Accepted Manuscript

BJGP OPEN

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DOI: https://doi.org/10.3399/BJGPO.2021.0081

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Received 14 May 2021
Revised 13 August 2021
Accepted 18 August 2021

Risk of Covid-19 in shielded and nursing care home patients: cohort study in general practice

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Keywords Covid-19, ethnicity, shielding, nursing home

Abstract

Background: Covid-19 cases were first detected in the UK in January 2020 and vulnerable patients were asked to shield from March to reduce their risk of Covid-19 infection.
Aim: To determine the risk and determinants of Covid-19 diagnosis in shielded vs. non-shielded groups adjusted for key comorbidities not explained by shielding.
Design: Retrospective cohort study of adults with COVID-19 infection between 1/2/20-15/5/20 in West London.
Method: Individuals diagnosed with Covid-19 were identified in SystmOne records using clinical codes. Infection risks were adjusted for socio-demographic factors, nursing home status and comorbidities.
Results: Of 57,713 adults, 573 (1%) individuals were identified as shielded and 1,074 adults had documented Covid-19 infections (1.9%). Covid-19 infection rate in the shielded group individuals compared with non-shielded adult individuals was 6.5 % (37/573) vs. 1.8 % (1,037/57, 140), p<0.0001. A multivariable fully adjusted Cox proportional hazards regression identified that Covid-19 infection was increased with aHR (95% CI)**:** shielding status 1.52 (1.00-2.30), p=0.048. Other determinants of Covid-19 infection included nursing home residency 7.05 (4.22-11.77) p<0.001, Black African, 2.52 (1.99-3.18) p<0.001, Other 1.74 (1.42-2.13) p<0.001, Non-stated 1.70 (1.02-2.84) p=0.04, or South Asian ethnicity 1.46 (1.10-1.93) p=0.01, history of respiratory disease 1.51 (1.06-2.16), p=0.02, deprivation (3rd vs. least deprived IMD quintile) 1.25 (1.01-1.56) p=0.045, obesity (BMI>30kg/m^2) 1.39

(1.18-1.63) p<0.001, and age 1.02 (1.01-1.02) p<0.001. Male gender was associated with lower risk of Covid-19 infection: 0.71 (0.62-0.82) p<0.001.
Conclusion: Shielded individuals had a higher Covid-19 infection rate compared with non-shielded individuals, after adjusting for socio-demographic factors, nursing home status, and comorbidities.

How this fits in: Shielding was introduced to protect individuals from Covid-19 infection risk. We found health inequalities with higher levels of Covid-19 in the shielded group compared to the non-shielded group, which persisted after adjusting for demographic factors nursing home status and comorbidities.

Article 2500/2500

Introduction

Covid-19 cases were first detected in the UK in January 2020 (1). Capacity for testing for the virus was initially very restricted in the UK and was not widely available via NHS Test & Trace until May/June 2020. This meant that GPs initially largely identified cases using the following key Covid-19 diagnostic symptoms: cough, fever, breathlessness, and loss (or change) of the sense of smell during clinical consultations. The NHS was rapidly supplied with a set of new codes and templates for GPs to record symptoms, physical signs, and diagnoses. Patients accessed the NHS through all available routes including GPs, NHS 111, the ambulance service and Hospital A/E departments and the distribution of such presentations is likely to have reflected severity as well as patient concern.

Early in the pandemic, it was recognised that certain patients were at particularly high risk due to their concurrent medical illnesses (2-4). This was the basis for a programme to protect high risk individuals and was defined in a letter from the Government Chief Medical Officer (5) on 23rd March 2020 in which GPs and hospital specialist units were required to contact their patients by letter and phone call to alert them of the need to protect themselves. [Box 1] Government letters were also sent. The programme involved asking this shielded cohort of patients to stay at home, being supplied with essential items via local authority action and voluntary agencies according to shielding list procedure (6). The programme started on 23rd March but was expanded from an initial target of 1.5m patients to more than double this number in three subsequent cohorts (7). The aim was to ensure that shielded patients received minimal exposure to SARS-CoV-2 thereby reducing the infection rate and subsequent morbidity and mortality.

We aimed to determine the risks of patients acquiring COVID 19 infection in 5 general practices in West London in those designated as shielded from Covid-19 according to Government guidance (23rd March 2020) compared with non-shielded adults, adjusted for nursing home status, demographic factors and comorbidities.

Methods

Study Design
A retrospective population-based cohort study using STROBE guidelines was conducted between 1/2/2020 until 15/5/20, using a Cox proportional-hazards model with people diagnosed with Covid-19 as the primary outcome adjusted for risk factors including shielded status. Individuals were censored when they were diagnosed with Covid-19, left the practice or died. Details of the study selection are shown in Figure 1.

Setting
5 practices in West London, UK covering 2 nursing homes in Hammersmith and Fulham CCG.

Data sources

A longitudinal study was undertaken in an ethnically diverse adult population, using primary care electronic health records (EHR) from 5 general practices (same partnership group). We examined patient level clinical data, prescribing data, laboratory data, and demographic information, including ethnicity based on categories of the UK 2001 census, risk factors and co-morbidities. This was extracted from the SystmOne electronic clinical record. We investigated shielding status, demographic and lifestyle factors, and comorbidities in a multi-ethnic population identified as having suspected or NHS laboratory confirmed Covid-19.

Study population

The study was carried out using anonymised data from adult patients aged ≥18 years registered with 5 GP clinics in West London.

Identification of Covid-19 status

Covid-19 status was determined using the Covid-19 diagnostic template based on clinical assessment for Covid-19 diagnosis (using current diagnostic guidelines) for the majority of cases, supplemented with NHS laboratory testing results where available. These codes were grouped together for combined analysis.

Covariates (exposures)

We examined factors such as age, gender, ethnicity, deprivation, (Index of Multiple Deprivation 2019, (8) BMI and selected comorbidities likely to affect health outcomes including type 2 diabetes, hypertension (HTN), chronic kidney disease (CKD), coronary heart disease (CHD) and history of respiratory disease (COPD or asthma), using QOF registers at the time of the data extract and self-reported lifestyle factors such as smoking. Ethnicity was self-reported and aggregated into 8 categories: White, Black African, South Asian, Chinese, Mixed, Other, Non-Stated, and missing. We were also able to identify by post code whether the patient resided in one of the two long term nursing homes within the practice population.

Outcomes

We examined:

1. Proportion of shielded group with Covid-19 infection.
2. Risk and determinants of receiving a shielded diagnosis.
3. Risk and determinants of receiving a Covid-19 diagnosis in shielded vs. non-shielded groups adjusted for key comorbidities not explained by shielding.

Analysis

A multivariable multi-level logistic regression was used to assess factors associated with shielding status in adult individuals using STATA 16. Differences between proportions of categorical variables were assessed using a $\chi 2$ test. Predictors of shielding status were assessed by univariable and multivariable logistic regression, (including missing categories) adjusted for practice effects and other confounders.

A Cox proportional-hazards (CPH) model adjusted for practice examined the association of demographic factors including deprivation, and comorbidities not associated with shielding, with Covid-19 infection status as an outcome. The proportional hazard assumptions were met, and log rank tests were used to assess significance. Partly adjusted (adjusted for age-group and gender) and fully adjusted (adjusted for age-group, gender, and other covariates) CPH analysis was conducted to adjust for potential confounders. The covariates adjusted for included ethnicity (White ethnicity as reference group), nursing home residency, obesity (BMI >30kg/m^2), locally based IMD deprivation score quintile, smoking status, and comorbidities. Analyses included testing for interactions such as age-group, sex, type 2 diabetes, and obesity in all models.

Results

Descriptive characteristics of the study population

The study population comprised of 57,713 adults in 5 GP practices in West London. The mean duration of follow up time was 102 days. Their characteristics for individuals are summarised in Table 1 (by shielding status) and Table 2 (by Covid-19 infection status). Table 1 confirms that 6.5% of our Shielded population were diagnosed with COVID-19 compared with 1.8% of the non-shielded population and that this difference was highly significant (p<0.001). The shielded patient group contains significantly more female, older, and Black African patients with higher levels of comorbidities (additional to those related to shielding), BMI, and deprivation. It was therefore important to adjust for these differences in determining whether shielded patients had higher infection rates or not.

Determinants of receiving a 'shielded' diagnosis (Table 3)

In the partially adjusted (adjusted for age and gender) logistic regression Table 3), the following were associated with an increased odds of shielding (adjusted odds ratio (95% CI)): history of respiratory disease 15.16 (12.24-18.76) p<0.001; smoking 2.45 (1.96-3.07) and ex-smoking status 2.16 (1.78-2.62) both p<0.001, Black African 2.23 ethnicity (1.68-2.97) p<0.001, CKD 2.05 (1.58-2.67) p<0.001, CHD 1.97 (1.47-2.63) p<0.001, type 2 diabetes 1.95 (1.56-2.45) p<0.001, obesity 1.60 (1.32-1.94) p<0.001, hypertension 1.45 (1.17-1.79) p=0.001, age 1.06 (1.05-1.06) p<0.001 and IMD level 5 (compared with least deprived) 1.48 (1.14-1.92) p= 0.003. Male gender was associated with decreased odds of shielding 0.74 (0.63-0.88) p<0.001.

In the fully adjusted logistic analyses, the following were associated with increased odds of shielding: history of respiratory disease 12.72 (10.00- 16.18); Black African 2.78 (2.02-3.81) both p<0.001, and Non-Stated ethnicity 2.23 (1.16-4.27) p=0.02, CKD 1.96 (1.47-2.63) p<0.001, smoking and ex-smoking 1.50 (1.16-1.94) and 1.68 (1.35-2.10) respectively, both p<0.001, type 2 diabetes 1.39 (1.07-1.80) p=0.01, obesity 1.32 (1.07-1.64) p=0.01, older age 1.03 (1.03-1.04) p<0.001. Male gender was associated with decreased odds of shielding 0.62 (0.52-0.75) p<0.001.

Characteristics of the Covid-19 infections

Figure 2 shows the incident cases per week during the study period and confirms that peak incidence was in the weeks of 4th and 11th April 2020. 3/28 cases in Shielded patients occurred prior to 28th March 2020, the first full week of shielding (10.7%). Table 2 shows older age, nursing home residence. Black African or South Asian ethnicity, obesity, CKD, hypertension, CHD, respiratory illness, and diabetes were all significantly higher in those with Covid-19. Figure 2 which shows weekly Covid-19 cases by shielding status, suggests some shielded cases may not have been adequately shielded or experienced household contacts/other exposure.

Determinants of Covid-19 infection (Table 4)

All reported analyses cover the full study period 1/2/2020 to 15/5/20. In the partially adjusted CPH analyses, adjusted for age and gender, the following were associated with increased risk of Covid-19 infection: adjusted odds ratio (95% CI): nursing home status 9.37 (6.68-13.15) p<0.001, shielded status 2.00 (1.35-2.86) p<0.001, Black African 2.68 (2.16-3.34), p<0.001, Non-stated 2.10 (1.34-3.30) p=0.001, Other 1.75 (1.45-2.12) p<0.001 or South Asian ethnicity 1.48 (1.14-1.93) p=0.004, obesity 1.50 (1.29-1.76) p<0.001, 3rd, 4th and 5th deprivation quintile 1.33 (1.07-1.64) p=0.01, 1.31 (1.05-1.63) p=0.02 and 1.46 (1.17-1.81) p=0.001 respectively and comorbidities Type 2 diabetes 1.63 (1.31-2.02) p<0.001, hypertension 1.25 (1.02-1.53) p=0.03, CHD, 1.38 (1.00-1.90) p=0.01 and history of respiratory disease, 1.68 (1.23-2.31) p<0.001. Male gender was associated with lower risk of Covid-19 infection: 0.68 (0.60-0.77) p<0.001.

A multivariable fully adjusted Cox proportional hazards regression identified that Covid-19 infection was increased with aHR (95% CI**):** nursing home residency 7.05 (4.22-11.77) p<0.001, and shielding

status 1.52 (1.00-2.30), p=0.048. We found other determinants of Covid-19 infection included Black African, 2.52 (1.99-3.18) p<0.001, Other 1.74 (1.42-2.13) p<0.001, Non-stated 1.70 (1.02-2.84) p=0.04, or South Asian ethnicity 1.46 (1.10-1.93) p=0.01, history of respiratory disease 1.51 (1.06-2.16), p=0.02, deprivation (3rd vs. least deprived IMD quintile) 1.25 (1.01-1.56) p=0.045, obesity (BMI>30kg/m^2) 1.39 (1.18-1.63) p<0.001, and age 1.02 (1.01-1.02) p<0.001. Male gender was associated with lower risk of Covid-19 infection: 0.71 (0.62-0.82) p<0.001. We found no statistical interaction in any of the models. Further details showing infection rates which is more rapid in the Shielded group and continues throughout the study period, attenuating by 15th May 2020 is given in the Kaplan Meier plots and shielded numbers, see Appendix (S1-S4).

Discussion

Patients in the shielded group had a higher Covid-19 infection rate compared with non-shielded individuals, and this effect remained after adjusting for demographic factors, nursing home residence, confounders, and comorbidities. We found nursing home status was a strong confounder of Covid-19 infection in the shielded patient cohort and this is the first report able to distinguish the separate risk of these two vulnerable patient cohorts using a unique population. The shielded patient proportion of our nursing homes 8/186 (4.3%) was higher than the shielded proportion in our non-nursing home population 565/57,527 (0.98%) p<0.001, with increased infection rates. This finding is consistent with previous reports in different patient cohorts which showed high mortality in these groups. (9, 10) During the first wave peak, shielded cases mirror population Covid-19 infection numbers suggesting some ongoing infection transmission via households or otherwise during the shielded period. We were unable to distinguish from our analysis whether the higher rate of diagnosis of Covid-19 in shielded patients was due to a true higher incidence or a greater level of symptom severity leading to a higher likelihood of presenting to primary care.

We found that older age, obesity, diabetes, smoking, CKD, Black African and Non-stated ethnicity, and respiratory disease were associated with increased odds of shielding and some comorbidities reflect shielding guidance. (11) Male gender was associated with decreased odds of shielding. Patients with these common conditions will also have other comorbidities which are associated with shielding characteristics. However, we were unable to adjust fully for immunosuppressive medication which is frequently prescribed from secondary care and immunosuppressive co-morbidities may be under-recorded. We noted that there were only 3 cases of infection prior to the implementation of the shielded patient scheme on 23rd March in both shielded and non-shielded group, and therefore we have not considered this period separately.

We found other determinants of higher Covid-19 infection rates were age, Black African, South Asian ethnicities, obesity (BMI>30kg/m^2), and history of respiratory disease, all consistent with previous reports (3, 12). The fact that we found increased rates but not reaching the level of significance for diabetes, CHD and hypertension and CKD may reflect the sample size and lower power of our study.

Strengths & Limitations

Our study examined a number of risk factors for Covid-19 and the effect of shielding in a socioeconomically, ethnically diverse population in West London covering over 57,000 patients, and reflects individuals presenting with Covid-19 to general practice. Those seeking healthcare advice and support will therefore have had more severe symptoms excluding those with fulminant illness requiring immediate hospital transfer and also those with mild or asymptomatic illness. We are also aware that GPs did not complete the templates in all cases and infection rates differed between our 5 practices, therefore we adjusted for practice in our models. No routine primary care testing was available between March and May 2020 during the study period, and therefore the majority of Covid-19 coded cases here are likely to be those clinically diagnosed via primary care telephone triage, which may be subject to misclassification. It is likely that shielded patients are more likely to be aware of such symptoms, experience overt symptoms (as opposed to asymptomatic/mild cases), report symptoms

and access healthcare (and possibly that GPs are also more proactive with diagnosing Covid-19 in this group). We did not record data on adherence to the shielding programme in this study and therefore were unable to report on this.

Patients had multiple access points to the NHS, however these GP practices had a clear denominator of registered patients, Covid-19 assessment and diagnostic centre and were highly prominent with good telephone access during this period of time. The epidemic curve and associations with demographic factors and pre-existing morbidity in our data are consistent with other studies.

The limitations apply to those found with observational data and include misclassification, missing data, and unmeasured confounders (frailty, health care usage), including GP practice factors. As > 98% patients are registered with a GP, data capture is high. We were unable to ascertain effect and direction of bias due to missing data, introducing possible bias for BMI and CKD for non-coded vs. coded patients (13). Other limitations include selection (due to comorbidities and QOF coding) and survivor bias. In London, the population is younger and more deprived compared to the rest of the UK. Finally, we did not have access to complete hospital admissions data or long term outcomes such as mortality. The study may be underpowered to detect true effects of comorbidities due to numbers of Covid-19 cases.

Comparison with existing literature

Our findings concur with that of Hull et al. in a primary care population of 1.3 million, (14) including an apparent protective risk for Covid-19 in men consulting in primary care. However both of these studies are susceptible to collider bias (15) which may be due to lack of mild or no symptoms and selection pressures bias samples toward those with decreased symptom severity and lower numbers of men consulting in primary care. Jani et al. also found excess risk of Covid-19 infection in shielded individuals in a general population cohort, but did not adjust for NH status (16).

The fully adjusted model includes deprivation and reveals that the findings are significant in spite of deprivation status indicating a biological underlying factor. Covid-19 is a new illness and much remains to be discovered about it. However, it is already known that it involves a hyperactivation of the immune and clotting systems of the body and that this can be ameliorated by the administration of dexamethasone (17). Recent trials have indicated that treatment with the IL-6 receptor antagonists, tocilizumab and sarilumab, may improve outcome, including survival in critically ill patients with Covid-19 in intensive care (18). Diabetes and obesity are associated with altered immune states (19) as is advancing age which may render individuals more susceptible to Covid-19 infection and mortality (20). Multimorbidity and physical frailty may additionally be independent risk factors in this illness, which we did not assess independently.

Implications for research and practice

Patients in the shielded group have a higher Covid-19 infection rate compared with non-shielded individuals, after adjusting for demographic factors, confounders, and comorbidities. This suggests that shielded patients along with nursing home patients were more exposed to Covid-19 infection than public policy intended, (21) and that exiting lockdown strategies should take this into account. (22, 23). Our results suggest that shielding alone is not enough to protect vulnerable people and that ongoing vaccination programmes remain the best way to protect these patient groups from the risk of serious illness and death from Covid-19. It is expected that shielded patients are more likely to experience symptomatic Covid-19 (which were largely the infections that were detectable during the study period, due to minimal testing availability), that would have been coded by GPs. This may inform future community shielding strategies and management in primary care, for future Covid -19 waves and research.

Demographic factors associated with Covid-19 were nursing home status, shielded status, Black African, South Asian, Other, or Non-stated ethnicity, obesity, diabetes, and age. The association with Black African, South Asian, and Other ethnicity is important as it demonstrates an ethnic health inequality, which remained after adjusting for deprivation, as mortality rates in Covid-19 are increased in these groups.

Ethical approval: Permission to access anonymised data for this study was granted by the Hammersmith and Fulham Partnership Clinical Governance Committee.

COI: DW is a practising GP in the Hammersmith and Fulham Partnership.

Acknowledgments: This research was in part supported by the National Institute for Health Research (NIHR) Applied Research Collaboration NW London. MM is supported by the Biomedical Research Centre at Guy's and St Thomas' NHS Foundation Trust and King's College London and the NIHR Applied Research Collaboration South London. We acknowledge the support of the Hammersmith and Fulham GP Partnership. The views expressed are those of the authors and not necessarily those of the Hammersmith and Fulham GP Partnership, the NHS, the NIHR, or the Department of Health and Social Care. We are grateful for the helpful comments from the reviewers.

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Box 1: First Shielding criteria March 2020 (withdrawn 1st May 2020) (11), [now updated (24)]

We are advising those who are at increased risk of severe illness from coronavirus (COVID-19) to be particularly stringent in following social distancing measures.

This group includes those who are:

- aged 70 or older (regardless of medical conditions)
- under 70 with an underlying health condition listed below (ie anyone instructed to get a flu jab as an adult each year on medical grounds):
    - chronic (long-term) mild to moderate respiratory diseases, such as asthma, chronic obstructive pulmonary disease (COPD), emphysema or bronchitis
    - chronic heart disease, such as heart failure
    - chronic kidney disease
    - chronic liver disease, such as hepatitis
    - chronic neurological conditions, such as Parkinson's disease, motor neurone disease, multiple sclerosis (MS), a learning disability or cerebral palsy
    - diabetes
    - a weakened immune system as the result of conditions such as HIV and AIDS, or medicines such as steroid tablets
    - being seriously overweight (a body mass index (BMI) of 40 or above)
- those who are pregnant

Note: there are some clinical conditions which put people at even higher risk of severe illness from COVID-19. If you are in this category, next week the NHS in England will directly contact you with advice about the more stringent measures you should take in order to keep yourself and others safe. For now, you should rigorously follow the social distancing advice in full, outlined below.

People falling into this group are those who may be at particular risk due to complex health problems such as:

- people who have received an organ transplant and remain on ongoing immunosuppression medication
- people with cancer who are undergoing active chemotherapy or radiotherapy
- people with cancers of the blood or bone marrow such as leukaemia who are at any stage of treatment
- people with severe chest conditions such as cystic fibrosis or severe asthma (requiring hospital admissions or courses of steroid tablets)
- people with severe diseases of body systems, such as severe kidney disease (dialysis)

Figure 1: Study flowchart.

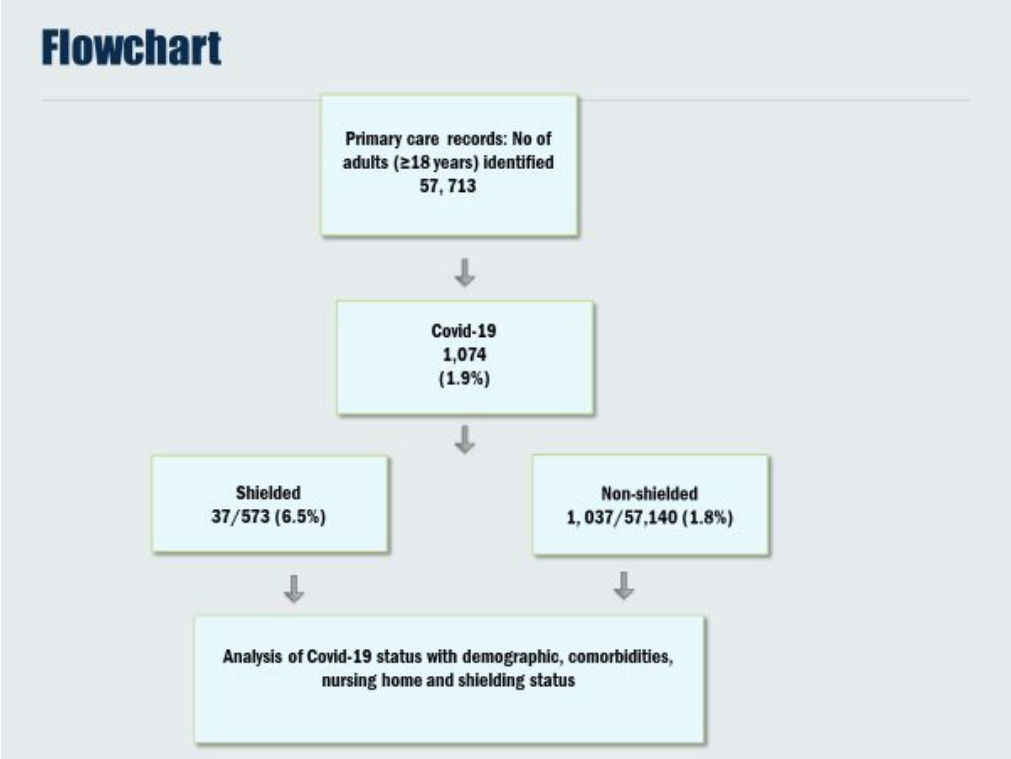

Figure 2. Weekly cases of Covid-19 infections by shielding categories from 23/03/2020 to 15/05/2020

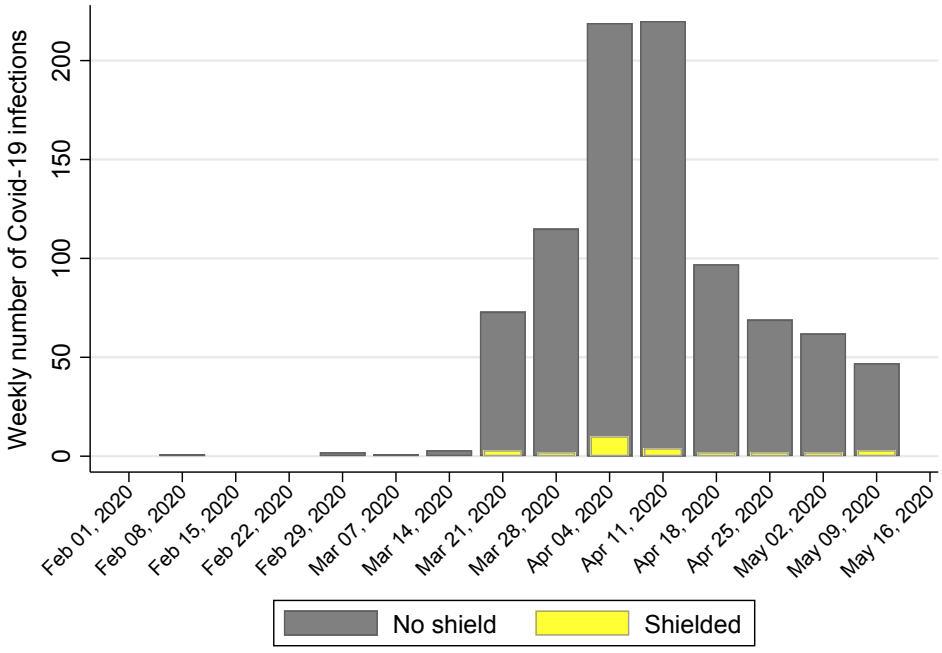

Table 1: Summary characteristics of shielded (7th April 2020) and non-shielded in 57,713 adults aged ≥ 18 years

Variables		Shielded N 573	Shielded Col %	Non-Shielded N 57, 140	Non-Shielded Col %	*p*-value
Covid-19 infection		37	6.5	1037	1.8	< 0.001
Sex	Female	341	59.5	28,974	50.7	< 0.001
	Male	232	40.5	28,164	49.3	
	Missing					
Age (years)	< 30	32	5.6	11,512	20.2	< 0.001
	30-39	48	8.4	16,945	29.7	
	40-49	53	9.3	11,389	19.9	
	50-59	111	19.4	8,207	14.4	
	60-69	118	20.6	4,646	8.1	
	70-79	142	24.8	2,848	5.0	
	>80	69	12.0	1,593	2.8	
	Nursing Home resident	8	1.4	178	0.3	< 0.001
BMI (kg/m²)	Underweight (<18.5 kg/m2)	26	4.1	2,350	4.5	< 0.001
	normal weight (18.5-24.9 kg/m2)	169	29.5	20,981	36.7	
	Pre-obesity (25.0-29.9kg/m2)	122	21.3	11,074	19.4	
	obese I (30.0-34.9 kg/m2)	78	13.6	3,855	6.8	
	obese II (35.0-39.9 kg/m2)	22	3.8	1,291	2.3	
	obese III (≥ 40 kg/m2)	17	3.0	714	1.3	
	missing value	139	24.3	16,875	29.5	
IMD Quintile (% coded)	1 (most deprived)	145	19.2	10,945	25.3	0.009
	2	107	18.7	10,935	19.1	
	3	114	19.9	11,565	20.2	
	4	95	16.6	11,297	19.8	
	5 (least deprived)	95	16.6	10,502	18.4	
	Missing	17	3.0	1,896	3.3	
Ethnicity	White	157	27.4	18,294	32.0	< 0.001
	Black African	71	12.4	3,537	6.2	
	Chinese	1	0.2	1,067	1.9	
	Asian	34	5.9	3,654	6.4	
	Mixed	170	29.7	16,080	28.1	
	Other	101	17.6	7,724	13.5	
	Not Stated	12	2.1	727	1.3	
	Missing	27	4.7	6,057	10.6	
History of comorbidities	Type 2 Diabetes	112	19.6	2,647	4.6	< 0.001
	HTN	153	26.7	4,042	7.1	< 0.001
	CKD	91	15.9	1,198	2.1	< 0.001
	Coronary Heart Disease, CHD	62	10.8	973	1.7	< 0.001
	Respiratory disease	178	31.1	691	1.2	< 0.001
Lifestyle factors	Non-smoker	218	38.1	32,897	57.6	< 0.001
	Current	130	22.7	10,208	17.9	
	ex-smoker	221	38.6	11,596	20.3	
	Missing	4	0.7	2,439	4.3	

Table 2 summarises characteristics of adults infected with Covid-19 compared to those not infected in 57,713 adults aged ≥ 18 years

	Covid-19 N 1,074 (1.9%)	No Covid-19 infection N 56,639 (98.1 %)	p-value
Sex			
Female	651 (60.6)	28,664 (50.6)	< 0.001
Male	423 (29.4)	27,973 (49.4)	
Age (Years)			< 0.001
18-30	94 (8.8)	11.450 (20.2)	
30-39	202 (18.8)	16,791 (29.7)	
40-49	223 (20.8)	11,219 (19.8)	
50-59	258 (24.0)	8,060 (14.2)	
60-69	137 (12.8)	4,627 (8.2)	
70-79	84 (7.8)	2,906 (5.1)	
>80	76 (7.1)	1,586 (2.8)	
Ethnicity N (%)			
White	251 (23.4)	18,200 (32.1)	< 0.001
South Asian	81 (7.5)	3,607 (6.4)	
Black African	138 (12.9)	3,470 (6.1)	
Chinese	11 (1.0)	1,057 (1.9)	
Mixed	268 (25.0)	15,982 (28.2)	
Other	221 (20.6)	7,604 (13.4)	
Non-stated	23 (2.1)	716 (1.3)	
Missing	81 (7.5)	6,003 (10.6)	
Lifestyle indicators			
Nursing home resident	52 (4.8)	134 (0.2)	< 0.001
Not obese	794 (73.9)	44,437 (78.5)	< 0.001
Obese (BMI > 30 kg/m2)	230 (21.4)	7,112 (12.6)	
Missing	50 (4.7)	5,090 (9.0)	
IMD Quintile (% coded)			
1 (most deprived)	241 (22.4)	10,849 (19.2)	< 0.001
2	233 (21.7)	10,809 (19.1)	
3	219 (20.4)	11,460 (20.2)	
4	176 (16.4)	11,216 (19.8)	
5 (least deprived)	156 (14.5)	10,441 (18.4)	
Missing	49 (4.5)	1,864 (3.3)	
Smoking Status			< 0.001
Current smoker	174 (16.2)	10,164 (18.0)	
Ex-Smoker	265 (24.7)	11,552 (20.4)	
Non-Smoker	623 (58.0)	32,492 (57.4)	
Missing	12 (1.1)	2,431 (4.3)	
Co-morbidities			
Type 2 Diabetes	128 (11.9)	2,631(4.7)	< 0.001
Hypertension	153 (14.3)	4,042 (7.1)	< 0.001
Chronic Kidney Disease	57 (5.3)	1,232 (2.2)	< 0.001
CHD	48 (4.5)	987 (1.7)	< 0.001
Respiratory disease	54 (5.0)	815 (1.4)	< 0.001

Table 3: Partially and Fully adjusted multi-level mixed effects regression of the odds of shielding status in 57,713 adults aged ≥18 years

Shielding status	Partially adjusted Odds Ratio 95% CI	p-value	Fully Odds Ratio 95% CI	p-value
Age (years)	1.06 (1.05-1.06)	< 0.001	1.03 (1.03-1.04)	< 0.001
Sex				
Female	ref		ref	
Male	0.74 (0.63-0.88)	< 0.001	0.62 (0.52-0.75)	< 0.001
Nursing home resident	0.80 (0.39-1.65)	0.54	1.07 (0.35-3.33)	0.90
BMI				
BMI<30 kg/m2	ref		ref	
Obese >30 kg/m2	1.60 (1.32-1.94)	< 0.001	1.32 (1.07-1.64)	0.01
Smoking status				
Non smoker	ref		ref	
current smoker	2.45 (1.96-3.07)	< 0.001	1.50 (1.16-1.94)	< 0.001
ex-smoker	2.16 (1.78-2.62)	< 0.001	1.68 (1.35-2.10)	< 0.001
Ethnicity				
White	ref		ref	
South Asian	0.98 (0.67-1.42)	0.91	1.37 (0.92-2.03)	0.12
Black African	2.23 (1.68-2.97)	< 0.001	2.78 (2.02-3.81)	< 0.001
Chinese	0.15 (0.02-1.07)	0.06	0.23 (0.03-1.64)	0.14
Mixed	1.11 (0.89-1.38)	0.36	1.11 (0.87-1.41)	0.40
Other	1.13 (0.88-1.46)	0.33	1.26 (0.95-1.67)	0.11
Non-stated	1.80 (0.99-3.28)	0.06	2.23 (1.16-4.27)	0.02
Missing	0.50 (0.33-0.75)	0.001	0.84 (0.54-1.30)	0.42
IMD Quintile (% coded)				
1 (least deprived) **	ref			
2	0.94 (0.71-1.25)	0.68	0.98 (0.72-1.33)	0.90
3	1.10 (0.83-1.44)	0.50	1.16 (0.86-1.55)	0.33
4	1.09 (0.83-1.44)	0.53	0.97 (0.72-1.31)	0.85
5 (most deprived)	1.48 (1.14-1.92)	0.003	1.24 (0.93-1.64)	0.14
Co-morbidities				
Type 2 Diabetes	1.95 (1.56-2.45)	<0.001	1.39 (1.07-1.80)	0.01
HTN	1.45 (1.17-1.79)	0.001	1.07 (0.84-1.36)	0.58
CKD	2.05 (1.58-2.67)	<0.001	1.96 (1.47-2.63)	< 0.001
CHD	1.97 (1.47-2.63)	<0.001	1.21 (0.87-1.68)	0.27
Respiratory disease	15.16 (12.24-18.76)	<0.001	12.72 (10.00-16.18)	< 0.001

[1] adjusted for age and gender

[2] adjusted for all covariates in the table and practice

Table 4: Partially and fully adjusted CPH regression of the odds of Covid-19; during 1/2/20-15/5/20 in 57,713 adults aged ≥18 years

Covid-19 infection	Partially adjusted Hazard Ratio 95% CI			Fully adjusted Hazard Ratio 95% CI	Fully adjusted p-value
Age (years)	1.03 (1.02-1.03)		< 0.001	1.02 (1.01-1.02)	< 0.001
Sex					
Female	-			-	
Male	0.68 (0.60-0.77)		< 0.001	0.71 (0.62-0.82)	< 0.001
Shielded group	2.00 (1.35-2.86)		< 0.001	1.52 (1.00-2.30)	0.048
Nursing home resident	9.37 (6.68-13.15)		< 0.001	7.05 (4.22-11.77)	< 0.001
BMI					
BMI<30 kg/m2	ref			ref	
Obese >30 kg/m2	1.50 (1.29-1.76)		< 0.001	1.39 (1.18-1.63)	< 0.001
Smoking status					
Non smoker	ref			ref	
current smoker	0.90 (0.75-1.08)		0.24	0.90 (0.74-1.09)	0.29
ex-smoker	1.02 (0.87-1.19)		0.81	1.10 (0.94-1.30)	0.24
Ethnicity					
White	ref			ref	
South Asian	1.48 (1.14-1.93)		0.004	1.46 (1.10-1.93)	0.01
Black African	2.68 (2.16-3.34)		< 0.001	2.52 (1.99-3.18)	< 0.001
Chinese	0.91 (0.50-1.66)		0.75	1.04 (0.57-1.91)	0.90
Mixed	1.11 (0.92-1.33)		0.28	1.12 (0.93-1.36)	0.24
Other	1.75 (1.45-2.12)		< 0.001	1.74 (1.42-2.13)	< 0.001
Non-stated	2.10 (1.34-3.30)		0.001	1.70 (1.02-2.84)	0.04
Missing	0.88 (0.67-1.16)		0.36	0.87 (0.64-1.18)	0.37
IMD Quintile (% coded)					
1 (least deprived) **	ref			ref	
2	1.13 (0.90-1.41)		0.30	1.07 (0.85-1.34)	0.58
3	1.33 (1.07-1.64)		0.01	1.25 (1.01-1.56)	0.05
4	1.31 (1.05-1.63)		0.02	1.11 (0.88-1.40)	0.38
5 (most deprived)	1.46 (1.17-1.81)		0.001	1.21 (0.97-1.53)	0.10
Co-morbidities					
Diabetes	1.63 (1.31-2.02)		< 0.001	1.26 (0.99-1.60)	0.06
HTN	1.25 (1.02-1.53)		0.03	1.01 (0.81-1.26)	0.93
CKD	1.00 (0.74-1.37)		0.98	0.79 (0.57-1.11)	0.17
CHD	1.38 (1.00-1.90)		0.01	1.20 (0.85-1.69)	0.29
Respiratory disease	1.68 (1.23-2.31)		< 0.001	1.51 (1.06-2.16)	0.02

[1] adjusted for age and gender and practice
[2] adjusted for all covariates in the table and practice