**MORTALITY DIFFERENCES AMONG CANADA'S
INDIGENOUS AND FOREIGN- BORN POPULATIONS,
1951-1971**

Frank Trovato

The University of Alberta, Edmonton, Alberta, Canada

Abstract — Vital statistics and census data are used to investigate the relationship between nativity and mortality in Canada for the census periods between 1951 and 1971. While it is generally known that mortality rates in Canada have been declining over time, this research demonstrates that this trend has not been shared equally by all sociocultural groups. A comparison of native-born/foreign-born mortality differences shows a minimal disparity in mortality; however when these two broad categories of nativity are broken down into more specific groupings, wide disparities emerge. If we were to place groups along a continuum of mortality rates, the native-born of British descent would show the most advantageous position, while the Aboriginal component (Native Indians, Metis, Inuit) would reflect the most disadvantage in the face of death. European immigrants fall in an intermediate position between these two extremes.

Key Words — mortality, nativity, ethnicity, logit model

Introduction

Mortality differentials reflect inequalities in society (Tumin, 1967). Disparities in life expectancy are assumed to emanate from inequities in life chances among social groups in the stratification system. The pervasiveness of this is reflected in the observation that in almost all parts of the world an inverse relationship between socioeconomic status and the death rate exists (Antonovsky, 1967). In the United States, for example, Kitagawa and Hauser (1973) have provided solid evidence to demonstrate that the more disadvantaged elements of society, such as blacks and other minorities, suffer disproportionately higher rates of mortality. In Canada, we are beginning to accumulate a solid body of knowledge about social position and mortality inequalities (Wigle and Mao, 1980; Wilkins, 1980). Concerning the relevance of sociocultural background, however, the available research has tended to focus mostly on the Native Indian ethnic group within certain regions (for example, Jarvis and Boldt, 1982; Millar, 1982; Young, 1983). Knowledge of the mortality experience of other subgroups is minimal. The low national death rate in Canada — currently seven per one thousand population — may lead one to conclude that if discrepancies in survival probabilities do exist, they are small or insignificant. However, it can be argued that inequities in mortality may be quite pronounced because one of the unavoidable consequences of a multi-ethnic society such as Canada is the development of a stratification system based partly on ethnic origin (Clement, 1975; Porter, 1965).

The purpose of this study is to document a virtually unexplored area of Canadian social demography by demonstrating that substantial differences in the likelihood of survival exist among ethnic and nationality groups in Canada over the 20-year interval, 1951 to 1971. A further objective of the paper is to elaborate a conceptual model of the major components of ethnic and minority group mortality analysis. The statistical approach relies on the application of logit modeling to analyze the conditional odds of dying for eight groups, four of which are native-born (French, British, Aborigines and other), the other four being of foreign-born origin (British, American, other European and other). The major scope of the study is to elaborate and evaluate hypotheses that may be applicable in explaining mortality differences among ethnic and minority groups in advanced societies.

Hypothesis

The Migration Selection Effect of Immigrant Mortality

In the case of first generation immigrant groups in a host society, an appropriate explanatory framework is the migration selection thesis of mortality (Brahimi, 1980; Krueger and Moriyama, 1967; Stenhouse and McCall, 1970). Although previous analysts have mentioned this selection effect, a well-formulated statement underlying the dynamics involved is lacking. Studies of migrants demonstrate that migration is a selective phenomenon. In general, movers tend to possess intermediate characteristics with respect to their population of origin and the receiving society as evidenced by their age-sex composition, education level and other social economic and demographic characteristics (Lee, 1966; Petersen, 1975; Ravenstein, 1885; Shaw, 1975; Thomas, 1938).

In the context of Canadian immigration policy and historical trends in the selection of immigrants entering the nation, it may be hypothesized that due to the increasing restrictiveness of immigration laws, foreigners in this country constitute a highly select population not only with regard to demographic and social characteristics, but also in connection with health and senescence. This is a reasonable prediction, as immigration involves a legal screening process whereby only persons who satisfy health and social demographic criteria are allowed to enter the new society. From the point of view of mortality, the thesis predicts that a comparison of immigrants to their respective populations of origin will demonstrate that the former possess lower odds of dying. A recent report by Marmot and colleagues (1983) on the mortality of immigrants in England and Wales lends some support to this prediction. Data on a host of immigrant groups are generally consistent with the hypothesis that migrants are a selected healthy group. They argue that the process of becoming an immigrant "selects" an individual who is healthier than average in the country he left.

In relation to the host country, immigrants are expected to show either equal or higher risks of dying, but if the cultural and national origin of the immigrant groups is similar to that of the receiving population, the differential will probably be minimal or nonexistent. When the two groups do not share such similarity, substantial differences will probably prevail. In the general case, the selection hypothesis posits an intermediate level of mortality for immigrants: they are expected to have an advantage over their country of origin, but possibly a disadvantage

with respect to Canada as a whole. The notion of cultural distance is an important qualifying feature of this prediction because similarities in culture may reflect similarities in social, economic and perhaps lifestyle dimensions of both the immigrants and their host society. Thus the closer the immigrant group to the host nation with respect to cultural origin, the greater the similarity in mortality levels between the two populations. Internationally, however, Canada possesses relatively low levels of mortality and, hence, one of the highest life expectancies in the world; given this fact, it would seem improbable that any immigrant group (regardless of its country of origin) would actually exceed the survival probabilities of the national population. Therefore, the expectation is that immigrants' odds of mortality will be intermediate to their origin population and their host society.

The Assimilation Hypothesis of Immigrant Mortality

An important question concerning the mortality of foreigners is whether they eventually assimilate the mortality pattern and level of the receiving country. Assimilation could mean gains in survival likelihood or possibly losses, depending on whether the mortality level of the host country is above or below that of new immigrants. From an empirical point of view, it is virtually impossible to execute a direct test for assimilation because in Canada — as is the case in most other countries of the world — information on the length of residence of foreign-born decedents in the host country is not included on the death certificate. Consequently, most analysts adopt indirect procedures to evaluate the association of length of residency in a host country to mortality (for example, Brahim, 1980; Krueger and Moriyama, 1967). A related fact, which is not independent of this problem, is that period observations of immigrants fail to detect the possible heterogeneity of immigration cohorts specific to a given national origin. Direct control for this confounding influence on the mortality of foreigners is not possible without the necessary knowledge of a decedent's period of immigration to Canada.

Given these constraints, it was decided that an appropriate way to determine whether there is an assimilation effect would be to examine and contrast the odds of death of immigrants in Canada against those of their origin population, the Canadian population, and the descendants of foreigners. To illustrate this approach, assume that British immigrants

in Canada possess a higher life expectancy than they would in Britain; at the same time, however, they experience a lower life expectancy in relation to the overall Canadian population. This situation would be consistent with a positive selection effect because the foreign-born have a superior level of life expectation than their origin society, and they are intermediate to the host environment. To elaborate further, assume that the indigenous British descendants born in Canada exhibit a mortality level that is equal to the national level, but more advantaged than their foreign-born counterparts. This variant of the hypothesis arises from an immigrant selection effect on the one hand, and assimilation on the other; the indication being that the mortality pattern of the foreigners and that of the host society may eventually converge. Thus, the relative mortality disadvantage of the first generation immigrants compared to the country of destination is overcome by the next generation, the descendants of the immigrants. It is likely that the rapidity of this process will vary depending on the degree of socioeconomic success of the first generation in the adoptive society.

Research in Canada by Kliewer (1979) suggests that prior to 1951 the foreign-born population had a slightly higher life expectancy than the indigenous society. Moreover, the survival probabilities of immigrants vis-à-vis their countries of origin tended to vary depending on whether the origin's level was either above or below that of Canada. Immigrants were observed to improve their chances of survival if their countries of origin had a lower life expectancy than Canada, but they lost units of life expectation if their national origin population showed a superior level of survival relative to Canada. However Kliewer (1979) determined that in the majority of cases the foreign-born in Canada enjoyed better odds of survival than their "parent" populations.

Studies of immigrants in other parts of the world tend to be consistent with these generalizations. According to Brahim (1980), immigrant groups in France tend to share lower age-specific death rates than the French populace, particularly at ages above 30. Furthermore, he observed that people in the countries from which the immigrants originated have lower life expectancies than their immigrant counterparts in France. Also, the more recent the immigrant group, the greater the difference in relation to the host country: "older" immigrant groups that presumably have resided in France for a considerable period of time had lower death rates in relation to both origin and host countries, thus suggesting a positive selection effect. The more recent arrivals, however, showed even greater advantages than the "older" groups in relation to the French

population. The fact that the "older" immigrant groups tend to exhibit rates which are lower, but very close to the host population, while "recent" groups experience a greater advantage in survival probabilities relative to the receiving French society, is suggestive of a negative assimilation effect. Initially the foreigners are positively selected in relation to their origins. In addition, they experience better odds of survival than the host population, but as time progresses (as evidenced by "older" immigrant groups), they suffer reductions in their initial superiority in survival probabilities thus tending to approximate the national mortality level of the receiving country. The analysis of Stenhouse and McCall (1970) in Australia provided results similar to those reported by Brahimi (1980). They found that with regard to cardiovascular mortality among immigrants from Italy, England-Wales and Scotland, their death rates were consistently below that of their countries of origin and the Australian national population. However, the longer the duration of residence of immigrants in Australia, the more likely that they approximated the level of the indigenous element (this is one country where duration of residence is coded on the death certificate). A positive assimilation effect occurs when immigrants start out with a higher mortality level and actually converge with the superior survival level of the host nation.

The Mortality Assimilation Hypothesis of Native-Born Ethnic Groups

Concerning native-born ethnic groups, the assimilation thesis can be tested in a more straightforward manner than can the case of immigrants. Since we are concerned with observing the mortality pattern of indigenous groups over three points in time, a trend toward general convergence — or, more stringently, toward the disappearance of differentials over time — will provide support for an assimilation phenomenon. Under the postulates of this thesis, differences in mortality are assumed to be a function of "culture lag." As the groups assimilate in lifestyles and health practices and become exposed to improving health care systems, their level of mortality is expected to converge with that of the national population (Goldscheider and Uhlenberg, 1969).

This hypothesis is actually a derivative of epidemiological and demographic transition models (Coale, 1975; McKeown *et al.*, 1972; Omran, 1971). In a general sense, these frameworks suggest that as society progresses from a traditional to an urban industrial social system

and vital rates reach historically low levels, differentials in mortality will tend to narrow and become minimal or insignificant (Goldscheider, 1971). The advanced society is assumed to contain the essential mechanisms, such as universal health care and generally high standards of living, to minimize mortality inequalities.

In actuality, research has tended to disconfirm the notion of minimal differentials in mortality. Antonovsky (1967) reviewed the historical pattern associated with social class and dying in the West and found that although a blurring of the class gradient in mortality has occurred, significant differentials persist at the extreme ends of the social class hierarchy. Stockwell and colleagues have provided more recent support for this and concluded that "the socioeconomic mortality differential has changed little, if any, since the 1950's" (1978:668). Other analysts share a similar opinion on the matter (for example, Fein, 1977; Kitagawa, 1977; Kitagawa and Hauser, 1973; Powels, 1978; Preston, 1977). The implication of these evaluations is that although Canada is well into its final stages of epidemiological and demographic transitions and is a fully modernized society, mortality discrepancies may be prevalent among different sectors of the social structure. Empirically, one might ask whether mortality differences continue to exist and, if so, whether these differences are disappearing.

The Ethnic Effect Hypothesis of Mortality Differences

The ethnic effect hypothesis predicts that social demographic phenomena are a function of subgroup membership *per se*, independent of other variables. The possible sources of an ethnic effect are many. As a case in point: the mortality of Native Indians in Canada is typically higher than the national level (Alder and Brusegard, 1980). In this case, an independent influence of group membership may be a function of social, economic and structural discrimination effects on the one hand, and endogenous subcultural influences on the other. The approach taken in this study is to ascertain first whether subgroup membership is a relevant factor, once relevant controls are introduced; and, if so, to speculate about the possible sources inherent in such a relationship on the basis of existing knowledge pertaining to the ethnic or immigrant groups in this analysis.

Data and Methods of Analysis

The mortality data for this study are taken from the mortality data base created by Statistics Canada (Smith and Newcombe, 1980). The file consists of over four million cases, as it encompasses all the deaths in Canada since 1950. Characteristics of decedents — such as age, sex, marital status, place (country) of birth, ethnic origin and medical information underlying the cause(s) of death — are also recorded in the data set.

There are problems concerning two key variables in this study, nativity and ethnicity, because their coding has followed an erratic pattern over time. During the 1960s, the degree of completeness of the place of birth variable was disappointingly low, and the ethnic variable was approximately 50 per cent complete. In the 1970s their degree of completeness was even lower. Given the importance of these variables, a method of apportioning the “missing” or “unknown” cases became necessary.¹

Table 1 outlines possible methodologies for the problem along with their related advantages and disadvantages. After a careful evaluation of the various solutions, it was decided to apply the Synthetic Method. This involves combining the apportionment of the “unknown” cases on the basis of a subpopulation’s age-sex structure and the group’s known age-sex distribution of deaths. The assumption is that age-sex structure determines one-half of the “unknown” cases, and subgroup membership determines the remaining half of the “missing” deaths. The advantages and limitations of this method are specified in Table 1.

Populations

The subpopulations studied are as following: the indigenous component consists of French, British, Aborigines and other native-born; the foreign-born groups are British, American, other Europeans and other foreign-born. The age-sex compositions for these groups were derived from published tabulations based on the 1951, 1961 and 1971 censuses of Canada.² In the case of Aborigines, the census tables combine Indians, Metis, Eskimos and Inuits. Due to this constraint, the deaths for these subgroups could not be analyzed separately and were therefore collapsed into one group. Instead of using 1960-62 deaths, it was deemed necessary to utilize the 1963-65 mortality data due to the high degrees of

TABLE 1. CONCEPTUAL OUTLINE OF METHODS OF DATA
ADJUSTMENT FOR MISSING CASES, ASSOCIATED
ASSUMPTIONS, WEAKNESSES, ADVANTAGES AND
FEASIBILITY OF EACH METHOD

METHOD	ASSUMPTIONS	WEAKNESSES	ADVANTAGES	WHEN MOST FEASIBLE TO APPLY
1. Knowledge of under-registration of death.	none	none	Ideal method.	Any time.
2. Apportionment on the basis of known cases.	Random distribution of missing cases.	Danger of over or under representation among groups with large and small frequencies, respectively.	Easy and quick method to apply.	When the number of missing cases is small.
3. Apportionment on the basis of population age-sex structure.	No difference in mortality among subgroups as far as missing cases are concerned.	It is insensitive to substantive subgroup differences in mortality along the missing cases.	Relatively easy and quick to apply.	When the number of missing cases is small, or when subgroup differences are assumed irrelevant or negligible.
4. Adjustment to a known previous structure and current marginal totals.	No change in the relationship between the factors of interest over time.	Insensitive to changes over time.	Produces good results; it is a powerful method.	When no change over time is assumed and when proper prior information is available.
5. Synthetic method.	Missing cases derived from provincial subgroup population age-sex distribution in conjunction with the known distribution of deaths; age, sex and ethnicity are assumed to affect mortality.	It may produce biased results if the "true" distribution of missing cases does not conform to population structure and are not randomly distributed.	Captures change over time; allows for differentials in mortality among subgroups; allows for population composition to partially determine the distribution of missing cases.	Any time there are many missing cases and no other one method seems feasible or suitable to apply.

incompleteness around 1961. It became necessary, therefore, to interpolate the 1964 age-sex compositions on the basis of 1951 and 1971 figures. Exponential and linear solutions were attempted, but the differences were minimal in the derived estimates; it was therefore decided to rely on the linear method.

The above classification system was adopted for two main reasons. A more refined breakdown of groups proved inefficient due to the large number of zero cells generated. Secondly, due to the problem of missing information delineated earlier, it was decided to confine the analysis to as few categories of death as possible in order to minimize the potential bias in the allocation of a substantial number of missing cases.

Analysis

Native-Born / Foreign-Born Differences

The crude death rates in Table 2 show that both sexes of foreign-born origin have experienced greater risks of death relative to the indigenous population of Canada. The immigrant rates are at least twice as high as those of the native-born.

In order to shed further light on the above findings, a logit main effects model was fit to the data to determine the gross and net effects of nativity on the expected odds of death. The logit model is a regression

TABLE 2. CRUDE DEATH RATES FOR THE NATIVE-BORN
AND FOREIGN-BORN POPULATIONS FOR CANADA, 1951, 1964
AND 1971

Year	Native-Born		Foreign-Born		Total	
	Male	Female	Male	Female	Male	Female
1951	8.48	6.82	19.74	13.88	10.21	7.81
1964	7.66	5.60	16.45	11.02	8.94	6.43
1971	7.06	5.04	17.37	12.46	8.64	6.17

NOTE: These represent three year averages around each period specified.

analogue appropriate for the multivariate analysis of odds (Goodman, 1972). A nativity main effect is interpreted as the extent to which nativity raises or lowers the logit of the expected odds of dying versus remaining alive, while controlling for the effects of age and sex. The net logit parameters in Table 3 indicate that in 1951, being foreign-born lowered slightly the odds, while in the subsequent two periods, the influence of nativity served to raise the likelihood of immigrants dying in relation to the native-born; however, the differentials are small. These results are only in partial agreement with Kliewer's (1979) findings: in accordance with his conclusions, these data show that being a foreigner tended to decrease one's chances of death in 1951, but in 1964 and 1971, the reverse was the case. In recent decades, immigrants as a whole, in relation to the native-born, have shared slightly greater odds of dying than was the case in previous decades. While the crude rates would provide an even stronger conclusion, simultaneously controlling for age and sex compositions has the effect of minimizing substantially the differentials. The implication of these results is that if immigrants in general constitute a select group, their level of mortality in Canada since the early 1960s has been slightly above the receiving society. Whether this generalization holds good for a more refined classification of nativity is a question that is evaluated below.

A more varied picture emerges when the two classes of nativity are

TABLE 3. LOGIT ADDITIVE MAIN EFFECTS FOR THE ODDS OF DYING FOR FOREIGN AND NATIVE-BORN POPULATIONS FOR CANADA, 1951, 1964 AND 1971

Nativity	Logit Main Effects		
	1951	1964	1971
Native-Born			
Gross Effect	-.402	-.376	-.458
Net Effect*	+.004	-.066	-.028
Foreign-Born			
Gross Effect	+.402	+.376	+.458
Net Effect*	-.004	+.066	+.028

* Net of age and sex.

TABLE 4. LIFE EXPECTANCY VALUES AT AGE ZERO AMONG EIGHT SUBPOPULATIONS FOR CANADA, 1951, 1964 AND 1971

SUBPOPULATION AND SEX	PERIOD		
	1951	1964	1971
MALES			
French NB	64.26	67.80	68.50
British NB	69.14	71.84	73.55
Aboriginals	47.52	59.26	66.17
Residual NB	66.41	68.22	69.23
British FB	67.28	70.32	70.52
USA	65.04	66.18	67.03
Other Europe FB	67.90	71.84	71.91
Other FB	64.37	66.09	68.43
TOTAL**	66.30	68.40***	69.30
FEMALES			
French NB	69.69	72.55	75.86
British NB	72.92	75.13	77.09
Aboriginals	50.72	64.89	71.44
Residual NB	71.20	73.96	75.98
British FB	72.91	76.26	76.96
USA	70.38	73.04	74.22
Other Europe FB	73.03	75.22	76.67
Other FB	66.72	73.10	75.00
TOTAL**	70.80	74.20***	76.40

** R. Beaujot and K. McQuillan Growth and Dualism: The Demographic Development of Canadian Society, p. 40.

*** Figure is for 1961.

broken down into specific subgroups. Table 4 shows life expectancies at age zero for eight subpopulations. An overall statement about the statistics in this table is that wide disparities in the average length of life prevail among Canadian ethnic and immigrant groups. These kinds of discrepancies range from the lowest life expectancies among Aboriginals to the highest level of survival associated with the British native-born. The French have experienced an intermediate level, but their life expectations are consistently below the national averages. Among immigrants, the British and other European groups have shared more superior levels of longevity than persons from the United States and other (residual) origins in Canada.

A logit main effect model was fit to the data in order to ascertain the relative impact of subpopulation membership on the expected odds of dying. Table 5 shows the equation in additive and multiplicative forms. Age, sex, time and subgroup membership all have substantial effects on the odds: the age logits conform to the expected J-curve of mortality; being male as opposed to female raises the likelihood of death; and, over time, there has been a gradual reduction in mortality. Of the eight subpopulations, being Aboriginal raises the expected odds of death to a greater extent than all other groups, while British native-born ethnicity has the strongest effect in diminishing the relative chances of mortality. The effect of French ethnic membership is intermediate to Aboriginals and British native-born. Among immigrants, the other Europeans, British, and American effects, in that order, are related to lessening the chances of death. Of the two residual categories, the odds of dying are greater for the foreign-born. Due to the fact that these two groups contain many subpopulations, generalizations are not substantively meaningful; therefore, the rest of the analysis will pay minimal attention to these classes of nativity.

Evaluation of Hypotheses

The Migration Selectivity Hypothesis

The data provide substantial evidence of the existence of significant mortality differentials among specific components of native- and foreign-born subpopulations in Canada. Concerning the hypotheses formulated earlier, the mortality assimilation thesis predicts a convergence of levels of mortality. The life expectancy figures in Table 4 suggest that even though there has been a general trend toward equalization, significant differentials in the length of life persist. The logit equations in Table 5 provide a second test for assimilation in that controlling for time, along with age and sex, does not eliminate disparities in the odds of death among the eight groups.

It was said that the migration selectivity hypothesis may be tested by examining a particular group of immigrants in Canada in relation to their population of origin, the host society, and their descendants in the host country. The only group in this study for which we have sufficient data that satisfies these kinds of contrasts is the British. The prediction is that British immigrants will exhibit intermediate risks of mortality. It is

TABLE 5. LOGIT REGRESSION ANALYSIS OF THE ODDS OF DYING: MULTIPLICATIVE AND ADDITIVE EQUATIONS

Variables	EFFECTS			
	ADDITIVE		MULTIPLICATIVE	
	α	β	η	τ
Age (A)	-4.934		.085	
0-4		-.056		.972
5-9		-2.456		.293
10-14		-2.674		.263
15-19		-1.926		.382
20-24		-1.678		.432
25-29		-1.760		.415
30-34		-1.568		.457
35-39		-1.238		.538
40-44		-.770		.680
45-49		-.326		.850
50-54		.174		1.091
55-59		.630		1.370
60-64		1.108		1.740
65-69		1.536		2.156
70-74		2.000		2.719
75-79		2.498		3.488
80-84		2.966		4.406
85+		3.540		5.870
SEX (S)				
Male		.212		1.112
Female		-.212		.900
SUBGROUP (N)				
French NB		.084		1.043
British NB		-.414		.813
Aboriginals		.524		1.300
Residual NB		.198		1.104
British FB		-.266		.876
USA		-.126		.939
Other Europe FB		-.276		.871
Other FB		.274		1.147
YEAR (Y)				
1951		.166		1.087
1964		-.046		.977
1971		-.120		.941

Note: The equation is based on the logit main effect model fitted to the data:
 [A S Y N] [DA] [DS] [DN] [DY]. The L^2 statistic is 95,611 with 319 D.F.,
 and a corresponding R^2 analogue of .968, using [ASYN] [D] as the baseline
 model.

expected that they will show lower probabilities of death than their origin population (British Isles), but a higher likelihood of dying in comparison to Canada as a whole and British Canadian-born descendents.

The test of this thesis is shown in Table 6, which displays logit parameters based on an additive main effects model involving four separate contrasts of the relevant groups. The findings are consistent with the selectivity effect. For example, the first comparison indicates that British immigrants do in fact experience lower odds of death than their population of origin. The second and third contrasts, respectively, show evidence that the British native-born also fare better than the British Isles, and that Canada as a whole has such an advantage over the British Isles as well. The contrast in the bottom panel (no. 4) of Table 6 is further support for the above conclusion: when all groups are considered simultaneously, rank order of effects can be established: British indigenous demonstrate the lowest odds; Canada is second-lowest, followed by British immigrants; and British Isles is highest in the expected odds of dying. Although a more direct test of a migration selection effect would require more detailed data — such as the length of time British foreigners have resided in Canada and how their characteristics change from the time of entry to the time of death — the present empirical approach represents an appropriate test, given the unavailability of more desirable data. The results suggest that immigrants conform to a positive selection model of mortality. However, this finding cannot be generalized beyond the British, as the available data do not allow for an evaluation of the other groups. An important objective for future investigation is to ascertain whether American and European immigrants in Canada share the same mortality experience as the British foreign-born.

The Ethnic Effect Hypothesis

A hierarchy of mortality levels seems to prevail within Canadian society. Support for this has been provided by the data on life expectation and the logit effects in Table 5. A further test was executed with the use of a saturated logit model (which includes all possible main and interaction effects); the additive net main effects associated with subgroup membership are displayed in Table 7. Substantively, there is little change from our previous observations: Aborigines are the most disadvantaged while British indigenous and immigrant groups, and other Europeans, tend to enjoy better odds of survival; the remaining subgroups share an

TABLE 6. LOGIT ADDITIVE MAIN EFFECTS FOR THE ODDS OF DYING BETWEEN BRITISH ISLES, BRITISH IMMIGRANTS IN CANADA, AND BRITISH NATIVE-BORN IN CANADA, 1951, 1964 AND 1971

Contrasts	Logit Main Effects*		
	1951	1964	1971
1. British Immigrants vs. British Isles (Origin Pop.)	-.118 .118	-.230 .230	-.094 .094
2. British Native-Born vs. British Isles (Origin Pop.)	-.130 .130	-.160 .160	-.214 .214
3. Canada vs. British Isles	-.412 .412	-.318 .318	-.642 .642
4. Canada (Less British NB and British FB)	-.160	-.176	-.182
British Isles	.291	.296	.299
British N.B.	-.201	-.197	-.198
British immigrants	.070	.067	.081

* Net of Age and Sex.

Note: The Crude Death Rates are as Follows:

	1951		1964		1971	
	Male	Female	Male	Female	Male	Female
British Isles	13.50	11.91	12.06	10.72	13.14	11.59
British FB	23.65	16.31	23.63	15.89	25.47	17.89
British NB	8.67	6.91	7.08	5.12	6.30	4.29
Canada	10.21	7.81	8.94	6.43	8.64	6.17

- Data for British Isles (England, Wales, Scotland, Ireland), 1951 and 1961 from Preston et al., *Causes of Death: Life Tables for National Populations*; For 1971, *U.N. Demographic Yearbook*, 1978.

intermediate position. The relative rankings of the groups correlate rather highly with their known ranks in the socioeconomic ladder of Canadian society. John Porter (1965), in his study of *The Vertical Mosaic* in Canada, observed that there is a strong relationship between ethnic origin, socioeconomic status and life chances. It may be argued that the high odds of death of Aborigines in contrast to the low mortali-

ty of the British (and also other Europeans' relative low odds of death), represent extreme polarities in both life chances and socioeconomic status. However, it must be cautioned that an ethnic effect in the context of mortality may reflect other possible causal mechanisms, not necessarily socioeconomic status alone. It may be that factors endogenous and exogenous to the groups are operating simultaneously, accounting for mortality differences. Endogenous forces may be subcultural practices and values associated with lifestyle (for example, smoking, diet, etc.) and health behaviour. Exogenous influences are derived primarily from the experience of prejudice and discrimination against the minority group which tend to exclude it from society's opportunity structure and rewards (for example, political and occupational). The inclusion of either direct or indirect measures of endogenous and exogenous sources of subgroup mortality remains an important objective for future study.

TABLE 7. LOGIT PARAMETERS FOR THE ODDS OF DYING
BASED ON A SATURATED MODEL, ADDITIVE EFFECTS*

<u>SUBPOPULATION</u>	<u>LOGIT (RANK)</u>
French N.B.	.034 (4)
British N.B.	-.458 (8)
Aboriginals	.488 (1)
Residual N.B.	.168 (2)
British F.B.	-.302 (6)
United States F.B.	.126 (3)
Other Europe F.B.	-.330 (7)
Other F.B.	-.274 (5)

* Variables included are age, sex, time, subpopulation. The saturated model involves all possible main and interaction effects.

Note:

- (1) A rank of 1 = highest; 8 = lowest.
- (2) It is interesting that based on what we know about Canadian stratification, the relative ranks of mortality correspond roughly to the groups' relative socioeconomic standings in Canada:

Aboriginals	-	Lowest SES
British N.B.	-	Highest SES
British F.B.	-	Highest SES
All Others	-	Intermediate SES

Conclusions

Mortality differentials between native-born and immigrants in Canada have been minimal from an aggregate point of view. When specific subgroups within and between the native and foreign-born components are examined, the disparities in the chances of death are substantial. This study set out to document such variations and, secondly, to test the hypotheses of assimilation, migration selection and ethnic effect, using available vital statistics and census information within a multivariate framework. Overall, there is evidence that mortality levels have been declining and that there has been some movement towards convergence, but substantial differentials still exist; thus the assimilation thesis received some support. The implication is that mortality levels are converging due to the nation's increasing equalization in the provision of health care to all groups. A test of migration selectivity involving the British provided validation for the notion that immigrants may be positively selected with regard to survival. However, further study is necessary before generalizations regarding other immigrant groups can be made. The persistence of substantial differences in death rates reflects an arrangement analogous to a "vertical mosaic" in Canadian society. That is, a group's mortality level is inextricably tied to its socioeconomic rank in the larger society.

In addition to more empirical work, future study ought to consider the development of a sociological theory of subgroup mortality variation. A fruitful starting point would be the application of stratification principles to mortality analysis. Also, the sociology of subcultures can be applied to study the relationship between subculture, life styles, social integration and mortality.

Towards A Sociological Model of Subgroup Mortality Analysis

Death is the end result of many factors associated with the life experience of individuals. In recent years, scientists have come to the realization that both social and biomedical factors are important determinants of death and that their influences on the organism quite often operate developmentally over a long period of time. This underlies a major difficulty in specifying a dynamic sociological theory of mortality because the causal linkages and temporal ordering of relevant sources are not always readily identifiable.

Mortality Differences Among Canada's Population, 1951-1971

1. <u>SOCIOSTRUCTURAL FACTORS</u>	3. <u>SOCIAL PSYCHOLOGICAL FACTORS</u>	<u>MORTALITY</u>
A. STRATIFICATION VARIABLES <ul style="list-style-type: none"> - income - occupation - education - employment status - social class 	<ul style="list-style-type: none"> - Group Norms About the Definition and Response to Illness - Utilization of Preventive Medical Services - Values About Life Style <ul style="list-style-type: none"> -diet -smoking -exercise - Social Support Systems <ul style="list-style-type: none"> -kin and family -friends - Life Changes and Stress <ul style="list-style-type: none"> - social mobility - life cycle changes - unintended changes 	A. <u>GENERAL</u> <ul style="list-style-type: none"> - all causes combined B. <u>CAUSE SPECIFIC</u> <ol style="list-style-type: none"> 1. Immediate Causes <ul style="list-style-type: none"> e.g. <ul style="list-style-type: none"> - suicide - violence - accidents etc. 2. Developmental Causes <ul style="list-style-type: none"> - neoplasms - heart disease - stroke - arterial disease - kidney failure, etc.
B. SOCIOCULTURAL VARIABLES <ul style="list-style-type: none"> - ethnicity - nationality - race - religion - marital status 		
C. ECOLOGICAL VARIABLES <ul style="list-style-type: none"> - urban-rural residence - distance from health centre - environment quality - air pollution 		
2. <u>SOCIOBIOLOGICAL FACTORS</u> <ul style="list-style-type: none"> - age - sex - race 	4. <u>ACCESS TO PROFESSIONAL MEDICAL CARE</u> <ul style="list-style-type: none"> - Supplementary Health Care - Health Insurance 	C. <u>INFANT MORTALITY</u> <ol style="list-style-type: none"> 1. Perinatal 2. Neonatal 3. Post-natal

FIGURE 1. COMPONENTS OF SUBGROUP MORTALITY DIFFERENTIALS

A further obstacle in establishing an overall theory of the sociology of death relates to the inherent lack of motivation for senescence. Thus, for the most part, with the exception of suicide, humans are not motivated by the wish to die. Sociological theory often presupposes that human action reflects persons' or groups' motivation towards some desirable end, be it status, power, achievement or material wealth. Mor-

tality as a criterion variable does not readily lend itself to this usual sociological framework of human action. Given this difficulty, an important task for the time being is to specify the components of subgroup mortality differences and then, eventually to proceed to theory construction once we gain a better understanding of the major sources of differentials and their causal ordering. Figure 1 is included as an initial effort in this objective.

The first component represents sociostructural factors which are assumed to be exogenous in their influence on death. The variables income, occupation, education, employment status and social class have received much attention in the literature (Antonovsky, 1967; Kitagawa and Hauser, 1973; Stockwell *et al.*, 1978; Tumin, 1967). In general, the effects of income, education and occupation levels on the mortality rate are inverse: the higher their levels, the lower the death rate. However, it is not always made explicitly clear in the literature how such variables translate into varying mortality levels. The effects of the above causes must operate through the intermediate variables in Figure 1. This is an important area of research which needs verification and further exploration. It is suggested that social class, for example, affects mortality through both social psychological and access to professional medical care components (3 and 4). Class is causally tied to life chances and, hence, access to high quality health care (Eyer, 1977; Dutton, 1978; Fein, 1977; Fordyce, 1977). Moreover, social class is known to be related to lifestyle habits (Powels, 1978) and social support systems (Turner, 1981), factors which have been linked to differentials in morbidity and mortality (Cassel, 1974; Eyer and Sterling, 1977).

Sociocultural factors such as ethnicity, nationality, race and religion have by and large been used as proxy for other variables such as social class. There is need to separate cultural from structural variables so that both subculture and socioeconomic effects may be studied for their relevance in explaining mortality. Furthermore, it will become essential to specify how such variables affect mortality through the two intermediate components in Figure 1. Some of the more classic studies in medical sociology have established that subcultures vary in their definitions and responses to illness (Mirowski and Ross, 1980; Suchman, 1964; Zborowski, 1952; Zola, 1966;). It seems that some elements in the population often respond to illness in a series of stages. These stages often begin with a denial of illness, progress to self-cure and folk medicine, and eventually lead to seeking professional medical care. In general, the longer the process, the greater the risk of serious health com-

plications tending to increase the severity of illness and of premature death. This, in addition to subcultural differences in lifestyle habits, may account for two key sources of variation in both illness and mortality specified in our framework.

Social support systems of subgroups mediate many of the stresses people experience in life (Antonovsky, 1979; Berkman and Syme, 1979; Cassel, 1974; Dohrenwend, 1967; Kobrin and Hendershot, 1977; Mirowsky and Ross, 1980). The social support mechanism is of particular relevance to the explanation of the immediate causes of death such as suicide, accidents and violence. The greater the extent to which a subgroup has normative controls concerning social cohesiveness and integration, the lower the likelihood of death from the immediate causes, which have psychological distress as a major antecedent. Social support systems may also be relevant in explaining developmental causes of death, such as cancer and heart disease (Antonovsky, 1979; Rahe *et al.*, 1974). This promises to be an important area of study, particularly in the investigation of immigrant mortality, because the adjustment process and the life stresses associated with it are mediated by social support systems (Kliwer, 1979).

Analysts have linked ecological variables to mortality rates (Barret, 1980; Basavarajappa and Lindsay, 1976; Bashlur *et al.*, 1971; Fabitz and Feinleib, 1980; Hamilton, 1955; Knox, 1979). It has been demonstrated that ecological areas vary with respect to sociocultural, stratification and mortality variables (Beaumont and Weiss, 1980; Benjamin, 1965; Newacheck *et al.*, 1980; Williams and Horn, 1977). Moreover, certain geographic areas have been documented as being linked to increased risks of disease due to air pollution and the presence of carcinogenic agents in the environment (Lowe and Seskin, 1970; McCarrol and Bradley, 1966).

Genetic and biological factors of morbidity and senescence have been studied primarily by medical scientists and epidemiologists. Age and sex have important relationships to mortality. Demographers and medical scientists have developed mathematical models of aging and its degenerating effect on the organism (for example, Strehler and Mildvan, 1960). With few exceptions, women generally experience lower probabilities of death than men, particularly in infancy and at later ages (Nathason, 1984; Verbrugge, 1976). For this reason, age and sex are usually employed as controls in most statistical analyses. Sex is also a social variable which affects mortality via the other components in Figure 1. Race has been documented as being a predisposing factor to

certain diseases (Damon, 1969). Thus, it too, must be viewed as both a sociocultural and a biological source of mortality differentials and, therefore, must be treated accordingly in empirical study.

Mortality in the context of differential analysis may be classified into two general classes: general and cause-specific. In the former case, mortality from all causes are combined, and the focus is on group-specific levels of longevity (for example, life expectancy) or death rates. In cause-specific mortality, a convenient division is the separation of immediate causes like suicide, accidents and violence (causes which do not necessarily involve a prolonged process of illness before death) from developmental causes, which usually take decades before they cause death. Infant mortality (perinatal, neonatal and post-neonatal) may also be studied in the context of the components delineated in Figure 1, but obvious modifications and additions would need to be incorporated to simultaneously take into account parental and infant factors.

In this brief section, an attempt has been made to present an organizing framework for the empirical study of subgroup differences in death. The primary interest in this paper has been on the analysis of nativity and the ethnic subpopulation's relationship to mortality; however, the framework elaborated here may be applied to other subgroups in the general population as well (for example, marital status categories). Although it is recognized that the necessary data are not always available, further work is needed to expand and refine the hypotheses elaborated in this paper and, correspondingly, the development of a general theory of minority group mortality differentials.

Acknowledgments

The author wishes to thank John Silins, Martha Smith and D. Nagnur, of the Vital Statistics and Disease Registry of Statistics Canada, for their cooperation in making the mortality data available for analysis. Responsibility for the contents of this study rests solely with the author.

Mortality Differences Among Canada's Population, 1951-1971

Footnotes

1. The number of missing observations for the three aggregate periods has varied as follows:

	<i>1950-1953</i>	<i>1963-1965</i>	<i>1970-1972</i>
Total Deaths Recorded for the Period	379,552	444,609	479,927
Total Missing	11,673	108,388	116,876

2. The age-sex structures used in this study were derived by subtracting the foreign-born from the ethnic distributions corresponding to the appropriate groups in this analysis. For example, the British native-born age-sex distribution was obtained by subtracting British foreign-born from British ethnic origin within categories of age and sex. The assumption is that in the census all British foreign-born state themselves as British ethnicity. To the extent that some people of British origin fail to say so on the census, the procedure reflects some degree of bias. The problem is that there is no way to check for this possibility. If this discrepancy does occur, it is assumed to be minor. The British have little reason to not identify themselves as British, as they are the dominant group in Canada. The same interpretation may be given for the French ethnic group. Although there is evidence of French linguistic losses to the British in terms of language of the home and mother tongue, there is no evidence to suggest that people of French origin report their ethnicity as something other than French. Overall, however, the definition of ethnic origin in the census may cause some concern because prior to the 1981 census, ethnic origin is based on tracing one's lineage through the male side only. No adjustments for this fact were made as the necessary information to do so is not available.

References

- Adler, H.A. and D.A. Brusegard. 1980. *Perspectives Canada III*. Ottawa: Statistics Canada.
- Antonovsky, A. 1967. Social class, life expectancy and overall mortality. *Milbank Memorial Fund Quarterly* 45:31-73.
- _____. 1979. *Health, Stress and Coping*. San Francisco: Jossey-Bass.

- Barret, F.E. (ed.). 1980. Canadian Studies in Medical Geography. Geographic Monographs No. 8.
- Basavarajappa, K.G. and J. Lindsay. 1976. Mortality Differences in Canada, 1960-62 and 1970-72. Ottawa: Statistics Canada.
- Bashlur, R.R., G.W. Shannon and C.A. Metzner. 1971. Ecological Differentials in the Use of Medical Services. *Health Services Research* 6:61-75.
- Beaumont, J.J. and N.S. Weiss. 1980. Mortality of welders, shiplifters, and other metal trades workers in Boilermakers Local No. 104 AFL-CIO. *American Journal of Epidemiology* 112(6):775-786.
- Benjamin, B. 1963. Social and Economic Factors Affecting Mortality. The Hague, Paris: Mouton & Co.
- Berkman, L.F. and S.L. Syme. 1979. Social networks, host resistance and mortality: A nine-year follow-up study of Alameda County residents. *American Journal of Epidemiology* 109(2):186-204.
- Brahimi, M. 1980. La mortalité des étrangers en France. *Population* 35:603-622.
- Cassel, J. 1974. Psychosocial processes and stress: Theoretical formulations. *International Journal of Health Services* 4(3):471-482.
- Clement, W. 1975. The Canadian Corporate Elite: Economic Power in Canada. Toronto: Maclelland and Stewart.
- Coale, A.J. 1975. The demographic transition reconsidered. *International Population Conference: Liege*
- Damon, A. 1969. Race, ethnic group and disease. *Social Biology* 16:69-80.
- Dohrenwend, B.P. 1967. Toward the development of theoretical models: Part I. *Milbank Memorial Fund Quarterly* 45(2 part 2):155-162.
- Dutton, D.B. 1978. Explaining the low use of health services by the poor: Costs, attitudes or delivery systems? *American Sociological Review* 43:348-368.
- Eyer, J. 1977. Prosperity as a cause of death. *International Journal of Health Services* 7(1):125-150.
- _____ and P. Sterling. 1977. Stress-related mortality and social organization. *Review of Radical Political Economy* 9:1-44.
- Fabitz, R. and M. Feinleib. 1980. Geographic patterns in county mortality rates from cardiovascular diseases. *American Journal of Epidemiology* 111(3):315-328.
- Fein, R. 1977. On achieving access and equity in health care. *Milbank Memorial Fund Quarterly* 44(2):157-166.
- Fordyce, E.J. 1977. Early mortality measures as indicators of Socio economic well-being. *Sociology and Social Research* 61(2):125-137.

Mortality Differences Among Canada's Population, 1951-1971

- Goldscheider, C. and P.H. Uhlenberg. 1969. Minority group status and fertility. *American Journal of Sociology* 74:361-372.
- Goldscheider, C. 1971. *Population, Modernization and Social Structure*. Boston: Little-Brown.
- Goodman, L.A. 1972. A modified multiple regression approach to the analysis of dichotomous variables. *American Sociological Review* 37:28-46
- Hamilton, C.H. 1955. Ecological and social factors in mortality variation. *Eugenics Quarterly* 2:212-223.
- Health and Welfare Canada. 1979. *Mortality Atlases, I, II, III*. Ottawa.
- Jarvis, G.K. and M. Boldt. Death styles among Canada's Indians. *Social Science and Medicine* 16:1345-1352.
- Kitagawa, E. 1977. On mortality. *Demography* 14:381-389.
- _____ and P.M. Hauser. 1973. *Differential Mortality in the United States: A Study in Socioeconomic Epidemiology*. Cambridge, Massachusetts: Harvard University Press.
- Kliwer, E.V. 1979. *Factors Influencing the Life Expectancy of Immigrants in Canada and Australia*. Ph.D. Thesis. The University of British Columbia, Vancouver, British Columbia, Canada.
- Knox, P.L. 1979. Medical deprivation, area deprivation and public policy. *Social Science and Medicine* 13(1):111-121.
- Krueger, D.E. and I.M. Moriyama. 1967. Mortality of the foreign-born. *American Journal of Public Health* 57(3):496-503.
- Lee, E.S. 1966. A Theory of Migration. *Demography* 3:47-57.
- Lowe, L.B. and E.P. Seskin. 1970. Air pollution and human health. *Science* 169(3947):723-733.
- Madigan, F.C. 1957. Are age, sex, mortality differentials biologically caused? *Milbank Memorial Fund Quarterly* 35(2):202-223.
- Marmot, M., A. Aldelstein and L. Balusu. 1983. Immigrant mortality in England and Wales, 1970-78. *Population Trends* 33:14-17.
- McCarroll, B. and W. Bradley. 1966. Excess mortality as an indicator of health: Effects of air pollution. *American Journal of Public Health* 56(11): 1933-1942.
- McKeown, T., R.G. Brown and R.G. Record. 1972. An interpretation of the modern rise of population in Europe. *Population Studies* 26:345-382.
- Millar, W.J. 1982. Mortality patterns in a Canadian Indian population. *Canadian Studies in Population* 9:17-32.

- Mirowski, J.II and C.E. Ross. 1980. Minority status, ethnic culture and distress: A comparison of Blacks, Whites, Mexicans and Mexican Americans. *American Journal of Sociology* 86:479-495.
- Nathanson, C.A. 1984. Sex differences in mortality. *Annual Review of Sociology* 10:191-213
- Newacheck, P.W., L.H. Butler, A.K. Harper, D.L. Piontkowski and P.E. Franks. 1980. Income and illness. *Medical Care* 18:1165-1176.
- Omran, A.R. 1971. The epidemiological transition: A theory of the edidemiology of population change. *Milbank Memorial Fund Quarterly* 49:509-538.
- Petersen, W. 1975. *Population*. New York:Macmillan.
- Pineo, P.C. 1977. The social standing of ethnic and racial groupings. *The Canadian Review of Sociology and Anthropology* 14:147-157.
- Porter, J. 1965. *The Vertical Mosaic*. Toronto: University of Toronto Press
- Powels, J. 1978. The effects of health services on adult male mortality in relation to the effects of social and economic factors. *Ethics in Science and Medicine* 5:1-13.
- Preston, S.H. 1977. Mortality trends. *Annual Review of Sociology* 3:163-178
- _____, N. Keyfitz and R. Schoen. 1972. *Causes of Death: Life Tables for National Populations*. New York: Seminar Press.
- Rahe, R.H., M. Romo, L. Bennett and P. Siltanen. 1974. Recent life changes, myocardial infraction and abrupt coronary death. *Archives of International Medicine* 133:221-228.
- Ravenstein, E.G. 1885. The laws of migration. *Journal of the Royal Statistical Society*. XLVII(Part 2):167-227.
- Shaw, R.P. 1975. *Migration Theory and Fact*. Philadelphia: Regional Science Research.
- Smith, M. and H.B. Newcombe. 1980. Automatic follow-up facilities in Canada for monitoring delayed health effects. *American Journal of Public Health* 70(12):1261-1268.
- Stenhouse, N.S. and M.G. McCall. 1970. Differential mortality from cardiovascular disease in migrants from England and Wales, Scotland and Italy, and Native-born Australians. *Journal of Chronic Diseases* 23:423-431.
- Stockwell, E.G., J.W. Wicks and D.J. Adamchak. 1978. Research needed on socioeconomic differentials in U.S. mortality. *Public Health Reports* 93(6):666-672.
- Strehler, B.L. and A.S. Mildvan. 1960. General theory of mortality and aging. *Science* 132(July):14-21.

Mortality Differences Among Canada's Population, 1951-1971

- Suchman, E.A. 1964. Sociomedical variations among ethnic groups. *American Journal of Sociology* 70:319-331.
- Syme, S.L. and L.F. Berkman. 1976. Social class, susceptibility and sickness. *American Journal of Epidemiology* 104(1):1-8.
- Thomas, D.S. 1938. *Research Memorandum on Migration Differentials*. New York: Social Science Research Council.
- Tumin, M.M. 1967. *Social Stratification: The Forms and Functions of Inequality*. Englewood Cliffs: Prentice Hall.
- Turner, J. 1981. Social support as a contingency in psychological well-being. *Journal of Health and Social Behaviour* 22:357-367
- Verbrugge, L.M. 1976. Sex differentials in morbidity and mortality in the United States. *Social Biology* 23:275-296.
- Wigle, D.T. and Y. Mao. 1980. Mortality by income level in urban Canada. Ottawa: Non-Communicable Disease Division, Health Protection Branch, Health and Welfare Canada.
- Wilkins, R. 1980. L'inégalité sociale face à la mortalité à Montréal, 1975-1977. *Cahiers Québécois de Démographie* 9(2):157-184.
- Williams, R. and J.W. Horn. 1977. Association of cancer sites with tobacco and alcohol consumption and socioeconomic status of patients: Interview study from the Third National Cancer Survey. *Journal of the National Cancer Institute* 58:525-542.
- Young, T.K. 1983. Mortality pattern of isolated Indians in northwestern Ontario: A 10-year review. *Public Health Reports* 96(5):467-475.
- Zborowski, M. 1952. Cultural components in response to pain. *The Journal of Social Issues* 8:16-30.
- Zola, I.K. 1966. Culture and symptoms — an analysis of patients presenting complaints. *American Sociological Review* 31:615-630.

Received July, 1984; revised January, 1985.

Appendix

PROCEDURES USED TO DERIVE THE AGE-SEX COMPOSITION OF THE GROUPS STUDIED

Age-Sex Composition for 1951

The following data sources were utilized: 1951 Census of Canada: General Review and Summary Tables, volume X; (particularly Tables 32, 34 and 35); and 1951 Census of Canada: Population Cross-Classification of Characteristics, volume II; (particularly Tables 4, 10 and 40).

The 1951 census provides a breakdown of Canada's age-sex distribution in five-year age groups (0-4 to 95 +). The data is partitioned on the basis of ethnicity. A separate tabulation contains the same kind of information classified by place of birth (for example, Canada by province, United Kingdom, United States, Germany, Italy, Poland, Russia, Scandinavia, Asia, Other).

Deriving the Total Native and Foreign-Born Age-Sex Structures

Table 10 in volume II of the 1951 census contains age-sex totals for persons born in Canada and in a separate column, overall age-sex totals. By way of simple subtraction it was possible to obtain the age-sex composition of the foreign-born.

Deriving the French, British, Aboriginal and Residual Native-Born Age-Sex Structures

British Native-Born. This group was obtained by subtracting the age-sex specific figures of British foreigners (Volume II, Table 10) from the British Ethnicity figures by age and sex (Volume II, Table 4). It is assumed that the ethnic data contain both native and foreign-born persons of British origin and that the difference between ethnicity and foreign-born figures reflect British persons born in Canada.

French Canadians. Utilizing the same sources of information, a

similar approach was taken as that described for the British. The major difference was that the census tables do not contain the French foreign-born into its age breakdown. Totals by sex were available, however. In order to derive the age-sex distribution of French foreigners, the age-sex composition (proportions) of "Other Europe" was applied to the French foreign-born sex totals.

Once the French foreign-born figures were obtained, calculation of the French native-born by age and sex became a simple procedure: the foreign-born figures were subtracted from the French ethnicity age-sex composition.

Two assumptions are worth noting in this regard. First, it is assumed that this approach provides an adequate account of the French native-born population. Secondly, it is implied that French foreigners have an age-sex composition which is the same as "Other Europeans".

Aboriginals. The census has recorded the population composition of this group. The figures were taken directly from the published tabulations. It is worth noting that Inuit, Eskimos and Metis are included in this population.

Residual Native-Born. This category was obtained as follows: the sum of French, British and Aboriginal age-sex figures were subtracted from the corresponding total native-born age-sex distribution for Canada. In formal terms this can be shown as follows:

$$RNB_{i,j} = \sum_{\substack{j=85+ \\ i=2 \\ i=1 \\ j=0-4}} [TNB_{i,j} - (FNB_{i,j} + BNB_{i,j} + AB_{i,j})]$$

where:

$RNB_{i,j}$ = Residual Native-Born population of sex i , age group j

$TNB_{i,j}$ = Total Native-Born population of sex i , age group j

$FNB_{i,j}$ = French Native-Born population of sex i , age group j

$BNB_{i,j}$ = British Native-Born population of sex i , age group j

$AB_{i,j}$ = Aboriginal population of sex i , age group j

Deriving the Age-Sex Structures for British, United States, Other Europe and Other Foreign-Born Populations

The age-sex compositions for three of the four populations (British, U.S.A.. and Other Europe), were taken directly from the published census tabulations of age-sex distributions by place of birth (1951 Census of Canada, Volume II, Table 10).

Residual Foreign-Born (Other Foreign-Born). This was approached in the same manner as was described in connection with the native-born residual population. In formal terms this can be shown as follows:

$$RFB_{i,j} = \sum_{\substack{j=85+ \\ i=2 \\ i=1 \\ j=0-4}} [TFB_{i,j} - (BFB_{i,j} \text{ } USA_{i,j} \text{ } OEFB_{i,j})]$$

where:

$RFB_{i,j}$ = Residual Foreign-Born population of sex i , age group j

$TFB_{i,j}$ = Total Foreign-Born population of sex i , age group j

$BFB_{i,j}$ = British Foreign-Born population of sex i , age group j

$USA_{i,j}$ = United States immigrant population of sex i , age group j

$OEFB_{i,j}$ = Other European Foreign-Born population of sex i , age group j

Mortality Differences Among Canada's Population, 1951-1971

Age-Sex Composition for 1961

The same procedures described for 1951 were applied to the 1961 Census data. The following bulletins from the 1961 Census of Canada were used:

- Population: Single Years of Age. Volume 1, Part 2, Catalogue 92-543 (particularly Tables 26 and 27);
- Population: Birthplace and Citizenship by Age Groups. Volume 1, Part 3, Catalogue 92-555 (particularly Table 89);
- Population: Ethnic Groups by Age. Volume 1, Part 3, Catalogue 92-553 (particularly Table 81);
- Population: Characteristics of Immigrants. Volume 1, Part 3, Catalogue 92-562 (particularly Tables 124 and 125);
- Population: Age Groups. Volume 1, Part 2, Catalogue 92-542 (particularly Tables 20);

Age-Sex Composition for 1971

Essentially the same procedures as described for the previous two census periods were applied to the 1971 data. Some differences were observed, however. They are noted below.

The following data sources were relied on for 1971: 1971 Census of Canada, Population: Age Groups by Birthplace. Volume 1, Part 4, Catalogue 92-737 (particularly Table 25); and the 1971 Census of Canada Public Use Sample Tapes, individual file.

British Foreign-Born. In 1971, published census tabulations for the British omitted Ireland from this group's foreign-born population. Since Ireland was included in previous censuses, it was decided to use the Public Use Sample Tapes for the 1971 census to obtain an estimate of the Irish foreign-born by age and sex. When this was derived, the figures were added to the British foreign-born.

French Foreign-Born. In 1971 the census tables do not show — as they did in 1961 — the desired breakdown for "Other Europe" place of birth (whose age-sex proportionate distribution would have been applied to the sex-specific French foreign-born to derive the latter's population composition). The published tabulations, however, provide the necessary

data for “Other Western Europe” foreign-born. Therefore, this designation provided the desired basis for calculating the French foreigners’ age-sex composition.