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Cancer Mortality Among Polish Migrants to Australia

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This paper investigates the risk of cancer in Polish migrants to Australia, and compares the results with earlier studies, as well as with results of studies of Polish migrants in other countries. Poisson regression models were used to estimate the risk of death in Polish migrants, relative to the Australia-born, as well as the relative risk of cancer in Poland compared to the Australia-born. In migrant males, a significantly lower risk was found for oral cavity and pharynx, larynx, melanoma, prostate and Hodgkin's disease, while a significantly elevated risk was found for stomach, liver, pancreas, kidney and thyroid gland. In migrant females, a risk significantly lower than in Australian-born individuals was found for oral cavity, colon, melanoma, breast and non-Hodgkin's lymphoma. Relative risk significantly higher than in Australia-born was detected for stomach, gall bladder, pancreas, cervix uteri, nervous system and thyroid gland. For some of these cancers, the risk in migrants approximates to that of the Australia-born with increasing duration of stay. Thus, there are progressive increases in risk for colon cancer in males, and breast cancer and melanoma in females, and decreases in risk for stomach and bladder cancers in males, and uterine cancers in females.

Key words: cancer, relative risk, migrants, Poland, Australia, mortality
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INTRODUCTION

POLAND IS a country from which migrants have departed in large numbers for many parts of the world. One of the largest groups of Polish origin is found in Australia. Poles and Australians of Polish origin form about 1.2% of the present population of Australia, the sixth largest group of immigrants with a non-English-speaking background.

The first individuals of Polish origin came to Australia in the 17th and 18th centuries. Migration to Australia before 1900 was mainly politically motivated, but after 1900 was mainly because of economic circumstances. The Australian census of 1921 showed 1787 residents were born in Poland, and the census of 1933 showed 3241 persons.

The wave of Polish migration occurred in the years 1948–1951, bringing the number of Polish-born residents from 6600 in 1947 to 56 600 in 1954, and reaching a peak of 61 600 in the mid-1960s [1]. There was no significant further intake from that time until the end of 1970s. The census of 1981 showed 59 500 Polish-born individuals in Australia, mainly concentrated in Victoria (38%) and New South Wales (31%).

This paper investigates the risk of cancer in Polish migrants to Australia, and compares the results with earlier studies [2, 3] as well as with results of studies of Polish migrants in other countries [4–7].

MATERIAL AND METHODS

Data on deaths from cancer in Australia were provided by the Australian Bureau of Statistics. The data consist of all deaths registered in Australia within the period 1964–1985. Death certificate records provided information on state of registration, year of death, sex, age at death, country of birth, duration of residence in Australia and cause of death.

Population data for Australia for the years 1966, 1971, 1976 and 1981 were also provided by the Australian Bureau of Statistics. The data consist of information on age, sex and origin of birth.

Mortality data for Poland for the period 1980–1984 were provided by GUS (Central Statistical Office) in Warsaw in the form of individual records. Records provided information on age, sex, cause of death and year of death. Polish population data by age and sex for the same years were also provided by GUS. Cause of death was coded according to the 7th revision of the International Classification of Diseases (ICD-7) for the years 1964–1967, 8th revision (ICD-8) for the years 1968–1978, and 9th revision (ICD-9) for the years 1979–1985. Age-standardised mortality rates were calculated using the World Standard Population [8]. Poisson regression models were used to estimate the risk of death in Polish migrants, relative to those Australia-born.

The variable "place of birth" was regrouped into four categories: born in Australia, born in Poland, other birthplace and unknown birth place. Age was grouped into the following six categories: 0–34, 35–44, 45–54, 55–64, 65–74 and 75 years and over. Five time periods were used for the analysis: four 5-year

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periods (1964–1968, 1969–1973, 1974–1978, 1979–1983) and one 2-year period (1984–1985).

The variable "duration of stay in Australia" was grouped into three categories: 0–19, 20–29 and 30 or more years. Based on the information about the duration of stay and year of death a new variable was created: "age at arrival". This variable was grouped as follows: 0–29, 30–49 and 50 or more years.

The Australian census data categorised "duration of stay" with different groupings at each census, and in some of them, the information was incomplete. We, therefore, evaluated the effect of length of stay with case–control methods, using logistic regression to estimate odds ratios of Polish migrants compared to those Australian-born [9, 10]. All models were fitted using the GLIM package [11], and were additive on the logarithmic scale. In GLIM program notation this model is expressed:

age + period of time + state of residence + birthplace × duration of stay

or equivalently,

age + period of time + state of residence + birthplace × age at arrival,

in which a plus sign (+) links variables whose combined effect on relative risk is additive on the log scale (or, equivalently, multiplicative on the arithmetic scale) and multiply (×) indicates that interactions between two variables were also fitted in the model.

Poisson regression was also used to estimate the relative risk of cancer in Poland, relative to those Australia-born. The model included only the variables age and birthplace, since no others were available from the Polish mortality data.

RESULTS

There were 180 502 cancer deaths among Australian-born males and 149 558 cancer deaths among Australian-born females in the years 1964–1985. The numbers of cancer deaths in the Polish-born population were 2617 and 1261 in males and females, respectively (Table 1).

Since one of the pair of variables "duration of stay" and "age at arrival" completely determines the other, in this study only changes in risk versus duration of stay were considered. In the Polish-born, 192 cases (7.3%) in males were of unknown duration of stay, while in females the number of cases of unknown duration of stay was 52 (4.1%).

Table 1 shows the distribution of cases in the Australian- and Polish-born populations by sex and site. Cancer of the lung is the most common cause of death in men, cancer of the breast in women.

Table 2 presents age-standardised mortality rates by site and sex for individuals born and living in Australia, and for Poland. Table 3 shows the estimated relative risks for Polish migrants to

Table 1. Distribution of cancer deaths in Australia in 1964–1985 by site and birth place

		Males				Females			
		Australia born		Poland born		Australia born		Poland born	
ICD	Cancer site	Number	%	Number	%	Number	%	Number	%
140	Lip	225	0.12	2	0.08	49	0.03	0	0.00
141,143–5	Oral cavity	2310	1.28	16	0.61	1077	0.72	2	0.16
146,148–9	Other pharynx	1726	0.96	12	0.46	449	0.30	2	0.16
147	Nasopharynx	346	0.19	8	0.31	138	0.09	3	0.24
140–149	Oral cavity and pharynx	5139	2.85	40	1.53	1990	1.33	9	0.70
150	Oesophagus	4822	2.67	61	2.33	2750	1.84	14	1.11
151	Stomach	12 982	7.19	341	13.03	9234	6.17	110	8.72
153	Colon	16 841	9.33	227	8.67	21 353	14.28	109	8.64
154	Rectum	7280	4.03	107	4.09	5794	3.87	54	4.28
155	Liver	1580	0.88	45	1.72	927	0.62	7	0.56
156	Gall bladder	1315	0.73	28	1.07	2392	1.60	39	3.09
157	Pancreas	8454	4.68	158	6.04	6809	4.55	76	6.03
161	Larynx	2550	1.41	14	0.53	345	0.23	1	0.08
162	Lung	48 260	26.74	776	29.65	10 566	7.06	87	6.90
172	Melanoma	4975	2.76	25	0.96	3390	2.27	15	1.19
174	Breast	—	—	—	—	27 796	18.59	229	18.16
179	Uterus nos	—	—	—	—	684	0.46	6	0.48
180	Cervix	—	—	—	—	5944	3.97	76	6.03
182	Corpus	—	—	—	—	3104	2.08	28	2.22
183	Ovary	—	—	—	—	8498	5.68	92	7.30
184	Other female genital	—	—	—	—	1023	0.68	7	0.56
185	Prostate	18 336	10.16	138	5.27	—	—	—	—
186	Testis	834	0.46	4	0.15	—	—	—	—
188	Urinary bladder	4669	2.59	65	2.48	2193	1.47	18	1.43
189	Kidney	4011	2.22	84	3.21	2772	1.85	31	2.40
191–192	Nervous system	5456	3.02	88	3.36	4160	2.78	51	4.04
193	Thyroid gland	305	0.17	12	0.46	709	0.47	16	1.27
200,202	Non-Hodgkin lymphoma	5538	3.07	64	2.45	4825	3.23	29	2.30
201	Hodgkin's disease	1337	0.74	7	0.27	990	0.66	12	0.95
204–208	Leukaemias	7491	4.15	97	3.71	5997	4.01	39	3.09
140–208	All sites	180 502	100.0	2617	100.00	149 558	100.00	1261	100.00

Table 2. Age-standardised mortality rates for people born and resident in Australia (1979–1983), and for Poland (1980–1984), by sex and site (rates per 100 000)

ICD	Cancer site	Males		Females	
		Australia born	Poland	Australia born	Poland
140	Lip	0.18	0.90	0.02	0.11
141,143–5	Oral cavity	2.33	1.62	0.79	0.30
146,148–9	Other pharynx	1.79	2.05	0.34	0.36
147	Nasopharynx	0.37	0.26	0.12	0.12
140–149	Oral cavity and pharynx	5.12	5.11	1.42	1.01
150	Oesophagus	4.52	4.51	1.72	0.84
151	Stomach	9.16	29.28	4.03	11.15
153	Colon	16.12	4.56	13.75	3.65
154	Rectum	6.94	7.92	3.79	5.65
155	Liver	2.08	7.68	0.86	6.88
156	Gall bladder	1.35	1.67	1.57	4.66
157	Pancreas	7.62	7.09	4.41	4.34
161	Larynx	2.35	6.40	0.26	0.41
162	Lung	47.80	59.61	9.95	7.48
172	Melanoma	5.41	1.16	2.77	0.96
174	Breast	—	—	20.26	15.13
179	Uterus nos	—	—	0.39	1.47
180	Cervix	—	—	3.77	8.55
182	Corpus	—	—	1.76	2.75
183	Ovary	—	—	6.17	6.26
184	Other female genital	—	—	0.56	1.98
185	Prostate	15.95	8.71	—	—
186	Testis	0.60	0.98	—	—
188	Urinary bladder	4.69	6.86	1.45	0.95
189	Kidney	3.90	3.95	2.18	1.87
191–192	Nervous system	5.23	5.28	3.52	3.38
193	Thyroid gland	0.26	0.37	0.42	0.72
200,202	Non-Hodgkin lymphoma	5.46	2.22	3.81	1.01
201	Hodgkin's disease	0.84	1.58	0.49	0.86
204–208	Leukaemias	6.47	5.73	4.15	3.76
140–208	All sites	168.30	186.70	103.40	106.40

Australia and for the Polish resident population, compared with the Australian-born population. In Tables 4 and 5, odds ratios by duration of stay in Australia are shown for males and females, respectively.

Description of the most important cancer sites

In this and subsequent sections the word "Australia" will be used for people born in Australia, "Poland" for the population resident in Poland, and "migrants" for Polish-born individuals living in Australia.

Oral cavity and pharynx

Mortality rates for cancer of the oral cavity and pharynx are similar in males in Australia and Poland (Table 2). In females, mortality in Australia is about 40% higher than in Poland. The relative risk (RR) for male migrants is less than half of that observed for Poland (0.46 for migrants and 1.00 for Poland). In females, risk in migrants is half of that observed for those in Poland (RR = 0.52 for migrants) (Table 3). There is some increase of risk with increasing duration of stay in Australia for males (from RR = 0.24 for 0–19 years of stay to RR = 0.60 for more than 30 years of stay) but this increase is not statistically significant, and no trend is discernible in females.

Oesophagus

Mortality rates from cancer of the oesophagus in males are similar in Australia and Poland (Table 2), while in females mortality in Australia is about twice that in Poland. In male migrants, the risk is 20% lower than in Australia, while female migrants have a risk (0.62) intermediate between that in Poland (0.47) and Australia (1.00). There is an increase in risk with duration of stay for males, and decrease of risk in females—neither statistically significant.

Stomach

Mortality from stomach cancer in Poland is more than three times higher than observed in Australia in males and more than 2.5 times higher in females. The risk for migrants remains high (2.06 and 1.69 for males and females, respectively), but there is a clear decrease in risk with duration of stay in Australia for males (from 2.61 at 0–19 years of stay to 1.86 for long-stay migrants), but there is no evident trend in females.

Colon and rectum

There are substantial differences in mortality from colon and rectum cancer in both sexes. Mortality from colon cancer is several times higher in Australia than in Poland while mortality

Table 3. Risk estimates for Polish migrants to Australia[§] and the resident population of Poland (relative to Australia-born Australian residents)

ICD	Cancer site	Males		Females	
		Migrants	Poland[‖]	Migrants	Poland[‖]
140	Lip	—	—	—	—
141,143–5	Oral cavity	0.41‡	0.67*	0.22*	0.35‡
146,148–9	Other pharynx	0.39†	1.15	0.47	1.08
147	Nasopharynx	1.51	0.72*	2.66	1.08
140–149	Oral cavity and pharynx	0.46‡	1.00	0.52	0.72†
150	Oesophagus	0.80	0.98	0.62	0.47‡
151	Stomach	2.06‡	3.13‡	1.69‡	2.51‡
153	Colon	0.92	0.28‡	0.59‡	0.26‡
154	Rectum	0.96	1.14	1.11	1.40†
155	Liver	1.73‡	3.69‡	0.92	8.33‡
156	Gall bladder	1.36	1.24*	1.96‡	2.82‡
157	Pancreas	1.24†	0.91	1.38†	0.93
161	Larynx	0.34‡	2.68‡	—	1.51‡
162	Lung	0.98	1.22	0.83	0.76‡
172	Melanoma	0.37‡	0.21‡	0.49†	0.34‡
174	Breast	—	—	0.82*	0.71‡
179	Uterus nos	—	—	1.05	3.50‡
180	Cervix	—	—	1.38†	2.17‡
182	Corpus	—	—	1.06	1.40*
183	Ovary	—	—	1.11	0.93
184	Other female genital	—	—	0.96	3.00‡
185	Prostate	0.64‡	0.52‡	—	—
186	Testis	0.66	1.72*	—	—
188	Urinary bladder	1.00	1.43†	1.08	0.61‡
189	Kidney	1.36‡	0.98	1.34	0.80
191–192	Nervous system	1.14	0.99	1.40*	0.88
193	Thyroid gland	2.70‡	1.42	2.90‡	1.60‡
200,202	Non-Hodgkin lymphoma	0.81	0.40‡	0.69*	0.23‡
201	Hodgkin's disease	0.43*	1.88‡	1.57	1.59†
204–208	Leukaemias	1.22	0.87	0.99	0.81

*$P < 0.05$, †$P < 0.01$, ‡$P < 0.001$. §RR adjusted for age, period of time and place of residence. ‖RR adjusted for age.

from cancer of the rectum is higher in the Polish population. For both sites, mortality in migrants has changed significantly towards Australian levels. In males, the change in risk with increasing duration of stay for colon cancer is coherent with this trend, but the risk of rectal cancer also appears to increase with longer length of stay. Trends with duration in females are less clear.

Pancreas

Mortality rates from the cancer of the pancreas are similar in Poland and Australia. Although the RR for Poland are slightly lower than in Australia-born individuals, the relative risks for migrants of both sexes are higher than observed in individuals born in Australia. Changes by duration of stay suggest that the excess risk in migrants occurs soon after migration.

Larynx

Mortality from laryngeal cancer is much higher in Poland than in Australia, especially in males (6.40 versus 2.35). Although the RR of the Polish resident population is more than 2.5 times higher than in Australia, the risk for migrants is only about 35% of that of the Australia-born (RR for female migrants has not been estimated because of the very small number of cases).

Lung

Mortality rates from lung cancer are higher in Poland than in Australia in males, and lower in females (Table 2). Migrants of both sexes have risks rather closer to the Australian-born (Table 3).

Melanoma

Mortality from melanoma is higher in Australia than in Poland in both sexes. Risk for migrants is higher than in Poland in both sexes. There is no increase of risk with duration of stay in males, but in females a positive trend is observed with increasing length of residence in Australia (from 0.31 for 0–19 years to 0.71 for stay over 30 years).

Breast

The mortality rate for breast cancer is higher in Australian-born females than for females living in Poland (20.26 versus 15.13 per 100 000). This is confirmed by the lower RR of the Polish population compared to Australian (RR = 0.71), and the RR in migrants is also lower than in Australia (RR = 0.82). There is an increase in risk with longer duration of stay in Australia (from 0.69 to 1.02 for long-stay migrants).

Table 4. Risk estimates for Polish migrants in Australia by duration of stay adjusted for age, period and place of residence (compared to Australian-born) logistic regression, males

ICD	Cancer site	Duration of stay 0–19 years	20–29 years	30+ years
140	Lip	—	—	—
141	Oral cavity	0.00	0.51	0.33*
143–145				
146	Other pharynx	0.00	0.28*	0.76
148–149				
147	Nasopharynx	2.89	1.07	1.49
140–149	Oral cavity and pharynx	0.24†	0.39†	0.60*
150	Oesophagus	0.31*	0.89	0.90
151	Stomach	2.61‡	2.10‡	1.86‡
153	Colon	0.77	0.82	1.04
154	Rectum	0.69	0.91	1.11
155	Liver	3.11†	2.04†	1.16
156	Gall bladder	1.15	1.67	1.28
157	Pancreas	1.44*	1.35*	1.06
161	Larynx	0.41	0.33*	0.32*
162	Lung	0.89	0.98	0.98
172	Melanoma	0.47*	0.33†	0.37†
185	Prostate	0.58*	0.55‡	0.74*
186	Testis	0.40	0.93	0.87
188	Urinary bladder	1.42	1.02	0.89
189	Kidney	0.97	1.18	1.64†
191–192	Nervous system	1.59*	0.96	1.16
193	Thyroid gland	3.04	3.26†	1.89
200,202	Non-Hodgkin lymphoma	0.61	0.87	0.89
201	Hodgkin's disease	0.01	0.69	0.52
204–208	Leukaemias	1.52*	1.14	1.13

*$P < 0.05$, †$P < 0.01$, ‡$P < 0.001$.

Table 5. Risk estimates for Polish migrants in Australia by duration of stay adjusted for age, period and place of residence (compared to Australian-born), logistic regression, females

ICD	Cancer site	Duration of stay 0–19 years	20–29 years	30+ years
140	Lip	—	—	—
141	Oral cavity	0.01	0.32	0.30
143–145				
146	Other pharynx	0.88	0.66	0.00
148–149				
147	Nasopharynx	3.41	2.53	2.63
140–149	Oral cavity and pharynx	0.64	0.67	0.33
150	Oesophagus	0.86	0.52	0.48
151	Stomach	1.59*	2.18‡	1.37
153	Colon	0.51‡	0.59†	0.62†
154	Rectum	0.73	1.14	1.01
155	Liver	2.05	0.38	0.96
156	Gall bladder	2.14*	2.37‡	1.36
157	Pancreas	1.41	1.66†	1.28
161	Larynx	—	—	—
162	Lung	1.07	0.75	0.80
172	Melanoma	0.31*	0.55	0.71
174	Breast	0.69*	0.77	1.02
179	Uterus nos	0.57	0.99	1.72
180	Cervix	1.80†	1.40	0.85
182	Corpus	1.48	0.98	0.81
183	Ovary	0.92	1.18	1.14
184	Other female genital	0.98	0.86	1.14
188	Urinary bladder	0.57	1.38	1.20
189	Kidney	0.84	1.60	1.47
191–192	Nervous system	1.44	1.19	1.76*
193	Thyroid gland	2.60	2.07	3.88‡
200,202	Non-Hodgkin lymphoma	0.72	0.48	0.81
201	Hodgkin's disease	1.40	2.16	1.19
204–208	Leukaemias	0.90	1.19	0.95

*$P < 0.05$, †$P < 0.01$, ‡$P < 0.001$.

Uterus

Mortality rates from uterine cancer—both cervix and corpus—are higher in Poland than in Australia. The differences are too great to be ascribed to the small percentage of deaths coded to uterus nos in both countries. Migrants show a significant decline in risk for both sites, a decline which appears to be associated with increasing length of stay in Australia (Table 5).

Prostate

Mortality from cancer of the prostate in Australia is nearly twice as high as in Poland (15.95 versus 8.71 per 100 000). RR in migrants remains low (0.64), although the risk for long-stay migrants (over 30 years) is higher than for other groups (less than 30 years).

Urinary bladder

The mortality rate in males in Poland is approximately 1.5 times higher than in Australia (6.86 and 4.69 per 100 000), while in females the reverse situation is seen (0.95 and 1.45 per 100 000). RR for migrants are very close to those observed for Australia in both sexes (1.00 and 1.08 for males and females, respectively), with a decrease in risk with duration of stay in males and an increase in females.

Non-Hodgkin's lymphoma

Mortality in Australia is nearly 2.5 times higher in males and 4-fold higher in females than in Poland. RRs in migrants are also below 1, but in both sexes are higher than RRs for Poland; in males, there is some increase of risk with lengthening duration of stay in Australia.

Leukaemias

The mortality from leukaemias is slightly higher in Australia than in Poland in both males and females. For male migrants, RR is slightly elevated (1.22) while for females it is at the level of Australia (RR = 0.99). There are no particular trends for risk for duration of stay in Australia.

DISCUSSION

This paper describes cancer mortality among Polish-born individuals who migrated to Australia and compares it with the mortality pattern in Poland, and in the local-born population of Australia.

The present analysis is based upon the mortality data from Australia for the years 1964–1985 and cancer mortality data from Poland for the years 1980–1984. Previous studies of Polish migrants to Australia were based upon the data from shorter time periods: 5 years [2] and 10 years [3]. The longer time period used in the present study (22 years) provides a greater number of cases for analysis, which permits a more precise estimation of risk, especially for the analysis of risk versus duration of stay. An additional advantage of the present study is that the methodology used allowed us to control the confounding effect

on risk estimates from variables which are not of primary interest (e.g. time period and place of residence within Australia).

The earlier studies made use of mortality data from Poland for periods (the 1960s and early 1970s) when the quality of such data was suspect (see [7] for discussion); since that time the quality of mortality statistics from Poland has improved [12]. Nevertheless, there is a suggestion that some of the differences in mortality rates between Poland and Australia result from variations in practices of certification and coding cause of death, factors well known to complicate international mortality comparisons [13]. Thus, some of the differences for sites within the large intestine could be due to differential assignment of deaths to colon or rectum. This is suggested by the abrupt decline in mortality from rectal cancer after migration (from 1.14 and 1.40 in males and females in Poland to 0.69 and 0.73 in short-stay migrants) with an increase in risk thereafter. The elevated risk of pancreas cancer in recent migrants compared to that in Poland or in longer stay migrants—a phenomenon called "overshoot" by some workers [4, 14]—could also be due to better diagnosis of this conditions in Australia than in Poland.

Total cancer mortality is higher in Poland than in Australia, especially for males (Table 2). This is mainly due to higher rates for the two major causes of cancer deaths—stomach and lung (in men). However, there are some sites where mortality is higher in Australia than in Poland—notably colon, melanoma, lymphoma, prostate (males) and breast (females).

Cancer mortality patterns for lung cancer are particularly interesting. In males mortality is higher in Poland (about 25% higher than in Australia) while in females mortality is higher in Australia (around 33%). This is probably the result of different experiences of tobacco smoking in the two populations in the past. It was shown by Masironi and Rothwell [15] that there is a significant difference in smoking prevalence between populations of Poland and Australia. While in the female population the percentage of smokers was similar (30% in Australia and 29% in Poland), the male populations were very different in respect of prevalence of smokers (63% in Poland and 37% in Australia) [15]. It is also interesting that the level of cigarette consumption per adult person was similar in Poland and Australia in 1960 (2440 cigarettes in Australia and 2314 in Poland) but by 1985 there was a large difference (2720 cigarettes in Australia and 3334 in Poland) [15–17]. It is possible that migrants (especially males) adopted smoking patterns of the locally born population, which has resulted in a risk for migrants very close to that observed in Australian-born individuals (RR = 0.98). The result is in contrast to the observation of Armstrong and colleagues [3], where a significantly elevated risk for Polish migrants was found (RR = 1.29). Conversely, the study of Staszewski and colleagues [2] showed a risk for migrants rather close to that observed in the country of origin. The current estimate is between these two extremes.

Risks for breast cancer in the Polish migrants are also of interest. Our estimate of risk (RR = 0.82) is very close to that obtained by Armstrong and colleagues [3] (RR = 0.84), and in general, closer to the risk of the country of origin than to the host country. Polish migrants to France also have a risk very close to that in the country of origin [7]. This is in very sharp contrast to the observation of Staszewski and colleagues [2] where the risk for Polish migrants was found to be very close to that observed in the host country. When the effect of duration of stay is considered, we observe a clearly increasing trend of risk from 0.69 for the 0–19 years of stay up to 1.02 for long-stay migrants. The same trend was observed for Italian migrants to Australia [3, 18–19]. This adoption of risk of the host country observed in the long-stay migrants suggests that changes in lifestyle after migration can influence the risk of breast cancer (albeit with some delay). It is possible that breast cancer risk for second generation Poles (born in Australia from Polish parents) will be close to native inhabitants of Australia.

Incidence and mortality rates from melanoma in Australia are the highest in the world, while Poland is a country of low (but increasing) risk of that cancer. The main reason for this is the difference in exposure to sunlight in the two countries. The present analysis is the first to study risk of melanoma in Polish migrants to Australia as a separate group. Previous studies showed only risk for groups of countries (i.e. central Europe or north-eastern Europe) [3, 20]. These earlier studies showed risks for north-eastern Europe at the level of 0.39 for males and 0.46 for females [3], or for eastern Europe of 0.42 for males and 0.41 for females [20]. These estimates are in close agreement with our results for migrants from Poland (0.37 for males and 0.49 for females). It is also interesting that risk in males did not change with lengthening duration of stay (0.47 for 0–19 years and 0.37 for over 30 years), but clearly increased in females (from 0.31 for short-stay migrants to 0.71 for long-stay migrants). This difference between the two sexes in the degree of change according to duration of stay in Australia was observed by Khlat and colleagues [20] for migrants from eastern Europe.

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MDA-MB-453, an Androgen-responsive Human Breast Carcinoma Cell Line With High Level Androgen Receptor Expression

R.E. Hall, S.N. Birrell, W.D. Tilley and R.L. Sutherland

The role of androgens and the androgen receptor (AR) in the development and progression of breast cancer is poorly understood. To further define a potential model for androgen action in breast cancer, MDA-MB-453 cells, which express AR in the absence of oestrogen receptors and progesterone receptors, were further characterised in terms of AR expression and androgen responsiveness. High level expression of AR was confirmed by northern blot analysis, radioligand binding and immunocytochemistry, and could not be accounted for by AR gene amplification. Three endogenous androgen-responsive genes (fatty acid synthetase, gross cystic disease fluid protein of 15 kDa and prolactin receptor) and a transfected reporter gene, containing an androgen-responsive element, were induced following androgen administration. A synthetic androgen, mibolerone, induced moderate (27% above control) stimulation of MDA-MB-453 cell proliferation, which was abrogated by the simultaneous administration of the synthetic androgen antagonist, anandron, demonstrating that the effect was AR-mediated. In summary, MDA-MB-453 cells express high levels of functional AR, and thus provide a valuable *in vitro* model for further studies on androgen regulation of gene expression, and perhaps cell proliferation in breast cancer.

Key words: androgen action, breast cancer, androgen receptor
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INTRODUCTION

THERE IS ample justification for extending studies on androgen action mediated by the androgen receptor (AR) in human breast cancer. A greater proportion of breast cancer patients with AR-positive tumours respond to endocrine therapy and survive longer than patients with AR-negative tumours [1]. In addition, a recent reassessment of AR expression, using more sensitive techniques, indicated that up to 80% of breast cancer patients are AR+ and more significantly, that tumours may retain AR expression when oestrogen (ER) and progesterone receptor (PR) expression are undetectable [2]. Furthermore, the recent observation ascribing a germline mutation in AR as the probable cause of breast cancer in two brothers with androgen insensitivity [3], illustrates the requirement for more detailed studies on the role of androgens and AR in the development and progression of breast cancer.

Prior to the establishment of human breast cancer cell lines *in vitro*, Shionogi S115 mouse mammary tumour cells, which proliferate in response to androgens, were the primary model for androgen responsiveness in breast cancer [4]. Among the human breast cancer cell lines which have been established in culture, MDA-MB-453 cells stand out, by virtue of their high level of AR expression [5], as a potentially useful model for further study of androgen action in breast cancer.

MDA-MB-453 is a human breast carcinoma cell line with a modal chromosome number of 45, derived from a pleural effusion of a 48-year-old Caucasian woman with metastatic disease [6]. In culture, these cells grow as single cells or loosely

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