Skin cancer and Vitamin D: should skin colour or ethnicity be the main variable for communicating health promotion messages?

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Abstract

There is strong evidence that the three main types of skin cancer are caused by excess harmful sun exposure. Related to this, skin colour has long been established as a risk factor for skin cancer. More recently, there has been significant focus on the potential beneficial aspects of sun exposure, mainly in assisting vitamin D synthesis. New Zealand has a challenging climate in relation to individuals managing UVR exposure *both* with regard to minimising skin cancer risk *and* achieving optimal, year-round serum vitamin D levels. Associated with this challenge, New Zealand is a country of migrants. All migrants, or children of such migrants, could be seen to be geographically displaced when considering both skin cancer and vitamin D.

A focus on the relationship between minimising skin cancer risk and maximising vitamin D uptake among the population throws up major challenges for researchers and health promoters. These challenges, including the many unknowns and uncertainties about vitamin D such as what constitutes an optimal level as well as its association with specific diseases, become even more complex when ethnicity is also considered. While in the immediate future ethnicity appears likely to remain the main frame of reference for assessing risk, based on our analysis, there are dangers in using ethnicity as the key variable on which to base advice concerning the risks and benefits of sun exposure. We consider that skin colour, along with other key variables, such as season and time of day are important.

However, advising about risk-based factors such as skin colour does not rule out using ethnic-based communication channels such as through Māori or Pacific health providers. But communication through ethnic-based channels also has to take account of the complexity of risk factors within their own target group, especially variations in skin colour.

Keywords: skin cancer, vitamin D, skin colour, ethnicity, New Zealand

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Introduction

Skin colour has long been established as a risk factor for skin cancer. The risk of melanoma, the most serious form of skin cancer, is much higher for individuals with red or fair hair and fair skin that freckles or burns easily (Armstrong and English 1996, Rhodes *et al*. 1987). While amounts and patterns of sun exposure influence skin cancer risk, there is strong evidence that the three main types of skin cancer – cutaneous malignant melanoma, squamous cell carcinoma (SCC), and basal cell carcinoma (BCC) – are caused by excess harmful sun exposure (Armstrong and Kricker 2001). Skin cancer risk also rises with increasing ambient solar radiation (Armstrong and Kricker 2001). Due to a unique combination of factors, New Zealand and Australia lead the world in melanoma incidence (Parkin *et al*. 2007).[1]

More recently, there has been significant focus on the beneficial aspects of sun exposure, mainly in assisting the body's synthesis of vitamin D. While some vitamin D can be obtained naturally from the diet (such as oily fish, eggs, and meat) the sun is the primary source. While vitamin D is known to be important for bone and muscle health, medical debates have centred on its potentially broader health benefits, including reduced risks of various cancers, heart disease, and some immune disorders (Lucas and Ponsonby 2002, Giovannucci *et al*. 2004, Holick 2004, Wang *et al.* 2008). A key consideration is whether there is a strong inverse association between blood vitamin D levels and incidence and mortality from certain cancers (Scragg 2007, Moan *et al*. 2008). This association has led various national cancer agencies to develop position statements on vitamin D and cancer risk, including a focus on the risks and benefits of sun exposure (for example, Cancer Council Australia 2007, Cancer Society of New Zealand 2008, United States National Cancer Institute 2009). In 2008, an international working group on vitamin D and cancer concluded that although there is sufficient evidence to suggest a relationship between colorectal cancer and vitamin D, research findings on the beneficial effects of vitamin D are generally inconsistent and new randomised controlled trials are needed (IARC Working Group on Vitamin D 2008).

Just as skin colour is associated with skin cancer risk, an individual's capacity to synthesise vitamin D varies by skin colour. People with naturally dark skin require more

[1] Since the Cancer Registry Act 1993 came into force from 1 July 1994, new cases of melanoma must be reported to the New Zealand Cancer Registry. Registration is not required for non-melanoma skin cancers meaning only melanoma is officially recorded.

ultraviolet radiation (UVR), more specifically UVB, exposure to produce sufficient levels of vitamin D (Norman 1998, Lucas and Ponsonby 2002).

In New Zealand skin colour is not a variable considered directly in official statistics or in studies measuring health inequalities.[2] In contrast, most studies that consider differences in health outcomes between groups of people, including differences in melanoma rates or vitamin D status, use 'ethnicity' as a key variable. Many reports have shown significant differences in a wide range of health, including cancer, outcomes when ethnicity is considered (Blakely *et al*. 2005, Robson *et al*. 2006).

Differences in health outcomes associated with ethnicity provide strong support for targeting health promotion messages, as well as health services, to particular at-risk groups. In terms of ethnicity, the two main identified at-risk target groups are Maori and Pacific peoples. One possible outcome of the emerging interest in vitamin D and its potential protective effects is that sun-exposure advice, including the possible risks and benefits of sun exposure, should differ according to ethnic group. Whether this is a good idea depends on whether culturally constructed ethnicity is the correct variable to be used when analysing health risks and outcomes and, underpinning this, what the variable 'ethnicity' is actually measuring, especially in the context of medical studies.

A further, but not entirely separate, consideration is whether advice about the risks and benefits of sun exposure should be disseminated to specific ethnic communities.

To begin this paper we briefly discuss the expression 'skin colour'.[3] Then, to contextualise current debates, we present a brief history of migration to New Zealand to show how much, if not all, of its population could be considered to be geographically 'displaced'.[4] We then overview the debates about the relationship between race or ethnicity and health outcomes and examine how New Zealand research on skin cancer addresses ethnicity. We briefly contrast this with the Australian approach. We follow this discussion with analysis of the developing hypotheses and research on vitamin D and cancer, including New Zealand research. The next section overviews what the variable ethnicity is officially measuring in New Zealand.

The final section considers two issues. The first issue is whether key public health messages about the risks and benefits of sun exposure should be targeted by ethnic group or

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2 With the notable exception of Statistics New Zealand's General Social Survey 2008, which asked respondents if, in the last 12 months, they had 'been treated unfairly or had something nasty done to [them] because of the group [they] belong to or seem to belong to'. If they had, they were asked where this took place and for what reasons, with one of the choices being on the basis of 'my skin colour'.

3 This paper builds on Callister (2008).

4 The concept of a 'displaced population' is discussed by McKenzie and Bodeker (1996).

whether more direct measures, particularly skin colour and at-risk behaviours, should guide such advice. The second issue is whether skin colour information should be systematically collected and recorded, as occurs with ethnicity information, in official health data sets, but with specific reference to the New Zealand Cancer Registry.

Skin colour

The colour of a person's skin depends on many factors. Skin colour is influenced by several factors, including haemoglobin levels in the blood, but a key determinant is the level of the pigment melanin (Chaplin and Jablonski 2009). However, factors such as inflammation can also affect skin colour. Moreover, across all populations, pigmentation changes over the lifecycle, increasing slowly from birth through childhood and adolescence, peaking during the reproductive years, and then gradually fading (Chaplin and Jablonski 2009). Sun exposure in childhood may also be more important, both for its good and bad effects, than such exposure in adulthood (Lucas and Ponsonby 2002).

It has been suggested that melanin pigmentation is adaptive and has been strongly influenced by natural selection and that vitamin D is the only agent that can account for light skin being actively selected in areas where UVB is seasonal, absent, or more variable (Chaplin and Jablonski 2009). Similarly, in areas where UVB is strong and constant, dark skin is positively selected. But this theory is not universally accepted (for example, Robins 2009). This issue of the development of skin colour in specific geographic locations is something we will return to.

Underpinning some discussions of skin colour is the assumption of an artificial binary – namely, that of 'fair' and 'dark' skinned groups – as opposed to a more graduated skin colour continuum. In addition, somewhat subjective terms such as 'very black skin' or 'Asian' skin have been noted in research papers (Lucas and Ponsonby 2002). However, some researchers have attempted to find objective and graduated measures of skin colour, often when studying discrimination. For example, Hunter (2002) measured skin colour in five categories for each data set: very dark, dark, medium, light, and very light. Respondents' complexions were rated by trained interviewers who used colour palettes to identify respondents' skin colour as best fitting into one of the categories. Borrell *et al*. (2006) also note that time of year is important as skin colour changes with sun exposure. This is one reason why objective skin colour tests often have two measures. One is taken at a place that is generally out of the direct sunlight, such as an inner upper arm, to give a measure of natural skin colour, and the other is taken at a site such as the forearm to give a measure of tanning

and is the skin colour that most people will see. In New Zealand, a study is under way to assess the validity and reliability of population measures for assessing skin photosensitivity by contrasting self-report with measurement by photospectrometer (Reeder *et al*. in progress).

The Fitzpatrick skin type scale, developed to assess skin cancer risk, is a key reference for classifying skin colour. The scale has six skin type categories.

- Skin type I: Always burns, never tans; sensitive to sun exposure; redheaded, freckles.
- Skin type II: Burns easily, tans minimally; fair-skinned, blue, green or grey eyes.
- Skin type III: Burns moderately, tans gradually to light brown.
- Skin type IV: Burns minimally, always tans well to moderately brown; olive skin.
- Skin type V: Rarely burns, tans profusely to dark; brown skin.
- Skin type VI: Rarely burns, least sensitive; deeply pigmented skin (Fitzpatrick 1988).

Although there is no measure of this, many New Zealanders with Māori, Pacific, and Asian ancestry are likely to have only moderately dark skin (that is, skin types III and IV) as measured by the Fitzpatrick skin type scale. A small study commissioned by the Cancer Society found that 'self-defined' Maori include a full range of skin types and a sizable proportion with a tendency to sunburn (Reeder 2001).

New Zealand's 'displaced' populations: A short history of migration

New Zealand is a country of migrants or descendents of migrants. This migration has occurred in waves, but in relation to possible genetic adaptation to the local environment, even the earliest known waves have occurred relatively recently. Migration has brought to New Zealand people with diverse genetic characteristics, including skin colour, as well as a variety of cultural practices, including diet and behaviours towards sun exposure. Some of these attitudes and behaviours may be relatively resistant to change while others may alter quickly.

The first migration to New Zealand is thought to have been by settlers from islands around the Marquesas and Cook Islands, possibly commencing about 1000 years ago (Irwin 1994, Howe 2007). These people became New Zealand's indigenous population, the Māori. Historically, this group is likely to have had dark skins better adapted to the environmental conditions through which they had migrated for perhaps 4000–5000 years and in their prior homelands in central and East Asia. This group came to a land with a climate quite different to that from where they had migrated. As now, New Zealand was likely to have been colder

and to have had stronger seasonal variations of temperature, but much lower UVR levels,[5] especially in the winter.[6] As is currently the case, both season and location would have probably affected sunburn risk and vitamin D status, given New Zealand's large seasonal and, albeit to a lesser extent, latitudinal variations in UVR.[7]

Although there are many unknowns, it is likely that Maori, given their probable skin colour at this time, would have been suited to New Zealand's UVR levels in relation to skin cancer risk but possibly not in terms of synthesising sufficient vitamin D.[8] However, it is possible in the early days of settlement that Maori gained much of their vitamin D requirements through diet, including fish. And it is possible, but not certain, through their lifestyle, including clothing, that they achieved additional and, overall sufficient, Vitamin D levels through sun exposure, at least during summer.

The first recorded European visit to New Zealand was by the Dutch explorer Abel Tasman in 1642 followed over 100 years later, in 1769, by James Cook's arrival from Britain. Between 1831 and 1881, Europeans grew in numbers from fewer than 1000 to half a million (Belich 1996, p. 278). Although there is likely to have been some variation in skin colour, in general these settlers had light-coloured skins. As for why skin colour may be lighter amongst these groups, evidence suggests humans emerged from Africa to colonise other areas, including Europe, some 70,000 years ago (Maca-Meyer *et al*. 2001, Jobling *et al*. 2003, Bellwood 2005). Some scientists suggest the migrating Africans were likely to have had dark, highly reflective skin and black hair (Jablonski and Chaplin 2000). It is hypothesised that as this group moved from equatorial regions northwards into central Asian, then into Europe, eastern Asia, and the polar north, dark skin became a liability (Clemens *et al.* 1982). At higher latitudes, the lower angle of the sun, the longer and darker winters, and the need to wear warm clothing may have made those who had darker skin deficient in vitamin D, which is mainly produced by the action of UV radiation on cholesterol in the skin. But changes in diet, from a predominantly hunting-based diet to a farming-based diet may have made sun-generated vitamin D even more vital to well-being (Chen *et al*. 2007). The timing of the 'development'

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5 For Ultraviolet Index (UVI) graphs for various New Zealand sites and the Cook Islands, including Rarotonga, see the National Institute of Water & Atmospheric Research (NIWA) website: http://www.niwa.co.nz/our-services/online-services/uv-and-ozone/yesterdays-uv-index.

6 See the diagram of daily averaged UVR dose over a three-month period in 1991 on the Socioeconomic Data and Applications Center's home page for the Stratospheric Ozone and Human Health Project {suggest removing blue}: http://sedac.ciesin.org/ozone/gifs/jja91.gif.

7 During the summer, the UVI can reach 13 in the north of the country, while in the south during winter it can be as low as 1. See Cancer Society of New Zealand, *UVR Levels in New Zealand,* http://www.cancernz.org.nz/reducing-your-cancer-risk/sunsmart/the-ultraviolet-index-uvi/UVR-Levels-in-New-Zealand.

8 The question of what constitutes an optimal level of vitamin D is discussed later in this paper.

of a group of Europeans with white skin is the subject of scientific debate, with one estimate being promoted in the media that this occurred as recently as 5500 years ago (Leake 2009).

Although the 'ozone hole' had yet to develop, it seems certain that the early European settlers came to a country with much stronger UVR than at equivalent latitudes in the northern hemisphere during the spring and summer months (McKenzie and Bodeker 1996).[9] As such, the European settlers were at greater risk of developing skin cancer once in New Zealand. Studies of migration and reverse migration between the United Kingdom and Australia and New Zealand and the effect on skin cancer rates support this (Khlat, *et al*. 1992, Cooke and Fraser 1985).[10]

In theory, these generally pale-skinned settlers were also better suited to absorbing vitamin D during low UVR periods, namely winter, than earlier migrants with darker skin. This would have been particularly so for those with very pale skin and red or fair hair, that is, physical characteristics or phenotypes that are particularly common amongst those migrating from Ireland and Scotland. Cultural attitudes, which are often associated with dress codes that determine how much skin is covered, as well as season and, albeit to a lesser extent, location, would have been important factors determining whether sun exposure did, in fact, provide these early settlers with sufficient vitamin D.[11] As Lucas and Ponsonby (2002, p. 594) note in relation to Europeans in Australia, in recent times a suntan has become fashionable and 'summertime clothing has shrunk to a minimum' for some groups.

After World War Two there was significant migration from the Pacific, predominantly Polynesia and Micronesia, with the Pacific population growing rapidly during the late 1960s and early 1970s. Again, while skin pigmentation among Pacific peoples varies considerably, overall this group was predominantly likely to have had dark skin. These migrants also changed many of their cultural practices once in New Zealand, including aspects of diet, physical activity, and exposure to the sun.

The fourth major migrant group, classified as Asians, pre-dates recent Pacific migration. There have been people of Asian origins and ethnicities living in New Zealand

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9 New Zealand's summer UVR levels can be up to 40 percent higher than at equivalent latitudes in the northern hemisphere (McKenzie 1996).

10 Migrants from countries with relatively low skin cancer incidence rates, such as the United Kingdom, who settle in countries with higher summer UVR levels, such as Australia and New Zealand, generally have significantly lower skin cancer rates than native born New Zealanders and Australians as a result of less sun damage in childhood and youth.

11 Note, however, that a variety of factors other than sun exposure is likely to influence an individual's vitamin D status (Brannon *et al*. 2008). There is some evidence of significant variation in serum vitamin D response among individuals exposed to similar amounts of UVB radiation, with some having low vitamin D status despite abundant sun exposure (Binkley *et al*. 2007).

from the early days of European settlement, although in very small numbers. However, a century later in the 1980s and 1990s, the number of migrants from Asia grew rapidly. In terms of skin colour there is a wide variation amongst Asian people, in part reflecting that the Asian grouping encompasses a variety of ethnicities. A more recent component of migration comprises refugees and other settlers from Africa and the Middle East. Again, in relation to skin colour there is much heterogeneity. For both groups there is also likely to be considerable differences in cultural practices. For example, in many parts of Asia some people try to develop or maintain light-coloured skin.[12] A lighter complexion is generally associated with wealth and higher education levels, whereas darker skin is associated with low-income outdoor work. Some of these attitudes are likely to have been transferred to New Zealand. In addition, some Muslim migrants, especially women, are likely to expose little skin while outdoors and this might affect their vitamin D uptake from the sun (Diamond *et al*. 2002, Grover and Morley 2001).

To add complexity, people who have migrated from different areas do not always confine themselves to their own groups. In New Zealand, there has been a high level of ethnic intermarriage. The resulting children of mixed ancestry means the often quoted 'browning' of New Zealand (Kiro 2002) is also likely to be resulting in a 'whitening' of the Maori and Pacific populations. These changes are already being noted. For instance, O'Regan (2001) notes some of the difficulties of being a 'white skinned' Maori. These changes, through a variety of ways, including discrimination, can alter health and other outcomes for individuals within particular ethnic groups.

Finally, not only do Australia and New Zealand lead the world in melanoma incidence, there is considerable movement of people, short term or long term, between Australia and New Zealand. This includes Māori, and it has been estimated that one in six Māori now lives in Australia (Hamer, 2009). This means many New Zealanders and Australians are being exposed to, and hopefully influenced by, health promotion messages on both sides of the Tasman.

[12] http://uniorb.com/ATREND/asianwhite.html

Race, ethnicity, and health

The relationship between race or ethnicity and health outcomes has always been contentious (Manly 2006). As is later discussed, one aspect of this complexity relates to what the variable race or ethnicity is actually measuring and how the data are reported.

With the advent of the Human Genome Project, the debates have become even more complex (Callister and Didham 2009). There is increasing research on topics such as whether 'races exist'; whether 'race (or ethnicity) based' medicine is useful or problematic; and how genes and the environment interact. Questions of nature versus nurture (or nature and nurture) show up in discussions of early Māori health with an examination of the role of genetic mixing as opposed to the social, economic, and cultural changes that accompany intermarriage and social mixing. For example, O'Regan (2001, p. 135) notes that early in the colonisation of New Zealand, 'Kāi Tahu leaders were quick to recognise the increased resistance to European illnesses in those of mixed descent'. But it is not clear whether this is because of a genetic response or due to access to improved resources.

In the current debates about genes, ethnicity, and health there are three broad positions. One position is that race has no biological basis. Morning (2007) cites the finding that human beings share 99.9% of their DNA as a key argument for undermining racial categories. The second broad position is that while 'racial' differences exist, these are primarily cosmetic. These racial differences include superficial characteristics such as skin and hair colour; features that involve a very small number of genes that were historically selected in particular environments. However, it is argued that these superficial differences do not reflect any additional genetic distinctiveness. But, as already discussed in relation to skin cancer risk and vitamin D insufficiency, skin pigmentation or phenotype is not simply a 'superficial characteristic'. It may also be an important factor in relation to discrimination, including possible discrimination in the health sector. The third broad position is that genes and race are intrinsically linked, particularly in health. The idea is that particular sets of genes are more common in particular racial groups, and these genes alter the propensity of groups to be at risk from certain types of illnesses or to exhibit certain behaviours. The concept of race-based genetically determined diseases or behaviour raises questions as to whether health promotion (particularly prevention and early detection advice), as well as medical treatment, should vary on the basis of ethnicity or race.

However, to date, medical research suggests there are few diseases, or behaviours, that have a simple genetic determination; one example being that of Huntington's disease, a rare,

inherited, neurological disorder. New Zealand health researchers have suggested that 'genetics plays only a small part in ethnic differences in health, and other factors are often more amenable to change' (Pearce *et al*. 2004, p. 1070). In relation to cancer in a United States context, Brawley (2009) assesses various arguments that attempt to explain the racial differences in incidence and mortality from a wide range variety of cancers. Again, while 'biology' cannot be ruled out entirely, environmental (including attitudinal and behavioural) factors, such as unequal treatment, are seen to be very important to outcomes (Harris *et al.* 2006).

Skin colour, ethnicity, vitamin D, and cancer

As noted, one area in which genetics has a clear impact is skin colour. But how skin colour then affects outcomes in areas such as skin cancer and vitamin D levels is influenced by a range of environmental and individual factors, in particular the strength of UVR and personal attitudes and behaviours regarding sun exposure and sun protection (Reeder 2005). Other factors, which are not mutually exclusive in their effect, include diet and exercise.

Skin cancer

New Zealand and Australia have melanoma incidence rates that are significantly higher than those from all other reporting countries worldwide (Parkin *et al*. 2007). Melanoma makes a significant contribution to New Zealand's cancer burden. In 2006, the year for which the most recent figures are available, there were 1982 melanoma registrations [1057 males and 925 females] (New Zealand Health Information Service 2009). Although non-melanoma skin cancers are not routinely collected and recorded, there are an estimated 67,000 new non-melanoma skin cancers in New Zealand each year (O'Dea 2009).[13]

The scientific evidence is reasonably clear that having light-coloured skin increases the risk of skin cancer, including melanoma, especially when light-skinned people then migrate to areas with strong UVR and do not adapt their behaviours to the new environment (Boyle *et al*. 2004). As well as skin cancers, there are other proven risks of excess sun exposure that are not related to skin colour, including eye diseases such as some types of cataract premature aging of the skin; and immune suppression (Lucas *et al.* 2006).

Skin cancer is a risk in Europe, but, as already noted, people from Europe have migrated to countries such as Australia and New Zealand where UVR levels are much higher

[13] Providing an exact figure for the number of non-melanoma skin cancers (basal cell carcinoma and squamous cell carcinoma) is difficult because, unlike melanoma, they are not required to be notified under the Cancer Registry Act 1993.

in the summer than at comparable latitudes in the northern hemisphere (McKenzie and Bodeker 1996). This is likely to be a key factor explaining why New Zealand and Australia have the world's highest melanoma rates. It has been estimated that, while potentially modifiable, as much as 90% of melanoma in Australasia is attributable to sun exposure (Armstrong and Kricker 1993, 2001).

In New Zealand, the descendents of northern European migrants include New Zealand Europeans but, through intermarriage, they also include Māori, Pacific, and Asian peoples. Particularly high rates of historic intermarriage have led to the perception of Ngāi Tahu as the 'white tribe' (Wanhalla 2007). With reference to skin cancer Boyle *et al*. (2004, p. 5) note:

> The highest incidence rates of melanoma are reported from (essentially European migrant populations in) Australia and New Zealand (non-Maori population) where the annual incidence is more than double the highest rates recorded in Europe. Incidence rates have been increasing rapidly for several decades in all Caucasian populations although there is now an indication that in those areas where the incidence is highest, the mortality rate is beginning to stabilise or fall.

In this context, the term 'Caucasian' means white skinned. In this situation, Caucasian is not an officially recognised ethnic group within New Zealand, but it is a term that has sometimes been used in New Zealand studies of skin cancer, for example (Sneyd and Cox 2006, p. 8):

> The main aetiological factor for melanoma is exposure of Caucasian skin to ultraviolet (UV) light, particularly intermittent exposure and particularly during childhood. The best avenue currently for melanoma prevention is believed to be by encouraging protection against sunburn, particularly in children, and in fair-haired and fair-skinned people.[14]

Shaw (1988) noted that malignant melanoma was rare amongst Māori. In an editorial in the *New Zealand medical journal*, Shaw (2008, p. 6) demonstrates that melanoma 'is rare in non-Caucasians', but with the data based on ethnic categories (with 'European' seen as equating to 'Caucasian'). The data Shaw presents indicate that, given the incidence of melanoma in New Zealand, approximately 99% of melanoma cases will be among Caucasians.

Shaw (2008) further notes that although melanoma is unusual among Māori and Pacific peoples, people from these groups along with Caucasians aged over 60 often present

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[14] Sunburns, especially those that occur in childhood, are believed to be a primary cause of melanoma (Armstrong 1988). However, according to a recent meta-analysis, sunburns increase the risk of melanoma, no matter at what age they occur (Dennis *et al.* 2008).

late with melanoma, which significantly reduces their life expectancy. He suggested targeting these three groups with melanoma awareness messages.

Shaw's 2008 study was reported in the *New Zealand Herald* (Eriksen 2008) with Shaw quoted as stating that the numbers proved that either skin cancer prevention and SunSmart messages such as 'Slip, slop, slap and wrap' were not getting through to these groups or that it could be too early in the history of skin cancer control campaigns to be seeing positive results due to the time delay between harmful sun exposure and the development of melanoma.[15]

Sneyd *et al*. (2008) agreed melanoma was a significant problem in New Zealand, but raised methodological issues in relation to Shaw's study, including denominator questions and questions related to the measurement and reporting of ethnic groups; issues we return to.

Sneyd and Cox (2009), using Cancer Registry data, examined trends in melanoma rates among Māori, Asian, and Pacific people in New Zealand.[16] This study emphasised nodular melanoma, which accounts for the majority of thick, and therefore potentially lethal, melanomas.[17] Overall, the data show that between 1996 and 2006, there were 19,149 first registrations of melanoma in New Zealand. Of these first registrations, 96% were verified by histology. In terms of ethnicity, there were 2,724 missing records. Of the remaining 16,425 registrations, 157 were for Māori, 35 for Pacific people, and 23 for Asian people. When considering the differences between Māori and Pacific registrations, it needs to be kept in mind that the system of ethnic prioritisation used in data of this period means people who recorded both Māori and Pacific ethnicity were counted as Māori only (Didham 2005).

Sneyd and Cox (2009) show that the crude melanoma incidence rate (per 100,000) for Māori and Pacific groups increased between 1997 and 2005. For Māori, the increase was greatest, from 1.4 to 3.1, while for Pacific people it was from 0.8 to 2.2. For Asian people, the trend was relatively flat with little change in the rate (from 0.9 to 0.8). Against these still very low figures, the rate for Europeans increased from 41.5 to 58.3. The data were then age standardised, and the rates for the total population and Māori were calculated. Between 1996 and 2006, the total population rate went from 30.9 per 100,000 to 34.6 while for Māori it went from 2.3 to 4.3.[18] Within those who were diagnosed with melanoma, nodular melanoma

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15 Although the New Zealand Cancer Society launched its skin cancer prevention campaign in 1983, skin cancer tends to have a long latency period, often taking several decades to develop.

16 An earlier but less systematic analysis of Māori skin cancer rates was undertaken by Callister (2008). Callister's study also indicated an increase in such rates from a low base.

17 A thicker lesion or later stage at diagnosis is associated with a higher risk of death.

18 Sneyd and Cox (2009) note that the small numbers created problems for age standardisation of data for Pacific and Asian groups.

occurred more commonly among Māori (15.9%) and Pacific people (17.1%) compared with Asian people (8.7%) and New Zealand Europeans (10.5%). Melanomas tended to be thicker and more advanced at diagnosis among Māori and Pacific people.

Sneyd and Cox (2009), echoing an earlier discussion by Callister (2008), discuss the possible influence of changing (that is, 'lightening') skin colour on melanoma incidence among Māori and Pacific groups, but acknowledge a lack of data in this area. However, moving away from skin colour, they advise that educational messages about skin cancer prevention and early detection should be specifically targeted at 'minority' ethnic groups in New Zealand.

Vitamin D and cancer

Internationally, there has been significant debate about the relationship between sunlight, vitamin D, and various conditions, including cancer. It has been suggested that vitamin D may protect against some forms of cancer, in particular colorectal cancer (Garland and Garland 1980, Gorham *et al.* 2007, Scragg 2007). Some of this discussion has involved dramatic claims, while other has involved careful deliberation. Headlines have included (Mittelstaedt 2008):

> ... the biggest bombshell about vitamin D's effects is about to go off. In June, U.S. researchers will announce the first direct link between cancer prevention and the sunshine vitamin. Their results are nothing short of astounding.

And (Vitamin D for cancer 2008):

> It sounds too good to be true … a little inexpensive pill that could block the development of some cancers, strengthen bones, prevent multiple sclerosis and alleviate winter depression. But it's not science fiction. The 'new aspirin' could be vitamin D. Just as we discovered that aspirin can guard against heart disease, Vitamin D could become a useful weapon in the fight against MS, osteoporosis, mild depression and one of the most devastating diseases of our time – cancer.

In New Zealand the magazine *Investigate* has been particularly upbeat about the effects of vitamin D and critical of SunSmart policies (Wishart *et al*. 2008). Some researchers have also been critical of SunSmart policies because of vitamin D–related concerns (Scragg and Bartley 2007, p. 2739):

> At the moment, non-government organisations, such as the Cancer Society of New Zealand and the Health Sponsorship Council, are driving the development of policy on sun exposure, vitamin D, and health, but with the focus firmly on (avoiding) sun exposure.

One result of this debate was that the Cancer Society commissioned a report by epidemiologist Robert Scragg, in advance of its *Roundtable on UVR Exposure, Vitamin D and Cancer* held in July 2007. This report suggests (Scragg 2007, p. 3):

> The strong evidence from studies showing an inverse association between vitamin D and colorectal cancer, when combined with similar (albeit limited) findings from studies of total cancer incidence and mortality, suggest that cancer incidence and mortality in New Zealand can be expected to decline if levels of vitamin D in the population are increased.

As yet, however, there is no scientific consensus regarding optimal blood levels of vitamin D (United States National Cancer Institute 2009). Some research has also suggested significant individual variation in UVB radiation responsiveness, causing some people to have low vitamin D status despite abundant exposure to the sun (Binkley *et al*. 2007).

One of the concerns sometimes raised about sun protection and skin cancer prevention policies is that they may protect particular ethnic groups from skin cancer, but potentially disadvantage other groups that are at risk of vitamin D deficiency or insufficiency (Scragg 2007).

Based on the analysis of blood samples that were collected as part of the 2002 National Children's Nutrition Survey, Rockell *et al.* (2005) found that Māori and Pacific children have, on average, lower vitamin D levels than European children have. With reference to their measure of vitamin D insufficiency (less than 37.5 nmol/L), the researchers found 41% (range 30% to 54%) of Māori, 60% (43%,74%) of Pacific, and 26% (16%, 37%) of European children fell below this measure.[19] The lower average serum vitamin D levels among Māori and Pacific children was assumed to be the result of their higher amounts of melanin, or skin darkness, and lack of exposure to the sun.[20] However, a variety of other

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[19] In schools three distinct groups of children were selected, Maori, Pacific, and European/Other. However, it is not clear from the published methodology how children who may have wanted to affiliate with more than one ethnic group were allocated to just one ethnic group. Note also that while the averages are different, the ranges overlap for European/Other and Māori children and for Māori and Pacific children.

[20] A study of vitamin D levels in South Asian women in New Zealand suggests that avoiding sun exposure may be a health risk for some groups of Asians (von Hurst et al., 2007). A British study of vitamin D adequacy cites research papers that identify skin pigmentation rather than ethnicity as important for the body's ability to synthesise vitamin D (Scientific Advisory Committee on Nutrition 2007).

factors may be influencing levels, including prevalence of obesity, type of diet, and exercise levels. In addition, a study which assessed the seasonal variation of vitamin D levels in adults in Canterbury, found over one-third (35%) of the subjects were vitamin D deficient (defined in the study as <25nmol/L) in the winter months of July and August of 2004 (Livesey *et al*. 2007). Furthermore, the majority (89%) were vitamin D insufficient (<50 nmol/L) in the same winter months. Ethnicity was not considered in this study. The relationship between sun exposure and skin type in New Zealand and these lower levels of vitamin D have not yet been validated against an objective measure of skin colour (Reeder *et al*. in progress).

One possible outcome of the debate about the potential protective effects of vitamin D is that sun exposure messages, including sun protection messages, should differ according to ethnic group. One suggestion might be that Māori and Pacific people are not at risk, or are at lesser risk, from melanoma, so do not need to 'cover up' in the same way as 'Europeans' need to during summer. In fact, the argument could be that Māori and Pacific people should actively seek out sun exposure even when UVR levels are high to extreme to protect themselves against certain conditions, such as colorectal cancer. But how good a predictor of risk factors is ethnicity? This depends to a large degree on what ethnicity is actually measuring.

What ethnicity officially measures

In New Zealand, ethnicity is currently 'culturally constructed'. In other words, individuals are free to 'choose' their ethnicity. But that has not always been the case and examples can be found from around the world where more biologically determined 'race' data are collected. Most governments collect some information on ethnicity or race, frequently treating these terms as synonymous. In a global comparison of census questionnaires, Morning (2008) shows that over half (56%) asked about ethnicity, 15% about race, and 7% about ancestry, while only 2% asked directly about skin colour. However, Morning notes that while ethnicity may be used in the wording of many questions, often the possible responses include colour-related categories. Examples include 'black' and 'white', often alongside responses that could be seen as 'race', such as African, or 'quasi-nationality' groupings, such as Bangladeshi. For instance, the British census has categories such as 'White British' and 'White Irish' as well as 'Black British', while the Canadian census has 'black' and 'white' in its list.[21] Similarly, race-based collections, such as in the United States, include 'black' and 'white' response options.

[21] Terms such as 'black' and 'white' are used in the United Kingdom, but some commentators suggest skin colour is a taboo subject in that country (Lane and Lawrence 2007).

However, in all these countries, as in New Zealand, there is also an awareness of increasing ethnic or racial intermarriage and how, over time, this can lead to people wanting to record multiple ethnic or racial responses, as well as resulting in many 'hues' or graduations of skin colour (Callister *et al.* 2005).

Before New Zealand shifted to culturally defined ethnicity, in common with other countries, race, based primarily on ancestry, was the foundation of statistical collections (Statistics New Zealand 2004). Inter-racial 'mixing' was recognised early on with nineteenth century census data identifying and separating out 'half-castes' (Brown 1984). According to Kukutai and Didham (2007), although information on birthplace was routinely collected, national origin differences were minimised in racial determinations – at least for people considered to be 'white'. They note that guidelines for the race question in the 1936 census advised that, 'All persons of "white" race should enter "European", irrespective of whether they are of New Zealand, English, Scottish, Irish, Frenchman, United States, or other stock'. The 'coloured' races, which included, among others, Māori, Chinese, and 'Negros', were separately identified. Yet, skin colour–related terms such as black and white never explicitly became part of the official language when discussing the composition of the New Zealand population. This was despite that fact that from early days of colonisation 'the colour line was hardly invisible on the ground' (Kukutai 2003, p. 27).[22] Also, unlike in countries such as Canada, the expression 'visible minority'(Potvin 2005) – a term referring to non-white groups – has not been used in New Zealand.

The concept of self-defined ethnicity, or more specifically 'ethnic origin', was first introduced in New Zealand census collections in the 1970s. The term 'ethnic origin' then became 'ethnic group' in the early 1990s. At this time, a separate question was added about Māori ancestry in the five-yearly census of population and this has been repeated in subsequent censuses. Although an important source of information, ancestry data are not considered in this paper.

Given the often complex backgrounds of people in settler societies, self-identified ethnicity in response to official surveys is often not straightforward. Much has been written about how ethnicity is, or should be, measured, in New Zealand (for example, Robson and Reid 2001, Kukutai 2003, Didham 2005, Statistics New Zealand 2004). A review of ethnicity statistics by Statistics New Zealand (2004) recognises that a wide variety of factors may

[22] Kukutai cited in http://unipr.waikato.ac.nz/publicat/WaikatoMagazineSummer04.pdf.

contribute to, or influence, a person's ethnicity. These factors include ancestry, culture, and country of birth or nationality.

The measurement, subsequent recording, then analysis of ethnic data have been particularly fraught in relation to health studies (Callister *et al*. 2007). Several issues important in the past have been resolved by improvements to the data, but some issues continue to create challenges. These challenging issues include:

- how to report and analyse dual and multiple ethnic responses
- what denominators to use, especially when there are undercount issues that have gender, age, and ethnic dimensions
- what level of ethnic grouping to use (for example, whether it is important to consider ethnic groups within the Pacific and Asian populations such as Samoans compared with Papua New Guineans or Japanese compared with Indonesians)
- the effect of 'New Zealander' type responses, particularly in census data
- whether within the Māori ethnic group there are 'core' and 'peripheral' Māori (Kukutai and Callister 2009)
- ethnic mobility (that is,. people changing ethnic groups across surveys or time)
- the relationship between skin colour and ethnicity, which is most important for this paper.

Each of these issues could be discussed in length but we consider just three briefly. First, the issue of how to report dual and multiple responses. Although many health researchers continue to prioritise ethnic data, several studies have shown this process to be problematic (for example, Didham 2005, Leather 2009). Kukutai and Callister (2009) demonstrate that amongst young people recording Māori and European ethnic responses, when pushed to record just one main ethnic group, of the approximately three-quarters that were willing to do this, over half chose European. If these children had been prioritised in the way once recommended by Statistics New Zealand, and still evident in many medical studies referring to ethnicity in New Zealand, then all these children would have been recorded as Māori.

The second issue relates to ethnic mobility. Several studies indicate an important level of ethnic mobility. This not only includes those who 'shuffle' their ethnic groups (that is, keep one and add or subtract other ethnicities), but people who change their ethnic responses completely over time (Carter *et al.* 2009).[23]

[23] Kukutai first used the terms ethnic 'shuffler' and 'leapers' at a Wellington School of Medicine presentation in 2009.

The third issue is the potential for significant within-group diversity, for example, in outcomes. Within-group diversity affects not only Māori, Pacific, and Asian populations but also the European population. This is a point noted by Bhopal (2002) who argues that comparisons between minority ethnic populations and majority populations have the potential to disguise significant health issues for particular subpopulations within the majority group. This within-group diversity can include skin colour.

All these issues are important in terms of determining both population risks and the best ways of communicating prevention messages.

Merits of targeting by ethnicity skin cancer prevention and vitamin D–related health messages

In the *Medical journal of Australia*, Lucas and Ponsonby (2002, pp. 597–598), while not specifically developing guidelines for appropriate levels of UVR, had three suggestions:

- If patients are likely to have low personal UVR exposure, doctors should encourage a diet high in vitamin D, monitor serum vitamin D levels and, if low, consider vitamin D supplementation.
- Excessive exposure to UVR should continue to be discouraged. If individuals need to be in the direct sun in high ambient UVR conditions, then doctors should strongly encourage sun-protection measures. However, we need to make sure this message is not taken to the opposite extreme of reducing beneficial UVR exposure, such as short exposures during winter.
- Public health messages regarding sun exposure should be tailored to the population — with regard to levels of pigmentation, behavioural practices, and regional and seasonal levels of ambient UVR.

In this advice ethnicity (or race) is not considered, instead the focus is on blood vitamin D levels (if low), skin pigmentation, behaviour, and environmental factors.

In the same journal, Samanak *et al*. (2006) provide detailed estimates (in terms of minutes of exposure) of beneficial and harmful sun exposure time over the year in a selection of Australian locations. Again, this is based solely on skin pigmentation not ethnicity, with the calculations based on skin type II on the Fitzpatrick skin type scale (that is, always burns easily, tans minimally (white skin), but it also refers to recommended behaviour for skin types V and VI in certain circumstances. Overall, they suggest that across Australia, summer UVR levels are likely to be high enough that short exposure, under most circumstances, will be

enough for most people to produce sufficient vitamin D. Turning this into an overall population public health measure, they stress that minimising summer sun exposure is important. But, in winter, the message should be individualised and include consideration of a variety of circumstances, including geography, skin type, and age. Taking a global perspective, Lucas *et al*. (2006) propose that all sun-related messages need to be increasingly tailored to specific locations, seasons, times of day, and skin types.

This approach suggests ethnicity should not be the focus of health promotion messages. But these Australian and international views contrast with ideas emerging in New Zealand. As already noted, Shaw (2008) has suggested targeting three groups with melanoma awareness messages: Māori, Pacific people, and Caucasians aged over 60, all of whom present late with melanoma and so have significantly reduced life expectancy. Similarly, Sneyd and Cox (2009) have suggested that educational messages about skin cancer prevention and early detection should be specifically targeted at 'minority' ethnic groups in New Zealand. In addition, Scragg (2007) has suggested that although current sun protection and skin cancer prevention policies may protect particular ethnic groups from skin cancer, they potentially disadvantage other ethnic groups that are at risk of vitamin D deficiency or insufficiency.

As already noted, evidence links UVR exposure, skin colour, and skin cancer, including melanoma, risk. There is also a strong, but increasingly imperfect, fit between ethnicity and the risk of developing skin cancer. This might suggest that in the past the association between ethnicity and skin colour was reasonably strong but that this is now weakening. This weakening could be due to the effects of ethnic intermarriage or ethnic mobility but it also might be exacerbated by a move towards culturally-defined ethnicity. However, in these relationships, other aspects of culture, including lifestyle, will also be influencing patterns of risk.

In contrast, much of the science about vitamin D sufficiency and its relationship to health is still inconclusive, including in relation to various cancers (IARC Working Group on Vitamin D 2008). Current mainstream advice if an individual is concerned about their vitamin D levels, is not to seek extra sun exposure in high UVR periods but rather to seek medical advice, including to determine whether supplementation is necessary.[24] However, it may be that, as opposed to those other groups at high risk of vitamin D insufficiency (that is, older people and exclusively breastfed babies of vitamin D–deficient mothers), individuals with

[24] The IARC Working Group on Vitamin D (2008) notes that the long-term effects of higher vitamin D levels are unknown.

darker skin may be better to obtain vitamin D through additional sun exposure rather than through supplementation, given that they may be adapted to require higher amounts of UVB in order to synthesise vitamin D. As yet, however, we do not have the evidence on which to base such advice (Kimlin et al. 2007). In determining what health messages should be promoted we need to ourselves heed the advice of Gilchrest (2008, p. 570S) and 'avoid poorly reasoned, sensationalistic recommendations regarding unprotected ultraviolet exposure' and instead 'should rigorously explore possible cause-and-effect relations between vitamin D_3 status and specific diseases while advocating the safest possible means of ensuring vitamin D_3 sufficiency'.

The two sets of issues, skin cancer and vitamin D sufficiency, mean SunSmart policy-makers are being asked to provide 'ethnically targeted' messages that are potentially in conflict with each other. It is being argued that Māori and Pacific people should become more aware of the risks of developing skin cancer, but it is simultaneously being argued that to reduce the risk of other cancers, they should be seeking more sun exposure. The challenges are not only to determine levels of sun exposure required to maintain healthy vitamin D status without increasing known skin cancer risk across a diverse population, but how to incorporate and communicate variations in *both* skin pigmentation and UVR by: season, location, time of day and / or Ultraviolet Index (which measures UVR intensity) levels in health promotion messages.

These issues also raise a fundamental dilemma for epidemiology, which is based on group or population measures. Group measures can be very important in identifying broad group outcomes, but what do they tell us about individuals, including appropriate advice? If there is much within-group diversity in relation to risk factors, then group-based advice is especially problematic.

Messages for both sun protection and sun exposure based on skin colour would seem more appropriate not only for Māori and Pacific people, but also for Asian people, Europeans, and all other New Zealanders. Ideally, data would be available to health researchers on both ethnicity and skin colour, but (except perhaps in narrow data sets such as the Cancer Registry) for a variety of reasons this is unlikely to happen. However, even without such data, the information we already have about the relationship between skin colour and both skin cancer risk and vitamin D sufficiency suggests that if any group health promotion targeting should be undertaken, then it should be on the basis of a clearly known, and highly stable, risk factor – namely, skin colour – rather than on the basis of an indirect, unstable, and imperfect measure of risk – namely, ethnicity.

There are, of course, dangers in messages based on skin colour. As in many other countries, there is a concern in New Zealand that skin colour has been a factor in discrimination. This is recognised in several ways. For example, the 2008 New Zealand General Social Survey asked whether respondents had experienced discrimination in the last 12 months in relation to several settings and, if they had, included skin colour as one of the possible reasons for this discrimination.[25] In relation to combating discrimination, the Human Rights Act 1993 is concerned with discrimination across the public and private sectors, in relation to employment, public access, and the provision of goods and services, including housing, education, and superannuation. Section 21 of the Act sets out 13 prohibited grounds of discrimination: sex; marital status; religious belief; ethical belief; colour; race; ethnic or national origin (including nationality or citizenship); disability; age; political opinion; employment status; family status (including pregnancy); and sexual orientation. These concerns relate to negative discrimination. However, promoting sun-protection strategies based on the colour of skin, means there may be actions that appear to be positive discrimination. For example, a teacher who is engaged in outdoor class activities may suggest that only light-skinned children need to wear sun protection or that for optimal vitamin D only dark-skinned children should seek sun exposure. Such decisions would be difficult for teachers and would raise the possibility of the stigmatisation of children. Such distinctions would also potentially undermine the development and implementation of sun protection policies relevant to various settings, such as schools and workplaces.

Collection of skin colour data by health researchers and social scientists

Finally, should we start collecting skin colour data in official surveys, especially in health data sets such as the Cancer Registry? In answering this, it is clear that ethnicity, despite all the problems of measurement and reporting, will remain a key variable in health analysis. Therefore, in the near future, both cross-sectional and retrospective studies of health risks and outcomes, including those for various forms of cancer, will use ethnicity as a key variable. However, recording skin colour on health records, including the Cancer Registry, could be useful for some medical research. It could also be useful when considering discrimination and already the New Zealand General Social Survey has shown that skin colour is a factor in discrimination.

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[25] Overall, 10% of respondents to the General Social Survey reported discrimination. Asian people recorded the highest rate at nearly 24% and Europeans the lowest at just over 7%. Of Māori (total responses) who reported discrimination, 40% noted skin colour as one reason, for Asian people this was 51%, for Pacific people 27%, and for Europeans 25%.

However, there would be problems in collecting such skin colour or skin type data. One problem is simply technical, ensuring we obtain objective data. But there may be other reasons for not collecting such information. It may be that focusing on skin colour would reinforce, rather then break down, differences between people. Just as collections of ethnic data may not only reflect ethnic groups but also create them by developing stereotypes based on behaviour, so too might collections that classify skin colour.

Conclusion

New Zealand has a challenging climate in relation to individuals managing UVR exposure. Associated with this challenge, New Zealand is a country of migrants. Some New Zealanders have one or more ancestors that have been in New Zealand for perhaps 1300 years, some have ancestors that arrived in the last century, while others arrived recently. All migrants, or children of such migrants, could be seen to be geographically displaced when considering both skin cancer risk and achieving optimal, year-round serum vitamin D levels.

A focus on the relationship between minimising skin cancer risk and maximising vitamin D uptake among the population throws up major challenges for researchers and health promoters. These challenges, including the many unknowns about vitamin D, such as what constitutes an optimal level as well as its association with specific diseases, become even more complex when ethnicity is also considered. While in the immediate future ethnicity appears likely to remain the main frame of reference for assessing risk, based on our analysis, there are dangers in using ethnicity as the key variable on which to base advice concerning the risks and benefits of sun exposure. We consider that skin colour, along with other key variables, such as season and time of day, should be the core considerations informing specific sun-related messages. In the longer term, direct measures of skin type are needed when assessing the risk of skin cancer alongside the actual and potential health benefits of vitamin D.

However, communicating risk-based factors such as skin colour certainly does not rule out using ethnic-based channels of communication. For example, as part of their overall health promotion messages Māori or Pacific health providers need to communicate ‘sunsmart’ (concerning both the risks and the benefits of sun exposure) messages. But communication through ethnic-based channels has to take account of the complexity of risk factors within their own target group, especially variations in skin colour.

Finally, migration data show there is considerable movement of people, including Māori, short term or long term, between Australia and New Zealand. Therefore, consideration

needs to be given to whether health promotion messages, including those regarding optimal sun-related behaviours, should be consistent on both sides of the Tasman.

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