# Melanoma in Maori, Asian, and Pacific Peoples in New Zealand

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## Abstract

New Zealand Maori, Pacific, and Asian people develop melanoma less frequently than New Zealand Europeans, but little is known about melanomas that develop in these people. We examined the characteristics of melanoma in these minority ethnic groups in New Zealand. In 2007, all first primary melanomas diagnosed from January 1996 to December 2006 were extracted from the New Zealand Cancer Registry database. Melanoma was more commonly diagnosed in Maori than in Asian or Pacific peoples. Age-adjusted incidence rates increased annually from 1996 to 2006 by 0.37 per 100,000 in the total population and 0.20 per 100,000 in Maori, a 12% (from 30.9 to 34.6) and 90% (from 2.3 to 4.3) increase, respectively, over the 11 years. Nodular melanoma occurred more often in Maori (15.9%) and Pacific peoples (17.1%) compared with Asians (8.7%) and New Zealand Europeans (10.5%). In Pacific peoples, acral lentiginous melanoma (22.9%) was the most common subtype. The median thickness of melanoma was 0.78 mm in New Zealand Europeans, 1.2 mm in Maori, 2.5 mm in Pacific peoples, and 0.73 mm in Asians ($P < 0.001$, difference in medians). Thirty-seven percent of melanomas in Pacific peoples were >4 mm thick compared with 7.9% in New Zealand Europeans. About 13% of Asians and 11% of Pacific peoples, compared with 4% of New Zealand Europeans with melanoma, were diagnosed by histology of metastases rather than the primary lesion. Minority ethnicities in New Zealand have a higher than expected risk of thick and more advanced melanoma, with poorer prognosis. Melanoma campaigns should include messages that incorporate the unique features of melanoma in minorities. (Cancer Epidemiol Biomarkers Prev 2009;18(6):1706–13)

## Introduction

The ethnic mix of New Zealand is diverse: it includes Europeans (79%), Maori (15%), Asian (9%), Pacific peoples (7%), and Middle Eastern, Latin American, and African (0.9%; ref. 1). Since 1996, ethnicity has been based on the concept of self-identification (2). This allows New Zealanders to belong to more than one ethnic group, so totals do not add to 100%.

Worldwide, cutaneous melanoma is predominantly a disease of people with fair skin and fair hair, who tan poorly; virtually all the known risk factors are associated with sun exposure and skin susceptibility to sun and there is little literature about the incidence of melanoma in dark-skinned populations. Melanoma generally occurs more often on the soles of the feet, the palms of the hand, and under nails and is often more advanced at presentation in dark-skinned ethnic groups, thus conferring significant morbidity and mortality (3). New Zealand Maori, Pacific, and Asian people (darker-skinned ethnicities) develop melanoma much less frequently than New Zealand Europeans, with Maori melanoma incidence rates about one tenth that of New Zealand Europeans (4), but little

is known about the melanomas that do develop in these people.

Melanoma is largely curable if diagnosed when still thin. Maori, Pacific, and Asian people usually do not exhibit phenotypes commonly associated with melanoma risk (fair skin, blue eyes, freckles, and red or blond hair), so it is important that physicians maintain an index of suspicion and know about the manifestations of melanoma in minorities in New Zealand so diagnosis and treatment can be instituted early.

This article describes some of the clinical and histologic features of cutaneous melanoma in Maori, Asian, and Pacific peoples in New Zealand in comparison with New Zealand Europeans.

## Materials and Methods

This study involved the analysis of routinely collected data for cutaneous melanoma from January 1, 1996 to December 31, 2006 in New Zealand.

**Data Sources.** New Zealand has had a national cancer registry since 1948. The New Zealand Cancer Registry (NZCR), part of the New Zealand Health Information Service (NZHIS), collects data about all incident malignant cancers, excluding squamous cell carcinoma and basal cell carcinoma of the skin (5). Notification of incident cancer has been mandatory since July 1994 after the introduction of the Cancer Registry Regulations 1994 pursuant to section 9 of the Cancer Registry Act 1993 and registration rates since then have been an accurate measure of incidence rates. In 2007, all melanoma notifications of single
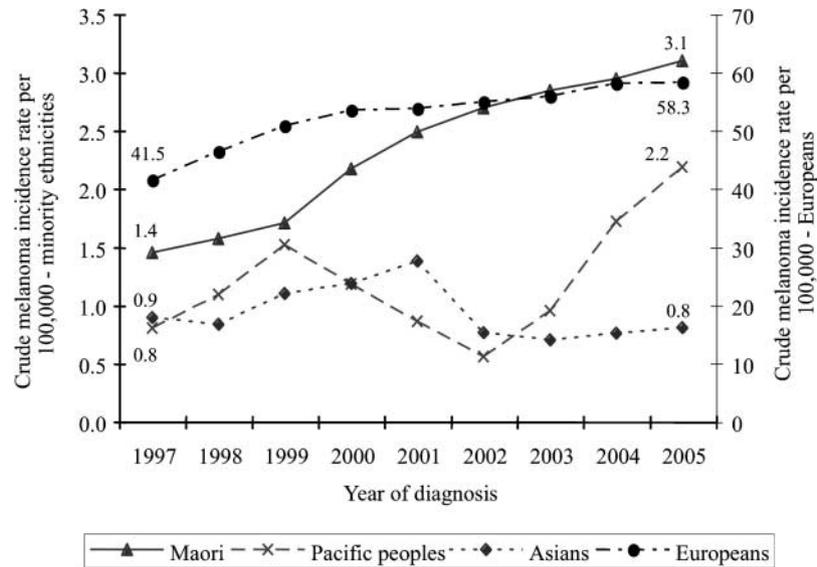
**Figure 1.** Crude melanoma incidence rates per 100,000 population (moving average of 3 years is plotted) by ethnic group in New Zealand, 1997 to 2005. The scale for incidence rates in minority ethnicities is on the left and the European scale is on the right.

or multiple primaries from 1996 to 2006 with an International Classification of Diseases, 9th edition (ICD-9), code of 172 or an ICD-10 code of C43 were extracted and the first primary melanoma occurring in the time window for each person was selected. For multiple melanomas diagnosed in the same person on the same date, the deepest melanoma was chosen as the primary melanoma as it is the lesion most likely to determine prognosis. The year 1996 was chosen as the start date for this analysis to allow time for the new system of notification to stabilize and to minimize the effect of delayed notification of prevalent previously unregistered melanoma cases. Data on age at diagnosis, sex, ethnicity, date of diagnosis, Breslow thickness in millimeter, histologic subtype, body site, and extent of disease at diagnosis were also extracted from the NZCR record. The Cancer Registry record is continuously amended as information is received, so figures from this download may differ from published data.

As ethnicity is self-identified in New Zealand, it can change over time. NZHIS therefore collects ethnicity for each registration from data providers, the National Minimum Dataset of hospital events or the National Health Index (a database of unique identifiers and demographics; ref. 6). The ethnicity data collected by Statistics New Zealand in the census are the self-identified ethnicity whereby people select up to three ethnic groups to which they feel they belong (7). Ethnicity data collected from the health sector use the same question as the census. Participants are then categorized into prioritized ethnic groups using the Statistics New Zealand algorithm. That is, each respondent is allocated to a single ethnic group using the priority system (Maori first, then Pacific peoples, then Asian, then other groups except New Zealand European, and lastly New Zealand European). Registrations with no ethnicity stated have been excluded from analyses of ethnic group but included in general analyses.

Melanoma thickness was measured in millimeter according to Breslow (8). When used as a categorical rather than continuous variable, thickness was grouped accord-

ing to prognostic categories ($\leq 1$ mm, $>1$-2 mm, $>2$-4 mm, and $>4$ mm; ref. 9).

Only the four main histologic subtypes of melanoma (Hutchinson's melanotic freckle or lentigo maligna, superficial spreading, nodular, and acral lentiginous) and melanoma not otherwise specified (MM-NOS) were included in analyses of histologic type. Other analyses included all melanoma subtypes.

Body site was classified as face, scalp or neck, trunk, upper limb including shoulder, and lower limb including hip and feet. Melanomas arising on plantar, palmar, or subungual sites could not be distinguished from lower limb or upper limb lesions.

Extent of disease at diagnosis was coded according to the Surveillance, Epidemiology, and End Results summary system as *in situ*, localized, regional (direct extension or nodal involvement), and distant (metastatic; ref. 10). After January 1, 1999, the Cancer Registry changed to alphabetical codes, which separated the previous regional code "2" into two parts: invasion of adjacent tissue "C" and regional nodes "D." To maintain consistency over all years, alphabetical codes were converted to the previous numerical codes and this system was used in analyses. *In situ* melanomas were excluded from all analyses.

**Statistical Analysis.** Total population and non-Maori and Maori population data were obtained from Statistics New Zealand for all individual years from 1996 to 2006. Population estimates for Pacific and Asian peoples by age were based on the 1996, 2001, and 2006 New Zealand population censuses and interpolated for intervening years. Population data for New Zealand Europeans were calculated by subtraction of ethnic-specific populations from the total population.

Incidence rates for the total population and for the Maori population were directly standardized for age (<30, 30-39, 40-49, 50-59, 60-69, 70-79, 80+ y) using Segi's world population. Incidence rates for Asians and Pacific peoples were indirectly age standardized using the New

Zealand European population as the reference category and expressed as a percentage: the standardized incidence ratio.

All statistical tests were done using Stata 10 (11). The nonparametric comparison-of-medians test was used to compare medians of nonnormally distributed variables. Comparison of proportions within groups of categorical variables was carried out using Pearson's $\chi^2$ test. A linear regression model was fitted separately to annual age-standardized incidence rates for Maori and the total population to examine univariate trends over time. A two-sided α of 0.05 was used for all statistical tests.

## Results

Between 1996 and 2006, there were 19,149 first registrations of melanoma in New Zealand and 96% were verified by histology. Fourteen percent ($n$ = 2,724) were missing data for ethnicity. Of the remaining 16,425 melanoma registrations, 157 occurred in Maori, 35 in Pacific people, and 23 in Asians.

For Asian and Pacific peoples, the low frequency of occurrence of melanoma resulted in considerable yearly variation in incidence rates and calculation of age-standardized rates was inappropriate. Therefore, crude incidence rates of melanoma (with 3-year moving averages) per 100,000 population for each ethnic group are shown in Fig. 1 and age-specific incidence rates for each ethnic group in Fig. 2.

Melanoma was more commonly diagnosed in Maori than Asian or Pacific peoples. Rates increased approximately exponentially with age for minority ethnicities, with Asians having the lowest rates in each group. Sixty-one percent of melanomas in Maori were diagnosed in

women compared with 48.6% in Pacific peoples, 42.6% in Asians, and 49.6% in Europeans [degrees of freedom ($df$) = 3; $P$ = 0.038, $\chi^2$ test]. Before the age of 50 years, non-Maori women (all ethnicities combined, except Maori) had higher rates of melanoma than non-Maori men, but after 60 years of age, incidence rates in non-Maori men were higher and increased faster than the equivalent female rates. In Maori, women had higher incidence rates than men up to the age of 60 years (data not shown).

Age-standardized incidence rates per 100,000 for Maori fluctuated from year to year because of the small numbers of people who developed melanoma: age-standardized incidence rates for the total New Zealand population are shown for comparison (Fig. 3). Between 1996 and 2006, the range of age-standardized incidence rates was 29.7 to 35.2 per 100,000 in the total New Zealand population compared with 0.9 to 5.0 in Maori, with a Maori to non-Maori ratio of about 1:9 in 2006. The average annual age-standardized incidence rate for Maori men from 1996 to 2006 was 3.05 per 100,000 population [95% confidence interval (95% CI), 2.94-3.16], lower than the equivalent rate in Maori women (age-standardized incidence rate = 3.82 per 100,000; 95% CI, 3.63-4.02; data not shown). Data for Asian and Pacific peoples with melanoma were too sparse for the direct calculation of age-standardized incidence rates, but indirectly standardized rate ratios gave standardized incidence ratios for Pacific and Asian peoples of 5.7% (95% CI, 3.8-7.5) and 2.8% (95% CI, 1.6-3.9), respectively (data not shown).

Melanoma incidence rates adjusted for age increased by 0.37 per 100,000 per year from 1996 to 2006 in the total population and 0.20 per 100,000 per year in Maori, representing a 12% increase (from 30.9 to 34.6) in the total population and a 90% increase (from 2.3 to 4.3) in Maori over the 11 years (see regression lines in Fig. 3). Data were too
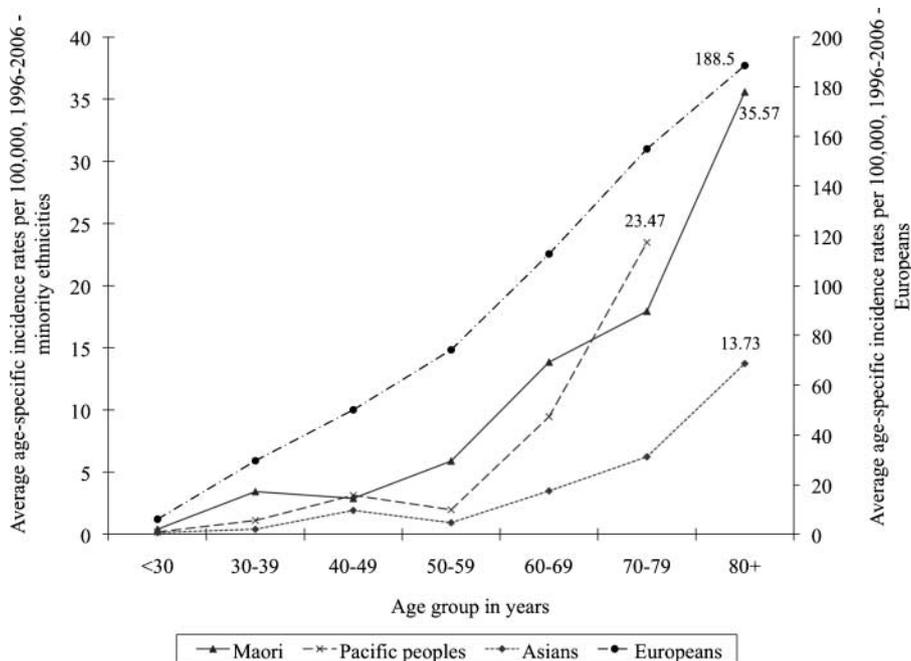


**Figure 2.**   Average age-specific incidence rates of melanoma per 100,000 population by ethnic group, 1996 to 2006. The scale for incidence rates in minority ethnicities is on the left and the European scale is on the right.
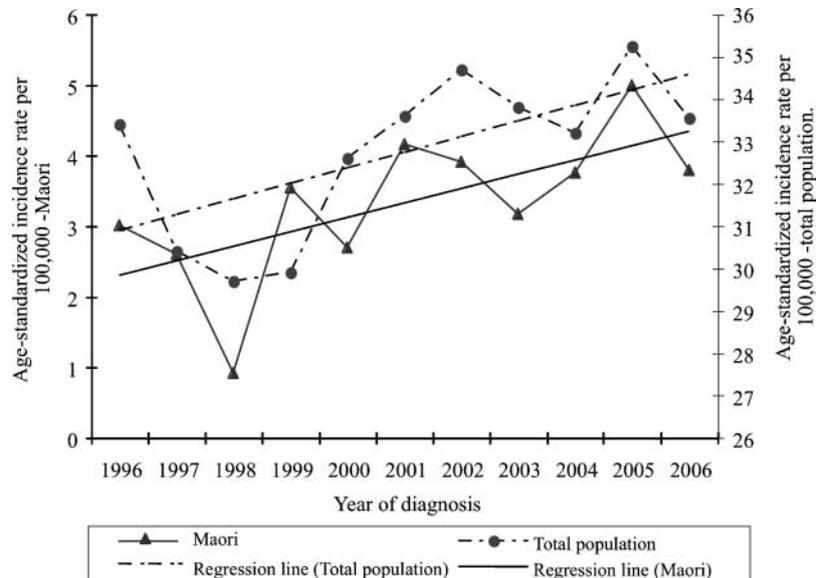
**Figure 3.** Age-standardized (directly standardized to Segi's world population) melanoma incidence rates per 100,000 population, 1996 to 2006. Incidence rates for Maori were calculated from age-specific rates in the data file provided by NZHIS. Incidence rates for the total population were taken from NZHIS published rates for 1996 to 2004 and calculated from provisional age-specific rates for 2005 to 2006. The scale for Maori incidence rates is on the left and the total population scale is on the right.

sparse to age standardize Maori melanomas by thickness categories separately, but crude rates suggested that the increasing incidence rate in Maori was due mainly to increasing numbers of melanomas >1.0 mm thick rather than thinner melanomas ≤1.0 mm.

Over a third of melanoma registrations ($n$ = 7,380, 36.7%) had no histologic subtype provided apart from MM-NOS. The histologic subtype distribution varied significantly by ethnic group ($df$ = 12; $P$ < 0.001, $\chi^2$ test). In all ethnic groups except New Zealand Europeans, the most common melanoma classification was MM-NOS, whereas in New Zealand Europeans it was superficial spreading melanoma (SSM; Fig. 4A). Hutchinson's melanotic freckles occurred most often in Europeans and were diagnosed latest in life (median age, 74 years). Nodular melanoma (NM) occurred more often in Maori (15.9%) and Pacific (17.1%) compared with Asian peoples (8.7%) and New Zealand Europeans (10.5%). In Pacific peoples with a known subtype, acral lentiginous melanoma (ALM; 22.9%) was the most common subtype and occurred much more often than in other ethnicities (3.2%, 4.3%, and 0.7% for Maori, Asians, and New Zealand Europeans, respectively). However, the crude rate of ALM per 100,000 population (data were too sparse to age standardize in all ethnic groups) was the same in non-Maori (0.31 per 100,000; $n$ = 112) and Pacific peoples (0.32 per 100,000; $n$ = 8), both higher than in Maori (0.08 per 100,000; $n$ = 5) and Asian peoples (0.04 per 100,000; $n$ = 1).

Information on melanoma site was missing for 939 (4.9%) records. Melanoma of the lower limb was the most common site of melanoma for Pacific and Asian peoples of both sexes, 48.6% and 39.1% of registrations, respectively (Fig. 4B), whereas Maori men were most commonly diagnosed with melanoma on the trunk and Maori women on the leg, a similar melanoma body site distribution to Europeans ($df$ = 12; $P$ = 0.041, $\chi^2$ for difference among

ethnic groups). All nine ALM in Pacific and Asian peoples occurred on the lower limbs and they accounted for 35% of their lower limb melanomas.

Since 1996, the collection of Breslow thickness by the NZCR has improved, from 18% missing thickness for Europeans diagnosed by histology of the primary in 1995 to an average of about 5% missing over the next 11 years, and in Maori from 40% missing in 1995 to 8% over the next 11 years. Over the same time, 13% of the Pacific notifications were missing thickness. Maori, Pacific, and Asian peoples had more thick melanomas than expected ($df$ = 9; $P$ < 0.001, $\chi^2$ for difference in thickness categories; Fig. 4C). The median thickness of melanoma differed significantly by ethnic group: 0.78 mm in New Zealand Europeans (range, 0.01-70 mm), 1.2 mm in Maori (range, 0.1-16 mm), 2.5 mm in Pacific peoples (range, 0.25-70 mm), and 0.73 mm in Asians (range, 0.35-23 mm; $P$ < 0.001 for a difference in medians). Although based on small numbers of melanomas, Pacific peoples had a greater proportion of very thick melanomas (37% >4 mm thick) compared with other ethnicities (18.5%, 16.7%, and 7.9% in Maori, Asians, and New Zealand Europeans, respectively). These very thick melanomas in Pacific peoples were mainly NMs (five of nine melanomas): only one ALM in Pacific peoples was >4 mm thick.

Asian and Pacific peoples, although they had a very low rate of melanoma, had a greater than expected number of cases with more extensive or metastatic disease at diagnosis ($df$ = 6; $P$ < 0.001, $\chi^2$ test; Fig. 4D). About 13% of Asians and 11% of Pacific peoples, compared with 4% of Europeans, were diagnosed by the histology of melanoma metastases rather than the primary lesion. Europeans had over 12 times the rate of localized melanoma at diagnosis compared with Maori but only a 3- to 4-fold higher rate of more extensive disease (data not shown).
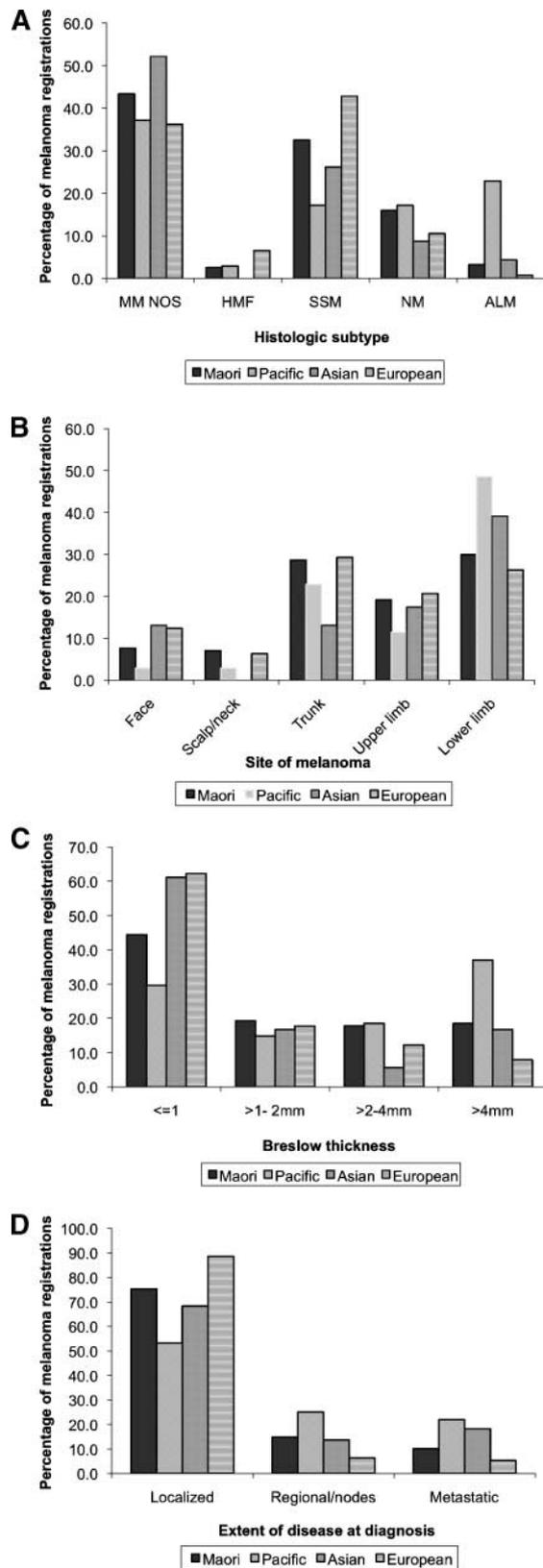
**Figure 4.** Percentage of melanoma registrations by ethnic group for histologic subtype (**A**), body site (**B**), Breslow thickness (**C**), and extent of disease at diagnosis (**D**).

## Discussion

In New Zealand, Maori, Pacific, and Asian people had much lower incidence rates of melanoma than New Zealand Europeans, with Maori rates higher than both Pacific and Asian peoples in all age groups. The age-standardized incidence rate of melanoma from 1996 to 2006 seemed to be increasing in Maori as well as in Europeans. The incidence presented for 2006 may be reduced due to a delay in reporting to the NZCR. This delay would result in an underestimate of any increasing trend in melanoma incidence.

Maori and Europeans with melanoma had a similar body site distribution with most on the trunk in men and most on the leg in women, whereas most melanomas in Pacific and Asian peoples were on the lower limb. In the minority ethnic groups, the melanomas tended to be deeper and at a more advanced stage at diagnosis than in New Zealand Europeans. As melanoma thickness is one of the most important prognostic indicators, this could impose significant burdens of mortality in minorities who develop melanoma. Moreover, health protection messages in New Zealand have been focused on the high-risk New Zealand European population.

Age-standardized incidence rates for melanoma worldwide are higher in white-skinned compared with dark-skinned races and are generally higher in men than in women (3, 12-14). In the United States, the black to white ratio for melanomas diagnosed from 2001 to 2005 was approximately 1:26 in men and 1:21 in women, and the Hispanic to white ratio was ~1:5 (14). The incidence of melanoma in Asians has generally been found to be similar to the rates in U.S. blacks (13). The melanoma incidence ratio of 1:9 in Maori to non-Maori in 2006 was intermediate between the ratios for U.S. blacks and Hispanics to U.S. whites, perhaps due to the very high non-Maori rates in New Zealand or possibly reflecting an intermediate skin color of Maori.

Although starting from a much lower baseline, the incidence rate of melanoma in Maori has increased over the last 11 years but at a slower rate than the increase in Europeans and is likely to be due to increases in thicker melanomas with poorer prognosis rather than thinner lesions. An increase in thick melanomas in Hispanics in California from 1988 to 2001 has also been noted recently (15). It is unlikely that these increases were due to changes in the coding of Breslow thickness as collection of these data in New Zealand has improved over this time.

Analysis of histologic subtypes is often limited by the amount of subtype data missing: for example, a Californian study was missing ~50% (13). In the current study, over a third of registrations had no histologic subtype specified. Notwithstanding, of those with known histologic subtype, the distribution is known to vary by ethnicity. In Hispanics in California, the most common subtype was SSM, in blacks it was ALM, whereas Asian peoples had almost equal numbers of SSM and NM (13). In another U.S. study, SSM was the most common subtype in all ethnic groups and ALM occurred most often in African-Americans followed by Pacific and Asian peoples combined (12). In a small South African study of 40 people of mixed ancestry with melanoma, ALM was the most common subtype (32.5%; ref. 16), and a similar preponderance of ALM (49%) was found in Japan (17). The current study presents a subtype distribution similar to those

above. In those with a known subtype (i.e., excluding MM-NOS), SSM was the most common subtype in New Zealand Europeans, Maori, and Asians, whereas ALM was the most common subtype in Pacific peoples. It has been believed that ALM, first identified two and a half decades ago, occurred more often in black-skinned ethnic groups and behaved more aggressively than other melanoma subtypes (18). It is possible that the incidence of ALM, which develops on non–sun-exposed body sites, or the incidence of plantar melanoma is similar in all races but the proportion is higher in black-skinned and Pacific peoples as they have many fewer melanomas in total (19). This was also suggested in the present study, which showed, albeit with small numbers, the same crude rate of ALM in Pacific peoples and non-Maori. Furthermore, although consensus has not been reached, the reputed poorer prognosis of ALM is likely due to the tumor thickness and advanced stage at diagnosis (20). No significant progress has been made in elucidating the etiology of ALM, but because of its unusual site distribution, it is very likely to be different from other melanoma subtypes (18).

U.S. blacks (21) and Japanese (17) tend to develop melanoma on non–sun-exposed skin (e.g., plantar, palmer, and mucosal surfaces) most often on the lower limb and most of these are ALM. The body site distribution of melanoma reported in Hispanics has varied from study to study, possibly reflecting the wide range of skin colors in Hispanic people (3). The current study only has data for cutaneous melanoma, but the most common site for melanoma in Pacific and Asian peoples was the lower limb, whereas in New Zealand Europeans and Maori it was the trunk in men and lower limb in women. Melanomas on the foot could not be distinguished from others on the lower limb; however, the site distribution in Pacific peoples was similar to the distribution of ALM in U.S. blacks.

This study found a much greater proportion of very thick melanomas (>4 mm thick) in Pacific peoples and to a lesser extent in Maori and Asian peoples. Data for the Breslow thickness of melanoma are often not available, but some studies in the United States have found a similar pattern with melanomas being deeper in nonwhites and thinner in whites (12, 15, 22). U.S. blacks and Hispanics are also more likely to have advanced-stage disease at presentation compared with white-skinned ethnicities (3, 12, 23).

Unlike Caucasians, UV radiation is not as important a risk factor for melanoma in dark-colored races. This lower risk of melanoma is thought to be due to photoprotection from melanin occurring as a result of three major mechanisms: UV-induced damage of the lower epidermis is less in dark skin, rates of DNA repair differ, and UV-induced apoptosis of precancerous cells is greater in dark skin (24). Melanomas in dark-skinned people show a propensity to develop on non–sun-exposed sites, such as palmar, plantar, and subungual sites, but the actual role sunlight has to play in their natural history is unclear (3). There is some ecological evidence to suggest that within black men in the United States there is a latitude gradient of melanoma incidence as there is for whites (25), but this finding has not been universal (26, 27).

Measurement of any health outcome by ethnic group is difficult, but when attempting to associate ethnicity with risk factors for melanoma (e.g., skin phototype), it becomes even more so. Ethnic group is no longer defined by ancestry in New Zealand but is a categorization of culturally based self-identification, and many New Zealanders identify with several ethnic groups (28). In New Zealand, interethnic marriage has always been common. There are no longer any Maori with only Maori ancestry, and thus, the phenotype of those who identify as Maori is changing. Furthermore, ethnicity and phenotypic expression are not equivalent and there is considerable heterogeneity in skin pigmentation within any ethnic group. For example, there are fair-haired, fair-skinned people who identify as Maori. In one, albeit small, sample of self-identified Maori, about 24% said their skin was fair or very fair and 20% reported getting sunburned during the previous weekend (29). As minority populations increase because of migration (Asians increased by ~50% between the 2001 and 2006 population censuses; ref. 30) and intermarriage continues, this distribution is likely to change. Therefore, melanoma rates by ethnicity do not allow conclusions with respect to skin pigmentation, but ethnic group is the only related demographic that is routinely collected in New Zealand. Fitzpatrick skin classification has been used overseas to classify skin sensitivity to sunlight but was developed from responses of white skin (31). A study in the United States showed inconsistent correlations between ancestry and constitutive skin pigmentation measured with a spectrophotometer (32), and a Korean study (33) showed little association with minimal erythemal dose in brown-skinned Korean men.

Population-based registries are a valuable resource to investigate melanoma incidence. Although melanoma was often underreported in New Zealand before 1995, this study was restricted to 11 years of registrations notified after the introduction of the Cancer Registry Act. This Act made notification of any cancer to the NZCR, excluding nonmelanoma skin cancer, mandatory and has minimized the number of cases missing due to underreporting, with only 0.3% of registrations identified from death certification and almost all notifications of melanoma (99.5%) confirmed by histology.

In a study of this type, there are always some weaknesses. Although registration of melanoma is believed to be almost complete, there are still some important fields in the record that are missing data in a nonrandom manner. For example, over a third of data for histologic subtype were categorized as MM-NOS, and these ranged from 36% in Europeans to 52% in Asian peoples. Bias from the missing data limits the interpretation of the results for histologic subtypes. For a small proportion, data for body site were missing, but these also varied by ethnicity with only 5% missing in Europeans, 11% in Pacific peoples, and 17% in Asians. In contrast, little data for Breslow thickness or "extent of disease at diagnosis" were missing.

The comparison of rates among ethnic groups may be hampered by missing data for ethnicity. In this study, 14% of new registrations were missing information for ethnicity. Ethnicity data were collected before diagnosis and were independent of both the diagnostic and treatment pathways, so the missing data are not expected to bias the features of disease presented here. In addition, ethnicity, although coded, may be misclassified. The classification of ethnicity by health personnel is intended to be standardized but potential for misclassification still exists. The classification of ethnicity in the census is self-identification, so some bias may be introduced into the calculation of rates due to systematic differences in classification

of ethnicity between numerator and denominator data. Moreover, in 1996, Statistics New Zealand changed the ethnicity question in the census, resulting in an overinflation in counts of the Maori population in 1996 (and thus an artifactual decrease in observed rates for Maori) but not Asian or Pacific peoples (34). In an analysis of increasing trends since 1996, this lowering of the rate in 1996 could possibly overinflate the significance of time trends in Maori.

Use of ethnic prioritization may be a problem in the future, particularly as the percentage of people who select multiple ethnic categories increases (it was 9% in the 2001 census and 10% in the 2006 census), as it can result in a minority ethnicity lower down the ranking effectively losing its members. However, only a small proportion of New Zealanders choose multiple ethnic groups and prioritization simplifies the statistics as population subgroup totals then sum to 100%.

Whether the differences in thickness and extent of disease at diagnosis by ethnic group are due to delay in diagnosis, different biological behaviors of similar lesions in different ethnicities, or the development of inherently different histologies with different biology is unknown. Melanoma prevention campaigns in New Zealand and elsewhere have understandably concentrated on prevention messages for fair-skinned populations. A low level of knowledge about and awareness of melanoma in African-Americans (35) and Hispanics (36) has been reported in the United States. A study in New Zealand showed that 31% of Maori children, 36% of Pacific children, and 44% of European children knew that melanoma was a form of skin cancer, but in spite of this, over half the Maori and Pacific children reported getting sunburned the previous summer (37). There does not seem to be any other data for minorities in New Zealand. It is plausible that physicians as well as the general public have a low level of awareness of melanoma in minorities and thus a low index of suspicion contributing to a delay in diagnosis.

Another reason proposed for more advanced melanomas in non-whites is that these melanomas may be overlooked as they occur on unusual places (21), but as shown in this study, Maori have an overall similar site distribution to Europeans. Perhaps a dark lesion on dark skin is harder to see, so any lesion may progress further before discovery (21).

Although ALMs seem to occur at the same rate in dark-skinned as in fair-skinned populations, they occur on unusual body sites on non–sun-exposed skin and their etiology is likely to be different from other melanoma subtypes. Trauma to the feet has been proposed as one possible etiologic agent, but as footwear is almost universal in the United States, this seems unlikely (19). NMs also contribute a major proportion of melanomas in Maori and Pacific peoples. Some evidence suggests that their natural history may be more aggressive than SSM or Hutchinson's melanotic freckles and they do not always appear or develop as the classic melanoma usually portrayed in education campaigns (38).

In New Zealand and internationally, primary and secondary (screening) melanoma prevention campaigns are understandably focused on the more common subtypes of melanoma in the white-skinned populations. Efforts to increase melanoma awareness and improve appropriate sun behavior should include educational messages for both the public and physicians that incorporate the

unique features and distribution of melanoma in minorities and also the unusual features of NM (such as often being a new rather than a changing lesion) and ALM (which may mimic trauma or subungual infection; ref. 38). This change in focus, to include educational material more relevant to melanomas in minorities in New Zealand and elsewhere, could also result in an increased awareness of the deeper and prognostically poorer melanomas in all ethnic groups, including people at the highest risk of melanoma development.

## Disclosure of Potential Conflicts of Interest

No potential conflicts of interest were disclosed.

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