Cancer in Migrants to Australia: Extending the Descriptive Epidemiological Data

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ABSTRACT

Australia experienced a large influx of European migrants during the period 1950-1975. The descriptive epidemiological data on cancer rates within the major migrant groups, reviewed here, provide strong evidence of environmental and behavioral influences on the etiology of various cancers. The opportunity to extend the conventional type of data analysis, to include an examination of the effect of duration of residence upon cancer risk, provides further insight into cancer etiology. The possibilities of further exploring the descriptive data are also discussed, and both the desirability and the timeliness of mounting analytical studies of the Southern European migrants to Australia are emphasized.

INTRODUCTION

Descriptive data on morbidity and mortality in migrant populations are a potent source of circumstantial evidence about the relative importance of environmental factors in disease etiology. When examined in relation to other ecological measures, such data can provide important clues about specific etiological factors.

Previously reported studies of cancer mortality in migrants have predominantly compared three rates—the Ro, Rh, and Rm1. In some studies it has been possible to compare the rate in the first generation migrants (Rm1) with that of their offspring, the second generation (Rm2); in particular, the studies of first and second generation Japanese migrants to the United States (1-4) have demonstrated considerable variation in the extent of postmigration change in the risk of different cancers.

These often-reported comparisons are shown in the top half of Fig. 1. The figure also reminds us that the subset of the country-of-origin population that migrates is likely to be a selected group with respect to various factors that bear on subsequent health risks. However, in view of the various hypotheses that postulate the importance of age at which exposure occurs or the likelihood that exposure factors (e.g., dietary habits) influence the later stages of carcinogenesis, it would be desirable to be able to classify members of the migrating population according to such characteristics. Comparison of the cancer rates occurring in those subgroups would then yield additional evidence about the likely etiological factors.

In the context of descriptive, group-based analyses, certain characteristics may be available for subdivision of the migrant population, e.g., age at migration, duration of residence in the host country, and extent of cultural change (perhaps estimable indirectly from such sources as membership lists of ethnic/cultural associations or traditional religious groups). These possibilities are illustrated in Fig. 1.

Inevitably, there are few, if any, preexisting bases for subdivision of the migrant population. It is therefore necessary to pursue etiological hunches or hypotheses with the more labor-intensive, more expensive, analytical epidemiological studies, gathering data de novo at the level of the individual migrant. Paradoxically, few such studies have been done despite the fact that the extent of exposure variation (particularly for labile lifestyle factors such as dietary habits) is likely to be very much greater in the first-generation migrant population than in the general population of the host country. One important practical difficulty may be the usual lack of any migrant population register to serve as a framework for either cohort or case-control studies.

In this paper we present a selective review of the cancer experience of the major migrant groups in Australia, the great majority of whom have arrived since World War II. Where a finer cut in the descriptive data is available, using the sort of subdivision shown in Fig. 1, we present and discuss it. In conclusion, we identify some of the potential studies that are either planned or should be considered in the next decade to capitalize on the experiment of opportunity offered by this unique population of first generation migrants.

CANCER MORTALITY, 1962-1971

Comprehensive analysis of cancer mortality in migrants to Australia has been carried out for the period 1962-1971, using routine mortality data files from the Australian Bureau of Statistics (5). Some selected results of that analysis have been summarized in Table 1. For cancers of the large bowel, breast, and prostate, each of which has been associated, in a range of epidemiological studies, with the Western (affluent) lifestyle, mortality rates have been consistently low in migrants from Southern Europe (i.e., Italy, Greece, Yugoslavia, and Malta).

These analyses of the early mortality experience of recent immigrants to Australia have also demonstrated a general tendency for the rates to converge upon those of the Australian-born population with increasing duration of residence in Australia. That tendency had previously been reported, more specifically, for heart disease mortality in Italian migrants to Australia (6) and for gastrointestinal cancers in SEMs to Australia (7). Such convergence was apparent after 5 to 10 yr of residence in Australia.

CANCER MORTALITY, 1980-1982

An analysis of more recent mortality in migrants to Australia has been published for 1980-1982 (8). Although the disease and country of birth categories were much broader than those used in the 1962-1971 analyses, some comparisons were able to be drawn for all cancers and major groups of cancer. The mortality advantage of the SEMs (excluding Yugoslavs) was still apparent 10 yr later than the earlier data. The SMRs for all malignant neoplasms and three major groupings are summarized in Table 2 for all SEMs and for the four countries of Southern Europe with sizable migrant populations in Australia. It is apparent that Greeks and Italians have sustained their mortality benefit for longer than either the Yugoslavs or Maltese.
CANCER IN MIGRANTS TO AUSTRALIA

Fig. 1. Schematic representation of changes in cancer (incidence/mortality) rates associated with migration. Details of possible comparisons of rates within the migrating population (m1) are shown in the lower half.

Table 1 Cancer in migrants to Australia compared with the Australian-born population: mortality during 1962 to 1971 (5)

<table>
<thead>
<tr>
<th>Cancer site</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colon and rectum</td>
<td>Low in Southern European, high in British (especially Scottish) migrants</td>
</tr>
<tr>
<td>Lung</td>
<td>High in British migrants</td>
</tr>
<tr>
<td>Breast</td>
<td>Low in Southern European migrants</td>
</tr>
<tr>
<td>Skin and melanoma</td>
<td>Low in all migrants</td>
</tr>
<tr>
<td>Nasopharynx</td>
<td>High in males from Asia (excluding India and Pakistan) and Malta (x9), Holland (x6)</td>
</tr>
<tr>
<td>Cervix</td>
<td>High (x20) in females from Mediterranean and Northern European countries</td>
</tr>
<tr>
<td>Prostate</td>
<td>Low in Southern European migrants</td>
</tr>
<tr>
<td>Thyroid</td>
<td>High (x3) in Welsh, Italian, and Yugoslav females</td>
</tr>
</tbody>
</table>

Table 2 Standardized mortality ratios for cancer: Australia (1980–1982), in migrants from Southern Europe aged 15–74 at death (8)

<table>
<thead>
<tr>
<th>Site</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Digestive</td>
<td>Respiratory</td>
</tr>
<tr>
<td>Greece</td>
<td>77</td>
<td>87</td>
</tr>
<tr>
<td>Italy</td>
<td>75</td>
<td>95</td>
</tr>
<tr>
<td>Malta</td>
<td>74</td>
<td>137</td>
</tr>
<tr>
<td>Yugoslav</td>
<td>90</td>
<td>99</td>
</tr>
<tr>
<td>Southern Europe</td>
<td>76</td>
<td>92</td>
</tr>
</tbody>
</table>

Table 3 Standardized mortality ratios: Australia (1980–1982), cancer in migrants from selected birthplaces by period of residence in Australia (8)

<table>
<thead>
<tr>
<th>Period of residence in yr</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–4</td>
<td>United Kingdom and Ireland: 79, 104, 104, 111</td>
<td>United Kingdom and Ireland: 84, 109, 111, 115</td>
</tr>
<tr>
<td>5–9</td>
<td>Southern Europe*: 48, 74, 77, 82</td>
<td>Southern Europe: 48, 58, 74, 70</td>
</tr>
<tr>
<td>10–14</td>
<td>Greece: —, 78, 77</td>
<td>Greece: —, 75, 76</td>
</tr>
<tr>
<td>15+</td>
<td>Italy: —, 70, 81</td>
<td>Italy: —, 84, 68</td>
</tr>
<tr>
<td></td>
<td>Asia: 83, 76, 72, 93</td>
<td>Asia: 58, 72, 85, 119</td>
</tr>
</tbody>
</table>

* Includes Greece, Italy, Malta, Albania, Spain, Portugal, and Cyprus.
| —, fewer than 25 deaths. |

The SMRs for most migrant groups for all malignant neoplasms by period of residence in Australia demonstrated a monotonic increase (Table 3) with increasing length of stay. One exception was that of Asian males who demonstrated a declining SMR during the first 15 yr of residence and an increase thereafter. For SEMs, however, after 15 yr or more of residence in Australia, their SMRs for all cancers remained low at 82 and 70 for males and females, respectively. Little breakdown was available for subsites of cancer in other than British migrants whose SMRs with increasing residence all exceeded 100. After 15 yr of residence, the SMRs for digestive system cancers were 76 and 75 for male and female SEMs, respectively, the SMR for genitourinary and breast cancer in SEM females being only 74 after 15 yr of residence, compared to 119 for British and 137 for Asian women.

Stomach cancer mortality has been consistently higher in migrant groups than in the Australian-born population. In view of the well-documented inverse association of this cancer with socioeconomic class, and since the migrants are predominantly from a working class (i.e., lower socioeconomic class) background and, in general, are also from countries with lower standards of living than in Australia, this is an expected finding. An early report was of increased stomach cancer mortality in Polish migrants (9), and a recent study has identified Chinese migrants at increased risk (10). The approximately 45% higher rates of stomach cancer mortality in both British-Irish and Southern European migrants are illustrated in Fig. 2 (11). Recent incidence data from South Australia for the period 1977–1984 indicate that these stomach cancer risk differentials are persisting unchanged (Table 4); indeed, the rates in migrants from Greece remain more than twice those of the Australian-born population. The effect of early life exposures appears to be of more importance to stomach cancer risk than factors acting later in life.

GASTROINTESTINAL CANCERS

Stomach cancer mortality has been consistently higher in migrant groups than in the Australian-born population. In view of the well-documented inverse association of this cancer with socioeconomic class, and since the migrants are predominantly from a working class (i.e., lower socioeconomic class) background and, in general, are also from countries with lower standards of living than in Australia, this is an expected finding. An early report was of increased stomach cancer mortality in Polish migrants (9), and a recent study has identified Chinese migrants at increased risk (10). The approximately 45% higher rates of stomach cancer mortality in both British-Irish and Southern European migrants are illustrated in Fig. 2 (11). Recent incidence data from South Australia for the period 1977–1984 indicate that these stomach cancer risk differentials are persisting unchanged (Table 4); indeed, the rates in migrants from Greece remain more than twice those of the Australian-born population. The effect of early life exposures appears to be of more importance to stomach cancer risk than factors acting later in life.

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For mortality from cancers of the large bowel, Fig. 2 shows that, whereas the British-Irish migrants have had rates similar to those of the Australian-born, the migrants from Southern Europe have had substantially lower rates. Likewise, the incidence data from South Australia for the period 1977–1984 (Table 4) show that colon cancer incidence rates in Southern European migrants are only about 55% those of the Australian born.

The data in Table 5, showing relative food consumption per person in these countries in the 1950s and 1960s, indicate that the British-Irish migrants brought with them a dietary culture similar to that of Australia (i.e., a variant of the chronology of earlier Australian colonial history) with the exception of their much higher consumption of potatoes, whereas the Southern European migrants had a very different dietary background. The consumption of cereals, pulses, nuts, vegetables, and fruits—all sources of dietary fiber—was much higher in Australia, while the consumption of animal (saturated) fats was much lower. If diets high in saturated fats and low in dietary fiber are, as widely postulated, a source of increased risk of colorectal cancer, then the data in Table 6 may explain the colorectal cancer pattern shown in Fig. 2.

This facet of migrant cancer experience is examined in more detail in Fig. 3, in which the migrant populations have been subdivided according to duration in residence in Australia (using the duration categories supplied by the Australian Bureau of Statistics). After standardization for age and sex, it can be seen that, for both colon cancer and rectal cancer, there was a general pattern of convergence upon the Australian-born rate with increasing duration of residence. The fact that this change in risk was clearly evident after 16 yr of residence in Australia suggests that, whatever the environmental factors responsible (which almost certainly included dietary changes), they predominantly influenced the later stages of carcinogenesis.

### BREAST CANCER

Incidence and death rates from breast cancer in women, within the past decade, showed moderate variation between different migrant groups, expressed relative to the rate in Australian-born women. In South Australia during 1977–1984, the age-standardized, incidence rate of breast cancer in women aged 30 or more was approximately 25% lower in migrants from Italy and Greece than in Australian-born women, whereas it was approximately 25% higher in migrants from the United Kingdom and Ireland. Mortality data for the period 1980–1982 showed a similar variation (8). The magnitude of these differences was generally less than between the migrant countries of origin and Australia (i.e., Ro versus Rh; Fig. 1), suggesting that postmigration changes in environment and lifestyle influenced the risk of breast cancer.

Among Italian-born migrant women, mortality from breast cancer has been shown to vary substantially as a function of duration of residence in Australia (Fig. 4). These data apply to an earlier period, 1962–1971, but it is unlikely that the pattern illustrated has not continued to apply to more recent immigrant women. In view of the predominant age at death among the breast cancer cases and the fact that most of the observations reported in Fig. 4 occurred within 5–20 yr of arrival within Australia, it is unlikely that a change in age at first completed pregnancy could account for this variation in risk. It is more plausible that a change in diet, perhaps towards a higher intake of saturated fats and/or energy, possibly coupled with reduced physical work expenditure of energy, accounted for some of the variation.

### LUNG CANCER

Dean’s early study of lung cancer mortality in British migrants to Australia compared their age-specific mortality rates with all Australia and with England and Wales and looked at differences in cigarette consumption (12). A later study showed that British-Irish rates were almost twice those of the Australian-born population (13). Subsequent analysis by duration of residence demonstrated that the rates were lower in those migrants who had arrived in Australia more than 16 yr earlier than in those who had arrived more recently (4).

Data from South Australia for 1977–1984 show that the age-standardized incidence rates of lung cancer in British-Irish migrants compared to the Australian-born population are 58% and 77% higher for men and women, respectively (Table 6). These variations were in accord with those in the prevalence of cigarette smoking, estimated from a population survey in 1981 and given in Table 8. Migrants from Italy and females from Greece have lung cancer rates which are in accord with the estimated prevalence of smoking, which was particular low in Greek-born women. However, Greek-born men have a 50%...
CANCER IN MIGRANTS TO AUSTRALIA

Fig. 3. Age-sex-standardized relative risk of colorectal cancer mortality in migrants to Australia, 1962–1976, by duration of stay. Australian born = 1.0.

Fig. 4. Age-standardized mortality ratios for breast cancer in Italian women migrants, during 1962–1971, by duration of residence in Australia. Australian born = 1.0.

MALIGNANT MELANOMA

Australia has the highest reported national rates of cutaneous malignant melanoma in the world. From the incidence data shown in Table 7 it can be seen that the age-standardized rate in the Australian-born adult population has been approximately 25–30 per 100,000 per yr. The fact that migrants from the United Kingdom and Ireland have had rates approximately half those of the Australian born, while having the sort of skin complexion that predominates in Australia suggests that sunlight exposure in early life may be of particular importance in setting lifetime risk of malignant melanoma. If that is true, and if a darker (more “olive”) complexion also confers protection against this cancer, then it is not surprising that migrants from Italy and Greece have even lower rates. In a case-control study, Holman and co-workers have shown that, in migrants to Australia, the younger the age at arrival the higher has been the subsequent risk of malignant melanoma (14).

Table 6 Age-standardized incidence of lung cancer (1977–1984) and prevalence of cigarette smoking (1981) in South Australia, by country of birth and sex

<table>
<thead>
<tr>
<th></th>
<th>Australia</th>
<th>United Kingdom/Ireland</th>
<th>Italy</th>
<th>Greece</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M F</td>
<td>M F</td>
<td>M F</td>
<td>M F</td>
</tr>
<tr>
<td>Prevalence of smoking (%)</td>
<td>35 26</td>
<td>44 35</td>
<td>48 10</td>
<td>36 6</td>
</tr>
<tr>
<td>Lung cancer incidence (per 100,000)</td>
<td>108 22</td>
<td>171 39</td>
<td>140 9</td>
<td>155 4</td>
</tr>
</tbody>
</table>

higher lung cancer incidence than Australian men but do not have a higher prevalence of smoking.

Recent unpublished data from the New South Wales Cancer Registry3 indicate that, between the periods 1976–1977 and 1980–1982, the incidence of lung cancer in women has remained stable in the Australian-born, has declined by 13% in British-Irish migrants, and has increased by 11% in Southern European migrants. Among men, the rates have increased in each of those three groups, by 21%, 18%, and 44%, respectively.

3 J. Ford, personal communication.

CANCER IN SOUTHERN EUROPEAN MIGRANTS: A RESEARCH OPPORTUNITY

Differences in Disease. Southern European migrants present a much different cancer profile than either the Australian-born or other migrant groups to Australia. Their persistent comparative cancer incidence and mortality advantage after more than 15 yr of residence in Australia make them an obvious group to study along the lines suggested in Fig. 1. Unlike other migrant groups their transition towards the Australian-born cancer rates

Table 7 Age-standardized incidence of cutaneous malignant melanoma, by sex and country of birth: three Australian states, circa 1980

<table>
<thead>
<tr>
<th>State (period)</th>
<th>Australia</th>
<th>United Kingdom/Ireland</th>
<th>Italy/Greece</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M F</td>
<td>M F</td>
<td>M F</td>
</tr>
<tr>
<td>South Australia (1977–1981)</td>
<td>26 22</td>
<td>10 11</td>
<td>3 7</td>
</tr>
<tr>
<td>New South Wales (1975–1982)</td>
<td>32 29</td>
<td>11 12</td>
<td>7 6</td>
</tr>
<tr>
<td>Western Australia (1975–1976)</td>
<td>26 24</td>
<td>10 13</td>
<td>6* 4*</td>
</tr>
</tbody>
</table>

* Refers to total continental Europe; see Ref. 14.
is slower and may now be static for certain cancers.

Between migrants from different countries within Southern Europe there exist differences with respect to their SMRs and the rate with which they approach the Australian norm. Italian and Greek migrants, who numbered 275,887 and 146,625 at the 1981 census, are more similar to each other, having lower SMRs and incidence rates than Yugoslavs and Maltese.

The speed with which cancer rates in migrant groups approach that of the host country is strong evidence of environmental effects acting at a late stage of carcinogenesis as promoters. The SEMs’ lower rates and slower transition suggest that there may be some factor(s) in their environment that may protect against or slow cancer progression. The decreased cancer incidence is common to all age groups. The SEMs’ SMRs are lowest for cancers of the colon, rectum, breast, and prostate, all cancers with epidemiological evidence of dietary factors and hormonal/reproductive factors in their etiology.

Dietary Differences. Relatively little work has been accomplished on the dietary content and dietary transition within Australia’s migrant groups. Hopkins’ study of Italians in Perth showed that Italians ate more bread and pasta, salami, fish, and red wine than Australians and derived more of their protein and fat intake from vegetables (15). Australians consumed more beer, tea, and milk and ate more potatoes and beef products than Italians.

With respect to dietary change on migration, Italians admitted to eating more meat and fat after coming to Australia. Studies of Greek migrants to Melbourne (16) and in migrants from one island (Levkada) and of their siblings who remained on the island (17) showed that dietary changes occurred soon after arrival and involved the addition of preferred foods, particularly meats (prepared in ways likely to reduce the potential increase in saturated fat consumption). The Greek migrants’ desire to maintain their culture and cuisine was seen to be very strong, demonstrated by the popularity of home wine making and the continued consumption of olive oil and wild leafy-green vegetables.

Preliminary findings of the 1983 national dietary survey have recently been published based on 24-h dietary recall by 6000 participants, 375 of whom were migrants from Southern Europe (18). These are the first population-based dietary data that are available by migrant groups living in Australia. Table 8 illustrates some of the differences in food consumption between the SEMs and the Australian born. The findings are consistent with the migrants maintaining the cuisines of their countries of origin (pasta, tomatoes, green leafy vegetables, citrus fruit, and red wine) and enriching them by the addition of more meats, particularly beef and veal.

Directions for Future Research. Haenszel has pointed to the exhaustion of research opportunities on migrants to the United States (with the exception of the Japanese), but he sees promise in the post-World War II migrants to Australia, Brazil, and Canada (19). Many case-control and cohort studies have failed to confirm international correlations between certain dietary factors such as fat and cancers of the bowel and breast. Reasons that have been suggested for this inconsistency include (a) the possibility that the populations studied have been too homogeneous with respect to the exposure measure, (b) our dietary methods for measurement of exposure are poor, and (c) that (for case-control studies at least) the value of retrospective data on diet is suspect. However, the observations of differences (to their advantage) in incidence and mortality from cancers of the digestive and reproductive tracts (including breast), and differences in dietary intakes in SEMs compared to Australian born, indicate their value for research.

It is in groups who are in transition from one culture to another that one can expect to find increased heterogeneity of exposure to the dietary factors suspected of either promoting or protecting against cancer. But before one can take full advantage of the unique research opportunities offered by the SEMs it is important to find out the degree of heterogeneity in their diet. Base-line studies of the current food consumption patterns in Greeks and Italians need to be conducted for each group separately using weighed diet records. (The Australian dietary survey (18) was based on only one 24-h recall, and the numbers of migrants were small.)

Given that sufficient dietary heterogeneity can be measured in the study population, it would be worthwhile to conduct case-control studies to explore the conventional hypotheses about protective and promotional factors and test for the effects of fat, fiber, energy, vegetables, alcohol, and other nutrients while also examining other factors such as parity, obesity, and exercise.

However, to address the question of diet and cancer adequately, it is time to explore the problem from the point of view of individual variability. There is little further information to be obtained from ecological studies comparing the mean intakes of different migrant groups. The way ahead is to identify populations within which there exist variations in consumption that are likely to give new information. Case-control studies of such populations might give some increased insight about the relationships which could be fruitful to explore, but the definitive analysis will need to adopt a prospective approach.

The most powerful way to answer dietary questions with respect to the incidence of common tumors of the gut and reproductive organs is to mount a cohort study where information and tissue are collected from the migrants while they are in good health and who are then followed up for the occurrence of cancer and other end points of interest, at which time they are entered into a case-control study from within the cohort. It is anticipated that the base-line and case-control studies currently under way in Australia will culminate in a
unique form of prospective study that will advance our understanding of the role of diet in the etiology of some of our common cancers.

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