Has mortality from melanoma stopped rising in Australia? Analysis of trends between 1931 and 1994

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Abstract

Objective—To describe recent trends in mortality from melanoma in Australia.

Design—An analysis of trends in age standardised and age and sex specific mortalities by year of death and median year of birth (cohort).

Setting—Australia.

Subjects—All deaths from melanoma registered in Australia between 1931 and 1994.

Results—Melanoma mortality rose steadily from 1931 to 1985. From 1959 the annual rate of increase was 6.3% in men and 2.9% in women, resulting in mortalities of 4.82 and 2.51 per 100 000 person years in 1985 and 1989, respectively. Mortalities for both sexes seem to have plateaued from June 1985 onwards. In 1990-4 the rate rose by 3.7% in men to 5.00 per 100 000 and in women it fell by 5.2% to 2.38 per 100 000. The non-significant increase after 1985 in mortality in men was restricted to those aged over 70 years of age, whereas the fall in rates in women was mostly in those aged under 55 years. This pattern was generally reflected in the state trends, though with some variation: rates for women in Queensland had peaked in the late 1970s; while rates for men in New South Wales continued to rise in 1990-4, placing them above those for Queensland. Examination of mortalities specific for age, period, and cohort for Australia as a whole showed several salient features. Rates in men rose steeply in cohorts born before about 1930; were stable in cohorts born between 1930 and 1950; and fell in more recent cohorts. Rates in women showed similar changes but about five years earlier.

Conclusion—Melanoma mortality in Australia peaked in about 1985 and has now plateaued. On the basis of trends in cohorts it can be expected to fall in coming years.

Introduction

Cutaneous malignant melanoma (melanoma) has been rising in incidence and mortality in white populations around the world, including Australia, for several decades.¹ Although national melanoma incidence data are limited in Australia to the period since 1982,² regional data have been reported for earlier times,³⁻⁴ and mortality data have been separately available for other skin cancers since 1931.⁵⁻⁶ Australian age standardised mortalities (per 100 000 person years) for melanoma were recently reported to have risen from 1.40 in men and 1.09 in women in 1950-4 to 4.92 and 2.53, respectively, in 1990-1.⁷

As in North America, Scandinavia, and New Zealand, rising melanoma mortality has been observed to be linked to birth cohorts.⁸⁻¹¹ In their analysis of melanoma mortality in Australia between 1950 and 1977, Holman *et al* showed that mortality had progressively increased in all states except Queensland and that these trends could be explained by successive increases

in cohorts born from about 1865 onwards, stabilising in cohorts born around 1925 in women and 1935 in men.⁶ On the basis of the cohort trend, it was anticipated that melanoma mortality would take another 30 to 40 years to peak. Apparent stability in Queensland rates was thought to be related to the Queensland melanoma project, which in terms of public and professional education about skin cancer was enjoying great success during the 1970s.¹² When this analysis was extended to 1984, however, the apparent flattening of rates in Queensland had disappeared.¹³

More dramatic than the trends in mortality has been recent sharp increases in incidence, particularly in elderly men and of thin melanomas.¹⁴⁻¹⁶ Thin invasive melanomas rarely cause death, and there is some evidence that many of these cancers may never metastasise even if untreated.¹⁷ The impact of the increase in incidence on mortality must, therefore, be driven by thicker lesions, which, in some areas at least, are increasing little if at all.¹⁸ Since the late 1980s there have been some suggestions that mortality trends are now flattening in several countries.¹⁹⁻²³ Given this possibility, we decided to re-examine the data on melanoma mortality for Australia and its more populous states, extending the analysis to 1994, the latest available year.

Methods

Mortality and population data covering the period 1931 to 1994 were obtained from tables provided by the Australian Bureau of Statistics. Data for individual states and territories were assembled from bureau publications and data files with the assistance of the Australian Institute of Health and Welfare. Age (in five year age groups) and sex specific rates per 100 000 person years were calculated for each five year period from 1935-9 to 1990-4 and for the four year period 1931-4. There were limitations in some of the states' data owing to the different aggregation of age groups before 1960 and to the small numbers of deaths. Rates for the Northern Territory were not included in the analysis because of the small numbers of deaths and the large aboriginal population, which is not susceptible to cutaneous melanoma. Australian and state rates were standardised to the age distribution of the world standard population.

Results

Melanoma mortalities for Australia as a whole increased steeply from 1945 to 1959 (average annual increase of 11.5% in men and 8.9% in women) and more slowly from 1960 to 1989 (average annual increase of 6.3% in men and 2.9% in women). In 1985-9 the average age standardised rates were 4.82 and 2.51 per 100 000 person years in men and women, respectively. The rates for 1990-4 showed a distinct flattening for men (5.00 per 100 000, an increase of only 3.7%) and a small fall in women (2.38 per 100 000, a decrease of 5.2%). Figure 1 illustrates the trend in five year average rates standardised for age from 1960-4 to 1990-4 by plotting the 95% confidence band around

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Table 1—Mortality from melanoma in Australia, 1931-94: age specific rates per 100 000 person years

Age (years)	1931-4	1935-9	1940-4	1945-9	1950-4	1955-9	1960-4	1965-9	1970-4	1975-9	1980-4	1985-9	1990-4
Men													
15-19	0.08	0.26	0.06	0.14	0.48	0.35	0.27	0.26	0.27	0.34	0.30	0.40	0.18
20-24	0.25	0.26	0.71	0.38	0.93	1.13	0.70	1.35	0.94	0.83	0.74	0.70	0.58
25-29	1.01	0.48	0.73	0.86	1.11	1.50	2.13	1.30	1.62	1.97	1.80	1.49	1.03
30-34	0.40	0.90	1.04	1.34	1.36	2.49	2.23	2.94	3.05	3.57	3.23	3.17	2.27
35-39	0.54	0.82	1.06	1.26	1.91	3.29	3.30	3.27	3.18	3.94	3.72	3.74	3.02
40-44	0.43	0.80	1.25	1.46	2.41	3.35	3.98	4.64	5.02	5.34	4.42	4.65	4.92
45-49	1.47	1.08	1.64	1.97	2.09	4.08	5.12	4.66	5.95	6.84	6.11	5.82	6.20
50-54	1.19	1.15	1.79	1.81	2.44	5.30	5.87	6.72	6.77	7.91	8.90	9.59	9.31
55-59	2.06	2.08	2.12	2.52	2.32	3.34	5.61	7.16	9.00	10.37	12.06	12.89	11.55
60-64	1.76	2.53	1.88	3.62	3.35	5.05	6.28	9.19	8.92	12.09	14.93	15.55	17.96
65-69	3.26	3.34	2.59	1.55	4.89	7.01	7.18	9.54	10.63	15.05	17.86	20.50	22.83
70-74	2.30	1.68	1.60	3.35	3.77	6.11	7.66	10.56	11.64	16.69	22.56	28.57	29.99
75-79	3.68	4.63	2.09	5.14	5.71	7.26	7.85	12.68	14.05	16.12	22.68	32.69	40.75
80-84	1.82	4.50	0.85	6.10	8.53	7.48	12.34	11.10	15.44	20.73	24.13	37.23	48.16
≥85	4.33	0.00	7.71	1.77	10.51	16.55	9.85	14.28	15.52	26.73	22.20	49.50	56.05
ASR	0.71	0.74	0.84	1.01	1.40	2.16	2.46	2.91	3.16	3.91	4.25	4.82	5.00
Women													
15-19	0.08	0.07	0.13	0.14	0.29	0.25	0.33	0.16	0.25	0.19	0.19	0.21	0.12
20-24	0.27	0.33	0.46	0.19	0.79	0.74	0.23	0.62	0.58	0.68	0.34	0.30	0.26
25-29	0.30	0.87	0.53	0.79	0.83	1.17	1.55	1.44	1.16	1.08	1.23	0.94	0.78
30-34	0.42	0.73	0.43	1.26	1.23	2.19	1.39	1.80	1.82	2.02	1.42	1.64	1.30
35-39	0.53	0.42	1.31	1.90	1.97	1.71	2.75	2.76	2.50	2.59	2.29	2.65	1.98
40-44	1.21	0.26	1.12	1.08	1.77	2.91	3.18	3.68	3.05	2.64	3.18	3.11	3.12
45-49	1.54	0.46	1.15	1.32	1.98	3.22	3.59	3.81	4.87	3.86	4.17	4.47	3.83
50-54	1.56	1.52	1.70	1.93	2.16	2.58	4.75	4.22	5.54	4.77	4.78	5.58	4.43
55-59	1.34	1.33	1.92	1.89	2.18	4.11	3.83	4.42	5.16	6.01	5.85	5.83	5.81
60-64	1.35	1.33	1.84	2.90	2.10	3.58	4.86	4.33	5.93	7.26	6.44	7.54	7.60
65-69	1.41	1.42	2.42	1.73	2.40	3.32	4.40	4.80	7.33	8.15	8.96	8.61	8.34
70-74	0.79	3.85	3.16	2.68	3.33	4.98	6.20	6.81	6.95	7.75	11.11	11.36	13.40
75-79	2.15	2.62	2.23	4.58	5.88	6.73	5.37	9.45	6.21	9.56	12.56	15.85	16.26
80-84	3.26	1.93	3.52	5.34	6.18	4.09	8.35	9.85	10.41	14.23	15.02	18.88	18.75
≥85	3.21	4.50	8.90	6.07	2.93	11.43	11.45	12.65	10.64	14.87	20.44	24.17	26.50
ASR	0.57	0.57	0.79	0.92	1.09	1.56	1.82	1.95	2.14	2.23	2.33	2.51	2.38

ASR = age standardised rate.

Fig 1—95% Confidence bands around age standardised five year average mortalities per 100 000 person years from malignant melanoma: Australia 1960-4 to 1990-4

Fig 2—95% Confidence bands around age standardised annual mortalities per 100 000 population from malignant melanoma: Australia 1975 to 1994

the point estimates of the rates. Figure 2 similarly plots the 95% confidence band around the annual rates standardised for age for 1975 to 1994 to show the plateau in mortality that has occurred since the mid 1980s.

Table 1 gives age, sex, and period specific mortalities. For each sex separately, the observed age and period specific rates have been plotted against year of birth (fig 3). Mortality in older men (over 59 years of age) rose steadily throughout the period of study, with some evidence of a reduction in the rate of increase in 1990-4 (fig 4). After initial increases in younger men mortality reached a maximum in those born in about 1930 and has since fallen in those born after about 1950. Similar patterns were seen in women, except that the peak was reached in those born in about 1925 and the fall in mortality began in those born in about 1945 (fig 4).

The trends in mortality by state did not show a uniform pattern, at least in men (fig 5). Whereas the overall trend was upwards in all states, there was an early transient downwards trend to 1960-4 in Western Australia and to 1965-74 in Queensland and Victoria. At the other end of the time period, the increase continued unabated in Queensland, New South Wales, and Victoria, whereas in Western Australia, South Australia, and Tasmania mortality fell from 1985 to 1994.

The state specific trends in mortality in women are more difficult to interpret because of the smaller numbers of deaths (fig 6). There were again some initial falls in mortality but only in Victoria and Western Australia. Mortality reached a peak in Queensland in 1975-9, fell, and then stayed reasonably stable. Rates in Western Australia also fell between 1975-9 and 1980-4 and then rose again. Each of the other states showed more recent downward trends in mortality, from 1980 to 1984 in Tasmania and from 1985 to 1989 in Victoria, New South Wales, and South Australia. The range of variation in mortality between states reduced substantially between the 1960s and the 1990s in both men and women.

Discussion

IS THE EPIDEMIC OF MELANOMA ABATING?

After at least 60 years of steadily increasing mortality from melanoma of the skin in Australia there is now clear evidence that this trend is coming to an end and that mortality has fallen in women. To our knowledge, this is the first time that a fall in age standardised rates (standardised to the age distribution of the world population) has been reported from any population of European origin. A recent report of melanoma trends in England and Wales²⁴ showed a small decline in mortality in women but used a different standard for age adjustment. On the basis of a similar analysis to that presented here, Holman *et al* predicted that mortality from melanoma would stop rising in Australia after about 2010⁶; this point seems to have been reached some 15 to 20 years earlier than expected. At the time of that analysis, however, the beginning of the substantial falls in mortality seen in younger age groups was barely evident, and the reduced rate of rise in mortality seen in older age groups in 1990-4 could not have been predicted.

Downturns in melanoma mortality in younger age groups have also been reported from the United States with evidence that overall mortality had stopped rising in women.^{19 20} A down trend may also be evident there. In a comprehensive review of trends in melanoma incidence and mortality, Armstrong and Kricke observed a flattening or downturn in mortality in people under 55 years of age in 13 of 18 sets of mortality data from populations of mainly European origin.¹ In England and Wales the slight downward trend in women but not in men was largely seen in women aged under 35 years born since 1950.²⁴ Given that the underlying, cohort based trends in mortality are similar in these populations, even more reports of a flattening or downturn in overall mortality from melanoma may be expected soon.

In contrast with mortality, the incidence of melanoma has been reported to have increased dramatically in several Australian populations (and some other populations, notably those in Scotland and New Zealand) in the late 1980s.^{15 16 25-27} These increases have mainly been in thin melanomas^{1 17} and have been explained on the basis of earlier detection of melanomas generally or increased detection of a form of melanoma which does not metastasise.¹⁷ Thus, these apparent trends in incidence do not necessarily contradict the evidence for a downturn in mortality. Indeed, earlier detection of melanomas that might otherwise cause death could explain the flattening or downturn seen in mortality in 1990-4 in both sexes and nearly all ages (figs 5 and 6).

IS THE REDUCTION DUE TO EARLY DETECTION?

Can increasingly early detection of melanoma explain the cessation in rise and the falls in mortality observed in those under 60 years of age? While it may have contributed, it is unlikely to be the whole story. This is because of the cohort based pattern of change in mortality in which points of inflexion correspond more closely to year of birth than year of death. Such a pattern is more consistent with a change, from one generation to the next, in exposure to a cause of melanoma. It would be consistent with a changing pattern of exposure to the sun beginning in those born around 1945 or 1950 as exposure to the sun probably causes more than 90% of melanomas in Australia¹ and some two thirds of melanomas are caused by exposure in the first 15 years of life.^{28 29} Unfortunately there are no data on trends in sun exposure in Australia from which trends by cohort of birth could be derived. Thus it is not known whether the cohort based trends in mortality from melanoma correspond to cohort based trends in exposure to the sun.

Early detection may have contributed to downtrends in melanoma mortality in Australia before 1990-4. In both Victoria and Queensland, the second and third most populous states, mortality in men fell steadily from 1960-4 to 1965-9 and 1970-4. A fall from 1960-4 to 1965-9 was also seen in Western Australia. No similar trend was seen in mortality in men in New South Wales, the most populous state. This difference in pattern between the three largest states could be explained by differences in intensity of local prevention and detection programmes for skin cancer. A review of relevant literature, including the annual reports of the Queensland,

Fig 3—Age specific five year average mortalities for men per 100 000 person years from malignant melanoma by median year of birth: Australia 1960-4 to 1990-4

Fig 4—Age specific five year average mortalities for women per 100 000 person years from malignant melanoma by median year of birth: Australia 1960-4 to 1990-4

New South Wales, and Victorian cancer societies, revealed the following information.

ROLE OF PUBLIC EDUCATION IN AUSTRALIA

The Queensland Cancer Fund was founded in 1961, and the Queensland melanoma project was launched in 1963.³⁰ Both led to increased public and professional education regarding skin cancer through the 1960s. Both the Queensland Cancer Fund and the Queensland Health Department greatly increased their skin cancer education programmes during the 1970s.^{12 31}

The Anti-Cancer Council of Victoria began in 1936 and increased its profile in 1958 by raising £1 500 000

Key messages

- Increasing trends in mortality from melanoma in Australia have resulted in campaigns to reduce exposure to the sun and increase early detection
- On the basis of cohort trends up to 1977 previous analysis predicted that melanoma mortality would not reach its peak before 2010
- Mortality, however, peaked in around 1985 and is now falling in women
- Variation in this trend between states underlines the need to evaluate the cost effectiveness of different strategies to promote early detection

Fig 5—Age standardised five year average mortalities for men per 100 000 person years by region of residence: Australia 1960-4 to 1990-4

Fig 6—Age standardised five year average mortalities for women per 100 000 person years by region of residence: Australia 1960-4 to 1990-4

for cancer research, patient aid, and public education. From 1959 onwards much activity and publicity was generated with regard to skin cancer. During this decade the council's newsletter, the *Victorian Cancer News*, was regularly giving advice about precautions against cancer of the skin.

The New South Wales Cancer Council was formed in 1955 but was primarily clinically based, and the Sydney Melanoma Unit was set up in 1968 primarily as a hospital unit treating melanoma. During the early 1960s educating the public about cancer in New South Wales was dealt with by the distribution of pamphlets and by lectures from the council's medical director; the first public education officer was appointed in 1967. Thus, by the time that New South Wales had an organised approach to skin cancer awareness, Queensland and Victoria already had a decade of public education in place.

It is possible, therefore, but by no means certain, that the differences between Queensland, Victoria, and New South Wales in the early trends in mortality in men were due to these differences in education about skin cancer. The lack of corresponding trends in women argues against this explanation (fig 6). The upward trend in mortality from melanoma was much less steep in women than that in men in all states, however, and men, particularly older men, generally present with much thicker lesions.^{17 27} Thus the scope for an effect of education on mortality by way of earlier diagnosis may have been greater in men than in women. Associations of public education programmes with a reduction in the rate of rise or a downtrend in mortality from melanoma have been observed in Scotland and Italy.^{26 32}

NEED FOR FURTHER EVALUATION

Though the inferences from our results are indirect, they provide encouragement to public health programmes designed to decrease exposure to the sun and promote earlier diagnosis of potentially life threatening melanoma. Neither kind of programme, however, has been adequately evaluated for its cost effectiveness. That reduction in sun exposure in Australia is cost effective seems highly likely. Data obtained by Hill *et al* from the Victorian Sun Smart programme suggest that the incidence of sunburn in adults in Australia can be reduced by one third by an annual expenditure of about \$A4.5m (£2.3m).³³ If it can be assumed that this or a similar programme would be equally effective in preventing sunburn in children and that a one third reduction in incidence of sunburn would produce a one third reduction in incidence of skin cancer, then \$A4.5m a year in prevention would lead, in the long run, to a reduction in some \$A53m (£27m) a year spent on "cure" (Australian Institute of Health and Welfare, unpublished data).

Analysis of a recent large increase in incidence of melanoma, however, suggests that increasing attempts to diagnose melanoma early leads to large and

disproportionate increases in the excision of benign skin lesions.²⁷ Some of these lesions will appear and be treated as invasive melanoma, with all that it signifies to the patient, even though they have no capacity to metastasise.¹⁷ Thus an adequate evaluation of the cost effectiveness of different approaches to promoting the early diagnosis of melanoma should be a high priority for research.

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Incidence and thickness of primary tumours and survival of patients with cutaneous malignant melanoma in relation to socioeconomic status

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Abstract

Objective—To study incidence of and survival from cutaneous malignant melanoma in relation to socioeconomic status.

Design—Application of Carstairs deprivation score to all malignant melanoma patients diagnosed in a geographically defined area over a 15 year period.

Setting—West of Scotland (area population 2 716 900).

Subjects—3142 patients first diagnosed with malignant melanoma in the period 1979-93.

Interventions—Surgical excision of primary malignant melanoma with additional treatment as appropriate and follow up until December 1994.

Main outcome measures—Malignant melanoma incidence, primary tumour thickness and five year survival by socioeconomic status

Results—From 1979 to 1993, the age standardised incidence rate for cutaneous malignant melanoma was 9.1/100 000 for the most affluent men and 2.4/100 000 for the least affluent men and 16.1/100 000 and 5.0/100 000 respectively for most and least affluent women ($P < 0.001$ for trend in both). The incidence increased steadily over time in both sexes in all socioeconomic groups. Good prognosis tumours (< 1.5 mm thick) were most common in the most affluent men and women, and over the

study period the proportion of such tumours increased most in the intermediate affluence group (both sexes) and in the least affluent women. Five year disease free survival from melanoma for the sexes combined was 81% for most affluent, 77% for intermediate, and 73% for least affluent groups. Even after adjustment for known prognostic factors of tumour thickness, ulceration, age, and body site of primary melanoma, the more affluent the group, the better the survival.

Conclusion—Although the incidence of cutaneous malignant melanoma is higher among more affluent people, the prognosis is better in this group than for less affluent individuals. Early diagnosis campaigns should be targeted particularly to less affluent men and primary prevention campaigns should emphasise the greater risk in more affluent women.

Introduction

Cutaneous malignant melanoma has been reported to be a disease of those in higher paid occupations.^{1 2} This could relate to differences in exposure to the sun and to affluence: short intense episodes of burning sun exposure, as occur on foreign holidays, are currently believed to be important in the development of malignant melanoma.³

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