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Exploring the Relationship between Care Homes and Excess Deaths in the COVID-19 Pandemic: Evidence from Italy

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ABSTRACT

Exploring the Relationship between Care Homes and Excess Deaths in the COVID-19 Pandemic: Evidence from Italy

We explore the relationship between the spatial distributions of excess deaths and care home facilities during the COVID-19 outbreak in Italy. Using registry-based mortality data (January 1st- March 31st, 2015-2020) for Lombardy, one of the areas hit most severely, we estimate that municipalities with care homes present significantly higher excess death rates among the elderly (+41%). We find that this effect is not driven by the size of care homes and of the vulnerable population that they host. Rather, our results suggest that the excess deaths did not occur only within care homes and these facilities acted as one of the possible catalysts in the diffusion of COVID-19 in the whole elderly population of their surrounding territory.

JEL Classification: I10, I18, I30

Keywords: care homes, COVID-19, excess mortality

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1 Introduction

Official COVID-19-related deaths reached 371,166 across the world by June 1st¹. Excess mortality estimates suggest significantly higher numbers (Faust and del Rio, 2020). The majority of COVID-19 deaths occurred in long-term residential facilities for personal care and health assistance (Wang, 2020).

This study estimates the concentration of excess mortality in municipalities with care homes as local hotspots in the diffusion of the pandemic. We use registry-based daily mortality records by municipality (*comuni*) from Lombardy (Italy), among the areas hardest-hit by the pandemic worldwide. Our identification strategy relies on estimating differences in excess mortality between municipalities with and without care homes, with respect to the previous five years' average.

Italy was the first western country to experience a severe COVID-19 outbreak. Preliminary results from an investigation of mortality in care homes of the National Institute of Health (ISS) estimate 6,773 COVID-19 fatalities as of April 2020, representing 40% of Italy's total. Those in Lombardy, in particular, registered a mortality rate of 6.7% against a national average of 3.3% (ISS, 2020). Excess deaths in Lombardy's care homes are at the center of media and policy attention as well as judicial enquiries for a lack of clear rules on containment practices such as the reception of patients with COVID-19-related symptoms, testing, availability of protective gear, and contact with outside visitors.²

Our analyses show that the excess mortality of adults aged 70+ was significantly higher in municipalities with at least one care home, reaching up to 18 additional daily excess deaths per 100,000 inhabitants by the end of March. On the contrary, we do not find a significant relationship between the number of beds in care homes and excess mortality. Our findings show that the result is not driven by the number of vulnerable people resident in care homes, who are prone to higher mortality risk due to pre-conditions, but by the simple presence of care homes. This suggests that care homes act as catalysts of contagion. To consider the locally correlated nature of the pandemic, we estimate a spatial autoregressive model (SAR),

¹ <https://covid19.who.int/>

² <https://www.ilpost.it/2020/04/17/regione-lombardia-rsa/>

confirming our results. Our work clarifies one of the potential channels behind the observed association between demographic structure and COVID-19 fatalities (Dowd et al, 2020) and suggests to consider the presence of care homes in the design of future containment measures based on local isolation areas.

2 Data

We use death registry data for Lombardy (ISTAT, 2020), which provide daily deaths by age between January 1st and March 31st, for the years 2015 to 2020, by municipality of residence. The sample includes 131,040 observations from 1440 municipalities (95% of Lombardy). We measure municipality-level excess mortality rates as the difference between (daily or total) deaths per 100,000 individuals by age group between January 1st and March 31st 2020 and the corresponding 2015-2019 average. Differencing total deaths with respect to previous years allows us to account for the differential baseline mortality in municipalities with care homes³ (Vandoros, 2020). Another advantage over official COVID-19 deaths is that our measure does not depend on how deaths are classified. We link this dataset with the location of residential care homes (RSAs) and nursing homes by municipality.⁴

85.6% of COVID-19 deaths occurred among the over 70 (ISS, 2020). To account for differential mortality risks between age groups, we consider separately the 70+, 50-69, and 0-49. We control for the presence of a hospital, population share above age 70, share of women by age group, an indicator for the first locked down municipalities, province, and time fixed effects. Table A1 (Appendix) describes the variables.

Figure 1 illustrates the spatial distribution of care homes and excess mortality rates. Care homes are present in 34.5% of the municipalities and distributed widely across the region. Excess death rates present some geographical clustering.

³ “Care homes” refer to all non-acute residential and nursing facilities that host patients for long-term care needs.

⁴ <https://www.regione.lombardia.it/wps/portal/istituzionale/HP/DettaglioServizio/servizi-e-informazioni/cittadini/salute-e-prevenzione/strutture-sanitarie-e-sociosanitarie/residenze-anziani>

3 Empirical Analysis and Results

To investigate the relationship between excess mortality and care homes, we use municipalities as unit of analysis. In Figure 2, we plot excess daily death rates by age group in 2020 for municipalities with and without a care home. Before the the first announced COVID-19 case (February 21st), there was no significant difference. Since the second week of March, municipalities with a care home exhibited significantly higher excess daily deaths for individuals aged 70 + (panel 3). By the end of March, they reached up to 18 additional excess deaths per 100,000 inhabitants. To consider the differential timing of the outbreak, in the fourth panel we normalize time by the first day in which a municipality recorded a positive excess death rate after the epidemic onset.

Next, we regress daily excess death rates on the presence of care homes by age group (*age*) as follows:

$$(1) \Delta Excess\ Death\ Rate_{d,m}^{age} = \alpha + \tau_d + \beta CareHome_m + \delta RedArea_{m,d} + \chi_m + \varepsilon_d^{age}.$$

τ_d are days after January 1st-fixed effects, *CareHome* (0-1) indicates the presence of at least one care home in municipality *m*, *RedArea* (0-1) marks the first complete lockdown for ten municipalities⁵ (February 23rd). χ_m is a vector of municipality characteristics: presence of a hospital, population (%) above age 70, women (%) in the age group, and province fixed effects. $\Delta Excess\ Death\ Rate_{d,m}^{age}$ is the difference between the daily death rate in *m* by age group in 2020 and its 2015-2019 average.

Table 1 reports the Results. For the 70+ (column 1), the coefficient of care homes is positive and significant, with 4.7 excess daily deaths per 100,000 individuals (40% of the mean, 11.64). For the other age groups (50-69 and 0-49), coefficients are positive but not significant.

Columns 4 and 5 report the estimates of a regression as in Equation 1 but with the number of beds in care homes instead of their presence.⁶ The sample includes only municipalities with a care home. Column 5 further excludes four cases with over 1000 beds, for robustness. The

⁵ Bertinico, Casalpusterlengo, Castelgerundo, Castiglione d’Adda, Codogno, Fombio, Maleo, Somaglia, San Fiorano, and Terranova dei Passerini.

⁶ The model includes also hospital beds.

coefficient for care home beds is not statistically significant.⁷ This suggests that the relationship with excess deaths goes beyond the size of care homes and of the population that they host.

We confirm the results for people 70+ using total excess death rates as a dependent variable (column 6). Next, we perform the Moran's I test for spatial correlation in residuals. The statistic (column 6) is positive and significant, indicating spatial dependence: contiguous municipalities tend to show similar total excess mortality rates.⁸ To account for this, we estimate a spatial autoregressive model (SAR) (Baltagi et al. 2018) for total excess mortality rates. Column 7 reports the results. The spatial autocorrelation adjustment exhibits a statistically significant coefficient of 0.12. When comparing the coefficient of Care Homes with the OLS model (column 6), we find that the size declines only slightly (4.27 versus 4.10, a 3% decline). In Appendix, we report also a difference-in-differences estimation that accounts for fixed municipality characteristics that may correlate with excess deaths. This specification confirms our results.

4 Discussion and conclusions

This paper provides evidence of substantially higher excess deaths among the elderly during the COVID-19 pandemic in municipalities with care homes. The result is economically and statistically significant also when accounting for spatial correlations.

Previous studies have indicated higher excess infections and deaths among care home residents in the COVID-19 pandemic (Trabucchi and De Leo, 2020).

Our findings suggest that, rather than this relationship simply being driven by a higher density of at-risk individuals, care homes catalysed COVID-19 deaths even beyond these residential facilities. As such, our work clarifies the role of one potential mechanism behind the observed association between demographic structure and COVID-19 fatalities (Dowd et al., 2020). Our results suggest also that future containment policies based on municipality-specific isolations should take into account the presence of care homes. This study has a few limitations. First, we do not have data on official COVID-19 deaths occurred in care homes, and we rely on the analysis of excess deaths exploiting municipality-level variation across areas with and without

⁷ Using beds per capita does not alter the finding.

⁸ The Moran I test is based on the contiguity matrix. We also used other weight matrices. Results are similar and available upon request.

home care facilities and with respect to the previous trend. Second, we do not have information on medical pre-conditions which are related with the lethality of COVID-19. Third, we do not have information on the safety practices adopted by each home care in response to the pandemic. Although our results may not be generalized to the rest of Italy, care homes may have played a role also in other regions (at least in the initial phase of the pandemic) as emerged from the ISS investigation (ISS, 2020). Subject to the availability of data that are currently lacking, future research may account for specific policy choices adopted during outbreaks, (Lombardy's neighbouring region, Veneto, experienced a similar outbreak in terms of initial numbers and timing but recorded only 1.3% deaths), the prevalence of medical pre-conditions related to the lethality of COVID-19, and information on each care home's mortality and safety practices.

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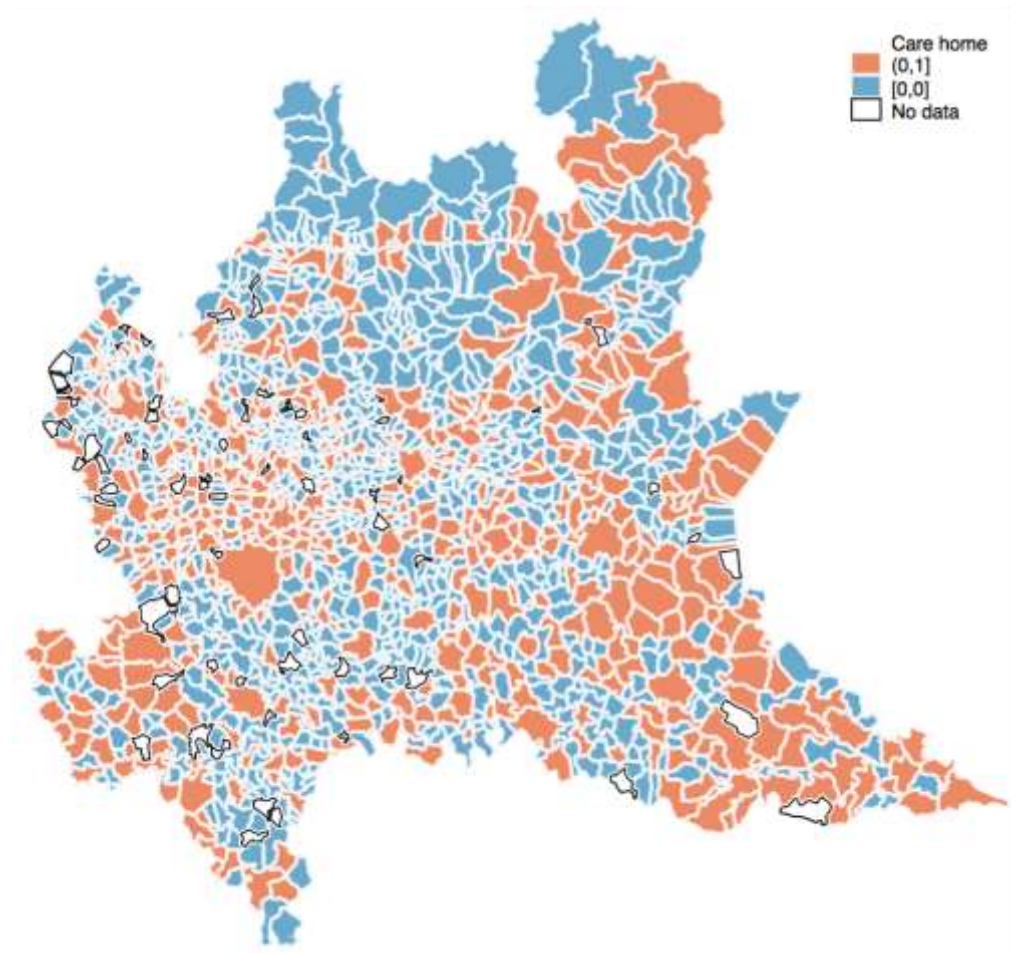
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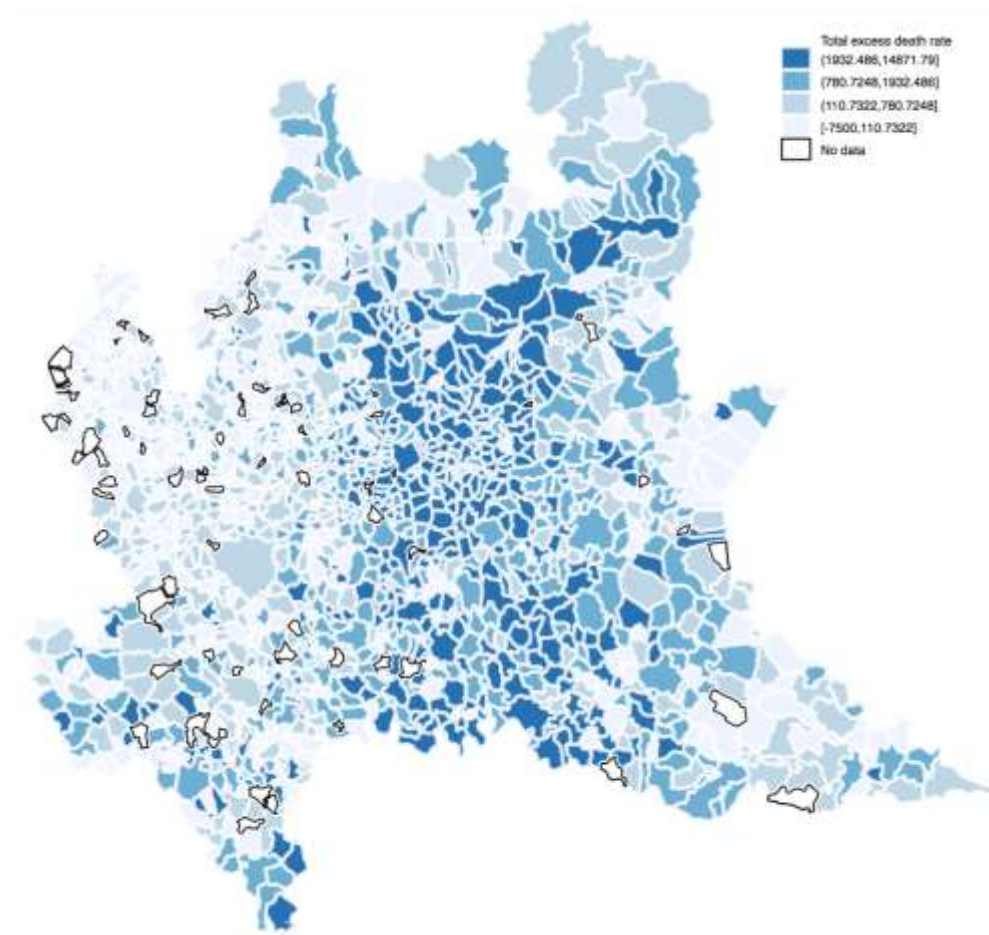
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Figure 1: Care homes and excess mortality rates in Lombardy's municipalities

Panel A: Care Homes



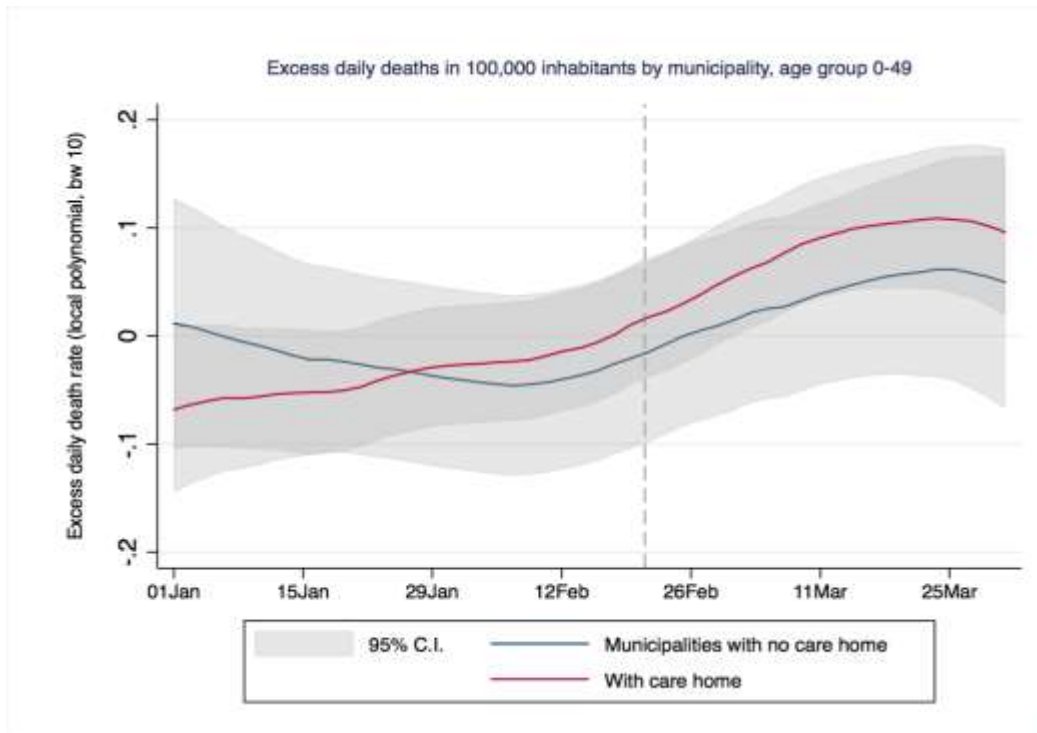
Panel B: Excess Mortality



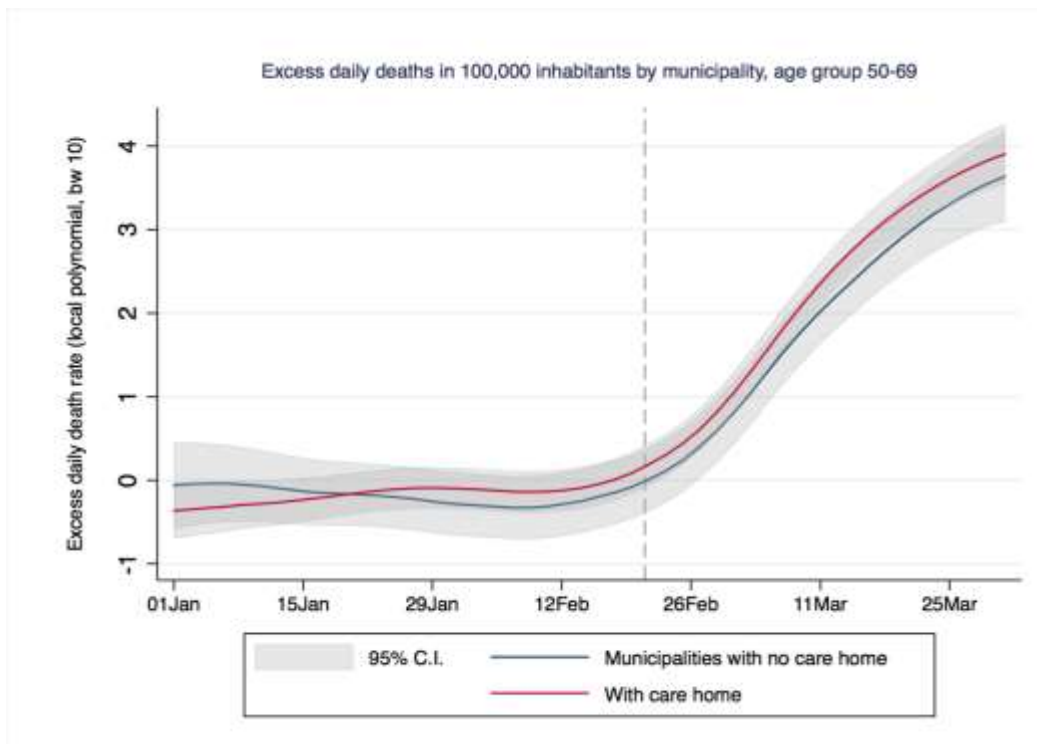
Own elaborations based on Lombardy region, Ministry of Health, and ISTAT data, 2020.

Figure 2: Excess daily death rates in 2020 in municipalities with and without care homes

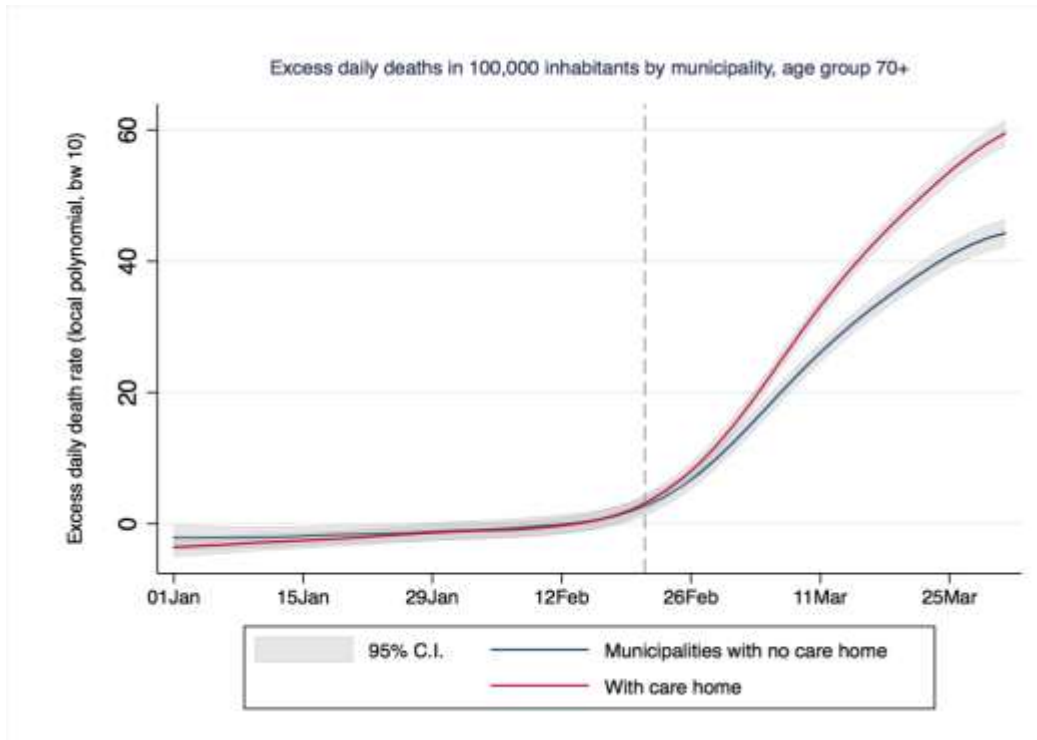
Panel 1



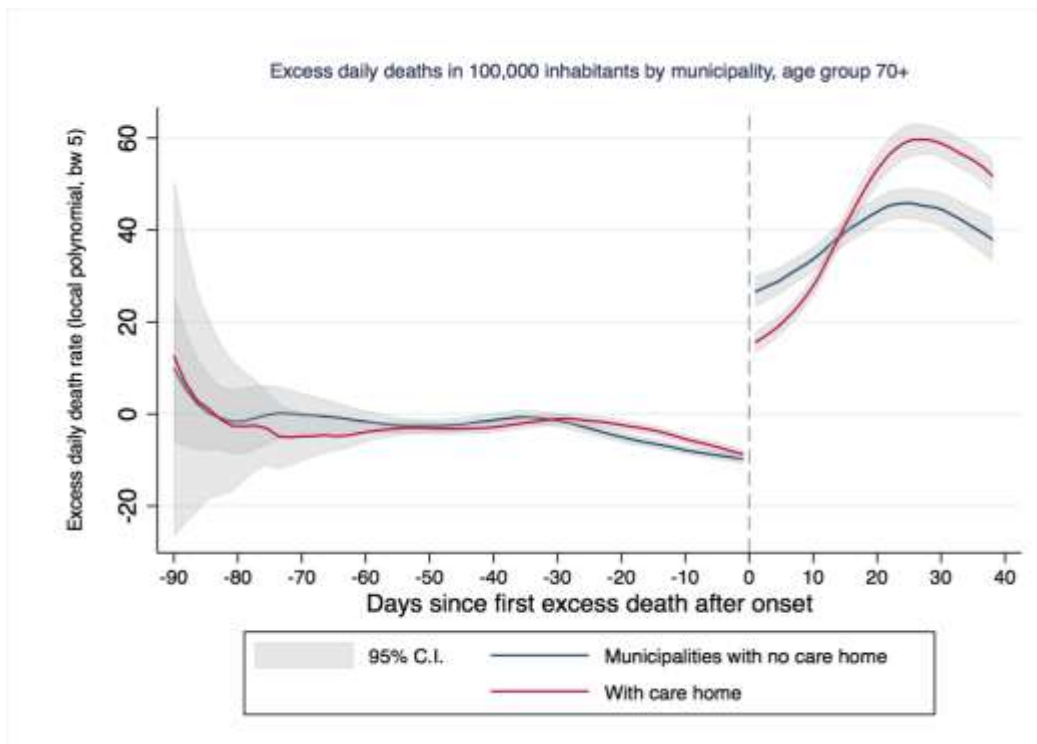
Panel 2



Panel 3



Panel 4



Own elaborations based on ISTAT, Lombardy, and Ministry of Health data (2020). Panel 4 normalises the number of days before and after the first excess death recorded in a municipality (day 0), after the pandemic onset.

Table 1: Regression estimations of excess mortality in 2020 (1 January - 31 March)

| | OLS | | | | | SAR | |
|-----------------------|-------------------------|-------------------|-------------------|-------------------|--------------------|-------------------------|----------------------|
| Outcome: | Daily excess death rate | | | | | Total excess death rate | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Age group | 70+ | 50-69 | 0-49 | 70+ | 70+ | 70+ | 70+ |
| Care home present | 4.578*** (0.871) | 0.301* (0.164) | 0.0103 (0.038) | | | 4.27*** 0.801 | 4.100*** (0.810) |
| Care home beds | | | | -0.002 (0.002) | -0.006* (0.003) | | |
| Spatial Weight Matrix | | | | | | | 0.120*** (0.044) |
| Observations | 131,040 | 131,040 | 131,040 | 9,009 | 8,645 | 1440 | 1440 |
| R-squared | 0.034 | 0.004 | 0.001 | 0.200 | 0.196 | 0.031 | 0.031 |
| Mean dep. var. | 11.64 | 0.797 | 0.005 | 10.19 | 10.23 | 10.59 | 10.59 |
| Std dev. | 127.8 | 31.25 | 6.834 | 47.23 | 47.91 | 15.78 | 15.78 |
| Moran I (residuals) | | | | | | 3211.20*** (0.000) | |
| Wald Test | | | | | | | 667.56*** (0.000) |

Outcome, columns 1-5: daily deaths per 100,000 inhabitants in 2020 minus 2015-2019 average. Additional controls: days, province FE; % population 70+, % women in age group, first “red area” municipalities. SE clustered at municipality level. Outcome in columns 6-7: total excess death rate. *** p<0.01, ** p<0.05, * p<0.1

Appendix (not for publication)

A) Difference-in-Differences

We estimate a difference-in-differences (DiD) model to investigate the dynamic of COVID-19-related excess deaths in relation to the presence of care home facilities, according to the following specification:

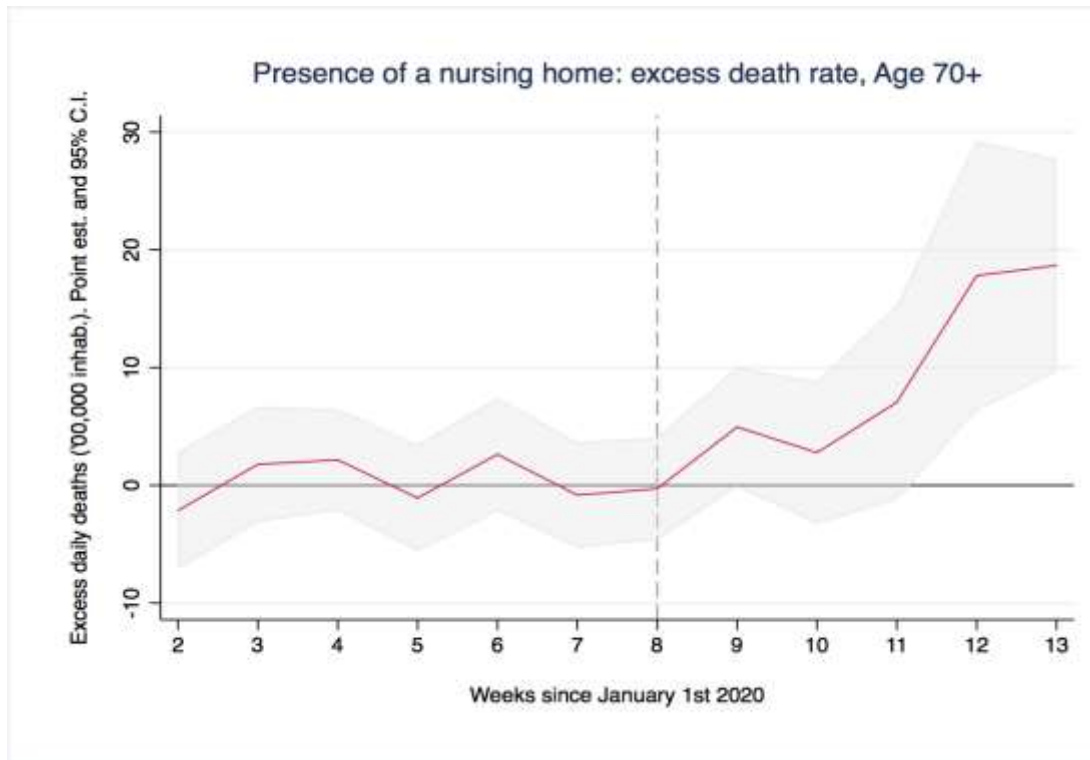
$$(2) \quad \Delta Excess\ Death\ Rate_{d,m}^{age} = \alpha_m + \tau_d + \sum_{w=1}^{13} (\beta_w Week \times CareHome_m) + \vartheta_w + \delta RedArea_{m,d} + \varepsilon_{m,d}^{age}$$

α_m, τ_d , and ϑ_w are municipality, days after January 1st, and week fixed effects. Week w indicates the week after January 1st, 2020; *CareHome* is a dummy variable for the presence of at least one care home in municipality m , and *RedArea* indicates the first isolation measure⁹. The dependent variable, $\Delta Excess\ Death\ Rate_{d,m}^{age}$ is computed as the difference between the share of daily deaths on the relative age-group population in 2020 (age) and an average of the five previous years' daily death rate. The coefficients of interest (β_w) correspond to the interaction of the presence of a care home with each week. This specification allows us to include municipality-specific fixed effects, which account for all the time-invariant municipality-specific characteristics that may directly or indirectly correlate with death rates and may thus generate an omitted variable bias in OLS-based results.

We plot the *Week x CareHome* coefficients relative to the 70+ age group in Figure 3A (full results are available upon request). Week 8 (vertical dash line) corresponds with the onset of the crisis (February 21st). The figure shows that, before the onset of the health emergency (week 8), there was no significant difference in excess daily death rates for municipalities with a care home and those without. The results indicate that, after the 11th week of the year, which began on March 11th, municipalities with a care home registered significantly higher rates of excess mortality.

⁹ See Equation 1

Figure 3A: Excess death rate in care homes, DiD coefficients



Additional regressors: a dummy variable for the period after the onset (Feb 21st 2020), a “red area”-dummy variable for the first ten municipalities on lockdown since February 23rd, days after Jan 1st FE, and week FE. Standard errors are clustered at the municipality level.

Table 1A. Descriptive statistics

| Variables | Obs. | Mean | St.dev. | Min | Max | Source |
|--|---------|--------|---------|--------|--------|--------------------|
| Δ Excess daily deaths ('00,000) age 70+ | 131,040 | 1.163 | 12.78 | -250 | 769.23 | ISTAT, 2020 |
| Δ Excess daily deaths ('00,000) age 50-69 | 131,040 | 0.079 | 3.12 | -95.23 | 500 | ISTAT, 2020 |
| Δ Excess daily deaths ('00,000) age 0-49 | 131,040 | 0.0004 | 0.683 | -57.14 | 138.88 | ISTAT, 2020 |
| Δ Excess deaths, total ('00,000) age 70+ | 1440 | 10.59 | 15.78 | -75 | 148.71 | ISTAT, 2020 |
| Number of care homes | 490 | 1.40 | 2.80 | 1 | 60 | Ministry of Health |
| Number of hospitals | 92 | 1.33 | 2.32 | 1 | 23 | Ministry of Health |
| Municipality has at least one care home | 1440 | 34.51% | 0.475 | 0 | 1 | Lombardy region |

| | | | | | | |
|---|---------|--------|--------|-------|-------|-------------------------------------|
| Municipality has at least one hospital | 1440 | 6.39% | 0.24 | 0 | 1 | Ministry of Health |
| Number of care home beds by municipality | 99 | 347 | 940 | 25 | 9005 | Lombardy region; Ministry of Health |
| Number of care home beds by municipality (excl. those with >1000) | 95 | 210.35 | 164.8 | 25 | 831 | Lombardy region; Ministry of Health |
| Number of hospital beds | 116 | 255.56 | 753.84 | 0 | 7877 | Ministry of Health |
| “Red area” (lockdown in first ten municipalities, Feb 23rd) | 131,040 | 0.26% | 0.05 | 0 | 1 | Ministry of Health |
| Share of women 70+ | 1440 | 0.568 | 0.032 | 0.348 | 0.714 | ISTAT, 2020 |
| Share of women 50-69 | 1440 | 0.494 | 0.024 | 0.25 | 0.582 | ISTAT, 2020 |
| Share of women 0-49 | 1440 | 0.484 | 0.020 | 0.30 | 0.66 | ISTAT, 2020 |
| Share of population 70+ | 1440 | 0.085 | 0.019 | 0.021 | 0.20 | ISTAT, 2020 |
