RESEARCH LETTER

Identifying changes in trends in the age standardized incidence of melanoma in Australia

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Melanoma is a serious public health issue in Australia.1 Despite numerous awareness campaigns, such as the “Slip! Slop! Slap!” and “SunSmart” campaigns, age standardized incidence of melanoma is steadily increasing.2,3 Studies analysing trends in state specific age standardized incidence rates, have identified changes in the rate at which the annual incidence of invasive melanoma is increasing.4 Decreases in incidence rates were identified in certain demographics.4

Annual age-standardized data for the incidence of melanoma in Australia is publicly available from the Australian Institute of Health and Welfare (AIHW). Cancer is a notifiable disease in Australia.5

Age standardized incidence for males, females, and all persons, between 1982 to 2015, was retrieved from the AIHW. A two-piece piecewise linear regression was fitted to each data set. The piecewise breakpoint was varied through an iterative process. An optimal breakpoint was determined by maximizing adjusted R-squared. The breakpoint was assessed for statistical significance using Chow’s test. Statistical data analysis was performed in R (3.3.2). Microsoft Excel (15.32) was used to produce figures.

For a breakpoint, $Year_t$, a dummy variable, $d_t$, is defined such that $d_t = 0$ when $Year < Year_t$, and 1 otherwise. The piecewise regression equation then follows:

$$Incidence = B_0 + B_1 Year + B_2 d_t + B_3 d_t Year$$

When $Year < Year_t$ the equation reduces to:

$$Incidence = B_0 + B_1 Year$$

And, when $Year >= Year_t$ the equation reduces to:

$$Incidence = B_0 + B_2 + (B_1 + B_3) Year$$

This method, therefore, determines if there is a single abrupt change in a trend over time.

For age standardized incidence for all persons, the model maximized adjusted R-squared ($adj-R^2 = 0.95$) at a breakpoint at 1998. This breakpoint is statistically significant ($P < 0.001$). The estimated gradient prior to the breakpoint (1.25; $P < 0.001$) is greater than the estimated gradient after the breakpoint (0.30; $P < 0.001$). In practical terms, this means that age-standardized incidence increases at a significantly smaller rate post-1998, but continues to rise. These findings are presented in Figure 1.
For males, the optimal breakpoint is also at 1998 ($\text{adj}-R^2 = 0.97; \ P < 0.001$). The estimated gradient prior to the breakpoint (1.84; $\ P < 0.001$) is greater than the estimated gradient after the breakpoint (0.44; $\ P < 0.001$). For females, the optimal breakpoint is also 2006 ($\text{adj}-R^2 = 0.88; \ P < 0.001$). The estimated gradient prior to the breakpoint (0.57; $\ P < 0.001$) is greater than the estimated gradient after the breakpoint (0.31; $\ P < 0.01$). These findings are presented in Figure 2.

The key limitation of this study is that the data does not provide detail of thickness or stage of melanoma. Trends in the age standardized incidence of thicker or higher staged melanoma would be useful because these factors correlate with prognosis. The observed incidence for New South Wales for 2015 was not available at the time of compilation of dataset and was estimated by the AIHW$^{3,5}$.

Breakpoints in the trends of age standardized incidence of melanoma in Australia have been identified for all persons, males, and females. For each group, the gradient of the trend decreased post-breakpoint, but remained positive. The reasons for this result are unclear. Public health campaigns advocating sun protection have been in place since the nineteen-eighties.$^2$ However, given the greater incidence of melanoma in older age groups, it is unlikely that population-level changes in sun exposure behavior could have translated into a tangible, and abrupt, change in incidence in the time frame between the initiation of those campaigns and the breakpoints identified in this letter.

The analysis of age standardized incidence rate trends presented in this letter provides a useful starting point for further analysis of trends. It may also be a catalyst for researchers to consider factors affecting changes in incidence rates. Further research is needed to appreciate the detail underlying the trends identified. Specifically, it would be valuable to separate in situ melanoma from invasive melanoma. State specific analysis may also prove useful.
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**References**


