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Supporting Information

Supplementary tables

This appendix was part of the submitted manuscript and has been peer reviewed.
It is posted as supplied by the authors.

Table 1. Devcan estimates for changes in lifetime risk of lung cancer, 1982–2012

It is generally agreed that lung cancer screening is associated with overdiagnosis.[1] Smoking rates declined from 1980 to 2012 by about 50% for both men and women.[2] But adjusting for declines prior to this period would require assumptions about the lag time between changes in smoking prevalence and those in lung cancer rates. Some screening has been undertaken, but reliable data on national screening rates are unavailable.[3] Given the substantial declines in smoking, the lag period, and the modest uptake of screening in Australia, it extremely difficult to disentangle the components underlying the change in incidence of lung cancer.

Sex	Lifetime probability		Change in lifetime probability	
	1982	2012	Absolute	Proportion
Women	0.012	0.050	0.038	76%
Men	0.103	0.073	−0.030	−41%

Table 2. Sensitivity analysis: estimated breast cancer overdiagnosis

Long term trends in the 20th century toward fewer children, earlier menarche, later age at first full term birth, and increased consumption of alcohol have contributed to increasing breast cancer risk. To capture their combined effect (while avoiding the overdiagnosis from screening) we adjusted for the observed increase in breast cancer incidence in women under 40 (or increasing invasive breast cancer incidence in women under 40, or under 50) years of age, using the formula:

$$\text{adjustment factor} = (P_{< X,2012} - P_{<X,1982})/P_{< X,1982}$$

where $P_{< X,Y}$ = probability of breast cancer diagnosis in women under X years in year Y.

Age cut-off	1982 lifetime probability	2012 lifetime probability	Change in probability, 1982–2012	Overdiagnosis proportion*
Unadjusted				
Including DCIS	0.095	0.153	0.058	38%
Invasive only	0.093	0.134	0.041	31%
Adjusted[†]				
< 40 years				
Including DCIS	0.110	0.153	0.043	28%
Invasive only	0.108	0.134	0.026	19%
< 45 years (main analysis)				
Including DCIS	0.119	0.153	0.034	22%
Invasive only	0.116	0.134	0.018	13%
< 50 years				
Including DCIS	0.128	0.153	0.025	16%
Invasive only	0.126	0.134	0.008	6%

DCIS = ductal carcinoma in situ. * Change in probability (1982–2012)/probability (2012). † Adjusted for increase in breast cancer incidence in women less than 40, 45, or 50 years of age.

Table 3. Sensitivity analysis: estimated melanoma overdiagnosis

As a second adjustment method we adjusted the 1982 lifetime probability according to reported changes in age-standardised melanoma mortality in Australia in the 10 years from 1975–79 to 1985–89:[4] from 3.91 to 4.82 deaths per 100 000 men, and from 2.23 to 2.51 deaths per 100 000 women, and remained steady thereafter.

If melanoma incidence increased over three decades at the same rate that mortality increased during the 10 years from 1975–99 to 1985–99, the increase would be $(4.82/3.91)^3 = 1.87$ in men and $(2.51/2.23)^3 = 1.43$ in women over the three decades.

For melanoma (including in situ tumours), we also multiplied the 1982 lifetime risk by 1.126 for women and by 1.101 for men to account for in situ cancers likely to have been diagnosed but not recorded in registries.

Sexr	1982 adjusted lifetime probability	2012 lifetime probability	Change in probability, 1982–2012	Overdiagnosis proportion*
Women				
Including in situ tumours	$0.025 \times 1.43 \times 1.126 = 0.040$	0.095	0.055	58%
Invasive only	$0.025 \times 1.43 = 0.036$	0.046	0.009	20%
Men				
Including in situ tumours	$0.027 \times 1.87 \times 1.101 = 0.056$	0.139	0.083	60%
Invasive only	$0.027 \times 1.87 = 0.05$	0.069	0.019	27%

* Change in probability (1982–2012)/probability (2012).

Table 4. Lifetime probability of cancer-specific death

We applied the Devcan method to assessing the lifetime risk of dying from specific cancers, adjusted for competing mortality changes between 1982 and 2012

Sex/cancer	Lifetime probability, 1982		Lifetime probability, 2012	Change in lifetime probability	
	Unadjusted	Adjusted*		Absolute	Proportion
Women					
Breast	0.031	0.041	0.030	−0.011	−37%
Melanoma	0.0031	0.0040	0.0054	0.0014	26%
Thyroid	0.0008	0.0010	0.0008	−0.0002	−25%
Renal	0.0030	0.0039	0.0043	0.0004	9%
All cancers	0.178	0.241	0.224	−0.017	−7%
Men					
Prostate	0.025	0.054	0.046	−0.008	−17%
Melanoma	0.0049	0.0067	0.012	0.0053	44%
Thyroid	0.0004	0.0006	0.0008	0.0002	25%
Renal	0.0043	0.0065	0.0066	0.0001	2%
All cancers	0.217	0.364	0.304	−0.06	−20%

* Adjusted by applying 2012 all-cause mortality rates to the calculation of lifetime probability of cancer specific death in 1982.

References

1   Esserman LJ, Thompson IM, Reid B. Overdiagnosis and overtreatment in cancer: an opportunity for improvement. JAMA 2013; 310: 797–798.
2   Scollo MM, Winstanley, MH. Tobacco in Australia: facts and issues. Melbourne: Cancer Council Victoria, 2016. https://www.tobaccoinaustralia.org.au/downloads/chapters/Ch1_Prevalence.pdf (viewed Feb 2019).
3   Manners D, Wilcox H, McWilliams A, et al Current lung cancer screening practice among general practitioners in Western Australia: a cross-sectional study. Intern Med J 2018; 48: 78-80.
4   Giles GG, Armstrong BK, Burton RC, et al. Has mortality from melanoma stopped rising in Australia? Analysis of trends between 1931 and 1994. BMJ 1996; 312: 1121-1125.