SKIN

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 ($adj\text{-}R^2 = 0.95$) 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.

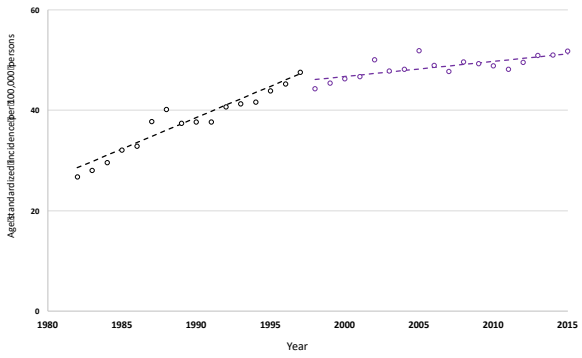

Figure 1: Age standardized incidence of Melanoma in Australia for all persons. Black circles represent the observed incidence between 1982 and 1997. The black dashed line is the estimated linear model for incidence between 1982 and 1997. Purple circles represent the observed incidence between 1998 and 2015. The purple dashed line is the estimated linear model for incidence between 1998 and 2015. (Data: AIHW 2018)

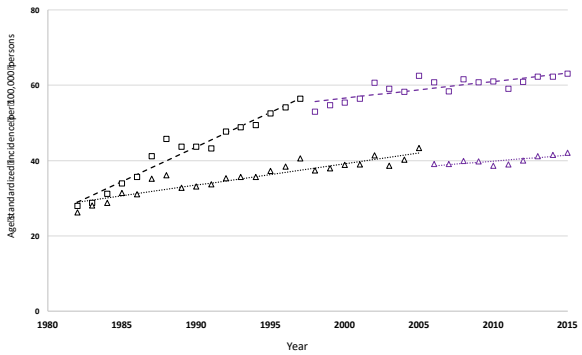

Figure 2: Age standardized incidence of Melanoma in Australia for males and females. Black squares (triangles) represent the observed Incidence for males (females) between 1982 and 1997 (2005). The black dashed (dotted) line is the estimated linear model for incidence for males (females) between 1982 and 1997 (2005). Purple squares (triangles) represent the observed incidence for males (females) between 1998 (2006) and 2015. The purple dashed (dotted) line is the estimated linear model for incidence for males (females) between 1998 (2006) and 2015. (Data: AIHW 2018)

For males, the optimal breakpoint is also at 1998 (*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 (*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

1. Australian Institute of Health and Welfare (AIHW) 2017. Cancer in Australia 2017. Cancer series no.101. Cat. no. CAN 100. Canberra: AIHW. <https://www.aihw.gov.au/getmedia/3da1f3c2-30f0-4475-8aed-1f19f8e16d48/20066-cancer-2017.pdf.aspx?inline=true>.
2. Iannacone MR, Green AC. Towards skin cancer prevention and early detection: evolution of skin cancer awareness campaigns in Australia. Melanoma management. 2014;1(1):75-84.
3. Australian Institute of Health and Welfare (AIHW) 2018. Cancer Data in Australia; Australian Cancer Incidence and Mortality (ACIM) books: melanoma of the skin Canberra: AIHW. <https://www.aihw.gov.au/reports/cancer/cancer-data-in-australia/>.
4. Curchin DJ, Harris VR, McCormack CJ, Smith SD. Changing trends in the incidence of invasive melanoma in Victoria, 1985–2015. Medical Journal of Australia. 2018;208(6):265-269.
5. Australian Institute of Health and Welfare (AIHW) 2017. Australian Cancer Database, 2014; Quality Statement. Canberra: AIHW. <https://meteor.aihw.gov.au/content/index.phtml/itemId/687104>.