Ovarian Cancer Mortality among Immigrants in Australia and Canada

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Abstract

This study examined the impact of changing environments on ovarian cancer by comparing age-standardized mortality rates of numerous immigrant groups in Australia and Canada to those in the origin countries for the period 1984–1988. Mortality rates by length of residence in Australia (0–29 and 30+ years) were also calculated. In Australia, the mortality rates for all four immigrant groups from low-risk countries and 53.8% from high-risk countries (n = 13) shifted toward the rate of the native-born Australians. In Canada, rates for 88.9% of immigrant groups from low-risk countries (n = 9) and 30.0% from high-risk countries (n = 10) converged to the rate of native-born Canadians. Among individual immigrant groups there was not a consistent pattern of convergence with length of residence in Australia. There was evidence of convergence among the long-term residents of some of the groups and in the aggregate analysis. The increased mortality among the majority of immigrant groups is consistent with the reported inverse relationship between parity and ovarian cancer and the generally lower parity of immigrant women compared to those in their home country. The period of residence analyses suggests that long-term environmental and lifestyle factors in the new place of residence may also influence ovarian cancer mortality.

Introduction

There are large geographical differences in ovarian cancer incidence and mortality rates (1). In 1985, among women aged 30–74, the highest direct age-standardized incidence and mortality rates occurred in Denmark (31.9 and 20.7/100,000, respectively). Non-Jews in Israel had the lowest incidence rates (6.1), followed by residents of Shanghai (9.4). The lowest mortality rates occurred in Mauritius (2.9), followed by Venezuela (5.4). The reasons for these large differences are poorly understood. However, the two factors that have most consistently been found to reduce ovarian cancer risk, increased parity, and oral contraceptive use (1–3) have been shown to be correlated with international variations in ovarian cancer (4, 5).

Migrants, by moving between countries of various levels of disease risk, provide a unique opportunity to examine the impact of exposure to new environments and lifestyles on the risk of developing a particular disease. If factors associated with the destination are important in the etiology of a disease, one would expect to see the rates for migrants converge toward those of the population in the destination country. To date, the majority of ovarian cancer studies of migrant populations have focused on those from low-risk to high-risk countries, primarily Asian migrants to the United States. The ovarian cancer incidence and mortality rates for these populations have generally been shown to increase and, therefore, provide support for a hypothesis of convergence (6–16). However, because few studies have included migrants from high-risk to low-risk countries, it is not clear whether the observed convergence of rates for migrants from low-risk countries to those of the population in the destination is associated with factors in the destination country or whether migrants generally experience an increase in ovarian cancer rates.

This study examined the impact of changing environments and lifestyles on ovarian cancer by comparing age-standardized mortality rates of numerous immigrant groups in Australia and Canada, many coming from high-risk countries, to those in the origin countries for the period 1984–1988. To examine the timing of change in ovarian cancer risk for immigrants to Australia, mortality rates were also calculated by length of residence in Australia. As a consequence of the often small number of deaths, the emphasis in this paper is more on the patterns of change across immigrant groups than on specific immigrant groups.

Materials and Methods

Individual mortality records for the period 1984–1988 and 1986 census data for Australia and Canada were obtained from the Australian Bureau of Statistics and Statistics Canada, respectively. National mortality and population data were available for some of the origin countries on WHO data tapes. For the majority of origin countries, 5 years of data for the period 1984–1988 were available. All deaths with International Classification of Diseases (Ninth Revision) code 183 were included in the analyses.

Direct age-standardized mortality rates and 95% CIs[2] were calculated for immigrant groups in Australia and Canada and for some of the respective origin countries with the use of a truncated version of the world standard population (17). Two sets of SRRs were also calculated for these populations; one was based on the Australian native-born rate and the other on the Canadian native-born rate. The analyses were restricted to the age range 35–74 years. This was done for several reasons: (*a*) ovarian cancer is relatively rare at younger ages; (*b*) it has been suggested that ovarian cancer is underdiagnosed at older ages (18); and (*c*) in the Canadian census, birthplace was asked of only a 20% sample of the population. The sample excluded institutionalized individuals and thus was an underestimate of the total population. This has a very small effect at young ages

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[1] The abbreviations used are: CI, confidence interval; SRR, age-standardized rate ratio.

Table 1 Age-standardized ovarian cancer mortality rates (per 100,000) for origin countries and immigrant groups by country of residence

Birthplace[a]	Origin		Residence					
			Australia			Canada		
	Rate	95% CI	*n*	Rate	95% CI	*n*	Rate	95% CI
Native born			1616	13.4	12.7–14.0	3202	15.1	14.6–15.7
Foreign born			646	14.9	13.8–16.1	885	13.8	12.9–14.7
United Kingdom and Ireland	20.7	20.4–21.0	272	16.0	14.1–17.9	265	15.6	13.6–17.6
England, Wales	20.9	20.6–21.3	216	16.2	14.0–18.4			
Scotland	19.4	18.3–20.5	41	15.6	10.7–20.5			
Ireland, Northern Ireland	19.7	18.5–21.0	15	14.0	6.9–21.1			
Southern Europe	9.9	9.8–10.1	121	12.4	10.1–14.6	120	10.9	8.9–12.9
Greece	7.3	6.8–7.8	23	12.7	6.9–18.5	9	7.9	2.6–13.3
Italy	11.6	11.3–11.8	62	12.5	9.4–15.7	81	12.1	9.5–14.8
Malta	19.2	14.7–23.7	8	11.0	3.3–18.7			
Portugal	7.1	6.6–7.5	1	6.2	0.0–18.3	13	9.3	4.1–14.5
Yugoslavia	10.7	10.3–11.1	27	15.7	9.5–21.9	17	11.0	5.7–16.4
Western Europe	16.9	16.7–17.0	84	19.0	14.9–23.2	130	15.6	12.9–18.3
Austria	19.1	18.2–19.9	12	27.6	11.9–43.4	13	21.2	9.5–32.9
Belgium	16.8	15.6–17.9	2	33.6	0.0–80.6	3	8.9	0.0–19.1
France	13.5	13.2–13.8	2	13.1	0.0–31.9	4	5.7	0.1–11.3
Germany	18.5	18.3–18.8	37	18.3	12.3–24.3	71	18.9	14.5–23.4
Netherlands	18.3	17.6–18.9	29	18.5	11.7–25.3	36	13.4	9.0–17.8
Northern Europe	19.2	18.7–19.7	4	14.5	0.0–29.0	29	27.0	16.8–37.2
Denmark	23.5	23.3–24.7	2	22.9	0.0–56.8	10	24.9	9.5–40.4
Finland	14.3	13.3–15.2	2	15.4	0.0–36.7	10	27.3	9.6–45.0
Sweden	19.0	18.2–19.9				6	41.3	3.8–78.9
Eastern Europe	15.9	15.7–16.2	42	17.5	11.6–23.4	123	19.3	15.5–23.2
Czechoslovakia	20.1	19.4–20.8	5	15.6	1.7–29.5	16	23.3	10.6–36.0
Hungary	16.6	15.9–17.3	8	13.3	3.8–22.8	27	21.2	12.7–29.8
Poland	16.3	15.9–16.7	25	18.5	9.9–27.0	68	17.7	12.9–22.6
Romania	10.8	10.2–11.4	3	26.4	0.0–58.9	11	19.9	6.8–33.0
USSR			21	20.6	9.9–31.2	47	11.7	7.9–15.5
Latvia			7	25.0	4.4–45.7			
Ukraine			5	34.8	0.0–79.4			
Middle East			8	10.3	2.9–17.7	5	17.9	1.5–34.4
Turkey			3	12.6	0.0–26.9	5	23.5	0.9–46.0
Southeast Asia			18	14.5	7.7–21.3			
Burma			3	22.2	0.0–47.4			
Malaysia			4	13.5	0.0–27.6			
Vietnam			6	23.0	4.3–41.6			
Northeast Asia			7	6.6	1.7–11.5	17	5.7	2.9–8.4
China			5	5.1	0.6–9.6	17	6.0	3.0–9.0
South Asia			13	13.5	6.1–21.0	8	5.6	1.8–9.5
India, Pakistan			10	14.0	5.2–22.8	8	5.6	1.8–9.5
Other Asia						25	8.2	4.8–11.5
North America	14.6	14.4–14.7	10	26.7	9.9–43.5	72	15.5	11.6–19.4
Canada	14.6	14.2–15.1	4	23.6	0.0–47.9			
United States	14.6	14.4–14.7	6	28.5	5.5–51.6	72	15.5	11.6–19.3
South America			3	11.0	0.0–23.4	11	11.7	4.7–18.7
Other America						13	7.2	3.1–11.2
Africa			16	13.4	6.8–20.0	13	11.7	5.2–18.2
Egypt			7	12.2	3.1–21.2			
South Africa			4	13.1	0.1–26.2			
Pacific			27	17.3	10.5–24.1	5	26.9	3.0–50.7
Australia	13.4	12.8–13.9				3	25.1	0.0–53.4
New Zealand	16.3	14.5–18.0	22	18.1	10.2–25.9	2	31.4	0.0–75.3

[a] The rates for regional totals include immigrant groups for whom there were less than three deaths or who were grouped into "Other."

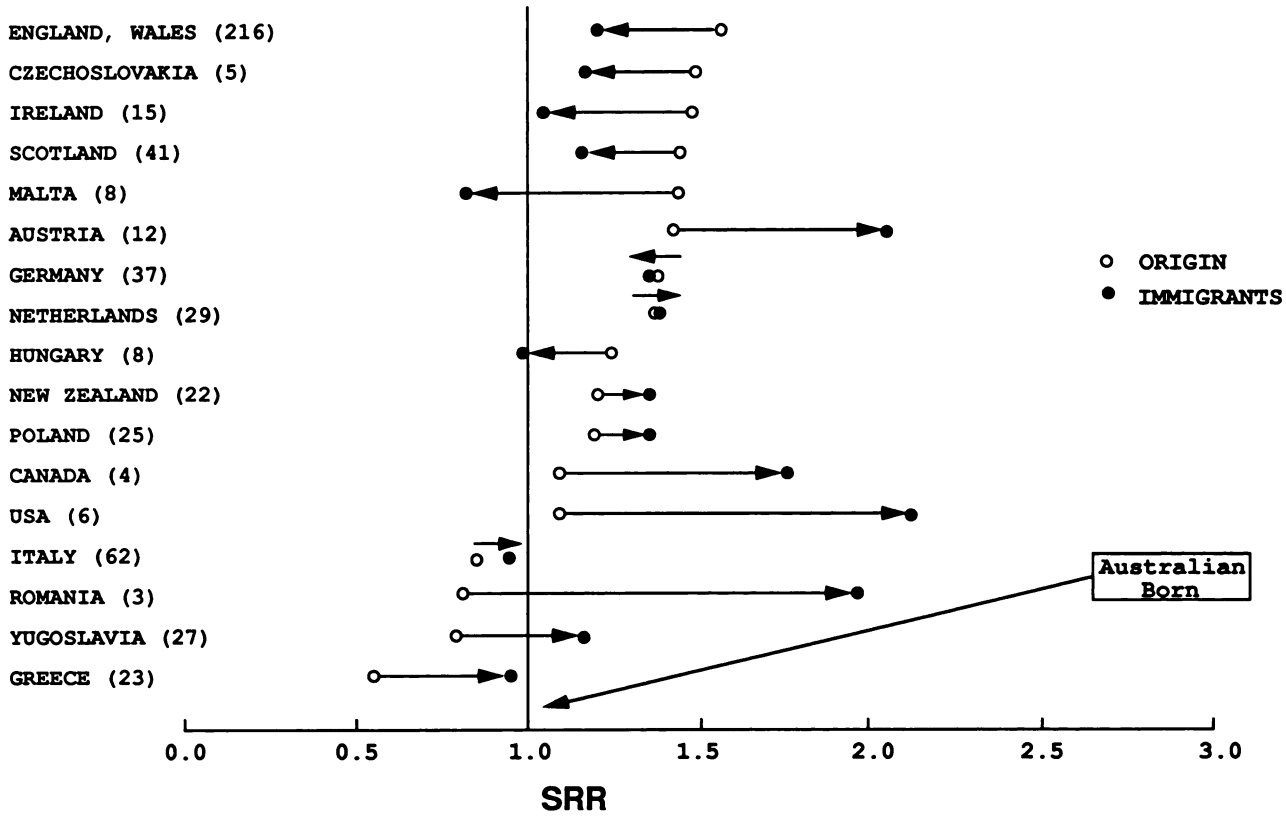

Fig. 1. Ovarian cancer SRRs of immigrants relative to the origin country, Australia, 1984–1988.

but a large impact at older ages when a substantial proportion of the population are institutionalized.

In Canada, for women aged 35–74 years, birthplace information was not recorded on 3.3% of ovarian cancer death records. These deaths were distributed according to the distribution of known birthplace by province of residence and age. There were no records with unknown birthplace in the 1986 Canadian census data because Statistics Canada imputed birthplace for such individuals before the release of the census data. In Australia, 0.4% of death records showed unknown birthplace, and 10.8% of the foreign-born population had unknown length of residence. In the 1986 Australian census, 1.6% of the records for females aged 35–74 years had unknown birthplace, and 2.8% had unknown length of residence. The death and population records with unknown birthplace and/or length of residence were distributed in a two-stage process. In the first stage, the birthplace of those women with both unknown birthplace and unknown length of residence were distributed according to the known birthplace distribution. The majority of these would have been added to the Australian-born population. For those with unknown birthplace but known length of residence, it was assumed that they were all foreign born. These were then distributed according to the known birthplace distribution of the foreign-born population. Similarly, records with unknown length of residence were distributed according to the known length of residence of the foreign-born population.

For immigrants in Australia, age-standardized rates were calculated by two length-of-residence categories (0–29 and 30+ years). This breakdown was primarily chosen for the resulting number of deaths in each category. Aggregate rates were also calculated for immigrants by level of mortality in the origin country relative to that of native-born Australians (*i.e.*, from low- and high-risk origins). A comparable aggregate origin country rate was calculated by weighting the individual origin country deaths and population by the size of the corresponding immigrant population in Australia.

Results

Overall, the ovarian cancer rates for the foreign-born in Australia and Canada were similar to the respective native-born rates; however, there were marked differences among individual groups (Table 1). In Australia, with the exception of Southern Europeans, the rates tended to be highest for European or European-derived populations, such as North Americans and New Zealanders, although they were only significantly higher for immigrants from England and Wales (16.2; 95% CI, 14.0–18.4) and for the regions of Western Europe (19.0; 95% CI, 14.9–23.2) and the United Kingdom and Ireland (16.0; 95% CI, 14.1–17.9). The lowest rates were observed for some of the Asian groups (China, 5.1; 95% CI, 0.6–9.6).

European immigrants, with the exception of Southern Europeans, also tended to have high rates in Canada. In terms of regions, Northern Europeans had ovarian cancer mortality rates which were significantly higher than those of the Canadian-born population (27.0; 95% CI, 16.8–37.2), whereas for Southern Europeans (10.9; 95% CI, 8.9–12.9), Northeast Asians (5.7; 95% CI, 2.9–8.4), South Asians (5.6; 95% CI, 1.8–9.5), other Asians (8.2; 95% CI, 4.8–11.5), and other Americans (7.2; 95% CI, 3.1–11.2), the rates were significantly

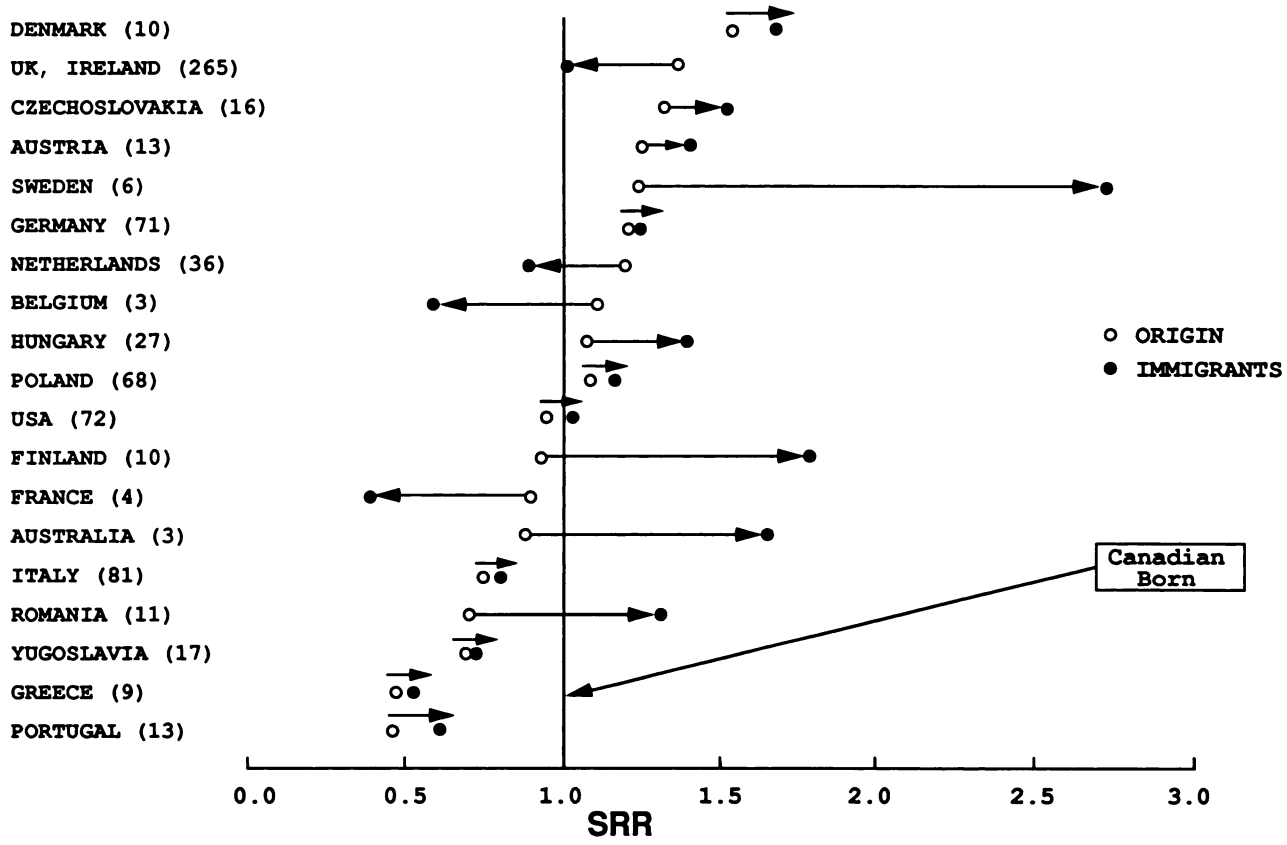

Fig. 2. Ovarian cancer SRRs of immigrants relative to the origin country, Canada, 1984–1988.

lower. In terms of individual immigrant groups, none had a significantly higher rate than the Canadian-born population, but immigrants from Greece (7.9; 95% CI, 2.6–13.3), Portugal (9.3; 95% CI, 4.1–14.5) China (6.0; 95% CI, 3.0–9.0) and India and Pakistan (5.6; 95% CI, 1.8–9.5) had significantly lower rates.

The SRRs for immigrants in Australia and Canada relative to those for the origin country are shown in Figs. 1 and 2. In both Australia and Canada, the ovarian cancer SRRs for immigrants often showed substantial changes from those of the origin population, although the differences tended not to be significant. For immigrant groups coming from countries where the SRR was lower than that of the destination native-born women, 100% in Australia (n = 4) and 88.9% in Canada (n = 9) experienced an increase in mortality. For immigrants from higher-risk countries, only 53.8% of the groups in Australia (n = 13) and 30.0% in Canada (n = 10) experienced decreases in mortality. However, if one considers only those groups in Australia coming from countries where the risk was substantially higher in the origin country (SRR >1.40; n = 6), the percentage of immigrant groups displaying convergence increases to 83.3%. In Canada there was only one such group, but it did not converge.

For individual immigrant groups, there was not a consistent pattern of convergence with increasing length of residence in Australia (Table 2; includes only groups with 3 or more deaths in both length of residence categories). This partly reflects the small number of deaths on which many of the rates were based. All three immigrant groups from countries where the ovarian cancer mortality rate was lower than that for the Australian native-born women experienced an initial increase in mortality, followed by a decrease among women resident in Australia for 30 or more years. For immigrants from high-risk countries, after 30 years of Australian residence, 6 of 10 groups had lower rates than those of the origin population.

The weighted aggregate SRRs for all immigrant groups with reliable origin country data showed a consistent pattern of change, with increasing length of residence for immigrants from high-risk origin countries but not for those from low-risk countries. The SRR for long-term residents from low-risk countries was higher, but not significantly higher, than the aggregate origin SRR.

Discussion

The convergence hypothesis suggests that exposure to the physical, social, cultural, and environmental factors in the destination country will result in a shift in the mortality rates of migrants toward the rate of the native-born population in the destination country. This study has provided mixed support for the convergence hypothesis.

In both Australia and Canada, the ovarian cancer mortality rates for almost all groups from low-risk countries displayed convergence. Convergence was substantially less evident in immigrant groups from high-risk countries, particularly in Canada where the majority of these groups displayed a pattern of divergence, that is, they also had increased ovarian cancer mortality rates. However, for immigrants to Australia, where

Table 2 Ovarian cancer mortality age-standardized rate ratios for origin countries and immigrant groups by length of residence (years), Australia 1984–1988

	Origin SRR (95% CI)	0–29		30+	
		n[a]	SRR (95% CI)	*n*	SRR (95% CI)
Low origins					
Greece	0.54 (0.50–0.59)	15	0.97 (0.53–1.79)	8	0.89 (0.45–1.75)
Yugoslavia	0.80 (0.75–0.85)	21	1.28 (0.74–2.21)	6	0.81 (0.39–1.66)
Italy	0.86 (0.82–0.92)	29	1.03 (0.69–1.53)	33	0.88 (0.63–1.22)
High origins					
Poland	1.22 (1.15–1.28)	8	1.45 (0.62–3.36)	17	1.27 (0.62–2.57)
New Zealand	1.22 (1.07–1.38)	9	0.70 (0.39–1.25)	13	3.57 (1.02–12.45)
Hungary	1.24 (1.16–1.33)	5	1.20 (0.46–3.15)	3	0.62 (0.26–1.53)
Netherlands	1.37 (1.29–1.45)	11	1.62 (0.77–3.42)	18	1.17 (0.70–1.97)
Germany	1.39 (1.32–1.45)	14	1.61 (0.80–1.70)	23	1.10 (0.71–1.70)
Austria	1.43 (1.33–1.53)	4	2.51 (0.55–11.41)	8	1.86 (0.71–4.84)
Malta	1.44 (1.08–1.90)	5	1.29 (0.46–3.61)	3	0.49 (0.22–1.07)
Scotland	1.45 (1.34–1.57)	18	1.10 (0.67–1.78)	23	1.05 (0.64–1.74)
Ireland, N. Ireland	1.47 (1.35–1.61)	6	0.82 (0.38–1.75)	9	1.58 (0.65–3.86)
England, Wales	1.56 (1.50–1.64)	141	1.41 (1.16–1.73)	75	0.92 (0.71–1.20)
Low origins[b]	0.82 (0.79–0.85)	70	1.06 (0.81–1.38)	50	0.89 (0.68–1.17)
High origins[c]	1.47 (1.39–1.54)	242	1.39 (1.19–1.62)	198	1.09 (0.92–1.30)

[a] *n*, number of deaths; SRR, standardized rate ratio relative to Australian born (13.4/100,000).
[b] Weighted rate (by immigrant population) for origin countries in Table 1 that had a lower rate than the Australian born.
[c] Weighted rate (by immigrant population) for origin countries in Table 1 that had a higher rate than the Australian born.

the origin country rates were at least 40% higher than the native-born population, the rates of 5 of 6 groups declined. In Canada, there was only one such group, and this may have accounted for why so few of the Canadian immigrant groups from higher-risk countries converged. Where there are only small differences in ovarian cancer mortality rates between the origin and destination native-born populations, intercountry differences in factors not related to ovarian cancer *per se*, such as medical practices or coding of death certificates, may obscure any evidence of convergence.

Most studies of ovarian cancer among immigrant populations have reported on those that moved from low-risk to high-risk countries. They have also found that the convergence hypothesis is generally supported for these groups (6–16). The few studies that have included immigrants from high-risk to low-risk areas indicate that convergence is much less common in these migration streams (12, 14–16, 19).

There was not a consistent pattern of mortality change with increasing length of residence in Australia. This may have been due to the small number of deaths for many of the immigrant groups. For the aggregated immigrant groups, however, the rates for those resident in Australia for 30 or more years had shifted toward the Australian rates. Armstrong *et al.* (20) also did not find a consistent gradient in ovarian cancer mortality rates with increasing length of residence in Australia. Studies in the United States have indirectly looked at length of residence effects by comparing first- and second-generation immigrants from low-risk Asian countries (6–10). Although second-generation immigrants tended to have higher rates than did first-generation immigrants, there have been exceptions (6, 10).

The mixed support for the convergence hypothesis would suggest that immigrant ovarian cancer mortality rates are being determined by an interaction taking place between the factors associated with the destination environment and some other factor(s) that tends to increase the risk of ovarian cancer. This latter factor(s) seems to mask the role of the destination environment for immigrants coming from countries where the mortality levels are only slightly higher than those of the destination population.

Numerous factors such as age at menarche, age at menopause, age at first birth, parity, breast feeding, oral contraceptive use, diet, lifestyle, and family history have been linked to ovarian cancer (3, 21, 22). Immigrant women may be differentially selected in terms of these risk factors, which may have contributed to the differences not only between the rates of immigrants and the origin population but also between immigrant groups. Variations between immigrant groups in terms of the uptake of destination lifestyles and behaviors may also have led to the difference in immigrant mortality rates.

The two most consistently reported protective factors for ovarian cancer are the use of oral contraceptives and high parity (1–3). Immigrants in Australia have lower usage of oral contraceptives than does the native-born population (23), and this may account for their overall higher ovarian cancer rates. Fertility rates of migrant populations in the United States and Canada have been reported to be lower than those of the origin populations (24–26). Furthermore, among traditionally high fertility groups such as Mexicans and Puerto Ricans, the rates have declined when in the United States (27, 28). In Australia, the average number of children born converged to the level of the Australian-born population, but convergence was much greater for migrants from high-fertility countries than from low-fertility countries (29). This may have contributed to the stronger pattern of convergence in ovarian cancer mortality among immigrants from low-risk countries.

The ovarian cancer mortality rates were underestimated because the population denominator included women who had had bilateral oophorectomies. Although there are large intercountry variations in oophorectomy rates (10), such findings have not been published for immigrant groups. Because a bilateral oophorectomy is often performed at the time of the hysterectomy (30), differences in hysterectomy rates among immigrant groups may provide an indication of differences in oophorectomy rates. In Australia, the foreign-born population had lower hysterectomy rates than did the native-born popula-

tion (2.54 *versus* 2.89/100,000) (31). In terms of regional origins, immigrants from the United Kingdom and Ireland had the highest hospital discharge rates (3.03), and Northeast Asians had the lowest (1.59). If these rates are indicative of the prevalence of oophorectomy among the immigrant populations in Australia, the ovarian cancer mortality differential between Asian and European immigrants reported here may be even larger.

In summary, there were substantial differences in the ovarian cancer mortality rates of immigrants in Australia and Canada. The majority of immigrant groups, including many from high risk countries, experienced an increase in mortality relative to the origin population. This is consistent with the reported disruption in childbearing among immigrant women and the inverse relationship between parity and ovarian cancer. However, as indicated by the length of residence analyses, in the long-term, there is some evidence of convergence in mortality rates among immigrants from both low- and high-risk countries. Also, among individual groups from high-risk countries, convergence was more evident where there were substantial differences in mortality rates between the origin and destination native-born populations. These findings suggest that environmental and lifestyle factors associated with the new place of residence also influence the risk of ovarian cancer mortality.

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