Robinson Crusoe: less or more depressed? With whom and where to live in a pandemic if you are above 50

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Abstract
Did the first wave of the COVID-19 epidemic and the various lockdown measures taken by European governments in the spring of 2020 impact individuals aged 50 and over differently according to their living arrangements and housing conditions? Focusing on three indicators of mental well-being, depression, loneliness and trouble sleeping, this paper answers the question using data on Europeans interviewed in the SHARE Corona Survey, fielded right after the first wave of the pandemic in summer 2020, linked longitudinally with two previous waves of SHARE (2013 and 2015). We find that the first wave of the pandemic changed the association between mental health and living arrangements and housing conditions. New to this pandemic period, the mental well-being of those who lived only with a spouse declined relative to the general population aged 50+. Relatedly, there was a protective impact for parents of having (adult) children in the same building as opposed to children, however close, who were not co-residing. Finally, living in cities and in multi-unit housing also led to a decrease in mental well-being relative to the general population aged 50+.

JEL classification I1 · J12 · J14 · R19

Keywords Lockdown · Living arrangement · Housing · Mental well-being · SHARE · COVID-19

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1 Introduction

In the fight for lives during the first spike of the pandemic, governments worldwide implemented strict stay-at-home policies, full lockdown, and the closure of public places. As the virus was assumed to be especially dangerous for older people, their confinement was particularly strict. Confinement measures reduce the spread of the virus, but they also result in social isolation that can affect mental well-being. The intensity of the social isolation resulting from confinement, the fear of contagion and uncertainty about the future and other effects of the pandemic and lockdown measures may depend on with whom and where people lived. As a consequence, housing and living arrangements could become key determinants of well-being during a pandemic. Positive agglomeration externalities have been central in urban economics since Marshall (1890).\(^1\) They explain why cities expanded: density provides economies of scale, interactions, increasing productivity, far above the negative externalities of transport congestion, pollution or disease contagion. But with confinement aimed at reducing contagion, the positive urban externalities are suddenly reduced with the suppression of face to face interactions. Moreover “within household density” takes a new role: it might generate new externalities, positive if other household members compensate for suppressed outdoor interactions, negative if a crowded apartment is a source of stress. The question can be worded as follows: was it good to live protected from the virus, away from cities, in large houses or alone, like Robinson on his island? Or was it good to stay in the crowd and not be depressed? More precisely, did the first wave of the COVID-19 epidemic and the various lockdown measures taken by European governments in the spring of 2020 impact the mental well-being of individuals aged 50 and over differently according to their living arrangements and housing conditions?

Leaving aside the effect of living arrangement and housing conditions on the direct spread of the virus, we focus on three mental well-being indicators: depression, loneliness and having trouble sleeping of those aged 50 or more during the first wave of the COVID-19 epidemic in 2020. We use a special telephone interview of SHARE (Survey of Health, Ageing and Retirement in Europe) run in summer 2020, called SHARE Corona Survey. Along with other questions on many aspects of their life, respondents were asked to report their mental well-being during the month preceding the interview.\(^2\) We analyze the role of two aspects of living arrangements, household composition and distance to the nearest child; and the role of three housing characteristics, the location (rural versus urban), the type of building (single house versus multiple-unit buildings), and the number of rooms. We ask if depression, loneliness, and trouble sleeping varied with living arrangements and housing characteristics at the end of the first wave of the COVID-19 pandemic relative to pre-COVID times.

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\(^1\) See e.g., Fujita and Thisse (1996).

\(^2\) European countries started to lift stay-at-home requirements gradually in May 2020. As of June 1, 2020 only Belgium had a strict stay-at-home order that was replaced by a recommendation on June 8, 2020 (see Oxford COVID-19 Government Response Tracker). Online Appendix A, Figs. A.1 and A.2 show the evolution of stay-at-home recommendations in the 12 countries we study.
This paper contributes to a rapidly growing literature about the impact of the COVID-19 pandemic on mental health or well-being. Our focus on the association between mental health and living arrangement/housing conditions is both new and important because living arrangement and housing conditions became clearly more important due to lockdowns or self-imposed restrictions. Another paper focusing on the relationship between living arrangements and mental health is Hamermesh (2020), which uses pre-pandemic time use surveys to examine how life satisfaction is related to with whom and how long we relate. Keeping people with no children under 18, he finds that life satisfaction among married couples increases with additional time spent together. Among singles (above age 30), satisfaction decreases as more time is spent alone. This leads him to predict that the likely impacts of a lockdown will be an increase in satisfaction among couples, a decrease in satisfaction among singles. However, some have underlined the strong pressure lockdowns put on couples. For instance, Béland et al. (2020) report an increase in financial instability and a risk of domestic violence. Our results, based on studying the older population and using actual data pre and post-pandemic, lead to a different conclusion from the one in Hamermesh (2020).

While a lot is being documented on the impact for young people or working-age individuals, less is known about the older population. Mendez-Lopez et al. (2022) and García-Prado et al. (2022) aim to estimate the impact of lockdown policies on mental health. Both only use the SHARE Corona data. Measuring the impact of the pandemic on mental health from a single cross-section of respondents observed during the pandemic is challenging. Both papers find a negative impact of lockdowns on mental health.3 Also using just SHARE data, Bertoni et al. (2021) look at the impacts of retirement on preventive behavior and mental health during the COVID-19 pandemic and find no effect on mental health except for singles. Several studies find an increase in mental health problems or a decrease in well-being based on longitudinal survey data (Banks and Xu, 2020; Pierce et al., 2020), on online surveys during the pandemic (Bu et al., 2021; Huebener et al., 2021; Jace and Makridis, 2020), and Google trends (Tubadji et al., 2020; Brodeur et al., 2021). However, there is little evidence about the role of living arrangements and housing characteristics for mental well-being during COVID-19. Atzendorf and Gruber (2021), using the SHARE Corona telephone survey concentrate on retired individuals aged 60 or more, and also rely on respondent reports of increase in loneliness

3 Both studies differ from ours not only in terms of the data used but also in the choice of the main outcome measures. The SHARE Corona Survey first asks the respondent if he/she is depressed (or has anxiety/sleep problems). A follow-up question is asked: “is this more, about the same or less than before the pandemic ...?”; but it is asked only if the answer to the first question is “yes”. Both studies use as outcome a single binary indicator for “more depressed”, leaving aside the answer to the first question, the binary indicator for depression, which we use in longitudinal analysis. The “more depressed” indicator of those studies is a difference, making up for lack of longitudinal data, but we believe this particular “deterioration” indicator has some problems which hinder a clean interpretation. First, it relies on recall and a subjective comparison which may be influenced by the pandemic itself. Second, the follow-up is asked only if the answer to the first question is “yes”. Thus a “one” does not distinguish between individuals who became depressed during the pandemic, and those who were already depressed but state that they are more depressed, which seems qualitatively different; even more so, a “zero” lumps together several qualitatively different improvements and non-changes in mental health. The mean of this “more depressed” outcome is neither a valid measure of the prevalence of depression in the population, nor of the change in prevalence in the population because it does not properly use flows in and out of the depression state.
or depression compared to the time before the outbreak of the pandemic. They relate them to macro indicators of the severity of the pandemic, and to some individual factors. They find that macro factors were somewhat less important than individual factors and that those living alone had a higher risk of mentioning increased depression after the first COVID-19 wave than those living with others. Litwin and Levinsky (2021) use not only SHARE Corona Survey, but also wave 6 of SHARE which allows them to control for some baseline individual characteristics. They find that face-to-face contact with members of one’s social network reduced depression and anxiety during the pandemic, while contacts via phone or electronic means did not. None of those studies consider other living arrangements or housing conditions.

Our strategy is somewhat similar to Litwin and Levinsky (2021), but we add one more former wave of SHARE, and we also fully make use of the longitudinal aspect of the data in fixed-effects specifications. We do not just look at the association between living arrangements/housing conditions and mental well-being during the first wave of COVID-19, but also at associations before the pandemic and our main focus is on changes in such associations after the first wave of the pandemic. To the best of our knowledge, this has not been done before. To summarize, our type of analysis allows us to control for predetermined characteristics and points to new effects linked to a totally new policy, namely lockdown in a pandemic. In addition, we are the first to consider how the pandemic changed the relationship between mental health and some other living arrangements and housing conditions, such as distance to children, city size, type of building, among others.

Overall, while feelings of loneliness among the 50+ were slightly higher in summer 2020 compared to what had been measured by SHARE surveys since 2004, the proportion of respondents that felt sad or depressed decreased from 42% in pre-COVID waves to 28% in the Corona Survey, and the proportion who had trouble sleeping decreased from 35% to 26%. Litwin and Levinsky (2021) notice the decrease in depression and quote Reibling et al. (2017) who point out that in Europe people were less depressed during the crisis of 2008. While keeping in mind this somewhat surprising evolution for SHARE respondents as a whole, we show how the mental health of persons with different (pre-determined) living arrangements/housing conditions deviated from that of the general population following the first wave of the pandemic.

Our main results are the following: First, with whom the elderly live matters. Before the COVID-19 pandemic, living alone was associated with worse mental well-being, as is well known; that is still the case in the SHARE Corona Survey. However, we find that the relative mental well-being of two particular groups of respondents was markedly different after the first wave of the pandemic. Respondents who were single but living with others (in 80% of cases those “others” are adult children) improved their mental well-being relative to that of the rest of the population, while the mental well-being of respondents who lived only with a spouse (and no one else) became relatively worse. For parents, the presence of an adult child in the household or living in the same building was associated with better mental well-
being relative to those whose children lived further away after the first wave of COVID-19. During the first wave of the pandemic, children living outside could not visit their parents during lockdowns, or might not visit them for fear of spreading the virus even if allowed to.

Second, the location where a person lived during the first wave of the COVID-19 pandemic also mattered: depression and loneliness became associated with living in big cities during the pandemic, a totally new phenomenon. Moreover this changed association was primarily driven by respondents living in multi-unit buildings.

The paper proceeds as follows. Section 2 describes the SHARE data and shows some descriptive statistics. In Section 3, we describe our empirical approach. Section 4 reports the results on the changes in the association between mental well-being and living arrangements and housing conditions and discusses causal interpretations and heterogeneity across gender. Section 5 concludes.

### 2 Data

#### 2.1 SHARE data

This study uses the Survey of Health, Ageing and Retirement in Europe (SHARE).\(^4\) It is a multidisciplinary longitudinal biannual survey providing information on the health, socioeconomic and demographic situation of individuals aged 50 or more in Europe. We keep two regular face-to-face surveys, wave 5 (2013) and wave 6 (2015), and the telephone survey conducted in summer 2020.\(^5\) SHARE Corona Survey. Scherpenzeel et al. (2020) provide an excellent description of the data structure and details on data collection.

Waves 5 and 6 are the last most recent waves providing the variables we need and for which a full representative sample is available.\(^6\) Since in some analyses we control for lagged health, we keep 12 countries that participated in the survey since

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\(^4\) This paper uses data from SHARE Waves 1, 2, 3, 4, 5, 6, 7, and 8 (DOIs: 10.6103/SHARE.w1.800, 10.6103/SHARE.w2.800, 10.6103/SHARE.w3.800, 10.6103/SHARE.w4.800, 10.6103/SHARE.w5.800, 10.6103/SHARE.w6.800, 10.6103/SHARE.w7.800, 10.6103/SHARE.w8.800, 10.6103/SHARE.w8ca.800, see Borsch-Supan et al. (2013) for methodological details. The SHARE data collection has been funded by the European Commission, DG RTD through FP5 (QLK6-CT-2001-00360), FP6 (SHARE-I3: RII-CT-2006-062193, COMPARE: CIT5-CT-2005-028857, SHARELIFE: CIT4-CT-2006-028812), FP7 (SHARE-PREP: GA N°211909, SHARE-LEAP: GA N°227822, SHARE M4: GA N°261982, DASISH: GA N°283646) and Horizon 2020 (SHARE-DEV3: GA N°676536, SHARE-COHESION: GA N°870628, SERISS: GA N°654221, SSCHO: GA N°823782, SHARE-COVID19: GA N°101015924) and by DG Employment, Social Affairs & Inclusion through VS 2015/0195, VS 2016/0135, VS 2018/0285, VS 2019/0332, and VS 2020/0313. Additional funding from the German Ministry of Education and Research, the Max Planck Society for the Advancement of Science, the U.S. National Institute on Aging (U01_AG09740-13S2, P01_AG005842, P01_AG08291, P30_AG12815, R21_AG025169, Y1-AG-4553-01, IAG_BSR06-11, OGHA_04-064, HHSN271201300071C, RAG052527A) and from various national funding sources is gratefully acknowledged (see www.share-project.org).

\(^5\) For a few countries, less than 3% of interviews took place in August (Börsch-Supan, 2022), for them we regroup August with July interviews.

\(^6\) Wave 7 (2017), focused on people’s life histories and does not provide the variables used in our analysis.
2010 (wave 4): Austria, Belgium, the Czech Republic, Denmark, Estonia, Germany, France, Italy, Slovenia, Spain, Sweden, and Switzerland.\footnote{We also estimate the model for the sample of 27 countries, based on wave 8 and the SHARE Corona Survey. Even though the findings are similar, we prefer to stick to the specification with 12 countries and waves 5 and 6 in the main text due to the nature of our research question and the existence of some selection in wave 8 (wave 8 started at the end of 2019 but had to be interrupted in March 2020 because of the pandemic). However, we use wave 8 to build our living arrangements, housing and socio-demographic variables in the Corona observations.}

The small fraction (1%) of respondents who lived in retirement or nursing homes are left out because their housing conditions and living arrangements are intrinsically different from those who live in the community. Once we pool waves 5 and 6 and the SHARE Corona Survey there are up to 80,291 wave-person observations which can be merged longitudinally. For each person-wave observation we construct the following variables obtained from the corresponding survey.

\subsection*{2.1.1 Mental well-being outcomes}

Our outcome variables are three indicators of mental health problems: depression, loneliness, and trouble sleeping.\footnote{For the COVID sample, we also use feeling nervous or anxious, which is not available in pre-COVID waves. Results are in line with other outcomes and are available upon request.} We consider as depressed those who answer “yes” to the following question, asked in exactly the same fashion in all waves: “\textit{In the last month, have you been sad or depressed? (If participant asks for clarification, say ‘by sad or depressed, we mean miserable, in low spirits, or blue’)}”. If they answered “yes” to this question, SHARE Corona Survey asked an additional question: “\textit{Has that been more so, less so, or about the same as before the outbreak of Corona?}”. We group the respondents in the SHARE Corona Survey into three categories: not depressed (75\% of the sample); depressed but either less so or about the same as before (8\%); and depressed and more so than before (17\%). For loneliness and trouble sleeping we use the same combination of two questions (“yes/no”, “if yes, compare with before the pandemic”) to define similar three-category outcomes for all respondents in the SHARE Corona Survey.\footnote{Feeling of loneliness is coded using three categories. We pool together answers “often” and “some of the time” compared to “hardly ever or never” to get an indicator in line with other mental well-being variables. The results remain the same using three categories instead.}

\subsection*{2.1.2 Living arrangements}

We define four categories of household structure: living alone (“Alone”), living only with a spouse or a partner (“Couple”), living with a spouse or a partner and someone else (“Couple-with-others”), and living without a spouse or partner but with others (“Single-with-others”). Those “others” are mostly adult children or
old parents. Thanks to the unique longitudinal data of SHARE, we can construct a variable indicating the distance of a parent to the nearest child, an important aspect of living arrangements, with also four categories: living in the same household or in the same building, less than 1 km away, from 1 to 25 km, and farther away.

2.1.3 Housing conditions

We use three measures of housing conditions. First, the location: big city, suburbs, large town, small town, and rural area. After a first exploration, we group them into two categories: big city (includes the first three categories) versus rural area (small town or rural area). Second, we use the type of accommodation: single house, row house, flat in a small building, flat in a large building, flat in high rise, that we also regroup into two categories: single house versus multiple unit buildings. Finally, we consider the number of rooms: fewer than 2, 3, 4, and more than 5.

2.1.4 Socio-economic and other variables

We use age in three groups (“pre-retired” 50–65, “young retirees” 65-79, and “oldest old” aged 80 or more), gender, and the number of surviving children. We also use three education levels (less than high school, high school or professional education, university), and the ability to make ends meet (four categories, from with difficulty to very easily) as proxies for permanent and current income. Importantly, we also control for four categories of baseline self-reported health in the previous period: excellent or very good, good, fair, and poor. When we study

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10 In the SHARE Corona Survey, 65% of the sample information about the household structure is taken from wave 8 (CAPI) fielded between November 2019 and March 2020. For the remaining 35%, household structure comes from the SHARE Corona Survey in early summer 2020. Although we believe the pre-pandemic measurement is preferable, we do not think this lag of a few months for the latter subsample poses a serious problem for our analysis because the household structure in SHARE is very persistent across waves. The most common transition is from living as a couple into living alone, mostly due to a partner’s death. Among the 35% subsample of the SHARE Corona Survey who reported household structure in summer 2020, we see that 90% reported the same household structure as in the previous SHARE wave in which they participated, which would be at least two-and-a-half years before. Persistence should be considerably stronger over the much shorter interval between the regular wave 8 and the Corona Survey. Furthermore, only 2% of Corona Survey respondents in summer 2020 say that they had temporarily moved elsewhere because of the pandemic. Accordingly, we do not expect that movements induced by the pandemic have much impact on our measurements and conclusions. Still, we perform several robustness checks in Section 4.4.

11 For wave 5 and wave 6 person-wave observations, housing conditions are measured in the corresponding wave. For person-observations in the Corona Survey, housing conditions are measured either in the regular wave 8 interview for 65% of the sample who completed it, and for the remaining 35% they are measured in the last available regular wave which is typically wave 7.

12 Number of rooms excludes kitchen, bathrooms and hallways and any rooms that are let or sublet as well as boxrooms, cellars, attics, etc.

13 For person-wave observation from waves 5 and 6 the previous period is wave 4 and wave 5 respectively, or the last available wave before them. For respondents in the SHARE Corona Survey we use the same question or self-reported health “before the outbreak of the pandemic”.

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the impact of the distance to the nearest child, we add the parent’s marital status: living with a partner or not.

Table 1 reports descriptive statistics, separately for pre-COVID waves and SHARE Corona data. In total, there are 22,943 individuals in the COVID sample, and about 80,291 wave-person observations in the longitudinal analysis.

Overall, while feeling of loneliness slightly increases from 26% to 27% from pre-COVID times to the period of the SHARE Corona Survey after the first wave of the pandemic, the rate of depression declined from 42% to 28%, and that of trouble sleeping from 35% to 26%. There have been many reports of mental health problems linked to COVID-19. Most are said to be concentrated among young people, and appeared after the fall of 2020 (Bu et al. 2021). But our finding of a decrease seems puzzling. Litwin and Levinsky (2021) mention the decline in depression and quote Reibling et al. (2017) who find, analyzing data from the European Social Survey, that in Europe depression symptoms decreased between 2006 and 2014, around the 2008 economic crisis. This is in line with Durkheim (1897) who found that in times of wars suicide rates tend to decrease. His explanation is that individuals are united around major national issues that rekindle the sense of belonging to a community. Indeed, data from 21 countries or areas show that there was no increase in suicide in the early months of the COVID-19 pandemic, and even a decrease in 12 of them (Pirkis et al., 2021).

One could also think of a purely seasonal effect, as the SHARE Corona Survey was conducted in summer 2020. We introduce survey month in our analysis to control for such an effect. Furthermore, in summer 2020 the lockdowns had ended or the most severe restrictions had been lifted. Finally, all pre-COVID SHARE data were obtained in face-to-face interviews (CAPI) whereas the SHARE Corona Survey was conducted by telephone (CATI). Therefore, we cannot rule out a mode effect. Regarding mode effects for mental well-being, there is limited evidence about CATI and CAPI surveys. Previous studies mainly compare CATI or CAPI versus self-administered mail-in or web surveys. One exception is Cernat et al. (2016). From a quasi-experiment on the Health and Retirement Study they find that answers from CATI are modestly more positive regarding depression relative to CAPI. However, by far, the largest differences are between personal interviews and self-administered modes.

More than 45% of the 50+ live in couple (with a spouse or partner), about one out of four lives alone, slightly more in SHARE Corona data; 22% live with a

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14 The rates of depression, loneliness and trouble sleeping had been constant since 2004, the 1st wave of SHARE.

15 The decrease in depression rates during the European summer 2020 was also found in other surveys. For instance, according to OECD (2021), the depression rate in France decreased from 20% at the end of March 2020, to 11% in summer 2020, a large drop, and peaked again at 23% in November. In the UK, depression levels overall were higher than usual reported averages, but also showed a marked dip during summer 2020 (Bu et al., 2021, p.17).

16 Prevalence of mental disorders and suicides did not change significantly in Norway - if anything it rather decreased (Knudsen et al., 2021). Suicides rather decreased in the US too (Sanchez, 2021).

17 The telephone survey was much shorter than the face to face interview. Length of interview and position of an item within the questionnaire are (potentially) part of the mode effect (Clark and Vicard, 2007).
|                          | Pre-COVID | SD | COVID | SD | Difference (1) - (2) | (P-value) |
|--------------------------|-----------|----|-------|----|---------------------|-----------|
| **Mental well-being outcomes** |           |    |       |    |                     |           |
| Depressed                | 0.419     | 0.493 | 0.279 | 0.449 | -0.140              | 0.000     |
| Felt lonely              | 0.259     | 0.438 | 0.271 | 0.445 | 0.012               | 0.000     |
| Trouble sleeping         | 0.349     | 0.477 | 0.263 | 0.440 | -0.086              | 0.000     |
| **Living arrangements**  |           |    |       |    |                     |           |
| **Household structure**  |           |    |       |    |                     |           |
| Alone                    | 0.257     | 0.437 | 0.283 | 0.451 | 0.027               | 0.000     |
| Couple                   | 0.456     | 0.498 | 0.481 | 0.500 | 0.025               | 0.000     |
| Couple-with-others       | 0.217     | 0.412 | 0.175 | 0.380 | -0.042              | 0.000     |
| Single-with-others       | 0.070     | 0.256 | 0.061 | 0.239 | -0.010              | 0.000     |
| **Distance to the nearest child** | | | | | | |
| Coreside                 | 0.361     | 0.480 | 0.306 | 0.461 | -0.055              | 0.000     |
| <1 km                    | 0.160     | 0.366 | 0.154 | 0.361 | -0.006              | 0.060     |
| 1–25 km                  | 0.303     | 0.459 | 0.335 | 0.472 | 0.032               | 0.000     |
| >25 km                   | 0.177     | 0.382 | 0.205 | 0.404 | 0.028               | 0.000     |
| **Housing variables**    |           |    |       |    |                     |           |
| Location                 |           |    |       |    |                     |           |
| Big city                 | 0.352     | 0.478 | 0.356 | 0.479 | 0.003               | 0.327     |
| Rural area               | 0.648     | 0.478 | 0.644 | 0.479 | -0.003              | 0.327     |
| Type of building         |           |    |       |    |                     |           |
| Multiple units           | 0.516     | 0.500 | 0.528 | 0.499 | 0.012               | 0.001     |
| Single house             | 0.484     | 0.500 | 0.472 | 0.499 | -0.012              | 0.001     |
| Number of rooms          |           |    |       |    |                     |           |
| ≤2 rooms                 | 0.110     | 0.313 | 0.109 | 0.311 | -0.001              | 0.544     |
| 3 rooms                  | 0.239     | 0.426 | 0.242 | 0.428 | 0.003               | 0.332     |
| 4 rooms                  | 0.280     | 0.449 | 0.261 | 0.439 | -0.019              | 0.000     |
| ≥5 rooms                 | 0.371     | 0.483 | 0.389 | 0.487 | 0.018               | 0.000     |
| Controls                 |           |    |       |    |                     |           |
| Female                   | 0.548     | 0.498 | 0.534 | 0.499 | -0.014              | 0.000     |
| 50–64                    | 0.473     | 0.499 | 0.432 | 0.495 | -0.041              | 0.000     |
| 65–79                    | 0.404     | 0.491 | 0.387 | 0.487 | -0.018              | 0.000     |
| 80+                      | 0.122     | 0.328 | 0.181 | 0.385 | 0.059               | 0.000     |
| Education                |           |    |       |    |                     |           |
| Less than high school    | 0.433     | 0.495 | 0.346 | 0.476 | -0.087              | 0.000     |
| High school/Professional | 0.361     | 0.480 | 0.411 | 0.492 | 0.051               | 0.000     |
| University               | 0.207     | 0.405 | 0.242 | 0.429 | 0.036               | 0.000     |
| Ability to make ends meet: |         |    |       |    |                     |           |
| With great difficulty    | 0.102     | 0.302 | 0.041 | 0.197 | -0.061              | 0.000     |
| With some difficulty     | 0.235     | 0.424 | 0.165 | 0.371 | -0.070              | 0.000     |
| Fairly easily            | 0.294     | 0.455 | 0.393 | 0.488 | 0.099               | 0.000     |
spouse or partner and someone else (94% of them with at least one child), slightly less during SHARE Corona Survey, and the remaining 7% live with someone who is not a spouse or partner (80% of them with a child and around 20% with a parent or sibling or someone else). Around 10% do not have a child. Note that many of the parents in our sample are elderly and the children with whom they live are adult children. For about 36% of parents, the nearest child lives in the same household or in the same building, less in the Corona Survey. The second most frequent distance is between 1 and 25 km. More than 64% of 50+ live in a rural area or a small town and 52% not in a single house. As for number or rooms, 11% have only one or two, 37% five or more. There are slightly more women than men because of longer females’ longevity. The mean age is 67 years old. On average the respondents are three years older (69) in the COVID sample than in former waves (66). This is because the so-called refresher sample that was drawn for the regular wave 8 could not be fully used because of the pandemic, which stopped the face-to-face survey in March 2020. Hence, our COVID sample is less representative of the young old than of the oldest old. Less than 10% reported poor health before the outbreak of COVID-19 or in the previous waves.

3 Methodology

We start by using only the SHARE Corona Survey. For each of our three mental well-being outcomes, i.e., depression, loneliness and trouble sleeping, the respondent can be in one of three states. For instance for depression: not depressed during last month; depressed but less so or about the same as before the pandemic; or depressed...
and more so than before the outbreak of the pandemic. We run multinomial probit models. This gives a first indication of the associations between living arrangements/housing conditions and mental well-being during the first wave of COVID-19, and also of the links of depression, loneliness and trouble sleeping with age, gender, education, income proxy, health preconditions, the month of interview, and country.\footnote{We also replaced country dummies by three indicators of COVID-19 impact and stringency: number of deaths per capita, number of cases per capita, and lockdown policies in each country (Appendix A, Table A.1).} The results are in Table 2. Next, we consider the subsample of parents, replacing household structure by the distance to the nearest child. Appendix B, Table B.1 reports the results.

In our main analysis we want to go further and study whether the associations we find between living arrangements/housing conditions and mental well-being in the Corona Survey are different from associations found in previous waves. Accordingly, we pool all three waves and switch from using the three-category outcomes which combined the two questions of the SHARE Corona Questionnaire, to the binary outcome obtained from the mental well-being question (about the level in last month) common to SHARE Corona and all the previous waves of SHARE.

We make the full use of the longitudinal nature of the data, and add individual fixed effects (Tables 3 and 4, Columns 2, 4 and 6):

\[
y_{it} = \beta_1 h_{it} + \beta_2 \text{COVID}_t \cdot h_{it} + \beta_3 \text{COVID}_t + \gamma X_{it} + \mu_i + \theta_t + \nu_{j(i)t} + \epsilon_{it},
\]

where \(y_{it}\) is an indicator of having been sad or depressed, having felt lonely or had trouble sleeping in the last month. \(\text{COVID}_t\) equals one for the wave of summer 2020 and 0 otherwise. \(h_{it}\) is one of the five housing variables of interest: household structure, distance to the nearest child, location, type of building or number of rooms. The full list of other controls, \(X_{it}\), depends on the living arrangements or housing conditions variable we analyze. We always control for age groups, previous self-reported health, ability to make ends meet, number of children, and month of interview.\footnote{We also performed two robustness checks. First, we replaced self-reported health with the number of limitations with daily and instrumental activities. Second, we added a control for employment status. The results were unchanged.} When we study living arrangements, we add controls for housing conditions (location, number of rooms and type of building); in case of the distance to the nearest child, we further control for whether the parent lives with a partner or not. For the analysis of the impacts of housing conditions, we control for living arrangements (household structure).\footnote{We control for the type of building if the variable of interest is area of living; area of living if we are analyzing the effect of the type of building; both (area and type of building) when we focus on the number of rooms.} \(\theta_t\) is a wave 6 dummy. \(\mu_i\) is the individual effects and \(\nu_{j(i)t}\) is the country-wave interaction. \(\epsilon_{it}\) is the error term. We cluster standard errors at the individual level to allow for correlation over time for the same individual.\footnote{The results remain the same if we use robust standard errors.} The fixed effect model allows to control for unobserved heterogeneity.

We also present the results from alternative specifications which do not control for individual fixed effects, \(\mu_i\), just pooling waves, adding gender,
### Table 2: Average marginal effect on mental well-being

|                     | Depressed | Felt lonely | Trouble sleeping |
|---------------------|-----------|-------------|------------------|
|                     | Not More  | Not More    | Not More More    |
| (1)                 |           |             |                  |
| (2)                 |           |             |                  |
| (3)                 |           |             |                  |
| (4)                 |           |             |                  |
| (5)                 |           |             |                  |
| (6)                 |           |             |                  |
| Reference categories: Single-with-others, rural area, single house, 5 or more rooms |
| Alone               | −0.0492***| −0.137***   | −0.0186 0.00638  |
|                     | (0.0128)  | (0.0144)    | (0.0133) (0.00776) |
| Couple              | −0.00625  | 0.115***    | −0.00813 0.00682 |
|                     | (0.0123)  | (0.0136)    | (0.0129) (0.00752) |
| Couple-with-others  | 0.0154    | 0.166***    | 0.01100.00200   |
|                     | (0.0141)  | (0.0146)    | (0.0149) (0.00867) |
| Big city            | −0.0227***| −0.0209***  | 0.00521 0.00377  |
|                     | (0.00617) | (0.00615)   | (0.00646) (0.00396) |
| Multiple units      | −0.00736  | 0.0129***   | −0.0173*** −0.00953 |
|                     | (0.00630) | (0.00623)   | (0.00664) (0.00400) |
| ≤2 rooms            | 0.00589   | 0.00836     | 0.00957 −0.00189 |
|                     | (0.00960) | (0.00942)   | (0.0100) (0.00599) |
| 3 rooms             | −0.00292  | 0.00158     | 0.00840 0.00681  |
|                     | (0.00782) | (0.00777)   | (0.00815) (0.00494) |
| 4 rooms             | −0.00460  | 0.000691    | 0.00173 0.00741  |
|                     | (0.00736) | (0.00731)   | (0.00771) (0.00465) |
| Female              | −0.115*** | 0.0873***   | −0.0970*** 0.0331*** |
|                     | (0.00550) | (0.00559)   | (0.00581) (0.00348) |
| 65−79               | 0.00667   | −0.00745    | 0.00794 −0.0167*** |
|                     | (0.00723) | (0.00726)   | (0.00753) (0.00495) |
| 80+                 | −0.0199** | −0.00497    | −0.0230*** −0.0256*** |
|                     | (0.00909) | (0.00895)   | (0.00950) (0.00587) |
| High school/        | 0.0140**  | −0.00613    | 0.00636 0.00935*** |
| Professional        |            |             |                  |
|                     | (0.00692) | (0.00598)   | (0.00727) (0.00433) |
| With some difficulty | 0.0830*** | −0.0724***  | 0.0605*** −0.0373*** |
|                     | (0.0177)  | (0.0172)    | (0.0176) (0.0122) |
| Fairly easily       | 0.143***  | −0.110***   | 0.106*** −0.0664*** |
|                     | (0.0173)  | (0.0167)    | (0.0171) (0.0120) |
| Easily              | 0.166***  | −0.128***   | 0.113*** −0.0768*** |
|                     | (0.0178)  | (0.0171)    | (0.0177) (0.0123) |
| University          | −0.00738  | −0.00223    | 0.00215 0.0231*** |
|                     | (0.00820) | (0.00805)   | (0.00853) (0.00539) |
| Having a child      | −0.0309***| −0.00434    | −0.00387 0.00472  |
|                     | (0.00902) | (0.00902)   | (0.00986) (0.00581) |
| Good                | −0.0617***| 0.0362***   | −0.0610*** 0.0168*** |
|                     | (0.00635) | (0.00545)   | (0.00683) (0.00380) |
The coefficient $\beta_3$ captures the overall impact of the pandemic on mental health. Coefficients $\beta_1$ capture the associations between mental health and living arrangements/housing conditions before the outbreak of the virus, relative to the reference living arrangements/housing conditions category. We interpret these coefficients with caution. For instance $\beta_1$ can be subject to reverse causality if some respondents live alone because they suffer from depression. Coefficients $\beta_2$...
Table 3  Impact of living arrangement on mental well-being

| Depressed | Felt lonely | Trouble sleeping |
|-----------|-------------|------------------|
| Multiwave FE | Multiwave FE | Multiwave FE |
| (1) | (2) | (3) | (4) | (5) | (6) |

**Panel I: Household structure**

*Reference group: Single-with-others*

| Alone | Couple | Couple-with-others | Alone × COVID | Couple × COVID | Couple-with-others × COVID | COVID |
|-------|--------|--------------------|--------------|---------------|---------------------------|-------|
| 0.00227 | 0.00792 | 0.0933*** | 0.0636*** | −0.00774 | −0.0338* | 0.0464*** |
| 0.00774 | 0.0338* | 0.00792 | 0.00774 | 0.0338* |
| −0.0464*** | −0.108*** | −0.162*** | −0.259*** | −0.00862 | −0.0527*** |
| 0.0102 | 0.0203 | 0.00987 | 0.0193 | (0.0104) | (0.0195) |
| −0.0336*** | −0.0929*** | −0.169*** | −0.265*** | −0.0183 | −0.0350* |
| 0.0111 | 0.0212 | 0.0104 | 0.0199 | (0.0112) | (0.0202) |
| 0.0460*** | 0.0578*** | 0.0351** | 0.0354* | 0.0267 | 0.0400*** |
| 0.0169 | 0.0189 | 0.0174 | 0.0185 | (0.0172) | (0.0189) |
| 0.0517*** | 0.0982*** | 0.0250 | 0.0428** | 0.0186 | 0.0458** |
| 0.0160 | 0.0179 | 0.0163 | 0.0174 | (0.0163) | (0.0179) |
| 0.0167 | 0.0626*** | −0.0201 | −0.00685 | 0.0127 | 0.0355* |
| (0.0178) | (0.0202) | (0.0175) | (0.0189) | (0.0182) | (0.0201) |
| COVID | −0.143*** | −0.156*** | −0.00983 | 0.00702 | −0.0640*** | −0.0634*** |
| 0.0202 | 0.0223 | 0.0192 | 0.0206 | (0.0203) | (0.0220) |
| Individual FE | No | Yes | No | Yes | No | Yes |
| Mean dep. var. | 0.3544 | 0.3544 | 0.2363 | 0.2363 | 0.3355 | 0.3355 |
| R² | 0.110 | 0.592 | 0.148 | 0.632 | 0.0880 | 0.623 |
| N | 80,291 | 80,291 | 80,291 | 80,291 | 80,291 | 80,291 |

**Panel II: Distance to the nearest child, Sample of parents**

*Reference group: A child in the same household or building*

| <1 km | 1–25 km | >25 km | <1 km × COVID | 1–25 km × COVID | >25 km × COVID | COVID |
|-------|---------|--------|--------------|-----------------|------------|-------|
| 0.00246 | −0.0115 | 0.0218*** | 0.000194 | 0.0104 | −0.00904 |
| 0.00801 | 0.0161 | (0.00677) | 0.0138 | (0.00819) | (0.0155) |
| 1–25 km | −0.00191 | 0.00538 | 0.0193*** | −0.00740 | 0.000497 | −0.0118 |
| 0.00671 | 0.0137 | (0.00560) | 0.0118 | (0.00680) | (0.0132) |
| >25 km | 0.00952 | −0.00805 | 0.0479*** | 0.00930 | 0.00178 | −0.00218 |
| 0.00815 | 0.0183 | (0.00685) | 0.0151 | (0.00823) | (0.0169) |
| <1 km × COVID | 0.0340*** | 0.0568*** | 0.0374*** | 0.0445*** | 0.00513 | 0.0255* |
| 0.0127 | 0.0148 | (0.0118) | 0.0129 | (0.0131) | (0.0146) |
| 1–25 km × COVID | 0.0476*** | 0.0507*** | 0.0438*** | 0.0430*** | 0.0129 | 0.0295** |
| 0.0106 | 0.0122 | (0.00968) | 0.0105 | (0.0108) | (0.0118) |
| >25 km × COVID | 0.0283*** | 0.0500*** | 0.0314*** | 0.0322*** | 0.00552 | 0.0273* |
| 0.0124 | 0.0142 | (0.0115) | (0.0124) | (0.0128) | (0.0140) |
| COVID | −0.124*** | −0.103*** | −0.00346 | 0.0329** | −0.0594*** | −0.0536*** |
| 0.0173 | 0.0193 | 0.0148 | 0.0158 | (0.0176) | (0.0191) |
| Individual FE | No | Yes | No | Yes | No | Yes |
| Mean dep. var. | 0.3559 | 0.3559 | 0.2269 | 0.2269 | 0.3409 | 0.3409 |
capture the differential associations between living arrangements/housing conditions and mental health during the first wave of the COVID-19 pandemic compared to pre-COVID time. These interaction coefficients $\beta_2$, the “differential COVID effects”, are our main focus and they are unlikely contaminated by reverse causality because they are plausibly predetermined. See further discussion about the interpretation and robustness checks in Section 4.4. Coming back to the potential effect of the change in the mode of interview (from face-to-face interview, to a telephone survey) we do not require an assumption that there are no mode effects, but rather that there are no interactions of mode and living arrangements/housing conditions variables, nor of seasonal effects and living arrangements/housing conditions variables.

4 Results

First, we present the results from the SHARE Corona Survey. Next, we discuss the longitudinal analysis.

4.1 COVID Sample

Table 2 reports the results of the multinomial probits which use only the SHARE Corona Survey. Among the 28% who were said they had been depressed 66% said they were more so than before the outbreak of the Corona; among the 27% who had been lonely, 44% said they were more so and among the 26% who had had trouble sleeping 37% said it was more so than before (weighted data).

| Depression | Felt lonely | Trouble sleeping |
|------------|------------|------------------|
| Multiwave  | FE         | Multiwave  | FE         | Multiwave  | FE         |
| (1)        | (2)        | (3)          | (4)        | (5)          | (6)        |
| $R^2$      | 0.106      | 0.0126      | 0.0858      | 0.0633      |
| N          | 57,622     | 57,622      | 57,622      | 57,622      |

*p < 0.10, **p < 0.05, ***p < 0.01. We cluster standard errors at the individual level. All specifications control for three categories of age, previously reported health, number of children, ability to make ends meet, location, type of building, the month of interview and country-wave interactions. In Panel II, we control for living with a partner. Columns 1, 3 and 5 control further for education, female, and country fixed effects. The sample includes Austria, Belgium, the Czech Republic, Denmark, Estonia, Germany, France, Italy, Slovenia, Spain, Sweden, and Switzerland.

As said above, in 80% of cases “others” are children.

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Robinson Crusoe: less or more depressed? With whom and where to live in a pandemic if... 449
Table 4  Impact of housing conditions on mental well-being

|                | Depressed    | Felt lonely   | Trouble sleeping |
|----------------|--------------|--------------|------------------|
|                | Multiwave FE | Multiwave FE | Multiwave FE     |
|                | (1)          | (2)          | (3)              |
|                | (4)          | (5)          | (6)              |

**Panel I: Location**

*Reference group: Rural area*

|                | Depressed | Felt lonely | Trouble sleeping |
|----------------|-----------|-------------|------------------|
| Big city       | 0.0041    | -0.00895    | -0.00331         |
|                | (0.00479) | (0.00828)   | (0.00407)        |
| Big city × COVID| 0.0175* | 0.0218*** | 0.0194*** |
|                | (0.00682) | (0.00753)   | (0.00629)        |
| COVID          | -0.107***| -0.0883*** | 0.00459          |
|                | (0.0136) | (0.0150)    | (0.0114)         |

Individual FE

|                | Depressed | Felt lonely | Trouble sleeping |
|----------------|-----------|-------------|------------------|
| No             |           |             |                  |
| Yes            |           |             |                  |

| Mean dep. var. |        |            |            |
|----------------|--------|------------|------------|
| 0.3544         | 0.592  | 0.148      | 0.0880     |

| R²              |        |            |            |
|-----------------|--------|------------|------------|
| 0.110           | 0.632  | 0.623      |

| N               |        |            |            |
|-----------------|--------|------------|------------|
| 80,291          | 80,291 | 80,291     | 80,291     |

**Panel II: Location and type of building**

|                | Depressed | Felt lonely | Trouble sleeping |
|----------------|-----------|-------------|------------------|
| Big city       | 0.0177** | 0.00169     | 0.00199          |
|                | (0.00740) | (0.00110)   | (0.00584)        |
| Multiple units | 0.0109*  | 0.0186**    | -0.00492         |
|                | (0.00585) | (0.00904)   | (0.00503)        |
| Big city × Multiple units | -0.0225** | -0.0188 | -0.00494 |
|                | (0.00952) | (0.0133)    | (0.00789)        |
| Big city × COVID | -0.00339 | 0.00392    | 0.0289***        |
|                | (0.0110) | (0.0124)    | (0.0101)         |
| Multiple units × COVID | -0.00814 | -0.0104 | -0.000377 |
|                | (0.00906) | (0.0102)    | (0.00851)        |
| Big city × Multiple units × COVID | 0.0332** | 0.0304*  | -0.0129         |
|                | (0.0147) | (0.0165)    | (0.0137)         |
| COVID          | -0.105***| -0.0860***  | 0.00498         |
|                | (0.0138) | (0.0152)    | (0.0115)        |

Individual FE

|                | Depressed | Felt lonely | Trouble sleeping |
|----------------|-----------|-------------|------------------|
| No             |           |             |                  |
| Yes            |           |             |                  |

| R²              |        |            |            |
|-----------------|--------|------------|------------|
| 0.110           | 0.632  | 0.623      |

| N               |        |            |            |
|-----------------|--------|------------|------------|
| 80,291          | 80,291 | 80,291     | 80,291     |

*p < 0.10, **p < 0.05, ***p < 0.01. We cluster standard errors at the individual level. All specifications control for three categories of age, household structure, previously reported health, number of children, ability to make ends meet, location, type of building, the month of interview and country—wave interactions. Columns 1, 3 and 5 control further for education, female, and country fixed effects. The sample includes Austria, Belgium, the Czech Republic, Denmark, Estonia, Germany, France, Italy, Slovenia, Spain, Sweden, and Switzerland.

points and 30.3 percentage points; but no significantly higher probability of having had trouble sleeping (see Columns 1, 3 and 5). Furthermore, since the outbreak of the pandemic those who live alone were 3.4 percentage points (6.5 percentage points)
more likely to say they had become more depressed (or more lonely) than single individuals who did not live alone (Columns 2, 4). There is no significant pattern for problems with sleep.

Moreover, while living with a couple is associated with less loneliness, it was not associated with depression or sleep troubles. Nevertheless, when depressed in summer 2020 individuals living with their spouse were 2.6 percentage points more likely than singles living with others to say they had become more depressed since the outbreak of the Corona. There are no such patterns for loneliness (couples, especially when living with others were less likely to have become more lonely compared to singles, alone or with others) and trouble sleeping.

Living in a big city or suburbs increased the probability of both being depressed in summer 2020, and becoming more so than before the outbreak of the pandemic. The effect of the type of building and number of rooms is not significant.

Together with living arrangements/housing conditions effects, individual characteristics also matter. For instance, the 10% of the 50+ who only made ends meet with great difficulty had a 17 percentage point (17 percentage point and 11 percentage point) higher probability to be depressed (lonely and to have trouble sleeping) than those who made ends meet easily (Columns 1, 3, and 5). It also increased the probability of developing more mental health problems since the outbreak (Columns 2, 4, and 6). Compared to our young, the oldest old (80+) were more likely to say they had felt sad or depressed, felt lonely and had trouble sleeping.

On a macro level, country effects are large. Individuals from some of the more badly hit countries based on excess mortality between March and June 2020, Italy, Spain and Belgium, had a 5 to 7 percentage points more chances to have become more depressed during the pandemic compared to those living in Germany. In Appendix A, Table A.1 confirms the result replacing country effects with COVID-related measures. A higher number of deaths per capita due to COVID and longer stay-at-home recommendations increased the probability of being in a worse mental state during the first wave of the pandemic.

We repeat this analysis for the sample of parents. Appendix B, Table B.1 shows that coresiding or living in the same building with a child had a mitigating impact on all three measures of mental health during the first wave of the pandemic. One explanation could be the larger change in lifestyle or frustration generated by strict confinement measures for parents who were not allowed to meet their children.

23 Chetty et al. (2016) show that large differences in US life expectancy across areas can be observed for the poor, but not for the rich. “Where you live matters much more if you are poor than if you are rich”. If we separate rich and poor based on their ability to make ends meet, the city effect on depression is the same for both (not shown).

24 Only living in a high rise building increases depression in a specification where types of buildings are detailed (not shown). However when living in the city is interacted with living in an apartment (rather than a single house) its effect of depression is nearly doubled (from 1.7 to 3.1 percentage points).
4.2 Longitudinal analysis: living arrangement

To assess the novelty of the association between housing conditions and mental well-being we now turn to longitudinal analysis. Table 3 documents findings for household structure (Panel I) and distance to the nearest child (Panel II). The three outcome variables are the mental well-being indicators. Odd columns (1, 3, 5) report the pooled multiwave analysis. Even columns (2, 4, 6) show our preferred specification which fully exploits the panel data structure and controls for individual observed characteristics, and for unobserved fixed effects. Although both specifications are complementary, the fixed effects model is our preferred specification because it alleviates concerns about bias from confounding factors and since there is enough variability in key variables across waves (see Appendix C).

In pre-COVID-19 time (the $\beta_1$ coefficients of our regressions), the probability of feeling sad or depressed was similar whether single individuals lived alone or with others, while the probability of feeling lonely was larger for those who lived alone, and their probability of having trouble sleeping was rather lower (Panel I, Columns 2, 4 and 6). The first wave of the pandemic changed this (the $\beta_2$ coefficients of our regressions). Depression rates of those living alone relatively worsened during the pandemic: the difference in depression rates between those living alone and singles-with-others increased by about 6 percentage points during the pandemic, which corresponds with 14% of the mean outcome variable (Panel I, Column 2). The probability of having trouble sleeping also increased for singles compared to singles-with-others by 4 percentage points or 9% of the mean value (Panel I, Column 6). Regarding feeling lonely, the differential effect is similar to other mental well-being indicators: it was more detrimental to live alone compared to singles-with-others during the first wave of the COVID-19 pandemic than before. The risk increased by roughly 4 percentage points or 9% of the mean outcome variable (Panel I, Column 4). Accordingly, during the pandemic, the loneliness penalty of living alone widened in Europe, and, as also found by d’Hombres et al. (2021), living alone was strongly associated with more loneliness in pre-COVID time.

This finding of the protective effect for singles of having other household members during the first wave of COVID-19 pandemic is in line with Hamermesh (2020). In his model a negative impact on happiness among singles aged above 30 is expected even in the absence of further income loss due to the economic crisis. Our sample includes only 50+. Accordingly, they were more likely to be outside of the labor force, and the confinement of spring 2020 may have been less difficult for them because their income was perhaps less impacted. Nevertheless, less contacts, resulted in relatively more mental health problems.

In pre-COVID waves, couples, whether they lived with others or not, reported the lowest prevalence of depression and loneliness. After the first wave of the pandemic,
the relative risk of depression dramatically increased by 10 percentage points or 31% of the mean outcome for those living only with their spouse (couples) and by 6 percentage points or 18% for those who lived with a spouse and with others (Panel I, Column 2), compared to singles-with-others. The findings for loneliness and trouble sleeping also confirm the protective effect of living with other persons during the pandemic. Couples who were not living only with their spouse, do not report a relatively higher risk of loneliness but do report more problems with sleeping (+3.6 percentage points) compared to other groups during the pandemic (Panel I, Columns 4 and 6). These findings contrast with the prediction in Hamermesh (2020), who shows an increase in life satisfaction among married individuals with additional time spent together. During the first wave of the COVID-19 pandemic, we document that it was not the case for elderly couples.

When we restrict the analysis to the sample of parents, we find that the distance to the nearest child matters during the first wave of the pandemic (Table 3, Panel II). Parents not living with a child or not in the same building report a significant increase in the prevalence of depression, loneliness and sleep problems, compared to other parents. Interestingly, the size of impact does not vary with the distance to the nearest child once that child is not in the same building, which can be in line with the strict stay-at-home restrictions and contamination fear in spring 2020. Accordingly, for the first time, having a child in the same household or in the same building became more crucial to keep face-to-face contacts with children that seem very important for mental well-being. In pre-COVID time, the distance to a child was not related to parental mental well-being in the model with fixed effects. Regarding the magnitude, after the first wave of the pandemic, not living with a child nor having one in the same building, reduced the overall relative decrease in sadness or depression by around 6 percentage points (17% of the mean outcome) and reduced the overall differential decline in sleep problems by 3 percentage points (9%) compared to pre-COVID time. It relatively increased loneliness by 4 percentage points (13%) compared to coresiding (Columns 2, 4 and 6).

4.3 Longitudinal analysis: housing conditions

The location where one lives had no measurable effect on mental well-being before the pandemic (Table 4). During the first wave of the pandemic there was a clear differential higher prevalence of mental health problems in denser places like big cities, their suburbs and large towns than in small towns or rural areas. Panel I documents that respondents from big cities experience a statistically significant higher prevalence of depression (increase of 2.2 percentage points, or 6%) and of loneliness (increase of 2.5 percentage points, or 11%) compared to individuals in rural areas. The result is robust to the choice of controls and inclusion of individual fixed effects. Yet, the total impact of the 1st wave

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27 The increase in loneliness with distance to children in the Multiwave model (Column 3 in Table 3, Panel II) might come from unobserved characteristics of families whose children do not coreside or move further away. The FE model accounts for potential unobservables like family ties or human capital.

28 Appendix D, Fig. D.2a, D.2b and D.2c document these changes using the non-linear probit specification. There, we split the sample into before and after the pandemic and compare the average marginal effect of distance to the nearest child on mental health outcomes.
of the COVID remains a decrease in depression and trouble sleeping. There is no statistically significant differential effect of living in the city on trouble sleeping which could be in line with a drop in air and noise pollution during lockdowns.

Living in a single house rather than in a multi-unit building does not differently impact mental well-being (see Appendix E, Table E.1, Panel I). However, the interaction between location and type of building became important during the pandemic. Panel II in Table 4 documents a significant increase by about 3 percentage points in depression and also 3 percentage points in trouble sleeping among individuals in multi-unit buildings in cities relative to respondents in single houses in cities. In our sample, 73% of all individuals from big cities live in apartments. There are two hypotheses in line with this finding. First, higher depression among urban residents in multi-unit buildings can be due to increased perceived risk of contagion associated with having more neighbors. Second, the mobility restrictions and closure of public places affected relatively more urban than rural residents. Together with limited space in apartments, these restrictions resulted in a dramatic change in lifestyle for urban residents in apartments. By contrast those with a larger private space in houses could still enjoy relatively higher freedom of movement, possibility of gardening and less reduced opportunity to exercise. This is in line with the fact that physical exercise impacts depression and mental health. Previous literature has shown the mediating impact of outdoor activities: McDowell et al. (2018) (for the elderly in Ireland), Bu et al. (2021) (young adults in the UK) and Giuntella et al. (2021) (adults in the US). We do not find evidence for changes in loneliness for such location and type of building interaction. Regarding the number of rooms, results show that respondents who stayed in dwellings with two or fewer rooms suffered more from depression symptoms and loneliness (Panel II in Table E.1, Appendix E).

Next, we looked at heterogeneity across gender in the impact of the pandemic on mental well-being through the living arrangements and housing conditions channels. COVID had a relatively more negative effect on women in big cities (Appendix F, Table F.1). The difference between women in cities and rural areas compared to men may reflect a relatively more dramatic change in women’s lifestyles due to shut down or because women were more likely to perceive COVID-19 as dangerous and to comply with the lockdown restrictions (Galasso et al., 2020).

Finally, we also study heterogeneity across countries depending on the excess mortality from March to June 2020. We divide the sample into two groups: badly hit countries with excess mortality above 14%, Belgium, Italy, Spain, France and Sweden; and less hit countries, namely Austria, the Czech Republic, Denmark, Estonia, Germany, Slovenia, and Switzerland. We do not find any suggestive evidence for differences across countries in our living arrangements and housing conditions effects (not shown).

### 4.4 Interpreting differential COVID-19 effects: discussion and robustness checks

There is of course no experimental treatment nor a natural experiment assigning living arrangements/housing conditions variables. Therefore, a tight causal interpretation of our main COVID interaction coefficients is not warranted. However, our use of a very suitable

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29 John Hopkins deaths/inhabitants and the Google percent change in mobility support the same grouping.
rich set of controls and fixed-effects specifications together with the unexpected nature of the pandemic should alleviate concerns about endogeneity of interaction effects. One particular concern is that reverse causality may play a role in our results. What if living arrangements are modified because of mental well-being? Say the mood of a lonely person would induce people in her household to move away, hence living alone would be the result of loneliness instead of its cause. Hence pre-COVID associations ($\beta_1$) between living arrangements and mental state measured contemporaneously may be blurred by reverse causality. However, the differential effect ($\beta_2$) due to COVID-19 should not. We argue that the pandemic was unexpected so that if we use living arrangements and housing conditions variables measured pre-pandemic for the subsample of Corona observations, the interaction of pre-pandemic living arrangements and housing conditions variables and the COVID indicator in Equation [1] should be predetermined. Two issues merit some additional discussion: our ability to combine pre-pandemic measurements of living arrangements/housing conditions variables with post-pandemic measurement of mental health outcomes in the Corona subsample; and the stability of living arrangements/housing conditions variables between the onset of the pandemic in March 2020 and our Corona Survey in summer 2020. As explained in Section 2, our living arrangements variables are indeed measured pre-pandemic for the 65% of the Corona sample that were interviewed in the regular wave 8 (November 2019 to March 2020). Because the interval is short and to the extent that the very lockdowns conditions were an obstacle to the usual changes in living arrangements we think we also essentially measure pre-COVID living arrangements for the 35% subsample whose living arrangements were reported in summer 2020. As for housing conditions, as noted before all are measured in pre-COVID time: mostly in the regular wave 8, or else in wave 7; but note that residential mobility is very low after age 50 (Angelini and Laferrère, 2012).

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30 We take care of endogeneity issues (if living arrangements and housing conditions are a function of health) by controlling for self-reported health.

31 Reverse causality of coefficients $\beta_2$ would mean that in the periods before the pandemic respondents anticipated the magnitude of confinement measures in spring 2020 and the outbreak of the virus. Accordingly, based on their expectations about outbreak and potential mental health problems after the first wave of the pandemic, respondents would have decided to change their household structure in periods before the pandemic. This seems highly unlikely because COVID-19 pandemic was unexpected and the largest pandemic since 1918 influenza pandemic and the scale of stay-at-home orders was unprecedented and had never been implemented before.

32 In any case to address concerns about contemporaneous measurement in the 35% subsample, we conducted two robustness checks: (1) Restricting SHARE Corona sample to the 65% subsample who reported living arrangements in the regular wave 8 interview (Panel I in Table G.1, Appendix G). (2) Keeping all SHARE Corona respondents but replacing information for the 35% subsample with information from previous SHARE waves (Panel II in Table G.1, Appendix G). A different but related concern is that the differential COVID coefficients might capture differential lack of reverse causality rather than a COVID impact because wave 8 measurements of living arrangements/housing conditions are taken before measurement of mental health whereas in waves 5 and 6 mental health and living arrangements/housing conditions measurements are contemporaneous. To address this we carried out the following check: for all person-wave observations in our full sample, we used lagged values of the living arrangements/housing conditions variables. That is, we use wave 7 living arrangements/housing conditions measurements for wave 1 COVID observations, wave 4 living arrangements/housing conditions measurements for wave 5 observations, and wave 5 living arrangements/housing conditions measurements for wave 6 observations. The key results hold in these three robustness checks (Table G.2 in Appendix G).
A related measurement concern is that even if living arrangements and housing conditions change slowly, the pandemic and pandemic control policies may have induced quick changes in living arrangements and housing conditions. Indeed, in some countries, some individuals who owned a second home and could work remotely moved to their second home, e.g., leaving apartments in big cities for houses in rural areas. Some young adult children also moved out of their student room to their parents when their university was closed. Anecdotal evidence suggests the parents were happy about the unexpected temporary reunion. The SHARE Corona Survey asked a question on the respondent’s own mobility: “Are you in your usual home now or have you temporarily moved elsewhere due to Corona?” In our sample the rate of temporary movers was a low 1.8%. We re-estimated our models excluding the movers, the results were unchanged. Moreover, such temporary mobility, likely out of big cities, tends to underestimate our city effect: some classified as living in a big city had actually moved to a rural area, hence relatively less depressed or lonely. The effect of unobserved adult children temporarily moving in with their parents would also probably underestimate the relative worse mental state of couples.

In addition, we estimate the model including the interaction terms between COVID and all covariates in the model. Our results remain very similar, see Table G.4 in Appendix G.

Finally, the results presented in Tables 3 and 4 remain the same if we use the balanced panel of individuals who participated in all three waves under study, see Table G.3 in Appendix G. The results also remain the same if we add wave 8 to the analysis together with waves 5 and 6 as opposed to the Corona Survey. The results are in Table G.5. Furthermore, the results remain very similar if we use a shorter panel with all 27 countries that participated in the regular wave 8 and the Corona Survey, see Tables H.1 and H.2 in Appendix H.

5 Conclusion

The reaction of governments facing the COVID-19 pandemic was to isolate people so they did not get infected, forcing them to live like Robinson on his island. Did this create differences between citizens according to whom and where they lived? This is the question we explored in this paper.

We used a special wave of SHARE data conducted in Europe in summer of 2020 after the first wave of the pandemic as well as data from previous waves. In the first part of this study, we rely only on the SHARE Corona Survey and analyze the determinants of three mental well-being measures and their evolution since the beginning of the Corona outbreak. Living arrangements and housing characteristics had a significant impact on mental well-being and its evolution as described by the respondents: those living alone experienced a large and significant increase in mental health problems relative to singles living with others. Couples, those living with only a spouse and no children also suffered compared to singles with others. Living in a city became detrimental, especially in apartments.

33 It was above 3% only in Sweden and in Spain.
In our main analysis, we ask if relationships between living and housing arrangements and mental well-being became different after the first wave of the COVID-19 pandemic, pooling SHARE Corona Survey with past waves of SHARE. We indeed find important changes in the associations of some aspects of living arrangements and housing conditions with mental health. Some of the positive agglomeration effects were reduced during the first 5 months of the COVID-19 epidemic: it became relatively better for mental well-being to live away from large cities, in a single house than in an apartment, but it was different for within-household density as living alone or only with one’s spouse had relative negative effects. Moreover, distance to the nearest child mattered for parents more than usual. The positive effect of living in rural areas and in a house may be linked to the relatively greater freedom of movement it provided, more space to move, less reduced or greater opportunity to exercise. When an urban person could not go to theaters, gym, cinemas, museums, restaurants or concerts anymore, a rural one, who does not haunt those places could increase gardening, or walk with less restrictions.

A better knowledge of the effect of housing conditions and living arrangements should help take more fine-tuned control decisions in the future. Our results suggest that restrictions such as those implemented during the pandemic had a differential negative impact on the mental well-being of people with specific living arrangements and housing conditions. Then, a clear policy implication for the future is to take into account such unintended consequences of similar mobility restrictions on such groups of people. Policies should be designed to focus on these affected groups in order to compensate and monitor their mental health. In addition, in the longer run, housing and location decisions may change if, for instance, the virus becomes endemic and mobility restrictions implemented to contain it persist, which may have important effects on the future of cities, housing structures and real estate markets. Policies should be ready to adapt to such a new organization of human life.

Data availability The data used in this study can be obtained at www.share-project.org.

Code availability Available from the authors upon request.

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Compliance with ethical standards

Conflict of interest The authors declare no competing interests.
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