UK - Death and Disability Trends for Malignant Neoplasms, Ages 15-44

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UK - Death and Disability Trends for Malignant Neoplasms, Ages 15-44

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ABSTRACT

In this study we investigate the UK trends in death rates and disabilities for malignant neoplasms for individuals aged 15 to 44 by computing excess death rates and excess disability claims, which are the difference between observed death/disability rates and a given baseline for expected death/disability rates. We measure changes in the behaviors of morbidity and mortality before the Covid-19 pandemic with the post-pandemic period, for malignant neoplasms.

We show a large increase in morbidity (disabilities) and mortality due to malignant neoplasms that started in 2021 and accelerated substantially in 2022. The increase in disability claims mirrors the increase in excess deaths in 2022, and both are highly statistically significant (extreme events). The results indicate that from late 2021 a novel phenomenon leading to increased malignant neoplasm deaths and disabilities appears to be present in individuals aged 15 to 44 in the UK.

Keywords: malignant neoplasms, excess mortality, disability claims, UK trends

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1 INTRODUCTION

Beginning in early 2020, the world changed due to the emergence of a global pandemic caused by the SARS-CoV-2 virus which, in some individuals, manifested in the form of Covid-19 viral disease. A short-term increase in mortality rates was anticipated due to the impact of this novel virus. However, excess mortality has continued in many countries. Various possible explanations have been proposed for this, including lasting effects of the virus, lockdowns and the resulting impact on healthcare delivery, and adverse effects of the new vaccines, some of which are based on newly implemented mRNA technology.

In order to establish the possible causation of the mRNA vaccinations with the onset of rapid cancer development, some scientists focus on animal studies, such as reported by (Eens, et al., 2023)[1]. These studies do not prove direct causation between the novel mRNA vaccinations and the onset of cancer as they are usually based on small samples and are aimed only at showing possible mechanisms of action (for example, the previous study was performed on 1 mouse, with a very large dosage). However, the reporting of case studies of rapid growth malignant neoplasms in humans following Covid-19 vaccine administration can be found in the medical literature. Such examples include cases of haematologic malignancies following administration of the mRNA Covid-19 vaccine produced by Pfizer-BioNTech: A diffuse large B-cell lymphoma and NK/T-cell lymphoma (Zamfir, et al., 2022) [2]; a rapid progression B-cell lymphoma (Sekizawa, et al., 2022)[3]; two similar reports from (Mizutani, et al., 2022)[4] and another one by (Goldman, et al., 2021)[5]; and also a subcutaneous panniculitis-like T-cell lymphoma following an adenovirus type 26 (Ad26) viral vector–based Covid-19 vaccination produced by Janssen Pharmaceuticals (Kreher, et al., 2022) [6].

Additional evidence that points towards a possible relationship between the novel Covid-19 vaccinations and the development of malignant neoplasms are not available in the form of population-based studies where vaccinated and unvaccinated individuals are compared. However, in section 4.10 of their draft paper, (Wiseman, et al., 2023)[7] the authors show that cancer reports following the Covid-19 vaccinations are more numerous than for all previous vaccines combined since 1990, when querying the VAERS[1] (Vaccine Adverse Events Recording System)from the CDC (Center for Disease Control and Prevention).

In this context, we performed several analyses showing excess mortality (all cause) since 2020, from Europe to the US. We published a methodology report to explain our estimates for excess mortality (Alegria et al., 2024)[8], which is based on measuring excess death rates instead of excess deaths. By accurately measuring, and then tracking, excess mortality trends, we can have a clearer picture of the implications of the different stages of the Covid-19 pandemic, as mentioned above.

The focus of this study is not to examine individual claims and anecdotes, but instead to provide a statistical analysis at a population level. Our analysis offers insight for health professionals regarding current trends in population health and uncovers relationships between these trends and the significant events of the past few years.

2 DATA

2.1 Cause of Death Data

The data used in this analysis is the number of deaths that occurred in England and Wales between 2010 and 2022, by underlying cause code (ICD-10), sex, and age group (up to 90+). The source is the UK Office for National Statistics (ONS). The direct links to the mortality data by cause for 2010 to 2021 and 2022 are listed below:

Death occurrences by sex, five year age group and underlying cause (ICD-10 code) England and Wales: 2022 - Office for National Statistics (ons.gov.uk)
(link to the 2022 data source)
(direct link to download the source file).

[1] https://wonder.cdc.gov/vaers.html

Death occurrences by sex, five year age group and underlying cause (ICD-10 code) England and Wales: 2010 to 2021 - Office for National Statistics (ons.gov.uk)
(link to the 2010-2021 data source)
(direct link to download the source file).

2.2 Registered Deaths (All Deaths)

Registered deaths are all the deaths registered in England and Wales, independently of whether a cause of death has been attributed. The investigation of deaths and attribution of ICD-10 codes with a cause of death can take up to 2 years to be performed.

UK Monthly Registered Deaths (All Cause): Deaths registered monthly in England and Wales - Office for National Statistics (ons.gov.uk) (link to the source).

2.3 Disability Claims

For investigating the changes in disability claims, we use data from the Personal Independence Payment (PIP) system of the Department for Work and Pensions (DWP). We analyze changes in PIP clearances for new claims to the system, as explained in our previous analysis, published on Phinance Technologies website[2].

Source for PIP data (from DWP): Personal Independence Payment statistics April 2013 to January 2023 (link).

Stat-Xplore system for DWP databases: (link).

3 METHODOLOGY

In this study, we investigate the trends in death rates and disability claims for the selected cause: malignant neoplasm (or oncologic causes for PIP disability claims). We investigate these trends using yearly data and therefore we do not have to perform a seasonal adjustment to the data.

[2] Phinance Technologies - Humanity Projects - Analysis of UK New Claims for Personal Independence Pension (PIP) by Body System.

In general terms, to measure trends in these variables we use a methodology of computing excess rates, which is the difference between the actual observed rates and a given baseline (expected rates). Because we want to measure the impact of the Covid-19 pandemic and post-pandemic periods relative to the prior state of the world, our baselines are based upon the estimation of the trend for a period prior to the pandemic.

In this study we will use method 2C, as described in our report on methodologies for measuring excess deaths in the population (Alegria C., et al., 2024)[8]. Method 2C is based on computing the trends in death rates (deaths adjusted by the population) instead of deaths, as the baseline for estimating excess mortality. This method significantly reduces the noise of the estimation as it adjusts for population growth or decline, and by also providing different rates for each age category, we adjust for changes in population age distribution. The method also considers the prior trend in death rates, which tend to decline over time as the population grows healthier and different risk factors are better managed.

3.1 Method 2C for Estimating Excess Death Rates

$$\begin{bmatrix} Excess \\ Deaths \end{bmatrix}_{t_i}^{AG} = Deaths_{t_i}^{AG} - Baseline_{t_i}^{AG} \quad (1)$$

Equation 1 is a general expression for estimating the excess absence rates relative to a given baseline. We use the superscript AG to indicate a given population age range, as this is the primary focus of the current analysis. Other cohorts which this equation could apply to include a specific region, sex, or underlying cause of death. The subscript t_i refers to time, that is, the corresponding year for which the excess deaths are computed.

For estimating the baseline for "normal or expected" death rates we use a simple linear fit:

$$Baseline(t_i) = \hat{b} + \hat{a}(t_i - t_0) \quad (2)$$

Where $\hat{a}$ and $\hat{b}$ are the estimated coefficients of the death rate trendline from 2010 to 2019. It should be noted that for the UK disability data (Personal Independence Payment (PIP) system) the estimation period we use is from 2016 to 2019. The data before 2016 is unreliable due to the transition from the prior system of Disability Living Allowance (DLA) to the PIP system in 2013, which only stabilized after 2015.

3.2 ICD-10 Code List of Selected Causes of Death for: Malignant Neoplasms

For this analysis we selected all the ICD-10 codes from category C, namely C00 to C99 which refer to deaths attributed to malignant neoplasms. It should be noted that ICD-10 codes C98 and C99 were not used in the ONS cause of death datasets and consequently, ICD-10 codes C00-C97 or C00-C99 are equivalent and will be used interchangeably throughout this report. Some ICD-10 codes, such as C27 with the generic description of "Malignant neoplasms" refer to ICD-10 codes that were not used in the UK from 2010 to 2022.

The detailed list that was extracted from the ONS cause of death database shows the codes and description that were aggregated for the purpose of our analysis. The list is shown in Annex 7.

4 YEARLY ANALYSIS OF TRENDS IN DEATH RATES FOR AGE GROUP 15-44

In this section we perform a yearly analysis of the death rates for England and Wales, using the ONS cause of death data. In this analysis we use the 2010-2019 trend in death per 100,000 (death rates) as the baseline estimate for excess death rates. Excess death rates for the 2010-2019 period are in-sample while the rates for 2020, 2021, and 2022 are out of sample computations.

The analysis is performed for all the deaths from a range of underlying causes of death, as described by the list of ICD-10 codes in section 3.2, which refer to all deaths from malignant neoplasms.

Our analysis is structured in multiple layers due to the available data on the cause of deaths for the UK being incomplete. Consequently, we first need to investigate the overall degree of missing data in the ONS cause of death databases, which is performed in section 4.1.

Secondly, in order to have a reference for comparison, we investigate trends in registered deaths, which are deaths from any cause that occurred in England and Wales, for the 15 to 44 age group. This analysis is performed in section 4.2.

In section 4.3 we analyze trends in death rates from malignant neoplasms without performing an adjustment to the data that corrects for the missing records in the ONS cause of death datasets. The missing records are due to delays in the attribution of death certificates, which is particularly noticeable in younger individuals. By excluding deaths without a known cause of death, this analysis provides a lower limit for excess mortality trends due to malignant neoplasms.

In section 4.4 we analyze the trends in adjusted death rates, where deaths are scaled proportionally according to the estimated amount of missing records in the ONS cause of deaths datasets.

Finally, section 4.5 investigates trends in the fraction of malignant neoplasm deaths by deaths from all causes in the ONS cause of death databases. This analysis is another way of correcting for the missing records in the data and shows the growth or fall of malignant neoplasm deaths relative to all other causes.

4.1 Deaths for All Causes Versus Registered Deaths

When analyzing the ONS data for cause of death we noticed that there are discrepancies between the number of deaths which have a cause of death and the number of registered deaths for a year. This is particularly striking for the case of deaths in 2022 (the most recent year) and for younger individuals,

where there are significant discrepancies between both these datasets.

The reason for the discrepancy is that death certificates for younger individuals take longer to produce as each many of these deaths are thoroughly examined and, on many occasions, post-mortems need to be performed. For older individuals, the discrepancies are small. In this report we only investigate deaths for individuals aged from 15 to 44. For this age group, we show the differences between registered deaths and all the known causes of deaths in Figure 1.

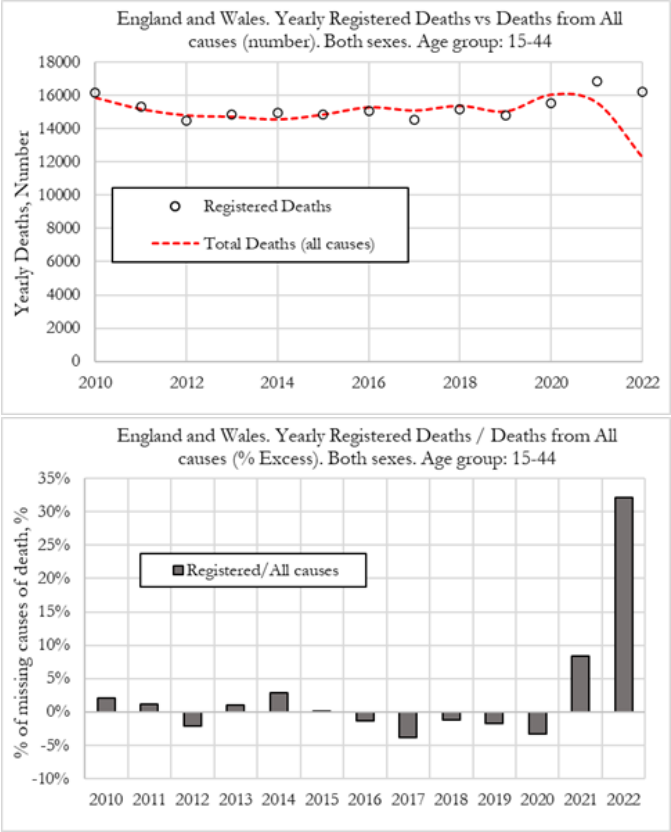

Figure 1. England and Wales, registered deaths versus deaths from all causes in the ONS deaths by cause data table for age group 15 to 44. Top: Yearly numbers. Bottom: Percentage of missing cause of death relative to registered deaths.

We can observe that the discrepancy between registered deaths and the sum of all deaths by cause ranges between -3% to +3% from 2010 to 2020. We consider these normal discrepancies between these databases as there are many factors that could lead to these discrepancies, including if the deaths occurred within England and Wales or abroad, or if the individuals were only temporarily staying in England and Wales.

For 2021, however, we observe about 8% more registered deaths than the sum of the deaths from all causes. In 2022, there are still about 32% of registered deaths without a final cause of death. This is a large discrepancy that needs to be corrected (Office for National Statistics (ONS), UK) [9].

To correct for the discrepancies in registered deaths compared to deaths from all causes, we scale the deaths for each ICD-10 code by the ratio $R = (registered/allcausedeaths)$. This adjustment is significant for 2022 and assumes that the proportion of deaths from the different ICD-10 codes will remain the same after the final figures are published in 1 or 2 years. This may not be the case and, therefore, the results need to be taken with a degree of caution. In particular, deaths from drug-related causes and suicide can have delayed reporting[3].

In summary, to estimate the trends in death rates for different causes, we use Adjusted Deaths (Adjdeaths) which refers to the deaths from a particular cause or range of causes adjusted by the ratio defined above. Adjusted death rates are computed based on adjusted deaths. We also analyze the trends in unadjusted deaths, that do not take account of the missing data. This analysis is obviously incorrect as it assumes that no further deaths in 2021 and 2022 will be attributed to malignant neoplasms once the cause of death is established. Nevertheless, this is useful as it provides a lower limit when observing trends in excess mortality for these particular ICD-10 codes. The final data, when it is released by the ONS, is likely to fall in between the analysis of unadjusted deaths and the adjusted deaths using the proportional adjustment method described above.

[3] ONS - Impact of registration delays on mortality statistics in England and Wales: 2021

4.2 Trends in death rates for registered deaths (all-cause)

The analysis of the registered deaths allows us to have a context by which we can then compare the death rates for malignant neoplasms. Figure 2 shows the death rate per 100,000 individuals for all registered deaths in England and Wales from 2010 to 2022. We can observe that registered deaths per year had been trending slightly lower from 2010 to 2019.

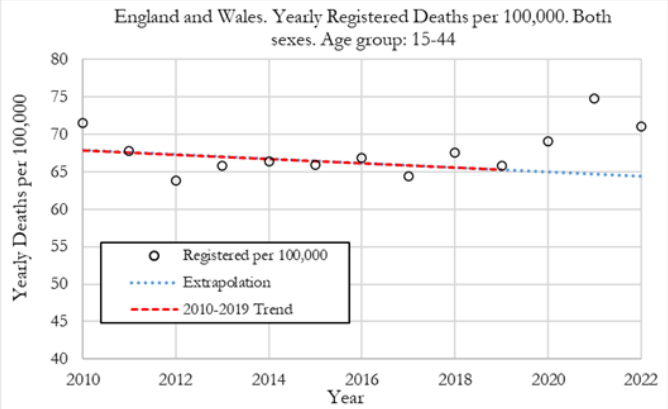

Figure 2. Yearly registered deaths per 100,000 for England and Wales. The red dashed line shows the average from 2010 to 2019. The dotted line shows the extrapolation of the trend from 2020 until 2022.

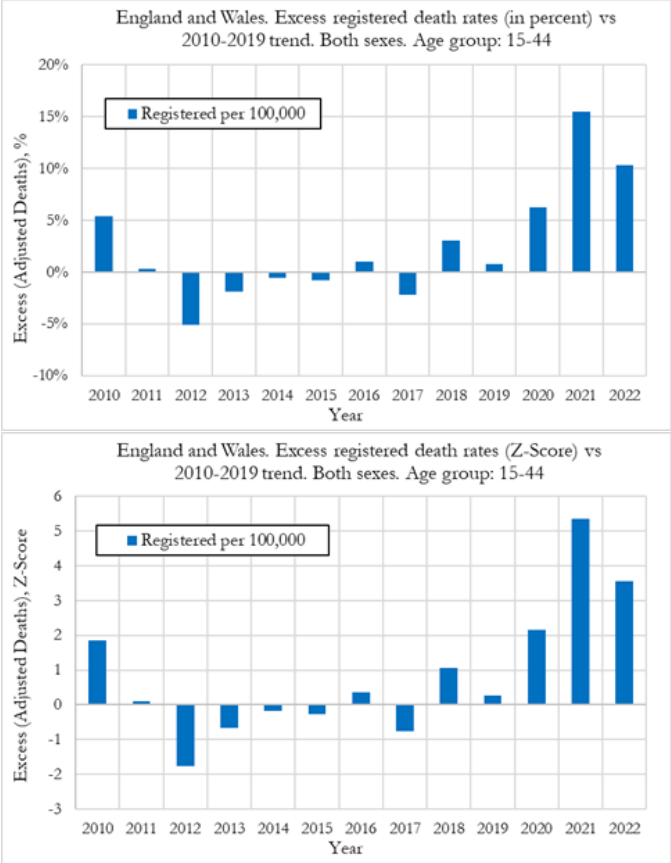

Figure 3. Excess registered death rates in England and Wales for both sexes with ages 15 to 44. Top: Relative deviation from trend, percent. Bottom: Deviation from trend Z-Score.

In 2019, the death rate was about 67 per 100,000 individuals aged 15 to 44. The death rate increased in 2020 to about 69 per 100,000 and then again in 2021 to 75 per 100,000. In 2022 the death rate dropped slightly to about 71 per 100,000, the same level as observed in 2010 and still above the 2020 level.

4.2.1 Excess registered death rates

Figure 3 shows the excess death rate for registered deaths (all-cause) in England and Wales from 2010 to 2022. Figure 3 (top) refers to relative deviations from the 2010-2019 trend, while Figure 3 (bottom) shows the Z-score (signal strength) for the deviations from trend.

Figure 3 shows that excess deaths in 2020 were around 7%, with a Z-score of 2.1. These values indicate some level of statistical significance, which could imply that the 15-44 age group suffered a small level of excess mortality in 2020. In 2021 excess deaths jumped to around 15% with a Z-score above 5 indicating very high statistical significance. Excess deaths in 2022 were about 10% with a Z-score of about 3.5 indicating high statistical significance. Excess death levels remained abnormally high in 2022, especially if one considers that the Covid-19 variants were successively milder.

The pattern of all-cause mortality shown in Figure 3 will provide an interesting baseline for comparing deaths from malignant neoplasms.

4.3 Trends in unadjusted death rates from Malignant Neoplasms (C00-C99)

The first analysis that we perform is the analysis of the unadjusted (raw) deaths from malignant neoplasms. Before starting the analysis, it needs to be reiterated that as mentioned in section 4.1, there are a significant number of missing records for causes of death relative to registered deaths in 2021 and 2022. This is particularly the case for younger individuals, whose deaths are more likely to require investigation to understand the underlying causes.

4.3.1 Unadjusted death rates (raw data)

In section 4.1 we observed that for the 15-44 age group, there are about 8.3% of missing records in 2021 in the ONS cause of death dataset, and 32% for 2022. The missing records for 2022 are about a third, which means that when analyzing the raw numbers of deaths (without adjustment) for malignant neoplasms, they will likely under-report actual deaths by that amount.

With these caveats in mind, Figure 4 shows the number of deaths (right) and death rate per 100,000 individuals (left) for malignant neoplasms in England and Wales from 2010 to 2022, as provided by the original data sources. Even with a large number of missing records, we can already observe a clear signal in above-trend malignant neoplasm deaths in both 2021 and 2022.

4.3.2 Excess unadjusted death rates

Figure 5 shows the excess death rate for unadjusted deaths from malignant neoplasms in England and Wales from 2010 to 2022. Figure 5 (top) refers to relative deviations from the 2010-2019 trend, while Figure 5 (bottom) shows the Z-score (signal strength) for the deviations from trend.

The results show that there is no noticeable signal pointing to abnormal excess death rates from malignant neoplasms from 2010 to 2021 (with Z-scores ranging from -1.5 to +1.5). However, in 2022, excess deaths from malignant neoplasms were about 4.3% with a correspondent Z-score of about 3, representing a very strong signal in spite of the 32% of

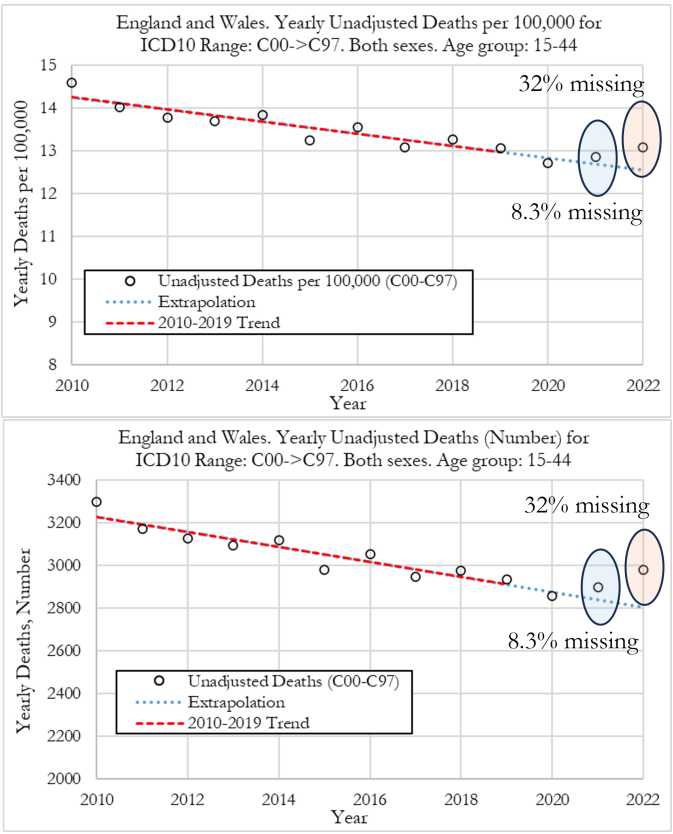

Figure 4. Yearly unadjusted (raw) deaths from malignant neoplasms in England and Wales, with missing datapoints in 2021 and 2022. The red dashed line shows the average from 2010 to 2019. The dotted line shows the extrapolation of the trend from 2020 until 2022. Top: Deaths per 100,000. Bottom: Deaths (number).

missing data points. Once the remaining registered deaths have their cause attributed, this signal is likely to be even stronger.

4.4 Trends in adjusted death rates from Malignant Neoplasms (C00-C99)

In this section we investigate the trends in adjusted death rates in England and Wales for the 15-44 age group. We also compare all-cause mortality (registered deaths) with adjusted deaths from malignant neoplasms. The adjustment to the deaths rates was performed using the methodology described in section 4.1, that is, by scaling causes of deaths proportionally.

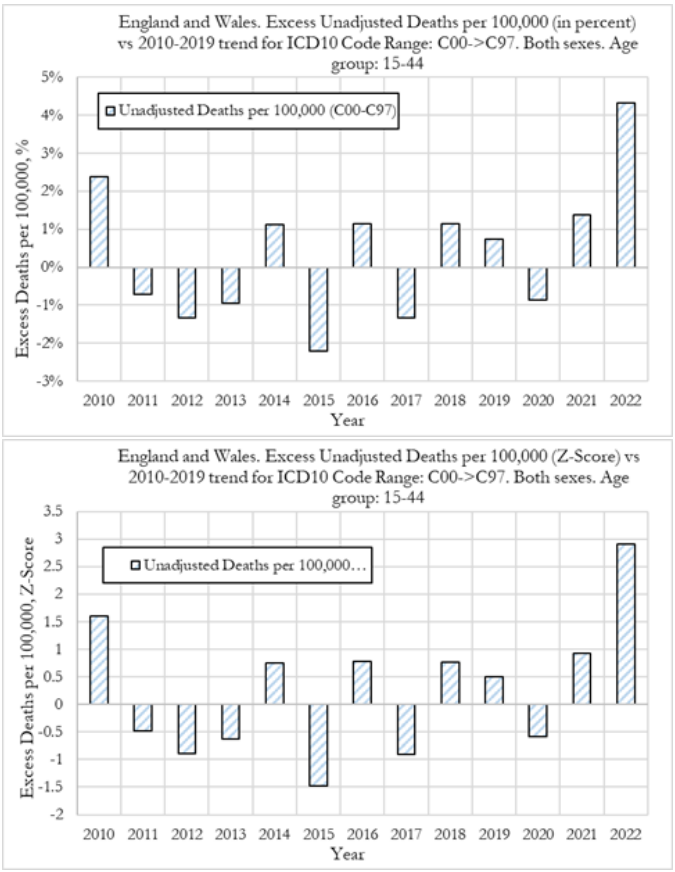

Figure 5. Excess unadjusted death rates for diseases by malignant neoplasms in England and Wales. Top: Relative deviation from trend, percent. Bottom: Deviation from trend Z-Score.

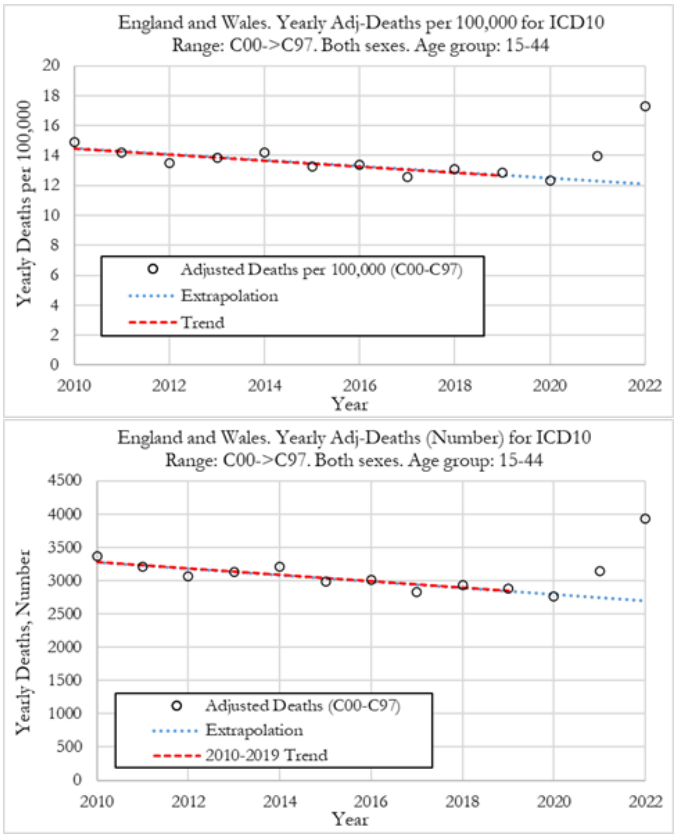

Figure 6. Yearly adjusted deaths for diseases by malignant neoplasms in England and Wales. The red dashed line shows the average from 2010 to 2019. The dotted line shows the extrapolation of the trend from 2020 until 2022. Top: Adj-Deaths per 100,000. Bottom: Adj-Deaths (Number).

4.4.1 Adjusted death rates

Figure 6 (top) shows the death rate per 100,000 individuals for malignant neoplasms deaths (adjusted for under-reporting) in England and Wales from 2010 to 2022. We can observe that deaths per year from malignant neoplasms have been trending lower from 2010 to 2019, with a significant downward slope. In 2010 the death rate was 15 per 100,000 and in 2019 it was around 12.8 per 100,000, a 14.7% drop.

The adjusted death rate dropped further in 2020 to about 12.5 per 100,000. In 2021 the adjusted death rate rose to 14 per 100,000 and in 2022 the death rate increased again to about 17.5 per 100,000, a level that is 11.7% higher than observed in 2010. The death rate in 2022 was about 4.7 deaths per 100,000 above the 2015-2019 average.

When translating these numbers into the absolute number of deaths from malignant neoplasms, shown in Figure 6 (bottom), we can observe that the 5-year average deaths from 2015 to 2019 was about 3,000 deaths. In 2020, malignant neoplasm deaths were about 2,800, 200 less than the prior 5-year average. In 2021 there were about 3200 deaths, which was 200 more than the 2015-2019 average. In 2022, the number increased to 4000, 1000 more than the 2015-2019 average.

4.4.2 Excess adjusted death rates

In this section we investigate the trends in excess adjusted death rates in England and Wales for the 15-44 age group. We compare excess all-cause mortality (registered deaths) with excess deaths from malignant neoplasms.

Figure 7 compares the excess death rate for malignant neoplasms (adjusted for under-reporting) and excess registered deaths in England and Wales from 2010 to 2022. Figure 7 (top) refers to relative deviations from the 2010-2019 trend, while Figure 7 (bottom) shows the Z-score (signal strength) for the deviations from trend.

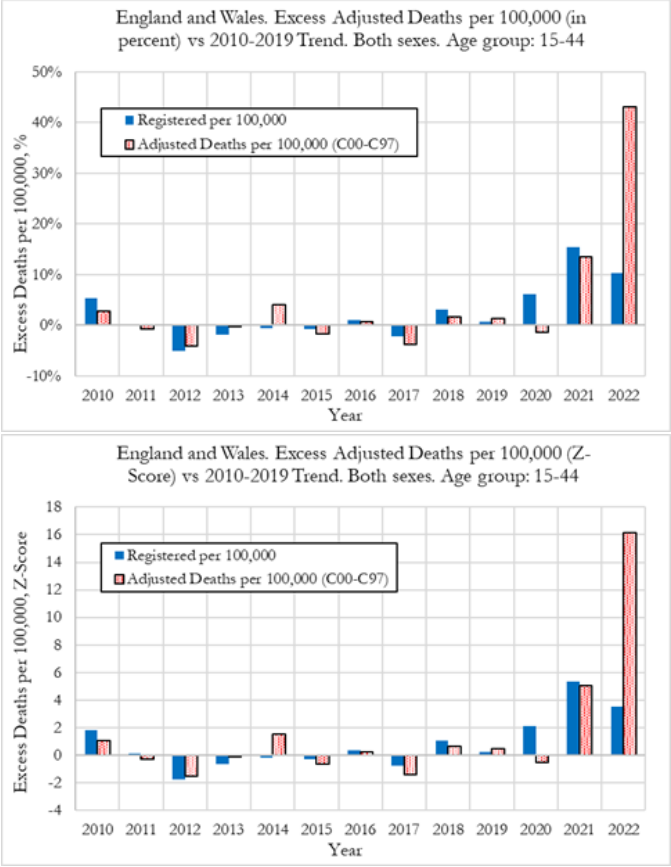

Figure 7. Excess adjusted death rates for diseases by malignant neoplasms in England and Wales. Top: Relative deviation from trend, percent. Bottom: Deviation from trend Z-Score. Excess death rates for all registered deaths are shown for comparison (Solid blue).

In Figure 7 (top) we can observe that the adjusted excess deaths rate from malignant neoplasms were close to zero in 2020, rose by about 13% in 2021, and about 43% in 2022. The excess mortality for all registered deaths was about 5% in 2020, 15% in 2021, and 10% in 2022. Interestingly, the drop in excess mortality for all registered deaths from 2021 to 2022 was not mirrored in a drop in adjusted malignant neoplasm deaths. In fact, the opposite occurred, with a sharp acceleration in adjusted excess deaths due to malignant neoplasms.

In terms of statistical significance of the excess deaths, we observe from Figure 7 (bottom) that for all registered deaths, the Z-score in 2020 was only about 2, which is not a strong signal. However, in 2021, the Z-score was slightly above 5 which is a very strong signal. In 2022 the Z-score dropped to about 3.5, which still indicates that the excess deaths are a statistically significant deviation from the 2010-2019 trend.

When looking at excess deaths from malignant neoplasms, the Z-score in 2020 was around 0, indicating no signal pointing to an increase in malignant neoplasm deaths. That trend however accelerated substantially in 2021 and 2022 where we observe Z-scores of around 5 and 16, respectively. These are extreme events.

4.4.3 Adjusted death rates for males and females

When looking at deaths attributed to malignant neoplasms for males and females, shown in Figure 8, we observe that historically females have about 33% higher death rates from malignant cancers than men. From 2010 to 2020 death rates from malignant neoplasms have been trending down for both cohorts, with visible breaks to the trend in 2021 and 2022, as shown in Figure 8. For females, death rates were 16.1 per 100,000 in 2010 and dropping to 13.9 per 100,000 by 2020, a 13.7% drop. For males, death rates were 13.6 per 100,000 in 2010 and dropping to 10.5 per 100,000 by 2020, a 22.8% drop.

In 2021 adjusted death rates from malignant neoplasms rose by 1.6 per 100,000 to 15.5 per 100,000 for females and by 1.7 per 100,000 to 12.2 per 100,000 for males.

In 2022 adjusted death rates from malignant neoplasms rose further to 18 per 100,000 for females and to 16 per 100,000 for males. The absolute rise in death rates was more pronounced for males than females, with adjusted deaths rates rising from 2020

levels by 5.5 per 100,000 in males, while only by 4.1 per 100,000 in females. Cancer death rates in 2022 for both males and females were substantially above 2010 levels, reversing the improvements in mortality from malignant neoplasms observed from 2010 to 2020.

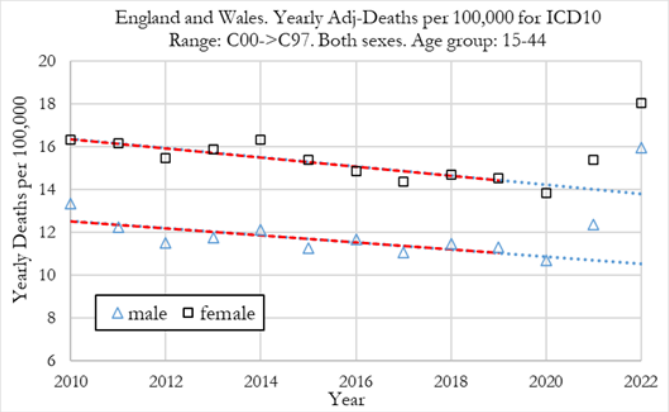

Figure 8. Yearly adjusted death rates for diseases by malignant neoplasms in England and Wales, for males and females. The red dashed line shows the average from 2010 to 2019. The dotted line shows the extrapolation of the trend from 2020 until 2022.

4.4.4 Excess adjusted deaths rates for males and females

When looking at adjusted excess deaths (measured as deviations from the 2010-2019 trend) attributed to malignant neoplasms for males and females, shown in Figure 9, we observe that in 2020, neither group had any noticeable excess mortality, with respective Z-scores close to zero (low statistical significance).

However, we also observe that in 2021 men suffered slightly worse outcomes than women, with men experiencing a 16% deviation from trend, compared to about 10% for women. In 2022 men suffered much worse outcomes than women, with men experiencing a 52% deviation from trend, compared to about 31% for women. The signal strengths for both men and women were highly statistically significant, as shown in Figure 9 (bottom).

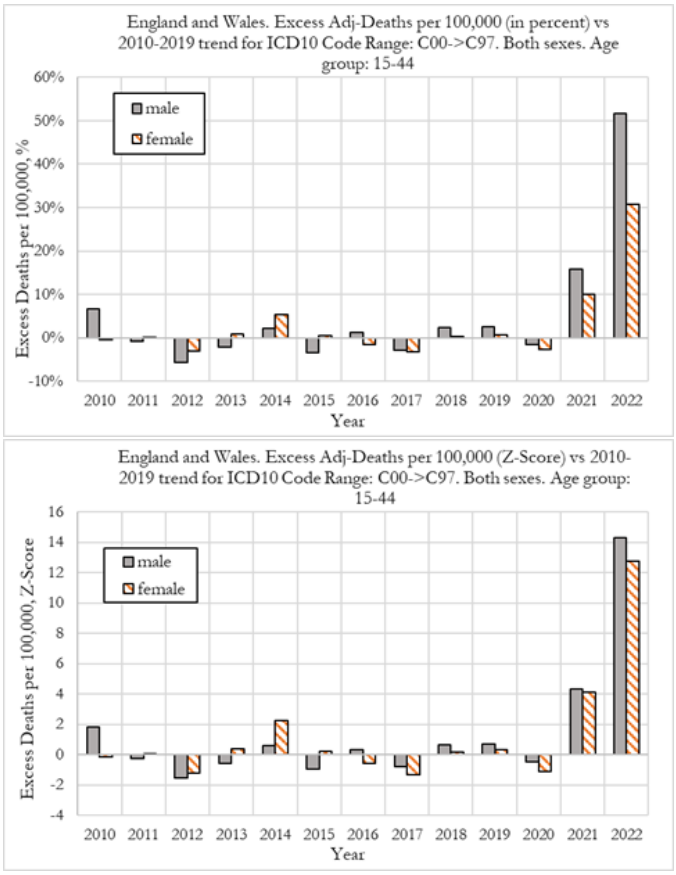

Figure 9. Excess adjusted deaths rates by malignant neoplasms for males and females, in England and Wales. Top: Relative deviation from trend, percent. Bottom: Deviation from trend Z-Score.

4.5 Trends in fraction Malignant Neoplasms (C00-C99) deaths versus deaths from all causes

In this section we analyze the trends in the relative incidence of malignant neoplasm deaths relative to all other causes, which provides a different type of information related to breaks in the normal pattern of deaths in this age group.

4.5.1 Fraction of deaths from Malignant Neoplasms (C00 to C99) Versus All Causes

For this purpose, in Figure 10 we plot the fraction of deaths from all causes that are attributed to malignant neoplasms. We observe that there was a slightly declining trend in the fraction of deaths due to malignant neoplasms from 2010 to 2019. In 2010,

deaths attributed to malignant neoplasms accounted for 21% of total deaths, while in 2019, the fraction was only 19.5%.

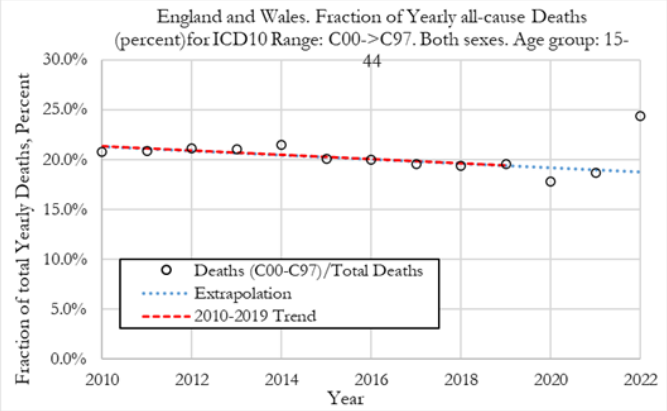

Figure 10. Fraction of all causes for yearly deaths attributed to malignant neoplasms, for England and Wales. The red dashed line shows the average from 2010 to 2019. The dotted line shows the extrapolation of the trend from 2020 until 2022.

In 2020 the fraction of deaths due to malignant neoplasms dropped to about 17.5% of total deaths. The fraction then increased to 18.5% in 2021 (back in line with the 2010-2019 trendline) and then jumped to about 24.5% in 2022, which is significantly above the 2010 level.

4.5.2 Excess Fraction of deaths from Malignant Neoplasms (C00 to C99) Versus All Causes

A different perspective is to analyze the fraction of deaths from all causes that are attributed to malignant neoplasms and compare them with the absolute changes in death rates due to malignant neoplasms, as shown in Figure 11.

We observe that in 2020 and 2021 the fraction of malignant neoplasm deaths relative to all other causes did not deviate significantly from the 2010-2019 trend. In 2021, both registered deaths and malignant neoplasm deaths increased by similar amounts so that the fraction of neoplasm deaths remained unchanged. For 2022, we observe that in similarity with excess death rates, the fraction of neoplasm deaths jumped substantially, by about 30%.

When looking at the statistical significance of the signals, in 2022, the fraction of excess deaths due to malignant neoplasms had a Z-score of about 16, similar in magnitude than that for excess adjusted deaths rates. This reinforces the fact that deaths related to the malignant neoplasms are of particular concern for this age group and needs further investigation.

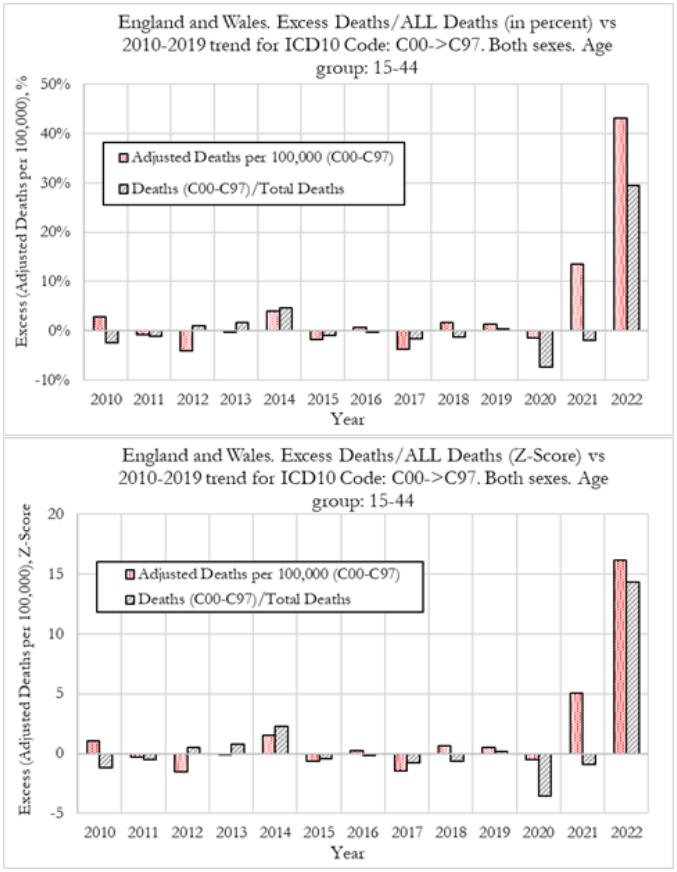

Figure 11. Excess fraction of all deaths that were from malignant neoplasms for ages 15 to 44, in England and Wales. Top: Relative deviation from trend, percent. Bottom: Deviation from trend Z-Score. Excess adjusted deaths rates for malignant neoplasms are also shown for comparison (Red dots).

4.6 Summary of the Analysis of Death Rates

We started our analysis of excess death rates due to malignant neoplasms by showing that the analysis needs to be performed with caution as not all deaths had a classified cause up to the time of publication of the ONS dataset. This issue is particularly relevant in younger age groups, which is the case of the present analysis, where we observe that in 2022 about 32% of registered deaths were still not classified with a cause (Figure 1).

We perform a correction to this problem by extrapolating the deaths in each year as if the proportion of each cause of death will remain the same when the missing deaths are finally classified. This is an assumption that must be taken with care. To make sure that we are identifying an actual trend in the data, we also analyze the deaths from malignant neoplasms relative to all classified causes of death (Figure 11). The results show that the rise in deaths from malignant neoplasms in 2022 was similar to the relative rise in malignant neoplasms in relation to all other causes. We also analyze raw unadjusted deaths (Figure 5) which shows that even without accounting for the missing records, 2022 already shows significant above-trend deaths from malignant neoplasms.

Our analysis shows that the adjusted excess death rates from malignant neoplasms were close to zero in 2020, rose by about 13% in 2021, and about 43% in 2022. On the other hand, the excess mortality for all registered deaths was about 5% in 2020, 15% in 2021, and 10% in 2022. The drop in excess mortality for all registered deaths from 2021 to 2022 was not mirrored in a drop in adjusted malignant neoplasm deaths. The opposite occurred, with a sharp acceleration in excess deaths due to malignant neoplasms.

The excess mortality from malignant neoplasm deaths in 2021 and 2022 are highly statistically significant with Z-scores of 5 and 16, respectively. These are very strong signals. As mentioned above, these signals are corroborated by similar findings when measuring rises in the fraction of deaths from malignant neoplasms relative to all other deaths with classified causes.

When translating these numbers into the absolute number of deaths from malignant neoplasms, in 2020, these were about 2765, 38.8 less than the extrapolated 2010-2019 trend. In 2021, there were about 3143 deaths (374.4 more than the extrapolated trend), and in 2022, 3939 deaths, which is 1187 more than the 2010-2019 trend.

When comparing outcomes for men and women, shown in Figure 9, we observe that both had no significant changes in deaths from malignant neoplasms in 2020. However, in 2021 men suffered slightly worse outcomes than women, with men experiencing a 16% deviation from trend, compared to about 10% for women. In 2022 men suffered much worse outcomes than women, with men experiencing a 52% deviation from trend, compared to about 31% for women. The signal strengths for both men and women were highly statistically significant, as shown in Figure 9 (bottom).

The timelines of these changes in mortality rates may help us to analyze whether the pandemic rules, lockdowns, vaccines, or Covid-19 itself have played a role in the rise of malignant neoplasm deaths. Although the initial pandemic measures did affect access to healthcare for routine matters, and in some cases also affected people's willingness to attend healthcare facilities for more serious conditions, the stability in mortality rates from malignant neoplasms in 2020 suggests that 'lockdowns' did not significantly increase the risk of death for people undergoing cancer treatment during that year. Rather, the increase in mortality began in 2021. This could indicate a lagged effect of the reduced access to healthcare provision, for example due to delayed diagnosis and treatment of malignant neoplasms, or from the lasting impact of the virus on those who were exposed to it. However, this timeframe also coincides with the large-scale rollout of the Covid-19 vaccines in the UK in 2021. The acceleration in malignant neoplasm excess deaths in 2022, despite a reduction in overall excess mortality rates, makes any lagged effect from the 2020 pandemic measures

less likely as a significant cause of excess cancer mortality. Unfortunately, the lack of monthly or weekly breakdown in mortality by cause, from the ONS, makes it difficult to compare malignant neoplasm mortality to other factors such as Covid-19 waves, or the vaccine rollout program. We will now turn our analysis to the increase in disability claims since the outbreak of the pandemic. The disability data for the UK, unlike the mortality statistics from the ONS, is broken down by month, and this may help us to pinpoint where the increase in malignant neoplasm morbidity began. Consequently, in the following section, we will be able to plot disabilities alongside the rollout of the Covid-19 vaccination program.

5 ANALYSIS OF UK DISABILITIES (PIP SYSTEM)

In this section we investigate the trends in disability claims in the UK's Department for Work and Pensions (DWP) Personal Independence Payment (PIP) system related to oncologic causes, to compare these trends with the previous chapter on excess mortality due to malignant neoplasms. The analysis we present here refers to clearances from new claims to the system. It should be noted that clearances refer to decisions made, which can be positive or negative. The fraction of positive clearances, leading to a grant allowance, is shown to be stable over time at a rate of about 40%.

One must be aware that PIP replaced the UK's previous Disability Living Allowance (DLA) system in 2013 and therefore we observe a sharp increase in claims in the few years following the initiation of PIP, which has been explained as "capacity issues" by the DWP. For this reason, only cases after January 2016 are included in this set of analyses.

5.1 Methodology

The methodology we use to estimate excess clearances of new claims in the PIP system is similar to that on measuring excess mortality, described previously in section 3. We compare the 2016 to 2019 trendline in PIP clearances with actual claims and compute the deviation from trend in relative terms (percentage deviation).

5.2 Baseline PIP Clearances for New Claims for Oncological Causes

Figure 12 shows the monthly PIP clearances for oncologic causes from January of 2016 to January of 2023. The dotted line refers to the cumulative Covid-19 vaccine doses as a percentage of the 16-44 age group , which is illustrated to show the timing of the changes in disability claims relative to the vaccination campaign.

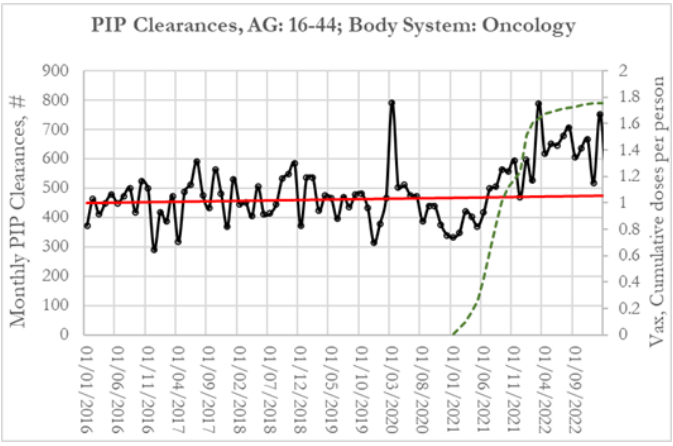

Figure 12. Monthly clearances (decisions) for new claims to the Personal Independence Payment (PIP) system in the UK, for oncological causes. The red line shows the 2016-2019 trend and the dotted line refers to the cumulative vaccinations for the 15-44 age group

From 2016 to 2019 we observe that there was an average of about 450 new PIP clearances per month. During 2020, we observe a large spike in March that appears to be a correction in the below-average PIP clearances in December 2019 and January 2020. For the first 6 months of 2021 we observe a below-average number of new monthly claims. However, from mid-2021, we observe a systematic rise in the PIP clearances, reaching a peak of 750 in January of 2023. During 2022 new PIP monthly claims averaged about 630.

The results above seem to corroborate the prior findings of increased deaths attributed to malignant

neoplasms. However, the results can be better compared by performing a yearly analysis of the PIP clearances.

5.3 Excess Yearly PIP Clearances for New Claims for Oncological Causes

When we compute the yearly PIP clearances from new claims for oncologic causes, shown in Figure 13, we observe that PIP clearances were very stable from 2016-2019 for the 16-44 age group, at around 5478 per year.

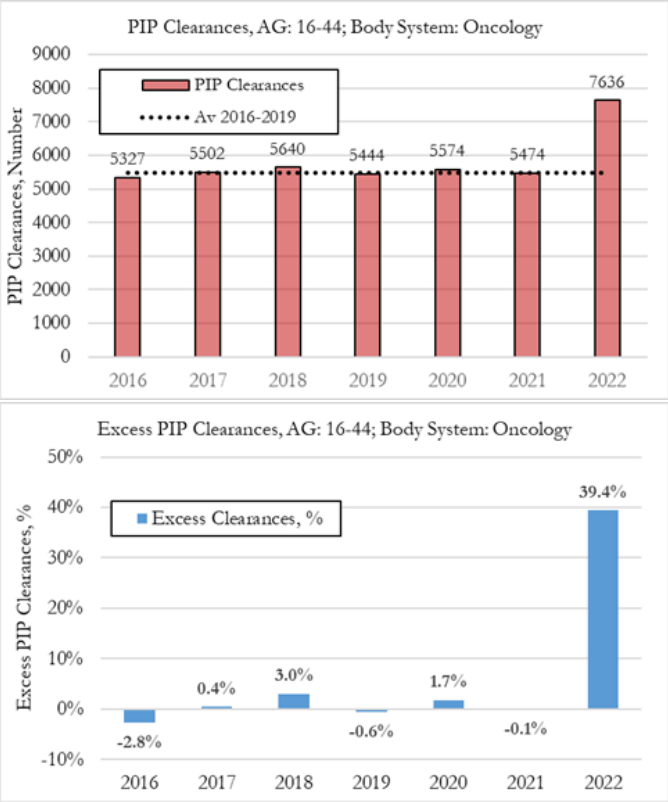

Figure 13. Yearly excess clearances for new claims to the Personal Independence Payment (PIP) system in the UK for oncologic causes for ages 16 to 44. The dotted line refers to the 2016 to 2019 average yearly number of new claims.

In 2020 PIP claims increased by about 1.7%, which was a slight increase from the 2016-2019 average. In 2021, PIP clearances were 0.1% below the baseline. However, in 2022, PIP clearances jumped by about 39.4%, relative to the baseline. We should recall that for excess deaths from malignant neoplasms, were close to zero in 2020, rose by about 13% in 2021, and about 43% in 2022.

We should note that there was a backlog in PIP clearances peaking in August of 2021 which led to claims taking up to 26 weeks to clear. The DWP mentions that the situation was normalized from early 2022 (UK - Department for Work and Pensions)[10], with PIP claims clearing in about 14 weeks[4]. Consequently, we must observe caution when directly comparing the timing of excess deaths with excess disability claims. However, on a yearly basis, these differences are smoothed out, as observed by the similarity of the trends in both excess deaths and excess disability claims for oncological causes.

5.4 Commentary of the Analysis of PIP Clearances for New Claims

Our previous analysis shows that there was a large rise in PIP new claims that started around mid-2021 (see Figure 12) and accelerated in 2022. In 2022, PIP clearances jumped by about 39.4%, relative to the baseline. These results corroborate the previous analysis of trends in death rates due to malignant neoplasms. The increase in PIP new claims were likely delayed by the delay in the process from a PIP registration until a PIP clearance, which can take 14 weeks or more.

The onset of disability after the Covid-19 vaccinations is already reported in the literature sources. Three population-based studies from South Korea show a relationship between the Covid-19 vaccinations and subsequent diverse non-fatal adverse events. The authors compare the incidence rates of different non-fatal health conditions in vaccinated versus unvaccinated individuals. The three types of adverse effects that were investigated are Immune-related adverse effects (Suhet al., 2023)[11], Haemtological disorders (Choi, et al., 2023)[12] and inflammatory musculoskeletal disorders (Park, et al., 2023)[13].

[4] Personal Independence Payment statistics April 2013 to January 2023 - Clearance and Outstanding Times

Looking back to the original clinical trials for the mRNA Covid-19 vaccines, (Fraiman, et al., 2022)[14], show that the combined rate of serious adverse events during the 2 to 3 months blinded period of the Pfizer and Moderna clinical trials was 13.2 in 10,000 (vaccine arm relative to placebo arm of the clinical trial)[5]. This translates to vaccinated individuals having a rate of serious adverse events of about 1 per 760. Our research into US disabilities shows that the timing of the vaccination rollout was synchronous with the start of the rise in disabilities in early 2021, as well as showing a high correlation between the cumulative disabilities and vaccine doses, and a relationship between the rate of excess disabilities and the rate of serious adverse events described by Fraiman et al[14].

All this evidence points towards the novel mRNA vaccines having played a significant role in the rise in disabilities (from all causes) from 2021. After this relationship was established the analysis of the UK PIP system allowed for more granularity in terms of investigating the underlying cause[6] for the increase in disabilities, one of which was due to oncologic diseases, discussed here.

Fraiman et al.'s[14] paper does not account for serious adverse events that might have originated some time after the Covid-19 inoculations. For instance, in our previous report on Cardiovascular deaths for 15 to 44 year-olds in the UK (Alegria, 2023)[15], we show that cardiovascular deaths increased over time and in 2022 reached their highest levels. This occurred more than 6 months after the main vaccination rollout for the 15-44 age group.

Similarly, it is possible that the rise in disabilities and deaths from malignant neoplasms has an underlying pattern that leads to a lag between the Covid-19 inoculations and the manifestation of the effect. Our results show that malignant neoplasms disabilities and deaths went up later than cardiovascular deaths, mainly in 2022, while cardiovascular deaths had started rising earlier, in 2020, and accelerated in 2021.

6 CONCLUDING REMARKS

The analysis of PIP clearances for new claims where the underlying causes were oncological, is consistent with the analysis of excess deaths.

We observe that in 2020 and 2021 the fraction of malignant neoplasm deaths relative to all other causes did not deviate significantly from the 2010-2019 trend. We also show that in 2022, the rise for disability claims was of similar magnitude in percentage terms to the rise in excess adjusted death rates.

Table 1 summarizes the yearly excess PIP claims for oncological causes and compares them with the equivalent numbers of excess deaths. In terms of the absolute number of deaths from malignant neoplasms, in 2020, malignant neoplasm deaths were about 2765, 38.8 less than the extrapolated 2010-2019 trend. In 2021, there were about 3143 deaths (374.4 more than the extrapolated trend), and in 2022, 3939 deaths, which is 1187 more than the 2010-2019 trend.

The results shown in Table 1 indicate that there was a significant rise in both disability claims and deaths due to malignant neoplasms for the 15-44 age group in the UK. Disabilities seem to only have started increasing in 2022, with no apparent rise in 2021, while excess deaths from malignant neoplasms were already recorded. This could be explained by delays in cancer clearances within the PIP system. In 2022 the relative deviation from baseline in disabilities was 39.4% while for deaths it was 43.1%, both being similar in magnitude corroborating that a common underlying phenomenon is likely present.

We also observe that the absolute change in disabilities was more than double the equivalent rises in deaths, which points towards the risk of higher malignant neoplasm deaths in the coming years if these conditions are not cured.

[5] Phinance Technologies - Humanity Projects - SAE in mRNA vaccine Clinical Trials

[6] Phinance Technologies - Humanity Projects - Analysis of UK New Claims for Personal Independence Pension (PIP) by Body System.

	2020	2021	2022
PIP Clearances Deviation from 2015-2019 average	N = 5,574 (+96) (+1.7%)	N = 5,474 (-4) (-0.1%)	N = 7,636 (+2,158) (+39.4%) (Z = 17.9)
Adjusted malignant neoplasm Deaths Deviation from 2015-2019 average	N = 2,765 (-38.8) (-1.4%)	N = 3,143 (+374.4) (+13.5%) (Z = 5.1)	N = 3,939 (+1,187) (+43.1%) (Z = 16.1)

Table 1. Summary for excess deaths and disabilities for malignant neoplasms in England and Wales (deaths) and the UK (PIP claims).

We are currently in the process of pursuing further investigations into this issue in more detail. In particular, we will analyze the trends in deaths and disabilities for the most common individual ICD-10 causes within malignant neoplasms, to gain insights into the underlying phenomenon of action.

CONFLICT OF INTEREST STATEMENT

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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7 ANNEX

Table 2 ICD-10 Code List for Malignant Neoplasms (C00-C99).

ICD-10 Code	Cause
C00	Malignant neoplasm of lip
C01	Malignant neoplasm of base of tongue
C02	Malignant neoplasm of other and unspecified parts of tongue
C03	Malignant neoplasm of gum
C04	Malignant neoplasm of floor of mouth
C05	Malignant neoplasm of palate
C06	Malignant neoplasm of other and unspecified parts of mouth
C07	Malignant neoplasm of parotid gland
C08	Malignant neoplasm of other and unspecified major salivary glands
C09	Malignant neoplasm of tonsil
C10	Malignant neoplasm of oropharynx
C11	Malignant neoplasm of nasopharynx
C12	Malignant neoplasm of pyriform sinus
C13	Malignant neoplasm of hypopharynx
C14	Malignant neoplasm of other and ill-defined sites
C15	Malignant neoplasm of esophagus
C16	Malignant neoplasm of stomach
C17	Malignant neoplasm of small intestine
C18	Malignant neoplasm of colon
C19	Malignant neoplasm of rectosigmoid junction
C20	Malignant neoplasm of rectum
C21	Malignant neoplasm of anus and anal canal
C22	Malignant neoplasm of liver and intrahepatic bile ducts
C23	Malignant neoplasm of gallbladder
C24	Malignant neoplasm of other and unspecified parts of biliary tract
C25	Malignant neoplasm of pancreas
C26	Malignant neoplasm of other and ill-defined digestive organs
C27	Malignant neoplasms
C28	Malignant neoplasms
C29	Malignant neoplasms
C30	Malignant neoplasm of nasal cavity and middle ear
C31	Malignant neoplasm of accessory sinuses
C32	Malignant neoplasm of larynx
C33	Malignant neoplasm of trachea
C34	Malignant neoplasm of bronchus and lung
C35	Malignant neoplasms
C36	Malignant neoplasms
C37	Malignant neoplasm of thymus
C38	Malignant neoplasm of heart, mediastinum, and pleura
C39	Malignant neoplasm of other and ill-defined sites in the respiratory system and intrathoracic organs

Continued on next page

Table 2 – *Continued from previous page*

ICD-10 Code	Cause
C40	Malignant neoplasm of bone and articular cartilage of limbs
C41	Malignant neoplasm of bone and articular cartilage of other and unspecified sites
C42	Malignant neoplasms
C43	Malignant melanoma of skin
C44	Other and unspecified malignant neoplasm of skin
C45	Mesothelioma
C46	Kaposi's sarcoma
C47	Malignant neoplasm of peripheral nerves and autonomic nervous system
C48	Malignant neoplasm of retroperitoneum and peritoneum
C49	Malignant neoplasm of other connective and soft tissue
C4A	Merkel cell carcinoma
C50	Malignant neoplasm of breast
C51	Malignant neoplasm of vulva
C52	Malignant neoplasm of vagina
C53	Malignant neoplasm of cervix uteri
C54	Malignant neoplasm of corpus uteri
C55	Malignant neoplasm of uterus, part unspecified
C56	Malignant neoplasm of ovary
C57	Malignant neoplasm of other and unspecified female genital organs
C58	Malignant neoplasm of placenta
C59	Malignant neoplasms
C60	Malignant neoplasm of penis
C61	Malignant neoplasm of prostate
C62	Malignant neoplasm of testis
C63	Malignant neoplasm of other and unspecified male genital organs
C64	Malignant neoplasm of kidney, except renal pelvis
C65	Malignant neoplasm of renal pelvis
C66	Malignant neoplasm of ureter
C67	Malignant neoplasm of bladder
C68	Malignant neoplasm of other and unspecified urinary organs
C69	Malignant neoplasm of eye and adnexa
C70	Malignant neoplasm of meninges
C71	Malignant neoplasm of brain
C72	Malignant neoplasm of spinal cord, cranial nerves and other parts of central nervous system
C73	Malignant neoplasm of thyroid gland
C74	Malignant neoplasm of adrenal gland
C75	Malignant neoplasm of other endocrine glands and related structures
C76	Malignant neoplasm of other and ill-defined sites
C77	Secondary and unspecified malignant neoplasm of lymph nodes
C78	Secondary malignant neoplasm of respiratory and digestive organs
C79	Secondary malignant neoplasm of other and unspecified sites
C7A	Malignant neuroendocrine tumors

Continued on next page

Table 2 – *Continued from previous page*

ICD-10 Code	Cause
C7B	Secondary neuroendocrine tumors
C80	Malignant neoplasm without specification of site
C81	Hodgkin lymphoma
C82	Follicular lymphoma
C83	Non-follicular lymphoma
C84	Mature T/NK-cell lymphomas
C85	Other specified and unspecified types of non-Hodgkin lymphoma
C86	Other specified types of T/NK-cell lymphoma
C87	of which malignant neoplasm of lymph/haematopoietic tissue
C88	Malignant immunoproliferative diseases and certain other B-cell lymphomas
C89	of which malignant neoplasm of lymph/haematopoietic tissue
C90	Multiple myeloma and malignant plasma cell neoplasms
C91	Lymphoid leukemia
C92	Myeloid leukemia
C93	Monocytic leukemia
C94	Other leukemias of specified cell type
C95	Leukemia of unspecified cell type
C96	Other and unspecified malignant neoplasms of lymphoid, hematopoietic and related tissue
C97	Malignant neoplasms