Seasonal variation in diagnosis of invasive cutaneous melanoma in Eastern England and Scotland

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ABSTRACT

Background: Worldwide, the incidence of cutaneous melanoma has been reported to be highest in the summer and lowest in the winter. Northern Irish data suggested seasonal variation for women only, especially those with thinner melanomas, sited on limbs. We interrogated two larger UK cancer registries for temporal differences in melanoma diagnosis and associated patient characteristics.
Methods: Melanomas diagnosed from 2006 to 2010 in the Eastern England and Scottish cancer registries ($n = 11,611$) were analysed by month of diagnosis, patient demographics and melanoma characteristics, using descriptive and multivariate modelling methods.
Results: More patients with melanoma were diagnosed in the summer months (June 9.9%, July 9.7%, August 9.8%) than the winter months (December 7.2%, January 7.2%, February 7.1%) and this pattern was consistent in both regions. There was evidence that the seasonal patterns varied by sex ($p = 0.015$), melanoma thickness ($p = 0.002$), body site ($p = 0.006$), and type (superficial spreading melanomas $p = 0.005$). The seasonal variation was greatest for diagnosis of melanomas occurring on the limbs.
Conclusion: This study has confirmed seasonal variation in melanoma diagnosis in Eastern England and Scotland across almost all population demographics and melanoma characteristics studied, with higher numbers diagnosed in the summer months, particularly on the limbs. Seasonal patterns in skin awareness and related help-seeking are likely to be implicated. Targeted patient interventions to increase sun awareness and encourage year-long skin inspection are warranted.

1. Introduction

Cutaneous melanoma is now the fifth commonest cancer diagnosed in the United Kingdom, following a rapid rise in incidence over the last few decades. While 11 cases per 100,000 population were diagnosed in 1999–2001, the age-standardised rate had increased by 55% to around 17 cases per 100,000 population in 2008–2010 [1]. The increase has been seen across sex and age groups, but most significantly among older men [2]. Importantly, more than a quarter of new melanoma cases were diagnosed in people aged less than 50 years in 2010, in contrast to only 11% among all cancers combined [1].

It is possible that some of the increase in incidence may be due to improved surveillance and earlier detection, as well as changes in diagnostic criteria [3]. However, most of the increasing incidence trends are considered to be due to exposure to ultra-violet radiation through increased frequency of sunbed use, intermittent unaccustomed exposure especially in childhood, and leisure-time exposure including holidays abroad and outdoor sport [4–6]. Approximately 86% of melanomas diagnosed in the UK in 2010 were estimated to be linked to exposure to ultra-violet radiation from the sun and sunbeds [7].

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There is well documented seasonal variation in rates of melanoma diagnosis worldwide. Among light-skinned populations the incidence of melanoma is highest in summer and lowest in winter, irrespective of latitude [8,9]. However, detailed analysis of seasonal variation within the UK is limited to small datasets, and only data collected up until 2006: in the Oxford Region using data routinely collected between 1952 and 1975 [10], and in Northern Ireland where an analysis of data collected between 1984 and 2006 confirmed seasonal variation for women only, especially those with thinner melanomas and tumours diagnosed on the limbs [11].

We conducted an analysis of routinely collected clinical data from the Eastern England and Scottish cancer registries between 2006 and 2010, and compared diagnosis by month of the year, taking into account key factors including patient demographics as well as melanoma characteristics relevant to predicting disease outcome.

2. Materials and methods

2.1. Patient cohorts

We analysed routinely collected clinical data regarding invasive cutaneous melanoma registered by the National Cancer Registration Service- Eastern Office and the Scottish Cancer Registry between 1st January 2006 and 31st December 2010. While the regions have a comparable population size at approximately 5.7 and 5.2 million respectively, they are geographically distinct and have diverse socio-demographic characteristics. Primary sources of information included electronic and paper-based reports and clinical notes from hospitals and pathology laboratories. Recent reports have highlighted the completeness of recorded Breslow thickness for all melanomas, at more than 85% across both registries since 2006 (CI5 Vol X).

We abstracted data items related to patient, disease and temporal factors. Demographic variables included sex, age group at diagnosis (two groupings were used: <30 years, 30–49, 50–64 year and ≥65 years for comparison with crude incidence rates, and <50 years, 50–64 years, 65–74 years, ≥75 years for other analyses), and national quintile of small area measures of deprivation (using income domain of either the English or Scottish Index of Multiple Deprivation as applicable).

Disease data included melanoma Breslow thickness, histological type and body site of occurrence. Breslow thickness data were split into two categories: <2 mm, and ≥2 mm. Breslow thickness was reported in millimetres for 94% of the Scottish cases, and 89% of the Eastern England cases (17 Eastern England cases had Breslow thickness reported as group only). Histological types of melanomas were categorised using the ICDO(3) morphology codes: superficial spreading melanoma (SSM), nodular melanoma (NM), lentigo maligna melanoma (LMM), unclassified/unknown melanoma (UM) (codes 8720 NOS, 8723 NOS regressing), and others (OM) (codes 8722 Balloon cell, 8730 Amelanotic, 8740 Malignant melanoma in junctional naevus, 8741 Malignant melanoma in precancerous melanosis, 8744 Acral lentiginous, 8745 Desmoplastic, 8746 Mucosal lentiginous melanoma, 8761 Melanoma arising in congenital melancytic naevus, 8770 Mixed epithelial and spindle cell, 8771 Epithelioid cell melanoma, 8772 Spindle cell NOS, 8780 Blue naevus malignant). Anatomical site was coded using the International Classification of Diseases (ICD) 10 (four digit) as follows: C430 (lip), C431 (eyelid), C432 (ear), C433 (other and unspecified parts of face), and C434 (scalp and neck) were located on 'Head and Neck'; C435 corresponded to 'Trunk'; C436 to 'Upper Limb'; C437 to 'Lower Limb'; C438 (other specified sites of skin) and C439 (site unspecified) to 'Other' sites. Melanomas

occurring in the eye or genital organs, and in situ melanomas were excluded.

Temporal differences were characterised by the month and year of melanoma diagnosis.

2.2. Statistical analysis

Initial descriptive analyses were undertaken to compare cases per year between the two regions, and to compare stratified Breslow thickness by patient demographics, tumour characteristics, and month of diagnosis. Multivariate analyses were then undertaken using a negative binomial regression to model the number of cases diagnosed in each month (outcome). The main exposure of interest was seasonal variation which was modelled using sine and cosine components with a period of one year. The model further included fixed effect exposures for sex, age, deprivation, region, Breslow thickness (as a binary variable <2 mm or ≥2 mm), site and histological type. Finally a longer term trend in incidence was accounted for with a cubic spline with 3 knots (a pragmatic choice providing more flexibility than a linear trend whilst remaining reasonably parsimonious). A negative binomial model was used as initial investigations suggested that more variation existed than suggested by the Poisson distribution (i.e. there was over-dispersion). As with Poisson regression, the negative binomial framework models counts rather than rates and so an offset equal to the log of the person time at risk needs to be included such that the outputs from the model may be interpreted as rate ratios. To do so we use the population at risk in each age by sex by deprivation group. This was calculated using 2008 national statistics aggregated up from the lower super output area level (a lower super output area is a geographic region defined for reporting of UK census data, each containing a population of around 1500 people). When initially specifying the model more complex parametrisations of seasonal variation were considered, however, early investigations suggested that higher order Fourier components did not significantly improve the fit of the model.

In addition to considering the overall seasonal trend we were also interested in whether the seasonal variation in incidence was dependant on other factors. In order to investigate this we considered interactions between the sine and cosine components and other variables retaining only those found to be statistically significant. Where more than one variable was found to have a significant interaction, interactions between those variables were also considered. As a supplementary analysis we repeated the final regression model treating Breslow thickness as a 4 category model (≤1 mm, 1–1.99 mm, 2–3.99 mm and ≥4 mm). Data analysis was undertaken using Stata 13 (Stata Corporation, College Station, TX).

3. Results

3.1. Sample description and incidence

A total of 11,611 invasive cutaneous melanoma cases were registered in both regions from 2006 to 2010: 5998 in Eastern England and 5613 in Scotland. The number of cases and crude incidence is shown in Table 1 by year, patient demographics and tumour characteristics. Analysis of overall melanoma incidence rates demonstrated a steady rise in numbers detected over the five years by 21% from 92 to 112 per 100,000 people per year. The incidence of melanomas was slightly higher in women than in men (109 versus 102 per 100 000), with higher incidence of diagnosed melanomas in the older age groups (<30 years 13 per 100,000 compared to 253 per 100,000 for >65 years). The incidence of melanoma decreased with increasing levels of deprivation ('least deprived' group 132 per 100,000 versus 71 per 100,000 in the 'most deprived' group). The majority (67%) of melanomas were