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ORIGINAL ARTICLE

# European cancer mortality predictions for the year 2021 with focus on pancreatic and female lung cancer

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**Background:** We predicted cancer mortality statistics for 2021 for the European Union (EU) and its five most populous countries plus the UK. We also focused on pancreatic cancer and female lung cancer.

**Materials and methods:** We obtained cancer death certifications and population data from the World Health Organization and Eurostat databases for 1970-2015. We predicted numbers of deaths and age-standardised (world population) rates for 2021 for total cancers and 10 major cancer sites, using a joinpoint regression model. We calculated the number of avoided deaths over the period 1989-2021.

**Results:** We predicted 1 267 000 cancer deaths for 2021 in the EU, corresponding to age-standardised rates of 130.4/100 000 men (−6.6% since 2015) and 81.0/100 000 for women (−4.5%). We estimated further falls in male lung cancer rates, but still trending upward in women by +6.5%, reaching 14.5/100 000 in 2021. The breast cancer predicted rate in the EU was 13.3/100 000 (−7.8%). The rates for stomach and leukaemias in both sexes and for bladder in males are predicted to fall by >10%; trends for other cancer sites were also favourable, except for the pancreas, which showed stable patterns in both sexes, with predicted rates of 8.1/100 000 in men and 5.6/100 000 in women. Rates for pancreatic cancer in EU men aged 25-49 and 50-64 years declined, respectively, by 10% and 1.8%, while for those aged 65+ years increased by 1.3%. Rates fell for young women only (−3.4%). Over 1989-2021, about 5 million cancer deaths were avoided in the EU27 compared with peak rates in 1988.

**Conclusion:** Overall cancer mortality continues to fall in both sexes. However, specific focus is needed on pancreatic cancer, which shows a sizeable decline for young men only. Tobacco control remains a priority for the prevention of pancreatic and other tobacco-related cancers, which account for one-third of the total EU cancer deaths, especially in women, who showed less favourable trends.

**Key words:** cancer, Europe, mortality rates, prediction models, pancreatic cancer, Brexit

## INTRODUCTION

Projected estimates of cancer mortality figures and rates are a necessary tool to evaluate disease management in Europe as in the USA[1] and other areas of the world.[2]

This is the 11th iteration of our report on current projected cancer mortality rates in the European Union (EU).[3] We focused on pancreatic cancer, as we did in 2014,[4] since this is a problematic cancer, with low survival and unfavourable trends over the past decade, and therefore represents a major public health concern.

After the separation of the UK from the EU, we defined the EU as the EU27. Consequently, the rates and trends in this work are no longer directly comparable with the results of previous reports. However, we included the results for the UK separately.

## MATERIALS AND METHODS

We retrieved official death certification data from the World Health Organization (WHO) database[5] for total cancer mortality and 10 major sites. Cancer deaths were recorded according to the 10th International Classification of Diseases (ICD) revision[6]: total cancers (C00—D48), stomach (C16), intestines (mainly colorectum; C17—C21, C26), pancreas (C25), lung (C33—C34), breast (C50), uterus (cervix and corpus) (C53—C55), ovary (C56), prostate (C61), bladder (C67) and leukaemias (C91—C95). We obtained

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resident population estimates from the same WHO database and, when data were missing, from the Eurostat database.[7] We derived figures from 1970 to 2015 for the EU (current 27 member states, excluding Cyprus where data were missing) and to the most recent available year for its five most populous countries. For comparison reasons, we also obtained comparable data for the UK.

We calculated country- and sex-specific death rates for each 5-year age group (0-4 to 85+ years) and calendar year or quinquennium. We calculated age-standardised (world standard population) rates for all ages and, for pancreatic cancer, for ages 25-49, 50-64 and 65+ years. We also applied joinpoint regression models,[8] testing up to three joinpoints, to age-standardised rates.

To compute predictions, we applied a logarithmic Poisson joinpoint regression model to each 5-year age-specific number of certified deaths, setting a maximum of five joinpoints, to identify the most recent trend segment. We estimated age-specific numbers of deaths and the corresponding 95% prediction intervals (PIs) for 2021 by fitting a linear regression to the mortality data from each age-group over the most recent trend segment identified by the joinpoint model. We computed predicted age-specific and age-standardised death rates with 95% PIs using predicted age-specific numbers of deaths obtained from our model and predicted populations retrieved from Eurostat.[7]

We estimated the number of averted cancer deaths for the EU27 and the UK over the 1989-2021 period by comparing observed deaths and expected ones on the basis of the 1988 age-specific peak rate.

## RESULTS

Table 1 shows predicted cancer deaths and age-standardised rates with the corresponding 95% PIs for 2021 for the EU27 and the UK, in comparison with observed data for 2015. In the EU27, we predict an increase of about 6.0% in total cancer deaths: in 2021, we estimate 1 267 000 cancer deaths (711 600 men, 555 400 women), compared with 1 195 323 in 2015. However, the total cancers age-standardised rate is predicted to decline from 139.5/100 000 in men in 2015 to 130.4/100 000 in 2021 (6.6% decrease) and in women from 84.8/100 000 to 81.0/100 000 (4.5% decrease). In the UK, the overall number of cancer deaths is predicted to increase by 4.5%, reaching 176 400 deaths in 2021, while the age-standardised rate for all cancers is estimated to decrease from 123.9/100 000 in men in 2015 to 114.6/100 000 in 2021 (7.5% fall), and in women from 93.4/100 000 to 89.2/100 000 (4.5% fall). In the EU, the numbers of cancer deaths rise for all considered cancers with the exception of stomach cancer in both sexes and are stable for lung and bladder cancers in men and colorectal and ovarian cancers in women. In the UK, the pattern is similar, but rises are recorded in male bladder and female colorectal cancers. The numbers of cancer deaths are stable for leukaemias in both sexes, male colorectum, prostate, breast and ovarian cancers.

Figure 1A and B shows observed and predicted EU27 and UK age-standardised rates per 100 000 person-years with 95% PIs for all neoplasms and 10 major cancer sites for men and women. In the EU27, lung cancer has the highest predicted rates for both sexes: 32.3/100 000 in men (35.9/100 000 in 2015, −10.2%) and 14.5/100 000 in women (13.6/100 000 in 2015, +6.5%). In women, the second highest rate in 2021 is 13.3/100 000 for breast cancer (7.8% fall since 2015). The rates for colorectal cancer are predicted to decline by 4.8% in men to reach 15.5/100 000 and by 9.6% in women to reach 8.4/100 000. The third highest predicted rate in men is 9.4/100 000 for prostate cancer (8.7% fall since 2015). Pancreatic cancer has stable trends for both sexes with predicted rates of 8.1/100 000 in men and 5.6/100 000 in women. Stomach cancer shows steady declines, 14.1% decrease in men and 16.3% in women, since 2015. Uterine and ovarian cancers show declines of 3.5% and 8.9%, respectively. Age-standardised rates for bladder cancer and leukaemias are below 4.5/100 000 in men and below 2.3/100 000 in women, with favourable trends in both sexes, accounting for about 6.0% of all cancer deaths. In the UK, the highest predicted rates are also for lung cancer: 23.8/100 000 in men and 18.8/100 000 in women. However, falls are predicted in both sexes. In women, the predicted lung cancer mortality rate is appreciably higher than that of breast cancer and the number of deaths from lung cancer are also higher than those from breast cancer (17 000 and 10 800, respectively). Stomach cancer has particularly low rates. In UK women, we predict a stable rate for colorectal cancer, a decline in rates for pancreatic cancer and rises for uterine and bladder cancers.

Figure 2 displays cancer mortality trends in quinquennia (from 1970-1974 to 2010-2014) and predicted rates for 2021, with 95% PIs for all neoplasms in EU men and women (left), and for specific cancer sites for men (centre) and women (right). In men, the downward trend for all neoplasms since the late 1980s was mainly influenced by the favourable trends from lung and stomach cancers. In women, all-cancer mortality has been declining since the early 1970s, even though falls are less marked than those in men. Colorectal, prostate and bladder cancer rates in men increased up to the early 1990s and then declined. In EU women, there have been major decreases in breast cancer since the early 1990s and in colorectal, stomach and uterine cancers since the early 1970s. Uterine cancer has tended to flatten over the last decade. Ovarian cancer rates rose up to the late 1980s and decreased thereafter. Since the 1990s, bladder cancer rates have declined in women. Lung cancer rates in women are still rising, after overtaking breast cancer rates in the mid-2010s. Pancreatic cancer rates rose slightly over the studied period for both sexes and level off in the predicted period for men; rates for leukaemias decline in both sexes up to 2021. Supplementary Figure S1, available at https://doi.org/10.1016/j.annonc.2021.01.006 shows the analogous mortality figures for the UK. Compared with the EU27, all-neoplasm UK rates declined over the whole period, reflecting the strongly declining trend in lung cancer in men from the early 1970s. In UK

**Table 1. Number of predicted deaths and mortality rates for the year 2021 and comparison figures for 2015, for the EU and for the UK, with 95% prediction intervals and the percentage differences between 2015 and 2021**

| | Observed number of deaths 2015 | Predicted number of deaths 2021 (95% PI) | Observed ASR 2015 | Predicted ASR 2021 (95% PI) | % Difference 2021 versus 2015 |
|---|---|---|---|---|---|
| EU | | | | | |
| Men | | | | | |
| Stomach | 31 849 | 30 700 (29 968-31 518) | 6.62 | 5.69 (5.52-5.85) | −14.1 |
| Colorectum | 82 361 | 88 300 (86 456-90 055) | 16.23 | 15.45 (15.11-15.79) | −4.8 |
| Pancreas | 37 993 | 42 300 (41 693-42 887) | 8.12 | 8.06 (7.93-8.18) | −0.8 |
| Lung | 164 743 | 164 600 (162 062-167 055) | 35.93 | 32.28 (31.69-32.86) | −10.2 |
| Prostate | 63 171 | 67 100 (65 943-68 165) | 10.34 | 9.44 (9.27-9.61) | −8.7 |
| Bladder | 28 257 | 28 800 (27 983-29 558) | 5.08 | 4.47 (4.32-4.62) | −12 |
| Leukaemias | 20 979 | 22 400 (21 846-22 991) | 4.51 | 3.84 (3.65-4.03) | −14.8 |
| All cancers (malignant and benign) | 670 338 | 711 600 (704 060-719 115) | 139.52 | 130.37 (128.79-131.95) | −6.6 |
| Women | | | | | |
| Stomach | 20 581 | 18 400 (17 781-19 051) | 3.07 | 2.57 (2.47-2.67) | −16.3 |
| Colorectum | 67 747 | 66 900 (65 579-68 137) | 9.32 | 8.43 (8.28-8.58) | −9.6 |
| Pancreas | 37 729 | 41 900 (41 044-42 721) | 5.59 | 5.62 (5.49-5.76) | 0.6 |
| Lung | 72 145 | 83 500 (82 085-84 831) | 13.56 | 14.45 (14.15-14.74) | 6.5 |
| Breast | 82 433 | 84 900 (83 609-86 246) | 14.46 | 13.33 (13.06-13.6) | −7.8 |
| Uterus (cervix and corpus) | 26 589 | 28 000 (27 318-28 682) | 4.92 | 4.75 (4.62-4.87) | −3.5 |
| Ovary | 26 146 | 26 000 (25 350-26 668) | 4.73 | 4.31 (4.17-4.45) | −8.9 |
| Bladder | 9192 | 9700 (9424-9928) | 1.11 | 1.07 (1.03-1.11) | −3.7 |
| Leukaemias | 17 197 | 18 200 (17 786-18 533) | 2.71 | 2.32 (2.21-2.42) | −14.6 |
| All cancers (malignant and benign) | 524 985 | 555 400 (550 059-560 728) | 84.8 | 81.02 (80.3-81.75) | −4.5 |
| UK | | | | | |
| Men | | | | | |
| Stomach | 2817 | 2700 (2531-2809) | 3.84 | 3.35 (3.16-3.55) | −12.7 |
| Colorectum | 10 880 | 11 200 (10 857-11 482) | 14.92 | 13.49 (13.04-13.95) | −9.6 |
| Pancreas | 4469 | 5000 (4778-5149) | 6.48 | 6.47 (6.16-6.78) | −0.2 |
| Lung | 19 200 | 19 200 (18 797-19 580) | 26.88 | 23.79 (23.24-24.35) | −11.5 |
| Prostate | 11 827 | 12 100 (11 672-12 582) | 13.25 | 11.85 (11.36-12.33) | −10.6 |
| Bladder | 3681 | 3900 (3749-4053) | 4.31 | 3.87 (3.69-4.06) | −10.2 |
| Leukaemias | 2734 | 2800 (2663-2942) | 3.84 | 3.24 (2.97-3.5) | −15.7 |
| All cancers (malignant and benign) | 89 773 | 94 300 (93 130-95 371) | 123.86 | 114.62 (112.95-116.3) | −7.5 |
| Women | | | | | |
| Stomach | 1581 | 1100 (931-1270) | 1.72 | 1.22 (1.03-1.42) | −28.9 |
| Colorectum | 9375 | 10 000 (9718-10 370) | 9.98 | 10.04 (9.61-10.48) | 0.6 |
| Pancreas | 4472 | 4700 (4536-4944) | 5.11 | 4.91 (4.6-5.21) | −4 |
| Lung | 16 357 | 17 000 (16 491-17 513) | 19.86 | 18.84 (18.25-19.42) | −5.1 |
| Breast | 11 470 | 10 800 (10 458-11 240) | 15.15 | 13.28 (12.74-13.81) | −12.4 |
| Uterus (cervix and corpus) | 3102 | 3500 (3365-3619) | 4.22 | 4.49 (4.29-4.69) | 6.4 |
| Ovary | 4067 | 4000 (3767-4276) | 5.25 | 4.67 (4.29-5.05) | −11.1 |
| Bladder | 1708 | 1900 (1740-1962) | 1.59 | 1.61 (1.5-1.72) | 1.1 |
| Leukaemias | 1940 | 2000 (1892-2104) | 2.2 | 1.94 (1.75-2.14) | −11.7 |
| All cancers (malignant and benign) | 78 972 | 82 100 (80 660-83 575) | 93.44 | 89.2 (87.24-91.16) | −4.5 |

ASR, age-standardised mortality rates using the world standard population; PI, prediction interval.

women, trends for lung cancer, after increasing up to 1990, were inconsistent and started to decline in the mid-2000s. Breast cancer rates decreased about one decade earlier compared to those in the EU27. Additional country-specific data and analyses are available in the Supplementary Appendix at *Annals of Oncology* online (Supplementary Tables S1-S9 and Supplementary Figures S1-S3, available at https://doi.org/10.1016/j.annonc.2021.01.006).

Figure 3 displays mortality trends for pancreatic cancer rates in the quinquennia from 1970-1974 to 2010-2014 for men and women, along with the estimates for 2021, for the EU27 and the five countries considered, plus the UK. In men, the trend for the EU27 strongly increased up to the late 1980s, then continued to steadily rise up to the most recent period. France, Germany and Italy showed similar patterns, but France and Germany show unfavourable predicted rates. Poland also had a marked increase up to the late 1980s, to then level off to 2021. The rates for Spain steadily increased over the whole period. The UK trend, starting from the highest rates, was the only one declining up to the 2000s, and then tended to stabilise. In women, pancreatic cancer trends for the EU27, France and Spain steadily increased over the whole period and up to 2021. Germany and Italy showed marked rises in rates up to the late 1980s and they continued to increase thereafter. The death rates in Poland strongly increased up to the mid-1980s, slightly rose up to the mid-2000s and then levelled off. Similar to men, UK women trends decreased at the start, slightly rose thereafter and then have a favourable predicted rate.

Table 2 shows age-standardised mortality rates for pancreatic cancer for the five countries plus the UK in 2005-2009 and 2010-2014, and the predicted rates for 2021 with 95% PIs. Rates for all ages and truncated for 25-49, 50-64 and 65+ year age groups for the EU27 are also presented. Age-standardised rates across considered quinquennia were

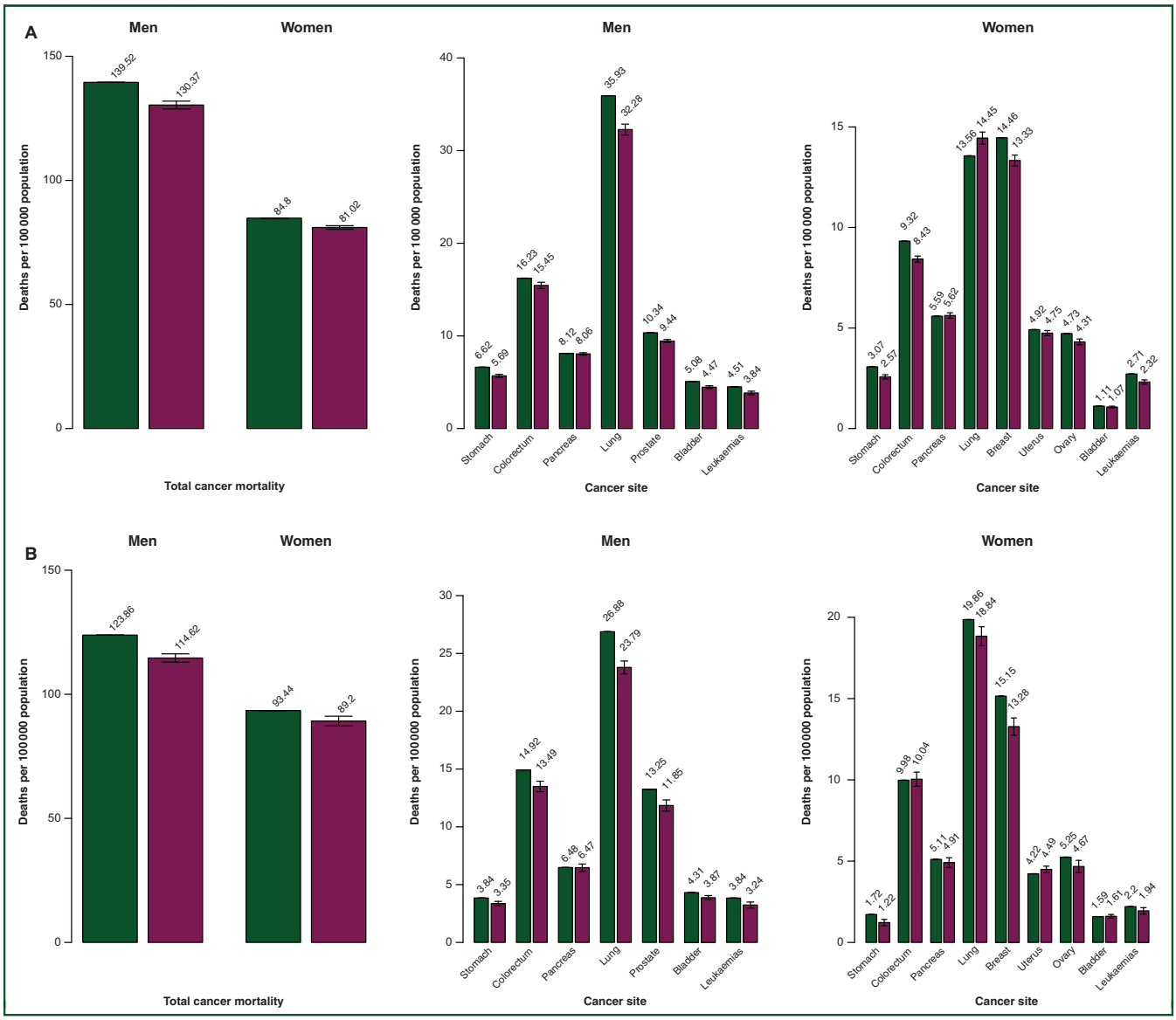


**Figure 1.** **(A) Bar-plots of age-standardised (world population) death rates per 100 000 persons for the year 2015 (green/dark grey) and predicted rates for 2021 (burgundy/light grey) with 95% prediction intervals for total cancer and 10 major cancer sites in EU men and women. (B) Bar-plots of age-standardised (world population) death rates per 100 000 persons for the year 2015 (green/dark grey) and predicted rates for 2021 (burgundy/light grey) with 95% prediction intervals for total cancer and 10 major cancer sites in UK men and women.**

almost stable in both sexes and all countries, ranging, in men, from about 6.5/100 000 (the UK) to about 8.4/100 000 (Germany) and in women from about 4.0/100 000 (Spain) to about 6.0/100 000 (Germany). In men, except in France and Germany, rates declined (Poland shows the most favourable predicted pattern). The EU rates for men aged 25-49 years declined by 10%, and those for men aged 50-64 years by 1.8%, but those for 65+ years increased by 1.3%. In women, Poland and the UK showed favourable predicted trends since 2010-2014, while other countries maintained upward trends. The rates for young EU women decline by 3.4%; older age groups show rises >3%. However, PIs contain the 2010-2014 rates in all countries, sexes and age groups, apart from the projected falls in Poland and the EU 25-49 age group in males, and rises in France, Italy, Spain, EU27 all ages and 65+ years in women.

Figure 4 displays joinpoint analysis of pancreatic cancer age-standardised mortality rates for the EU27, in both sexes and different age groups, along with predictions for 2021 and 95% PIs. Except for age 25-49 years, the rates in both sexes and all age groups rose over the whole studied period; men aged 50-64 years, however, show decreases in rates over the last decades and a favourable predicted rate.

Figure 5A and B shows the estimated number of averted cancer deaths for the EU27 and for the UK, respectively, from 1989 to 2021. In the EU27, we estimated a total of 4 957 800 avoided deaths (3 338 900 men and 1 618 900 women) over the whole period and 348 000 in 2021 alone (245 700 men and 102 300 women). In the UK, we estimate a total of 1 063 200 averted deaths (722 700 men and 340 500 women) since 1989 and 69 000 in 2021 (47 200 men and 21 800 women).



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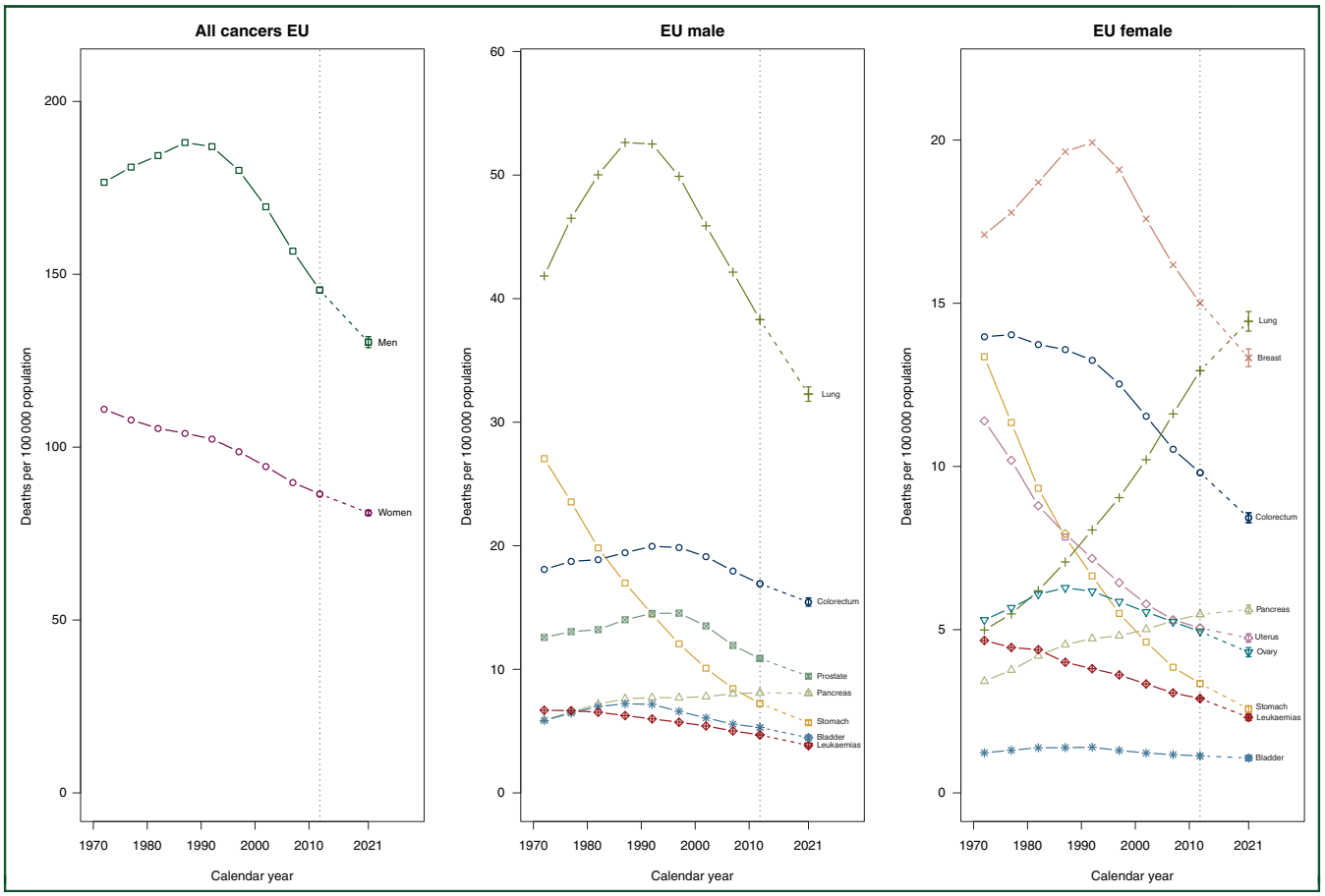


**Figure 2.** **Age-standardised (world population) cancer mortality rate trends in quinquennia from 1970-1974 to 2010-2014 and predicted rates for 2021 with 95% prediction intervals, for all neoplasms and both sexes (left) and each cancer site under study for men (centre) and women (right), in the EU27.**

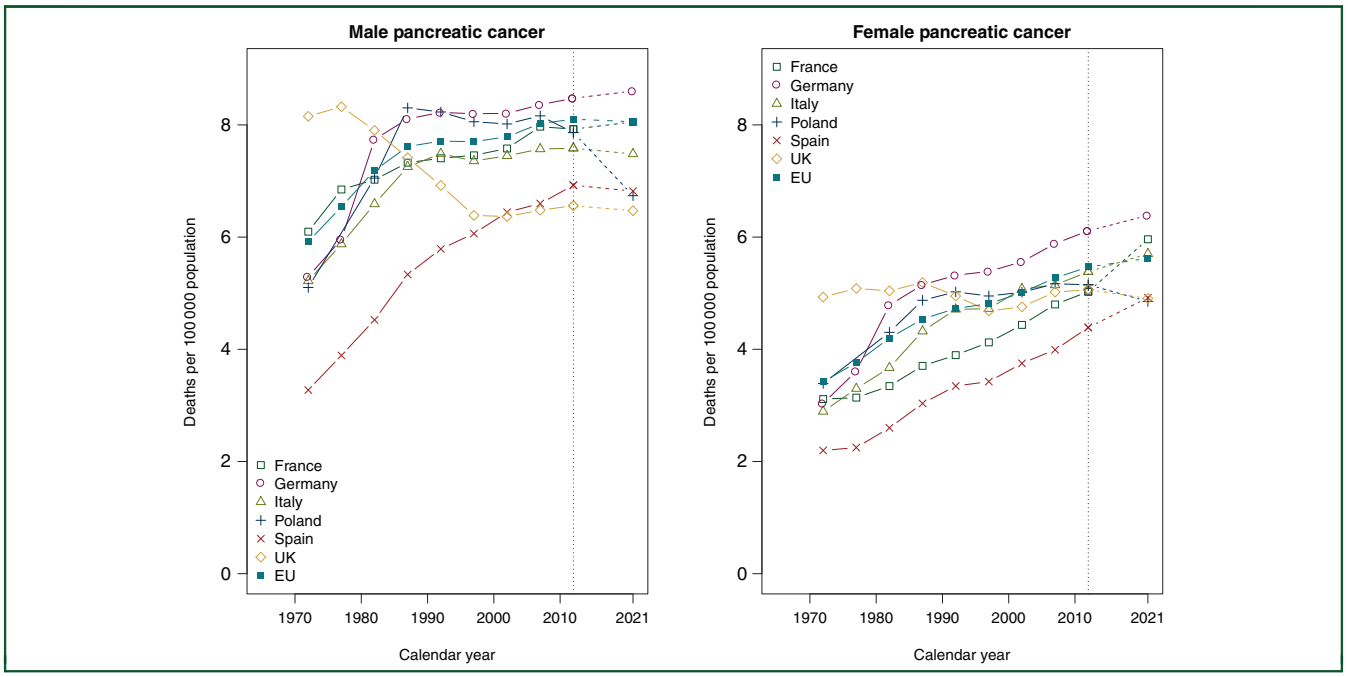


**Figure 3.** **Age-standardised (world population) cancer mortality rate trends at all ages for men and women in quinquennia from 1970-1974 to 2010-2014, and predicted rates for 2021 with 95% prediction intervals for pancreatic cancer in studied countries and the EU27 as a whole.**

**Table 2. Age-standardised pancreatic cancer mortality rates for all ages in selected European countries, and for the EU as a whole at all ages, 25-49, 50-64 and 65+ years in the 2005-2009 and 2010-2014 quinquennia and predicted rates for 2021, with percentage differences between 2010-2014 and 2021**

| | | Men | | | | Women | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | ASR 2005-2009 | ASR 2010-2014 | Predicted ASR 2021 (95% PI) | % Difference 2021 2010-2014 | ASR 2005-2009 | ASR 2010-2014 | Predicted ASR 2021 (95% PI) | % Difference 2021 2010-2014 |
| France | | 7.97 | 7.92 | 8.05 (7.73-8.38) | 1.7 | 4.8 | 5.03 | 5.96 (5.67-6.25) | 18.5 |
| Germany | | 8.36 | 8.48 | 8.6 (8.26-8.95) | 1.5 | 5.88 | 6.11 | 6.39 (6.1-6.67) | 4.5 |
| Italy | | 7.57 | 7.58 | 7.48 (7.25-7.72) | −1.3 | 5.15 | 5.38 | 5.7 (5.51-5.9) | 6 |
| Poland | | 8.16 | 7.87 | 6.74 (6.29-7.19) | −14.4 | 5.17 | 5.15 | 4.85 (4.49-5.22) | −5.8 |
| Spain | | 6.6 | 6.92 | 6.82 (6.54-7.1) | −1.5 | 3.99 | 4.39 | 4.92 (4.72-5.12) | 12.1 |
| UK | | 6.48 | 6.56 | 6.47 (6.16-6.78) | −1.4 | 5.02 | 5.06 | 4.91 (4.6-5.21) | −3 |
| EU | All ages | 8.02 | 8.1 | 8.06 (7.93-8.18) | −0.5 | 5.27 | 5.47 | 5.62 (5.49-5.76) | 2.8 |
| | 25-49 years | 1.84 | 1.65 | 1.48 (1.35-1.61) | −10 | 1 | 0.97 | 0.94 (0.81-1.06) | −3.4 |
| | 50-64 years | 22.07 | 21.46 | 21.06 (20.41-21.72) | −1.8 | 12.46 | 12.59 | 13.08 (12.43-13.73) | 3.9 |
| | 65+ years | 65.11 | 68.25 | 69.14 (67.95-70.34) | 1.3 | 47.53 | 50.21 | 51.69 (50.32-53.07) | 3 |

ASR, age-standardized mortality rates using the world standard population; PI, prediction interval.

## DISCUSSION

The present analysis updates the cancer mortality predictions to 2021, confirming and further quantifying the persistent declines in total cancer mortality for both sexes in Europe, and in several specific cancer sites. The proportionally highest declines (>10%) were predicted in stomach cancer and leukaemias in both sexes and in lung and bladder cancer in men. In addition, other major cancer sites, including colorectum, prostate, breast and ovary, showed appreciable favourable trends. However, in the EU27 there were no substantial changes in pancreatic cancer mortality, apart for some fall in young men, confirming its status as a major public health concern in Europe.

Following Brexit, we presented the UK separately as in previous reports, but we did not include it in the EU aggregate (EU27 as of 2020). Lung cancer patterns in the UK are closer to those seen in the USA than those in the EU27. Male lung cancer rates are more than 25% lower in the UK than in the EU27, because of earlier and larger decreases in smoking prevalence in UK men.[9] This is also reflected in a lower predicted total cancer mortality rate in the UK. The decreases in smoking prevalence in subsequent cohorts of European men explain the predicted fall in lung cancer mortality in the EU27.[10] UK lung cancer rates in women remain higher than those of the EU27, and this is mirrored in a higher overall total UK mortality rate. However, the UK shows a favourable

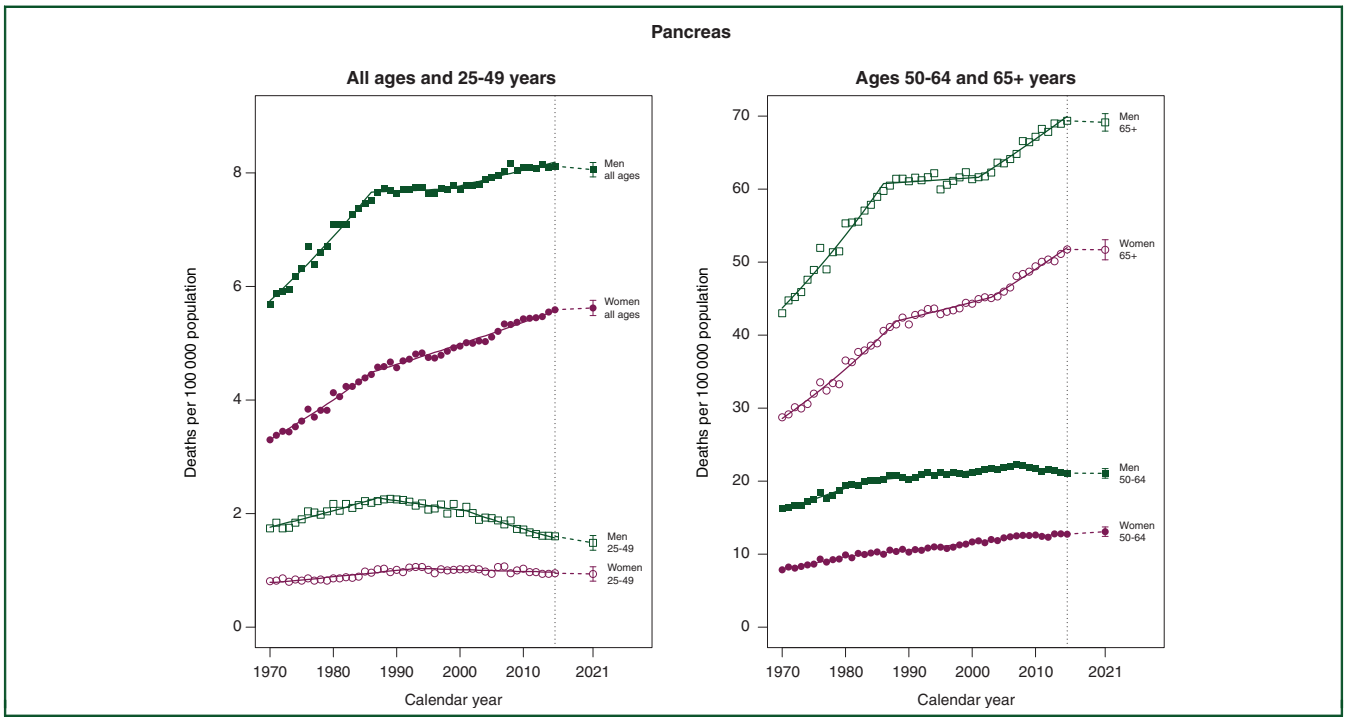


**Figure 4. Annual pancreatic cancer age-standardized (world population) death rates in the EU27 per 100 000 for the all-ages, 25-49, 50-64, and 65+ years age groups from 1970 to 2015, the resulting joinpoint regression models, and predicted rates for the year 2021 with 95% prediction intervals.**
On the left, men and women at all ages (full squares and full circles, respectively) and at 25-49 years (empty squares and empty circles); on the right, men and women at 50-64 years (full squares and full circles) and at 65+ years (empty squares and empty circles).

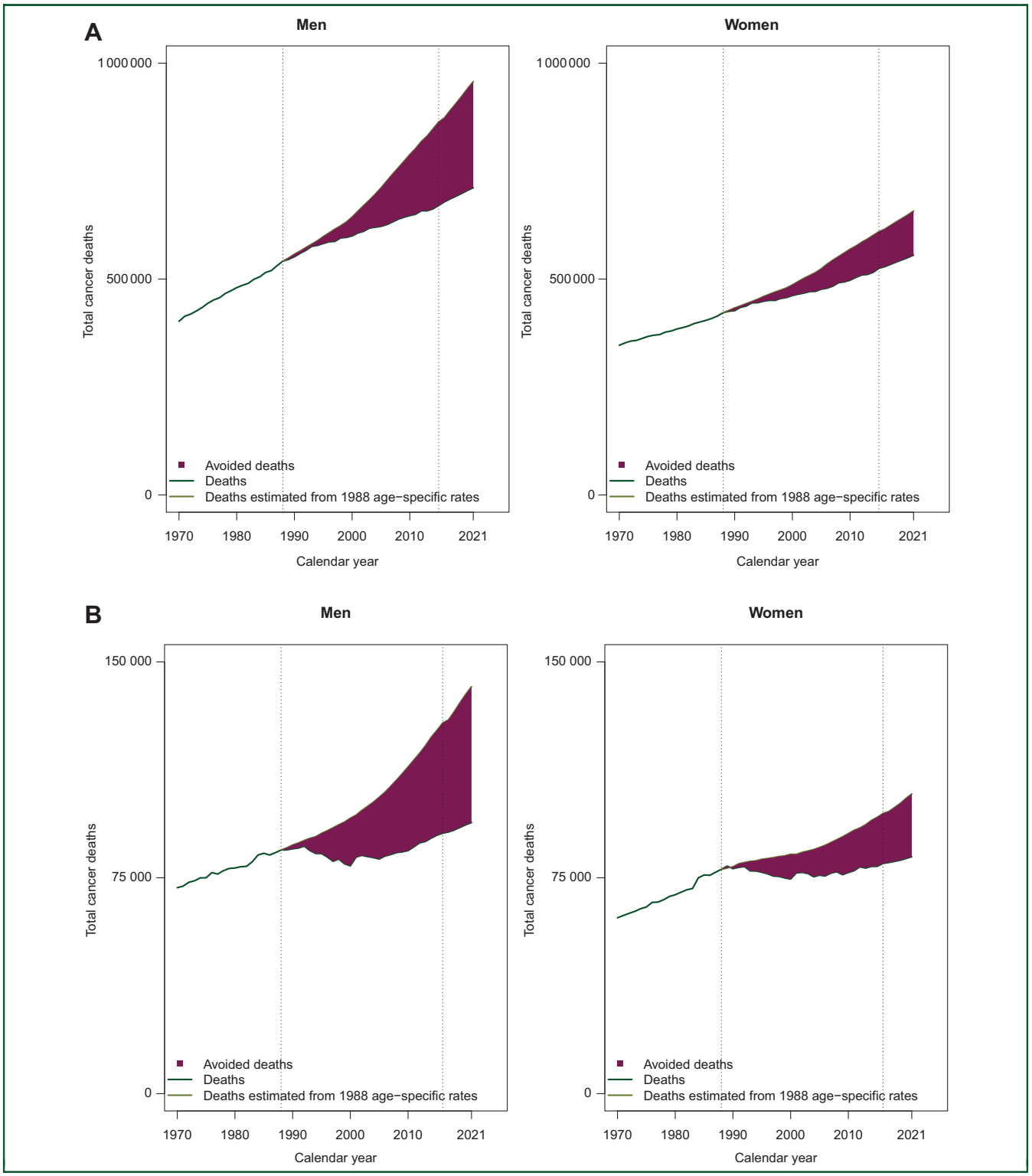


**Figure 5.** **(A) Total avoided cancer deaths for EU men and women between the top rate in 1988 and 2021; observed numbers of cancer deaths from 1970 to 2015 and predicted cancer deaths from 2016 to 2021; estimated numbers of total cancer deaths by applying 1988 age-specific peak mortality rate. During the 33-year period 4 957 800 cancer deaths have been avoided (3 338 900 in men and 1 618 900 in women). In 2021 alone, 245 700 deaths in men and 102 300 deaths in women are predicted to have been avoided, giving a total of 348 000. (B). Total avoided cancer deaths for UK men and women between the peak rate in 1988 and 2021; observed numbers of cancer deaths from 1970 to 2015 and predicted cancer deaths from 2016 to 2021; estimated numbers of total cancer deaths by applying 1988 age-specific peak mortality rate. During the 33-year period 1 063 200 cancer deaths have been avoided (722 700 in men and 340 500 in women). In 2021 alone 47 200 deaths in men and 21 800 deaths in women are predicted to have been avoided, for a total of 69 000.**

lung cancer trend, in contrast with persistent upward trends in EU women. As previously reported,[11] lung cancer rates are the highest of any cancer site in EU women, too, although the absolute number of deaths is still predicted to be slightly higher for breast cancer. In the all ages estimates, there is little indication of levelling of female lung cancer trends in the EU. It is therefore possible that rates will reach 16-18/100 000 women in the next decade, in the absence of effective tobacco control interventions tailored to European women.[12]

In all major Western European countries considered, colorectal cancer mortality continued its steady decline, largely attributable to improved diagnosis, screening and management.[13] The main exceptions are Polish men, indicating that diagnosis and treatment of this neoplasm should be improved in Poland and probably in several countries of Central and Eastern Europe. Of interest are the confirmed trends towards uniform colorectal cancer mortality in both sexes across Europe.[14]

Similar lines of reasoning apply to breast and prostate cancer, major declines of which are likely attributable to improved diagnosis, (organised) screening for breast cancer and advancement in medical, radiological and surgical treatments.[15,16] For breast this may also explain levelling towards similar rates across Europe. An exception was prostate cancer in Poland, again pointing to the necessity of improving cancer management in Poland and probably other countries of Central and Eastern Europe. Over the last decades, the fall in breast cancer mortality has been in the order of 30% in most European countries, but 50% in the UK, which is predicted to have similar rates to other major European countries. Besides the effect of screening, better diagnosis and treatment, breast cancer rates are levelling across Europe, reflecting more uniform reproductive, hormonal and lifestyle habits (e.g. the prevalence of obesity).[17]

Over the past decade, uterine cancer had less marked declines in rates (recorded and projected) compared with other neoplasms. Although the interpretation of this result is complicated by the fact that the data combine deaths from endometrial and cervical cancer, it suggests the importance of introducing high-coverage human papillomavirus vaccination across Europe and effective screening particularly in Central and Eastern Europe, which showed the highest rates.[18]

The widespread declines in ovarian cancer mortality, likely due to oral contraception use,[19] reductions in hormone replacement therapy use[20] and possibly to greater efforts in early diagnosis and targeted therapy,[21] are again smaller in Poland than in Western European countries.

While the substantial and continuous fall in leukaemias rates is likely due to accumulating therapeutic advancements for various types of this group of diseases,[22] the fall in stomach cancer was largely due to the control of *Helicobacter pylori* and other risk factors, including tobacco, food preservation and dietary aspects, and only partly to better management and treatments.[23,24] Stomach cancer also includes the neoplasms from the gastric cardia which is linked to excess weight and obesity and the incidence of which has not been falling.[25,26]

Bladder cancer is much more common in men than in women, and its declines have been larger in men, with the exclusion of Poland. This is attributable to the declines in male tobacco smoking, together with the reduced occupational exposure to occupational carcinogens, particularly aromatic amines.[27] Advances in management, surgery and the introduction of new immune checkpoint inhibitors may also have played some role.[28,29]

Pancreatic cancer represents the fourth most common cause of neoplastic deaths in both men and women in the EU27 and the UK. Among major cancer sites, pancreatic cancer remains the only one showing no overall falls over the last two decades in the EU27 in both sexes. Indeed, over the last decades, rates have been approximately stable in men, but have continued to rise in women and some decline was observed only in people below the age of 50 years, particularly in men. This likely reflects the different smoking prevalence patterns in subsequent generations of men and women in Europe, since tobacco is the major recognised risk factor for pancreatic cancer,[30] accounting for 20% of cases.[31] The absence of falls for males, in sharp contrast with all other tobacco-related cancers in European men, is therefore surprising. The more favourable trends in pancreatic cancer mortality in young and middle-aged men are, however, consistent with the stronger declines in smoking in more recent cohorts across Europe. Other recognised risk factors for pancreatic cancer are obesity and diabetes, as well as heavy alcohol drinking and, perhaps, selected aspects of diet,[32] but they account only for a small proportion of cases.[31] It remains possible, however, that improved diagnosis had some role on pancreatic cancer rates, particularly on the substantial rises in earlier calendar periods. Despite more widespread and improved diagnosis through mainly echography and magnetic resonance imaging, this had little impact of pancreatic cancer mortality, since survival remains low even with earlier diagnosis. Some progresses in survival have been reported for stage I pancreatic cancer from the SEER database,[33] which, however, are counterbalanced in increased incidence due to greater surveillance. Precision medicine is leading to improved preoperative treatments of pancreatic cancer,[34] but the potential impact of these innovative approaches is difficult to quantify. It is important to focus additional resources in the prevention, early diagnosis and management of pancreatic cancer to favourably modify the trends in the near future.

Interpretation of results of prediction models needs caution. However, the large populations under analysis should protect from random variation. We did not apply other prediction models, but we compared our 2015 predictions[35] with observed data.[11] All the estimates were within 5% of the subsequently certified data, and most of them within 2%. Additional uncertainties for 2021 are related to the effect of the coronavirus disease 2019 (COVID-19) pandemic, which may increase cancer mortality due to delayed diagnosis and

treatment, but also decrease it due to a harvesting effect on late-stage cancer patients.[36,37]

To summarise, the favourable trends in cancer mortality documented in previous years are confirmed, as are the priorities in tobacco uptake prevention and cessation promotion, with particular attention to women. There is also the need to improve the adoption rate of more effective diagnosis, therapy and management in Eastern Europe. Pancreatic cancer should be a major focus of public health efforts, since it continues its comparably unfavourable trend, with little in the way of better therapy or management options.

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## DISCLOSURE

The authors have declared no conflicts of interest.

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