

SUPPLEMENTARY INFORMATION

Smoking Effects

The basic ERR_{smk} model was linear in pack years (ppd times $sdur$), which stopped accumulating when smoking cessation was reported. However, we also considered more general models in which the smoking effect was proportional to the $ppd^{\theta_p} sdur^{\theta_s}$ where θ_p and θ_s were not constrained to be equal. This is equivalent to the pack-year model when $\theta_p = \theta_s = 1$. For most analyses, we assumed that ERR_{smk} remained unchanged after smoking cessation. The smoking effect models also included sex-specific time-dependent effects of unknown smoking status (people were treated as having unknown smoking status prior to the time they first reported their smoking status).

Table S1. Parameter estimates of smoking and/or alcohol drinking for upper digestive tract cancers in the multiplicative excess relative risk model for oral cavity/pharyngeal cancers other than salivary gland cancer.

Table S2. Parameter estimates of smoking and/or alcohol drinking for upper digestive tract cancers in the multiplicative excess relative risk model for salivary gland cancer.

Table S3. Parameter estimates of smoking and/or alcohol drinking for upper digestive tract cancers 3 in the multiplicative excess relative risk model for esophageal cancer.

Table S4. Parameter estimates of smoking and/or alcohol drinking for upper digestive tract cancers 8 in the multiplicative excess relative risk model for stomach cancer.

Table S5. Parameter estimates of radiation dose terms and comparison of model fitting by handling of subjects with $> 4Gy$ kerma.

Fig. S1. Background incidence rates of oral cavity/pharyngeal cancer excluding salivary gland cancer. The left panel presents fitted sex-specific rates for males and females by birth cohort. The right panel presents sex-specific background rates for subjects who were born in 1915 adjusted for the effects of smoking and alcohol drinking. The black lines are for males and gray lines are for females.

Fig. S2. Background incidence rates of esophageal cancer, with and without adjustment for smoking and alcohol. The left panel presents fitted sex-specific rates for men and women by birth cohort. Male rates are

given for three birth cohorts. A single curve is given for females since there were no significant birth cohort effects. The right panel presents sex-specific background rates for subjects who were born in 1915 with adjustment for the effects of smoking or alcohol consumption. The black lines are for males and gray lines are for females.

Fig. S3. Background incidence rates of stomach cancer, with and without adjustment for smoking and alcohol. The left panel presents fitted sex-specific rates for men and women by birth cohort. The right panel presents sex-specific background rates for subjects who were born in 1915 adjusted for the effects of smoking and alcohol drinking. The black lines are for males and gray lines are for females.

1 Supplementary Table S1
 2 Parameter estimates of smoking and/or alcohol drinking for upper digestive tract cancers
 3 in the multiplicative excess relative risk model for oral cavity/pharyngeal cancers other
 4 than salivary gland cancer

| | Smoking | Alcohol drinking | Smoking + alcohol drinking |
|-----------------------------------------------------|------------------------------------------------|----------------------|-------------------------------|
| Male ever smoker (/50 pack-years) | 3.32 ^a (1.42, 7.97) ^b | - | 3.05 (1.27, 7.37) |
| Female ever smoker (/50 pack-years) | 0.84 (0.80, 2.80) | - | 0.64 (<0.02, 0.38) |
| Male smoking status unknown | 2.10 (0.74, 5.37) | - | 1.70 (0.44, 4.73) |
| Drinking amount (/7drinks ^c per week) | - | 0.29 (0.10, 0.62) | 0.22 (0.06, 0.50) |
| Male drinking status unknown | - | 0.71 (0.12, 1.68) | 0.71 (0.03, 1.89) |
| AIC difference ^d | 30.7 | 9.3 | 36.0 |

5 ^aExcess relative risk, ^b 95% Confidence Interval, ^c 1 drink=14g ethanol weight, ^d Akaike Information Criterion (AIC)
 6 difference from the back ground model without adjustment for smoking and alcohol drinking

7 Supplementary Table S2
 8 Parameter estimates of smoking and/or alcohol drinking for upper digestive tract cancers
 9 in the multiplicative excess relative risk model for salivary gland cancer

| | Smoking | Alcohol drinking | Smoking + alcohol drinking |
|------------------------------------------------------|--------------------------------------------------|-------------------------------------|--------------------------------------------------|
| Ever smoker (/50 pack-years) | 0.30 ^a (<0.001, 1.63) ^b | - | 0.33 (0.01 ^d , 8.73 ^d) |
| Drinking amount (/7 drinks ^c per week) | - | 0.02 (-0.21 ^d , 0.41) | -0.01 (-0.09 ^d , 0.37) |
| AIC difference ^e | -1.4 | -2.0 | -3.40 |

10 ^aExcess relative risk, ^b 95% Confidence Interval, ^c 1 drink=14g ethanol weight, ^d Wald-type confidence limit
 11 ^e Akaike Information Criterion (AIC) difference from the back ground model without adjustment for smoking and
 12 alcohol drinking

1 Supplementary Table S3
 2 Parameter estimates of smoking and/or alcohol drinking for upper digestive tract cancers
 3 in the multiplicative excess relative risk model for esophageal cancer

| | Smoking | Alcohol drinking | Smoking + alcohol drinking |
|-----------------------------------------------------------|------------------------------------------------|------------------------|-------------------------------|
| Male ever smoker (/50 pack-years) | 2.98 ^a (1.44, 6.30) ^b | - | 2.34 (1.08, 5.03) |
| Female ever smoker (/50 pack-years) | 0.54 (<0.001, 3.15) | - | 0.64 (0.18, 2.24) |
| Male smoking status unknown | 2.59 (1.24, 5.42) | - | 2.35 (1.06, 5.00) |
| Male drinking amount (/7 drinks ^c per week) | - | 0.66 (0.34, 1.26) | 0.53 (0.26, 1.04) |
| Female drinking amount (/7 drinks per week) | - | 0.09 (<0.001, 0.91) | 0.15 (<0.001, 1.94) |
| Drinking status unknown | - | 1.58 (0.69, 3.20) | 0.92 (0.18, 2.24) |
| AIC difference ^d | 43.8 | 39.9 | 74.6 |

4 ^a Excess relative risk, ^b 95% Confidence Interval, ^c 1 drink=14g ethanol weight, ^d Akaike Information Criterion (AIC)
 5 difference from the back ground model without adjustment for smoking and alcohol drinking

6 Supplementary Table S4
 7 Parameter estimates of smoking and/or alcohol drinking for upper digestive tract cancers
 8 in the multiplicative excess relative risk model for stomach cancer

| | Smoking | Alcohol drinking | Smoking + alcohol drinking |
|-----------------------------------------------------|------------------------------------------------|--------------------------|-------------------------------|
| Ever smoker (/50 pack-years) | 0.78 ^a (0.59, 0.99) ^b | - | 0.77 (0.58, 0.98) |
| Smoking intensity log(pack/day) | -0.70 (-0.91, -0.48) | - | -0.71 (-0.92, -0.49) |
| Male smoking status unknown | 0.21 (0.08, 0.36) | - | 0.23 (0.09, 0.40) |
| Drinking amount (/7drinks ^c per week) | - | 0.02 (-0.003, 0.06) | 0.01 (<-0.01, 0.04) |
| Male drinking status unknown | - | -0.11 (-0.19, -0.009) | -0.02 (-0.13, 0.10) |
| AIC difference ^d | 129.0 | 11.8 | 126.2 |

1 ^a Excess relative risk, ^b 95% Confidence Interval, ^c 1 drink=14g ethanol weight, ^d Akaike Information Criterion (AIC)
2 difference from the back ground model without adjustment for smoking and alcohol drinking

Supplementary Table S5

Parameter estimates of radiation dose terms and comparison of model fitting by handling of subjects with > 4Gy kerma.

| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
|------------------------|-----------------------------------|------------------------|----------------------|-------------------------|---------------------------------------------------|----------------------------------------------------|
| Male d | 0.20 (0.10, 0.34) ^a | 0.003 (-0.24, 0.26) | 0.21 (0.10, 0.35) | 0.13 (0.01, 0.27) | 0.13 (0.01, 0.27) | 0.16 (-0.12, >0.31) |
| Male d^2 | - | 0.10 (-0.01, 0.25) | - | - | - | -0.02 (0.002 ^b , 0.15) |
| Female d | 0.45 (0.25, 0.68) | 0.46 (0.26, 0.69) | 0.47 (0.28, 0.70) | 0.50 (0.29, 0.74) | 0.50 (0.27 ^b , 0.74) | 0.50 (0.27 ^b , 0.74) |
| Male (> 4Gy) d | - | - | 0.21 (0.10, 0.35) | 0.55 (0.24, 1.00) | -2.77 (-5.90 ^b , >-0.98) | -2.77 (-5.93 ^b , >-0.98) |
| Male (> 4Gy) d^2 | - | - | - | - | 1.09 (0.001 ^b , 2.17 ^b) | 1.09 (-0.003 ^b , 2.18 ^b) |
| Female (> 4Gy) d | - | - | 0.47 (0.28, 0.70) | 0.13 (<-0.001, 0.67) | 0.13 (-0.10 ^b , 0.67) | 0.13 (<0.001, 0.67) |
| Indicator for > 4Gy | 0.41 (-0.70, 1.01) | 0.13 (-0.76, 0.84) | - | - | - | - |
| Deviance | 28992.4 | 28989.3 | 28992.9 | 28984.1 | 28980.7 | 28980.6 |
| AIC ^c | 29030.4 | 29029.3 | 29028.9 | 29024.1 | 29022.7 | 29024.6 |
| P value ^d | - | 0.08 | - | 0.01 | 0.06 | > 0.5 |

Model 1: Basic linear (L) model with indicator for subjects with total shielded kerma of > 4 Gy as an effect modifier

Model 2: Male linear-quadratic (LQ) female L model with indication for subjects with total shielded kerma of > 4 Gy as a effect modifier

Model 3: A L model without indicator for subjects with total shielded kerma of > 4 Gy as an effect modifier

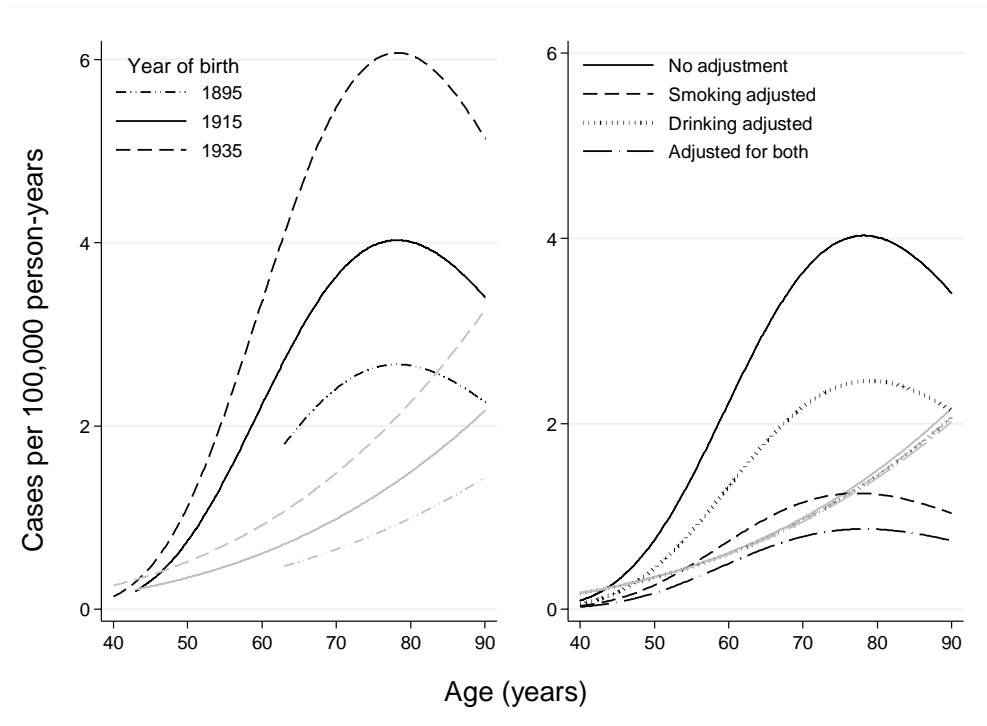
Model 4: A L model allowed female male ratio could be different between total shielded kerma of <= 4 Gy and > 4 Gy

Model 5: A model allowed dose-response shape could be different between total shielded kerma of ≤ 4 Gy (L) and > 4 Gy (Male LQ, Female L)

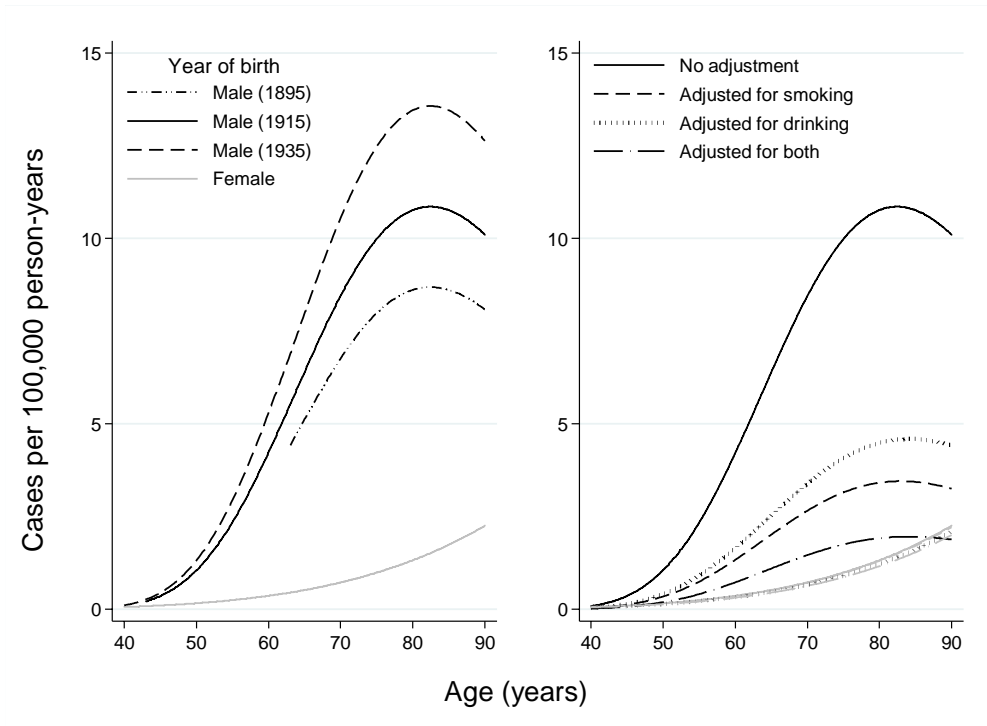
Model 6: A model allowed dose-response shape could be different between total shielded kerma of ≤ 4 Gy (Male: LQ, Female L) and > 4 Gy (Male LQ, Female L)

^a 95% Confidence interval, ^b Wald-type confidence limit, ^c Akaike information criterion, ^d Likelihood ratio test compare with the model in the left column

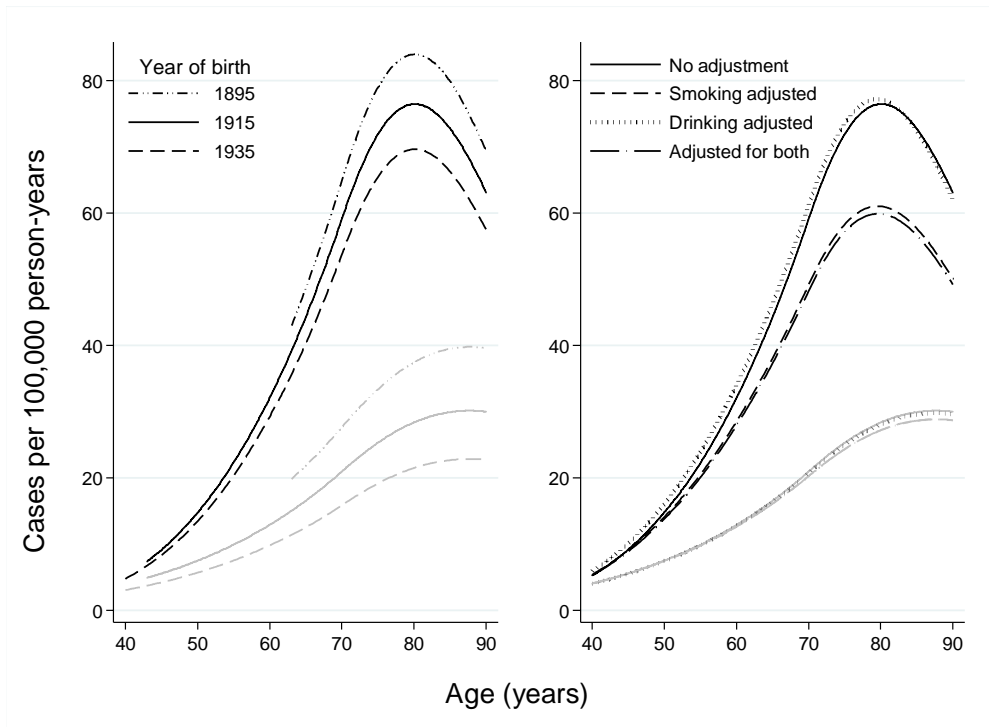
Supplementary Figure S1



Supplementary Figure S2



1 Supplementary Figure S3



2