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Official mortality data for England suggest systematic miscategorisation of vaccine status and uncertain effectiveness of Covid-19 vaccination

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12 January 2022

UPDATED WITH ONS DECEMBER DATA RELEASE & HEALTHY VACCINEE/MORIBUND ANALYSIS

Abstract

The risk/benefit of Covid vaccines is arguably most accurately measured by comparing the all-cause mortality rate of vaccinated against unvaccinated, since it not only avoids most confounders relating to case definition but also fulfils the WHO/CDC definition of "vaccine effectiveness" for mortality. We examine two of the most recent UK ONS vaccine mortality surveillance reports, which provide the necessary information to monitor this crucial comparison over time. At first glance the ONS data suggest that, in each of the older age groups, all-cause mortality is lower in the vaccinated than the unvaccinated. This conclusion is cast into doubt upon closer inspection of the data due to a range of fundamental inconsistencies and anomalies in the data. Whatever the explanations for these are, it is clear that the data is both unreliable and misleading. It has been suggested that the anomalies are the result of healthy vaccinee selection bias and population differences. However, we show why the most likely explanations for the observed anomalies are a combination of systemic miscategorisation of deaths between the different categories of unvaccinated and vaccinated; delayed or non-reporting of vaccinations; systemic underestimation of the proportion of unvaccinated; and/or incorrect population selection for Covid deaths. We also find no evidence that socio-demographic or behavioural differences between vaccinated and unvaccinated can explain these anomalies.

1. Introduction

Our recent articles [1, 2] have argued that the simplest and most objective way to assess the overall risk/benefit of Covid-19 vaccines is to compare all-cause mortality rates of the unvaccinated against the vaccinated in each separate age-group. For such an assessment we need accurate periodic data on both age-categorized deaths and the number of vaccinated/unvaccinated people in each age group for that period.

Any systemic errors or biases can lead to conclusions that are inversions of reality. For example, simply reporting deaths one week late when a vaccine programme is rolled out will (with statistical certainty) lead to any vaccine, even a placebo, to seemingly reduce mortality. The same statistical illusion will

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happen if any death of a person occurring in the same week as the person is vaccinated is treated as an unvaccinated, rather than vaccinated, death [16].

The UK Government has been better than most countries in providing detailed data on Covid cases and deaths indexed by vaccine status. However, in [1] we highlighted the absence of relevant age-categorized mortality data for England, and major inconsistencies in the data provided by different agencies. Of most concern are the very different estimates provided by UKHSA (United Kingdom Health Security Agency) and the ONS (Office for National Statistics) of the number of vaccinated and unvaccinated people. The reports from UKHSA use estimates from the NIMS (National Immunisation Management Service) database [10], while the estimates from the ONS are based on 2011 census respondents and patients registered with a GP in 2019. Hence the ONS England population (which therefore includes only people aged at least 10) is only approximately 39 million, compared to the approximately 49 million listed in NIMS. While our focus is on mortality by vaccination status, accurate periodic estimates for the proportion of people vaccinated are also crucial for determining vaccine effectiveness, since this is simply a comparison between the 'cases', hospitalisations and deaths per 100K vaccinated and unvaccinated.

An indication of just how critical it is to get accurate estimates of the number vaccinated is illustrated by UKHSA report for week 44 [3], which showed that, in each age group above 29, the Covid case rate was higher among the vaccinated than the unvaccinated.

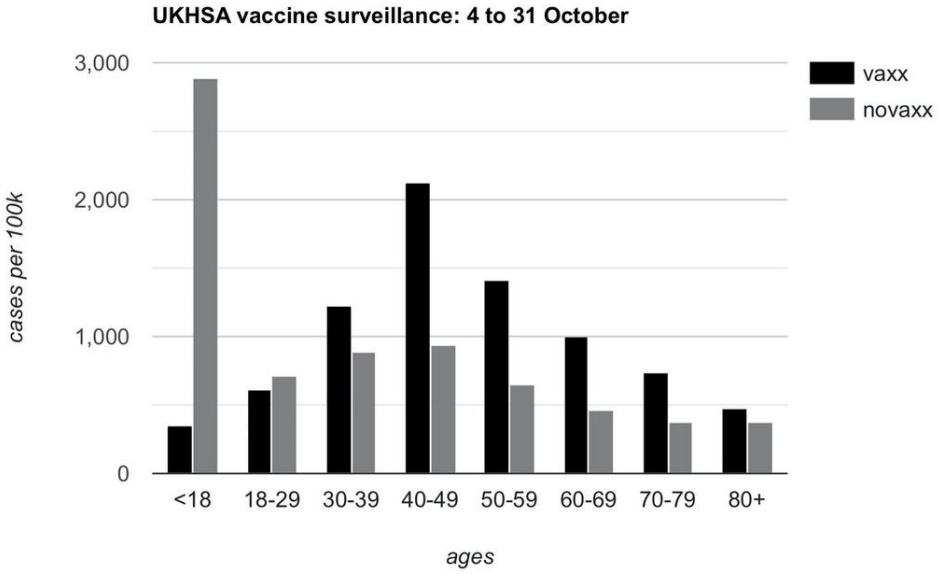

Figure 1: Covid-19 case rates based on UKHSA data in [3] and reproduced from [5]

The UKHSA report caused a flurry of indignation, and prominent scientists, such as Professor Sir David Spiegelhalter, claimed that the data was 'feeding conspiracy theorists worldwide' [4] and subsequently led to the UK statistics regulator stepping in and chastising the UKHSA for using inappropriate population denominators [5]. An article describing the fallout from this can be found in [6].

The justification for these criticisms (which were aimed at both UKHSA and any others simply reporting the UKHSA data) was that NIMS was double counting some vaccinated people, and hence the NIMS population estimates for the number of people vaccinated were therefore too high. They claimed that the ONS data 'fixed' this bias and hence properly adjusted the results. However, as we pointed out in [1], while the NIMS data may indeed overestimate the number of vaccinated, it is likely that it also underestimates the number of unvaccinated (a much more difficult number to estimate than those vaccinated).

Until the 1st November 2021 version of the ONS surveillance report was released [7], it was essentially impossible to compare mortality rates of the vaccinated against the unvaccinated because the reports did not provide the necessary age categorised data. However, this version did contain some age-categorized data and in what follows we primarily analyse this latest ONS report and other relevant sources of data on mortality to examine patterns of mortality and any connection this might have with vaccination. The ONS released further data on December 20th 2021, albeit at a significant lower level of granularity that inhibits cross comparison with earlier data (different age categories; monthly rather than weekly data; age-adjusted mortality rather than raw death and population data; death counts updated; and fractional membership of vaccination category based on time spent in category) and with different categories for vaccine status than those used in November (five categories rather than four with double dose vaccinated split into less than and greater than 21 days). However, it does contain additional data on people in "very poor health" in the 70-79 age group [25], which can be used to test hypotheses asking whether health affects mortality differences in this age group.

In section 2, we examine the all-cause mortality rates in the ONS data [7]. Section 3 then compares vaccinated and unvaccinated non-Covid mortality. Section 4 looks at the correlation between the vaccine rollout and non-Covid mortality, discussing curious oddities in the data that may be explainable by miscategorisation of vaccine status at death. In section 5 we look to explain this and correct for this miscategorisation. In section 6 (and accompanying Appendix), we test the hypothesis that the anomalies are the result of vaccinations being denied to moribund or terminally ill patients, or that there is a healthy vaccinee effect. We use the most recent ONS report [26] in this analysis. Section 7 focuses on Covid mortality and looks at the relationship between vaccination and infection and hypothesises that the data is better explained by a temporal offset correction model that takes this into account. Further oddities in the population data are revealed in Section 8, with other factors discussed in Section 9, and finally Section 10 discusses caveats in the analysis and draws conclusions.

2. All-cause mortality rates

In response to our request, the ONS included age categorised all-cause death numbers by vaccination status in [7]. Unfortunately, although separate data for age groups 60-69, 70-79 and 80+ were provided in the ONS November data release, data were aggregated into a single group for age group 10-59.

The mortality rate (deaths per 100K people) for all age groups derived from the unadjusted data is shown in Figure 2. Clearly the early weeks show a higher mortality rate for the older age groups, compared to later weeks.

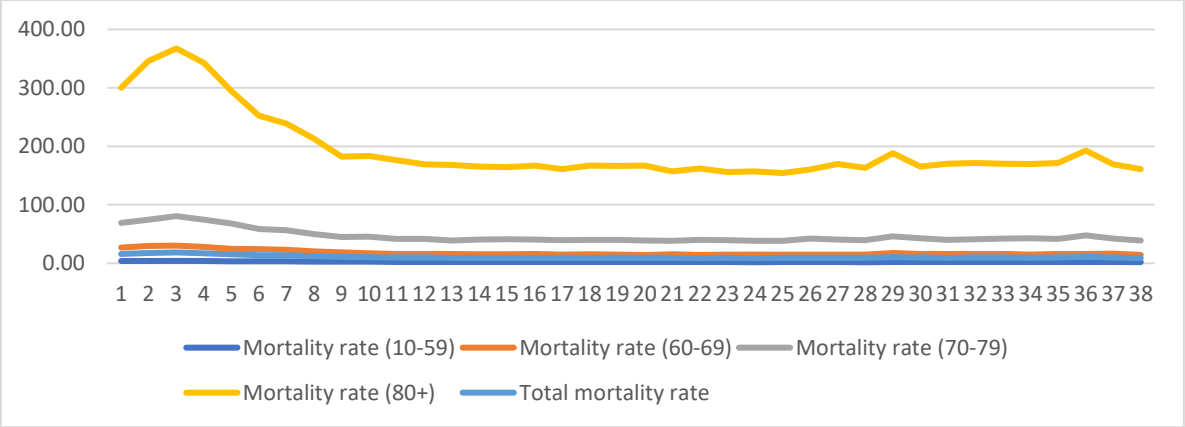

Figure 2: Total mortality rate and age-group specific mortality rates (weeks 1-38, 2021)

The mortality rate for non-Covid deaths is shown in Figure 3, which shows a more or less stable pattern through the year to September, and certainly by the summer months, they look to have stabilised to averages of 14.8, 39.6 and 164.8 (deaths per 100k population) for each age group per week. Also note that the mortality rates are in approximate agreement with those published in actuarial life tables, which are 18, 46 and 214. This suggests there are no significant excess non-Covid deaths included in the ONS data.

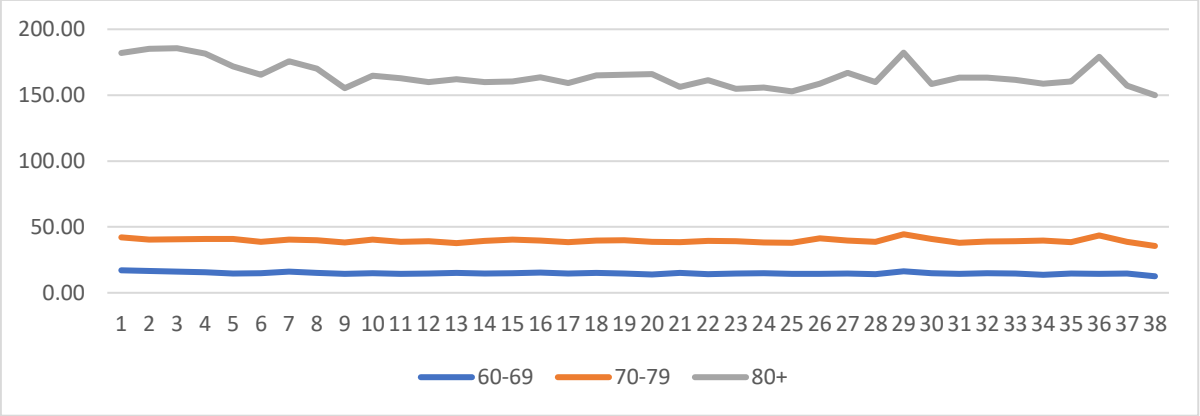

Figure 3: Non-Covid mortality rates per age groups, 10-59 excluded (weeks 1-38, 2021)

In comparing mortality rates by vaccination status, curiously, in the youngest age group the mortality rate is currently around twice as high for those who have received at least one dose of the vaccination compared to those who are unvaccinated, as shown in Figure 4.

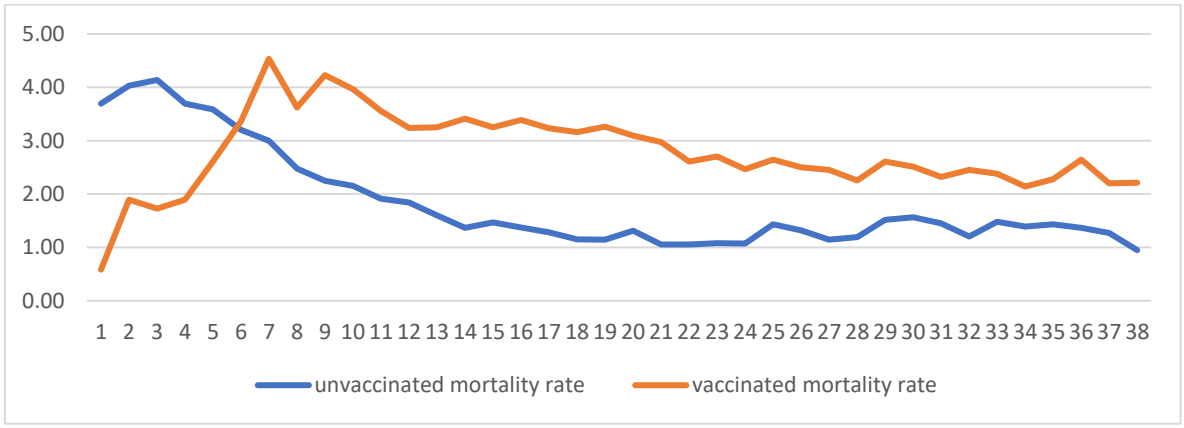

Figure 4: All-cause mortality rate: vaccinated versus unvaccinated in age group 10-59 (weeks 1-38, 2021)

However, because this group includes such a wide age range it is possible that this potentially extremely disturbing statistic remains strongly confounded by age. Therefore, without a finer age categorisation it is impossible to tell what the actual difference in all-cause deaths might be. Why the age confounding was not apparent in weeks 1 to 5 when only the most vulnerable were being vaccinated remains unexplained.

Where age groups are narrower, 60-69, 70-79 and 80+, the age confounding effects are somewhat mitigated, and the data appear to show (in each of these age groups) a lower all-cause mortality for the vaccinated, compared to the unvaccinated. See Figures 5, 6 and 7.

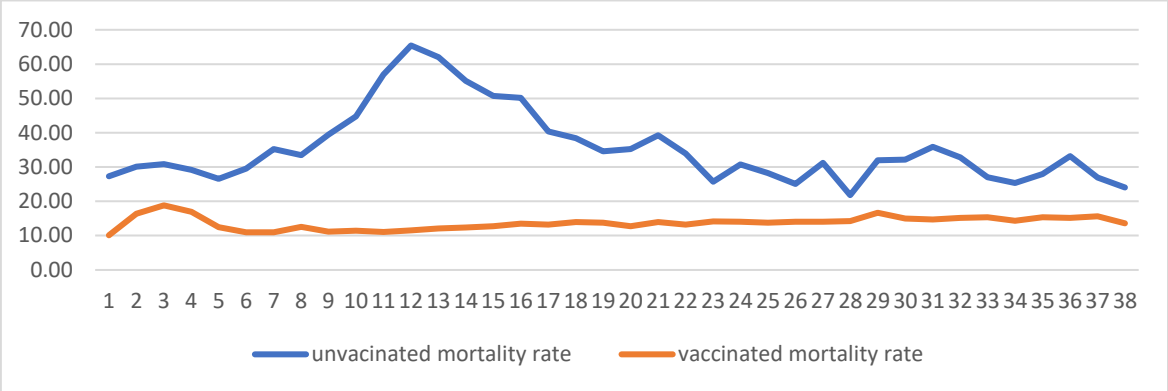

Figure 5: All-cause mortality rate: vaccinated versus unvaccinated in age group 60-69 (weeks 1-38, 2021)

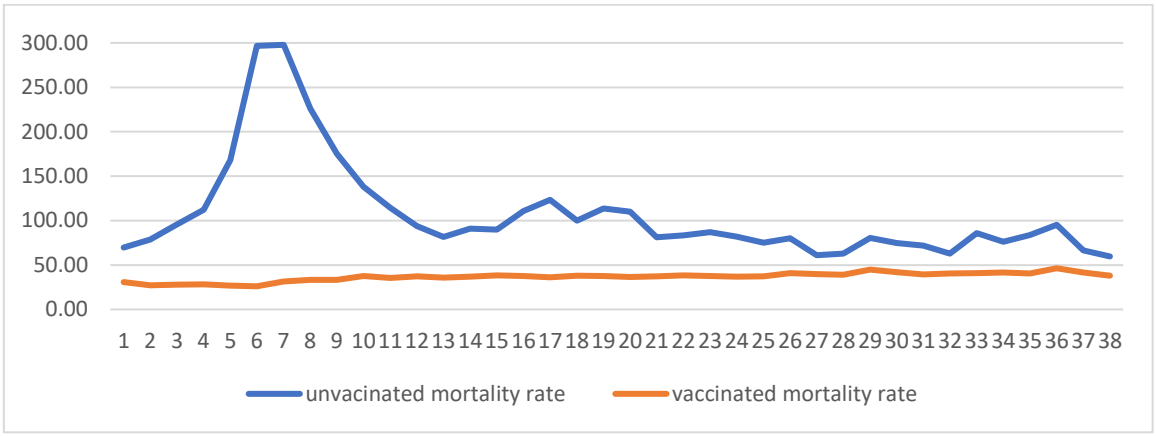

Figure 6: All-cause mortality rate: vaccinated versus unvaccinated in age group 70-79 (weeks 1-38, 2021)

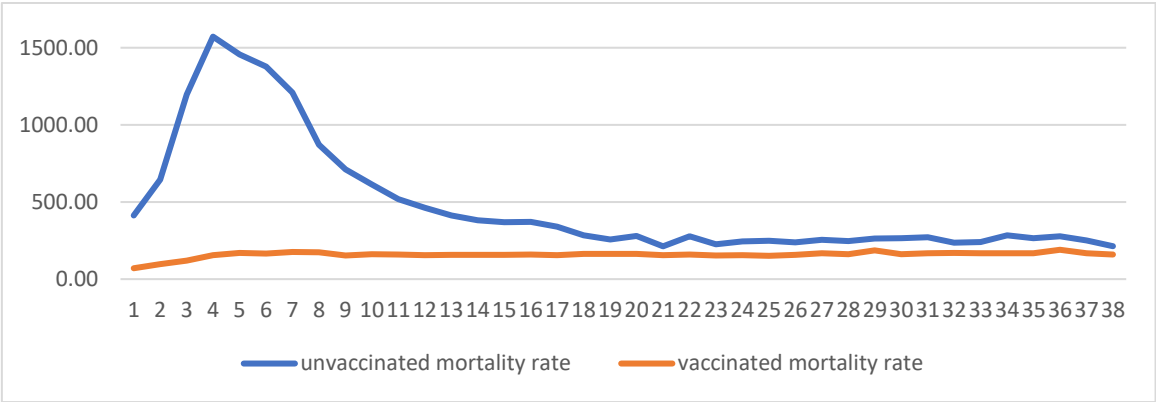

Figure 7: All-cause mortality rate: vaccinated versus unvaccinated in age group 80+ (weeks 1-38, 2021)

Note that from Figures 5-7 we might conclude that the unvaccinated face an all-cause mortality rate higher than that faced by the vaccinated because they bear the burden of higher mortality caused by Covid. This is something we will return to in Section 3.

In previous years, each of the 60-69, 70-79 and 80+ groups have mortality peaks at the same time during the year (including 2020 when all suffered the April Covid peak at the same time). Yet in 2021 each age group has non-Covid mortality peaks for the unvaccinated, at a different time, namely a time shortly after the vaccination rollout programmes for those cohorts reach a peak, which for 60-69, 70-79 and 80+ age groups was week 7, week 5, and week 1 respectively.

3. Comparing vaccinated and unvaccinated mortality

An examination of these older age groups reveals a different fundamental anomaly in the data, which becomes most evident when we look at causes of death other than Covid. By looking at non-Covid mortality (i.e., all-cause minus Covid mortality), we are removing the Covid death signal from the data and looking at changing patterns of mortality caused by other causes of death such as cancer, heart diseases, accidents and so forth.

Setting aside age group 10-59 because of probable age confounding, the data appear to show (in each of the older age groups) a significantly lower non-Covid mortality rate for the vaccinated, compared to the unvaccinated. See Figures 8, 9 and 10.

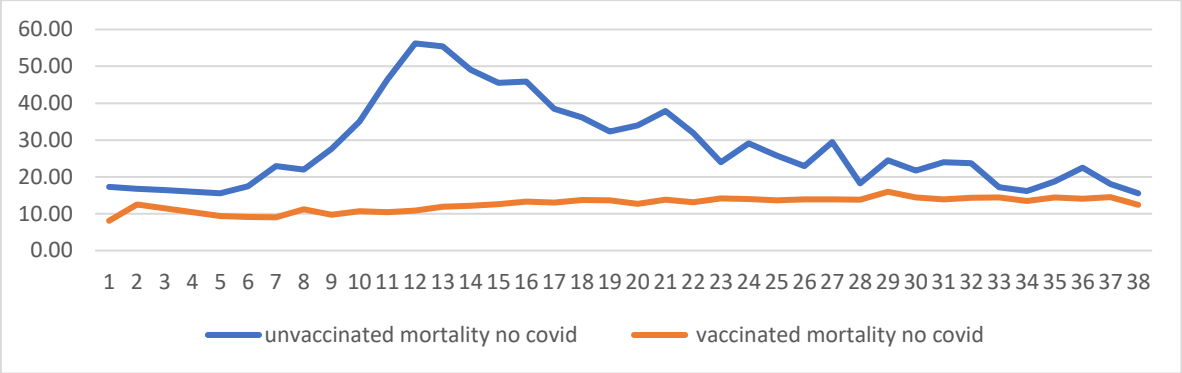

Figure 8: Non-Covid mortality rate: vaccinated versus unvaccinated in age group 60-69 (weeks 1-38, 2021)

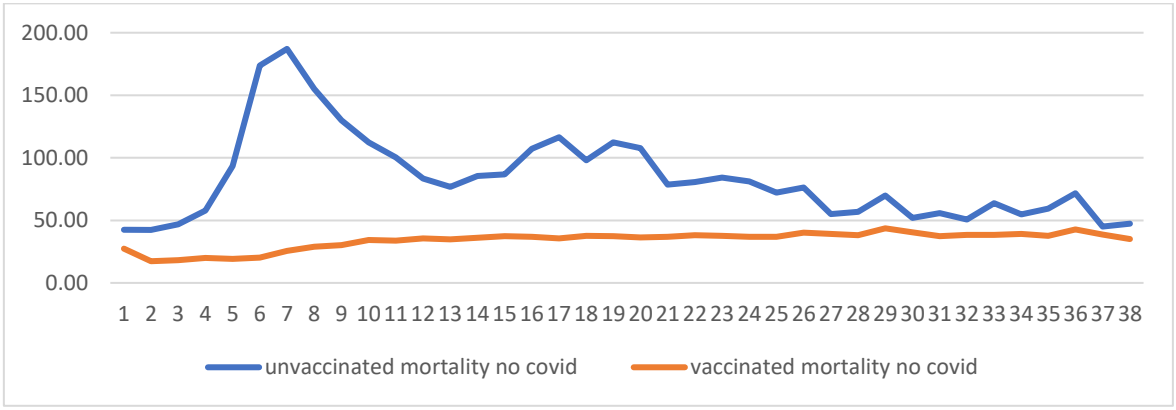

Figure 9: Non-Covid mortality rate: vaccinated versus unvaccinated in age group 70-79 (weeks 1-38, 2021)

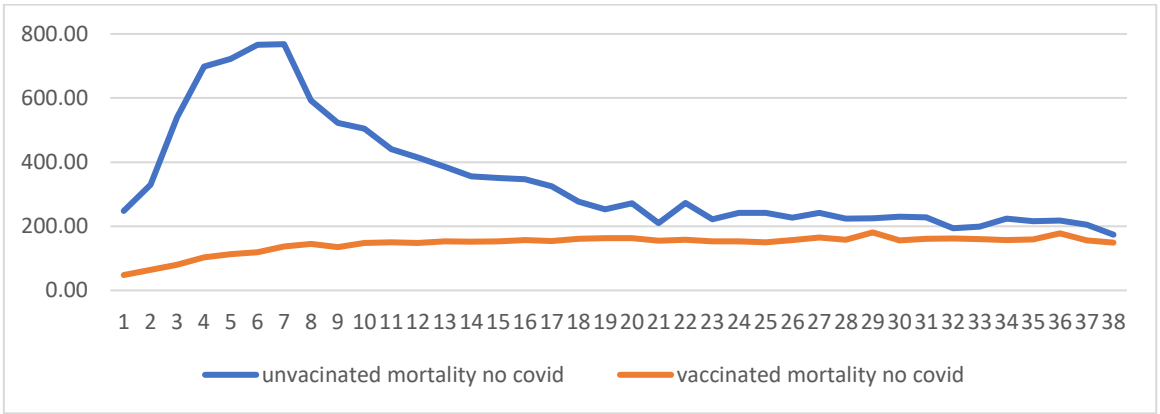

Figure 10: Non-Covid mortality rate: vaccinated versus unvaccinated in age group 80+ (weeks 1-38, 2021)

Moreover, the unvaccinated mortality rates peak in each age group at the same time as the vaccine rollout peaks for that age group, before falling and approaching that of the vaccinated. This mirrors Figure 2, where we saw early peaks in all-cause mortality in each of these age groups.

If we compare these results to weekly average actuarial mortality from the ONS national lifetables for England [8] we can again see some surprising results. Here the lifetable values are adjusted according to the population pyramid proportion given in [9] to arrive at a lifetable average weighted by population size.

From Table 1 we can see that the average all-cause mortality for weeks 1-38 for the vaccinated group is lower than the lifetable values for age groups 70-79 and 80+. The unvaccinated mortality is more than double lifetable mortality for all causes.

Age group	Unvaccinated	Vaccinated	Lifetable
60-69	63 (39, 121)	26 (18, 32)	18
70-79	106 (59, 297)	36 (26, 46)	46
80+	480 (212, 1571)	158 (70, 190)	214

Table 1: Comparison of mean all-cause mortality (per 100k) for each age group for weeks 1-38 (min, max) with mean of historical lifetable values

In Table 2 we set out the data for non-Covid causes of death. Here the unvaccinated mortality rate is again higher than the lifetable value suggesting that even with Covid mortality risk removed, the unvaccinated still have a much higher mortality rate than expected and that this cannot be due to Covid.

Age group	Unvaccinated	Vaccinated	Lifetable
60-69	28 (15, 56)	12 (8, 15)	18
70-79	83 (42, 187)	34 (17, 43)	46
80+	344 (173, 768)	145 (47, 180)	214

Table 2: Comparison of mean non-Covid mortality (per 100k) for each age group for weeks 1-38 (min, max) with mean historical lifetable values. Values are mean (min, max)

Table 3 compares the average non-Covid mortality of the unvaccinated and vaccinated with historical lifetables and shows the respective equivalent lifetable age group for the data, i.e., the age group that historically corresponded to that mortality rate.

Unvaccinated Age group	Equivalent Lifetable Age group for unvaccinated	Vaccinated Age group	Equivalent Lifetable Age group for vaccinated
60-69	70 (63 - 76)	60-69	61 (56 - 63)
70-79	79 (73 - 86)	70-79	71 (64 – 73)
80+	91 (86 - 99)	80+	84 (75 – 86)

Table 3: Estimated lifetable ranges for unvaccinated and vaccinated for other-than covid mortality based on historical lifetables. Values are mean (min, max)

Clearly the corresponding lifetable age group for the unvaccinated has an average significantly older than the lifetable for that age group, with min/max values that are much higher than we might expect from lifetables. Conversely, for the vaccinated the corresponding lifetable age group is significantly younger than we would expect from lifetables.

Intuitively – as would be the case for any other vaccine - we would actually expect to see slightly higher non-Covid mortality rates in the vaccinated than the unvaccinated because those most at risk of death were most likely to be vaccinated, and in addition there may have been adverse effects from the vaccine. Moreover, we might also expect to see a much higher mortality for the vaccinated early in

the vaccine rollout, since people with comorbidities were prioritised for Covid vaccination. Instead, the vaccinated appear to have the health of people much younger.

Consider what we are witnessing here: we have a vaccine whose recipients are suffering fewer deaths by causes *other* than Covid and hence are benefitting from improved mortality. It appears very unlikely that this can be from the vaccine, since the very best we can hope for is that the vaccine is causing no adverse reactions leading to additional non-Covid deaths.

Instead, the unvaccinated appear to experience increased non-Covid mortality, especially in the near term close to the vaccine rollout for each age group. This is enigmatic. Does the vaccine have short-term benefits beyond reducing Covid deaths? Does undetected Covid increase mortality in the unvaccinated in a way that presents itself as other causes of death? If so, why would it be staggered by vaccine rollout periods across age groups? None of these possible reasons make any sense, so we need to look elsewhere for a more plausible explanation.

The one thing that stands out is that, compared to historical mortality lifetable values, not only is there a difference in all-cause mortality between vaccinated and unvaccinated, but the mortality rates look to differ significantly from historical norms. By simple comparison with historical lifetable values, the vaccinated appear to suffer less mortality than we would expect them to (and this is during a period of expected higher seasonal mortality) and vice versa for the unvaccinated. This is very odd. It has been proposed that the lower observed rates of non-Covid mortality among the vaccinated could be explained by that fact that people choosing vaccination are generally healthier than those who do not. If this were the case, then all observational studies of vaccination effectiveness and safety (including all Government data) would also be systematically and very significantly overestimating effectiveness because of sample bias.

However, further evidence of problems with the data that cannot be explained by such self-selection bias can be seen when we consider non-Covid mortality rates of the different categories of vaccinated people. The vaccinated are categorised into three different categories, namely: ‘within 21 days of first dose’, ‘at least 21 days after first dose’, and ‘second dose’. In each age category the mortality fluctuates in a wild but consistent manner. For example, the two-dosed vaccinated non-Covid mortality rate is consistently far lower than the baseline, while the greater than 21 days 1-dose vaccinated non-Covid mortality rate is consistently far higher than the baseline. This is illustrated in the 70-79 age group in Figure 11, but the other age groups show very similar patterns.

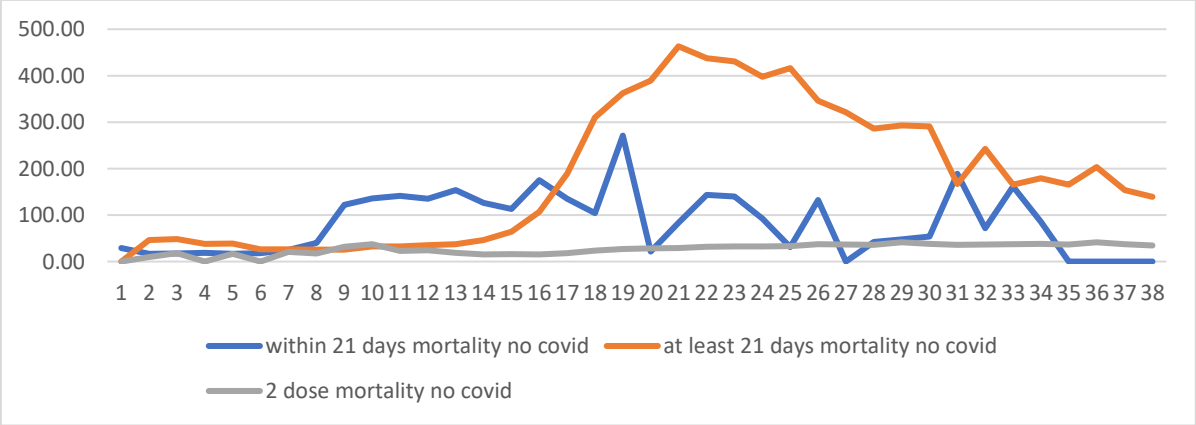

Figure 11: Non-Covid mortality rate for 'within 21 days' and 'at least 21 days' of first dose and ‘two dose’ in age group 70-79

4. Correlating unvaccinated mortality with the vaccine roll out

Figures 12, 13 and 14 compare the non-Covid mortality rate of the unvaccinated with the vaccinated (all vaccination categories combined), along with the timing of the first and second dose rollout.

Each figure shows the percentage uptake of the first and second dose of the vaccine (these are the dotted lines and the right-hand side vertical axis show the percentage of the age group vaccinated during that week). These lines show increasing uptake of the first and second doses of the vaccine. Each clearly envelops the period within which the majority of the first and second vaccinations were administered to each age group. Again, we have removed Covid mortality to isolate the signal of interest.

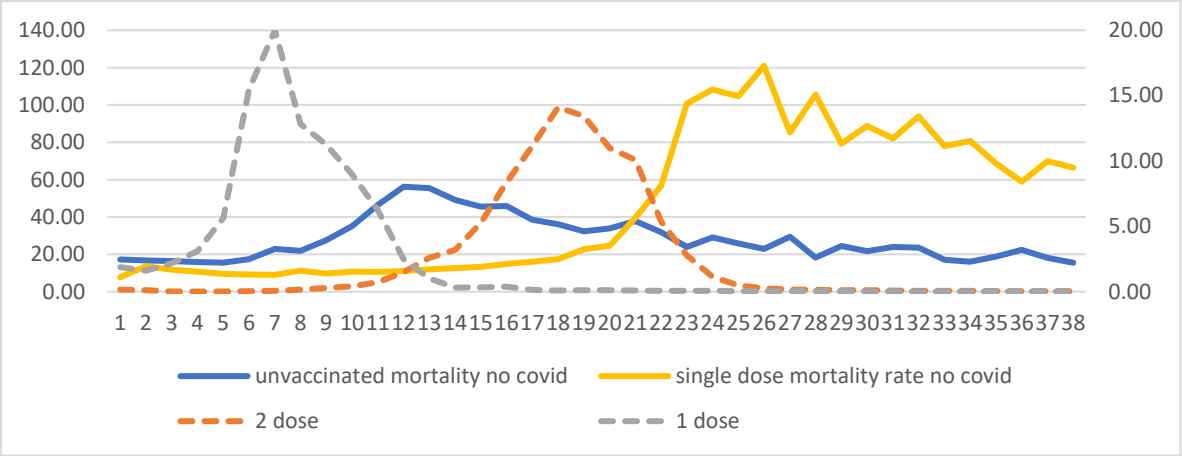

Figure 12: Non-Covid mortality rate in unvaccinated and vaccinated versus % vaccinated for age group 60-69 (weeks 1-38, 2021)

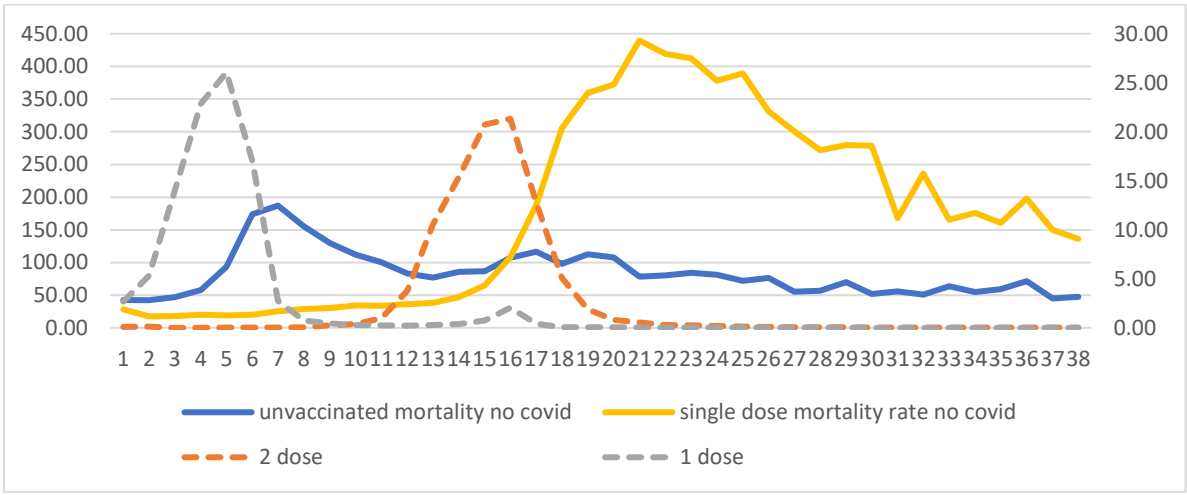

Figure 13: Non-Covid mortality rate in unvaccinated and vaccinated versus % vaccinated in age group 70-79 (weeks 1-38, 2021)

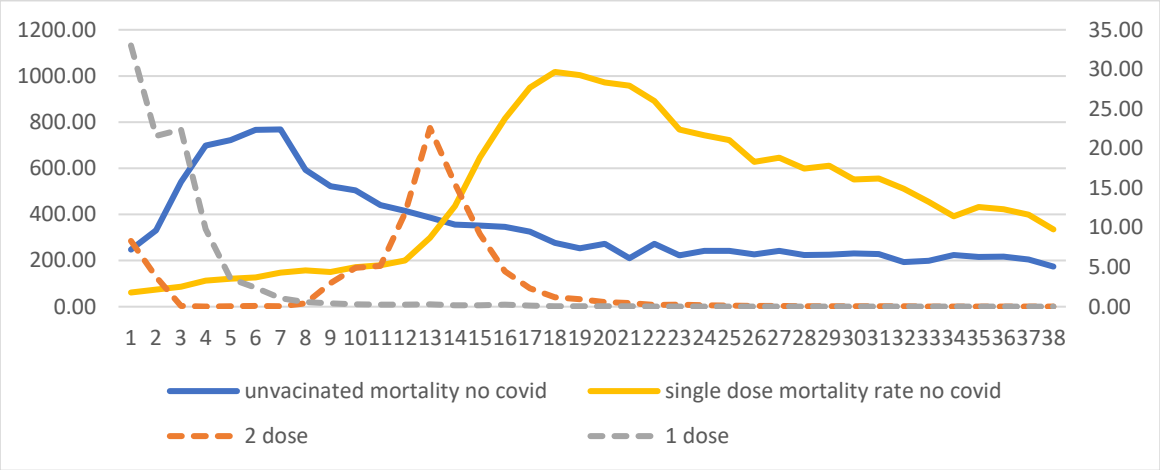

Figure 14: Non-Covid mortality rate in unvaccinated and vaccinated versus % of age group vaccinated in age group 80+ (weeks 1-38, 2021)

In all three figures we see peaks in mortality risk for the unvaccinated across each age groups that occur almost immediately after they had received the first vaccine and peak at consecutively later times in line with when vaccine was administered for that age group. The fact that the peaks in mortality are not temporally aligned strongly suggests that this is not caused by natural events. Nor can it be argued that it is caused by undiagnosed covid infection [32] given that the peaks in non-Covid mortality occur later than the much earlier peak in covid infection, especially for the younger age groups. As reported previously [16], such a phenomenon would be inevitable if the deaths of people who die shortly after vaccination are miscategorised as unvaccinated.

5. Correcting hypothetical miscategorisation

A major problem in evaluating the overall risk-benefits of a vaccine is that different classifications of what constitutes a 'vaccinated' person are required depending on whether we are primarily interested in its efficacy in reducing infections or in whether we are primarily interested in its impact on all-cause mortality. In this section we are interested in the latter, which is why we believe it is important to consider a person as 'vaccinated' if they have received at least one dose since adverse reactions are most likely shortly after the vaccination. However, for efficacy in reducing infections, it is argued that it is reasonable to allow for suitable elapsed time (and even number of doses) before considering that a person is 'vaccinated'. Indeed, the vaccine manufacturers claim that they are only effective when the recipient is fully vaccinated, which they define as being greater than 14 days after the second dose [18], with a recommended gap between the first and second dose of 3 weeks [20]. This may be why the ONS and other data sets focus on categorisation before and after the 21-day period elapsed between doses.

There are also claims that the vaccines are effective after the first dose, but only after 14 days have elapsed. In fact, the USA CDC (Center for Disease Control) classifies any case, hospitalization or death occurring during this 14-day period after first dose as 'unvaccinated', despite injection [18]. Evidence from Israel suggests that this definition applies there [23], but in the UK it was never clear that this was the case until the release of documentation suggesting that the vaccinated who die within 14 days of vaccination might be categorized as unvaccinated [17].

Similarly, if it is possible that someone who dies within 14 days of vaccination (first dose) is miscategorised as unvaccinated then, hypothetically at least, a similar thing could occur post second dose, whereby the people who die within a period of taking the second vaccine are miscategorised as 'single dose vaccinated'. In an FOI request [26] the UKHSA confirmed that, in their vaccine surveillance

reports, those who have received 2 doses but less than 14 days before the specimen date of their positive Covid test are included in the received 1 dose greater than 21 days category. Likewise, in [30] the UKHSA combine unvaccinated and 'less than 28 days' since first dose vaccination as being equivalent in their assessment of risk of hospital admission. A fuller investigation of the miscategorisation problem as seen in the Dagan study [23] is expanded in the analysis by Reeder [22] and demonstrates that confounding by miscategorisation can account for most, if not all, of any effectiveness claimed in an observational study.

The possible miscategorisation processes are summarised in Figure 15.

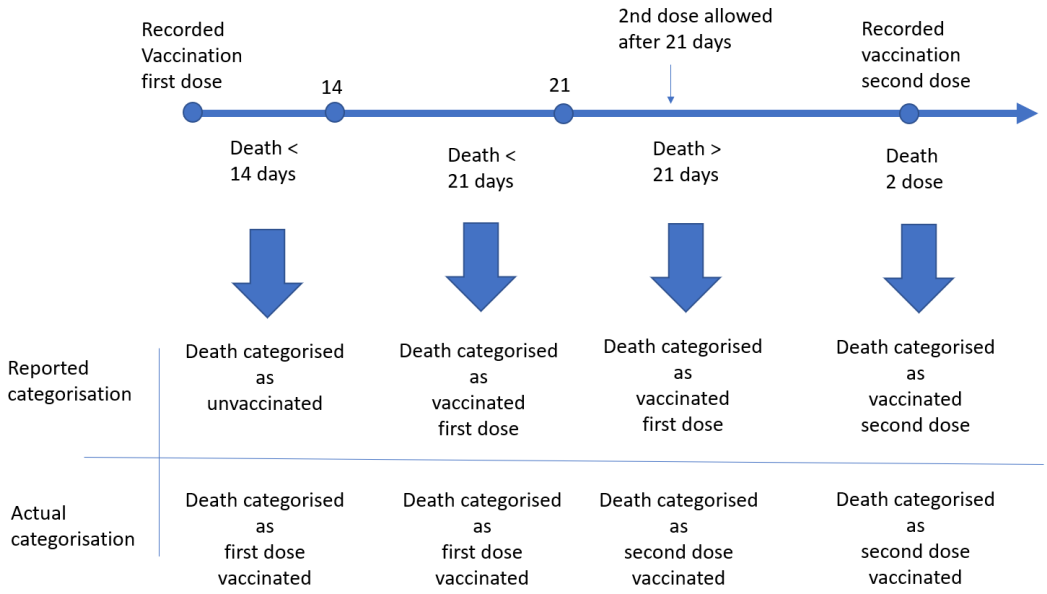

Figure 15: Possible reported versus actual vaccination status miscategorisation

If we accept the possibility of miscategorisation, then how might the ONS data be adjusted to take account of it? Our hypothesis is that miscategorisation might explain the various anomalies described in Sections 3 and 4.

To test this hypothesis, we proceed as follows:

- We compare each group to the expected mortality from actuarial life tables to determine how far they were from historical expectations.
- We assume the true mortality rate for the unvaccinated equals a value close to the lifetable values (using [8] and [9]). Recognising that no data will exactly match history, we selected a baseline for comparison equal to the average of the final 12 week mortality rates in the ONS data. This includes the summer period, when covid mortality rates were almost zero. For the age groups these mortality rates were (lifetable values in brackets):
    - 60-69: 14.48 (18)
    - 70-79: 39.62 (46)
    - 80+: 163.40 (214)
- The difference between this mortality baseline and the unvaccinated and single dose mortalities was calculated to determine possible miscategorised mortality and this was re-assigned to the first dose and second dose mortality rates per week. Hence, excess mortality in the unvaccinated was assigned to the single dose vaccinated and that in the single dose vaccinated was assigned to the double dosed.
- We plot the new adjusted mortalities for the vaccinated and unvaccinated and compare to the vaccine roll out periods for each of the age groups.

Figures 16 to 18 show the adjusted mortalities for each of the three age groups for vaccinated and unvaccinated, along with the percentage of that age group being vaccinated for first and second doses. The similarity between them all is notable. In each there is an early spike in non-Covid mortality in the vaccinated groups, which then settles down and converges with that for the unvaccinated group, which is equal to the baseline mortality. In all cases the spike begins with the roll out of the first dose for each age group.

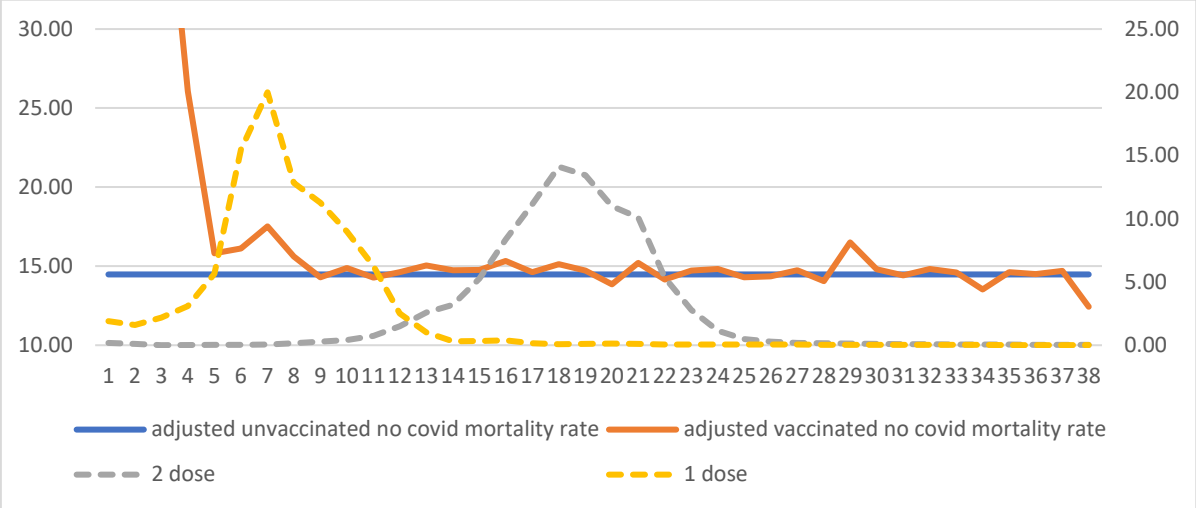

Figure 16: Adjusted non-Covid mortality rate in unvaccinated and unvaccinated versus % vaccinated for age group 60-69 (weeks 1-38, 2021)

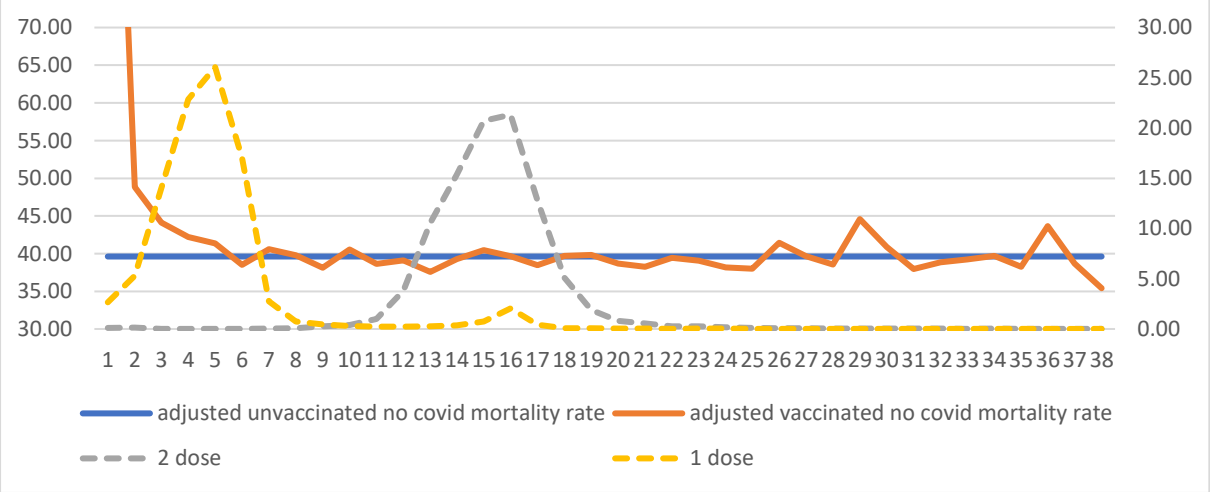

Figure 17: Adjusted non-Covid mortality rate in unvaccinated and vaccinated versus % vaccinated for age group 70-79 (weeks 1-38, 2021)

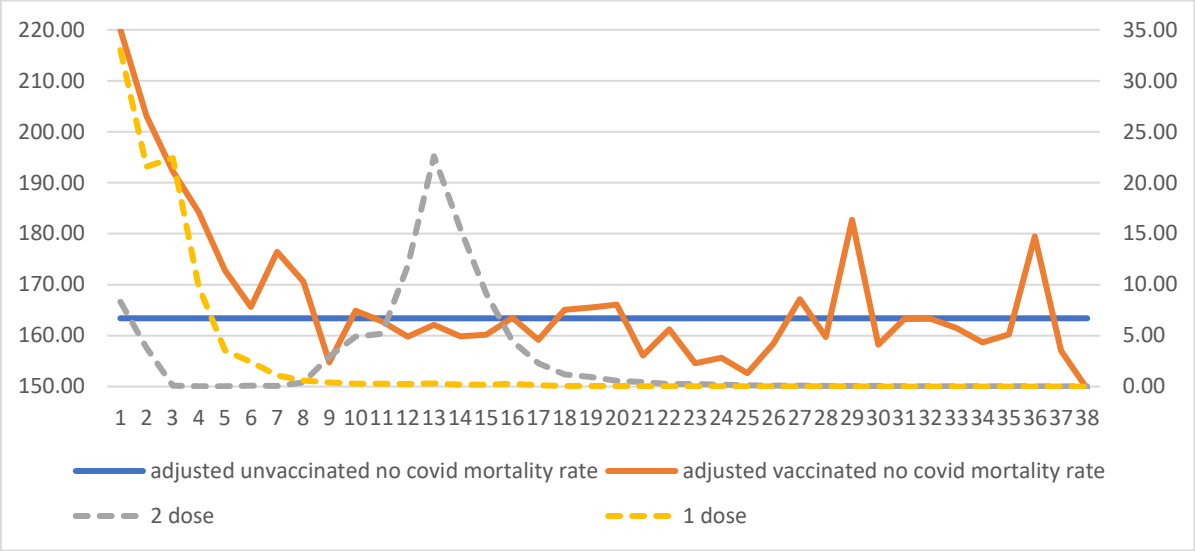

Figure 18: Adjusted non-Covid mortality rate in unvaccinated and unvaccinated versus % vaccinated for age group 80+ (weeks 1-38, 2021)

The scale of the mortality adjustment is such that, if miscategorisation was the sole reason for the difference, then approximately 14% of all deaths are miscategorised across all three age groups. Figures 19 to 21 show the number of deaths that our analysis identifies as miscategorised per week in each of the age categories. In total there were 4,704 miscategorised in the 60-69 age group, 11,144 miscategorised in the 70-79 age group and 27,358 miscategorised in the 80+ age group.

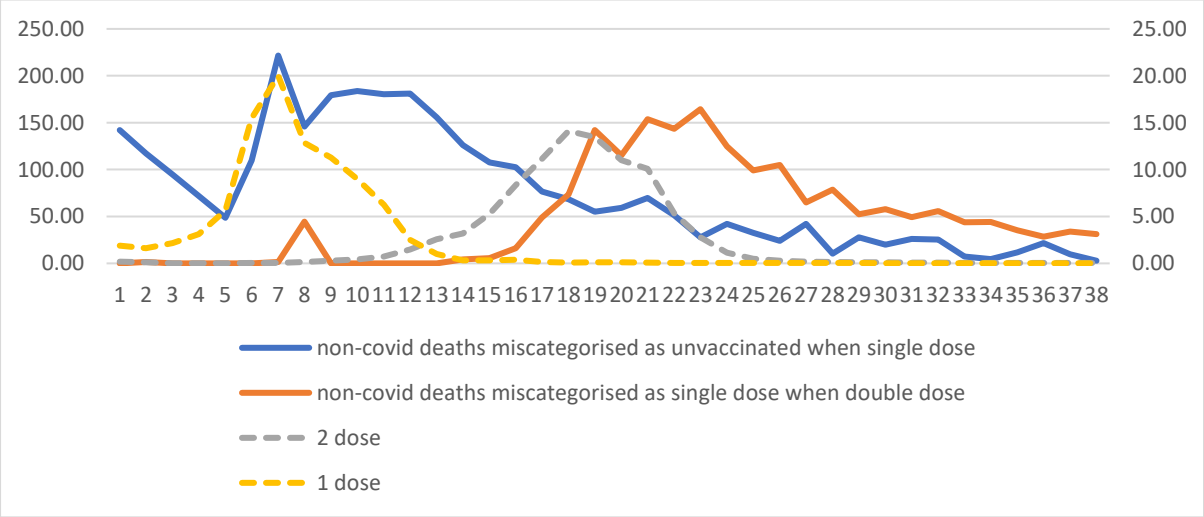

Figure 19: Miscategorised non-Covid deaths versus % vaccinated in age group 60-69 (weeks 1-38, 2021)

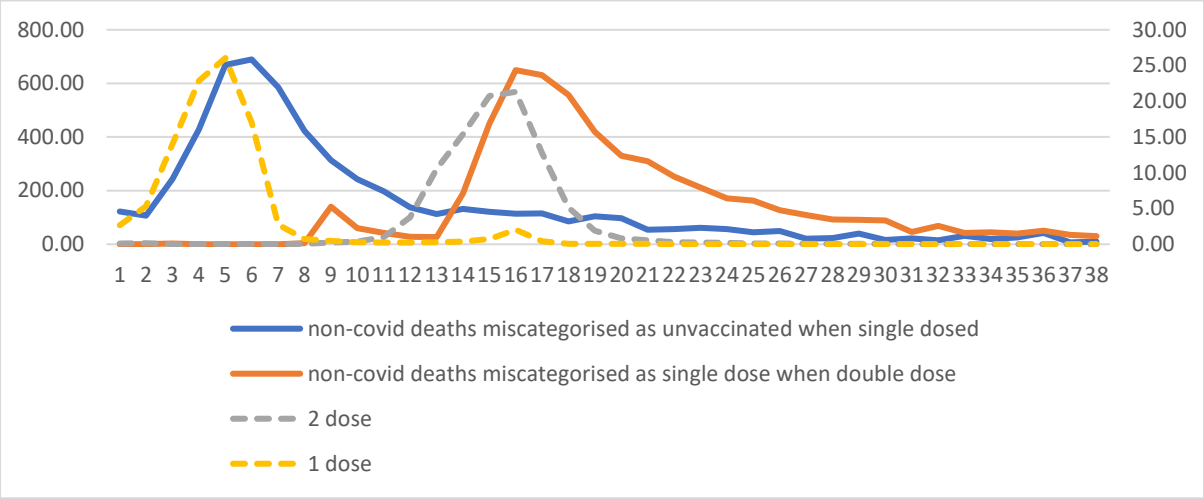

Figure 20: Miscategorised non-Covid deaths versus % vaccinated in age group 70-79 (weeks 1-38, 2021)

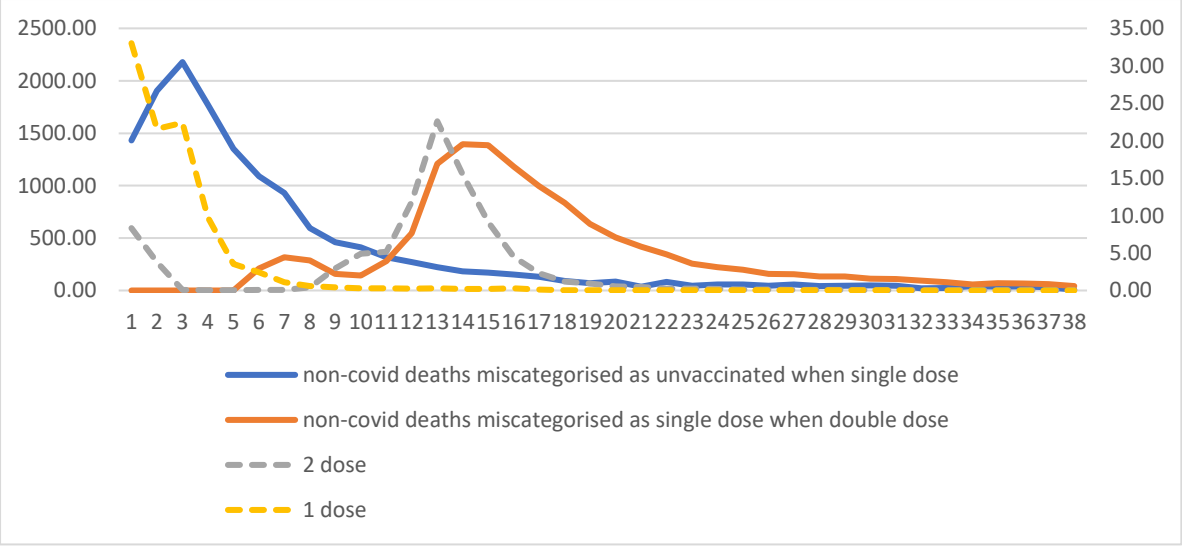

Figure 21: Miscategorised non-Covid deaths versus % vaccinated in age group 80+ (weeks 1-38, 2021)

In line with the fact that the data does not reveal excess mortality compared to previous years, we see no direct evidence of overall excess mortality caused by vaccine side effects in the data. The spikes in mortality that appear to occur soon after vaccination may be caused by the infirm, moribund, and severely ill receiving vaccination in priority order and thus simply appearing to hasten deaths that might otherwise have occurred later in the year.

This exploratory analysis suggests there is sufficient evidence to indicate that single and double dosed vaccinated may be being systemically miscategorised (either accidentally or as a matter of policy). Given the simplicity of this analysis in explaining what must be flaws in the ONS data, it is surprising that the ONS has not considered this hypothetical possibility or sought to correct for it, should it be true.

6. Hypothetical healthy vaccinee and moribund effects

An alternative explanation has been proposed for the sharp increase in all-cause and non-Covid mortality, seen in the unvaccinated and single dose vaccinated following first and second dose rollouts, respectively. Specifically, it has been suggested that patients close to death were unlikely to be vaccinated [31] and this introduced a form of selection bias. An unvaccinated person close to death would not receive a first dose and, similarly, a person who had previously been in better health and

had received a first dose, but who was now close to death, would not receive a second dose. This is, in essence, a healthy vaccinee effect, or conversely a moribund effect. In such a scenario, those most likely to die in the near future would be least likely to be vaccinated, resulting in a healthier-than-average vaccinated cohort and an unhealthier-than-average unvaccinated cohort.

It is worth noting that there is very little indication that terminally or critically ill patients in the UK were less likely to be vaccinated. On the contrary, the NHS Guidelines [27, 28, 29] explicitly state that the most critically ill people are the ones who must be prioritised for vaccination in each age group. Moreover, feedback from palliative care doctors known to the authors confirm that terminally ill patients were indeed prioritised to receive the vaccination.

The ONS, in their December data release [25], state that:

> "The all-cause ASMRs for the year-to-date were lower in the first three weeks after a vaccine dose than in subsequent weeks after that dose. This could be because of a "healthy vaccinee effect" where people who are ill (either due to COVID-19 or another relevant illness) are likely to delay vaccination. Therefore, the people who have been recently vaccinated are, in the short term, in better health than the general population."

However, in the same document the ONS states that:

> "…the vaccination roll-out was also prioritised by health status of individuals, with the extremely clinically vulnerable and those with underlying health conditions being vaccinated earlier…"

This would appear to contradict the idea of a healthy-vaccinee/moribund effect having occurred. Nevertheless, here we explore whether there is evidence to support such a hypothesis in the reported data.

Figures 12-14 show a sharp increase in unvaccinated mortality followed by a relatively shallower decline shortly after the rollout of the first and second doses of the vaccine for each age group. By the moribund/healthy-vaccinee hypothesis, if healthier people select into the vaccinated group, then as the size of the unvaccinated group shrinks, the disproportionately large number of unhealthy people remaining in the unvaccinated group substantially increases the group's mortality.

In [25] the ONS claim the mortality peaks are the products of population denominators and very poor health in the unvaccinated and single dose vaccinated. They present percentages from January to October 2021, of people in very poor health, defined as having experienced 12 or more recorded hospital episodes since 1 January 2020 or having two or more comorbidities – but do so only for 70-79 year olds. 13% of 70- to 79-year-olds were in this very poor health group in January 2021.

It seems reasonable to assume the size of this very poor health group is strongly correlated with the size of any moribund (near-death) group and would therefore serve as a good proxy. If very poor health alone explains the non-Covid mortality rate, we should expect to see a more or less constant non-Covid mortality within this very poor health group regardless of vaccination status.

We estimate the non-Covid mortality rate by dividing the non-Covid deaths by the estimated size of the very poor health population. Given we only have monthly data from [25], we have converted this to weekly data by interpolation and have used the weekly population statistics from [7], together with relevant percentages from [25], to derive the populations of those in very poor health.

In [25] the monthly percentage of the population in the very poor health category by vaccine status in the 70-79 age group is provided, as shown in Figure 22, which also includes an all-population average, calculated from the data. In week 3 the percentages of very poor health people for each vaccination

category are very similar, lying within approximately 13 and 16 percent, suggesting these populations are very similar at the beginning of the vaccine roll out.

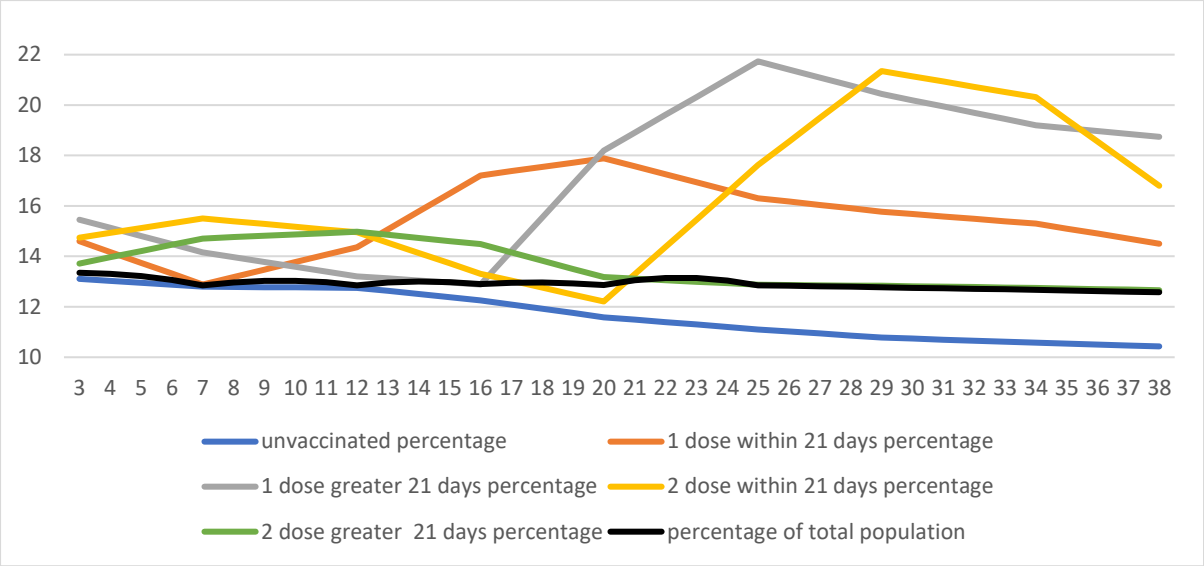

Figure 22: Weekly percentage of 70-79 age group population in very poor health category by vaccination status (weeks 3-38, 2021)

The unvaccinated cohort contains, always, a lower percentage of very poor health people than all of the vaccinated groups. There is no increase observed in the percentage of very poor health people in the unvaccinated group at the time of dose one rollout, and it is consistently below the percentage in very poor health for the whole population. This suggests that not only were those in very poor health not excluded from the dose one rollout, but that they were prioritised: hence the reduced percentage remaining. The decrease rather than increase in the percentage of unvaccinated in very poor health around the time of dose one rollout offers, therefore, a direct refutation of the hypothesis that the increase in non-Covid mortality observed in the unvaccinated at that time was due to them being moribund.

Figure 22 shows a significant increase in people in very poor health in the greater than 21 days after first dose cohort around the time of dose two rollout, with the percentage of people in very poor health in June being around two times higher than April. However, the non-Covid mortality rate in this cohort shows something in the order of a ten-fold rise (see Figure 13). Very poor health cannot, therefore, account for the apparent increase in mortality observed. Furthermore, given the evidence indicating that those in very poor health were vaccinated and even prioritised, it would seem unlikely that a policy of not vaccinating those in very poor health would then be used during the dose two rollout. There was no period where the percentage of the unvaccinated in very poor health increased, instead it fell throughout the period. This strongly suggests a relative absence of potentially moribund people in the unvaccinated population and thus also an absence of an unhealthy vaccinee effect that has been offered to explain the anomalies.

Figure 23 shows the unvaccinated non-Covid mortality rate for the whole unvaccinated population and for those categorised as being in very poor health. The non-Covid mortality rate is not constant in the very poor health group, contrary to what we should expect, but instead we see that it displays the same unnatural spike at the time of the rollout of the first dose of the vaccine. Hence, the spike in mortality cannot be solely explained by a higher proportion of moribund in the population that remains unvaccinated, because this analysis focuses on the subset of the unvaccinated population who are most likely to be moribund. Also, note that the initial spike occurs at a time when the population of unvaccinated was still relatively high in that age group.

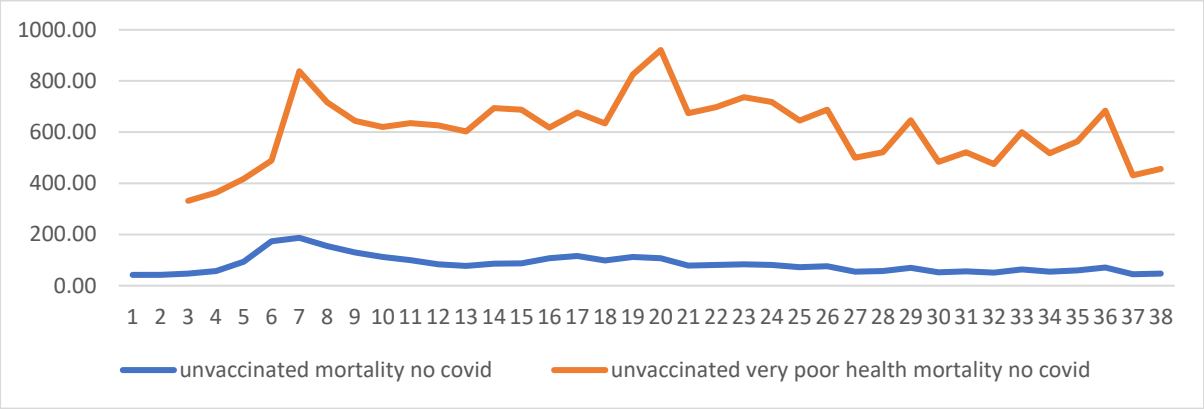

Figure 23: Non-Covid mortality rate for all unvaccinated and unvaccinated very poor health category, 70-79 age group (weeks 1-38, 2021)

When we compare the vaccinated against the unvaccinated in the very poor health group, the picture is even clearer. Figure 24 shows the non-Covid mortality rates for the vaccinated and the unvaccinated. The non-Covid mortality rates for each of these groups are completely different despite having the same health profile. Given the ONS data population and death data is in weekly format but the data on very poor health is provided monthly, we have had to interpolate the latter before combining it with the former. We estimate the weekly very poor health population has a potential error of ±20% and we take this into account when computing the mortality rate confidence intervals shown in Figure 24 (using a Bayesian beta-binomial model).

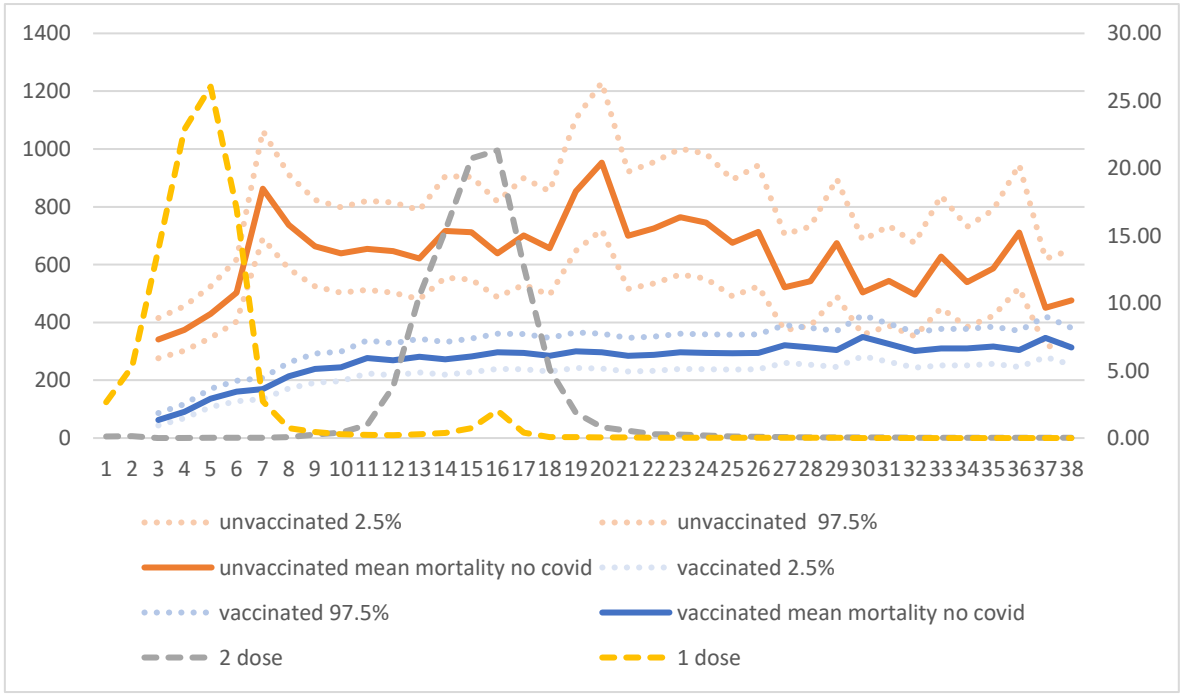

Figure 24: Non-Covid unvaccinated and vaccinated mortality rates in 70-79 age group for very poor health category with 95% confidence intervals and with vaccine roll out doses superimposed (weeks 1-38, 2021)

Empirically, we see that those defined as being in very poor health do not appear to behave as they might be expected to if they were responsible for the unnatural spikes in non-Covid mortality identified earlier. In Figure 24 there are two statistically significant spikes in mortality suffered by those who are unvaccinated and in very poor health just after each vaccine roll out, as we saw before

in Section 3. Also, across the whole period from week 3 to 38 the very poor health and vaccinated population have a mortality rate that is lower than that for those unvaccinated in very poor health.

The rise in mortality, within the unvaccinated group in very poor health, following vaccine rollout supports the miscategorisation hypothesis. Hence, in summary, we conclude that in the ONS data sets, moribund or healthy vaccine effects cannot explain the anomalies in non-Covid mortality between the vaccinated and unvaccinated.

For completeness, in the Appendix we have provided a theoretical statistical model for the 'moribund' hypothesis that can be made to explain the reported data, but only using highly implausible model assumptions.

7. Temporal offset adjustment of Covid-19 mortality

When we examine the Covid mortality curves for the three age groups, we find what at face value appears to be clear evidence of vaccine effectiveness, with the vaccinated benefitting from a lower Covid mortality rate than the unvaccinated. Figures 25 to 27 show this for each age group.

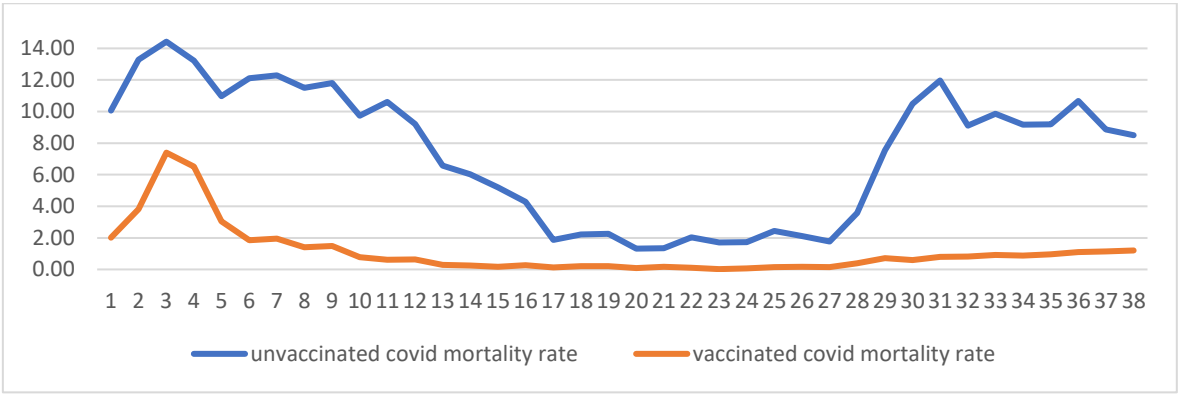

Figure 25: Covid mortality rate among unvaccinated and vaccinated for age group 60-69

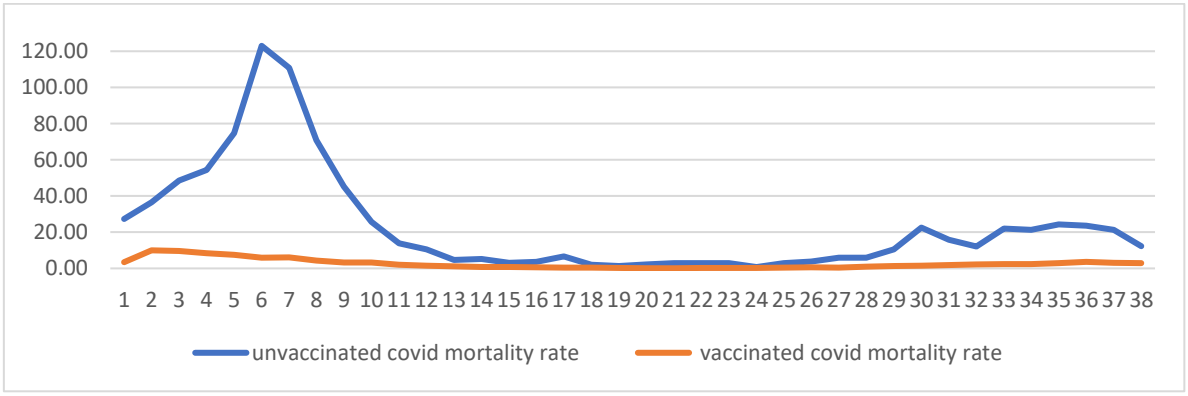

Figure 26: Covid mortality rate among unvaccinated and vaccinated for age group 70-79

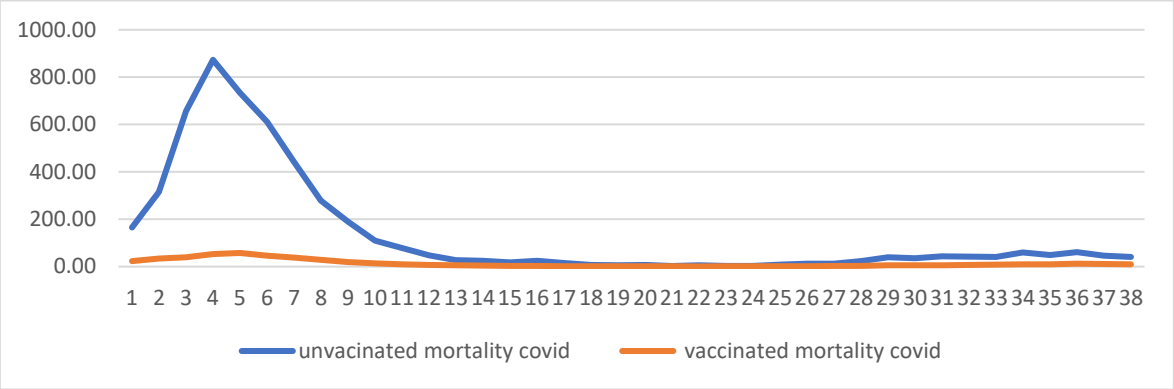

Figure 27: Covid mortality rate among unvaccinated and vaccinated for age group 80+

However, in interpreting these results it is important to avoid an overly simplistic understanding of the processes at play before and after vaccination. On the one hand, after vaccination the vaccinee is reported to endure a weakened immune response, [19], [21], for a period of up to 28 days [20] and may be in danger of infection from Covid or some other infectious agent at any time during that period [24]. On the other hand, infection prior to vaccination, where Covid remaining symptomless for a period of up to three days, might endanger the vaccinee after vaccination because vaccination is supposed to be prohibited for 3-4 weeks after contracting Covid. Both processes are shown in Figure 28.

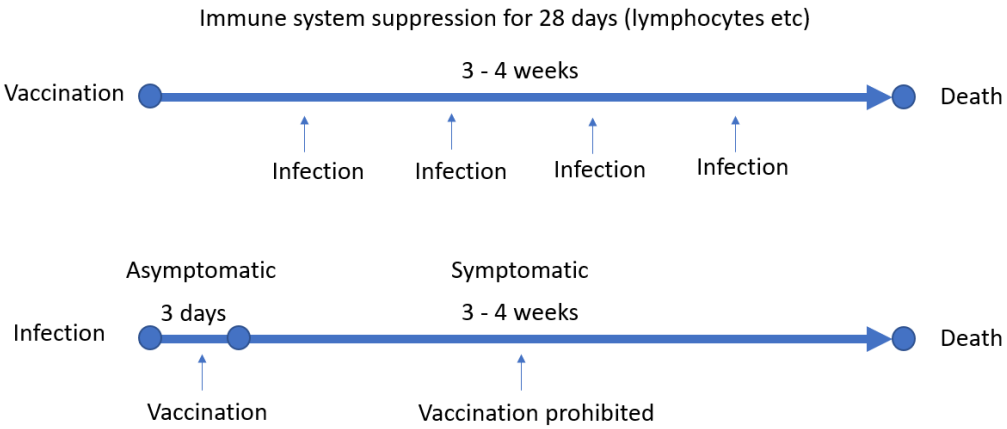

Figure 28: Infection and Vaccination processes

Given the fact that infection may cause death around three weeks after infection, it makes sense to examine *infection date* rather than *death registration date*. Our exploratory hypothesis is therefore that a three-week offset in the death data, where we offset Covid deaths in week, *t*, when they were registered, to week, *t-3*, when they were hypothetically infected would restore the correct temporal relationship between infection and death that underpins the reported data.

Figures 29 to 31 show this offset adjustment for the Covid mortality rate for both the vaccinated and unvaccinated, along with the percentage of that age group receiving the first and second doses of the vaccine (right hand side axis).

After the temporal offset adjustment, we can see a large spike in Covid mortality for all age groups during the early weeks, when Covid prevalence was higher, and when the first dose vaccination rollout peaked. After that early spike the Covid mortality rates for both the vaccinated and unvaccinated look indistinguishable from each other: as the summer months progressed there was little covid around

and hence little opportunity for vaccine protection. However, by late summer we can see a rise in covid mortality for both groups.

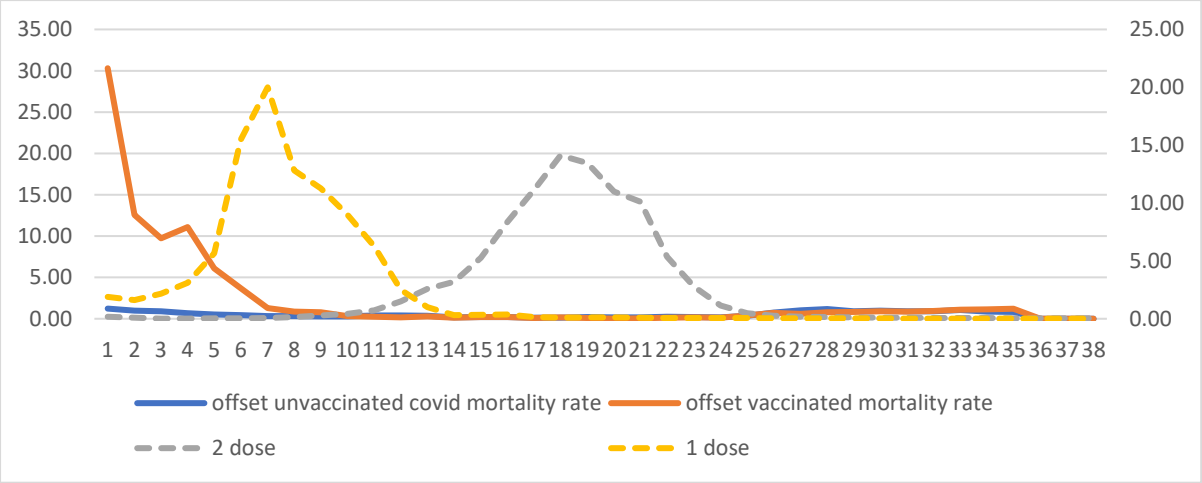

Figure 29: Offset Covid mortality rate in unvaccinated and vaccinated versus % of vaccinated for age group 60-69 (weeks 1-38, 2021)

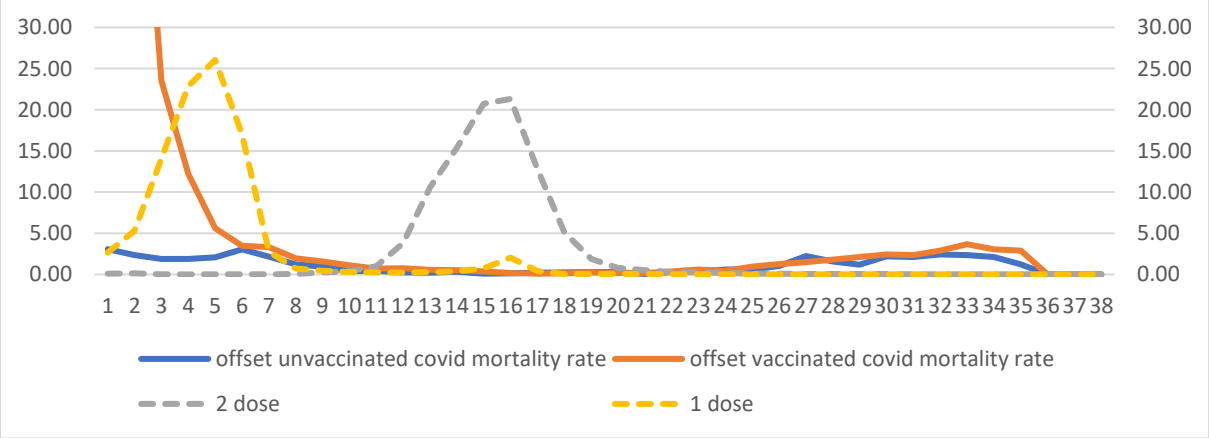

Figure 30: Offset covid mortality rate in unvaccinated and unvaccinated versus % of age group vaccinated for age group 70-79 (weeks 1-38, 2021)

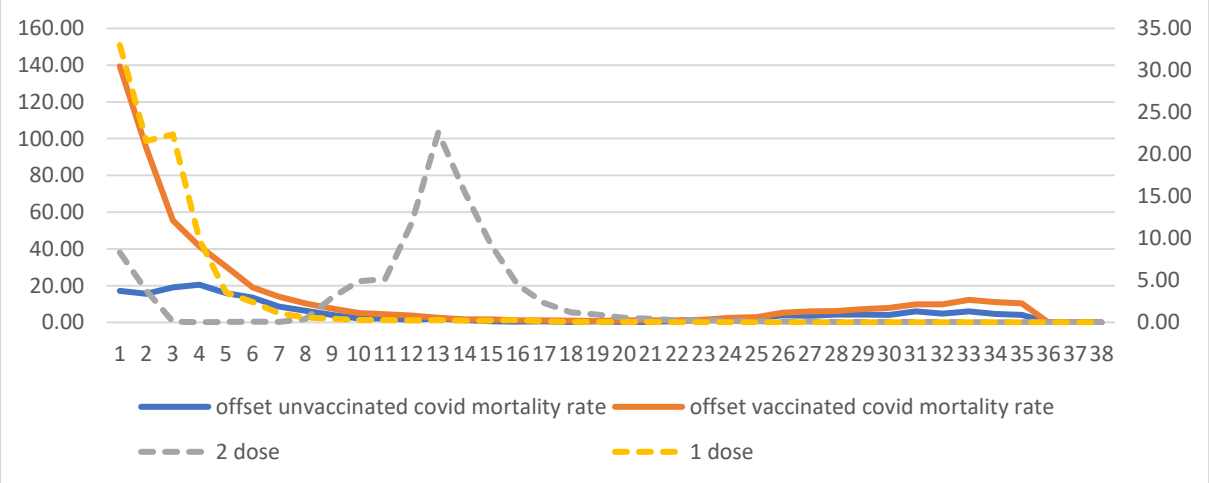

Figure 31: Offset Covid mortality rate in unvaccinated and unvaccinated versus % vaccinated for age group 80+ (weeks 1-38, 2021)

Hence, after our offset adjustment we observe no significant benefit of the vaccines in the short term. They appear to expose the vaccinee to an increased mortality, in line with what we know about immune exposure or pre-infection risks, but with no evidence of a sustained protective benefit accruing post second vaccination, as illustrated by Figure 32 where the vaccinated have higher offset Covid mortality than the unvaccinated up to week 35.

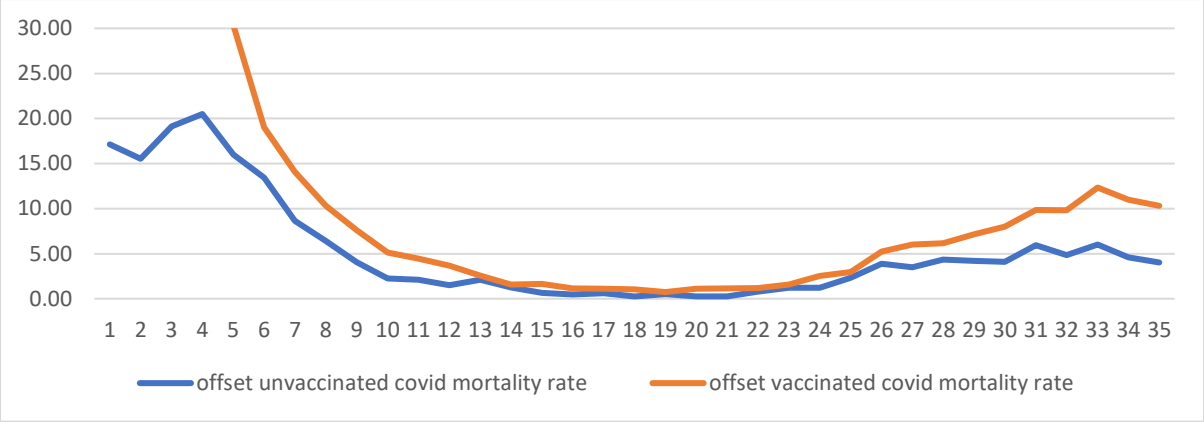

Figure 32: Offset Covid mortality rate in unvaccinated and unvaccinated for age group 80+ (weeks 1-35, 2021)

An excellent analogy for what we are observing is made in [15] where the challenge is to get from a foxhole to a bunker, which is protective against artillery but to get to the bunker you must cross a minefield where you are exposed to accurate and deadly sniper fire. The second vaccine is like the bunker, while those in the foxhole are like the unvaccinated; those who die when crossing the minefield are classified as fox-hole deaths.

8. Anomalies in population data

There is one further oddity in the November ONS data[5] that clearly compromises its reliability and accuracy. The ONS population data is defined in such a way that the total deaths per week and total loss of population should be the same each week. That is because the total maximum population is exactly the set of people registered in the 2011 census and who were also registered with a GP in 2019. This explicitly excludes the possibility for numbers changing due to emigration or immigration or indeed birth. Obviously, the populations move between age groups as people have birthdays, but overall, the total population in each week should be exactly equal to the total population in the preceding week minus the total number of deaths.

Figure 33 shows how total deaths and population change from weeks 1 to 37. The total number of deaths unaccounted for by the change in total population is around 10,000 per week until week 10 and positive until week 12. This should not be possible. Likewise, logically we might expect the total population change to be negative across the whole period but remarkably it is positive between weeks 8 to 10, suggesting population has somehow been added to the data set. From week 12 the decline is predictable and steady as expected but in the first three weeks the decline is much steeper before the period in which population is added back in. After week 12 the total change in population exactly matches the total deaths, as expected.

[5] We acknowledge Dr. Hans-Joachim Kremer for pointing out this anomaly

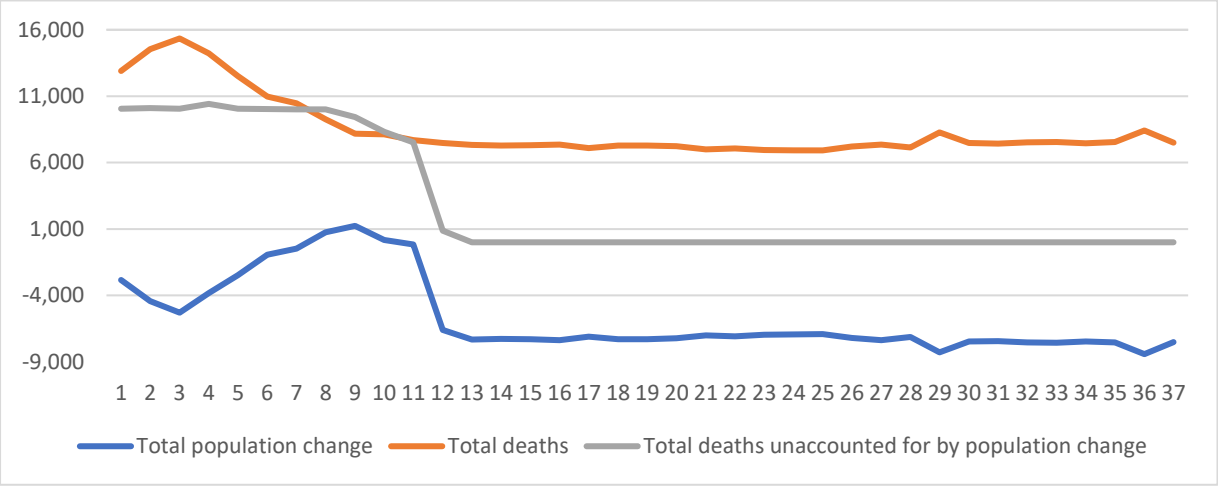

Figure 33: Total deaths, total population change and total deaths unaccounted for by total population change for all age groups (weeks 1-37, 2021)

This suggests something odd is going on up to week 11, during which a possible systematic bias is introduced, which is then 'recovered' by week 12 and the bias disappears thereafter. We cannot explain why this pattern exists, but it is clearly a concern.

9. Can demographics, behavioural or health factors explain the differences?

We have shown that miscategorisation can explain the strange phenomena in the ONS data. We have also shown that, these anomalies cannot be explained by terminally ill patients being denied vaccination unless the moribund population is not drawn from people classified as being very poor health. Moreover, there is no evidence this happened in the UK; on the contrary the evidence is that such patients were prioritised for vaccination. Other possible explanations have been suggested, including socio-demographic and behavioural differences between the two groups. Indeed, the ONS has claimed their data is trustworthy, given that there are, as yet hypothetical, but presumed plausible explanations for these differences [14], including:

- "If a more virulent strain is active for a particular period of the year, this can increase the mortality rates in this period."
- "… that after most people had been able to receive two doses, this group becomes atypical, with people being too ill to receive their second dose becoming over-represented".
- "…more vulnerable people and health and social care workers were vaccinated first, and as the vaccine rollout progressed, the group of people who had received one dose became more representative of the general population."

It has also been argued that there may be systematic self-selection for vaccination, whereby the healthiest people choose vaccination. As already noted, such self-selection bias could partly explain the lower non-Covid mortality rates in the vaccinated, but it would also mean that all the Government data would be systematically overestimating the effectiveness and safety of the vaccines. In any case, our adjustment based on the lifetable mortality figures would address this bias. In fact, there is no evidence of this self-selection bias happening in the UK; on the contrary, there is evidence that it is the healthier people or those who have natural immunity to the virus who are more likely to remain unvaccinated, which would make the ONS data even less reliable.

The above alternative explanations to miscategorisation are multivariate and involve very complex interactions and patterns. Thus far we have seen no evidence to support these explanations, nor do

we see how they can explain the unique pattern of findings we report, especially the temporally staggered pattern of deaths in each age group coincident with vaccine rollout.

Another possible explanation is that the differences are driven by ethnicity and deprivation, with the population separating into sub-groups where the unvaccinated contain a higher proportion of the deprived and ethnic minorities who might be less likely to be vaccinated for a variety of reasons. Fortunately, we can look to the ONS and their academic partners for data here [11] and ask whether deprivation and ethnicity are credible explanations.

From [11] we know vaccination take-up is high in white British, Indian, and Chinese populations and lower in those of Bangladeshi & Pakistani heritage and in the Black population. Jointly, this lower take-up group are only 5.4% of England's population and vaccination rates by August 2021 were somewhat lower across all age groups drawn from the Bangladeshi & Pakistani heritage and Black ethnicities, but not significantly lower.

There are approximately 39 million people in the ONS data set. Adopting the 5.4% figure above for minorities with lower take-up, this results in a total sub-population of approximately 1.9 million in this group. It is stated in [11] that between 65-85% of these ethnicities are vaccinated, so this is approximately 1.4m. Yet, the ONS data claims 7,637,511 people are unvaccinated. If only 1.4m of these might be minority ethnic who have declined the vaccine, it is too low a proportion to support any claim that ethnicity explains the differences.

We can also ask if the historical mortality of these ethnic minorities might explain the differences. Well, again, this is not supported by published data on life expectancies by ethnicity, [12], where we find that the life expectancies of these groups are at least as high, if not higher, than those of whites.

Finally, we examine deprivation. From [11] we find that the two most deprived groups are on average around 80% likely to be vaccinated. Approximately 40% of the population belong in these two deprivation groups, so in the ONS data we might expect approximately 15.6m deprived people and of these approximately 3m would be unvaccinated. Using the same logic as before, we know that in the ONS data 7,637,511 people are unvaccinated, hence, at most approximately 3m of these are deprived. Yet the ONS life expectancy statistics by deprivation show only an 8-year life expectancy difference [13]. Given that most of the deprived are actually vaccinated, this would surely negatively affect the life expectancy of the vaccinated group should it contain a disproportionate number of the deprived population (which it doesn't).

Of course, the above are rough calculations, but if the ONS and other commentators or policy makers wish to claim that social and demographic factors explain the striking mortality differences between these groups, they should release the data and present their case.

In summary, as there is no empirical evidence to support these various alternative explanations for the anomalies in the ONS data. We believe that the simpler hypotheses of different types of miscategorisation are more plausible.

10. Summary and Conclusions

The accuracy of any data purporting to show vaccine effectiveness or safety against a disease is critically dependent on the accurate measurement of: people classified as having the disease; vaccination status; death reporting; and the population of vaccinated and unvaccinated (the so called 'denominators'). If there are errors in any of these, claims of effectiveness or safety are unreliable.

The risk/benefit of Covid vaccines is best – and most simply - measured by all-cause mortality of vaccinated against unvaccinated, since it avoids the thorny issue of what constitutes a Covid

'case/infection'. In principle, the data in the ONS vaccine mortality surveillance reports should provide us with the necessary information to monitor this crucial comparison over time. However, until the ONS released its November report [7], no age categorized data were provided, meaning that any comparisons were confounded by age (older people are both disproportionately more vaccinated than younger people and disproportionately more likely to die).

The week 44 ONS report and data release from November [3] finally provided some relevant age categorised data. Specifically, it includes separate data for age groups 60-69, 70-79 and 80+, but there is only a single group of data for the age group 10-59. After the November data release the ONS released further data on December 20th 2021 [25], albeit at a significant lower level of granularity that inhibits cross comparison with earlier data (different age categories; monthly rather than weekly data; age-adjusted mortality rather than raw death and population data; death counts updated; and fractional membership of vaccination category based on time spent in category) and with different categories for vaccine status than those used in November (five categories rather than four with double dose vaccinated split into less than and greater than 21 days).

At first glance the data suggest that, in each of the older age groups, all-cause mortality is lower in the vaccinated than the unvaccinated. In the 10-59 age group all-cause mortality is higher among the vaccinated, but this group is likely confounded by age since it is far too wide for the data provided to be sufficient to draw any firm conclusions.

However, despite this apparent evidence to support vaccine effectiveness for the older age groups, on closer inspection this conclusion is cast into doubt. That is because we have shown a range of fundamental inconsistencies and flaws in the data. Specifically:

- In each group the non-Covid mortality rates in the three different categories of vaccinated people fluctuate in a wild, but consistent way, far removed from the expected historical mortality rates.
- Whereas the non-Covid mortality rate for the unvaccinated should be consistent with historical mortality rates (and if anything, slightly lower than the vaccinated non-Covid mortality rate), it is not only higher than the vaccinated mortality rate, but it is far higher than the historical mortality rate.
- In previous years, each of the 60-69, 70-79 and 80+ groups have mortality peaks at the same time during the year (including 2020 when all suffered the April Covid peak at the same time). Yet in 2021 each age group has non-Covid mortality peaks for the unvaccinated at a different time, namely the time that vaccination rollout programmes for those cohorts reach a peak.
- The peaks in the Covid mortality data for the unvaccinated are inconsistent with the actual Covid wave.
- There are sufficiently serious anomalies in the population and very poor health category data to suggest the data are unreliable.

Whatever the explanations for the anomalies, it is clear that the data is unreliable and conclusions regarding vaccine efficacy specious. Likewise, given the ONS's suggestion in its December report [25] that the anomalies are the result of vaccinations being denied to moribund or terminally ill patients, or that there is a healthy vaccinee effect, we tested this hypothesis and found it was not plausible. The onus is now on those who propose this explanation to demonstrate empirically how it works. We considered the socio-demographic and behavioural differences between vaccinated and unvaccinated that have been proposed as possible explanations for the anomalies but found no evidence supporting any of these explanations. By Occam's razor we believe the most likely explanations are:

- Systematic miscategorisation of deaths between the different groups of unvaccinated and vaccinated.

- Delayed or non-reporting of vaccinations.
- Systematic underestimation of the proportion of unvaccinated.
- Incorrect population selection for Covid deaths.

With these considerations in mind, we applied adjustments to the ONS data and showed that they lead to the conclusion that the vaccines do not reduce all-cause mortality, but rather produce genuine spikes in all-cause mortality shortly after vaccination.

There are, of course, some caveats to our analysis. While we have completely ignored the 10-59 age group because it is far too broad so age confounding would likely overwhelm any conclusions, the age groups 60-69, 70-79, 80+ are themselves quite coarse, and there may be some age confounding within these age groups. For example, the average age of the vaccinated 60-69 age group may be higher than that of the unvaccinated 60-69 group and hence the number of deaths would naturally be slightly higher.

We have deliberately chosen not to subject the data to a degree of sophisticated statistical or probabilistic modelling but can readily imagine what might be done. We have carried out some basic computations of confidence intervals to address the fact that at various points the population sizes differ dramatically, and from this the patterns reported remain visible, significant and our analysis credible.

Ultimately, our analysis is hypothetical insofar as it presents two processes, one based on the risk presented by the period before/after vaccination and infection and one based on categorisation, both of which might better explain the patterns in the data. However, we believe it is up to those who offer competing explanations to explain how and why the data is the way it is. We have explained that various social and ethnic factors are very unlikely to explain these odd differences in the ONS data set. Same with the moribund/healthy vaccinee effect. Absent any other better explanation, Occam's razor would support our conclusions. In any event, the ONS data provide no reliable evidence that the vaccine reduces all-cause mortality.

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Appendix: Moribund Hypothesis Model

We discuss here a theoretical model of what we refer to as the 'moribund' hypothesis, in which those close to death are identified as being in a moribund state and are therefore not vaccinated.

In the population as a whole (all vaccinated and unvaccinated categories combined), the makeup of the healthy and moribund sub-populations is dynamic, with people moving from 'healthy' to a moribund state and then death over time. If that were not the case, we would have the strange situation of a population that became, on average, ever healthier over time as the moribund died off but were not replaced, while the healthy survived.

In our model, each week a proportion of previously healthy people become moribund, and a proportion of the current moribund population die. Categorisation as moribund is a mathematically terminal category in the sense that, once someone enters this category, they cannot leave, except by death. The model uses two simple parameters:

- Moribund transition rate: This is the rate at which people enter the moribund state.
- Moribund mortality rate: Given that someone is categorised as moribund, this is the probability of death each week.

To simulate the healthy-vaccinee/moribund hypothesis, in which those close to death are not vaccinated, or not given a second dose if they have already received a first, we include the following rule: once someone has become moribund, they cannot leave their current vaccination category. A moribund unvaccinated person cannot move into a vaccinated category and a moribund first dose recipient cannot move on to second dose. A moribund person remains in the vaccination category in which they became moribund, leaving it only when they die.

To fit the ONS data using this moribund model the following assumptions are necessary:

- For all three age groups the moribund transition rate would have to be approximately equal to the overall average non-Covid mortality rate, calculated from the data and as mentioned above. We must therefore believe that virtually all the unvaccinated who die do so after entering an identifiable critically ill condition where death is supposedly imminent, and vaccination is then either not offered or declined. While this may have been true in some cases, it is hard to believe that this could accurately characterise virtually all the unvaccinated deaths during this period (and similarly for first dose recipients at the time of dose two rollout).

- The moribund mortality rate required to closely fit the observed data would be 25% for the unvaccinated (20% for the single dose vaccinated), with an average time to death of 4 weeks, but with a significant proportion of people lasting up to 16 weeks before death (during which they continue either not to be offered or to refuse vaccination). This does not suggest that deaths are imminent, and it assumes a high level of clinical prescience about the likelihood of death that may be very implausible.

- The moribund mortality rate needed to force the best estimates would need to be identical across each age group, where the probability of death was independent of age. This is just not credible.

Thus, the moribund hypothesis has the appearance of credibility, but requires highly implausible assumptions to fit the reported data. To support the model fit, virtually all deaths must be anticipated

in advance and people categorised as moribund with near perfect prescience. Likewise, a 25% moribund mortality rate is equivalent to an average time to death of four weeks, with 90% of deaths occurring within two months and 99% of deaths occurring within 4 months. Is it plausible that the death of an individual could be anticipated up to four months ahead with such high reliability? Is it reasonable to believe that these moribund people would not be offered, or would refuse if offered, the opportunity to receive a vaccine - and that this would remain the case even if they survived for many weeks? Also, is it truly feasible that, once a person is in a moribund state, the average time to death is the same irrespective of age, across all the age cohorts examined here (60-69, 70-79, 80+)?

Figures 34 to 36 show the estimates produced by these implausible assumptions in the moribund model compared with the observed data, for the unvaccinated. A similar result (not shown) occurs with the single dose vaccinated (greater than 21 days) group during the rollout of the second dose.

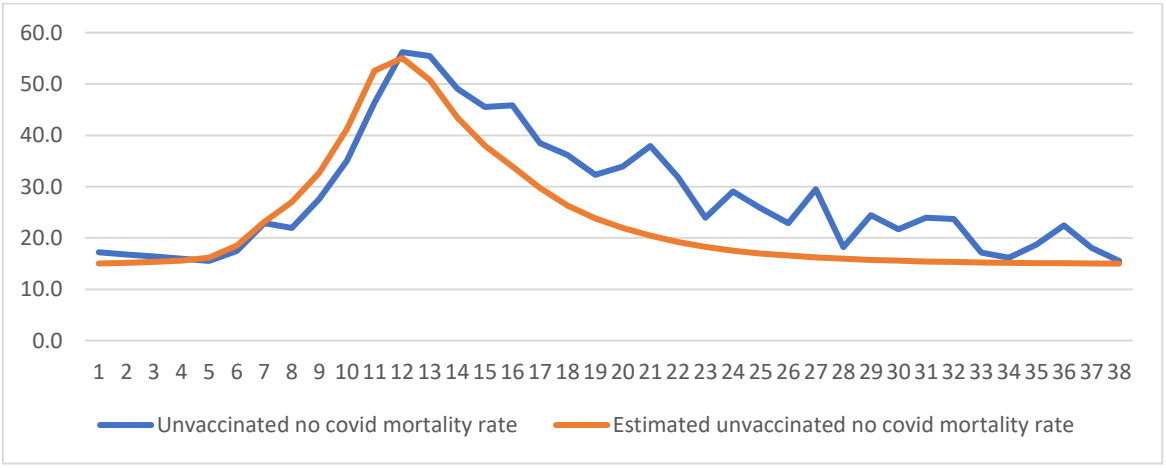

Figure 34: Non-Covid unvaccinated mortality rate in 60-69 age group and moribund model estimate (weeks 1-38, 2021)

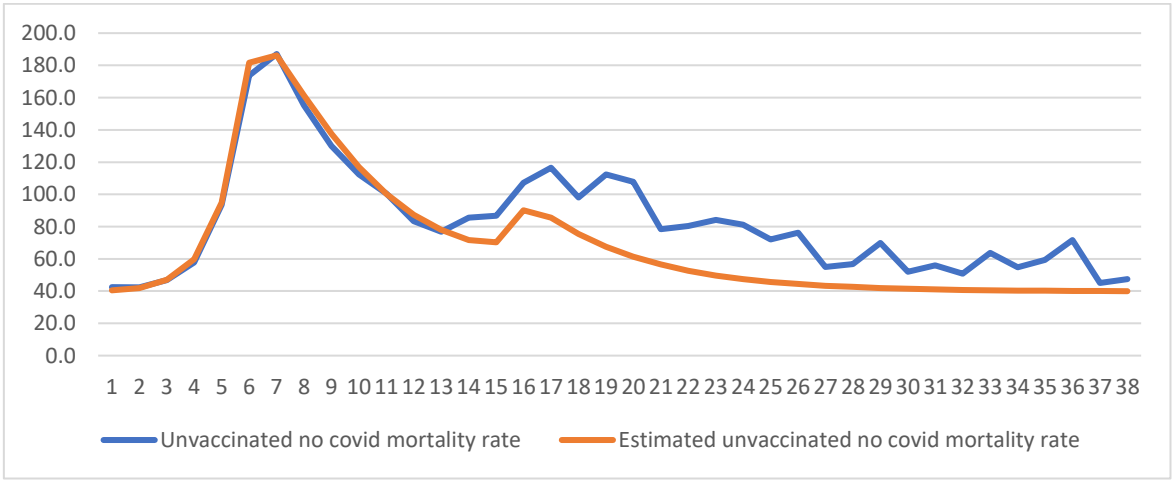

Figure 35: Non-Covid unvaccinated mortality rate in 70-79 age group and moribund model estimate (weeks 1-38, 2021)

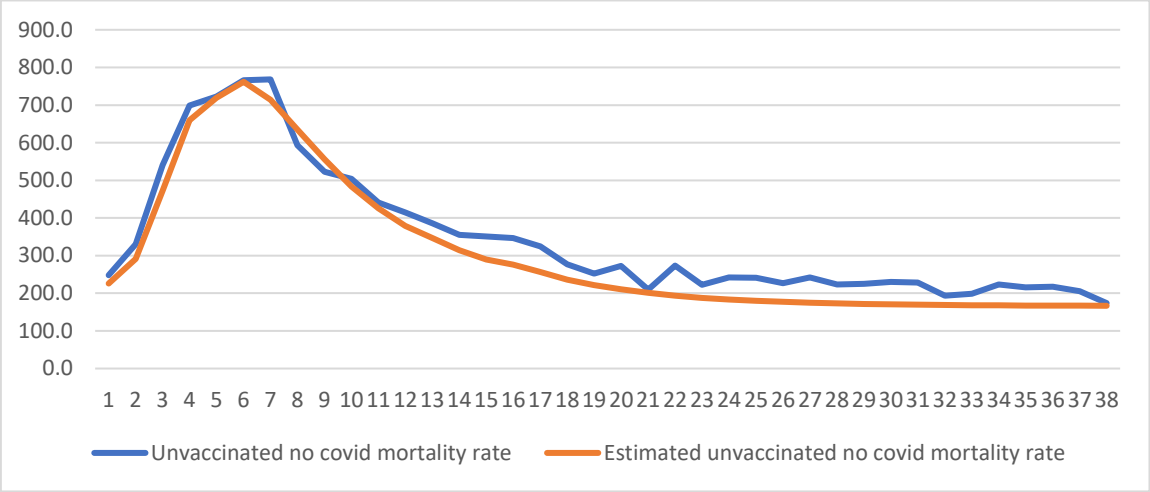

Figure 36: Non-Covid unvaccinated mortality rate in 80+ age group and moribund model estimate (weeks 1-38, 2021)

Our moribund model is intended to assess whether the healthy vaccinee effect could hypothetically account for the reported data. We showed that it could but only by the application of assumptions that are highly implausible. It is perhaps worth noting that, mathematically, there are other phenomena (e.g., temporal offsets) that would give the same results as a moribund hypothesis. In any case the empirical data on very poor health analysed in Section 7 is sufficient to undermine the moribund / healthy vaccinee hypothesis without this theoretical analysis.

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