Case–control study to estimate odds of death within 28 days of positive test for SARS-CoV-2 prior to vaccination for residents of long-term care facilities in England, 2020–2021

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ABSTRACT

Background Persons living in long-term care facilities (LTCFs) are presumed to be at higher risk of adverse outcomes from SARS-CoV-2 infection due to increasing age and frailty, but the magnitude of increased risk is not well quantified.

Methods After linking demographic and mortality data for cases with confirmed SARS-CoV-2 infection between March 2020 and January 2021 in England, a random sample of 6000 persons who died and 36 000 who did not die within 28 days of a positive test was obtained from the dataset of 3 020 800 patients. Based on an address-matching process, the residence type of each case was categorised into one of private home and residential or nursing LTCF. Univariable and multivariable logistic regression analysis was conducted.

Results Multivariable analysis showed that an interaction effect between age and residence type determined the outcome. Compared with a 60-year-old person not living in LTCF, the adjusted OR (aOR) for same-aged persons living in residential and nursing LTCFs was 1.77 (95% CI 1.21 to 2.6, p=0.0017) and 3.95 (95% CI 2.77 to 5.64, p<0.0001), respectively. At 90 years of age, aORs were 0.87 (95% CI 0.72 to 1.06, p=0.21) and 0.74 (95% CI 0.61 to 0.9, p=0.001), respectively. The model had an overall accuracy of 94.2% (94.2%) when applied to the full dataset of 2 978 800 patients.

Conclusion This study found that residents of LTCFs in England had higher odds of death up to 80 years of age. Beyond 80 years, there was no difference in the odds of death for LTCF residents compared with those in the wider community.

INTRODUCTION

Given that increased age and frailty are key prognostic factors for SARS-CoV-2, residents in long-term care facilities (LTCFs) have a higher risk of mortality compared with the general population.[1 2] Nevertheless, the level of additional risk from SARS-CoV-2 among residential and nursing LTCF residents compared with the rest of the population is not well described.

In England, residential LTCFs provide accommodation and support with personal care, whereas nursing LTCFs offer additional support with provision of nursing care.[3] Those resident in an LTCF are likely to be more frail and requiring staff support compared with those not resident in LTCFs.[4] This study aimed to estimate the odds of death within 28 days of a positive SARS-CoV-2 test for residential and nursing LTCF residents compared with those not in LTCFs in England.

METHODS

Data sources

Since the start of the epidemic in January 2020, diagnostic laboratories in England are required by law to report all laboratory-confirmed cases of SARS-CoV-2 to the UK Health Security Agency (UKHSA). Patient-level data provided by laboratories across England are stored in the Second-Generation Surveillance System (SGSS), the national microbiology data repository at UKHSA for statutory notifiable diseases. SARS-CoV-2 records in SGSS were deduplicated to retain the earliest positive specimen result for each case reported to UKHSA.

Information on residential address provided by patients at the point of testing was preferentially used and, in its absence, was supplemented with the details registered on a patient's record in the NHS Digital Patient Demographic Service. To derive the residence type, the full residential addresses of patients were matched against three reference databases—Ordnance Survey (OS), Care Quality Commission list of registered LTCFs and OS AddressBase Premium database. OS AddressBase is a repository populated from local authority databases containing all addresses in England. Each property is designated a unique property reference number (UPRN) and property type (Basic Land and Property Unit class). ESRI LocatorHub software was used to facilitate matching in a cascade process starting with full exact address matching, with additional locations searched where records fail to be matched (fuzzy matching) to allow for minor discrepancies. This latter process included a postcode validation step. On the remaining unmatched records, a manual match process was undertaken. Cases not matched through the aforementioned process were matched by NHS number to the Master Patient Index held by NHS England. This holds UPRNs based on the patient's GP registration; any remaining unmatched cases were deemed unmatchable and flagged as 'undetermined'. Cases resident in other property categories encompassing

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Table 1 Characteristics of patients with SARS-CoV-2 included in the multivariable logistic regression model, March 2020–January 2021, England

Variable	Levels	Died within 28 days	Did not die within 28 days	Total	Univariable OR (95% CI)
Age (years)	Median (IQR)	82.0 (74.0–89.0)	39.0 (25.0–54.0)	44.0 (27.0–62.0)	1.12 (1.12 to 1.13)
Sex	Female	2742 (12.2)	19 745 (87.8)	22 487	Reference
	Male	3258 (16.7)	16 255 (83.3)	19 513	1.44 (1.37 to 1.52)
Ethnicity	White	5327 (16.3)	27 298 (83.7)	32 625	Reference
	Asian	419 (7.2)	5400 (92.8)	5819	0.4 (0.36 to 0.44)
	Black	197 (10.1)	1763 (89.9)	1960	0.57 (0.49 to 0.66)
	Other	57 (3.6)	1539 (96.4)	1596	0.19 (0.14 to 0.25)
Residence	Private home	4137 (10.7)	34 476 (89.3)	38 613	Reference
	Residential LTCF	855 (50.9)	824 (49.1)	1679	8.65 (7.82 to 9.57)
	Nursing LTCF	1008 (59.0)	700 (41.0)	1708	12.0 (10.84 to 13.29)
IMD decile	1	666 (13.8)	4173 (86.2)	4839	0.94 (0.83 to 1.07)
	2	713 (14.1)	4341 (85.9)	5054	0.97 (0.85 to 1.09)
	3	671 (13.7)	4226 (86.3)	4897	0.93 (0.82 to 1.06)
	4	606 (13.6)	3844 (86.4)	4450	0.93 (0.82 to 1.05)
	5	611 (14.2)	3696 (85.8)	4307	0.97 (0.85 to 1.11)
	6	542 (13.3)	3524 (86.7)	4066	0.90 (0.79 to 1.03)
	7	588 (15.3)	3266 (84.7)	3854	1.06 (0.93 to 1.21)
	8	570 (15.7)	3070 (84.3)	3640	1.09 (0.96 to 1.25)
	9	549 (15.4)	3014 (84.6)	3563	1.07 (0.94 to 1.22)
	10	484 (14.5)	2846 (85.5)	3330	Reference
Region	South West	337 (14.5)	1994 (85.5)	2331	Reference
	East Midlands	555 (15.9)	2937 (84.1)	3492	1.12 (0.97 to 1.30)
	East of England	739 (15.3)	4090 (84.7)	4829	1.07 (0.93 to 1.23)
	London	865 (10.9)	7060 (89.1)	7925	0.72 (0.63 to 0.83)
	North East	312 (15.3)	1729 (84.7)	2041	1.07 (0.90 to 1.26)
	North West	954 (14.4)	5675 (85.6)	6629	0.99 (0.87 to 1.14)
	South East	907 (15.3)	5031 (84.7)	5938	1.07 (0.93 to 1.22)
	West Midlands	770 (16.1)	4016 (83.9)	4786	1.13 (0.99 to 1.30)
	Yorkshire and Humber	561 (13.9)	3468 (86.1)	4029	0.96 (0.83 to 1.11)
Month	March 2020	507 (66.0)	261 (34.0)	768	36.08 (21.41 to 65.92)
	April 2020	1132 (55.2)	917 (44.8)	2049	22.93 (13.82 to 41.42)
	May 2020	301 (33.0)	612 (67.0)	913	9.13 (5.44 to 16.65)
	June 2020	78 (23.9)	248 (76.1)	326	5.84 (3.32 to 11.01)
	July 2020	16 (8.7)	168 (91.3)	184	1.77 (0.84 to 3.77)
	August 2020	14 (5.1)	260 (94.9)	274	Reference
	September 2020	67 (5.2)	1210 (94.8)	1277	1.03 (0.59 to 1.93)
	October 2020	403 (7.7)	4847 (92.3)	5250	1.54 (0.93 to 2.80)
	November 2020	673 (10.2)	5893 (89.8)	6566	2.12 (1.28 to 3.83)
	December 2020	1099 (10.2)	9702 (89.8)	10 801	2.10 (1.27 to 3.79)
	January 2021	1710 (12.6)	11 882 (87.4)	13 592	2.67 (1.62 to 4.81)

IMD, Index of Multiple Deprivation; LTCF, long-term care facility.

prisons, medical facilities, residential institutions (universities, army barracks, etc), houses of multiple occupancy, no fixed abode, overseas address, other and undetermined were excluded. For the purpose of this study, each patient was thus classified to a residence setting of nursing LTCF, residential LTCF or private home.

Death status and associated date of death was derived by linking case data to the UKHSA COVID-19 mortality dataset.[5] Records of deaths in persons within 28 days following a laboratory-confirmed SARS-CoV-2 infection in England are compiled from (1) deaths in hospitals reported by NHS England, (2) deaths recorded on the NHS Spine (national electronic health record database) identified through Demographic Batch Service tracing, (3) death registrations from the Office for National Statistics (ONS) and (4) reports of deaths reported from UKHSA's health protection teams in relation to local public health enquiries and outbreak investigations.

Ethnicity data for each case were derived from the Hospital Episode Statistics dataset and was collapsed in to white, Asian, black or other ethnic group based on ONS categories.[6] The postcode-based Index of Multiple Deprivation (IMD) is a summary measure of relative deprivation between small areas

of England based on a weighted average of deprivation across seven domains: income, employment, education, health, crime, housing and the living environment. The degree of relative deprivation for each patient was assessed using IMD deciles linked to residential lower super output area.

Statistical analysis

To estimate the odds of death among nursing and residential LTCF residents compared with those living in private homes in England, we conducted a case–control analysis with fixed effects multivariable logistic regression on a sample of patients who died and did not die within 28 days of a positive specimen. We used a random subset of the much larger dataset of confirmed SARS-CoV-2 cases in order to detect practically important effects as statistically significant at the 5% level while not detecting trivial differences to be so. Following a sample size calculation to detect a difference of OR of 2 between LTCF and non-LTCF residents with a design effect of 2, significance level of 0.05, 80% power and two-way interaction, 6000 cases who died and 36 000 cases who did not die, respectively, were randomly sampled from the full dataset after removing those with missing data for one or more covariates. Patients with a positive specimen date in January and February 2020 were excluded as few confirmed cases were reported in that period and testing was limited to hospital inpatients.

Exploratory data analysis and univariable logistic regression were conducted. The model included cubic function of age, sex, ethnic group, residence type, UKHSA region, IMD decile and month of specimen date as explanatory variables. A fourth-order polynomial term was checked but assessed as not required by likelihood ratio test (LRT). After confirming non-significance of effect sizes and lack of better fit for a three-way interaction term with cubic function of age, sex and residence type when compared with a two-way interaction term for residence type and cubic function of age by LRT, the latter was deemed as the final model. This model had a better fit compared with the same model without interaction by LRT. Clustering was assessed by adding postcode-level random intercepts to the fixed effects model with two-way interaction, but the mixed model was not significantly better as assessed by Akaike information criterion(AIC).

Adjusted ORs (aORs) with 95% CIs were reported for variables considered as potential risk factors for mortality. P values for main effects in the main model were calculated by LRT after dropping the relevant variable and comparing model fit to the remaining variables. Due to the presence of interaction between cubic function of age and residence type, aORs are given for specified ages (every 5 years between 60 and 90 years of age) in

Table 3 aORs for specified ages in residential and nursing LTCF for death within 28 days of positive SARS-CoV-2 test, March 2020–January 2021, England

Age (years)	Residential LTCF		Nursing LTCF	
	aOR (95% CI)*	P value†	aOR (95% CI)*	P value†
60	1.77 (1.21 to 2.6)	0.0017	3.95 (2.77 to 5.64)	<0.0001
65	1.51 (1.11 to 2.05)	0.006	2.89 (2.16 to 3.85)	<0.0001
70	1.31 (1.01 to 1.68)	0.036	2.11 (1.67 to 2.67)	<0.0001
75	1.15 (0.93 to 1.43)	0.26	1.56 (1.28 to 1.91)	<0.0001
80	1.04 (0.85 to 1.26)	0.88	1.18 (0.98 to 1.42)	0.085
85	0.94 (0.79 to 1.13)	0.69	0.92 (0.77 to 1.09)	0.46
90	0.87 (0.72 to 1.06)	0.21	0.74 (0.61 to 0.9)	0.0011

*Adjusted for sex, ethnicity, IMD decile, geographical region and month of specimen. Reference group is an individual of the same age in a private home.
†calculated by Dunnett adjustment.
aOR, adjusted OR; IMD, Index of Multiple Deprivation; LTCF, long-term care facility.

residence type with appropriate reference groups for interpretation using emmeans package in R. P values for multiple comparisons were calculated by Dunnett adjustment method. The final model derived from the sample dataset was applied to the rest of the complete patient dataset to assess model accuracy. Cross-tabulation of observed and predicted deaths was undertaken, with overall accuracy rate and 95% CIs reported. Statistical analysis was conducted in R software V.4.1.[7]

RESULTS

As of 31 January 2021, 3 371 221 individuals had been confirmed with SARS-CoV-2 and reported to UKHSA. Complete data on variables investigated in the study were available for 3 020 800 patients with specimen dates between 1 March 2020 and 31 January 2021, from which a random sample of 6000 and 36 000 patients who died and did not die, respectively, was obtained. Baseline characteristics of the 42 000 patients included in the multivariable logistic regression model are shown in table 1. The median age of patients who died was 82 years (IQR 74–89 years), compared with 39 years (IQR 25–54 years) for those who did not die. Univariable analysis by sex, residence type, UKHSA region, month of specimen date and IMD decile showed statistically significant differences for the odds of death between levels of explanatory variables . The number of patients with specimen dates in June–August 2020 was lower compared with the other months, coinciding with the decreased levels of circulating SARS-CoV-2 in England.

In the multivariable model, the interaction term for residence type and cubic function of age was statistically significant and had a better fit compared with a model without interaction term

Table 2 aORs for specified ages by residence type for death within 28 days of positive SARS-CoV-2 test, March 2020–January 2021, England

Age (years)	Private home		Residential LTCF		Nursing LTCF	
	aOR (95% CI)*	P value†	aOR (95% CI)*	P value†	aOR (95% CI)*	P value†
60	Reference		1.77 (1.07 to 2.94)	0.015	3.95 (2.47 to 6.33)	<0.0001
65	2.07 (1.98 to 2.16)	<0.0001	3.12 (2.07 to 4.69)	<0.0001	5.97 (4.07 to 8.77)	<0.0001
70	4.13 (3.81 to 4.49)	<0.0001	5.39 (3.85 to 7.56)	<0.0001	8.73 (6.38 to 11.94)	<0.0001
75	7.81 (6.99 to 8.72)	<0.0001	9 (6.71 to 12.08)	<0.0001	12.2 (9.31 to 16)	<0.0001
80	13.68 (11.99 to 15.61)	<0.0001	14.17 (10.84 to 18.51)	<0.0001	16.15 (12.56 to 20.77)	<0.0001
85	21.81 (18.71 to 25.43)	<0.0001	20.59 (16.13 to 26.28)	<0.0001	20.04 (15.8 to 25.4)	<0.0001
90	31.04 (25.5 to 37.78)	<0.0001	27.04 (21.26 to 34.38)	<0.0001	23.04 (18.19 to 29.2)	<0.0001

*Adjusted for sex, ethnicity, IMD decile, geographical region and month of specimen.
†Calculated by Dunnett adjustment.
aOR, adjusted OR; IMD, Index of Multiple Deprivation; LTCF, long-term care facility.

Table 4 Covariates in multivariable logistic regression model for death within 28 days of positive SARS-CoV-2 test, March 2020–January 2021, England

Variable	Levels	Adjusted OR	95% CI	P value*
Sex	Female	Reference		<0.0001
	Male	1.87	1.72 to 2.03	
Ethnicity	White	Reference		0.11
	Asian	1.15	0.98 to 1.33	
	Black	1.25	0.99 to 1.56	
	Other	0.95	0.66 to 1.34	
IMD decile	10	Reference		<0.0001
	1	1.48	1.22 to 1.79	
	2	1.37	1.14 to 1.64	
	3	1.39	1.15 to 1.67	
	4	1.28	1.06 to 1.54	
	5	1.2	1 to 1.45	
	6	0.99	0.82 to 1.19	
	7	1.14	0.95 to 1.38	
	8	1.3	1.08 to 1.58	
	9	1.03	0.85 to 1.25	
Region	South West	Reference		0.17
	East Midlands	1.36	1.1 to 1.68	
	East of England	1.33	1.09 to 1.63	
	London	1.29	1.06 to 1.58	
	North East	1.31	1.03 to 1.67	
	North West	1.21	1 to 1.47	
	South East	1.29	1.06 to 1.56	
	West Midlands	1.3	1.07 to 1.59	
	Yorkshire and Humber	1.21	0.98 to 1.5	
Month of specimen	August 2020	Reference		<0.0001
	March 2020	11.23	5.84 to 22.82	
	April 2020	7.71	4.09 to 15.38	
	May 2020	2.49	1.3 to 5.02	
	June 2020	2.04	1 to 4.35	
	July 2020	1.42	0.57 to 3.57	
	September 2020	1.39	0.69 to 2.93)	
	October 2020	1.44	0.76 to 2.87	
	November 2020	1.87	1 to 3.72	
	December 2020	2.33	1.24 to 4.61	
	January 2021	2.36	1.26 to 4.67	

*Assessed by likelihood ratio test for significance of variables included in the model.
IMD, Index of Multiple Deprivation.

by LRT. Hence, aORs with 95% CIs were calculated for specified ages with two different reference groups. Table 2 shows the aORs with a 60-year-old individual in private home as reference group—this allows interpretation of increased odds for those in different residential settings in comparison to the referent individual. In table 3, aORs are provided for the specified ages and residence settings but with reference to an individual in private home in that particular age. This allows comparison of odds at specific ages for persons living in different residential settings. Table 4 provides a summary of aORs for all other covariates included in the model.

The predicted probabilities from the model were compared with the observed probabilities of death in the sample dataset. In the sample dataset, the model had an accuracy of 91.6% (95% CI 91.3% to 91.8%). When the model was applied to the full dataset excluding the sample dataset, it had an overall accuracy of 94.2% (95% CI 94.16 to 94.22). The interaction effect between age and residence type on the predicted and observed probabilities of death is shown in figure 1.

Given the interaction effect (figure 1) and the importance of the month when the positive test was taken (tables 1 and 4), trends over time of patients dying by specific age groups and residence type were explored. figure 2 shows that for those under 80 years, a higher proportion of residential and nursing LTCF residents died compared with those living in private homes. For those aged 90 years and above, a higher proportion of those living in private homes with a positive test died (except for March 2020) compared with those in residential and nursing LTCF residents.

DISCUSSION

This study found that after adjusting for the effects of sex, ethnic group, month of specimen date, geographical region and deprivation, an interaction effect between age and residence type determined the odds of death within 28 days of a positive test for SARS-CoV-2. In particular, we found that residents of LTCF had higher odds of death compared with those in the wider community up to 80 years, beyond which there was no increased risk. This intriguing observation that, beyond 80 years, residents in the wider community had a similar (or marginally higher) risk compared with those resident in LTCFs merits further consideration.

For context, the ONS estimated that there were 348, 832 and 10 178 394 people aged 65 years and over living in LTCF and non-LTCF in England in 2020, respectively.[8] Put simply, for each person aged 85 and over living in a LTCF, there are 5.7 people in the same age group living in the wider community in England. While a previous ONS study including data to June 2020 showed an increased mortality risk of at least 6.2 times for residents in LTCFs over the age of 85 years compared with those not in LTCFs, it is unclear if this excess risk has persisted since.[9] In this study, we found that beyond 80 years of age, residents of LTCFs had a similar risk of death when compared with those of the same age living in the wider community.

An earlier smaller analysis of data over a 10-week period between June and September 2020 for England showed lower case fatality risk among LTCF residents compared with non-LTCF residents.[10] It should be noted that the odds of deaths and case fatality rates are highly influenced by access to testing. There are different arrangements for access to SARS-CoV-2 testing for those living and not living in LTCFs. Since April 2020, those in residential and nursing LTCFs in England have been offered regular testing for SARS-CoV-2 regardless of symptoms. Furthermore, testing of all residents and staff in the LTCF is initiated when outbreaks are suspected.[11] This programme of regular asymptomatic testing and additional testing during suspected outbreaks is more likely to detect mild cases of infection. In contrast, those not resident in LTCF or institutional settings were advised to get tested only in the presence of symptoms compatible with COVID-19. As a consequence, testing arrangements in England are likely to detect mild and asymptomatic infections in LTCFs, whereas those in non-LTCF residents with a positive test for SARS-CoV-2 represent mainly those with a symptomatic and severe illness. This explanation is supported by the effect sizes of the month of specimen date in the final model. The finding of higher odds of death in the first wave (Mar-Jun 2020) with much lower odds in the inter-wave period (Jul-Nov 2020) reflects periods of limited access to testing in the first wave with more widespread access available from July 2020.
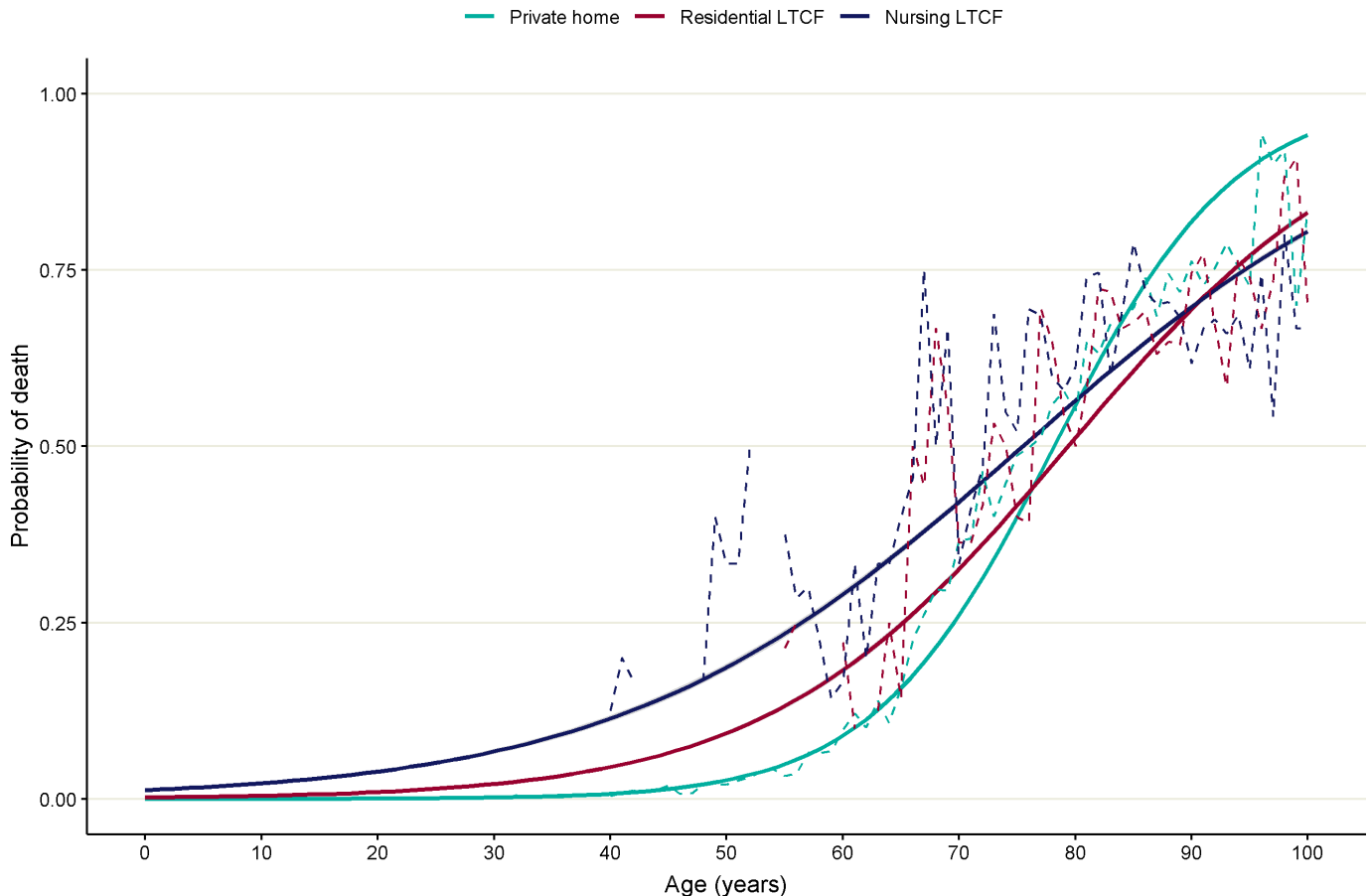
Figure 1 Predicted and observed probability of death within 28 days of positive test by residence type, March 2020–January 2021, England. Solid lines indicate predicted probability from fitted model to full dataset. Dashed lines indicate observed proportion with outcome in sample dataset used to derive model. LTCF, long-term care facility.

During the study period, there were several changes in isolation policies in England in response to changing community prevalence and access to testing. Whole home testing of all residents and staff regardless of symptoms was introduced on 11 May 2020. This enabled rapid identification of infectious and exposed persons leading to more robust isolation of residents and staff. In mid-December 2020, testing of all visitors was introduced in response to the second wave of the epidemic.

It is not known if the reduced odds among older residents (over 85 years of age) in LTCFs compared with those of the same age not in LTCFs are primarily a result of detection of cases with mild illness in LTCFs who may not have died within 28 days, or alternatively, better case ascertainment prevented deaths among those resident in LTCFs by facilitating prompt access to treatment services. It is plausible but unproven that better access to testing for older adults in the community may reduce the odds of deaths by detecting infection early and triggering prompt referral for healthcare for those with deteriorating health. Of note, some have questioned the public health value of regular testing of residents and staff in the absence of symptoms.[12]

There are multiple potential explanations for why residents in LTCFs are at higher risk of adverse outcomes from SARS-CoV-2. Increasing age and frailty are important risk factors for severe SARS-CoV-2, which also relate closely with residence in a LTCF.[1] Those resident in the wider community may be able to stay at home and have fewer contact with potentially infectious persons during periods of high community prevalence. In contrast, residents of LTCFs are less likely to be able to minimise their exposure to

infectious persons because they are likely to be regularly exposed to staff providing care and may require more frequent contact with healthcare professionals due to medical needs. Studies have shown that once SARS-CoV-2 infection is introduced into an LTCF, it is difficult to limit transmission despite implementation of robust control measures.[13 14] Given these challenges, key preventive measures include ensuring high vaccination uptake for residents and staff, including booster doses for waning immunity and maintenance of good infection control measures to prevent introduction and transmission of SARS-CoV-2.[15]

Consistent with published literature, increasing age and male gender were found to be the dominant risk factors for death.[16] Of note, the model showed higher odds of death for those in the most deprived areas (IMD deciles 1–4) compared with those in least deprived areas and in line with recent literature.[17] Geographical location, assessed by mapping cases' residence to UKHSA regions, was not statistically associated with higher odds of death.

The COVID-19 vaccination programme in LTCFs in the UK started on 8 December 2020 with the campaign ramping up in January 2021.[18] Given that at least 2–3 weeks are required for vaccination effect, this study covering the period up to 31 January 2021 is unlikely to be biased by effects of vaccination. By confirming the higher odds of deaths for those living in LTCFs, the findings of this study support the approach taken in the UK to prioritise vaccination for those living in LTCFs.

There are several limitations to this study. First, the study did not adjust for comorbidities and other important covariates, which are likely to vary between those in LTCFs and private

Figure 2 Proportion of those with positive SARS-CoV-2 dying within 28 days of positive test, March 2020–January 2021, England. LTCF, long-term care facility.

homes.[19] Second, while we used sophisticated methods to assign the residence category, there is likely to be some degree of misallocation. We consider that any misallocation was more likely to be bias towards allocating some residential and nursing LTCF residents as non-LTCF residents. Furthermore, address matching was based on the residence status at the time of testing and not at the time of death and hence does not take into account those who might have moved residence. Third, the study design linked laboratory-confirmed cases and death within 28 days of a positive test; hence, deaths due to undiagnosed SARS-CoV-2 are not captured in the dataset. As such, the study is likely to underestimate the number of deaths in the non-LTCF setting more often than in the LTCF setting due to the availability of more regular testing since April 2020. Finally, this study did not take in to account other variables such as the size of LTCF, rural or urban location, and access to health services that might have had an impact on the outcome.

What this study adds

► This study shows that in the epidemic phase prior to vaccination in England, residents in LTCFs up to the age of 80 years had higher odds of death within 28 days of a positive SARS-CoV-2 test compared with those residents in the wider community. Beyond 80 years of age, the odds of death were similar for those resident in LTCFs and in the wider community.

What is already known on this subject

► Residents in long-term care facilities are known to be at higher risk of adverse risk from COVID-19 compared with others in the general community. This is primarily due to individual factors such as frailty and increased age, as well as the clustering of individuals at high risk in the care facility.

The strength of this study is in robustly linking specimen, demographic, mortality and ethnic group data on a large number of patients confirmed with SARS-CoV-2 in England. Given that the sample was derived randomly from the dataset of confirmed cases in England, the findings can be generalised to the whole of England. The model demonstrated high accuracy of predicting deaths and survival when fitted to the full patient dataset between March 2020 and January 2021.

Further research may be needed to explore whether there are barriers to testing and treatment services for older people not resident in LTCFs. In the meantime, it may be prudent to consider enhanced health service support and review of older persons confirmed with SARS-CoV-2 who are not resident in LTCFs.

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