care. To our knowledge, this has not been explored so far. Third, our analysis clearly distinguishes between existing, and therefore more experienced, informal carers and new carers, that is those who started providing informal care during the pandemic. Though potentially relevant, the mental health effects on these different groups of informal carers during the pandemic have not been examined yet.

2. Literature

It is well-established that informal caregiving is associated with increased physical strain (Pinquart and Sörensen, 2003) and psychological distress (Lacey et al., 2019) among carers. However, establishing whether informal caregiving had a causal effect on mental health is challenging given potential endogeneity issues, including self-selection into caregiving (Bom et al., 2019). To account for selection into caregiving, recent papers used different matching techniques. (Bom and Stöckel, 2021) and Stöckel and Bom (2021) employed propensity score matching to explore the health effects of informal caregiving using data from the UK and the Netherlands. They found negative mental health effects of caregiving, especially among caregivers who provided care for longer, and with higher intensity as measured by additional hours of caregiving. De Zwart et al. (2017) also employed matching to deal with selection issues when studying health outcomes of spousal informal caregivers. Analysing data from the Survey of Health Ageing and Retirement in Europe (SHARE), they found that caregiving has a negative short-term effect on informal carers' overall health. Previous evidence also appears to show that the negative effect of informal caregiving seems to be larger among specific groups of caregivers, such as older caregivers (Bom et al., 2019); women (de Zwart et al., 2017; Lacey et al., 2019; Brenna, 2021); and people with more intense caregiving duties (Bom and Stöckel, 2021; Stöckel and Bom, 2021). However, an important limitation of these studies is that they appear to infer causality using matching as their main identification strategy and therefore rely on the conditional independence assumption (effectively assuming that there are no unobservable confounders).

Although there are many studies on the mental health effects of COVID-19, empirical research identifying causal effects of COVID-19 on informal carers' mental health is still limited. While existing evidence suggests an increase in psychological distress during the pandemic, previous studies mainly focus on convenience samples of informal caregivers using information from ad-hoc interviews conducted during the pandemic, thus having limited external and general validity (e.g. Azevedo et al., 2021; Lightfoot et al., 2021; Ng et al., 2020; Greaney et al., 2022; Irani et al., 2021). Other studies are based on cross-sectional data and do not include pre-pandemic information (Borelli et al., 2021; Beach et al., 2021; Leggett et al., 2021; Todorovic et al., 2020; Li et al., 2021); hence, they lack natural control groups.

A few studies used longitudinal data to explore mental health among informal carers. However, such studies do not appear to account for self-selection into informal caregiving nor provide causal estimates of mental health effects while accounting for timing and duration of informal care. Gallagher and Wetherell (2020) used two waves of the UK Household Longitudinal Study (Understanding Society) to explore whether depression increased among caregivers during the first month of the pandemic (April 2020). They found that caregivers were more likely to experience depressive symptoms compared to non-caregivers. Whitley et al. (2021) used the same dataset to investigate informal caregivers' mental health, as measured by the GHQ-12. Using OLS, they estimated differences in changes in mental health between home-carers and non-carers, and found that GHQ-12 scores of informal carers were already higher pre-pandemic compared to non-carers and that mental health further deteriorated after the COVID-19 outbreak. Wister et al. (2022) used the Canadian Longitudinal Study on Aging to explore depression and anxiety among informal caregivers during the first nine months of the pandemic, finding, using linear mixed models, that informal caregivers had worse mental health compared to non-carers. Park (2021) estimated logistic and negative binomial models to examine differences in mental distress among groups of non-caregivers; short-term ($\leq$ 1 year); and long-term ($>$ 1 year) informal caregivers, analysing data from the Understanding America Study. Findings showed that long-term caregivers were the most affected by the pandemic, possibly due to caring for longer. Truskinovsky et al. (2022) estimated linear probability models to examine associations between care disruptions and mental health in US. They found that caregiving arrangements were disrupted by COVID-19, and that these disruptions were associated with increased depression, anxiety, and loneliness among caregivers.

To our knowledge, only two studies try to account for self-selection into caregiving while focusing on informal caregivers' mental health during COVID-19. These studies control for selection into caregiving, through matching on observable factors rather than considering both observable and unobservable factors. Mak et al. (2021) used propensity score matching to compare informal caregivers and non-caregivers' mental health using primary data collected during the pandemic in the UK. They found that carers experienced higher depressive symptoms and anxiety. Their empirical approach ignored potential unobservable differences between the two groups of carers and relied on a convenience sample collected during the COVID-19 pandemic, meaning that their results cannot be necessarily generalised. Furthermore, they cannot observe pre-pandemic levels of outcomes. Bergmann and Wagner (2021) investigated the effect of COVID-19 on informal caregivers' health using two waves of SHARE. They found that the mental and physical health of informal caregivers deteriorated during the first months of the pandemic. However, their statistical approach is similar to that of propensity score matching, relying on the conditional independence assumption and selection on observables (i.e. all observed health differences are attributable to the caregiving role). In addition, the observed characteristics they used do not appear to account for How people decide to become informal caregivers, and therefore self-selection into caregiving does not seem to be appropriately accounted for.

3. Data

We analysed the UK Household Longitudinal Study (Understanding Society), which contains detailed individual-level information of a representative sample of the UK's population. Specifically, we analysed three mainstage questionnaires collected before COVID-19 (i.e. Wave 8, 9 and 10, covering 2016–18; 2017–2019; and 2018–2020) together with eight COVID-19 surveys specifically designed to collect relevant information on a monthly or bi-monthly basis (from April 2020 until March 2021). The sample analysed included 4698 respondents who were interviewed in all eleven waves considered in the analysis. This sample was obtained after omitting those interviewed in the mainstage questionnaire (pre-pandemic waves) but during or after March 2020 (when the first national lockdown was imposed in the UK). In this way, all the interviews of the mainstage questionnaire were conducted *before* COVID-19. We then retained only those who always answered questions related to mental health (our outcome of interest) and informal care. We also dropped those who were already informal carers during the first wave analysed (Wave 8), so that nobody was providing informal care during the first period considered, which is essential for matching requiring pre-treatment variables for both treated and control groups. Importantly, we considered only caregivers who continuously provided care, i.e. those who started caregiving and continued caregiving throughout the period analysed. Specifically, the question about caregiving is asked in the mainstage questionnaires and in the first COVID survey (April 2020). Given the social restrictions imposed, we assume that if someone provides care during the first lockdown, it is reasonable to assume they will also provide care later during the pandemic (at least during the period we observe).

Importantly, given that in the first COVID survey (April 2020) the question about informal care is related to people providing care to someone living outside their household, we use the same question in the mainstage questionnaires to identify informal carers. Moreover, we only consider "external" informal carers because caregiving tasks such as grocery shopping and helping around the house might be misreported if caregivers and care recipients live together. It is also likely that home-carers may have been already providing some form of care pre-pandemic which might have changed only in caregiving intensity, given formal care services disruptions. Compared to more general samples (i.e. the mainstage questionnaire sample before COVID and the COVID questionnaire sample with missing data), our estimating sample includes individuals who are older; more likely to be white; better educated; better off economically (in terms of employment and income); more likely to be married; physically healthier, and in better mental health. Given that individuals included in our estimating sample have greater social and financial resources, it is plausible that their mental health might have been less affected when providing informal care. As such, our estimated effects on mental health may provide a lower bound of the mental health effects of interest.

3.1. *Key variables*

To estimate the effect of caregiving on the mental health of informal carers with different caregiving experience and duration, we exploited information included in both the mainstage UKHLS questionnaire and the COVID-19 surveys. Accordingly, we defined two treatment groups, existing carers (349 individuals) and new carers (1655 individuals), and a control group of never-carers (2694 individuals). More specifically, new carers were defined as those who started caregiving after the COVID-19 outbreak, as recorded by the related question in Wave 1 of the COVID survey (April 2020). These definitions were based on the variable "*Do you provide some regular service or help for any sick, disabled or elderly person not living with you?*", identifying the provision of any type of informal care outside an individual's own household.

Our outcome is mental health as measured by the 12-item General Health Questionnaire (GHQ-12) (Goldberg et al., 1997). GHQ is a self-completion psychometrically validated questionnaire, which has been extensively used in different research fields, including economics, to measure mental ill-health. GHQ-12 contains twelve questions asking whether respondents experienced specific symptoms or feelings, with each item rated on a four-point scale ranging from *"Not at all"* to *"Much more than usual"*. Following previous literature, the main analysis used GHQ-caseness as the outcome (e.g. Banks and Xu, 2020; Chandola et al., 2020; Serrano-Alarcon et al., 2022). In GHQ-caseness, each of the 12 questions is rated with a binary variable: 1 for each answer with a score of 3 or 4 (corresponding to the answers "*More than usual*" and "*Much more than usual*"), and 0 otherwise. Scores range from 0 to 12 with higher values indicating worse mental health (i.e. this measure indicates an increase in mental ill-health). As a robustness check and following earlier studies (Banks and Xu, 2020; Serrano-Alarcon et al., 2022), we also used a binary indicator of a GHQ score of 4 or more, which indicates likely mental ill-health (NHS Digital, 2017). The results of our robustness checks were similar to those of the main analysis and are available on request.

3.2. *Other variables*

Additionally, we also included the following control variables (measured pre-treatment): age; age squared; marital status; living alone; number of dependent children; gender; ethnicity, educational attainment; being employed; and household income measured using quintiles. We also included the governmental regions of the UK in which respondents live (regions of England, Wales, Scotland and Northern Ireland) and the specific COVID-19 status in each region using the daily cumulative number of deaths at a regional level and whether respondents reported being tested for COVID-19. The number of COVID-19 deaths were drawn from UK governmental websites (UK Government, 2022), while information about testing was found in the COVID surveys.

4. Empirical approach

We employed a combination of propensity score matching (PSM) to pre-process the data and difference-in-differences (DD) models to identify the causal effect of COVID-19 on the mental health of informal carers. We used propensity score matching to pre-process the data and hence account for observed characteristics potentially driving selection into informal caregiving. Matching combined with fixed effects in DD models helps produce more comparable treatment and control groups while also accounting for individual-level unobservable characteristics (via fixed effects in the DD models). Note that we also estimated models employing the longitudinal weights provided in Understanding Society as an alternative to those produced by matching (results are similar and available upon request). In addition, we also considered using a Regression Discontinuity Design (RDD) to identify the mental health effects of COVID-19 among informal carers. However, there would not be enough observations around the cut-off created by the first COVID-19 wave (and corresponding national lockdown), where treatment and comparison units/individuals are most similar, and the treatment would be considered as good as random. Thus, an RDD study would have to rely on too few observations around the threshold, especially after the imposition of COVID restrictions, on which to draw any conclusions.

4.1. Propensity score matching

PSM is increasingly used when the treatment of interest is providing informal care (Bom et al., 2019; Stöckel and Bom, 2021; de Zwart et al., 2017). This is because people may self-select into informal caregiving due to specific circumstances, and this could result in systematic differences between informal carers versus non-carers. This may ultimately lead to biased estimates of the treatment effect (Cunningham, 2021). Essentially, matching assumes that after conditioning on observables, the difference in the outcome of interest can be solely attributed to the treatment (Rubin, 1974), which in our case is the provision of informal care.

We used PSM (Leuven and Sianesi, 2003) to make the groups of informal carers and never-carers balanced on observed variables related to the decision to provide care (Berg, 2011). As for the variables used in matching, we followed Schmitz and Westphal (2017) who argue that the decision to provide care depends on characteristics concerning three main areas: (i) the need to, (ii) the willingness to and (iii) the ability to provide care. Indeed, deciding to become an informal carer is driven by corresponding conditions: (i) someone close needs assistance; (ii) the future caregiver is prone to provide care, given their household situation and personality; and (iii) they are in good health and can provide assistance to someone. Here, we employed PSM using pre-treatment variables for both groups of informal carers (existing and new carers). Note that our matching models also included baseline (pre-treatment) mental health. As a result, after matching, both caregivers and never-carers would also present similar baseline mental health.

One-to-one matching was estimated, where each respondent in the treated group was matched to a respondent in the control group. As an alternative, we also performed Kernel PSM, whereby each respondent is matched to a weighted average of all control group members (Heckman and Vytlacil, 2007). While both methods produced very similar results, since there is a large control group we can rely on one-to-one matching. In this way, a unique control group member can be matched to a corresponding treated individual. Results obtained using one-to-one PSM are displayed in Appendix Table A1. The pairwise t-tests show, after matching, no statistically significant differences in the observed variables (at the 5% level for all variables, with one variable presenting a weakly significant difference at the 10% level). It should be noted that even if the bias attributable to observed confounding factors has been minimized, matching does not eliminate the potential bias driven by unobservables. To ease concerns around the role of unobservables and to account for individual-level unobserved heterogeneity, we included fixed effects in our DD models. In addition, and to further account for the potential role of unobserved heterogeneity, we employed an Oster test (Oster, 2019) to explore whether results would change in the presence of selection on unobservables. Results indicate that it would require a proportional level of selection on unobservables well beyond the conventional value of 1 (usually defined as an upper bound value for the proportional level of selection on unobservables) to fully confound the mental health effects in our difference-in-differences models (results are available upon request).

4.2. Difference-in-differences models

Our empirical approach relies on estimating a series of difference-in-differences (DD) models on the sample obtained using matching. In these DD models the treatment is represented by providing informal care during COVID while different treatment groups are defined according to when respondents started caregiving for the first time, either during the pandemic (new carers) or before the pandemic (existing carers). More specifically, we first estimated generalised DD via two-way fixed effects (TWFE) models. The first approach allows us to identify the mental health effects of caregiving during the COVID-19 pandemic alternatively on existing and new carers using never-carers as a control group. We then estimated a difference-in-differences model with multiple periods as proposed by Callaway and Sant'Anna (2021). This second approach enables us to estimate the mental health effects among the two groups of informal carers at different points in time, therefore accounting for timing and duration of care (i.e. when carers started to provide care and for how long) as well as the effects of the different COVID waves. However, even in this case the corresponding average treatment effects are always separately estimated for new and existing carers using never-carers as a control group.

Generalised difference-in-differences.

A generalised difference-in-differences approach is used, estimating standard two-way fixed effects (TWFE) regression models (Wooldridge, 2010):

$$Y_{it} = \alpha_i + \lambda_t + \delta^{DD} D_{it} + \gamma X_{it} + \varepsilon_{it} \tag{1}$$

Equation (1) specifies the effect of providing informal care during the COVID-19 pandemic (δ^{DD}) on the outcome of interest (Y_{it}), i.e., caregivers' mental health as measured by the GHQ-12. We included individual and time fixed effects (α_i and λ_t), along with a wide set of observed covariates (X_{it}). Standard errors (ε_{it}) are clustered at the primary sampling unit level (Abadie et al., 2017). Importantly, separate TWFE regressions are estimated for different groups of informal caregivers. This follows recent papers (Baker et al., 2021; Callaway and Sant'Anna, 2021; de Chaisemartin and D'Haultfoeuille, 2020; Goodman-Bacon, 2021; Sun and Abraham, 2021) which suggest that standard TWFE estimators are not robust to treatment effect heterogeneity, i.e. when groups are treated at different times. Therefore, we first considered existing carers vs never-carers, and subsequently considered new carers vs never-carers. $D_{it}$is a binary variable defining treated units during treatment, so that it will equal one for groups of informal caregivers (existing carers and new carers in separate TWFE analyses) and it will be zero for never-carers. Specifically, the effect of interest is the interaction between the time of the pandemic and the variable defining the different informal caregivers' groups. .

4.3. Difference-in-differences with multiple time periods

A difference-in-differences model with multiple time periods is estimated, as proposed by Callaway and Sant'Anna (2021). Following this approach, it is possible to generalise the average treatment effect on the treated (ATT) to multiple periods. That is, we can directly estimate the ATT at any time for group g at time t, where a group is defined based on when it is first treated. Under the parallel trends assumption on never-treated units, the ATT is estimated as Equation (2) shows.

$$ATT(g,t) = E\left[Y_t - Y_{g-1} \middle| G = g\right] - E\left[Y_t - Y_{g-1} \middle| C = 1\right] \tag{2}$$

Where: Y_t is the observed outcome at time t; Y_{g-1} is the observed outcome just before the unit becomes treated; G indicates each treated group as defined by when units are first treated (g); and C is an indicator variable for individuals who are part of the never-treated group (the control group of never-carers). Therefore, this difference-in-differences model with multiple time periods simultaneously estimates the ATT for each treated group at any point in time included in the analysis. Another advantage of this framework is that researchers can test for parallel trends based on never-treated units for all treated groups, while conditioning on observed covariates.

This additional DD specification accounts for potential differences in the mental health effects driven by the timing and duration of informal care. In this case, the analysis considered a treated group including both existing carers and new carers, and this group of treated individuals was divided into different sub-groups according to the timing (i.e. wave) in which they started to provide care, as displayed in Table 1. Another feature of this framework is that nobody is treated in the first period, as shown in Table 1 (Wave 8). Moreover, once units are treated, they are assumed to be treated during all subsequent periods. Because of this assumption, we also made sure that informal caregivers provided continuous care throughout the period analysed. Finally, two groups of existing carers are considered: those who started caregiving in Wave 9 and those who started in Wave 10.

5. Descriptive statistics

Figs. 1 and 2 present the weighted mean of mental health over time by groups of existing caregivers and new carers versus never-carers obtained using the weights provided by the PSM. It is clear from these figures that informal carers always have worse mental health compared to never-carers. During the first year of COVID-19, mental health fluctuated according to social restrictions, improving when restrictions were lifted (May–September 2020) and worsening during national lockdowns (March–April 2020; September 2020–March 2021).

Figs. 1 and 2 show plots of the weighted average of the outcome over time, displaying pre-treatment trends. Although not a formal test (Cunningham, 2021), these figures suggest the plausibility of the assumption, by showing parallel trends before the treatment (i.e. providing informal care). This implies that, in the absence of treatment, the difference in levels of mental health between treated and control groups would have been constant over time and therefore researchers could attribute the difference in mental health post-treatment to the treatment itself. To further check the validity of this assumption, we interact the treatment variable with pre-treatment periods in our TWFE models and multiple time periods DD models, finding coefficients that are not statistically significant. Overall, this supports the assumption of parallel trends. We note that while in Fig. 2 the pre-COVID trends of mental health of the two groups intersect, their corresponding 95% confidence intervals overlap. This implies that we cannot reject the null hypothesis that the levels of GHQ scores before COVID were similar across never carers and new carers.

Table 1
Informal caregiving patterns.

Period	Years	Treated			Control
		Existing carers	New-carers	Never-carers	Period
		Wave 9	Wave 10		
Pre-COVID-19	WAVE 8 (2016–2018)	0	0	0	0
	WAVE 9 (2017–2019)	1	0	0	0
	WAVE 10 (2018–2020)	1	1	0	0
After-COVID-19	April 2020	1	1	1	0

Note: April 2020 is the first wave of the COVID questionnaire.
Existing carers are grouped according to when they start caregiving. The Wave 9 group comprises caregivers mainly starting in 2017–18 and the Wave 10 group comprises caregivers mainly starting in 2018–19.

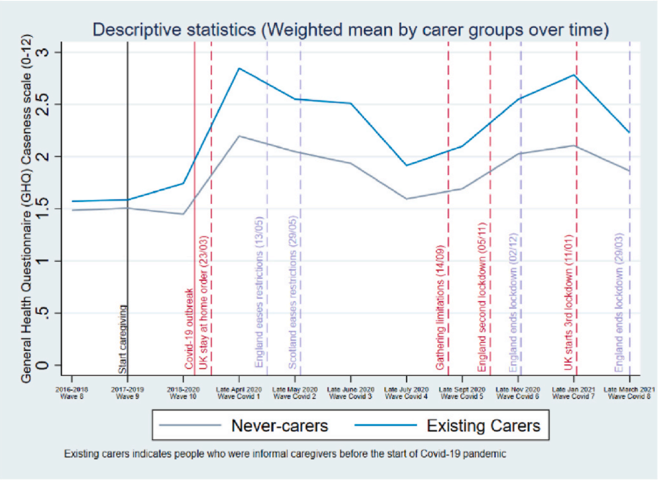

Fig. 1. GHQ weighted mean over time by existing carers and never-carers.

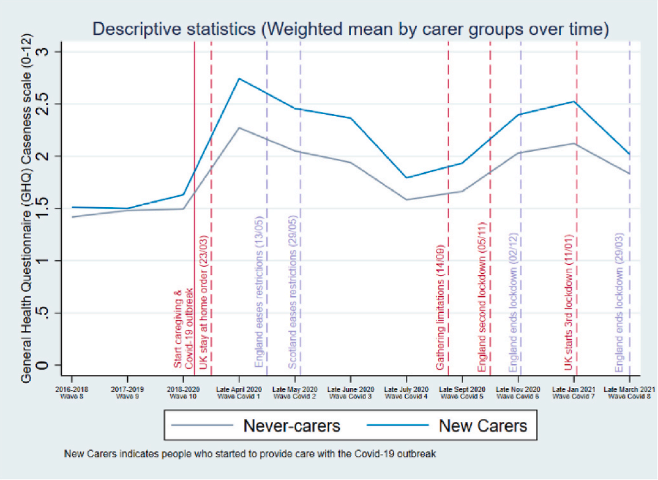

Fig. 2. GHQ weighted mean over time by new carers and never-carers.

Table 2 shows the descriptive statistics of variables in the mainstage Wave 8 (when individuals were not providing informal care) for each group of informal caregivers (existing and new carers) versus never-carers. Table 2 shows that, on average, existing carers are older than never-carers, while new carers are the youngest group. Compared to existing carers, new carers and never-carers are more likely to live alone, be single and less likely to be widowed or divorced. New carers tend to have more dependent children and are more likely to be employed. Existing caregivers have poorer physical health with greater functional limitations and long-standing illnesses. Importantly, all groups have similar levels of mental health before providing informal care. This suggests that becoming an informal carer may affect mental health. Interestingly, while all groups have similar demographic characteristics in terms of gender, ethnicity, education, and nation of residence, existing carers are on average older compared to new carers. As such, it is

Table 2
Descriptive statistics of groups in Wave 8.

Variables	Never-Carers (2,694)		Existing Carers (349)		New Carers (1,655)	
	Mean	SD	Mean	SD	Mean	SD
Age	52.509	16.364	55.476	10.994	48.593	13.326
Female	0.499	0.500	0.625	0.485	0.628	0.483
White	0.933	0.250	0.966	0.182	0.928	0.259
Education:						
Less than O-level or eq.	0.574	0.495	0.605	0.490	0.593	0.491
O-level, A-level or eq.	0.134	0.341	0.123	0.330	0.134	0.341
Higher than A-level	0.291	0.455	0.272	0.446	0.273	0.445
Live alone	0.844	0.363	0.771	0.421	0.866	0.340
Marital status:						
Single	0.235	0.424	0.147	0.354	0.224	0.417
Married/Civil partnership	0.612	0.487	0.638	0.481	0.636	0.481
Divorced/ Widowed	0.153	0.360	0.216	0.412	0.140	0.348
Number of children under 16	0.317	0.722	0.223	0.564	0.505	0.866
Job status:						
In paid employment	0.584	0.493	0.630	0.483	0.732	0.443
Unemployed	0.019	0.135	0.029	0.167	0.013	0.115
Retired	0.308	0.462	0.281	0.450	0.177	0.382
Other non-paid activities	0.089	0.285	0.060	0.238	0.077	0.267
Income (quintiles)	2.286	1.396	2.313	1.340	2.406	1.363
SF-12 physical score	51.217	9.716	49.518	10.208	52.284	8.897
SF-12 mental score	50.179	9.846	50.003	8.875	49.717	9.236
Number functional limits	0.417	1.116	0.549	1.06	0.309	0.887
Long-standing illness	0.323	0.468	0.372	0.484	0.283	0.451
Self-rated health	2.540	0.990	2.670	0.978	2.422	0.941
Nation:						
England	0.824	0.381	0.794	0.405	0.828	0.378
Wales	0.057	0.231	0.066	0.248	0.057	0.232
Scotland	0.092	0.289	0.095	0.293	0.082	0.274
Northern Ireland	0.027	0.162	0.046	0.209	0.034	0.181
Life satisfaction	5.395	1.386	5.398	1.317	5.404	1.289
GHQ-Caseness	1.389	2.819	1.479	2.708	1.514	2.812
GHQ-Likert	10.496	5.289	10.762	4.941	10.718	4.986

Note: Descriptive statistics are calculated in Wave 8, when nobody was caregiving.

plausible to assume that existing carers might have started to provide care earlier to support older parents or relatives.

Since it might be relevant to provide information about the type of care provided as well as about the person cared for, we report in the Appendix a series of additional tables (see Tables A2-A3). These include more specific information on the tasks performed by informal carers and the type of person they cared for during the first COVID wave (broken down by existing and new carers). Table A2 suggests that new and existing carers tended to mostly perform similar tasks (e.g. gardening and shopping); however, existing carers seemed to more frequently "*look after personal affairs*" and this might be a reflection of longer standing arrangements. Table A3 also shows that both existing and new carers appeared to have provided care mostly to neighbour/friends and older individuals. While this information might be useful, this question was answered by a relatively small proportion of individuals in the sample and only during COVID Waves 1, 6 and 8.

6. Results

6.1. Two-way fixed effects models

Estimates of the two-way fixed effects (TWFE) models are presented in Table 3. These were separately estimated using alternative treatment groups of existing (Columns 1–3) and new carers (Columns 4–6). Note that in all models, the control group included never-carers; our outcome of interest is GHQ-12, which indicates an increase in mental ill-health; and Wave 10 is the baseline wave, i.e. the last wave before the COVID-19 outbreak. TWFE regressions were estimated with an incremental number of controls (columns 1–3) and the rows shaded in grey correspond to when lockdowns or strict social restrictions were in place.

Table 3 shows that pre-treatment periods (first two rows) are not statistically significant, and this further supports the parallel trends assumption. Table 3 also appears to show that existing carers present generally worse mental health compared to never-carers during the COVID-19 pandemic. However, the only statistically significant estimate (at a 10% level) corresponds to COVID Wave 7, where being an existing caregiver contributes to an increase in psychological distress by 0.48 points on the GHQ scale. Since COVID Wave 7 was collected during January 2021 (when the UK was in its third national lockdown), this implies that while existing carers were coping relatively well with the pandemic, possibly due to their previous experience, imposing another lockdown almost one year after the start of the pandemic might have negatively affected their mental health. Although this coefficient is only weakly significant, to have a sense of its magnitude, we can compare it with the effect of other major life events on the GHQ-12 score in the UK as shown by Clark and Georgellis (2013). For example, experiencing unemployment increases mental ill-health by 0.41 points on the GHQ scale for men and 0.60 points for women, while the death of a partner leads to a worse mental health by 0.51 points for women and 0.53 points for men. This suggests that a deterioration of 0.47 GHQ points is a sizeable effect.

Concerning new caregivers, we notice their mental well-being more clearly deteriorated during the pandemic. Specifically, mental health is significantly worse compared to never-carers during the first national lockdown (COVID Waves 1–2: April–May 2020), persisting also throughout June 2020 (COVID Wave 3), and during the second and third national lockdowns (COVID Waves 6–7: November 2020–January 2021). These results suggest that COVID-19 and its related social restrictions led to a statistically significant mental health decline among informal caregivers who started to provide care after the COVID-19 outbreak. In terms of the size of the corresponding coefficients, during the first national lockdown, being a new caregiver contributed to a highly statistically significant decline in mental health by around 0.37 points on the GHQ scale in April 2020; 0.32 points in May 2020; and 0.39 points in June 2020. In November 2020 and January 2021, when further lockdowns and stay-at-home orders were reintroduced, new caregivers' mental health also weakened compared to never-carers by about 0.27 and 0.25 points on the GHQ scale, respectively, although these estimates are only weakly significant. A possible explanation of these results might be linked to the lack of experience of new caregivers combined with the strict lockdown rules limiting social interactions as well as external support. Overall, it should be noted that the mental health effects of new carers appear to be more precisely estimated compared to the effect on existing carers. This might imply that we cannot categorically exclude the presence of some mental health effects among existing carers as well and that these could be potentially more precisely identified using a larger sample.

All models controlled for covariates that might influence mental health. In line with the previous literature, white people have better mental health (1.19 GHQ points for existing carers and 0.81 GHQ points for new carers). Women present better mental health (a change of 0.71 GHQ points among existing carers). Finally, being in paid employment is correlated with better mental health (0.36 GHQ points for new carers),

Table 3
DD results. GHQ-caseness.

DD interactions (Wave 10 as baseline)	GHQ Existing carers			GHQ New carers		
	(1)	(2)	(3)	(1)	(2)	(3)
Carer x Wave 8 (2016-2018)	-0.312	-0.342	-0.343	-0.040	-0.024	-0.024
	(0.358)	(0.251)	(0.251)	(0.104)	(0.121)	(0.121)
Carer x Wave 9 (2017-2019)	-0.428	-0.199	-0.199	-0.116	-0.071	-0.071
	(0.347)	(0.223)	(0.223)	(0.099)	(0.115)	(0.115)
Carer x Wave COVID 1 (April 2020)	0.480	0.296	0.296	**0.336*** **	**0.369*** **	**0.369*** **
	(0.414)	(0.283)	(0.283)	(0.119)	(0.137)	(0.137)
Carer x Wave COVID 2 (May 2020)	0.512	0.125	0.126	**0.270** **	**0.319** **	**0.320** **
	(0.356)	(0.243)	(0.243)	(0.117)	(0.136)	(0.136)
Carer x Wave COVID 3 (June 2020)	0.370	0.359	0.361	**0.289** **	**0.387*** **	**0.386*** **
	(0.378)	(0.256)	(0.257)	(0.119)	(0.138)	(0.138)
Carer x Wave COVID 4 (July 2020)	0.107	0.054	0.053	0.073	0.180	0.181
	(0.342)	(0.244)	(0.244)	(0.113)	(0.131)	(0.132)
Carer x Wave COVID 5 (Sept 2020)	0.225	0.064	0.066	0.135	0.193	0.193
	(0.331)	(0.241)	(0.242)	(0.114)	(0.130)	(0.130)
Carer x Wave COVID 6 (Nov 2020)	-0.007	0.317	0.314	**0.228***	**0.265***	**0.266***
	(0.275)	(0.246)	(0.246)	(0.118)	(0.137)	(0.137)
Carer x Wave COVID 7 (Jan 2021)	0.323	**0.476***	**0.476***	**0.267** **	**0.246***	**0.246***
	(0.309)	(0.244)	(0.244)	(0.123)	(0.140)	(0.140)
Carer x Wave COVID 8 (Mar 2021)	-0.034	0.090	0.091	0.049	0.092	0.092
	(0.354)	(0.246)	(0.245)	(0.121)	(0.138)	(0.138)
Age		-0.098	-0.097		0.064	0.068
		(0.080)	(0.080)		(0.061)	(0.061)
Age squared		0.001	0.001		0.000	0.000
		(0.001)	(0.001)		(0.000)	(0.000)
Living alone		0.104	0.102		-0.019	-0.021
		(0.116)	(0.116)		(0.113)	(0.113)
Children(<16) in household		**0.429***	**0.428***		**0.377*** **	**0.376*** **
		(0.226)	(0.227)		(0.144)	(0.144)
Female		**-0.597*** **	**-0.709*** **		-0.005	-0.021
		(0.105)	(0.131)		(0.386)	(0.398)
White		**-1.199*** **	**-1.194*** **		**-0.829*** **	**-0.810*** **
		(0.112)	(0.113)		(0.110)	(0.112)
Education		-0.005	-0.004		0.004	0.004
		(0.394)	(0.397)		(0.300)	(0.301)
Paid employment		-0.061	-0.062		**-0.361*** **	**-0.360*** **
		(0.112)	(0.112)		(0.101)	(0.101)
Income (quint) ++		0.038	0.038		0.018	0.018
		(0.051)	(0.051)		(0.040)	(0.040)
Cum daily deaths by region			**0.001***			**0.001** **
			(0.001)			(0.001)
Being tested			0.097			0.028
			(0.086)			(0.062)
Observations	30360	23176	23176	47322	34472	34472
N of respondents	2760	2112	2112	4302	3143	3143

Note
Carer equals one if respondents are existing caregivers, or new caregivers and zero if they are never-carers.
**** p<0.01, ** p<0.05, * p<0.1*
++ indicates variables are projected from the mainstage waves
Robust standard errors in parenthesis, clustered at primary sampling unit.
Shaded rows indicate when the UK was under strict social restrictions while white rows indicate more relaxed periods.
All specifications included time and individual fixed effects. Models (2) and (3) also included regional fixed effects.

while having dependent children appears to decrease mental health (0.43 and 0.38 GHQ points for existing and new carers). As expected, a higher cumulative number of daily COVID-19 deaths measured at a regional level is associated with worse mental health, although the effect is of a small magnitude, while being tested for COVID is positively but insignificantly associated with a mental health deterioration.

6.2. *Multiple time periods difference-in-differences*

Difference-in-differences models with multiple periods were also estimated (Callaway and Sant'Anna, 2021). Using this approach, we simultaneously estimated the group-time average treatment effect (ATT) on each treated group of carers. This ultimately accounts for timing and duration of care when estimating the mental health effects of COVID-19 among informal carers. Accordingly, we divided existing caregivers into two sub-groups based on when they started caregiving, either in Wave 9 or Wave 10. Figs. 3–5 show the group-time average treatment effects over time for each treated group when the entire set of covariates were included in the analysis. Figs. 3 and 4, which are related to existing caregivers, show that for the group of existing carers starting in Wave 9 the ATT is always positive. This suggests this group of carers experienced worse mental health compared to never-carers; however, coefficients are not statistically significant. Existing carers starting in Wave 10 show a statistically significant ATT, although only at the 10% level, of about 0.56 points on the GHQ scale in COVID Wave 7 (time 7 in Fig. 4). This is in line with our previous finding, suggesting that existing caregivers starting in Wave 10 (2018–2020) might explain the results of the TWFE models relative to existing carers.

Fig. 5 shows that new carers present significantly worse mental health, especially during the first national lockdown of about 0.29 GHQ points in both COVID Wave 1 (time 0 in Fig. 5) and COVID Wave 2 (time 1 in Figs. 5), and 0.35 GHQ points in COVID Wave 3 (time 2 in Fig. 5). However, the statistically significant effect previously found during the second and third national lockdowns does not persist in the most comprehensive specification of this DD analysis.

7. Conclusions

We investigated whether the current COVID-19 pandemic had a causal effect on mental health among informal carers. Unlike previous studies, we employed a quasi-experimental approach combining difference-in-differences with matching to account for the potential roles played by timing and duration of caregiving. To our knowledge, this is the first analysis employing multiple time periods difference-in-differences specifications while also looking at different types of informal carers: existing and new informal carers. Results about the harm to the mental health of new carers, i.e. those who started providing informal care only during the pandemic, might be of particular interest to policy makers as they refer to a sizeable group of individuals that has been overlooked by most previous studies.

Our findings suggest that mental health fluctuated according to social restrictions, but informal carers had consistently worse outcomes during the pandemic compared to never-carers. Specifically, our estimates show that new carers were the most affected, with statistically significant and sizeable deteriorations in their mental health when lockdowns and social restrictions were in place. Therefore, even if social restrictions were essential to curb infection rates by limiting COVID-19 transmission, our results imply that imposing stay-at-home orders harmed mental health, especially for those who became informal caregivers only after the COVID-19 outbreak.

This study has limitations. First, only informal caregivers providing care to someone living outside their household were investigated. However, considering the stay-at-home orders and travel bans, informal caregivers providing care to someone living outside their household might have been less affected by COVID-19 compared to home-carers. External caregivers might provide less intense care compared to informal carers living with the care-recipient, especially when social restrictions were in place. Thus, our results might represent the lower bound of the true mental health effects on informal carers. Second, the intensity of care is not examined. We examined the duration of care, i.e. when someone became a caregiver for the first time, but we do not consider care intensity such as the number of hours of care provided. This is because such information is not available in each wave of the survey. Finally, we do not have information about use of therapy or medications that might have influenced mental health.

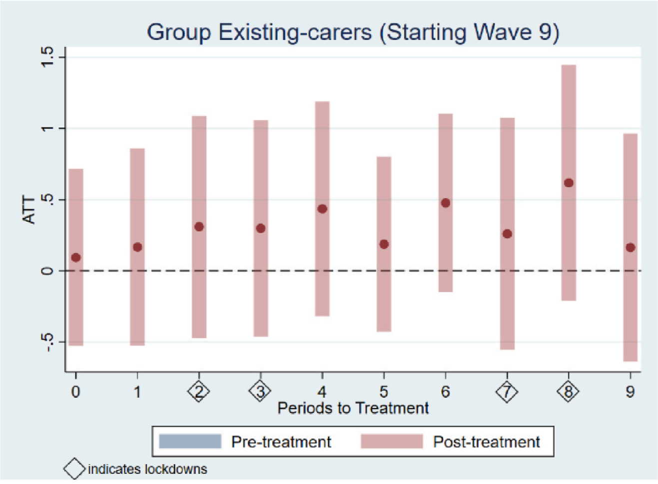

Fig. 3. ATT over time by existing carers (Wave 9) and never-carers.

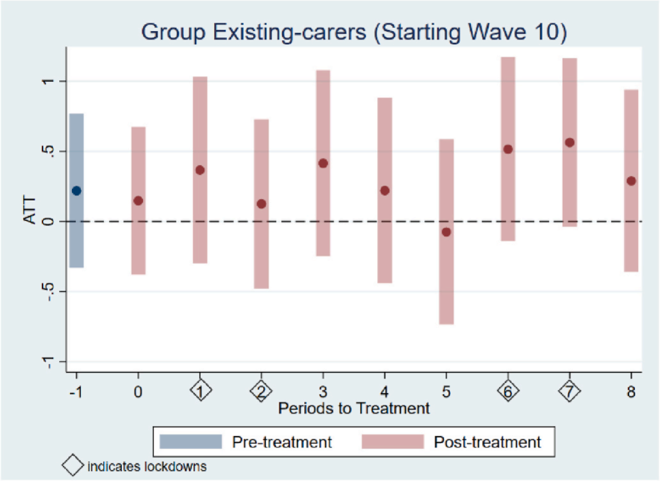

Fig. 4. ATT over time by existing carers (Wave 10) and never-carers.

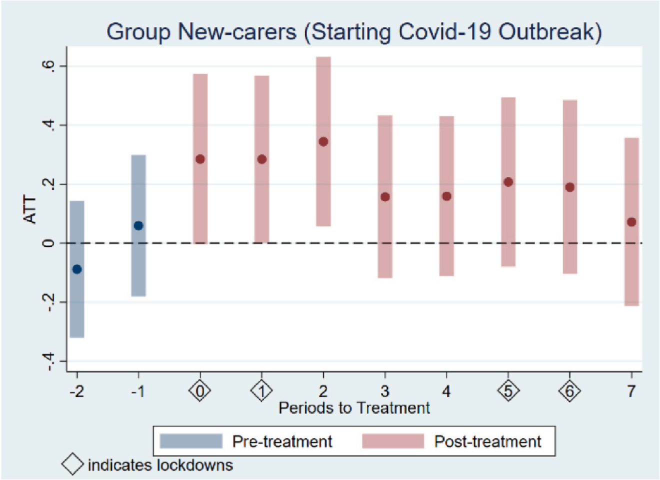

Fig. 5. ATT over time by new carers and never-carers.

Overall, our results are of interest to those considering the policy relevant need to better understand how informal caregivers' mental health was affected during COVID-19. Estimates suggest that mental health was mostly affected when social restrictions were imposed, especially among those people who started caregiving after the COVID-19 outbreak. Of course, that is not to say that social restrictions were necessarily damaging in aggregate. Our findings add to recent evidence which suggests that caregivers in general had significantly worse mental health than non-carers during the pandemic, including long-term mental health issues (Park, 2021; Dhiman et al., 2020). Moreover, our results reinforce the need to implement policies to provide psychological support for new informal caregivers, potentially online (Bertuzzi et al., 2021). This might be particularly effective at the start of informal care provision, especially for those who become informal carers for the first time during a public health crisis and for those who might be socially isolated, thus lacking the support of a social network. The type of support offered during a pandemic might have to be very different to other forms of support offered to new informal carers, where more traditionally this would have taken the form of financial support or respite care (Courtin et al., 2014). This may further highlight the need for research into the availability and cost effectiveness of digital tools, the reopening of face-to-face services post pandemic (Giebel et al., 2021), and the relevance of communication (Bailey et al., 2022) to support informal carers, especially in emergency situations and their longer-term aftermath.

CRediT author statement

Chiara Costi: Data curation; writing- original draft preparation; methodology; conceptualisation. Vincent O Sullivan: conceptualisation; methodology; writing- reviewing and editing. Eugenio Zucchelli: conceptualisation; methodology; writing- reviewing and editing. Bruce Hollingsworth: conceptualisation; methodology; writing- reviewing and editing.

Data availability

The authors do not have permission to share data.

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Appendix

Table A1
Propensity Score Matching on pre-treatment variables

	Existing carers VS never-carers		New carers VS never-carers	
	Before PSM: p-value of difference	After PSM: p-value of difference	Before PSM: p-value of difference	After PSM: p-value of difference
Need to provide care:				
Married/civil partner	0.3452	0.753	**0.0336**	0.511
Living alone	**0.0005**	0.648	**0.0050**	0.127
Number of children under 16	**0.0204**	0.602	**0.0000**	0.507
Willingness to provide care:				
Paid employment	0.3130	0.814	**0.0000**	0.908
Job type	0.4261	0.625	**0.0389**	0.847
Income (quintiles)	0.7268	0.267	**0.0042**	1.000
Ability to provide care:				
Age	**0.0010**	0.495	**0.0000**	0.403
Female	**0.0000**	0.815	**0.0000**	0.885
White	**0.0180**	0.690	0.5379	0.333
Longstanding illness or disability	**0.0664**	0.875	**0.0071**	0.165
Self-assessed health	**0.0202**	0.593	**0.0001**	0.370
SF-12 physical health	**0.0023**	0.507	**0.0006**	0.614
SF-12 mental health	0.7500	0.778	**0.0912**	0.353
Number of functional limitations	**0.0369**	0.823	**0.0012**	0.291
Satisfaction with health	**0.0457**	0.677	**0.0114**	0.587
Satisfaction with income	**0.3640**	0.315	0.7616	0.445
Satisfaction with life overall	0.9661	0.779	0.2632	0.772
GHQ likert scale (baseline)	0.3734	0.988	**0.0054**	0.263
GHQ caseness scale (baseline)	0.5735	0.795	**0.0662**	**0.094**

Table A2
Caregiving tasks performed in COVID Wave 1, by caregiver status

Caregiving task:	Existing carers	New carers
Giving lifts	0.059	0.027
Shopping	0.826	0.908
Cooking	0.233	0.138
Helping with personal needs	0.042	0.006
Washing/cleaning	0.127	0.028
Dealing personal affairs	0.258	0.078
Assisting online or internet access	0.157	0.118
Gardening/house repairs	0.097	0.076
Looking after children	0.03	0.023
Something else	0.131	0.125
Sum of tasks	1.962	1.527
N. observations	236	1403

Table A3

Identity of person being cared for in COVID Wave 1, by caregiver status

Care-recipients:	Existing carers	New carers
Adult children (also in-law)	0.148	0.134
Parents or grandparents (also in-law)	0.619	0.504
Siblings	0.047	0.088
Spouse or partner	0.038	0.023
Former spouse or partner	0.004	0.010
Friends	0.195	0.247
Neighbours	0.415	0.432
Someone else	0.076	0.080
Sum of number of care recipients	1.542	1.518
N. observations	236	1404

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