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Why did care home residents face an elevated risk of death from COVID-19? A demographic perspective using data from Belgium and from England and Wales

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Abstract

In many countries, deaths from COVID-19 were highly concentrated among care home residents during the initial wave of the pandemic. Care home residents may have faced higher risks of exposure and infection than the general population of older people. Once infected, residents may have been more likely to succumb to this disease as they were both older and frailer than the general population of older people. This study presents a quantified assessment of these factors in Belgium and in England and Wales. In doing so, this paper applies the Das Gupta decomposition method to explain the contributions of these three factors to the observed differences in mortality rates from COVID-19 between older people residing in care homes and older people living at home. According to these estimates, older people residing in care homes were 36 times more likely to die in Belgium and were 23 times more likely to die in England and Wales from COVID-19 than older people living at home during the initial wave of the pandemic. Decomposition of the differences in the mortality rates of these populations in Belgium and in England and Wales showed that the two key determinants were the greater underlying frailty of older people in care homes (accounting for 46% of the differences in Belgium and 66% of the differences in England and Wales) and the higher infection prevalence of older people in care homes (accounting for 40% of the differences in Belgium and 26% of the differences in England and Wales).

Keywords: COVID-19; care home/nursing home; infection prevalence; decomposition

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1 Introduction

In much of Europe, North America and Australia, the COVID-19 epidemic disproportionately affected care home residents (Comas-Herrera et al., 2020; ECDC, 2020; Fisman et al., 2020; Ladhani et al., 2020; Petretto and Pili, 2020). Deaths among care home residents accounted for more than one-half of all COVID-19 deaths in Australia (75%), Belgium (57%), Canada (59%), the Netherlands (51%) and Slovenia (56%); and for more than one-third of deaths in Austria (44%), France (43%), Spain (40%), Sweden (47%) and the USA (39%) by January 2021 (Comas-Herrera et al., 2020). Why did care home residents face such an elevated risk of death from COVID-19?

This paper explores three causal factors: the older ages, the greater underlying frailty and the higher exposure to infection of care home residents. Among the general population, age and underlying health conditions were the key determinants of the risk of dying from COVID-19 (Panagiotou et al., 2021; Williamson et al., 2020). Older people were at much higher risk of dying from COVID-19 than any other age group (Dowd et al., 2020; Dudel et al., 2020; Goldstein and Lee, 2020; Kashnitsky and Aburto, 2020; Riffe et al., 2021; Williamson et al., 2020; Zhou et al., 2020). A large cohort study in the United Kingdom using the primary health care records of 17 million patients, including of 11,000 individuals who died from COVID-19, found that patients over age 80 were at least 20 times more likely to die from the disease than those in their fifties, and hundreds of times more likely to die than those under age 40 (Williamson et al., 2020). Furthermore, individuals with comorbidities such as cardiac disease, pulmonary disease, kidney disease, cancer or obesity have an increased risk of COVID-19 mortality (Williamson et al., 2020). Older people living in care homes tend to be older and frailer than older people living at home. Therefore, both age and underlying frailty would be expected to contribute to the higher rates of COVID-19 mortality observed in care homes.

A third contributing factor is the high risk of exposure to COVID-19 among care home residents. Studies have highlighted the key role of staff in the transmission of infection in care homes, especially when the staff are temporary or work across multiple locations (Ladhani et al., 2020; ONS, 2020; Shallcross et al., 2021). The high rates of COVID-19 transmission in care homes have also been linked to crowded conditions, shared bedrooms and bathrooms, low staff-to-resident ratios and high community prevalence of COVID-19 infections (Abrams et al., 2020; Brown et al., 2021; He et al., 2020; Li et al., 2020; ONS, 2020; Shallcross et al., 2021; Stall et al., 2020).

To date, there have been few studies that examined the causal factors behind the marked differences in COVID-19 mortality between older adults living in care homes and those living elsewhere. This is due in part to a lack of published data on counts of COVID-19 deaths by both age and place of residence (i.e., living in a care home or living at home). Three studies that did examine this relationship are Hardy et al. (2021), Fisman et al. (2020) and Schultze et al. (2022). Using data from the Wallonia region of Belgium, Hardy et al. (2021) compared the care home population to the general population (of all ages) living outside of care homes. They found that

the COVID-19 mortality rate of care home residents was 130 times higher than that of non-residents. Using the Miettinen (1972) method, they decomposed this relative risk into three multiplicative effects of differences in the residents' age and sex structure (11 times greater risk), in health frailty (3.8 times greater risk) and in infection risk (3.5 times greater risk). Studying the first wave of the pandemic, Fisman et al. (2020) compared the COVID-19 mortality rates in 627 long-term care facilities with those in the general older population in Ontario, Canada. They found that mortality from COVID-19 was 13 times higher among long-term care residents than it was among community-living adults over age 69. Schultze et al. (2022) studied the age-standardised risks of death due to all causes and to COVID-19 among adults aged 65 and older in England between 1 February 2019 and 31 March 2021. They found that the relative risk of death among care home residents compared to that among non-residents was 17 times higher among older women and was 18 times higher among older men during the first wave, but did not change during the second wave.

Can the observation that COVID-19 death rates were higher among care home residents than among non-residents be explained by the residents' advanced ages, their greater underlying frailty (at every age) or their higher levels of exposure to and subsequent infections with COVID-19? This paper seeks to compare the COVID-19 mortality of older people in care homes with that of older people not living in care homes, and to assess the impact of the differences in the age composition, the age-specific underlying frailty and the infection rates of these two groups. In doing so, this paper applies the Das Gupta (1993) decomposition to quantify the contributions of these three key factors in Belgium and in England and Wales.

2 Data

For the analysis of the COVID-19 mortality risk factors of care home residents presented in this paper, data are needed on the numbers of deaths linked to COVID-19 by age for both care home residents and non-residents. Such data are not widely available. This paper uses data from Belgium and from England and Wales.

Data from Belgium on the number of COVID-19 deaths disaggregated by age and place of usual residence were provided by Sciensano, the Belgian institute for health (Appendix Table A.1). The COVID-19 death numbers for care home residents include the deaths of residents that occurred in hospitals. The data include both confirmed cases (by molecular testing for COVID-19 or radiological results) and possible cases[1] of COVID-19. Detailed information on the COVID-19 data and

[1] At least one of the following major symptoms of acute onset, with no other obvious cause: cough, dyspnoea, thoracic pain, anosmia or dysgeusia. Or two or more of the following minor symptoms, with no other obvious cause: fever, muscle pain, fatigue, rhinitis, sore throat, headache, anorexia, watery diarrhea, acute confusion, sudden fall. Or exacerbation of chronic respiratory symptoms (COPD, asthma, chronic cough. . .), without any other obvious cause (Peeters et al., 2021).

methodology can be found in Bustos Sierra et al. (2020), Peeters et al. (2021) and Renard et al. (2021).

There were two major waves of the COVID-19 epidemic in Belgium: a first wave that lasted from 1 March 2020 until 21 June 2020, and a second wave that lasted from 31 August 2020 until 1 February 2021 (Bustos Sierra et al., 2020; Peeters et al., 2021). The data provided by Sciensano for this analysis are for the period from week 11 of 2020 (14 March 2020) until week 39 of 2020 (28 September 2020), which allows for the analysis of the first wave of the epidemic in Belgium. This period was prior to the start of the nationwide mass vaccination campaign in early 2021. The data on the number of deaths from all causes by age and place of death for the year 2018 were obtained from STATBEL, the Belgian statistical office (Appendix Table A.2). The annual data on the number of people by age and place of residence (residents of collective housing vs. non-residents) as of 1 January 2019 (Appendix Table A.3a) and 1 January 2020 by age were provided by STATBEL, the Belgian statistical office (Appendix Table A.3b). The population of older people in collective housing is a good but imprecise measure of the population of older people in care homes, as the category of collective housing also includes older people living in prisons and religious communities. In addition, the population registry may include some care home residents who continue to be listed under their previous residence (usually a private home).

All data for England and Wales were provided by the Office for National Statistics of the United Kingdom licensed under the Open Government Licence (https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/datasets/carehomeresidentdeathsregisteredinenglandandwalesprovisional). The numbers of COVID-19 deaths are based on any mention of COVID-19 on the death certificate, and thus include both confirmed and possible cases.[2] The numbers of deaths of care home residents include the deaths of residents regardless of their place of death. That is, the deaths of care home residents refer to both the deaths of residents that occurred in a care home and the deaths of individuals whose place of residence was a care home but who died elsewhere. The obtained data include the number of deaths involving COVID-19 among care home residents and non-residents by age from 14 March 2020 to 2 April 2021 (Appendix Table B.1a and Table B.1b); the number of deaths from any cause among care home residents and the general population by age in 2019 (Appendix Table B.2); and the number of care home residents and non-residents by age in 2020 (Appendix Table B.3). Unlike the data for Belgium, these data allow for the analysis of two major waves in England and Wales: the first wave that lasted from 14 March 2020 to 11 September 2020, and the second wave that lasted from 12 September 2020 to 2 April 2021.

[2] The definition of COVID-19 includes some cases in which the certifying doctor suspected the death involved COVID-19, but was not certain. For example, a doctor may have clinically diagnosed COVID-19 based on symptoms, but this diagnosis may not have been confirmed because no test was available, or the test result was inconclusive (ONS, 2020).

Table 1:
Data sources

	Belgium	**England and Wales**
COVID-19 deaths	By age and place of usual residence for the period of 14 March 2020 to 28 September 2020. Source: Sciensano, the Belgian institute for health (Appendix, Table A.1)	By age and place of usual residence for the period of 14 March 2020 to 2 April 2021. Source: Office for National Statistics of the United Kingdom (Appendix, Table B.1a and Table B.1b)
All-cause mortality rates	By age and place of death for the year 2018. Source: STATBEL, the Belgian statistical office (Appendix, Table A.2)	By age and place of usual residence in 2019. Source: Office for National Statistics of the United Kingdom (Appendix, Table B.2)
Population counts	By age and place of usual residence in 2019 and 2020. Source: STATBEL, the Belgian statistical office (Appendix, Table A.3a and Table A.3b)	By age and place of usual residence in 2020. Source: Office for National Statistics of the United Kingdom (Appendix, Table B.3)

3 Methods

Using data on COVID-19 deaths by age and by place of residence (care home vs. non-care home) and similar data for population counts, the COVID-19 mortality rates by age and by residence are calculated using equation (1). These rates are calculated for four age groups: the 65+ age group, which is further sub-divided into the 64–74, 75–84 and 85+ age groups for each population: the care home population and the non-care home population. These sets of rates are calculated for Belgium for the period of March 2020 to September 2020; and for England and Wales for two periods: 14 March 2020 to 11 September 2020 and 12 September 2020 to 2 April 2021.

$$m^r(x) = d^r(x)/k^r(x) \tag{1}$$

where:[3]

m is the COVID-19 mortality rate at age x in population r;
d is the number of reported COVID-19 deaths at age x in population r;

[3] d and k are not annualised rates in this paper since the reference period is irregular. However, this paper reports ratios, and the decompositions are unaffected.

k is the mid-year count of population at age x in population r; and
r refers to the place of residence (1 = lives in care home; 0 = lives elsewhere).

As death from COVID-19 is a two-stage process of infection followed by death, the age-specific mortality rate for COVID-19, $m^r(x)$, can be defined as:

$$m^r(x) = i^r(x) \cdot f^r(x) \tag{2}$$

where:

m is the COVID-19 mortality rate at age x in population r;
i is the infection prevalence at age x in population r, i.e., the number infected divided by the population count;
f is the infection fatality rate at age x in population r, i.e., the number of deaths from COVID-19 of those infected with COVID-19; and
r refers to the place of residence (1 = lives in care home; 0 = lives elsewhere).

If the data were available, the decomposition presented in equation (2) would provide the most straightforward approach to answering the question of why the care home population faced such highly elevated risks. Theoretically, the true number of infected individuals could be estimated through serological testing of a representative random sample of the population (Kritsotakis, 2020; Metcalf et al., 2016). However, serological testing requires investments of time and resources, and there are many situations in which such tests may not be conducted in a timely manner, or even at all (WHO, 2020). Unfortunately, the lack of accurate and timely health information has been a hallmark of the pandemic. Data on the infection prevalence and the infection fatality rates in the care home population are not publicly available. In addition, measuring the proportion of individuals who are infected is a challenge because the infections of those who have mild or no symptoms are often undetected. Thus, some people who are infected may not be aware that they are spreading the disease (Kim et al., 2020; Li et al., 2020; Nishiura et al., 2020; Sharman, 2020). In addition, due to the widespread lack of testing and contact tracing, many cases have gone unreported, especially in the early stages of the pandemic (Ioannidis, 2021; Lau et al., 2020). For example, according to official estimates from the United States Centers for Disease Control and Prevention (CDC), only one in four COVID-19 infections was reported between February 2020 and September 2021 (CDC, 2021). As a result, there are wide disparities in the published estimates of both infection prevalence and infection fatality rates based on different modelling approaches and assumptions (Meyerowitz-Katz and Merone, 2020). Therefore, the analysis presented in this paper is based solely on the observed rates of COVID-19 mortality during the pandemic and of all-cause mortality in a year prior to start of the epidemic.

Since neither the infection prevalence nor the infection fatality rates of equation (2) are observed, the analysis relies on the indirect estimation of these factors. The key assumption is that the risk of succumbing to COVID-19 after being infected

is proportional to the risk of all-cause mortality. Indeed, this seems to be the main explanation for the age pattern of COVID-19 mortality and its variation around the world (Demombynes, 2020; Goldstein and Lee, 2020; Promislow, 2020; United Nations, 2020). COVID-19 mortality by age seems to closely follow the same pattern observed for all-cause mortality by age at older ages. That is, it is a fixed proportion b of the age-specific all-cause mortality rate, as seen in equation (3):

$$f^r(x) = b \cdot n^r(x) \tag{3}$$

where:

f is the infection fatality rate at age x in population r, i.e., the number of deaths from COVID-19 of those infected with COVID-19;
b is an unknown proportion, assumed to be a constant across ages and populations (care home residents and non-residents);
n is the all-cause mortality rate at age x in population r during a pre-pandemic year; and
r refers to the place of residence (1 = lives in care home; 0 = lives elsewhere).

If this assumption is true, then data from observations collected in previous years of all-cause mortality by age and care home status can be leveraged to estimate a proxy for the infection fatality rates. In essence, this method assumes that frailer individuals are at greater risk of dying from COVID-19 once infected. Increased age and the presence of co-morbidities are indicators of increased "frailty" or susceptibility to illness and death from a broad range of causes (United Nations, 2020). While all-cause deaths rates are a useful proxy for frailty, they may be imperfect, since deaths from some causes are not closely tied to any physiological vulnerability, such as deaths from violence and some accidents (United Nations, 2020).

Equation (4) re-expresses the age-specific mortality of equation (2) using this proxy from equation (3).

$$m^r(x) = i^r(x) \cdot b \cdot n^r(x) \tag{4}$$

where:

m is the COVID-19 mortality rate at age x in population r;
i is the infection prevalence rate at age x in population r;
b is an unknown proportion, assumed to be constant across ages and populations (care home residents and non-residents); and
n is the all-cause mortality rate at age x in population r during a pre-pandemic year.

Note that the only variables that are measurable in this equation are the mortality rates from COVID-19 during the period of study and from all causes during a pre-pandemic year. Therefore, the infection prevalence rate, $i^r(x)$, cannot be estimated. Only the composite term, $i^r(x) * b$, is estimated.

The ratio of the age-specific COVID-19 mortality rates of the care home population relative to those of the non-resident population can be expressed as

the product of two ratios, as shown in equation (5). This equation can be used to derive the relative infection risk of care home residents compared to that of non-residents, as the relative risks of COVID-19 mortality and the relative risks of all-cause mortality in a pre-pandemic year are known quantities

$$\frac{m^1(x)}{m^0(x)} = \frac{i^1(x)}{i^0(x)} \cdot \frac{b}{b} \cdot \frac{n^1(x)}{n^0(x)} = \frac{i^1(x)}{i^0(x)} \cdot \frac{n^1(x)}{n^0(x)} \tag{5}$$

where:

m is the COVID-19 mortality rate at age x in population r;
i is the infection prevalence rate at age x in population r;
b is an unknown proportion, assumed to be constant across ages and populations (care home residents and non-residents); and
n is the all-cause mortality rate at age x in population r during a pre-pandemic year; and
superscripts $1, 0$ indicate the place of residence (1 = lives in care home; 0 = lives elsewhere).

Note that equation (5) is also useful for exploring counterfactual scenarios for the age-specific mortality rates among the care home population. For example, evaluating equation (5) with $i^1(x)$ equal to $i^0(x)$ shows the hypothetical mortality rate among care home residents if they had experienced the same infection prevalence as non-residents.

The COVID-19 mortality rate for care home residents aged 65 and older is the weighted sum of the age-specific mortality rates at ages 65–64, 75–84 and 85+ weighted by the age distribution of the population (see equation (6)). Therefore, the different rates of COVID-19 mortality experienced by these two populations is a result of differences in the three factors: infection prevalence, $i^r(x)$; frailty as measured by all-cause mortality in a pre-pandemic year, $n^r(x)$; and the age distribution of the population, $p^r(x)$.

$$M^r(65+) = \sum_x i^r(x) \cdot b \cdot n^r(x) \cdot p^r(x) \tag{6}$$

where:

$M(65+)$ is the COVID-19 mortality rate for the population aged 65 and older in population r;
i is the infection prevalence rate at age x in population r;
n is the all-cause mortality rate at age x in population r during a pre-pandemic year;
b is an unknown proportion, assumed to be constant across ages and populations (care home residents vs non-residents);
p is the proportion of population r at age x; and
r refers to the place of residence (1 = lives in care home; 0 = lives elsewhere).

To what extent were the higher COVID-19 death rates among care home residents due to their higher infection rates, their higher levels of frailty or to their advanced ages? In demography, the Kitagawa (1955) method for standardisation and decomposition is often used to turn a difference in mortality rates between populations into a component effect attributed to the differences in the age structure, and a rate effect attributed to the differences in the age-specific mortality rates. The age component effect is calculated as the differences in the age distributions of the two populations weighted by the arithmetic mean of the age-specific mortality rates of the two populations. The rate effect is calculated as the differences in the age-specific mortality rates of the two populations weighted by the arithmetic mean of the age distribution in the two populations. The Das Gupta (1993) method is an extension of Kitagawa's decomposition method for more than two effects, following the same logic. Equation (7) presents a decomposition of the differences in the COVID-19 mortality rates of care home residents and non-residents into three effects: differences in the infection prevalence at each age, differences in the infection fatality rate at each age (proxied by the all-cause mortality in a pre-pandemic year) and differences in the age structure. Note that the estimation of the decomposition in equation (7) uses the composite term, $i^r(x) * b$, estimated using equation (3); as was previously noted, the infection prevalence rate, $i^r(x)$, cannot be measured. Equation (7) also shows that the inability to measure the infection prevalence rate does not affect the decomposition estimates, as an equivalent expression for the decomposition in the case in which the infection prevalence rates could be measured shows that all three factors are multiplied by the unknown term "b", and hence that the share of the difference attributed to each factor is unchanged.

$$
\begin{aligned}
&M^1(65+) - M^0(65+) \\
&= \sum_x (i^1(x) \cdot b - i^0(x) \cdot b) \\
&\quad \cdot \left[\frac{n^1(x) \cdot p^1(x) + n^0(x) \cdot p^0(x)}{3} + \frac{n^1(x) \cdot p^0(x) + n^0(x) \cdot p^1(x)}{6} \right] \\
&\quad + \sum_x (n^1(x) - n^0(x)) \\
&\quad \cdot \left[\frac{i^1(x) \cdot b \cdot p^1(x) + i^0(x) \cdot b \cdot p^0(x)}{3} + \frac{i^1(x) \cdot b \cdot p^0(x) + i^0(x) \cdot b \cdot p^1(x)}{6} \right] \\
&\quad + \sum_x (p^1(x) - p^0(x)) \\
&\quad \cdot \left[\frac{i^1(x) \cdot b \cdot n^1(x) + i^0(x) \cdot b \cdot n^0(x)}{3} + \frac{i^1(x) \cdot b \cdot n^0(x) + i^0(x) \cdot b \cdot n^1(x)}{6} \right] \\
&= b \sum_x (i^1(x) - i^0(x))
\end{aligned}
$$

$$\cdot \left[\frac{n^1(x) \cdot p^1(x) + n^0(x) \cdot p^0(x)}{3} + \frac{n^1(x) \cdot p^0(x) + n^0(x) \cdot p^1(x)}{6} \right]$$
$$+ b \sum_x (n^1(x) - n^0(x))$$
$$\cdot \left[\frac{i^1(x) \cdot p^1(x) + i^0(x) \cdot p^0(x)}{3} + \frac{i^1(x) \cdot p^0(x) + i^0(x) \cdot p^1(x)}{6} \right]$$
$$+ b \sum_x (p^1(x) - p^0(x))$$
$$\cdot \left[\frac{i^1(x) \cdot n^1(x) + i^0(x) \cdot n^0(x)}{3} + \frac{i^1(x) \cdot n^0(x) + i^0(x) \cdot n^1(x)}{6} \right] \quad (7)$$

where:

$M(65+)$ is the COVID-19 mortality rate for the population aged 65 and older in population r;
i is the infection prevalence rate at age x in population r;
n is the all-cause mortality rate at age x in population r during a pre-pandemic year;
b is an unknown proportion, assumed to be constant across ages and populations (care home residents vs non-residents);
p is proportion of population r at age x; and
superscripts $1, 0$ indicate the place of residence (1 = lives in care home; 0 = lives elsewhere).

4 Results

Between March 2020 and September 2020 in Belgium, COVID-19 deaths were heavily concentrated in care homes (see Table 2a). The number of deaths among care home residents aged 65+ was 6111, which represents 61% of all COVID-19 deaths in the population aged 65+ (9399). Among the general population, there were 0.9 COVID-19 deaths per 1000 people during this period. But among older people, the mortality rate was four times higher, at 4.3 deaths per 1000 people. And among these older people, the mortality rate of those living in care homes was 57 deaths per 1000, which was 36 times higher than the mortality rate of non-residents (1.6 deaths per 1000).

Similarly, in England and Wales, COVID-19 deaths were heavily concentrated among the care home population, with these deaths accounting for 39% of all deaths during the first wave of the pandemic from 14 March 2020 to 11 September 2020 (see Table 2b). Among the general population, there were 0.9 COVID-19 deaths per 1000 people during this period. But among older people, the mortality rate was four times higher, at 4.1 deaths per 1000 people. And among these older people, the mortality rate of those living in care homes was 55 deaths per 1000, which

Table 2:
COVID-19 deaths and mortality rates for people aged 65 and older by care home status

A. Belgium, 14 March 2020–28 September 2020					
	All ages	**Ages 65+**			
Place of residence	**Total**	**Living in care home (A)**	**Not living in care home (B)**	**Total (A+B)**	**Ratio (A/B)**
COVID-19 deaths	9,975	6,111	3,288	9,399	1.86
Population	11,492,641	107,257	2,097,221	2,204,478	0.05
COVID-19 mortality rate (per 1000)	0.9	57.0	1.6	4.3	36.3

Source: Author's calculations based on COVID-19 deaths by age provided by Sciensano, the Belgian institute for health, and care home residence and estimates of care home residents and non-residents by age provided by provided by STATBEL, the Belgian statistical office.

B. England and Wales, 14 March 2020 to 11 September 2020 (wave 1)					
	All ages	**Ages 65+**			
Place of residence	**Total**	**Living in care home (A)**	**Not living in care home (B)**	**Total (A+B)**	**Ratio (A/B)**
COVID-19 deaths	51,912	20,231	26,132	46,363	0.77
Population	59,867,666	369,483	10,828,745	11,198,228	0.03
COVID-19 mortality rate (per 1000)	0.9	54.8	2.4	4.1	22.7

Source: Author's calculations based on COVID-19 deaths by age and care home residence and estimates of care home residents and non-residents by age provided by the Office for National Statistics of the United Kingdom.

C. England and Wales, 12 September 2020 to 2 April 2021 (wave 2)					
	All ages	**Ages 65+**			
Place of residence	**Total**	**Living in care home (A)**	**Not living in care home (B)**	**Total (A+B)**	**Ratio (A/B)**
COVID-19 deaths	84,762	21,321	53,541	74,862	0.40
Population	59,867,666	369,483	10,828,745	11,198,228	0.03
COVID-19 mortality rate (per 1000)	1.4	57.7	4.9	6.7	11.7

Source: Author's calculations based on COVID-19 deaths by age and care home residence and estimates of care home residents and non-residents by age provided by the Office for National Statistics of the United Kingdom.

was 23 times higher than the mortality rate of non-residents (2.4 deaths per 1000). The figures for England and Wales are strikingly similar to those for Belgium in

terms of the overall COVID-19 mortality rate and the rates for the older population and for the care home population. Data for England and Wales are available for the second wave of the pandemic, which took place from 12 September 2020 to 2 April 2021 (see Table 2c). In this second wave, care home residents experienced COVID-19 death rates similar to those in the first wave (57.7 per 1000 compared to 54.8 per 1000), but they did much better in comparison to other population groups. Whereas the mortality rate of people living in care homes was 23 times higher than that of non-resident older people in the first wave, the ratio fell to 12 times higher in the second wave (57.8 per 1000 compared to 4.9 per 1000). Accordingly, the concentration of COVID-19 deaths among the care home population declined from 39% of all COVID-19 deaths in the first wave to 25% of all COVID-19 deaths in the second wave.

The care home residents were older than the non-residents. The average age of care home residents was about 86 in Belgium and 83 in England and Wales, while the average age of non-residents was about 76 in both Belgium and England and Wales based on the age distribution data from Table 3. Compared to non-residents, older people living in care homes were about 10 years older in Belgium and were about seven years older in England and Wales. As age is a known risk factor for COVID-19 mortality (Dowd et al., 2020; Dudel et al., 2020; Kashnitsky and Aburto, 2020), these age differences partly explain the higher levels of mortality experienced by care home residents.

Furthermore, at every age, care home residents had a much higher COVID-19 mortality rate than non-residents. For example, in Belgium, the COVID-19 death rates for care home residents were 31 per 1000 for those aged 65–74, 53 per 1000 for those aged 75–84, and 65 per 1000 for those aged 85+, as shown in Table 3a. Non-residents had much lower rates, at 0.6 per 1000 for those aged 65–74, 2.0 for those aged 75–84, and 4.6 for those aged 85+. England and Wales displayed the same pattern, with COVID-19 death rates being higher for residents than for non-residents at every age in both waves, as shown in Tables 3b and 3c.

The age-specific mortality data in Table 3 are expressed as ratios of COVID-19 mortality among care home residents relative to that among similarly aged non-residents in Table 4. As was previously noted, as a group, the care home population experienced substantially higher COVID-19 mortality than non-residents. In addition, a very strong age gradient is observed. The gap in COVID-19 mortality rates between the two groups was largest in the youngest age group (ages 65–74) and was smallest in the oldest age group (ages 85+). For instance, compared to non-residents, care home residents in Belgium had death rates that were 51 times higher for those aged 65–74, 26 times higher for those aged 75–84 and 14 times higher for those aged 85+.

As COVID-19 mortality is the product of the infection prevalence and the infection fatality rate, the much higher risk of dying from COVID-19 of care homes residents relative to that of non-residents was due to differences in the infection prevalence as well as differences in the infection fatality rate. As was discussed in the methods section (see equation (3)), the infection fatality rates from COVID-19

Table 3:
COVID-19 mortality rates and population counts by age and care home status

A. Belgium, 14 March 2020–28 September 2020						
	Living in care home			Not living in care home		
		Population			Population	
Age	COVID-19 mortality rate (C) (per 1000)	Count	Distribution (%)	COVID-19 mortality rate (D) (per 1000)	Count	Distribution (%)
65–74	31.23	13,771	13	0.60	1,156,628	55
75–84	52.51	29,402	27	1.99	669,538	32
85+	64.56	64,084	60	4.64	271,055	13
Total 65+	56.98	107,257	100	1.57	2,097,221	100

Source: Author's calculations based on COVID-19 deaths by age provided by Sciensano, the Belgian institute for health, and care home residence and estimates of care home residents and non-residents by age provided by provided by STATBEL, the Belgian statistical office.

B. England and Wales, 14 March 2020 to 11 September 2020 (wave 1)						
	Living in care home			Not living in care home		
		Population			Population	
Age	COVID-19 mortality rate (C) (per 1000)	Count	Distribution (%)	COVID-19 mortality rate (D) (per 1000)	Count	Distribution (%)
65–74	45.54	34,451	9	1.03	5,943,094	55
75–84	55.71	112,274	30	2.93	3,601,514	33
85+	55.70	222,758	60	7.39	1,284,137	12
Total 65+	54.75	369,483	100	2.41	10,828,745	100

Source: Author's calculations based on COVID-19 deaths by age and care home residence and estimates of care home residents and non-residents by age provided by the Office for National Statistics of the United Kingdom.

C. England and Wales, 12 September 2020 to 2 April 2021 (wave 2)						
	Living in care home			Not living in care home		
		Population			Population	
Age	COVID-19 mortality rate (C) (per 1000)	Count	Distribution (%)	COVID-19 mortality rate (D) (per 1000)	Count	Distribution (%)
65–74	36.40	34,451	9	2.08	5,943,094	55
75–84	49.58	112,274	30	5.72	3,601,514	33
85+	65.10	222,758	60	16.02	1,284,137	12
Total 65+	57.70	369,483	100	4.94	10,828,745	100

Source: Author's calculations based on COVID-19 deaths by age and care home residence and estimates of care home residents and non-residents by age provided by the Office for National Statistics of the United Kingdom.

are assumed to be proportional to all-cause mortality. Hence, the estimates of the ratio of the COVID-19 infection fatality rates for care home residents relative to those for non-residents (reported in column F of Table 4) are based on the ratio

of the all-cause mortality rates for care home residents relative to those for non-residents, which are drawn from pre-pandemic years (2018 for Belgium and 2019 for England and Wales). At every age, care home residents had much higher all-cause mortality than non-residents, reflecting their greater frailty. However, this disadvantage declined with age. For instance, in Belgium in 2018, the all-cause mortality rates were nine times higher at ages 65–74, seven times higher at ages 75–84 and four times higher at ages 85+ for care home residents than for non-residents. Similar results have been reported for England and Wales. The greater health frailty of the care home residents is an important factor in the higher COVID-19 mortality experienced by this population, and it underlies the strong age gradient observed in COVID-19 mortality. That is, care home residents were at higher risk of dying from COVID-19 than other older people because they are generally at higher risk of death than other older people at every age.

The ratio of the infection prevalence of care home residents to non-residents, $(i^1(x)/i^0(x))$, reported in column G of Table 4, was estimated using equation (5), which divides the observed ratio of COVID-19 mortality $(m^1(x)/m^0(x))$ by the observed ratio of all-cause mortality $(n^1(x)/n^0(x))$ in a pre-pandemic year. The results indicate that care home residents aged 65+ in Belgium were 3.8 times more likely to become infected with COVID-19 than other older people. In England and Wales, care home residents aged 65+ were 1.79 times more likely to become infected with COVID-19 than other older people during the first wave. During the second wave, this difference was reversed, with care home residents being less likely to become infected than the general population (i.e., residents had 0.9 times the prevalence of non-resident older people).

Table 4 shows that the age-specific infection prevalence was nearly constant across ages. This finding lends support to the hypothesis that this factor is measuring infection risk (which is unlikely to have much of an age gradient within care home facilities). This assumption is consistent with evidence from Akhtar-Danesh et al. (2022) indicating that, among long-term care residents in Ontario, the infection prevalence was nearly constant by age. Therefore, the results displayed in Table 4 suggest that care home residents experienced higher death rates from COVID-19 in part because they were more likely to be exposed to COVID-19 than the general population of older people during the first wave of the pandemic. That is, the infection spread more rapidly within and between care home facilities than it did in the general population. As other respiratory viruses such as the seasonal flu also appear to spread more rapidly among care home residents, it is likely that a similar pattern of transmission occurred during the COVID-19 pandemic (Anderson et al., 2020; CDC, 2020; Chen et al., 2020). In addition, a lack of resources, such as testing and personal protection equipment for care home staff, meant that there were likely vectors of spread within and between care home facilities (Shallcross et al., 2021).

The examination of the age pattern of COVID-19 mortality has shown that care home residents faced a much higher risk of death than non-residents, but that this disadvantage declined with age. The estimates indicate that this declining disadvantage with age was likely due to decreasing differences between the two

Table 4:
Ratios of mortality, infection fatality and infection prevalence: comparing older people living in care homes to older people not living in care homes

A. Belgium, 14 March 2020–28 September 2020			
Age	**Ratio: COVID-19 mortality (C/D) = E**	**Ratio: infection fatality rate (estimated) (F)**	**Ratio: infection prevalence (estimated) G = (E/F)**
65–74	51.74	9.01	5.74
75–84	26.38	7.23	3.64
85+	13.92	3.74	3.72
All 65+	36.34	9.56	3.80

Source: Author's calculations based on COVID-19 deaths by age provided by Sciensano, the Belgian institute for health, and care home residence and estimates of care home residents and non-residents by age provided by provided by STATBEL, the Belgian statistical office.

B. England and Wales, 14 March 2020 to 11 September 2020 (wave 1)			
Age	**Ratio: COVID-19 mortality (C/D) = E**	**Ratio: infection fatality rate (estimated) (F)**	**Ratio: infection prevalence (estimated) G = (E/F)**
65–74	44.34	20.97	2.11
75–84	19.04	9.46	2.01
85+	7.54	4.48	1.68
All 65+	22.69	12.71	1.79

Source: Author's calculations based on COVID-19 deaths by age and care home residence and estimates of care home residents and non-residents by age provided by the Office for National Statistics of the United Kingdom.

C. England and Wales, 12 September 2020 to 2 April 2021 (wave 2)			
Age	**Ratio: COVID-19 mortality (C/D) = E**	**Ratio: infection fatality rate (estimated) (F)**	**Ratio: infection prevalence (estimated) G = (E/F)**
65–74	17.50	20.97	0.83
75–84	8.66	9.46	0.92
85+	4.06	4.48	0.90
All 65+	11.67	12.71	0.92

Source: Author's calculations based on COVID-19 deaths by age and care home residence and estimates of care home residents and non-residents by age provided by the Office for National Statistics of the United Kingdom.

populations in frailty by age. That is, among the youngest age group (ages 65–74), people who were living in care homes were much frailer than those who were living outside of care homes, whereas among the oldest age group (ages 85+), this frailty

difference – though still large – was much reduced. Therefore, the larger gap in COVID-19 mortality rates between the care home population and the population at large in the 65–74 age group was likely attributable to the care home population in that age group being far more selected for frailty than the population in the 85+ age group. Finally, the age patterns show that the higher infection prevalence of care home residents relative to that of non-residents did not vary much by age.

The large differences in the COVID-19 mortality rates observed between residents and non-residents can be decomposed into three components: (1) the component due to different age structures (age composition); (2) the component due to different infection prevalence rates at each age; and (3) the component due to different infection fatality rates at each age, which reflects underlying frailty. The Das Gupta method (1993) is applied using equation (6), and the results are reported in Table 5. During wave 1 in Belgium, 13% of the differences in mortality between care home residents and non-residents could be attributed to the older ages of the care home residents (age composition effect). The greater frailty of the care home population accounted for 46% of the differences in mortality. Finally, an estimated 40% of the differences in mortality were likely due to the higher infection levels among the resident population. The fourfold greater risk of infection among care home residents in Belgium during wave 1 was a second major factor, accounting for about two-fifths of the elevated COVID-19 mortality rates experienced by this population during wave 1. These results are not directly comparable to those of Hardy et al. (2021), who examined the Wallonia region (rather than all of Belgium, as in this study), and compared care home residents to the general population of all ages (rather than the older population, as in this study). Nevertheless, in line with the results of this study, they identified higher infection rates among care homes residents as an important explanatory factor that likely had nearly the same impact as underlying frailty.

Similarly, in England and Wales during the first wave, the 1.79 times higher infection rate (estimated) observed among care home residents was a second major factor that accounted for 26% of the elevated COVID-19 mortality rates experienced by this population. However, by the second wave, the infection rate was estimated to be slightly lower among care home residents, accounting for −6% of the elevated mortality rates experienced by this population. The better outcomes of the care home population during the second wave might be attributed to the higher immunisation rates among this population, and/or to better infection control procedures within care homes (ONS, 2020; Schultze et al., 2022).

Having identified infection prevalence as a significant contributor to the large differences in COVID-19 mortality experienced by the care home populations in Belgium and England and Wales, it is useful to construct a counterfactual: What would have happened if care home residents had experienced the lower infection rates observed among non-residents? Using equations (5) and (6), we calculate the hypothetical COVID-19 mortality rate of care home residents given their population age structure and their underlying frailty, but with the lower infection rate of non-residents. In this hypothetical scenario, if the infection prevalence of the care home

Table 5:
Decomposition of the differences in the COVID-19 death rates between older people living in care homes and older people living at home

	Belgium, 14 March 2020–28 September 2020		England and Wales, 14 March 2020–11 September 2020 (wave 1)		England and Wales, 12 September 2020–2 April 2021 (wave 2)	
	Deaths per 1000 persons	Distribution	Deaths per 1000 persons	Distribution	Deaths per 1000 persons	Distribution
Differences in COVID-19 mortality rates between care home residents and non-residents	55.4	100%	52.3	100%	52.8	100%
Contributions of age compositional differences	7.5	13%	4.3	8%	10.0	19%
Contributions of differences in age-specific frailty	25.6	46%	34.3	66%	46.2	88%
Contributions of differences in age-specific infection rates	22.3	40%	13.7	26%	−3.4	−6%

Source: Author's calculations based on COVID-19 deaths by age in Belgium provided by Sciensano, the Belgian institute for health; care home residence and estimates of care home residents and non-residents by age in Belgium provided by STATBEL, the Belgian statistical office; and COVID-19 deaths by age and care home residence and estimates of care home residents and non-residents by age in England and Wales provided by the Office for National Statistics of the United Kingdom.

population had been as low as that of the non-resident population in Belgium, the COVID-19 mortality rate among the care home population would have fallen from 57 deaths per 1000 to 15.5 deaths per 1000. Note that relative to the non-resident population, they still would have experienced death rates that were 10 times higher due to the underlying frailty of the population. Overall, the COVID-19 mortality rate would have fallen by 49% from 4.3 deaths per 1000 to 2.2 deaths per 1000 among the population aged 65 and older, as presented in Table 6. That is, the number of COVID-19 deaths among people aged 65 and older would have fallen from the observed 9399 deaths to 4955 deaths. For England and Wales, the COVID-19 mortality rate for the care home population would have fallen from 54.8 deaths per 1000 to 30.4 deaths per 1000. Note that as was the case for Belgium, the care home population still would have experienced a death rate that was much higher than that of the non-resident population (13 times higher) due to the greater underlying frailty of this population. Overall, if the infection prevalence of the care home population had been as low as that of the non-resident population, the COVID-19 mortality rate for the population aged 65 and older would have fallen by 20% from 4.1 deaths per

Table 6:
COVID-19 deaths and mortality rates as observed and under an alternative scenario in which nursing home residents had the same infection prevalence as non-residents

A. Belgium, 14 March 2020–28 September 2020					
		Total	**Residents**	**Non-residents**	**Ratio**
Baseline	Deaths	9,399	6,111	3,288	1.9
	Rate	4.3	57.0	1.6	36.3
Alternative scenario	Deaths	4,955	1,667	3,288	0.5
	Rate	2.2	15.5	1.6	9.9

B. England and Wales, 14 March 2020–11 September 2020 (wave 1)					
		Total	**Residents**	**Non-residents**	**Ratio**
Baseline	Deaths	46,363	20,231	26,132	0.8
	Rate	4.1	54.8	2.4	22.7
Alternative scenario	Deaths	37,357	11,225	26,132	0.4
	Rate	3.3	30.4	2.4	12.6

1000 to 3.3 deaths per 1000 in wave 1. That is, the number of COVID-19 deaths among those aged 65 and older would have fallen from the observed 46,363 deaths to 37,357 deaths.

5 Limitations

A key limitation of this analysis is the inability to directly observe infection prevalence and infection fatality rates. An indirect method had to be used to measure these rates based on the strong assumption that the unobserved COVID-19 infection fatality rates for care home residents relative to those for non-residents were closely approximated by the all-cause mortality rates for care home residents relative to those for non-residents (observed in the years prior to the epidemic). Support for this assumption is provided by the growing body of evidence that age-specific COVID-19 mortality rates seem to closely approximate the age-specific all-cause mortality rates in most countries. However, to the extent that this approximation has understated the true infection fatality rate differences between care home residents and non-residents, the analysis would have overstated the role of infection prevalence in explaining the differences between these populations.

A second limitation in the case of Belgium is the use of all-cause mortality data based on the place of death rather than on the place of usual residence. Since some care home residents died in hospitals, the true mortality differences between care home residents and non-residents in the pre-pandemic year were underestimated in Belgium. The use of data by the place of death rather than by the place of usual residence would have led to an understatement of the mortality differences between

care home residents and non-residents in the pre-pandemic year. This would, in turn, have led to an underestimation of frailty and an overestimation of infection prevalence (see equation (5)).

A third limitation stems from the fact that COVID-19 deaths are underreported. The level of underreporting may differ between countries as well between population groups within countries. Similarly, caution is warranted in interpreting international comparisons of COVID-19 mortality, as the potential for underreporting also applies to the within-country differences examined in this study. A priori, it is difficult to know if the underreporting of COVID-19 deaths was more or less severe among care home residents than it was among non-residents.

A fourth limitation is the measurement of the care home population. For Belgium, data on the number of people in collective housing at ages 65 and older were used. These data provide a close approximation of the number of people in care homes. In addition, for England and Wales, the study used population data for care home residents in 2020 for the denominator in calculating mortality rates in both waves of the pandemic. Thus, population change over the course of the epidemic was not accounted for. To the extent that the care home population declined over time due to reduced entrants as well as increased deaths (due to COVID-19), the rates for care home residents in the second wave would have been too low.

A fifth limitation is that this paper aimed to analyse the significance of the three factors of age composition, infection prevalence and underlying frailty within each country, but not across countries. Conducting international comparisons with the available data would be difficult due to the different approaches countries use in recording deaths, and because different countries have different definitions of what constitutes a care home (Comas-Herrera et al., 2020). There are several data issues to be considered when conducting international comparisons of COVID-19 mortality, including: the time lag between the occurrence of a death and its publication; the coverage of different places of death; the criteria for attributing the cause of death to COVID-19; the start date of the epidemic; the magnitude and the dynamics of the death curve; and the age and the gender structure of the population (INED, 2020).

A sixth limitation is that sex differences in COVID-19 were not considered in this paper due to data limitations. Women have a lower risk of dying from COVID-19 than men (Ng et al., 2020), and care homes tend to have more women than the general population in European countries (United Nations, 2017). Therefore, sex differences between these populations would tend to lower COVID-19 mortality among care home residents relative to that among non-residents. But this effect was small relative to the other factors analysed in this study, such as age, frailty and increased exposure, which is why nursing home residents faced risks that were more than 20 times higher than those of non-nursing home residents.

A seventh limitation is that in computing the mortality rate for all-cause mortality in 2018 in Belgium, population by age and place of usual residence in 2019 was used instead of in 2018 due to a lack of available data. However, the 2019 population can be considered a good proxy for the 2018 population given that the annual changes in the population were small.

6 Conclusion and discussion

In much of Europe, Australia and North America, deaths from COVID-19 have been concentrated among care home residents, with deaths among this population accounting for 39% to 79% of all COVID-19 deaths (Comas-Herrera et al., 2020). Why has this been the case? We know that care home residents are older and frailer than the general population of older people. These factors have contributed to their increased risk of death from COVID-19. In addition to being more likely to die once infected, care home residents might have also faced higher risks of exposure and infection relative to the general population. This study has presented a quantified assessment of these factors.

The first key aim of this study was to measure the COVID-19 mortality of care home residents relative to that of non-residents among the population aged 65 and older in Belgium and in England and Wales. In Belgium, older people residing in care homes were 36 times more likely to die from COVID-19 than non-residents (57 deaths vs 1.6 deaths per 1000) between March 2020 and September 2020. In England and Wales, the likelihood was 23 times higher during wave 1 (14 March 2020–11 September 2020) and 12 times higher during wave 2 (12 September 2020–2 April 2021). The improvement in outcomes in the second wave in England and Wales may have occurred because there was delayed access to care services and rapid testing during wave 1; and lower care home occupancy, more vaccine availability and mortality displacement[4] during wave 2 (ONS, 2020). In short, the care home population experiencing the second wave was likely to be more robust to the effects of COVID-19 for two main reasons. First, because of the high mortality levels care home residents experienced in the first wave, the remaining population in the second wave was younger and more robust (Schultze et al., 2022), and was more resistant to infection from COVID-19 due both to acquired immunity and increasing immunisation rates (Krutikov et al., 2021). Second, by the second wave, care homes may have learned how to handle COVID-19 using new guidelines issued by the government that were specifically focused on care homes (Marshall et al., 2021).

The second key finding was that the older age structure of care home residents relative to that of non-residents was only a small factor in the elevated mortality rates among residents. The age-specific mortality rates for COVID-19 were substantially higher at every age for care home residents than for non-residents. These higher rates were the likely result of residents having both a higher risk of becoming infected and a higher risk of succumbing to the disease once infected.

This study attempted to identify and measure these two risks by assuming that the higher relative risks of succumbing to COVID-19 once infected could

[4] Mortality displacement occurs when a high-mortality event is followed a period of below-average mortality. During the high-mortality event, frailer individuals die sooner than expected. In a sense, their deaths are displaced backwards in time. These individuals do not die in the following days, weeks and months when they would have died, which leads to a lower-than-average period of mortality.

be approximated by measuring the higher relative risks of all-cause mortality experienced by care home residents. Pre-pandemic data on age-specific all-cause mortality showed that care home residents were 10 times more likely to die than non-residents in Belgium and were 12 times more likely to die than non-residents in England and Wales. The third key finding of this study was that this underlying health frailty was a major cause of the higher COVID-19 mortality experienced by care home residents. In Belgium, it accounted for 46% of the differences in mortality rates between care home residents and non-residents, while in England and Wales, it accounted for 66% of the differences in the first wave and 88% of the differences in the second wave.

Finally, the fourth key finding was that care home residents likely faced a much higher risk of COVID-19 infection than non-residents during the initial wave of the pandemic. In Belgium, the risk of infection was four times higher among care home residents than among non-residents during wave 1. In England, the risk was about 1.79 times higher in wave 1, but was slightly lower in wave 2 (0.92 times).

This study lends support to the hypothesis that the failure to provide care home residents with the levels of protection against exposure and infection enjoyed by the general population was a significant factor in the tragic concentration of deaths observed in care homes during the initial wave of the COVID-19 pandemic in Belgium and in England and Wales. At the same time, the study provides encouraging evidence of a much improved response in the second wave in England and Wales, with care home populations experiencing infection rates below those of the general population. However, COVID-19 mortality continued to be concentrated among older people in care homes due to the underlying frailty of this population.

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Appendix

A. Belgium

Table A.1:
Number of COVID-19 deaths, Belgium, week 11–week 39, 2020

	Total	Resident	Non-resident
Total	9,975	6,224	3,751
Under 65	576	113	463
65–74	1,128	430	698
75–84	2,877	1,544	1,333
85+	5,394	4,137	1,257
65+	9,399	6,111	3,288

Source: Sciensano, the Belgian institute for health.

Table A.2:
All-cause deaths by age, Belgium, 2018

	Total	Resident	Non-resident
Total	110,645	31,644	79,001
Under 65	16,839	626	16,213
65–74	17,615	1,699	15,916
75–84	29,334	7,190	22,144
85+	46,857	22,129	24,728
65+	93,806	31,018	62,788

Source: STATBEL, the Belgian statistical office.

Table A.3a:
Population by age, Belgium 2019

	Total	Resident	Non-resident
Total	11,431,406	106,381	11,325,025
Under 65	9,266,106	–	9,266,106
65–74	1,147,009	13,425	1,133,584
75–84	690,685	29,702	660,983
85+	327,606	63,254	264,352
65+	2,165,300	106,381	2,058,919

Source: STATBEL, the Belgian statistical office.

Table A.3b:
Population by age, Belgium, 2020

	Total	Resident	Non-resident
Total	11,492,641	107,257	11,385,384
Under 65	9,288,163	–	9,288,163
65–74	1,170,399	13,771	1,156,628
75–84	698,940	29,402	669,538
85+	335,139	64,084	271,055
65+	2,204,478	107,257	2,097,221

Source: STATBEL, the Belgian statistical office.

B. England and Wales

Table B.1a:
Number of COVID-19 deaths, England and Wales, wave 1 (14 Mar 2020 to 11 Sept 2020)

	Total	Resident	Non-resident
Total	51,912	20,664	31,248
Under 65	5,549	433	5,116
65–74	7,673	1,569	6,104
75–84	16,792	6,255	10,537
85+	21,898	12,407	9,491
65+	46,363	20,231	26,132

Source: Office for National Statistics of the United Kingdom licensed under the Open Government License.

Table B.1b:
Number of COVID-19 deaths, England and Wales, wave 2 (12 Sept 2020 to 2 Apr 2021)

	Total	Resident	Non-resident
Total	84,762	21,677	63,085
Under 65	9,900	356	9,544
65–74	13,613	1,254	12,359
75–84	26,176	5,566	20,610
85+	35,073	14,501	20,572
65+	74,862	21,321	53,541

Source: Office for National Statistics of the United Kingdom licensed under the Open Government License.

Table B.2:
All-cause deaths by age, England and Wales, 2019

	Total	Resident	Non-resident
Total	527,234	137,998	389,236
Under 65	81,410	3,176	78,234
65–74	87,492	9,484	78,008
75–84	149,651	34,082	115,569
85+	208,681	91,256	117,425
65+	445,824	134,822	311,002

Source: Office for National Statistics of the United Kingdom licensed under the Open Government License.

Table B.3:
Population by age, England and Wales, 2020

	Total	Resident	Non-resident
Total	59,867,666	442,888	59,424,778
Under 65	48,669,438	73,405	48,596,033
65–74	5,977,545	34,451	5,943,094
75–84	3,713,788	112,274	3,601,514
85+	1,506,895	222,758	1,284,137
65+	11,198,228	369,483	10,828,745

Source: Office for National Statistics of the United Kingdom licensed under the Open Government License.