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Mortality Differences by Nativity During 1985-87

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Abstract

This study extends the Canadian based literature on immigrant mortality to the 1985-87 census period. Previous work in Canada and in other countries has indicated that foreigners tend to experience a lower level of mortality in relation to their host populations. This analysis demonstrates that death rates are lower among immigrants in relation to the Canadian-born. The overall age pattern of mortality is characterized by lower death rates for the immigrants. In a multivariate analysis the main effect of nativity indicates that the Canadian-born's overall death rate is 26% greater than that of foreigners. The analysis also reveals that age interacts with nativity. Between the ages of 10 and 64, the interaction effects show a survival advantage for the immigrants over their host population. Below the age of 10, there is one statistically significant differential (for age groups 5-9), which is in favour of the Canadian-born. The post-retirement effects are significant (except for age group 65-69) and are in favour of the indigenous population. These interaction effects are interpreted in the context of the migration selection hypothesis.

Résumé

La présente étude étend les travaux canadiens consacrés à la mortalité des immigrants à la période de recensement de 1985-87. Des études précédentes effectuées au Canada et ailleurs indiquaient que les taux de mortalité semblaient plus bas chez les immigrants que dans leurs populations d'accueil. Notre analyse démontre que les taux de mortalité sont plus bas chez les immigrants que chez les Canadiens de naissance. La distribution générale de la mortalité par âge est caractérisée par des taux de mortalité plus bas chez les immigrants. Dans une analyse multivariée, l'effet majeur de la natalité indique que les taux de mortalité des Canadiens de naissance dépassent de 26 pour cent ceux des étrangers. L'analyse révèle aussi qu'il y interaction entre l'âge et la natalité. Entre 10 et 64 ans, les effets de l'interaction indique un avantage de survie en faveur des immigrants par rapport à la population d'accueil. Avant l'âge de 10 ans, on relève une différence statistiquement significative (pour les groupes d'âges 5-9), qui favorise les Canadiens d'origine. Les effets de l'après-retraite sont significatifs (sauf pour le groupe d'âges 65-69) et sont en faveur de la population indigène. Les effets d'interaction sont interprétés dans le contexte de l'hypothèse de sélection des migrations.

Key Words: Immigrant Mortality, Age Pattern of Mortality, Multivariate Analysis

Introduction

Migrant studies of mortality can provide valuable insights into the sociological, epidemiologic and demographic dimensions of immigration. In Canada, there is a considerable body of literature pertaining to the adaptation and adjustment process of immigrants (Kalbach, 1970; Richmond and Kalbach, 1980; Richmond, 1967); however, limited attention has been directed to their mortality experience. This situation contrasts sharply with that of other receiving nations such as Australia, France, the United States, and England where mortality differences by nationality have been documented extensively (e.g., Brahimi, 1980; Jacobson, 1963; Kestenbaum, 1986; Kitagawa and Hauser, 1973; Marmot, et al., 1983, 1984a, 1984b; Young, 1987, 1991).

Studies based on Canadian data demonstrate that the foreign-born tend to have higher survival probabilities in relation to the Canadian-born population (Michalowski, 1990; Sharma, Michalowski and Verma, 1989; Trovato, 1992; Trovato and Clogg, 1992). This observation coincides with much of the documented evidence in other countries where immigrants comprise a significant portion of the total population (i.e., USA, Australia, France, England and Wales).

However, differences by cause of death are not always consistent with this general conclusion, as in some cases the immigrants show higher death rates than the receiving society. In the United States, prior to World War II, foreigners had higher death rates than the American-born population from virtually all major causes of death, such as from cancer, cardiovascular disease, accidents, violence and suicide (Dublin and Baker, 1920; Dublin, 1933; Dublin, et al., 1949; Jacobson, 1963). According to Kestenbaum (1986), the contemporary situation is quite different: the immigrant population as a whole shows better survival probabilities than the American-born population from these major causes of death.

A similar situation is documented for France by Brahimi (1980). In relation to French-born men, foreign-born men have reduced odds of death from cardiovascular complications, cancers, alcoholism and suicide; but they have a higher risk of death from accidents and violence. Females born outside France have higher mortality risks from cardiovascular disease, cerebrovascular problems, respiratory ailments, and accidents and violence in relation to French-born women.

In Australia, Young (1987, 1991) has recently corroborated previous findings by Burwill and colleagues (1973, 1982), Stenhouse and McCall

(1970) and McMichael, et al., (1980). With respect to external causes of death (i.e., suicide, violence, accidents), most immigrant groups continue to show higher rates of mortality than the host population. In connection with degenerative and chronic diseases, however, foreigners generally fare better than native-born Australians.

Research by Marmot and colleagues (1983, 1984a, 1984b) in England and Wales indicates that overall the immigrant population tends to exhibit a lower risk of mortality from major causes of death. Death rates from accidents and violence are higher across all immigrant groups studied, however.

The main objectives of this study are as follows: (1) to document mortality differences between native-born and foreign-born components of Canada's population for the period 1985-1987, as previous research has generally not covered the time period beyond 1971; and (2) to test a number of statistical models describing the level and age pattern of mortality differences between the foreign-born and the native-born populations.

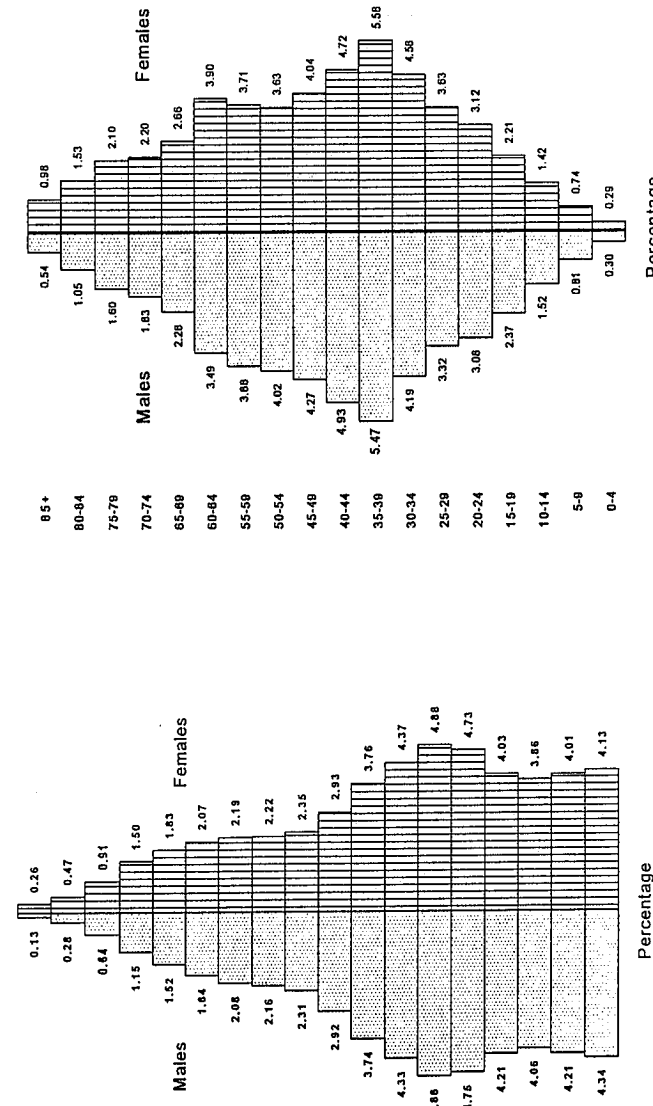
Data

The mortality data were taken from The Mortality Data Base, stored at Statistics Canada in Ottawa. Statistics Canada receives from the provinces and territories all official death records for a given year. The death certificates contain identifying information of decedents, plus official identification of cause of death (medical and/or non-medical causes). The population counts for the computation of rates were taken from the 1986 Census (special tabulations from Statistics Canada). The data file consists of a multiway tabulation of all deaths in 1985 to 1987 and the corresponding population counts for 1986 cross-classified by age (0, 1 - 4, 5 - 9, . . ., 85+), sex (male, female) and nativity (Canadian-born, foreign-born).

Official death records contain few social demographic variables beyond age and sex. A second limitation pertains to the degree of completeness in the reporting of some variables on the death certificate (see Trovato, (1985) and Trovato and Clogg, (1992) for a detailed discussion of this). While variables such as cause of death, age, and sex are coded on a yearly basis, the same cannot be said for variables such as ethnicity (discontinued since the early 1970s) and country of birth.

Fortunately, from the standpoint of this study, the proportion of records with unknown country of birth is only 3.26% for the three-year period under

FIGURE 1. AGE-SEX COMPOSITION, CANADIAN-BORN AND FOREIGN-BORN, 1986.



investigation (total deaths = 550,994). Therefore, the introduction of adjustment procedures for the "unknowns" should not introduce a significant degree of error in the statistical results. Specific adjustments are described later.

Age and Sex Compositions

Figure 1 shows the age-sex structures of the Canadian-born and foreign-born populations based on the 1986 Census. These two populations have radically different age-sex compositions. In comparison to the foreign-born, the Canadian-born is a younger population. This is understandable since the nature of international migration is inherently characterized by a concentration of migrants in the young adult and adult years. There are few immigrants between the ages of zero and four. At ages below 35-39 foreigners comprise a smaller proportion in relation to the Canadian-born. Beyond this age class, proportionally there are more older people in the immigrant population.

Death Rates

The crude death rates in Table 1 fail to take into account the confounding effects of age composition. Therefore, age-standardized death rates (direct method) are also displayed in the table. Both measures were computed using three different procedures. The first computation (Method I) is based on the "known" age-sex-nativity distribution of deaths; it disregards cases for which country of birth was not coded on the death certificate. Method II is based on the assumption that the distribution of "unknowns" reflects the age-sex-nativity distribution of "known" deaths. Thus, it consists of adjusted deaths once the "unknowns" have been apportioned on the basis of the "known" distribution of deaths. The third method (Method III) considers apportionment of the "unknown" cases on the basis of the average of the combined proportionate distributions of both the "known" deaths and the populations of the two groups being studied. It was thought that mixing both distributions would enhance the apportionment process since the force of mortality is reflected in both the "known" age-sex-nativity distribution of deaths and also in their age-sex compositions.[1]

As can be seen from the results in Table 1, both crude and standardized rates are underestimated when only the "known" distribution of deaths is used in the computations (that is, when "unknowns" are deleted from the analysis). On the other hand, there is virtually no difference in results with Methods II

and III. Therefore, it was decided to proceed with Method II for the rest of this analysis due to its simplicity.

TABLE 1. CRUDE AND STANDARDIZED DEATH RATES FOR THE CANADIAN-BORN AND FOREIGN-BORN POPULATIONS OF CANADA, 1985-87, COMPUTED BY THREE DIFFERENT METHODS

		Canadian-Born		Foreign-Born	
Crude Death Rates (per 1000)		Male	Female	Male	Female
(I)	"Known" Deaths	7.00	5.42	12.73	11.25
(II)	Apportionment Based on the "Known" Distribution of Deaths	7.24	5.59	13.24	11.63
(III)	Apportionment Based on the "Known" Distribution of Deaths and Population Distribution	7.25	5.59	13.20	11.62
Standardized Rates (per 1000)*					
(I)	"Known" Deaths	7.52	5.87	6.27	5.14
(II)	Apportionment Based on the "Known" Distribution of Deaths	7.90	6.06	6.87	5.45
(III)	Apportionment Based on the "Known" Distribution of Deaths and Population Distribution	7.90	6.05	6.89	5.46

* Directly standardized using the Canadian Population in 1971 as the standard.

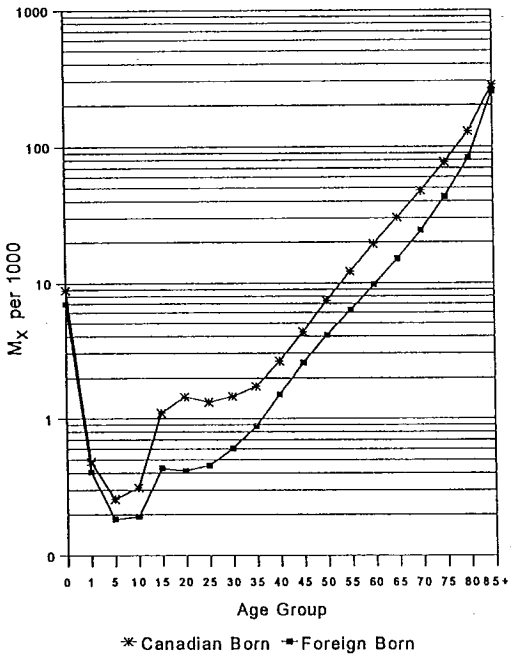
NOTES: (I) Assumes only the "known" deaths by country of birth (excludes all "unknown" country of birth deaths).

(II) Age-sex-specific "Unknown" country of birth deaths apportioned on the basis of the proportionate distribution of "known" deaths in each age-sex-nativity configuration.

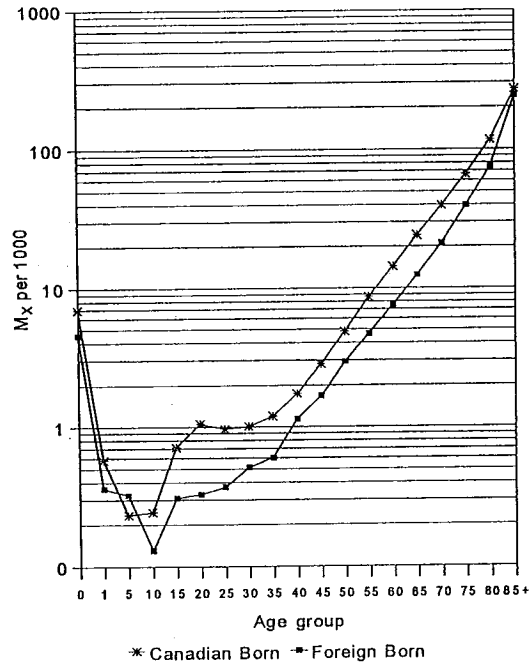
(III) Age-sex-specific "Unknown" country of birth deaths apportioned on the basis of 1/2 the proportionate distribution of "known" deaths in each age-sex-nativity configuration + 1/2 the proportionate distribution of population in each age-sex-nativity configuration.

The Canadian-born have higher levels of mortality. Their standardized death rates for men and women are 7.90 and 6.06 per 1000 population, respectively. The corresponding crude death rates for the immigrants are 6.87 and 5.45. In comparison to foreign-born men, Canadian-born men show an excess risk of 15% (the ratio of the two standardized rates is 1.15). The corresponding native-born/foreign-born ratio of female death rates is 1.11 (or 11% higher for the Canadian-born). Therefore, the relative advantage in survivorship is slightly greater for immigrant men than for immigrant women.

FIGURE 2. AGE-SPECIFIC DEATH RATES, CANADIAN-BORN AND FOREIGN-BORN, 1985-87.



Males



Females

Age Pattern of Mortality

These differences can be explored further by examining the age-sex specific death rates in Figure 2. For both sexes, age-specific death rates are lower for the immigrants. The differential is noticeably wider in the case of males, particularly between ages 15 through 39. In infancy, immigrants (both sexes) display lower rates of mortality. In the age group 5-9, foreign-born females have higher odds of death, but at age 10 and above, the risk for immigrant women is consistently lower than that of their Canadian-born counterparts.

Multivaritate Analysis

These observations corroborate the initial results shown in Table 1: immigrants have a lower level of mortality than their host society; and this differential is also evident by age. In order to determine the relative effects of age, sex and nativity in explaining these observed discrepancies, a number of log-rate models were fitted to the data using the LOGLINEAR program in SPSSx. A good fitting log-rate model is one which produces parameters that describe the observed data parsimoniously; that is, without having to consider all possible interaction terms. In Table 2, out of 14 models computed, number 9 provides an adequate fit to the data. This conclusion is based on the amount of reduction in error of the fitted model in relation to a baseline model (intercept term only). The R^2 analogue was used to measure the amount of variance explained by the fitted model and is computed as $1-(L^2_m/L^2_B)$, where L^2 is the Log-Likelihood Chi-Square of the fitted model, and L^2_B is the corresponding statistic for the baseline model which includes only the intercept term. Model 9 indicates that death rates can be adequately described by the main effects of nativity (N), age (A), sex (S), and three interaction terms (AS, NA, NS). The following log-linear equation for the expected death rate is consistent with this model:

$$\ell n\,(D_{ijk} / P_{ijk}) = \lambda + \lambda^{N}_{i} + \lambda^{A}_{j} + \lambda^{S}_{k} + \lambda^{AS}_{jk} + \lambda^{NA}_{ij} + \lambda^{NS}_{ik},$$

i = nativity (1 = Canadian-born, 2 = foreign-born)
j = age group (1 = 0, 2 = 1–4, 3 = 5–9, . . . , 19 = 85+)
k = sex (1 = male, 2 = female)

where:

D_{ijk} = expected deaths by nativity, age and sex,

P_{ijk} = the corresponding population at risk of death,

λ = the intercept term (baseline hazard = mean of log of death rates),

λ_i^N = the parameter for nativity, with restriction $\Sigma \lambda_i^N = 0$,

λ_j^A = the parameter for age, with restriction $\Sigma \lambda_j^A = 0$,

λ_k^S = the parameter for sex, with restriction $\Sigma \lambda_k^S = 0$,

λ_{jk}^{AS} = interaction parameter of age and sex, with restriction $\Sigma \lambda_{jk}^{AS} = 0$,

λ_{ij}^{NA} = interaction parameter of nativity and age, with restriction $\Sigma \lambda_{ij}^{NA} = 0$,

λ_{ik}^{NS} = interaction parameter of nativity and sex, with restriction $\Sigma \lambda_{ik}^{NS} = 0$.

This model assumes that deaths are Poisson distributed; that is, they are independent events and are randomly distributed; the probability of death is small and the population exposed to the risk of death is large. Moreover, the number of expected deaths in each age-sex-nativity configuration is the product of the underlying probability multiplied by the population exposed to the risk of dying (Clogg and Eliason, 1987; Agresti, 1990; Laird and Olivier, 1981).

From panel (B) in Table 2, it is evident that age has the largest effect in reducing the error in predicting the overall death rate (refer to to ΔL^2), followed by the effects of nativity and then the interaction of age and sex. Nativity's interactions with age and sex are not as impressive, but are statistically significant.

Table 3 presents the additive log-linear parameters from model 9. Of main interest are the coefficients involving nativity. The main effect of nativity is positive ($\lambda = .11489$), indicating that Canadian-born persons share a disproportionate risk of death in relation to the foreign-born. The risk is 12% greater for the host population (exp (.11482) = 1.12).

The interaction of nativity with sex shows that Canadian-born men have a slightly higher conditional probability of death than foreign-born men. This difference, although small, is also highly significant. Conversely, Canadian-born females in comparison to their foreign-born counterparts possess a slightly lower probability of death, net of main and interaction effects in the model. Thus, while it is true that overall men have higher death rates than women, the interaction of nativity with sex results in immigrant men sharing

a slight advantage in comparison to foreign-born women. These results confirm the earlier observations in Table 1.

TABLE 2. LOG-RATE MODELS FOR THE GENERAL MORTALITY RATE, CANADA, 1985-87

Model Fitted*		L^2	df
1.	λ (Baseline)	1,717,188.44	75
2.	N	1,676,036.82	74
3.	A	45,562.68	57
4.	S	1,710,425.73	74
5.	N, A, S	8,498.40	55
6.	N, A, S, NA	7,376.81	37
7.	N, A, S, NS	7,945.03	54
8.	N, A, S, NA, NS	6,965.11	36
9.	N, A, S, AS, NA, NS	33.15	18
10.	N, A, S, AS, NA	53.23	19
11.	N, A, S, AS, NS	1,129.19	36
12.	N, A	43,221.02	56
13.	N, S	1,669,128.68	73
14.	A, S	11,201.89	56
15.	Saturated Model	0.00	0

(B)

	Decomposition			
Effect	Models Contrasted	ΔL^2	Δdf	Probability
N	2–1	41,151.62	1	< .01
A	13–5	1,660,630.28	18	< .01
S	13–2	6,907.93	1	< .01
NA	6–5	1,121.59	1	< .01
NS	8–6	411.70	18	< .01
AS	9–8	6,931.96	18	< .01
Residual	---	33.15	18	< .01
Total		1,717,188.44	75	

* N = Nativity (Canadian-Born = 1, Foreign-Born = -1)
A = Age Group (1 = 0, 2 = 1 - 4, 3 = 5 - 9, ..., 19 = 85+. Each age group is coded as 1, else = 0, and age 85+ = -1 as the left out category)
S = Sex (Male = 1, Female = -1)
λ = Intercept Term

The interaction effects of age with nativity reflect an interesting and unexpected pattern. Recall that a graphic description of age-sex-nativity death rates in Figure 2 denoted lower rates of mortality among the foreign-born, with the exception of females in the age group 5-9. However, the multivariate log-rate model reveals that a large number of age-by-nativity interaction terms are statistically important in describing nativity differentials in general mortality. These coefficients show that the Canadian-born tend to do better than the foreigners in terms of survival

TABLE 3. PARAMETERS FROM LOG-RATE MODEL [N, A, S, AS, NA, NS].

Variable	**Parameter**	**Z**	**Variable**	**Parameter**	**Z**	**Variable**	**Parameter**	**Z**
Intercept	-4.91442	---	**Age x Sex**			**Sex** (Male vs. Female)	.29529	86.43
Nativity (CB vs. FB)	.11489	12.87	Male vs. Female			**Age**		
Nativity x Age			0	-.18416	-17.08	0	.60671	7.20
CB vs. FB:			1-4	-.20528	-9.35	1-4	-2.08561	-23.84
0	.04600	0.55	5-9	-.14771	-5.30	5-9	-2.70754	-39.38
1-4	-.14761	-1.69	10-14	-.05741	-2.13	10-14	-2.84759	-46.73
5-9	-.22729	-3.31	15-19	.16195	9.83	15-19	-1.86706	-59.36
10-14	.02956	0.49	20-24	.31748	21.31	20-24	-1.69652	-67.66
15-19	.08322	2.72	25-29	.22690	15.86	25-29	-1.68979	-70.07
20-24	.02771	1.17	30-34	.12537	9.47	30-34	-1.50351	-72.27
25-29	.02255	0.97	35-39	.03664	3.03	35-39	-1.27421	-70.93
30-34	.03189	1.58	40-44	-.03201	-2.99	40-44	-.78823	-49.48
35-39	.06822	3.88	45-49	-.04002	-4.27	45-49	-.30810	-21.31
40-44	.06447	4.11	50-54	-.01280	-1.64	50-54	.21277	16.70
45-49	.09641	6.77	55-59	.03064	4.69	55-59	.70845	62.11
50-54	.08049	6.42	60-64	.04015	7.09	60-64	1.18381	111.71
55-59	.04668	4.16	65-69	.04355	8.35	65-69	1.65923	159.74
60-64	.02691	2.57	70-74	.03404	7.03	70-74	2.14916	213.58
65-69	-.00920	-0.89	75-79	-.01897	-4.03	75-79	2.70027	277.58
70-74	-.03136	-3.15	80-84	-.07448	-15.57	80-84	3.28711	340.26
75-79	-.05302	-5.48	85+	-.24388	---	85+	4.26065	---
			(R)			(R)		
80-84	-.06354	-6.61						
85+ (R)	-.09209	---						
Nativity x Sex								
CB vs. FB: Male	.00725	4.48						
Female	-.00725	---						

NOTE: (R) =Left out category
--- =Z score not computed

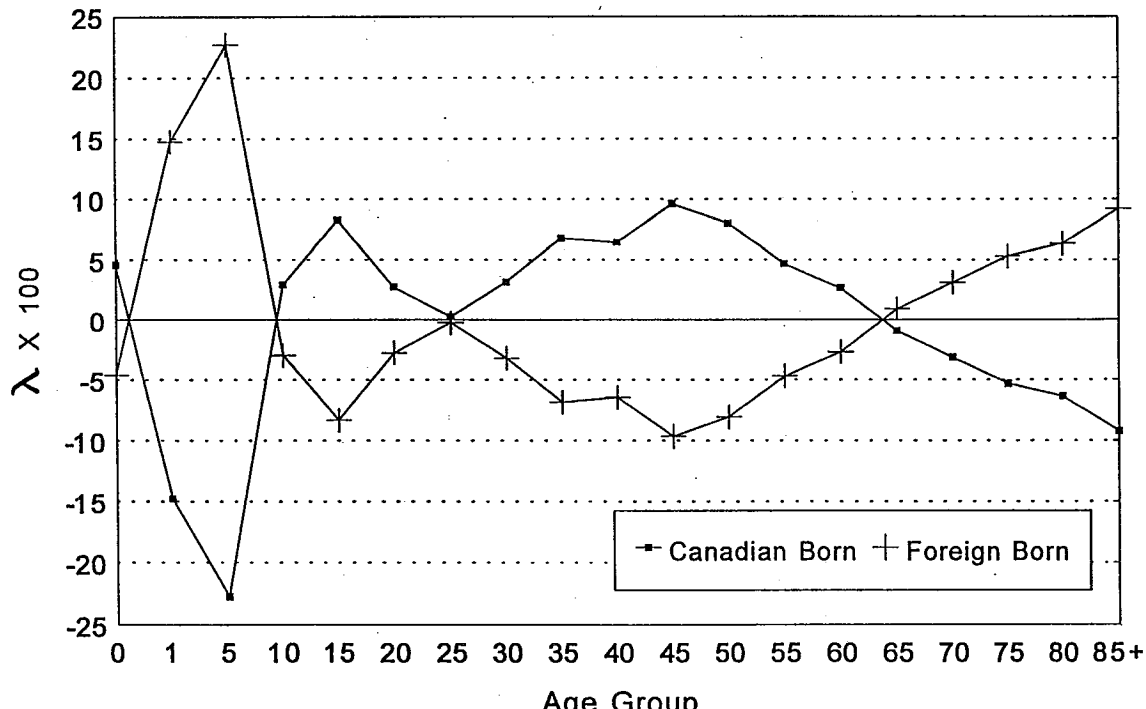
probabilities at ages 1-4, 5-9, and 65 and older. But at all other ages the immigrants share superior levels of survivorship (see Figure 3). Such an unexpected pattern of differences would not have been detected had we not proceeded beyond the analysis of Table 1 and Figure 2. It should be noted, however, that notwithstanding these interactions, the coefficients are small in comparison to the main effect of nativity or of age itself. Only two of the age-nativity interactions exceed the magnitude of the nativity main effect, these being for age 1-4 and 5-9 favouring a lower mortality risk for the Canadian-born.[2]

We may speculate on the meaning of the results in Table 3. The main effect of nativity captures a host of unmeasured factors. Perhaps immigrants have healthier lifestyles than the Canadian-born (i.e., more healthy diets adopted in their countries of origin, etc.) and/or are selected in personal and health characteristics (i.e., the more qualified, skilled, healthy and adventurous migrate) due to mandatory health screening before immigration. Another possibility is that the foreign-born may have higher levels of socioeconomic status (e.g., higher incomes) than the Canadian-born, and that these differences result in better health and lower death rates for the immigrants. However, it is unlikely that socioeconomic differences in access to health care are of primary relevance in this case. In general, the population of Canada has universal access to health care. Lower immigrant mortality may also be related to their greater levels of social supports and informal networks in their ethnic communities, which not only serve to facilitate the adjustment and adaptation of newcomers to the new society (Trovato, 1992; Trovato and Jarvis, 1986; Trovato and Clogg, 1992; Breton, 1964; Reitz, 1980; Darroch and Marston, 1984), but may also reduce mortality risk (Berkman, 1985; House, Landis and Umberson, 1988).

According to Brahimi (1980), the fact that immigrants' advantage in survivorship is substantial in the young adult working years and throughout the working ages, lends some credence to the possibility of a health selection effect. Brahimi (1980) found a similar differential for immigrants and the native-born in France. He concluded that this age-specific pattern of differences in mortality risk is indicative of selection because the variation is most visible in the working ages. Since most immigration is economically driven, it can be expected that the majority of immigrants will consist of healthy and occupationally qualified individuals.

The interaction effects at the advanced ages, favouring a lower mortality risk among the Canadian-born, may be a reflection of accumulated stresses and/or trauma among older immigrants during their working years, such as due to prolonged exposure to occupational hazards, injuries, and

FIGURE 3. DIFFERENTIAL RISK OF MORTALITY BY AGE, CANADIAN-BORN AND FOREIGN-BORN (INTERACTION EFFECTS FROM LOG-RATE MODEL N, A, S, AS, NS, NA), 1985-87.



psychological problems arising out of the immigration experience (e.g., problems of adjustment and adaptation to the new culture, etc.). Perhaps for older immigrants the selection process has eroded gradually with advancing age. Unfortunately, this hypothesis cannot be verified directly since death records do not contain any information on duration of residence in Canada.

Conclusions

Based on data for the period 1985-1987, it was shown that immigrants enjoy an overall lower level of mortality than the Canadian-born. This observation is consistent with previous studies in other receiving countries such as France, England-Wales, Australia and the United States. The pattern of mortality differences indicates that the advantage for the immigrants is largely concentrated in the years from age 10 through 64. Beyond retirement age, the Canadian-born tend to show slightly higher probabilities of survival. It was suggested that this pattern of differences in conditional death probabilities may be a function of health selectivity. Analysis by cause of death (Tables available on request) indicated that for immigrants between the ages of 40-59, probabilities of heart disease are significantly lower than those of the Canadian-born. This differential explains in part the relative advantage in survivorship for the immigrants.

It has been implicitly assumed throughout this analysis that the denominators (the populations at risk) are free of error. Attention was directed solely to problems associated with the death counts. For the period under observation, the problem of "unknown" nationality in the death counts is minimal, as such cases represent a very small proportion of total deaths. Population counts by nativity in the census are also subject to some degree of error due to undercoverage. However, since the estimated undercoverage rate in the 1986 census is less than 2% (Sharma, Michalowski and Verma, 1989), there is little reason to suspect that there would be a disproportionate degree of error in the results of this analysis. On a different aspect of data error, there is probably some nativity differences in institionalization rates at older ages, and since the institutionalized population is not counted in the denominators, some error in the death rates at older ages is to be expected. Unfortunately, it is not possible to discern nativity-specific institionalization rates from the available census data.

From this analysis, it is clear that the pattern and level of mortality for immigrants and the Canadian-born are not identical. In future study, it will be important to monitor how mortality patterns and levels fluctuate over time. Every year many new immigrants enter this country, and their varying

origins imply a significant degree of heterogeneity in terms of social and demographic characteristics. Consequently, the extent of selection will likely vary across different immigrant cohorts. Future development in statistical modeling to describe differences in death rates should incorporate measures of health selectivity and of duration of residence in Canada. The inclusion of such variables would facilitate the assessment of how mortality probabilities change with length of stay in Canada, and whether selection effects erode with the passage of time in the new society.

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Footnotes

1. For Methods I and II, the apportionment was computed separately within all age-sex categories.

2. If the terms in the model were to be used to compute the hazard functions by age and sex for the two nativity groups, the main effects would essentially override the age-nativity terms and the overall age-sex-nativity patterns of mortality would ultimately appear as a smoothed version of Figure 2 shown earlier.

3. The higher death probabilities at ages 1-9 for the foreign-born are also unexpected. At this point it is not possible to say with any degree of certainty the reasons for this result. Further analysis is needed.

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