5.0 MULTIVARIATE ANALYSIS: APPROACH AND METHODS

5.1 Poisson Regression Model for the Expected Death Rate

The hypotheses stated earlier can be evaluated with a series of multivariate Poisson regressions. This type of regression can be computed using log-linear techniques (Laird and Olivier, 1981; Larson, 1985). The Poisson model assumes deaths are random independent events, and that the total number of deaths in a given time interval is random. It also assumes that competing causes of death are independent of one another (one can only die of one cause). In the Poisson model the mean and variance of expected deaths are equal (Laird and Olivier, 1981; Larson, 1984; Clogg and Eliason, 1987; Agresti, 1990).

Accordingly, if θ is the underlying probability of death in the population, the expected number of deaths in that population P, at any specified time interval would be θP. Letting $\lambda = \theta P$ (the expected number of deaths), the Poisson probability for the independent occurrence of any **x** number of deaths in the population during a specified interval of time is:

$$\Pr(\mathbf{x}; \lambda) = e^{\lambda} \lambda^{\mathbf{x}} / \mathbf{x}! \qquad \mathbf{x} = 0, 1, 2, 3, \ldots$$

In their development of the log-linear Poisson model for rates, Laird and Olivier (1981), incorporated elemental principles of log-linear frequency models with the properties of the Poisson probability distribution, which is inherently an exponential mathematical model analogous to Cox's (1972) proportional hazards model. In fact, Laird and Olivier (1981) show that, like the Cox model, life table survival probabilities are derivable from the log-linear Poisson regression model. Since both Cox and Laird

and Oliver's models are inherently exponential, the ratio of hazard rates for any two social categories (e.g., males and females) is constant (i.e., both are constant hazards, or exponential, models).[1] The application of the log-linear Poisson regression model in this study may be expressed in generalized form as:

$$E(D_{ij}) = P_{ij}(\theta_{ij})$$

Where,

$E(D_{ij})$ = the expected number of deaths in the intersections of covariates **I** and **J**;

P_{ij} = the number of people exposed to the risk of death in the intersections of covariates **I** and **J**;

θ_{ij} = an underlying hazard rate for the intersections of covariates **I** and **J**.

Due to the exponential properties of the Poisson, this expression can be specified as a log-linear model for the expected deaths. In this case the subscript **r** is introduced to denote cause of death:

$$\ln(D_{\mathbf{r}_{ij}}^*) = \lambda + \ln(P_{ij}) + \Sigma_j \lambda_j \mathbf{X}_{ij},$$

with constraints $\Sigma\lambda_j = 0$.

[1] As described by Larson (1985), the formal expression of the Poisson hazard model for the death rate can be approximated by a step function on disjoint time intervals by making the time interval arbitrarily small: $\lambda(\mathbf{r}; t, x) = \text{Limit}_{\Delta \to 0}\, 1/\Delta\, [\Pr(\mathbf{Z} = \mathbf{r}, \mathbf{t} < \mathbf{T} \leq \mathbf{t} + \Delta \mid \mathbf{T} \geq \mathbf{t}, \mathbf{X})]$. That is, the **r**th cause-specific (where**,** $1 \leq r \leq R$) instantaneous death rate $\lambda(\mathbf{r}, t, x)$, is the probability that death **T**, due to **r**, will occur within a small interval of time **t, t+Δ,** given that one is alive at the beginning of the interval **t**, conditional on the values of **X** covariates. Stated differently, the instantaneous hazard at any moment is the average death rate over an indefinitely short time interval, as that interval approaches its limit (i.e. approaches zero, but never reaching zero).

Where,

$\ln(D_{\mathbf{r}_{ij}}^{*})$ = the natural logarithm of the number of expected deaths for a given cause of death **r** in the intersection of covariates **I** and **J**;

P_{ij} = the number of people exposed to the risk of death in the intersection of covariates **I** and **J**;

λ = the mean of the natural logarithm of expected deaths (i.e. intercept term);

$\Sigma_j\lambda_j$ = a set of regression coefficients (lambdas)

$\mathbf{X}_{ij}$ = a vector of covariates (categorical or interval predictor variables).

This equation can be rewritten in a more intuitive form for the expected cause-specific death rate:

$$\ln (D_{r_{ij}}^{*} / P_{ij}) = \alpha + \Sigma_j\lambda_j \mathbf{X}_{ij}$$

This version of the log-linear model is often referred to as the "log-rate model," as the left-hand side of the equation clearly expresses the logarithm of a rate as the dependent variable. Here, the numerators are the expected number of deaths estimated by the fitted model, whereas the P_{ij} values are observed population counts. (The model does not estimate these latter quantities as such; rather, they serve as offsets for the computation of ML estimates of regression coefficients) (Laird and Olivier, 1981; Clogg and Eliason, 1987). The λ terms (regression coefficients) measure the effect of unit change in a given covariate to either raise or lower the overall expected death rate, α. In the case of categorical predictors, "a unit change" implies a shift from one category to the next (e.g. for the variable gender, this would mean a change from male to female or vice-versa, depending on the coding of this variable). Generally, parameter estimates are

constrained such that their sums equal zero (i.e. $\Sigma\lambda_j = 0$). However, under certain conditions in this study, this equality will not hold by design. In some equations the coefficients for "country of birth" is constrained such that the Canadian born is treated as the reference group, whereby all other nationality categories are contrasted against it. Treated in this manner, the resultant parameter estimates in the log-rate model for the county of birth variable will be of the form (λ_r **g** - $\lambda_{r\ CB}$); and taking exponents of these differences derives a measure of relative risk (RR). That is, RR = Exp(λ_r **g** - $\lambda_{r\ \mathbf{CB}}$). Where λ_r **g** is the country of birth coefficient for cause **r** for nationality group **g**, and $\lambda_{r\ \mathbf{CB}}$ is the corresponding group term for the Canadian born population (i.e., the reference group). Note that this measure thusly defined translates into the usual Standardized Mortality Ratio (SMR) in mortality analysis (Namboodiri, 1998). Thus a relative risk greater than 1.00 means group **g** in relation to group CB has a greater level of mortality, whereas a RR below 1.00 means the opposite; and RR of unity implies no difference in risk. As can be seen by these relationships and definitions, the log-linear Poisson model for rates is a flexible and efficient method of standardization (Teachman, 1977).

The parameters in the log-linear rate model are estimated by Maximum Likelihood (MLE). Essentially, this procedure derives parameters for covariates **I** and **J** that would reproduce the observed mortality data as closely as possible under a specified equation, such that the observed minus the expected values under the fitted model would constitute a minimum (i.e., observed – expected = a minimum). In this sense of MLE, a good fitting model is one which produces a Log-Likelihood Chi-Square (L^2) that is insignificant under the Chi-Square probability distribution. However, given the large dimensionality of the data matrix in this study (i.e., as a result of a large number of cross-

classified variables), the degrees of freedom will tend to be so large as to cause virtually all L^2 values to be statistically significant. Of course, a saturated model (all possible main and interaction effects) would produce an insignificant L^2 (a perfect fit to the data), but that would represent a non-parsimonious fit of little substantive utility (i.e. too many parameters to interpret). Under the present conditions a suitable measure of goodness of fit is the Pseudo-R^2, defined as: 1- L^2_M/L^2_B, where L^2_M is a fitted model, and L^2_B is a baseline model. A suitable baseline would be the model of equiprobability (only the constant term included). In the present case, it was decided to define the baseline as the model containing age and sex, which is a more stringent baseline than that of equiprobability (intercept only). Using this measure of goodness of fit, the large the R^2 value (range is between 0 and 1), the better the fit of a specified model in relation to the baseline model.[2]

5.2 Operationalizations

5.2.1 Country of Origin Effects

One of the hypothesis of this study is that the mortality chances of immigrants in their host nations are partly conditioned by factors associated with their background culture and socialization experiences in their home countries before migration. This has been referred to as "country of origin effect." As explained earlier, the causal mechanisms linking country of origin to immigrant mortality are numerous, but for certain causes of premature mortality, particularly suicide, religion and associated moral proscriptions

[2] A word of caution is in order when interpreting this type of fit statistic in connection with deciding which, out of any alternative models one has obtained a better fit to the data. The pseudo-R^2 statistic works well when the modes being compared are nested (or hierarchical). That is, when each model is a subset of a larger model. However, when the models are not nested, it is not possible, strictly speaking to speak of one model being a better fit than another. Some of the models in this study are not of the nested type; therefore,

learned in the home society are obvious links. Age-sex-cause specific death rates for countries corresponding to as many immigrant groups as possible in this analysis were obtained from the World Health Organization (1995) Statistics Annual for the period around 1991 (in some cases 1986 data had to be used). The causes of death for the home countries were compiled as to match the causes of death for their immigrant counterparts. Not all immigrant groups could be matched with a specific country of origin. Other Asia, Africa, and "Other Countries" migrant categories do not have a representative country of origin, as these categories are too broad to allow a reasonable match with one specific nation. In the case of South-Central America/Caribbean/Mexico immigrants, a composite country of origin population was composed by combining the death rates of Argentina, Colombia, Puerto Rico and Mexico. These are the only South American national populations available in the World Health Statistics Annual tables. Though imperfect, it was felt this composite provides a reasonable representation of country of origin for this immigrant group. The origin population corresponding to "Other Scandinavia" immigrant group consists of Denmark, Finland, Norway and Iceland.

5.2.2 Ethnic Community Effects

Immigrants welcomed by an established community of same nationality should have an easier and less stressful settlement experiences than immigrants who do not have access to an established ethnic community. This proposition calls for the inclusion of a composite measure of ethnic community completeness (Breton, 1964). Ideally, one would combine into an index a number of relevant indicators of community, including: degree of ethnic institutional completeness (i.e., number of ethnic based churches, social clubs, newspapers,

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the pseudo R^2 measure will be of limited utility in comparing such models from the point of view of

radio stations, etc.), extent of residential concentration, and informal social networks (family, relatives, friends of same ethnic origin). A highly integrated ethnic community would score very high on these dimensions of community. Another important dimension of community integration would be degree to which an ethnic community promotes linkages between its ethnic members and the larger society. The predominant model of immigrant communities in Canada is one of integration. Once established, ethnic communities tend to play these two important functions: on the one hand serving to enhance its own group identity, and on the other, it acts as a bridge to the outside world. Differences in ethnic community integration depend on a number of factors, including the average length of time a given immigrant group resides in the new society, its degree of cultural proximity to the dominant receiving culture, plus a host of demographic processes, including: degree of exogamy, net internal migration of ethnic members, net gains through international migration, fertility and mortality levels (Trovato, 1989).

A direct measure of ethnic community integration is not available. Therefore, a proxy measure is used in this analysis: residence in a Census Metropolitan Area (CMA). CMAs are large urban areas in which the majority of Canadians reside and conduct their daily activities. The Canadian CMAs share a number of characteristics, including: (1) they consist of urban agglomerations of at least 100,000 population; (2) the urban agglomeration that forms a CMA is highly integrated in terms of social and economic activities; (3) most of the population in the agglomeration is engaged in non-agricultural work. Currently, there are 25 CMAs in Canada. Their combined population accounts for over 80 per cent of the country's total. The largest CMAs in the country are Toronto, Montreal, Vancouver and Ottawa-Hull. Among other things, CMAs are heavily

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goodness of fit.

represented by immigrants and their ethnic communities (Trovato, 1988a). It is in this sense that CMA location serves as a proxy for differential immigrant community effects on mortality risk.

The linkage of immigration, ethnic community formation and persistence in urban Canada in the context of demographic and sociological processes that promote or deter a community's viability may be stated briefly. Location, in the geographic sense, is inextricably linked to immigrant ethnic community formation. The predominance of ethnic communities for locating in the large urban areas of the country is based on a random process. In fact, this is part of a long-standing process, tied to the development of Canada as an urban-industrial complex, beginning with the early days of the industrial revolution of the late 19th century. As the need for nation building and manpower arose in the context of a changing economy, immigrants from a rapidly growing Europe (due to its demographic revolution) arrived to Canada in large numbers. Given the location of the new economy being situated mostly in the urban areas, the immigrants would establish enclaves and eventually communities in the urban places that received them---Montreal, Toronto, Ottawa, Vancouver, Edmonton, Winnipeg, Hamilton, being some of the more notable cases.

These and many other cities in Canada have flourished largely because of the immigrants and their contribution to a rapidly evolving urban industrial economy. It is no surprise therefore that the main receiving CMAs in the present context for immigrants continue to be Toronto, Montreal, Vancouver and Ottawa-Hull, where over three-quarters of the Canadian population resides. The present reality represents a continuation of a legacy of settlement preferences of the past century. A powerful attraction factor for newcomers to these urban locations is among other things the presence of established ethnic communities.

Many of the exiting and even newly emerging urban ethnic communities are quite complete in the institutional sense (i.e., with churches, ethnic clubs, newspapers, etc.) that help facilitate the settlement and adjustment process of new immigrants.

The long-term viability of an urban ethnic community is determined by an ethnic group's demography, namely continued immigration from the home country (or countries), group fertility and death rates (i.e., net migration and natural increase). These demographic factors in combination also determine the age-sex composition of a community. Through the age and sex composition, a host of sociological factors arise that may in the long term help promote continuity on the one hand, or possibly gradual decline on the other. Sociological factors related to these two alternatives include ethnic endogamy, exogamy, residential concentration, language retention, institutional completeness, and social mobility.[3] These sociological processes of course are not independent of each other.

The rationale for our operationalization of ethnic community rests on a number of important considerations. First, the vast majority of immigrants in Canada gravitate to the largest cities in Canada. Ethnic communities are therefore situated in the largest CMAs of this nation (i.e., Toronto, Montreal, Vancouver, Ottawa, Edmonton, Calgary, and Winnipeg), where viable ethnic communities have existed for many decades. Secondly, residence in a CMA offers immigrants access to the larger society beyond their ethnic community boundaries, primarily by way of jobs, education, and civic involvement. Ideally, these two features of CMA would be analyzed separately. This is not possible here due to lack of appropriate data. Nevertheless, the net effect of CMA residence, as opposed to non-

[3] The reader is referred to the independent works of Darroch and Marston (1984), Yancy, Ericson and Juliani (1976) and of Ward (1971) for additional insights on the historical and economic processes in the formation and evolution of ethnic communities in the North American context. For an updated overview of

CMA residence, on mortality is expected to be inverse, due to the strong relationship between CMA location and ethnic communities.

5.2.3 Socioeconomic Status

The measure of socio-economic status in this study is family income, taken from the 1991 census. Each configuration of nationality by age, sex, CMA, region, and marital status is assigned an average family income value from the census for the same configuration of characteristics. Since the census gives family income in categories of income, mid-points of categories were taken to produce a continuous variable. Family income can be used as a proxy for socio-economic status. Since official Canadian mortality records do not contain any socio-economic information, it was decided to take income information from the 1991 census of Canada and relate it to the cell-specific configuration of deaths by age, sex, and country of birth, along with the other characteristics in the file of deaths and populations. Appropriate mid-point values were assigned to the census income categories to derive an interval measure of family income. This variable was taken from the Public Use Master Files of the 1991 census of Canada. This procedure assumes that income values based on the census population correspond perfectly to the income values of the decedents. Of course, this is likely not correct; however, once can safely assume that there would be a very high correlation, between the income of decedents from a given nationality group and the income of their corresponding census population.

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contemporary issues pertaining to Canadian cities, including aspects of immigrant settlement, see Bunting and Filion (2000).

5.2.4 Acculturation Effects

Immigrants usually undergo a number of behavioural, social and psychological transformations as part of their experience in a new society. In this connection, sociologists speak of the interrelated processes of acculturation, integration, and assimilation. While integration defines the degree of inclusion of an immigrant group into the social and economic institutions of the receiving society, acculturation, refers to the acquisition of values, attitudes, orientations and behaviours of the host society (Berry, 1992). In a broader sense, both processes entail a progression toward the immigrants becoming more like the members of their host society---i.e. assimilation (Gordon, 1964). Therefore, part of the immigrant's experience entails learning new behaviours while unlearning others. As stated by Berry (1992: 75), this is not always a smooth process: "acculturation sometimes enhances one's life chances, and sometimes virtually destroys one's ability to carry on." Consequently, some immigrants may experience extreme levels of anxiety, depression, psychosomatic symptoms and problems in living. For some, the situation may become so overwhelming as to provoke suicide (MacLachlan, 1997; Shuval, 1993; Stenhouse and McCall, 1970; Trovato and Clogg, 1992). Of course, acculturation can also engender positive outcomes. As immigrants become increasingly acculturated they will garner social and economic benefits, thus gaining a greater sense of mastery over their adopted environment. This should promote psychological well being, and thus help lower the chance of suicide among immigrants.

A direct measure of acculturation is unavailable; therefore, an indirect measure of this concept was constructed by combining three census variables thought to reflect aspects of acculturation, into an overall index: (1) the percentage of an immigrant group that stated in the census an ethnicity other than English or French (thus an indirect measure of "own"

ethnicity); (2) the percentage of an immigrant group that stated in the census the most common language used in the home is other than English or French (thus an indirect measure of "own" ethnic language use in the home); (3) the percentage of an immigrant group that stated having a mother tongue (first language learned in childhood) as being other than English or French (thus an indirect measure of "own" ethnic mother tongue). These three variables were combined into an index using Factor Analysis (Principal Components). In accordance with the earlier discussion, the acculturation experience can have positive or negative effects on immigrants. Therefore, the hypothesis concerning acculturation's relationship with mortality is left open ended (i.e. non-directional). A negative relationship between the index and mortality would denote that on the whole, the greater the degree of acculturation, the lower the risk of premature death; a positive association on the other hand, would denote the opposite influence.

The above operationalizations assume a perfect correspondence between social demographic characteristics of the census population for the immigrant groups and their corresponding decedents. In reality the correspondence between census based characteristics and those of decedents is probably less than perfect. The ideal situation would be to have both mortality and socio-economic characteristics for immigrant decedents in the same data file; unfortunately, at present such data do not exist in Canada.

5.2.5 Health Selectivity Effects

As was suggested earlier, selectivity is both a statistical and substantive concept. In statistical terms, it refers to the problem of observing a subset of a study population, whereby that subset, by virtue of its homogeneity on a property of interest, cannot be measured directly by the researcher. For example, if immigrants are self-selected for

good health, it will not be possible to examine this selective property among immigrants due to lack of sufficient variation, in this case health status. Thus, any observed relative advantage immigrants posses with respect to mortality may be due to health selectivity alone, something else (i.e. better socio-economic conditions, etc.), or possibly selectivity in conjunction with other factors. Since it is not possible to obtain a direct measure of health selectivity, researchers usually apply indirect methods. For example, Trovato, Verma and Dai (1993) have shown that life expectancy is highest for more recent immigrant groups, followed by more established immigrant categories, and then by the Canadian born population. This pattern of life expectancy differentials can be interpreted as reflecting in part the influence of health selectivity, whereby such effect is most pronounced in the early years of settlement and become less intense with the passage of time.

In terms of health, migration selectivity should result in more recent immigrants having lower rates of mortality than both their more established counterparts and the Canadian born population. This proposition assumes that selection effects are most intense in the early years after immigration and less intense with the passage of time. The longer the duration of stay in the host society, the greater the tendency to assimilate the life styles, diets and health orientations of the receiving society. In time, for many individuals, the initial health advantage afforded by migration selectivity would dissipate or perhaps even disappear altogether. Therefore, the inclusion of a duration of residence variable in a multivariate analysis should capture this effect, albeit imperfectly. The anticipation is that there will be an inverse relationship between duration of residence in Canada since the time of immigration and mortality risk. Duration of residence in

Canada is derived from the census variable period of immigration. The census codes for this variable are categories of time; therefore, appropriate midpoints were taken to reflect the year of immigration.

Immigrant groups vary in their settlement histories. Some groups are fairly recent experience of settlement, while others have been in Canada for a much longer period of time. Earlier, we looked at the New Wave and the Old Wave immigrant classification as a way to examine indirectly the potential effect of duration of residence in Canada on mortality. Since duration of residence in Canada is not recorded on the death certificate of foreign born decedents, there is no direct measure of duration. This is a serious limitation because the longer one resides in the host country, presumably the more integrated and acculturated once becomes. If acculturation in social and cultural domains is assumed to translate into the adoption of health and mortality profiles of the host population, a duration variable is of crucial importance to test this type of proposition. As a way of coping with this deficiency, the solution was to take relevant duration information for each the immigrant groups from the 1991 Canadian census. Unfortunately, official death records do not provide social demographic information beyond the standard variables of age, sex, marital status, country of birth, and place of death.

Regarding the indirect measure of duration of residence in Canada, in the census, persons were asked to state their period of immigration to Canada. The census codes for this variable are: 1 = <1946; 2 = 1946-50; 3 = 1951; 4 = 1952; 5 = 1953-55; 6 = 1956; 7 = 1957; 8 = 1958-60; 9 = 1961-62; 10 = 1963-65; 11 = 1966; 12 = 1967; 13 = 1968-70; 14 = 1971-72; 15 = 1973-75; 16 = 1976-77; 17 = 1978-79; 18 = 1980; 19 = 1981; 20 = 1982-83; 21 = 1984-85; 22 = 1986; 23 = 1987; 24 = 1988; 25 = 1989; 26 = 1990; 27 = 1991. It was

decided to re-code these values in inverse order, such that 1 = "arrival in 1991"; 2 = "arrival in 1990"; 3 = "arrival in 1989", …, 27 = "arrival before 1946." Thus, the higher the score on this measure, the longer the duration of residence in Canada.

From this, cell-specific duration values were compiled and appended to the corresponding nativity group configurations of characteristics in the cross-classified mortality and population data matrix. The assumption behind this operational approach is that the duration information based on the census population for the various nationalities in this study are the same as those of their deceased counterparts. Though not precise, there should be a reasonable level of correspondence between these two information sources.

Finally, given the reliance on census data for the computation of some predictors, an important caveat must be stated explicitly. Inclusion of census information into this analysis assumes there is a perfect correspondence between census characteristics (collected from the corresponding population alive for each immigrant group during the time of the census), and the sociodemographic characteristics of decedents on the death file. In reality this relationship is likely not a perfect one (though it has never been verified empirically). Nevertheless, there should be a close correspondence between the two sets of characteristics (i. e. census and vital statistics).

5.2.6 Country of Birth of Immigrants

Appendix A lists the 20 nationality groups in the analysis: Canadian born, USA, Germany, Republic of Ireland, England/Wales/Scotland/Northern Ireland, Greece, Italy, Portugal, Hungary, Poland, USSR, Czechoslovakia, Sweden, Other Scandinavia, Japan, China, Other Asia, Africa, South-Central America/Caribbean/Mexico; and Other Countries (Residual). As noted in a preceding part of this study, the 19 immigrant groups can also be reclassified

more broadly as New and Old Wave immigrant categories on the basis of their assumed period of immigration to Canada (i.e. relatively recent as opposed to relatively established immigrants).

5.2.7 Age

Nineteen age categories are examined: 1 = infancy, 2 = 1-4, 3 = 5-9, …, 19 = 85+. During certain aspects of this study the number of age categories will be modified. For instance, in the analysis of certain causes of death, like diabetes or cirrhosis of the liver, the number of cases below age 50 are few, and virtually non-existent in the ages under 25, thus requiring a different specification of age. Naturally, the variable "gender" is coded as "male" and "female."

5.2.8 Region of Death

Due to the sparseness of the death data across the large data matrix in this study, deaths and corresponding population counts for the 10 provinces and two Territories were collapsed into five regions: (1) Atlantic (Newfoundland, Nova Scotia, New Brunswick, Prince Edward Island); (2) Quebec; (3) Ontario; (4) Prairies (Manitoba, Saskatchewan, Alberta); (5) British Columbia. (BC includes Yukon and Northwest Territories). Region of death can serve as a proxy for differential access to socio-economic opportunities, as not all the regions in Canada are equally endowed economically. Generally, the majority of immigrants prefer to settle in Ontario (over 50 percent), due to the generally better economic opportunities prevailing in this province. In the West, British Columbia and Alberta are also important settlement areas, due to these provinces' resource-based economies and periodic cycles of economic prosperity.

5.2.9 Causes of Death

Although initially a large number of causes of death were specified in a special request to Statistics Canada's Health Division, the small number of cases for many individual cause-categories dictated a more parsimonious reclassification of "cause." Thus, in addition to general mortality, the following causes of death (and corresponding International Classification of Disease reversion 9) codes are examined in this study.

Cause of Death Category	ICD-9 Code
(1) Ischemic Heart Disease (IHD)	410-414
(3) Other Heart Disease (OHD)	391, 392.0, 393-398, 402-404, 415, 416, 420-429
(3) Stomach Cancer	151
(4) Lung Cancer	162
(5) Other Cancers	Remainder of 140-208
(6) Diabetes	250
(7) Chronic Liver Disease/Cirrhosis	571
(8) Cerebrovascular	430-438
(9) Motor Vehicle Accidents	E810-E819
(10) Accidental Falls	E880-E888
(11) Suicide	E950-E959
(12) Suicide + Undetermined Deaths	E950-E959 plus E980-E989
(13) Homicide	E960-E969
(14) Other Accidents and Violence	Rest of E800-E999
(15) All Other Causes (Residual)	Remainder of 001-799

These cause-categories comprise two major classes of conditions afflicting humans: "chronic/degenerative ailments" and "external" types of mortality. The former causes (i.e. (1) to (8)) are generally linked to long term situations in the lives of individuals that ultimately lead to erosion of good health (e.g., smoking, poor diet, lack of exercise, excessive consumption of alcohol, prolonged exposure to toxins in the workplace, etc.). Chronic/degenerative diseases usually develop gradually, over a number of years, and even decades. Genetic predisposition also plays a role,

independently and possibly in interaction with environment (Balzi et al, 1993; Thomas, 1986; Blackburn and Luepker, 1986; Ramsay and Weisfeld, 1986; Fielding, 1986; Rankin and Ashley, 1986). External causes of death (i.e. (9) to (14)) are conditions external to the organism, directly responsible for premature death. Obvious examples of this are suicide, homicide, and motor vehicle fatalities. The residual category of cause of death is a mix of numerous conditions/ailments.

Though a more exhaustive classification of "cause of death" would be desirable, for the purposes of this study, the present grouping is sensible. These categories provide a parsimonious list of chronic and external causes of premature death, and comprise important categories of disease and conditions that are relatively in statistical terms account for the majority of deaths on a yearly basis. They allow for a reasonable quantitative analysis of mortality differentials. Depending on the analysis and the number of deaths in a given category, it will become necessary to collapse some of these cause categories (e.g., "accidental falls" with "other accidents and violence"). These causes reflect various aetiologies as suggested by Gove (1973): (1) mortality due to overt social acts (e.g., suicide, homicide, motor vehicle accidents, other accidents); (2) mortality associated with the use of socially approved narcotics (e.g., lung cancer, cirrhosis of the liver); (3) mortality associated with diseases requiring prolonged and methodical care (e.g., diabetes); (4) mortality associated with stress (e.g. heart disease, cancer of the stomach); and (5) mortality from all causes. Finally, a more detailed list of causes of death would have been preferable; however, given the varying population sizes of the groups in this analysis, one would face problems of sufficiency in numbers of deaths, particularly for the relatively small immigrant groups.

6.0 GENERAL MORTALITY

The multivariate analysis begins with the examination of differences in general, or overall mortality, followed by cause-specific types of death. In both cases, demographic controls (age, sex, marital status), CMA residence and income predictors will be included. Later, in subsequent multivariate analyses, a more extensive set of predictors will be entered into the equations in order to provide a more complete test of hypotheses delineated earlier. These two features of the investigation are based on adult ages 15 and older. Deaths to ages below 15 are relatively few, and follow a different set of causes of death from adult mortality, thus justifying a separate set of equations (see Appendix I).

Table 3 displays four log-rate equations. The first consists of only the country of birth main effects, which is analogous to an analysis of group-specific crude death rates. In this case, group coefficients are expressed as deviations from the expected death rate of the Canadian born (the standard population). With this approach, it is possible to compare results across all immigrant categories, as the corresponding coefficients in the model are all expressed in relation to a standard group. As expected, given the varied age and sex distributions of the sub-populations, a large number of groups show relatively higher unadjusted mortality levels than their Canadian born counterparts. For instance, with the exceptions of Greeks, Portuguese, Japanese, Other Asians, Africans, South Central American/Caribbean/Mexico migrants, the remaining immigrants show positive log-rate parameters, indicating higher mortality than the Canadian born. One may express these deviations as measures of relative risk by taking the exponent of the individual coefficients. For example, taking the exponent of the USA immigrants coefficient give a value of 2.16, meaning that migrants from the USA share over twice the mortality risk of the Canadian born.

Table 3: Log-linear equations for general mortality; population aged 15+

Effects	Model (1)	Model (2)	Model (3)	Model (4)
Intercept	-4.70677	-4.69912	-4.72551	-4.72001
Nationality				
Canadian Born	ref	ref	ref	ref
USA	.7702*	-.0176*	-.0138	.0176
EW Germany	.16151*	-.2633*	-.2433*	-.2642*
Irish Republic	1.5350*	.9754*	.9608*	.9239*
EW/Scot./NIr.	.8822*	-.1049*	-.0912*	-.0743*
Greece	-.3013*	-.5754*	-.5598*	-.5596*
Italy	.1241*	-.3655*	-.3269*	-.3169*
Portugal	-.5777*	-.3038*	-.2787*	-.2895*
Hungary	.8875*	-.1119*	-.1083*	-.1791*
Poland	.7832*	-.2222*	-.2073*	-.1731*
Former USSR	1.5476*	-.1344*	-.1187*	-.1104*
Czechoslovakia	.7064*	-.1495*	-.1442*	-.2472*
Sweden	1.2140*	-.0991*	-.0790*	-.2217*
Other Scandinavia	1.0854*	-.1109*	-.1101*	-.0635*
China	.1005*	-.4578*	-.4392*	-.4009*
Japan	-.2272*	-.5941*	-.5868*	-.4880*
Other Asia	-1.6308*	-1.0664*	-1.0547*	-1.0699*
Africa	-1.4849*	-1.0070*	-1.0178*	-1.0139*
SCAm./Carib./Mex.	-2.1132*	-1.5463*	-1.5735*	-1.4497*
Other Countries	.2098*	-.2873*	-.2659*	-.3237*
Age				
15-19		-2.2867*	-2.5354*	-2.5519*
20-24		-2.0519*	-2.2281*	-2.2281*
25-29		-1.9996*	-2.0261*	-2.0261*
30-34		-1.8576*	-1.8071*	-1.8034*
35-39		-1.5871*	-1.5101*	-1.5082*
40-44		-1.2787*	-1.1908*	-1.1823*
45-49		-.7971*	-.7045*	-.6934*
50-54		-.3069*	-.2136*	-.2053*
55-59		.1999*	.2886*	.2967*
60-64		.6837*	.7584*	.7603*
65-69		1.1343*	1.1909*	1.1887*
70-74		1.5993*	1.6283*	1.6243*
75-79		2.1212*	2.1096*	2.1023*
80-84		2.7131*	2.6544*	2.6396*
(85+)		3.7141*	3.5855*	3.5868*
Male vs. (Female)		.2406*	.3122*	.3209*
Married vs. (Other)			-.2356*	-.2449*
Family Income				-.683E-6*
CMA vs. (non-CMA)				-.0163*
L_2	1,586,750.5	68,475.4	43,825.5	35,595.5
df	9417	9402	9401	11013
Pseudo R^2	.29	.96	.97	.98

Note: In this and subsequent multivariate regressions, the degrees of freedom for a fitted model are calculated as number of non-zero fitted cells minus the number of parameters estimated. See text for definition of Pseudo R^2. As the last equation in this table is not a nested model of the preceding ones, its pseudo R^2 is not comparable to that of the other equations. Terms in parentheses are reference categories for that specific variable, computed as the negative sum of the corresponding terms. This convention is used in all relevant tables in this study. See text for definition of linear covariate(s) in this and subsequent regressions.

*p < =.05

Model (1) consists of gross effects and should therefore be treated as a starting point into the multivariate analysis. Model (2) takes into account age and sex compositional differences among the various sociocultural groups. As can be readily noted by the pattern of group effects, with the exception of Irish Republic migrants, they are all negative and significant statistically. From this, one must conclude that sole reliance on the results of model (1) would lead to erroneous conclusions of differential mortality. What does it mean to say that once age and sex are controlled statistically, the immigrants share lower mortality levels than their host population? Some light on this question may be shed by subsequent equations in Table 3.

Equation (3) looks at the group differentials once marital status is also taken into account. In general, the effect of marital status serves to lower overall expected mortality. The coefficient indicates that the married, in relation to "other" categories of marital status, enjoy a reduced risk of premature death. This result is not surprising. There is a vast literature that supports the proposition that marriage is a protective institution with regard to health and mortality probabilities (Gove, 1973; Trovato, 1992a; Trovato and Lauris, 1989; Joung, 1996; Lillard and Waite, 1995). Controlling for this variable does not in any fundamental way alter the group coefficients in Model (2). From this one may conclude that group differences in marital status composition do not account for the apparent superior mortality profile of the foreign born. (The exception being the Irish Republic immigrants, but see Appendix A for a discussion of suspected data problems with this group).

In accordance with the literature, measures of socio-economic status, such as family income, and CMA residence, should both bear inverse relationships with mortality risk (Wigle and Mao, 1980; Wilkins, 1980). Model (4) included these additional variables

into the analysis. Both terms show negative effects on mortality risk, indicating indeed, that for the population of Canada as a whole, mortality risk reduces significantly with increasing income, and also for those living in large urban areas (in relation to residents of non-metropolitan localities).

7.0 MORTALITY ACCORDING TO CAUSE OF DEATH

7.1 Heart and Cerebrovascular Disease Mortality

Table 4 shows equations for ischemic heart disease, other heart disease, all heart disease mortality (ischemic and other heart disease combined), and cerebrovascular disease mortality, respectively. In Canada and most other industrialized nations, circulatory disease (of which heart disease is a major component) accounts for almost half of all annual deaths (World Health Organization, 1995). Undoubtedly, heart disease, and other circulatory ailments play a leading role in accounting for overall mortality across national populations. This is also likely the case for immigrants. Migrants from the United States are not statistically different in their relative risk of heart disease mortality from the Canadian born. With the notable exception of the Irish Republic, all other immigrant groups tend to share a relative mortality advantage to their host population, though the magnitude of effects are far from being uniform.

Generally speaking, New Wave immigrants possess a notable advantage in their heart disease risk profiles. For instance, the IHD coefficient for South Central America/Mexico is –1.75 (corresponding relative risk (RR) is exp(-1.75) = .170). One can also see very low risk levels for the Chinese (RR =. 39), Other Asians (RR = .449), Africans (RR = .463), and Japanese (RR = .468). Among the Old Wave immigrants, the most advantaged in this respect are the Greeks, with a relative risk of .518). In terms of "Other Heart Disease"

mortality, the overall picture looks quite similar: immigrants from South Central America/Mexico enjoy the best risk profile, followed by the other New Wave groups. Generally speaking, the heart disease risk profile of the Old Wave immigrants appears to be intermediate between their New Wave counterparts and the Canadian born. This suggests there may be some assimilative process at work, accounting for this apparent differential in heart disease. The more established groups have been assimilating the diet and life style of the Canadian born, and over time this is resulting in a convergent process in death risks. What is also interesting is the insignificant coefficients for the Americans, who for all practical purposes are similar to the Canadian born in terms of life style and diet, and correspondingly share the same risk of heart disease mortality.

The multivariate results for cerebrovascular disease mortality indicate that the Greeks and the New Wave immigrants demonstrate the low risk levels. It is interesting to note that the overall chance of dying from cerebrovascular related causes of death begins to exceed expectation at age 55-59 (the age group at which the corresponding lambda coefficients turn positive), while for heart disease this occurs between ages 50 to 54. Both the gender and marital status coefficients in the equations are in the anticipated direction (positive for gender, negative for marital status). The income variable shows an insignificant relationship with heart disease mortality, but is statistically important in the case of cerebrovascular disease---the higher the income, the lower the relative risk. CMA residence shows a net negative effect on the conditional mortality risk across all four equations in the table.

Table 4: Log-linear equations for heart and cerebrovascular disease: population aged 15+

Effects	IHD	Other Heart Disease	All Heart Disease	Cerebrovascular
Intercept	-6.20653	-7.49762	-5.95574	-5.02945
Nationality				
Canadian Born	ref	ref	ref	ref
USA	-.0301	.0358	-.0143	.0424
EW Germany	-.3189*	-.2056*	-.2970*	-.3104*
Irish Rep.	.8290*	.9087*	.8458*	1.0239*
EW/Sc./NIr.	-.1175*	-.1609*	-.1271*	-.0421*
Greece	-.6581*	-.4291*	-.6101*	-.4280*
Italy	-.3780*	-.2207*	-.3438*	-.2432*
Portugal	-.4987*	.0009	-.3855*	-.2724*
Hungary	-.2120*	-.2459*	-.2174*	-.0659
Poland	-.0940*	-.1751*	-.1103*	-.2138*
Former USSR	-.0352*	-.1353*	-.0558*	-.0627*
Czechoslovakia	-.1334*	-.1290*	-.1336*	-.2369
Sweden	-.4864*	-.1655	-.4074*	-.2826
Other Scandinavia	-.1935*	.2326*	-.0941*	.2098*
China	-.9472*	-.3639*	-.8047*	.1125
Japan	-.7591*	-.3120	-.6347*	-.0892
Other Asia	-.8030*	-.9514*	-.8285*	-.7035*
Africa	-.7660*	-.7162*	-.7551*	-.8036*
SCAm./Carib./Mex.	-1.7469*	-1.0625*	-1.5703*	-1.0975*
Other Countries	-.3380*	-.4585*	-.3599*	-.2114*
Age				
15-19	-5.8344*	-3.3906*	-4.5027*	-4.1395*
20-24	-4.9162*	-3.1628*	-4.1336*	-3.2728*
25-29	-4.0720*	-2.6125*	-3.4959*	-2.9894*
30-34	-2.9507*	-2.3391*	-2.8426*	-2.2923*
35-39	-1.8894*	-1.7448*	-1.9630*	-1.7386*
40-44	-.8981*	-1.3852*	-1.1422*	-1.1821*
45-49	-.0699*	-.8236*	-.3644*	-.6750*
50-54	.5879*	-.0856*	.3074*	-.1446*
55-59	1.2460*	.4461*	.9436*	.2923*
60-64	1.7679*	.9644*	1.4643*	.8936*
65-69	2.2751*	1.5395*	1.9826*	1.5195*
70-74	2.7780*	2.0465*	2.4859*	2.2246*
75-79	3.3166*	2.6851*	3.0431*	2.9651*
80-84	3.8620*	3.3490*	3.6132*	3.7334*
(85+)	4.7972*	4.3424*	4.6039*	4.8054*
Male vs. (Female)	.3774*	.2227*	.3445*	.1347*
Married vs. (Other)	-.2116*	-.2417*	-.2180*	-.1874*
Family Income	.4185E-6	-.0365E-6	.2365E-6	-.1567E-6*
CMA vs. (non-CMA)	-.0214*	-.0834*	-.0345*	-.0232*
L_2	12,923.3	5,845.2	14,184.5	4,944.8
df	11013	11013	11013	11013
Pseudo R^2	.92	.96	.93	.89

Note: See Footnotes in Table 3.
* p < = .05

These data on heart and cerebrovascular disease mortality cannot by themselves disclose the sources of observed differentials by nationality group. It can be surmised that behavioural factors must bear importantly on this cause of death. The literature on immigrants and health (e.g., Berry, 1992; Cassel, 1974, 1975; Hull, 1979; Janes, 1990; Shuval, 1993) indicates that that the process of migration and adjustment to a new society can be very stressful, often manifesting itself as above average rates of heart disease morbidity and mortality, as well as high death rates from other afflictions for which stress is assumed to be a causal factor (e.g., suicide, accidents, violence). Given the assumed association between prolonged life stresses and heart disease, the evidence for the hypothesis that the stresses of migration lead to high immigrant mortality from heart disease is not supported in the context of Canada. For the most part, the immigrant groups in this analysis display low relative risks from heart disease. There are other possible tests of the stress thesis -- for example, it may be that immigrants have high relative risks from suicide and other forms of violence; these, causes of death will be examined later.

7.2 Cancer

Table 5 looks at cancer mortality differentials. A major contributor to lung cancer is cigarette smoking (Ravenholt, 1984). In Canada, there are approximately 14,000 annual deaths attributed to this disease. As noted in the table, only the immigrants from Republic of Ireland surpass the lung cancer mortality risk of the Canadian born; all other immigrant groups share reduced risks from this disease. The Irish have been observed to suffer high death rates from both lung cancer and alcohol abuse in England and Wales Harrison, Sutton and Gardiner (1997) report that this situation may reflect, among other

things, this group's difficulty with adaptation to their new society and possibly also socio-economic disadvantages.

With regard to stomach cancer, immigrants tend to have elevated mortality in relation to the Canadian born. The exceptions to this situation are United States migrants, Other Asians, Africans, and South Central America/Mexico foreign born. Parkin and Coleman (1990) have reviewed migrant studies pertaining to dietary change and certain types of cancer among migrants, including stomach, colorectal and breast cancers, all assumed to have a strong association with diet. They point the difficulties of making inferences from migrant data on the potential role of environmental change on cancer. In most cases, there is insufficient information about how immigrants change their diets after resettlement in a new land. The usual assumption made in such studies is that immigrants gradually change their dietary habits to approximate the diets of their host populations. This is probably a valid assumption, though probably not totally applicable to all individual cases. For instance, Balzi and colleagues (1993) found that Italians in Australia tend to reduce their risk of stomach cancer in increased duration of stay in the new land. As in most other migrant studies, the evidence here can be regarded as suggestive for a possible role of dietary change.

Table 5: Log-linear equations for lung cancer, stomach cancer, other cancers, and all Cancers: population aged 15+

Effects	Lung Cancer	Stomach Cancer	Other Cancers	All Cancers
Intercept	-7.3320.	-9.24921	-6.35838	-5.99844
Nationality				
Canadian Born	ref	ref	ref	ref
USA	-.1694*	-.3330*	-.0140	-.0600*
EW Germany	-.4087*	.1695	-.1298*	-.1945*
Irish Republic	.8006*	1.2197*	.9021*	.8877*
EW/Scotland/N. Ireland	-.0701*	.0926	-.0690*	-.0644*
Greece	-.5425*	.4582*	-.4946*	-.4629*
Italy	-.4682*	.6328*	-.2633*	-.2708*
Portugal	-.4730*	1.0559*	-.1493*	-.1646*
Hungary	-.4106*	.4162*	-.1159*	-.1735*
Poland	-.4239*	.2882*	-.1390*	-.1909*
USSR	-.3610*	.5149*	-.1210*	-.1456*
Czechoslovakia	-.7367*	.1379	-.1524*	-.2771*
Sweden	-.6011*	-.1991	-.1171	-.2277*
Other Scandinavia	-.2555*	.0554	-.0986	-.1364*
China	-.4045*	.5276*	-.2980*	-.2873*
Japan	-.9488*	1.1219*	-.6027*	-.5050*
Other Asia	-1.7903*	-.6443*	-1.1756*	-1.2916*
Africa	-2.0816*	-.9359*	-.7870*	-1.0308*
SCAm/Carib/Mexico	-2.4424*	-.6213*	-1.5339*	-1.6617*
Other Countries	-.4678*	.2816*	-.2474*	-.2820*
Age				
15-19	-6.3798*	-5.3989*	-3.3026*	-3.5968*
20-24	-5.6957*	-4.3129*	-3.0173*	-3.2899*
25-29	-4.1528*	-2.9853*	-2.6488*	-2.8614*
30-34	-2.6437*	-2.3202*	-2.1132*	-2.2579*
35-39	-1.6294*	-1.4676*	-1.4804*	-1.5768*
40-44	-.5089*	-.8077*	-.8993*	-.9096*
45-49	.4642*	-.2080*	-.2811*	-.2141*
50-54	1.2222*	.3961*	.2539*	.3835*
55-59	1.8789*	1.0606*	.7575*	.9391*
60-64	2.3852*	1.5569*	1.2044*	1.4067*
65-69	2.7276*	2.0674*	1.5617*	1.7623*
70-74	2.9469*	2.4988*	1.9051*	2.0693*
75-79	3.0586*	2.8744*	2.2477*	2.3480*
80-84	3.1546*	3.2385*	2.6242*	2.6596*
(85+)	3.1721*	3.8079*	3.1885*	3.1380*
Male vs. (Female)	.5307*	.3852*	.1368*	.2478*
Married vs. (Other)r	-.1680*	-.0898*	-.0764*	-.1028*
Family Income	.6839E-6	.4708E-6*	.3270E-6	.5692E-6*
CMA vs. (non-CMA)	.0194*	-.0559*	.0079*	.0090*
L_2	6,552.1	2,795.8	8,730.9	11,445.7
df	11013	11013	11013	11013
Pseudo R^2	.94	.97	.98	.91

Note: See footnote in Table 3.
p < = .05

Additional support for this hypothesis may be gained by contrasting the immigrants' death rates with both the Canadian born and their corresponding countries of origin in Appendix C, which shows SMRS for immigrants and their respective countries of origin (where it is possible to make the comparison). On the whole, when compared to their countries of origin, immigrants tend to experience lower risk levels from this type of cancer, but suffer a generally higher death rate than the Canadian born host population. This suggests that part of the above average risk level may be due to a carryover effect from the country of origin. In other words, there may be a predisposition among immigrants to continue the dietary habits of the old country and to therefore experience in some cases elevated odds of mortality in the new society. Whether all of the observed effect is due to dietary change or due to additional factors is impossible to verify. Different kinds of data are needed to shed further light on this question. Specifically, survey information should be collected on immigrants to check for a number of hypotheses regarding immigration and change in dietary and consumption patterns. A review of the literature by Parking and Coleman (1990) indicates that in a few controlled studies researchers have found evidence of significant dietary change with immigration, the tendency being for the migrants to gradually approximate the diets of the receiving society. The fact that the New Wave groups in this analysis, a relatively recent category of immigrants, show reduced risks from this ailment adds further evidence to the proposition that stomach cancer mortality may be linked to acculturative dietary change. Indeed, according to Balzi and associates (1993: 206), the main risk factors for stomach cancer are diet-related. Many epidemiological studies show that a low intake of fresh fruit and vegetables are associated with increased gastric cancer risk. Diets rich in

preserved foods and high in salt also increase risk. They are also cautious in pointing out that stomach cancer can also arise as a function of familial predisposition

The effect of CMA location on the overall conditional risk of cancer mortality is positive---as it is in connection with lung cancer. There is limited information on the possible relationship between urban life and cancer, and why exposure to an urban environment may be a risk factor for lung cancer particularly. A recent report by Gilmour and Gentleman (1999) suggests that mortality from cancer and cardiovascular conditions tend to be high in the CMAs in the Atlantic region and Quebec, while low in the Prairies and British Columbia CMAs. However, it was also noted that Ontario contains CMAs with some of the highest mortality rates in Canada for certain diseases as well as others whose rates are among the lowest. Also important is the observation by these authors that a CMA may have high mortality for one cause and low death rates for another. In other words, there is a high degree of variation in CMA death rates depending on the cause of death being examined.

In the case of lung cancer mortality, the main cause is invariably tobacco smoking. However, other factors have been implicated. For instance, Balzi and associates (1993) indicate that prolonged occupational exposure to materials as asbestos, radon and a host of other chemicals are known carcinogens. Due to the strong association between prolonged smoking and lung cancer, many immigrant deaths from this disease can be attributed to a pattern of behaviour (smoking) that may have originated prior to relocation to the new country, as the vast majority of immigrants migrate as adults. An analysis of time trends in lung cancer mortality by Lopez (1990) shows Canada as being in the category of “high and rising” death rate. Canadian rates of lung cancer tend to exceed the

rates of a large number of industrialised countries (both sexes). Therefore, it is not surprising that in the present study immigrants have generally low death risks in relation to Canadian born persons (the exception is the Irish Republic immigrants). However, not groups share equal risks; most noticeable is the very low mortality levels for the more recent immigrant groups. This suggests that in general, the risk for developing lung cancer rises with increasing duration of residence in Canada.

CMA residence shows a negative effect on the risk of stomach cancer. The beneficial effects of CMA residence may be a reflection of greater access to services and medical therapies that prolong life for those individuals with the disease. The morbidity levels in CMAs are likely as high as anywhere else in the country, but people's greater accessibility to treatment in the CMAs is what may make the difference in prolonging life for those afflicted. As shown in the table, the effects of family income on stomach cancer and on overall cancer is positive---an unexpected finding. A final word on this relationship is reserved to a later part of the analysis, once other factors have been taken into account. It may be that once other variables are introduced, the sign of this association might change in the expected direction.

7.3 External Causes of Death

Immigrants may experience high rates of suicide because of the stresses associated with settlement in a new land. On this theme, Marmot and colleagues (1984: 64) have stated that: "[T]he process of becoming an immigrant and settling in a new society, entails stresses on the individual that serve to increase suicide risk." The results in Table 6 cast some doubt on the stress thesis of immigrant mortality, however. If immigration is a stressful experience, immigrant groups should have relatively high suicide rates. As it

turn out, 11 of the 19 groups show a lower than expected suicide risk; and the remaining eight categories show no statistical difference from the Canadian born population. If migration is a stressful process, the stresses should be more intense during the early years after relocation, when the demands of adjustment to a new environment are greatest, and therefore, suicide risk should be above average. As it turns, it out, another important observation in the table is that the more recent migrant groups---the so-called New Wave, have very low suicide death rates. This points to other factors in the explanation of immigrant suicide in host societies.

As discussed earlier, one possible factor is background culture of immigrants. The pattern of significant lambda terms for the group variable indicates that Greeks, Italians, Portuguese, and immigrants from the United Kingdom, have reduced risks, while Hungarians, Polish, and USSR migrants, share elevated rates of self-destruction. There appears to be some association of immigrant suicide rates with religion, as evidenced in the cases of Italians, Portuguese, and South Americans/Mexicans, all of whom share a Catholic religious background culture. And yet, the Polish, who are a predominantly Catholic group, show above average suicide; and migrants from the United Kingdom, a predominantly Protestant group, have suicide rates below expectation. This suggests that both religion and other elements of national culture may be important determinants of suicide. For instance, the low suicide rates of Southern Europeans are conditioned primarily by Catholicism's condemnation of this extreme act. On the hand, the relative high suicide rates of East Europeans---including those of the Polish---may be more a function of other elements of the culture, that in totality, may act to pre-empt the salutary effects of Catholicism. Stated differently, the Polish's rates of suicide, though above

average, could potentially be even greater, where it not for the presence of Catholicism. The high rates of self-murder among the Hungarian immigrants correspond to the high suicide risk that prevails in Hungary. This nation is known for having the highest suicide rates in the industrialized world. Similarly, migrants from the former USSR, and from Germany, represent two other high-risk groups, from the point of view of suicide.

Table 6: Log-linear equations for suicide, other accidents and violence, and residual causes: population aged 15+

Effects	Suicide	Suicide + Undetermined	Other Accidents/Violence	Residual Causes
Intercept	-8.72259	-8.65849	-7.79279	-5.76979
Canadian Born	ref	ref	ref	ref
USA	-.1254	-.0913	.1544*	.0828*
EW Germany	.1472	.1434*	-.0506	-.3886*
Irish Republic	.5444*	.4675*	.7723*	1.0131*
EW/Scotland/N. Ireland	-.4068*	-.4213*	-.0134	-.0520*
Greece	-1.1383*	-1.0917*	-.2048	-.6622*
Italy	-.5183*	-.5160*	-.0902	-.3772*
Portugal	-.5844*	-.5383*	-.3810*	-.3130*
Hungary	.5957*	.5177*	.0778	-.2331*
Poland	.2860*	.2869*	.0653	-.2512*
USSR	.8615*	.8690*	.2065*	-.1846*
Czechoslovakia	-.1249	-.0493	-.3808	-.3290*
Sweden	.8138	.7438	.1541	-.1570*
Other Scand.	-.3643	-.4273	.1834	-.0160*
China	-.0488	.0588	-.0777	-.2983*
Japan	-.0394	-.1146	-.1071	-.4221*
Other Asia	-1.4909*	-1.4831*	-.9374*	-1.0148*
Africa	-1.5363*	-1.5378*	-1.3710*	-1.0693*
SCAm/Car/Mex.	-2.1620	-2.1435*	-1.2977*	-1.1593*
Other Countries	-.0123	-.0508	-.1893*	-.3905*
Age				
15-19	-.8996*	-1.0111*	-.8973*	-3.0586*
20-24	-.4272*	-.4443*	-.5374*	-2.7237*
25-29	-.0356	-.0531	-.4434*	-2.1052*
30-34	.2076*	-.1985*	-.3947*	-1.6818*
35-39	.3047*	.3103*	-.3690*	-1.3336*
40-44	.2514*	.2628*	-.4197*	-1.0755*
45-49	.2439*	.2685*	-.3634*	-.6805*
50-54	.2710*	.2928*	-.3017*	-.3013*
55-59	.2435*	.2414*	-.2891*	.1387*
60-64	.0697	.0557	-.2184*	.6465*
65-69	.0421	.0340	-.1890*	1.1618*
70-74	-.0879	-.0949	.1707*	1.7170*
75-79	-.0357	-.0477	.5805*	2.3191*
80-84	-.1225	-.0704	1.2099*	2.9615*
(85+)	-.0254	.0577	2.4620*	4.0156*
Male vs. (Female)	.7164*	.7040*	.4934*	.3172*
Married vs. (Other)	-.6908*	-.7014*	-.5524*	-.3131*
Family Income	.20113E-6*	.11926E-6	-.3580E-6*	-.2660E-6*
CMA vs. (non-CMA)	-.1630*	-.1456*	-.2176*	.0093*
L_2	4,268.5	4,387.9	6,988.0	19,830.3
df	11013	11013	11013	11013
Pseudo R^2	.92	.90	.89	.88

Note: See Footnote in Table 3.
p < .05

An important issue here concerns the treatment of cases for which the cause of death was declared on the official record as "undetermined." (This is an official category in the International Classification of Diseases, ICD-9 codes E980-E989). The suspicion is that "undetermined" deaths (officially defined as *"injury undetermined, whether accidentally or purposely inflicted* "), likely comprise "disguised" suicides. The circumstances surrounding such deaths are of such an ambiguous nature as to render them officially "undetermined" (Ohberg and Lonnqvist, 1998; Holding and Barraclough, 1978; Wasserman and Varnik, 1998). The second equation in Table 6 includes suicides plus undetermined cases. As can be seen from the results, the pattern of coefficients largely confirms the preceding observations. Thus, including undetermined cases with the known suicides into this analysis makes no substantive difference to results.

Concerning the influence of demographic variables on suicide, 35-39 year olds are the most vulnerable to self-destruction. Men are more likely to take their own lives, and the married less inclined to do so. Unexpectedly, the effect of family income on suicide is positive, while living in a large urban area (CMA) has a net negative impact on the risk of self-murder.

Table 6 also looks at accidental and violent types of mortality combined (i.e., homicide, motor vehicle accidents, other accidents, etc.), and "residual" causes of death. Americans, Irish Republic, and former USSR migrants all share elevated chances of death from "other accidents and violence." Of the remaining nativity groups, significant coefficients are noted for the Portuguese, Other Asians, Africans, South Central American/Caribbean/Mexico, and "other countries" immigrants. In this case, both family

income and CMA residence contribute to lowering the chances of this type of mortality, net of all other factors in the model.

Concerning residual causes of death, the nationality group coefficients are consistent with earlier observations in connection with general mortality. Only the Irish Republic immigrants show elevated risk levels as compared to the Canadian born. All the remaining groups have lower death rates, net of all other variables in the model. In this equation, income is inversely correlated with mortality risk, while CMA residence serves to raise the overall risk.

The preceding analyses are viewed as preliminary. No attempt was made to test competing hypotheses, as delineated in an earlier part of this study. The main purpose behind these equations was to provide a preliminary indication of the extent of variation in general and cause specific mortality differentials by nationality, and to gauge the statistical relevance of income and CMA location on mortality risk. In the next section, these two covariates will be reintroduced into the analysis along with other pertinent terms, to provide more extensive tests of hypotheses.

8.0 EVALUATION OF HYPOTHESES

8.1 General Mortality

Table 7 looks at three log-rate equations involving the Canadian born population alone, all 20 groups, including the Canadian born, and finally only the immigrants. The first two models test for the importance of demographic variables, geographic, and socioeconomic status effects on mortality risk. The SES composite index (derived by Factor Analysis of education with family income, using principal components rotation) shows an inverse relationship with mortality for the Canadian born and Canadian born

plus all immigrants combined. This is not unexpected, given the literature in this aspect of mortality analysis (Duleep, 1989; Feinstein, 1993; House et al., 1990; Marmot, 1995). However, as indicated in the immigrants model, the effect of SES on mortality risk is actually positive in this case. It seems that a rise in socioeconomic status for immigrants translates into an increased risk of mortality. This result is investigated further below on the basis of immigrant status as being either Old or New Wave. There may be a different type of association of SES with mortality depending on this type of breakdown.

As far as age, sex and marital status effects are concerned, the results in the equations are consistent with expectation. That is, the risk rises exponentially with age, males have a greater overall mortality risk, and the married enjoy lower mortality chances overall. The pattern of results for these variables is fairly similar across the three equations in Table 7.

Table 7: Log linear models for overall mortality: Canadian Born and 19 immigrant groups

Effects	Canadian Born	Canadian Born + Immigrants	Immigrants Only
Intercept	-4.45752	-4.04431	-3.88871
Old Wave			.825*
(New Wave)			-.828*
Canadian Born		ref	
USA		.174*	
EW Germany		-.144*	
Irish Rep.		1.132*	
EW/Sc/NIr.		.117*	
Greece		-.465*	
Italy		-.269*	
Portugal		.236*	
Hungary		.053*	
Poland		-.064*	
USSR		.091*	
Czechoslovakia		.081*	
Sweden		.389*	
Other Scand.		.161*	
China		-.323*	
Japan		-.146*	
Other Asia		-1.030*	
Africa		-.957*	
SCAm/Car/Mexico		-1.558*	
Other Countries		-.140*	
Age 15-24	-2.098*	-2.106*	-2.603*
25-34	-1.575*	-1.584*	-1.922*
35-44	-1.052*	-1.071*	-1.211*
45-54	-.227*	-.254*	-.387*
55-64	.719*	.704*	.816*
65-74	1.530*	1.527*	1.802*
(75+)	2.703	2.784	3.505
Male vs. (Female)	.336*	.318*	.342*
Married vs. (Other)	-.309*	-.311*	-.278*
CMA vs. (non-CMA)	-.030*	-.036*	.029*
Atlantic Region	.031*	.007*	-.437*
Quebec	.082*	.056*	.147*
Ontario	.072*	.039*	.058*
West	-.092	-.036*	.371*
(British Columbia)	-.093	.066	-.139
Linear Covariates			
SES	-.02599*	-.00858*	.08431*
Origin			-.00387*
Duration			.02390*
Acculturation			.00071*
L^2Model/ df	15939.30 / 265	35194.10 / 4828	8013.00/ 539
Pseudo R^2	.92	.90	.89

Notes: See footnotes in Table 3.

p < = .05

All the group effects in equation two are statistically significant. Controlling for SES, some of the nationalities share reduced chances of death, though in varying degrees: EW Germany, Greece, Italy, Poland, China, Japan, Other Asia, Africa, South Central America/Mexico and Other Countries. The above average groups (as measured against the Canadian born risk level) are USA, Irish Republic, United Kingdom (i.e. England and Wales, Scotland and Northern Ireland), Portugal, Hungary, USSR, Czechoslovakia, Sweden, and Other Scandinavia.

With regard to geographic effects, living in a CMA reduces the chances of premature death in both the Canadian Born equation and in the one consisting of the whole population (second equation). However, in the immigrants model, the effect of CMA, though small, is positive (.029). This result contradicts the expectation of a salutogenic effect of the urban ethnic community on the odds of death explained earlier. For those born in Canada, the risk of premature death is lowest in the Prairies and in British Columbia. This is also true for the nation as a whole (see second equation). The CMA effect needs further elaboration, as it may vary in intensity and direction of effect, depending on whether immigrants are Old Wave or New Wave. This question will be explored later.

For immigrants, only the Atlantic region and British Columbia pose reducing effects on the conditional risk of death. The largest positive regional effect in the Prairies (.371). What is it about the Prairies region that is responsible for immigrants' high overall mortality rates? This question can be explored by first looking at the crude death rates for immigrants and the Canadian born in the Prairies region as compared to other parts of the country. As demonstrated below, in an overall sense the Prairies region actually shows a

lower overall crude death rate than the rest of Canada as a whole. In the Prairies, there are 8.82 deaths per 1000 population, while elsewhere the rate is 9.06. Furthermore, both males and females in this region show lower crude death rates (9.90 and 7.76 as opposed to 10.03 and 8.13, respectively).

	Prairies		Rest of Canada	
	Males	Females	Males	Females
Canadian Born	8.66	6.21	9.92	7.76
Old Wave	24.05	22.82	15.39	14.13
New Wave	3.20	2.73	2.52	2.01
Total	9.90	7.76	10.03	8.13

In the Prairies, both Old Wave and New Wave immigrant categories share higher crude death rates than their counterparts in other regions, while the Canadian born have lower death rates. Particularly striking is the high crude death rate among the Old Wave in the Prairies region. We must now ascertain whether these differences persist once age and sex compositional differences across the two immigrant categories are standardized. Below are directly standardized death rates per 1000 population for the Old and New Wave immigrants in the Prairies and in the rest of Canada. The standard population is the sex-specific Canadian born population within each of the two regional designations.

	Prairies		Rest of Canada		Prairies – Rest of Canada	
	Male	Female	Male	Female	Male	Female
Old Wave	9.38	8.32	4.77	4.13	4.61	4.19
New Wave	8.24	7.82	3.72	3.18	4.52	4.64
Old Wave – New Wave	1.14	0.5	1.05	0.95		

Direct standardization provides a more realistic picture of the situation. The death rates for the immigrants are no higher than 9.4 per l000 population (i.e. Male Old Wave in the Prairies). Thus, the high crude death rates for the Old Wave immigrants were largely

reflective of this category's older age composition. Old and New Wave immigrants in the Prairies share almost the same degree of relative disadvantage in the face of death. That is, as compared to their respective counterparts in the rest of Canada, they experience an excess of almost five deaths per thousand population. As shown below, further analysis indicates that the excess mortality of the Old Wave in the Prairies is largely a function of their greater mortality rates in the older age groups.

	Prairies		Rest of Canada	
Age Group	Old Wave Male	Old Wave Female	Old Wave Male	Old Wave Female
15-24	1.0970	.2890	.8810	.2990
25-34	1.3590	.3990	1.1570	.4390
35-44	1.7280	.9620	1.6390	.8950
45-54	3.5250	2.2840	3.5190	2.1690
55-64	10.2550	5.5750	10.1250	5.3490
65-74	27.5720	15.2610	25.8230	14.5990
75+	140.4560	115.0890	110.5580	96.4690

In addition to the SES index, the third model in Table 7 (all immigrants) includes a measure of acculturation (i.e., most frequent language spoken in the home: the percentage of a group speaking either English or French as the principal language in the household) and of duration of residence in Canada (i.e., time since immigration). As suggested by the acculturation index, the greater the proportion of a group using either English or French as the language of the home, the higher the death rate for that group. However, one should note here that language of the home is a proxy for other associated processes, including the acculturation of diet and life styles to the Canadian ways; thus, it is not language use *per se* that is the presumed cause of increased mortality risk, but rather the associated processes, as discussed earlier in connection with the independent works of Shuval (1993) and Berry (1992).

An important result in this equation is the significant positive effect of CMA residence on overall mortality. The expectation was for an inverse relationship of this factor with death risk. The hypothesis called for a negative effect due to the presumed link between CMA residence and ethnic community as a protective structure for immigrants. Later, the analysis will be confined to Old and New Wave immigrants to see whether this effect changes on the basis of this designation.

The positive effect of duration of residence in Canada suggests that the longer the time since immigration to this Land, the greater the conditional risk of overall death. Recall that the hypothesis called for a positive effect on the assumption that with time in the host society, immigrants increasingly lose some or all of their initial protection due to positive health selection; thus, the hypothesis is supported here. Later, the analysis will be confined to the immigrants to check whether this variable will continue to exert a negative effect.

The country of origin effect on immigrant mortality is significant and negative, suggesting that the higher the overall mortality level of a group's home nation, the lower the mortality for that immigrant group in Canada. This suggests that immigrants are generally better off in Canada as compared to their home countries. Also, it may indicate the tendency for positive health selectivity being greatest among those migrants from relatively high mortality countries. In any case, the effect of "origin" appears to have an overall negative impact on the conditional probabilities of mortality for the immigrants. The group effect in this equation is clear: In comparison to Old Wave, New Wave immigrants share a clear advantage in the face of death. The mortality risk of the Old Wave is 2.28 times that of New Wave immigrants (i.e., exp(.825) = 2.28)).

In order to evaluate the earlier finding concerning CMA's effect on immigrant death risk, Table 8 contains three equations, all in connection with immigrants, excluding the Canadian born. The first equation in this table looks at the possibility that there may be an interaction of CMA with group. In fact, this interaction term helps to clarify matters. Old Wave immigrants in CMAs share a relatively high death risk, while New Wave in such localities enjoy a reduced chance of premature death. Interestingly, once immigrants are partitioned into New and Old Wave categories, the effect of SES turns negative, as expected. The country of origin effect also changes, in that it turns positive for the New Wave immigrants. This suggests that for relatively new immigrants to Canada, the higher the mortality level of the country of origin, the higher the death risk for the immigrants. However, it must be kept in mind that this effect operates at a low level of effect---i.e. New Wave immigrants have very low mortality risk in Canada. There is a similar change in the duration variable. While positive in the overall sense, the effect of this term on mortality is positive for the Old Wave, and negative for the New Wave immigrants. Acculturation also shows a different direction of effect for these two classes of immigrants: negative among the Old Wave, and positive for the New Wave. Clearly, these results indicate the necessity to examine the two groups separately in the multivariate analysis.

Table 8: Log-linear models for general mortality; immigrants only

Effects	All Immigrants	Old Wave	New Wave
Intercept	-4.88016	-4.51761	-3.09100
Old Wave	.726*		
(New Wave)	-.726*		
Age 15-24	-2.605*	-2.931*	-2.115*
25-34	-1.919*	-2.079*	-1.583*
35-44	-1.712*	-1.275*	-1.073*
45-54	-.387*	-.368*	-.425*
55-64	.817*	.914*	.724*
65-74	1.804*	2.018*	1.747*
(75+)	4.022	3.721	2.707
Male vs. (Female)	.341*	.361*	.228*
Married vs. (Other)	-.279*	-.353*	-.165*
CMA vs. Other	-.089*	-.001	-.194*
Atlantic Region	-.435*	-.327*	.341*
Quebec	.145*	-.224*	.348*
Ontario	.054*	.126*	-.481*
West	.372*	.421*	-.032
(British Columbia)	-.136	.004	-.176
Linear Covariates			
SES	.08498*	-.07473*	-.03857*
Origin	-.00372*	-.00225*	.00356*
Duration	.02496*	.09929*	-.12566*
Acculturation	.00053*	-.01154*	.00264*
CMA x Group			
Old Wave—CMA	.125*		
New Wave—CMA	-.125*		
L^2Model/df	7807.16/ 538	4604.85/ 262	1128.27/ 260
Pseudo R^2	.85	.76	.62

* p < = .05.

See footnote in Table 3.

8.2 Summary: General Mortality

From the preceding analysis, it can be concluded that there exist substantial differences in the face of death across immigrant groups in Canada. However, there is a mix of differences, with some groups having above average death rates, and others are below the standard level of the Canadian born. Relatively recent immigrant groups to Canada persist

in showing rather low conditional mortality risks, while those groups in Canada for a longer period of time tend to demonstrate high odds of premature mortality. A fairly consistent finding in this analysis of general mortality is that SES is for the most part inversely related to mortality, in both Canadian born and immigrants. Concerning the effects of ethnic community, it was hypothesized that CMA residence, as a proxy for ethnic community, would show an inverse association with the criterion variable. This thesis received qualified support, in that only among the New Wave migrants is the effect negative. For the Old Wave, this variable emerged of no statistical consequence. Concerning country of origin effects on immigrant mortality, the hypothesis gained partial support. The expectation was for a positive relationship between the death rates of the home country and the corresponding immigrants. In fact, among Old Wave migrants, the association is negative, and among New Wave, it is positive, as expected. Thus, insofar as this operationalization adequately captures a persistence of a link between the home based country and an immigrant group's predisposition to mortality risk, this suggests that there may be a dynamic process operating, whereby among recently arrive immigrants, the linkage is positive---as reflected in the New Wave, while as time progresses, the relationship gradually turns negative. That is, because Canada enjoys one of the highest living standards in the world, immigrants benefit from their new environment and over time will generally exceed the survival levels of their countries of origin, thus making the association between country of origin mortality rates and those of the immigrants inverse, as shown by the Old Wave immigrants in this analysis. A similar phenomenon may actually prevail with respect to duration of residence in Canada. It was seen in the preceding analysis that the effect of duration of residence in Canada is positive for the Old Wave, while negative for the New

Wave immigrants. It was hypothesized that in the early phases of the relocation process, immigrants would carry with them the positive health benefits associated with the selective aspects of migration. Being relatively recent, the New Wave immigrants share low odds of mortality, as reflected in the negative term for the duration variable. The other side of the selectivity thesis calls for the effects of health selectivity to wane with the passage of time. In fact, for the Old Wave immigrants, the duration effect was seen to be positive. Finally, concerning the acculturation hypothesis of mortality, the results differ for the Old and the New Wave immigrants. In the former case, the greater the level of acculturation, the lower the risk of premature death, while for the New Wave, it is positive. While difficult to prove directly, this suggests that acculturation among relatively new immigrants may be problematic; on the one hand, rapid acculturation may be adaptive in a new environment, while on the other it may entail a too rapid abandonment of one's ties to his/her culture and associated benefits, thus predisposing the individual to an increased risk of death.

8.3 External Causes of Death

8.3.1 Suicide

In recent decades, Canada has been experiencing significant changes with immigration. Whereas in the decades preceding the 1970s most migrations were predominantly American and European in origin, today the vast majority of newcomers are from non-European regions of the world (Badets and Chui, 1994; Castles and Miller, 1997). Given this reality, an important question is whether recent waves of immigrants share greater or lower mortality risks than their host populations and more established immigrant counterparts. Given the selective nature of immigration (self-selection plus official health screening), recent immigrants may enjoy a better health profile than the receiving

populations. Whether such health advantage persists indefinitely for immigrants remain an open question. The adjustment process to a new society may over the course of time erode or possibly eliminate any initial health advantage immigrants bring with them to the New World. Clearly, this is a complex and multifaceted issue. Deriving a complete picture of such processes requires examination of not only changes in health status over time, but also immigrants' pattern of change with respect to morbidity and cause-specific mortality.

This part of the investigation looks at suicide differentials. Both Old and New Wave immigrants are examined. First, the analysis looks at overall suicide risk, and then follows with the investigation of differentials in the methods applied in the commission of self-murder. If immigration is a stressful process, migrants should demonstrate elevated odds of self-destruction as compared to the host population. And if the extent of difficulties in their adjustment and adaptation experience is not uniform, there should be notable variations in suicide risk across immigrant groups. Suicide variations across social groups reflect to some degree, group variations in psychological distress, and therefore indicate something reflective of the type of adjustment experience immigrants may experience in the New Land. Moreover, observed suicide rates provide some clue concerning the broader issue of suicidality in a population. The tabulation below displays the numbers and rates (per 100,000) of suicides plus undetermined cases for 1990-92 by gender and nativity.

	Male		Female		Total	
	Number	Rate	Number	Rate	Number	Rate
Canadian Born	7785	30.97	2003	7.62	9,788	19.04
Old Wave	910	22.75	300	7.15	1,210	14.77
New Wave	145	5.83	85	3.30	230	4.55
Total	8,840	27.95	2,388	7.23	11,228	17.36

Table 9 shows crude suicide rates per 100,000 population, with and without "undetermined" cases---i.e. deaths that are pronounced officially as "cause uncertain." These are thought by some analysts to be disguised suicides (Ohberg and Lonnqvist, 1998; Holding and Barraclough, 1978; Wasserman and Varnik, 1998). During 1990-92, out of 11,225 deaths (suicides plus undetermined cases) 9,789 victims had been born in Canada. There is wide variation in crude suicide rates; in some cases immigrant rates are well above those of the nation as a whole (16.28 based on known suicides; 17.36 based on suicides plus undetermined cases, respectively) and also those of the Canadian born population (17.88 and 19.04, respectively). Though as a whole immigrants enjoy relatively low suicide rates, some specific categories of immigrants have unusually high rates of self-murder. The most suicide prone groups appear to be the Hungarians, the Irish, former USSR, Swedes, and Czechoslovakians. The Germans, Americans, Canadian born, Other Scandinavians, Chinese and the residual group, "Other Countries," have intermediate crude suicide rates in the range of 13 to 19 per 100,000 population. The lowest incidence of self-murder is found among migrants from South/Central America/Mexico (rates of only around 2 per 100,000 population), followed by Africans and persons from "Other Asia" (rates between 3 and 4 per 100,000). The Greeks, Italians, Portuguese and United Kingdom migrants show rates in the range of 5 to 10 per 100,000.

Table 9: Crude suicide rates by nationality group; Canada, 1991

Group	Suicide Rate (1)	Suicide Rate (2)
Canadian Born	17.88	19.04
USA	14.55	15.93
EW Germany	18.74	19.78
Ireland Republic	28.53	29.72
UK/Scotland/N. Ireland	10.12	10.76
Greece	5.47	5.86
Italy	9.04	9.59
Portugal	9.45	10.70
Hungary	29.55	31.29
Poland	17.30	19.18
USSR	28.93	31.56
Czechoslovakia	17.44	22.19
Sweden	20.44	20.44
Other Scandinavia	15.99	17.38
China	12.52	13.32
Japan	16.25	16.25
Other Asia	3.81	4.11
Africa	3.82	4.01
SCAmerica/Caribbean/Mexico	1.91	2.13
Others Countries	15.40	15.99
Totals	16.28	17.36
Suicides or Suicides + Undetermined cases	10,528	11,225
Rate for immigrants only	9.49	10.20

8.3.2 Standardized Suicide Rates

A more precise indication of suicide differentials may be gained once group variations in age composition are taken into account through indirect standardization. The age-specific death rates of the Canadian born were applied to the corresponding age-specific populations of the immigrants. Since under this procedure, the same standard is used, SMRs can be compared across groups. Values above 1.000 indicate a higher than expected rate of suicide; SMRs below 1.000 imply a lower than expected risk; and a value of 1.000 means no difference in risk in relation to the standard group. Table 10 displays suicide SMRs for immigrant groups and their corresponding countries of origin (where available). SMRs for as many nations of origin as possible are included to check on the proposition that

there may a close correspondence between immigrant suicide rates and those prevailing in the home countries. Some of the total SMRs are very close to 1.000, indicating hardly any difference in risk from the Canadian born standard. Groups in this range are United States, Poland, Czechoslovakia, Other Scandinavia and Japan.

In Table 10, the lowest SMRs are found amongst the New Wave immigrants from South/Central America/Mexico (.12), Africa (.19), and Other Asia (.21). Next lowest are the values for the Greeks (.30), Italians (.49) and Portuguese (.53). United Kingdom migrants also share below average risks, as do the Chinese (total SMR of .75). Of the groups in this investigation, the most suicidal appear to be immigrants from the former USSR (1.92), Hungary (1.71), the Irish Republic (1.67), Sweden (1.32) and Germany (1.14). The unusually high index value for the Irish Republic immigrants seems puzzling. Others researchers have also noted a high levels of mortality among immigrants from Ireland, particularly in the contexts of England and Wales and the United States (Rafferty, Jones and Rosato, 1990; Rosenwaike and Hempstead, 1990). Part of this unusual finding may be may relate to data problems with this group's numerators (the deaths) and denominators (the census population counts. An extensive investigation of this problem is beyond the scope of this study. It was decided to keep the Irish Republic category in the analysis; but some caution needs to be exercised in interpreting this group's suicide rates.

Table 10: Suicide SMRs: immigrants and their countries of origin (Canadian born as standard)

	Immigrants in Canada			Country of Origin of Immigrants		
Nationality	Males	Females	Total	Males	Females	Total
Canadian Born	1.00	1.00	1.00	1.00	1.00	1.00
United States	.91	1.08	.95	.95	.94	.95
EW Germany	1.15	1.10	1.14	1.08	1.87	1.24
Ireland Republic	1.33	2.01	1.67	.82	.85	.82
UK/Scotland/NIr	.58	.88	.65	.58	.71	.61
Greece	.35	.12	.30	.25	.29	.26
Italy	.48	.54	.49	.64	.77	.67
Portugal	.51	.63	.53	.61	.87	.66
Hungary	1.55	2.46	1.71	2.69	3.73	2.90
Poland	1.01	1.12	1.03	1.19	.94	1.14
USSR	1.72	2.86	1.92	1.74	1.87	1.77
Czechoslovakia	1.10	.82	1.05	1.30	1.66	1.37
Sweden	1.01	2.38	1.32	1.08	1.94	1.25
Other Scandinavia	.74	1.18	.95	1.49	2.32	1.64
China	.48	1.10	.75	.69	3.54	1.21
Japan	.95	1.00	.98	.94	2.10	1.17
Other Asia	.17	.23	.21			
Africa	.18	.20	.19			
SCAmerica/Mexico	.10	.14	.12			
Other Countries	.83	.89	.86			

Notes: SMRs based on suicides excluding "undetermined" cases. SMRs for some national categories could not be computed due to lack of appropriate information. Data for countries of origin is for 1991 or as close as possible to that year (World Health Organization Statistics Annuals).

Below are the intercorrelations among the six sets of rates, as well as SMRs based on Canadian born rates (standard) that included "undetermined" deaths (denoted by +).

	Mimmig	Fimmig	Totimmig	Forigin	Morigin	Totorigin	Mimm+	Fimm+	Totimm+
Mimmig	1.000	.896*	.993*	.368	.786*	.719*	*.990**	*.904**	*.993**
Fimmig		1.000	.941*	.462	.557*	.568*	.944*	*.985**	*.993**
Totimmig			1.000	.417	.733*	.692*	.998*	.943*	*.999**
Forigin				1.000	*.659**	*.814**	.391	.539*	.404
Morigin					1.000	*.973**	.726*	.695*	.751*
Totorigin						1.000	.678*	.568*	.701*
Mimm+							1.000	.949*	.999*
Fimm+								1.000	.947*
Totimm+									1.000

p <= .05

Notes: Mimmig = male immigrants; Fimmig = female immigrants; Totimmig = total immigrants; Forigin = female origin; Morigin = male origin; Totorigin = total origin; Mimm+ = male immigrant suicides + male immigrant undetermined cases; Fimm+ = female immigrant suicides + female immigrant undetermined cases; Totimmig+ = total immigrant suicides + total immigrant undetermined cases.

The footnote in Table 10 includes the intercorrelation matrix of the six sets of SMRs in the top part of this table, as well as correlations with SMRs computed on the basis of suicides plus undetermined deaths in the standard rates (i.e., the Canadian born rates). This was done to see whether results would change appreciably with or without the inclusion of "undetermined" deaths in the standard rates. Judging from the very high positive correlations between SMRs based on known suicides and suicides plus undetermined death rates (i. e. *Mimm+, Fimm+, Totimm+ with Mimmig, Fimmig, Totimmig*), there is hardly any basis for considering these two types of computations as being meaningfully different. In fact, all zero-order correlations among these rates are .90 to .99, denoting an almost perfect linear association. (SMRs in the top panel of Table 10 were computed using Canadian born suicide rates that excluded undetermined deaths.) There is a modest positive correlation of .692 between the total SMRs of the origin nations (*Totorigin*) and those of their antipodes in Canada (*Totimmig*). The corresponding correlations for males (*Mimmig with Mimm+*) and females (*Fimmig with Fimm+*) are .786 and .462, respectively. The link between home country and immigrant suicide is clearly stronger for males than for females. In Canada, however, the correlation between male and female immigrant suicide (i. e. between *Mimmig and Fimmig*) is even more substantial (r = .896). Judging from the actual values of these SMRs, some of the female relative risks tend to exceed those of males (i. e. Hungary, Irish Republic, and USSR, Sweden). This situation suggests that certain aspects of the migration experience may be more suicidogenic for females than for males.

Two questions worth examining are whether immigrants experience a shift in risk subsequent to their relocation, and whether the change entails a movement toward the

risk level of the host population or not. Comparing SMRs of immigrants with those of the respective home countries to ascertain the implied directional shift in risk for immigrants in relation to their home populations may derive an indirect sense of these possibilities. In Table 11, a ratio of unity would suggest "no change"; a ratio below one would imply "a decline in risk with immigration"; a ratio above 1.000 would denote "a rise in suicide propensities following immigration." Furthermore, risk proximity to either the host or home country can be ascertained by taking the difference in suicide SMRs between those of the immigrants and those of the corresponding home nations. If the difference between immigrants and the host population were smaller than that between immigrants and their corresponding home population, this would suggest an assimilative process for the migrants towards the Canadian born risk level. A smaller difference in the opposite direction may be indicative of a retention of risk phenomenon, whereby immigrant risk levels persist in conforming to the risk levels of their societies of origin. In the table below, for males, the overwhelming pattern seems to be a general shift in risk to below that of home nations. Exceptions are the Germans (1.06), the Irish (1.62) and the Greeks (1.40), for whom the home based suicide rates are much lower than those of the Canadian born. Six of the female ratios imply a rise in suicide subsequent to migration---i. e. USA (1.15), Irish (2.35), United Kingdom (1.24), Poland (1.19), USSR (1.53) and Sweden (1.23). In total, out of 30 SMRS in Table 11, 19 appear to be consistent with the proposition that immigration to Canada entails a reduction in suicide chances in relation to the migrants' country of origin. Moreover, male suicide risks approximate more those of their countries of origin (in 9 out 15 cases) than those of their Canadian born

counterparts. The situation for female immigrants is virtually the opposite. Their risks tend to be closer in magnitude to their Canadian born counterparts (in 9 out of 15 cases).

Table 11: Ratio of immigrant suicide SMRs to the SMRs of corresponding countries of origin (I / O), presumed direction of change in migrant SMRs in relation to country of origin, and proximity of migrant SMRs to either country of origin or the Canadian born (CB) population

Immigrant Group	Male I/O	Female I/O	Direction of change vs. origin: Male	Direction of change vs. origin: Female	Male immigrant ratio is closer to:	Female immigrant ratio is closer to:
USA	.96	1.15	decline	increase	CB	CB
Germany	1.06	.59	increase	decline	origin	CB
Ireland Republic	1.62	2.35	increase	increase	CB	CB
UK/Scotland/NIr	1.00	1.24	no change	increase	origin	CB
Greece	1.40	.41	increase	decline	origin	origin
Italy	.75	.70	decline	decline	origin	origin
Portugal	.84	.72	decline	decline	origin	origin
Hungary	.58	.66	decline	decline	origin	origin
Poland	.85	1.19	decline	increase	CB	CB
USSR	.99	1.53	decline	increase	origin	origin
Czechoslovakia	.85	.49	decline	decline	CB	CB
Sweden	.94	1.23	decline	increase	CB	origin
Other Scandinavia	.50	.51	decline	decline	CB	CB
China	.70	.31	decline	decline	origin	CB
Japan	1.01	.48	increase	decline	origin	CB

Note: The standard population is the Canadian born. Only groups with identifiable countries of origin included in these calculations. See footnote in Table 10.

The first equation in Table 12 looks at group membership only for its effect on suicide. The Canadian born, along with USA immigrants, Germans, Irish, and from "Other" countries, all show above average risks. Six migrant categories enjoy a lower than expected suicide risk: UK, Greeks, Italians, Other Asia, Africans, and South/Central American/Mexico foreign born. These last three groups---all fairly recent arrivals to Canada, have very low risk levels. Once other variables are introduced into the equation (model (2)), most group-specific terms become statistically insignificant---that of the

Canadian born being one of them; and most of the Old Wave immigrant categories no longer differ substantially in risk from that of the nation as a whole.

Equation (3) is identical to (2), the only difference being that the Canadian born population is now treated as the reference category (i. e. standard group). The bottom part of the table contains statistical results useful for evaluating the hypotheses specified earlier. As expected, SES has a significant inverse relationship with suicide. The effect of country of origin on immigrant suicide tendencies is positive. This is consistent with the proposition that immigrants from high suicide countries carry with them to the New World elements of their background culture that predisposes them to the risk of committing suicide. The duration effect is negative, suggesting that the longer the time since immigration, the lower the chances of self-destruction. In accordance with the selection thesis, the expectation was for recent immigrants to experience reduced chances of self-murder. This result suggests the opposite: the more recent the time since immigration, the greater the suicide risk. Further analysis is undertaken later concerning this result.

Table 12: Log-linear equations for suicides (plus undetermined deaths)

Effects	(1)	(2)	(3)	(4)
Intercept	-8.5664	-8.6590	-8.6590	-9.1142
Age 15-24		-.578*	-.578*	-.779*
25-34		.087	.087	-.151*
35-44		.335	.335	.060
45-54		.280	.280	.202*
55-64		.136	.136	.205*
65-74		-.078	-.078	.107
(75+)		-.182	-.182	.356
Male vs (Female)		.542*	.542*	.537*
Married vs (Other)		-.674*	-.674*	-.502*
Region Atlantic		-.182*	-.182*	.128
Quebec		.224*	.224*	.168*
Ontario		-.227*	-.227*	-.237*
Prairies		.227	.227	.075
(BC)		.-042	-042	-.134
Canadian Born	.347*	-.119	**ref**	**---**
USA	.194*	.257*	.376*	.183
Germany	.416*	.258*	.377*	.419*
Irish Republic	.823*	1.000*	1.119*	.962*
UK/Scotland/NIreland	-.195*	.004	.123	-.097
Greece	-.775*	-.399	-.279	-.553*
Italy	-.313*	-.080	.039	-.094
Portugal	-.209	.051	.170	-.011
Hungary	.872*	-.291	-.172	.294
Poland	.379*	.256*	.375*	.323*
USSR	.870*	.234	.353*	.524*
Czechoslovakia	510*	.157	.275	.330
Sweden	.506	.301	.420	.406
Other Scandinavia	.277	.013	.132	.125
China	.044	.226	.345	.114
Japan	.176	.227	.346	.245
Other Asia	-1.156*	-.622*	-.503*	-.876*
Africa	-1.189*	-.779*	-.660*	-1.065*
SCAmerica/Mexico	-1.803*	-1.389*	-1.270*	-1.626*
(Other Countries)	.199	.695	.812*	1.161
SES Index		-.02744**	-.02744**	-.00799
Origin		.01380*	.01380*	.00730*
Duration		-.03347*	-.03347*	.01378
CMA (ethnic community proxy)		-.133*	-.133*	-.064*
Acculturation Index		-.00162	-.00162	.00124
L^2	12614.83	3463.96	3463.96	2510.62
df	4842	4825	4825	4546
Pseudo R^2	.91	.92	.93	.95

Notes: See footnote in Table 3.
p < = .05 ** p <= .10

It is also evident in model (3) that the presence of an ethnic community (as operationalized here) serves to reduce the likelihood of suicide. This gives no evidence in support of the acculturation hypothesis, as its operational measure is statistically unimportant. Of course, it must be stated, however, that its measurement is far from being ideal in this analysis; therefore, this finding should be viewed as tentative.

Equation (4) considers the same model as the preceding one, but excludes Canadian born to check on how well the fitted model applies to the immigrants. The group terms thus reflect deviations from the overall immigrant expected suicide level. In comparison to the previous models, the only major change in the group main effects is with the Greeks, who now show a negative coefficient, and the USA born, who no longer show a significant effect. Judging from the region terms, Quebec appears to be a high-risk area for immigrants (lambda = .168), while Ontario (-.237) and British Columbia (-.134), respectively, constitute low risk places. Why this is so, remain open for speculation. It was surmised earlier that region represents differential opportunities for socio-economic advancement. From the pattern of results it seems clear that this is not a complete explanation. For instance, the Atlantic region is generally a poor area of the country, and yet immigrants in this region do not experience an above average risk level. At the same time, however, Ontario is a relatively wealthy area of Canada, and in this case, the relative risk of death for immigrants is below average. Country of origin and CMA location appear to be important sources of variation, while SES, duration, and acculturation indexes fail to reach statistical importance. Before commenting on these results, it is prudent to first examine separate equations for the two broad classes of immigrants---Old Wave and New Wave.

Table 13 displays equations for the Canadian born, the Old Wave, and New Wave immigrants, respectively. A number of observations are in order. First, for the Canadian born, only SES and CMA are of statistical relevance, and in both cases, the result is in the anticipated direction: the higher the SES, the lower the chances of suicide. Residence in a CMA is protective against the risk of self-murder.

Looking at the two immigrant categories, there is evidence that the regional effects are not uniform. Old Wave immigrants experience an elevated risk in the Prairies, while New Wave show a high risk of suicide in Quebec, though a lower than expected likelihood in Ontario. Clearly, more study is needed to examine these differentials in greater detail.

For both categories, SES is inversely associated with suicide, though the relationship is somewhat stronger for the New Wave. Interestingly, in view of the findings presented earlier in Tables 10 and 11 regarding SMRs, the association between the suicide rate of the country of origin and the corresponding rate for the Old Wave immigrants, is inverse, as shown earlier, but in actual fact, the relationship for New Wave immigrants is positive. Moreover, in the present equation, duration of residence in Canada now shows a positive and significant relationship with suicide in both Old and New Wave groups. Thus, once immigrants are classified in terms of this designation, the duration effect is more in line with postulates of the selection thesis. The risk increases with the passage of time in the New Land, which also implies that suicide is less likely in the early phases of relocation; presumably, selectivity would have some role in this phenomenon.

For the established immigrants the presence of ethnic community itself seems to be of no relevance as a protective structure against the odds of self-destruction. CMA residence is only significant for the New Wave immigrants. It would seem, therefore, that ethnic community is of critical importance for newcomers, who because of their recent contact with a foreign environment would have greater need of help and assistance from a receiving community of co-ethnics. Finally, as noted earlier, there is no statistical support for the acculturation hypothesis as operationalized here.

Table 13: Log-linear equations for suicide (plus undetermined deaths): Canadian born, Old Wave, and New Wave immigrants; Canada 1991

Effects	Canadian Born	Old Wave Immigrants	New Wave Immigrants
Intercept	-8.5126	-7.863	-9.661
Age 15-24	-.631*	-.842*	-.614*
25-34	.125*	-.280*	.046
35-44	.352*	.204*	.176
45-54	.317*	.352*	.434
55-64	.117*	.412*	.360
65-74	-.089*	.116*	-.035
(75+)	-.191	.038	-.367
Male vs (Female)	.724*	.426*	.408*
Married vs (Other)	-.698*	-.544*	-.367*
Region Atlantic	-.194*	.100	.473
Quebec	.234*	-.152	.663*
Ontario	-.242*	-.036	-.840*
Prairies	.234*	.250*	.016
(BC)	-.138	-.162	-.312
SES Index	-.04072*	-.11786*	-.25450*
Origin		-.02125*	.02857*
Duration		.05326*	.06026*
CMA (ethnic community)	-.138*	-.003	-.411*
Acculturation Index		-.00150	-.00227
L^2	889.05	330.69	208.23
df	265	262	260
R_A^2	.92	.90	.86

Note: See footnote in Table 3.
* p < = .05 ** p <= .10

8.3.3 Method of Suicide

An important question is whether the preceding results would change on the basis of the method of suicide. Given the statistical rarity of suicide to begin with, and the relatively few numbers of cases by method of self-inflicted murder, it was decided to confine the statistical analysis to the Canadian born, the New Wave and the old Wave immigrants, rather than the twenty specific groups. The types of methods are classified into four categories: (1) *solids/liquids poisonings*; (2) *firearms/explosives*; (3) *hanging/strangulation*; (4) *other means (plus undetermined)*. To begin with, it is instructive to look at the crude method-specific suicide rates per 100,000 population by three broad designations of nativity. The figures are shown below.

	Solids/ Liquids	Firearms/ Explosives	Hanging/ Strangulation	Other Means + Undetermined
Canadian Born	2.73	5.02	5.67	4.47
Old Wave	2.38	4.22	2.72	4.39
New Wave	.61	2.00	.36	1.09
Total	*2.52*	*4.68*	*4.88*	*4.44*

As can bee seen from these data, the rank order of rates conforms to what was seen earlier with respect to general mortality: The Canadian born have the highest rates, followed by the Old Wave immigrants, and finally the New Wave category. The latter have very small rates by method of suicide. For the Canadian born suicide is mostly committed by hanging or strangulation, followed by the use of firearms or explosives. However, among Old Wave and New Wave migrants, firearms/explosives are used most frequently.

Table 14 below, examines these differentials in greater detail with the application of log-linear methods. Due to the sparseness of these data, some caution must be exercised in the interpretation of the results; is particularly true in the case of New Wave immigrant

equations, as the numbers are very small, indeed. The focus of attention in this analysis is on the linear covariates, which represent opeartionalizations of hypotheses. Concerning SES, in most cases it is inversely related with suicide method, though in some cases it is not statistically important. The ethnic community effect is mostly in the expected direction: in most cases it has a negative effect on suicide. However, as noted in the earlier analysis, the effect of CMA is not always significant for the Old Wave. In fact, the only occasion it shows a statistically relevant effect on the risk is in connection with the chance of suicide by "firearms/explosives." On the other hand, ethnic community is significant for the New Wave immigrants in connection with the first three categories of "method" in the table: "solids/liquids," "firearms/explosives," and "hanging/strangulation."

The most consistent finding in Table 14 is with regard to the culture of origin index: its effect in all cases is positive. There is a significant correlation between the type of suicide death and the home based suicide rates of countries of origin of immigrants within the broad designations of Old and New Wave immigrants. This indicates strong support for the hypothesis that background national culture is a predisposing influence on immigrant suicide in host nations.

Table 14: Log-linear equations for suicide by method of suicide; Canadian born, Old and New Wave immigrants

	Solids/liquids			Firearms/Explosives			Hanging/Strangulation			Other Means (+Undetermined)		
Effects	CB	OW	NW	CB	OW	NW	CB	OW	NW	CB	OW	NW
Intercept	-10.5091	-10.6458	-12.0072	-9.8995	-10.5122	-10.5123	-9.8995	-10.0731	-10.8198	-10.0155	-10.0336	-11.4267
Age15-24	-1.249*	-.783*	-2.984*	-.483*	-.813*	na	-.342*	-1.569*	.204	-.860*	-.619*	-.969*
25-34	.084	-.203	-1.522*	-.014	-.664*	-1.015*	.316*	-.479*	.683	.150*	-.169	-.079
35-44	.790*	.131	.409	.053	.157	.389	.246*	.047	.760*	.515*	.134	-.010
45-54	.678*	.480*	1.950*	.148*	.105	-.384	.089	.466*	.633	.498*	.222	.945*
55-64	.552*	.592*	1.901*	043	.403*	-.113	-.003	.659*	.064	.121*	.218	.469
65-74	-.128	.177	-1.114	.084	.349	-.165	-.115	.485*	-.709	-.163*	.143	.107
(75+)	(-.729)	(-.394)	(1.360)	(.169)	(.463)	(.288)	(-.191)	(.691)	(-1.635)	(-.261)	(.071)	(-.463)
Male vs. (Female)	.021	.031	.193	1.421*	.992*	-.436*	.924*	.487*	.435*	.596*	.377*	.574*
Married vs. (Other)	-.875*	-.696*	-.325*	-.600*	-.448*		-.721*	-.521*	-.360*	-.689*	-.571*	-.520*
Atlantic Region	-.413	.231	---	-.047	.501*		-.285*	.045	---	-.223*	.160	---
Quebec	-.114	-.085	.397	.056	-.280		.520*	-.091	.624*	.301*	.064	.716*
Ontario	-.047	-.495*	-1.062*	-.294*	-.213		-.342*	.002	-.898*	-.151*	-.087	-.981*
Prairies	.310*	.365*	.474	.284*	.043		.140	.154	.414	.255*	.211	.458
(BC)	(.264)	(-.016)	(.191)	(.001)	(-.051)		(-.033)	(-.110)	(-.140)	(-.182)	(-.348)	(-.193)
CMA (Ethnic community)	-.074	-.020	-.747*	-.491*	-.410*		-.159*	.110	-.427*	.-123*	.060	-.261
SES Index	.07391	-.01186*	.14151	.01852	-.06849*		.03444	.04506	-.31238*	-.17302*	-.144	-.23869
Origin		.01653*	.05315*		.01851*			.02245*	.05124*		.01953*	.03369*
Acculturation Index		.00982*	-.02369*		.00204			-.00089	-.01722*		.00063	-.00674
Duration		.06753	1.0402*		.12439*			.07497*	-.03043*		.02724	.21611
L^2 Model	233.44	233.44	64.90	452.94	196.73	56.43	483.93	226.37	134.35	406.19	218.80	121.15
df	265	262	206	265	262	89	265	262	206	265	262	206
Pseudo R^2	.94	.97	.98	.92	.91	.79	.80	.85	.87	.84	.87	.89

Notes: In the New Wave (NW) equation for "Firearms/explosives", only age (except 15-24) and marital status could be included due to sparseness of the data. In the case of region, in some of the equations the Atlantic Region is not included, due to empty cells for that region (see "---"). See footnote in Table 3. Since the fitted equations are not nested, strictly speaking they cannot be compared to each other for goodness of fit.

p < = .05 ** p <= .10

The index of acculturation, as in the preceding analysis, emerges as virtually unimportant, except in connection with "solids/liquids" poisonings and "hanging/strangulation." In the former case, the association is positive for the Old Wave, but negative for the New Wave migrants. In the latter case, the effect is significant only for New Wave immigrants. Thus, for relatively new immigrants to Canada, becoming more integrated culturally serves to reduce the risk of committing suicide by the use of solids/liquids poisonings, or by hanging/strangulation. On the other hand, for the more

established contingent of immigrants, acculturation would seem to entail an increased risk of using solids/liquids in the commission of self-death. Concerning the duration effects, only four are statistically significant. In the first instance, the New Wave show a strong tendency to commit suicide with the use of solids/liquids agents (regression coefficient = 1.0402). This also implies that the shorter the duration, the lower the risk. However, the New Wave immigrants show a small negative effect with respect to hanging/strangulation. The results suggests that the longer the duration of residence, the lower the risk of using this method of suicide. Among the Old Wave, duration serves to increase the application of firearms/explosives and hanging/strangulation.

It might be instructive to combine the two immigrant categories into the same equation to observe the relative impact of group membership on suicide risk for each of the methods in this analysis, and to better evaluate the hypotheses. This would also strengthen the statistical results given the larger number of cases to be analysed. Table 15 contains four equations, corresponding to four types of suicide for Old and New Wave immigrants combined. The age pattern of method-specific suicide is fairly similar across method. The lowest risk appears to be among the 15-24 year olds, while the greatest chances are in the 45 to 65 year old range. The usual gender and marital status differences hold in this grouping of cases, with the exception that for the "solids/liquids" equation, gender is of no statistical relevance. As far as regional differentials are concerned, much of the variation observed earlier seems to have disappeared in this set of equations. The only region which persists to show a significant main effect is Ontario---and in this connection, only with respect to the first two equations in the table ("solids/liquids" and "firearms/explosives").

The terms in the lower part of the table can be evaluated with reference to hypotheses stated earlier. Interestingly, the effects of CMA, as the proxy for ethnic community, is consistently negative across all four equations, though statistically insignificant in the case of "other/undetermined" suicides. The question as to whether CMA has a differential effect on the two immigrant groups here is assessed with the interaction term of CMA with Group. Note that now the CMA effect is only significant for the New Wave and not for the Old Wave immigrants. This is consistent with earlier observations. The effect of CMA on New Wave risk of suicide is negative in connection with the chances of committing suicide with the use of "solids or liquids" (regression coefficient = -.322) and "hanging/strangulation" (regression coefficient = -.308). Thus, there is in general a protective effect of an urban ethnic community against the risk of suicide (i.e., the general inverse relationship of CMA on suicide); however, this protective effect is enjoyed primarily by the New Wave immigrants and to a lesser extent by the Old Wave. This point was also noted in the earlier analysis. Of the remaining proxy measures in Table 15, SES is no longer statistically significant, nor is the acculturation index. As in the earlier analysis, however, both "origin" and "duration" proxies are highly significant determinants of suicide risk for all four methods (except in the case of "other+undetermined" in connection with duration). These results further reinforce the relevance of culture of origin for immigrants in the explanation of suicide risk, and that of duration in the New Land, as explained before.

Table 15: Log-linear equations for immigrant suicide in accordance with method of suicide

	Solids/Liquids	Firearms/Explosives	Hanging/Strangulation	Other+Undetermined
Intercept	-11.1101	-10.3766	-11.0810	-10.5049
Group: NW vs (OW)	-.796*	-1.322*	-.417*	-.935*
Age 15-24	-1.044*	-.883*	-1.013*	-.573*
25-34	-.242	-.449	-.288	-.165
35-44	.105	.089	.114	.049
45-54	.410*	.087	.423*	.167
55-64	.615*	.352*	.494*	.333
65-74	.261	.377	.232	.140
(75+)	-.105	.427	.038	.049
Male vs (Female)	-.014	1.079*	.405*	.296*
Married vs (Other)	-.644*	-.450*	-.441*	-.503*
Region Atlantic	.158	.409	.232	.044
Quebec	-.109	-.097	.006	.174
Ontario	-.522*	-.312*	-.183	-.129
Prairies	.344*	.062	.064	.060
(BC)	.129	-.062	-.119	-.149
CMA (ethnic community)	-.353*	-.408*	-.187*	-.036
CMA x New Wave	-.322*	.012	-.308*	-.085
CMA x Old Wave	.322*	-.012	.308*	.085
SES	.07652	-.05401	-.04961	-.07808
Origin	.01947*	.01806*	.02696*	.02306*
Acculturation Index	.00351	.00228	-.00152	-.00024
Duration Index	.08197*	.11975*	.06478*	.04039
L^2	332.87	263.09	429.69	326.63
df	538	538	538	538
Pseudo R^2	.88	.86	.85	.89

Notes: See footnote in Table 3. Since the fitted equations are not nested, strictly speaking they cannot be compared to each other for goodness of fit.

p < = .05 ** p <= .10

8.3.4 Discussion of Suicide Results

Immigrants in Canada account for relatively few suicides (about 12 per cent in 1990-92). Consequently, once appropriate statistical standardization has been executed, on the whole, the risk of suicide is greater for the Canadian born. Multivariate analyses indicated that SES, culture of origin of immigrants, duration of residence in the new land, and ethnic community, have, in varying degrees of importance, some relevance in the explanation of immigrant suicide differentials. A consistent finding was that SES is

inversely related to suicide, and that culture of origin (i.e., country of origin) of the immigrants also has a significant effect on suicide risks (though in different directions, depending on whether a group is recent or not). Duration of residence for both New and Old Wave immigrants was positively associated with the risk of suicide, indicating that with increasing time in Canada suicide propensities increase. While it is not possible to prove directly, this finding does suggest some indirect support for the notion that immigrants enjoy positive health selection at the time of arrival to Canada, though this advantage seems to erode as time passes. The duration effect may also signal the possible importance of other unmeasured aspect of the immigrant experience.

The notion that ethnic communities can facilitate the adjustment and integration process of newcomers is well established in the literature (Breton, 1964; Egolf et al., 1992; MacDonald and MacDonald, 1965; Noh and Avison, 1996; Noh, Wu and Avison, 1994; Noh et al., 1992; Janes, 1990). The ethnic community as a social structure consisting of formal and informal social networks helps to dampen psychological distress among community members (Noh and Avison, 1996). A community of co-ethnics gives the newcomer a source of emotional and material support, thereby diminishing the probability of suicide under conditions of serious difficulties in life. Though not a perfect measure for such a complex and multidimensional concept, CMA residence was reasoned as constituting a reasonable proxy for ethnic community. The results in this study are not inconsistent with the notion that ethnic community is a protective structure against the risk of suicide. However, its relevance may be more critical in the case of relatively recent immigrants. More extensive research is needed to better specify the many mechanisms involved in this type of phenomenon. It would also be important to examine systematically

how ethnic communities help to bridge the world of the immigrant to that of his larger society, and in so doing, help reduce suicide risk. To the extent that the community fosters wellbeing for its members while at the same time promoting integration to the larger society, its importance in the adjustment and integration process of newcomers remains unquestioned. The role of ethnic community as a buffer against extreme distress and suicide may change as the community itself grows and matures. As immigrants establish themselves and integrate into the large society, they dependence on the ethnic communities may wane in the psychological sense.

Finally, the statistical analysis of completed suicides, while useful, can only provide an indirect clue as to the actual level of mental health problems in a population. Groups with low suicide rates may in actual fact suffer high rates of attempted suicide (parasuicide) that often go unnoticed (Bland et al., 1998). On the other hand, it is not inconceivable that groups possessing high rates of self-murder may experience low levels of parasuicide. These potentially counterintuitive possibilities should alert therapists, health practitioners, and researchers, to the strong possibility that observed suicide rates and parasuicide may be weakly correlated in immigrant populations. Thus, in the case of New Wave immigrants, who in this study were shown to have very low suicide rates, one cannot discount the possibility that they may at the same time experience a high incidence of suicide attempts. In the general population, suicide attempters tend to be predominantly female, young, single or divorced/separated (Bland et al., 1998). It is not clear whether such a profile would also apply to immigrants.

It has been reported that suicide ideation is partly associated with certain characteristics (i. e. being relatively young and female, having low self-esteem, being

introverted and possessing an external locus of control, severe mental health problems), negative life experiences (intra familial conflicts, chronic illness, problems in school, unemployment, etc.), and weak or absent social supports systems (De Mann, 1998; Runeson, 1998; Brent et al., 1996). Future research should be directed to better ascertain what is the incidence of clinical depression, suicide ideation, and parasuicide among immigrants, especially recent newcomers. Such knowledge can be of help in the identification and prevention of potential suicides. Though difficult to monitor such problems, community based agencies and health care practitioners in contact with immigrants may be able to gather such types of information (Whyte, Arce and Ortiz, 1995; Whyte, Apanowicz and Kurdziel, 1995; Walter, 1995). The potential for self-harm is most intense among those who are bereft of family and who lack a community of co-ethnics (Beiser, 1988). Given that problematic nature of refugee migrations, refugees are perhaps most vulnerable psychologically to the possibility of self-harm (Beiser and Hyman, 1997; Loue, 1998; Masi, Mensah and McLeod, 1995; Masi, 1995; Noh, Wu and Avison, 1994; Janes, 1990; Lynam, 1985). Future research is needed to address this problem systematically.

8.4 Homicide

Fortunately, relatively few homicides take place in Canada. According to the World Health Statistics Annual in 1992 there were 597 killings in this country (World Health Organization, 1994). The corresponding homicide death rate per 100,000 population was 2.10. By comparison with some of the most violent places in the world, Canada has a relatively minor problem in this regard. For instance, for Colombia, the World Health Organization reported 29,413 murders in 1992, for a corresponding rate of 89.5 per

100,000 population---one of the highest murder rates in the world! In Mexico, the number of homicides reported was 16,560, for a rate of 19.0 per 100,000. And our closest neighbour, the United States, experienced during the same period, 26,254 cases of murder, for a corresponding death rate of 7.0 per 100,000 population (World Health Organization, 1994). In the present analysis, the three-year count surrounding 1991 was 1610 cases. Given such a small number of deaths, the analysis below proceeds with only three broad designations of nativity: the Canadian born, the Old and the New Wave immigrants. A more refined classification (i.e., 20 nationalities) would produce many empty cells, thus rendering the analysis meaningless.

Looking at the table below, the vast majority of homicides in Canada occur to persons born in this country. However, the crude homicide rates per 100,000 population indicate that while the Canadian born have the highest risk, New Wave immigrant males share rates that are very close to those of the Canadian born men (3.38 vs. 3.52). Given these three groups' differing age compositions it would be important to examine the pattern of age-specific differences in death rates. The table below shows numbers of homicides and death rates per 100,000 population by gender and nativity, 1991.

	Male		Female		Total	
	Number	Rate	Number	Rate	Number	Rate
Canadian Born	884	3.52	466	1.77	1350	2.63
Old Wave	91	2.28	59	1.41	150	1.83
New Wave	84	3.38	26	1.01	110	3.70
Total	*1059*	*3.35*	*551*	*1.67*	*1610*	*2.49*

Among men, with the exception of the age group 15-24, the highest death rates are among the Canadian born. The rates for New Wave males are close to those of their Canadian born counterparts until age 45-49, at which point they drop noticeably. Old

Wave rates are lowest from age 15 to 44. The situation for women sees New Wave immigrants as possessing the lowest homicide death rates, irrespective of age category. Until age 35-44, the homicide rates are highest for Canadian born women; but beyond that age group, the differences in age-specific risk between Canadian born and Old Wave immigrants are minimal.

A convenient way to standardize age compositional differences across groups is to take their geometric means of age-specific death rates. The geometric mean is the exponent of the sum of the natural logs of age-specific death rates (non-zero rates) divided by the number of non-zero rates. Schoen (1970) has demonstrated that the geometric mean is actually a standardized measure of death risk, thus obviating the need for conventional standardization procedures as in the case of direct standardization of rates to remove confounding effects of age composition or some of the compositional effect. Following Schoen, the geometric mean (GM) of age-specific death rates is:

$$GM_j = (\Pi r_{ij})^{1/n}$$

where r_{ij} are age-specific death rates for age group *i* and nationality group *j*, and *n* is the total number of age-specific rates. Taking natural logs of rates, this measure can be expressed as:

$$GM = \exp\,[(1/n \sum_i \ln(r_{ij})].$$

As can be seen by this measure, the highest geometric mean belongs to the Canadian born men (3.01), followed by New Wave male immigrants (2.28), and Old

Wave male migrants (1.79). Among the females, the Canadian born show the largest geometric mean for homicide (1.44), followed by Old Wave females (1.31) and finally, New Wave females (0.93).

	Canadian Born		Old Wave		New Wave	
Age	Male	Female	Male	Female	Male	Female
15-24	3.39	2.03	1.09	1.08	4.45	0.94
25-34	4.52	2.44	3.55	1.48	4.11	1.29
35-44	3.91	1.87	3.19	1.75	3.90	1.39
45-54	3.05	1.24	3.12	1.56	2.41	0.83
55-64	2.66	1.33	1.19	1.56	0.94	0.43
65-74	2.06	1.03	1.46	0.95	0.55	0.11
75+	2.21	0.83	0.88	1.03	1.99	0.10
GM	*3.01*	*1.44*	*1.79*	*1.31*	*2.09*	*0.1.00*

The high death rate for New Wave males is surprising, as New Wave immigrants have generally shown very low death rates in virtually every other cause of death examined in this study. Log-linear rate equations were fit to the homicide deaths to check further into these differentials. The log-linear multivariate approach to this type of analysis allows for the separation of group main effects, while controlling for a larger set of variables (i.e., gender, marital status, region, etc.).

In Table 16, the first model looks at the Canadian born only, while the remaining four equations examine the situation for the immigrants. The results for the Canadian born are quite predictable. There seems to be an east-west pattern of homicide mortality. The Atlantic region and Ontario have below average homicide rates, while the Prairies and British Columbia share elevated risk levels. In this case both SES and CMA location fail to reach statistical significance. Concerning immigrants, initially, the Old Wave immigrants show a 56 percent greater risk of homicide death than their New Wave counterparts (exp (0.223*2) = 1.56); however, once other variables are taken into account

the risk differential changes to 71 percent (i.e. exp (0.268*2)). In this multivariate analysis, there are only two significant age effects among the immigrants: age 35-44, and 65-74. In terms of region, Quebec is only geographic area showing a significant impact on the odds of death by homicide (.653); none of the other regional terms are important for explaining immigrant homicide variations. Why Quebec is especially problematic in the sense of immigrant risk of homicide is not known, nor can it be discerned from the available information in this study. Clearly, this is something to pursue in future study.

Table16: Log-linear equations for homicide mortality by nativity

Effects	Canadian Born + Immigrants	Canadian Born		Immigrants		
Intercept	-12.89920	-11.5673	-11.55510	-11.02130	-11.05010	-11.03361
Canadian Born	-.989*					
Old Wave	1.121*			.223*		.268*
(New Wave)	-.132*			-.223		-.268
Age 15-24	-.382*	.194*	-.442*		-.003	.064
25-34	.437*	.449*	.456*		.114	.406
35-44	.546*	.262*	.528*		.042	.489*
45-54	.325*	-.034	.287*		.050	.246
55-64	.098*	-.108	.130		-.067	.059
65-74	-.377*	-.354*	-.301*		-.207	-.639*
(75+)	-.647	-.407	-.658		.071	-.625
Male vs. (Female)	.335*	.334*	.342*		.224*	.202*
Married vs. (Other)	-.796*		-.878*			-.467*
Atlantic Region	-.415*		-.410*			-.993
Quebec	.027		-.069			.653*
Ontario	-.291*		-.328*			-.001
Prairies	.342*		.392*			.221
(BC)	.337		.415			.120
CMA (ethnic community)	-.005		-.009			-.143*
SES	-.08257**		-.03711			.01369
Origin						.04708**
Duration						-.07369**
Acculturation Index						.00462
L^2M/ df	870.11/ 821	1418.68/ 272	457.32/ 265	488.32/ 550	489.88/ 556	341.38/ 539
Pseudo R^2	.61	.36	.79	.78	.79	.86

Notes: See footnotes in Tables 3 and 15.

p < = .05 ** p <= .10

It is interesting to note that CMA location is significant in predicting immigrants homicide risk, and is in the hypothesized direction: the concentration of immigrants in the urban areas of Canada helps to reduce the risk of suicide. The presumed causal link for this effect is the increased level of social control and integration afforded by ethnic communities. While SES has no statistically relevant effect, there is a significant country of origin influence on the risk of homicide. The positive coefficient suggests that immigrants from high homicide nations tend to experience increased chances of homicide

in Canada. The longer the period since immigration to Canada, the lower the risk of death due to homicide. This may indicate that the early years of relocation may be problematic, and more likely to create for immigrants situations leading to an increased risk of death from homicide. From the results obtained in this analysis, there is no support for an acculturative effect on immigrant homicide.

8.5 Other Forms of Accidental and Violent Mortality

Although this is a heterogeneous class of mortality, it is important to examine such deaths in the context of this analysis. To some extent, these deaths represent conditions associated with some sort of personal or interpersonal problem, above and beyond suicide, homicide, or motor vehicle fatalities. Many of the deaths in this class of mortality are in actual fact accidental falls. Undoubtedly, some of these deaths may have occurred in the workplace, in the home, or during leisure activities. As far as numbers of cases is concerned, during the period 1990-92, there were just under 9,000 deaths classified as "other accidents and violence." Of these, about 85 per cent were Canadian born decedents. The crude death rates (per 100,000 population) for Canadian born, Old, and New Wave immigrants, are shown below.

	Male	Female	Total
Canadian Born	21.86	6.64	14.09
Old Wave	18.30	9.82	13.96
New Wave	5.79	1.78	3.76
Total	20.15	6.67	13.26

The pattern or crude death rates correspond to many of the earlier findings concerning group differences in death risk. Generally, the Canadian born males share the highest crude death rates of "other accidents/violence", followed by Old Wave

immigrants. New wave migrants enjoy the lowest overall risk of premature death from this heterogeneous cause of death. New Wave females have particularly low death rates. Old Wave female share the higher crude death rate.

Another way to examine these data would be to look at the pattern of age-specific death rates by sex and nativity. Such rates would also allow the calculation of the geometric mean (GM), as described earlier. Death rates tend to peak in the oldest age group 75+, where the Old Wave has the highest rate (57.62 per 100,000). This suggests that many of the deaths in this class of mortality are in actuality related to accidents incurred by the elderly, most likely in their own homes. At young ages, Canadian born males have the highest death rates. The geometric means also reflect the relatively high-risk levels of Canadian born males and the unusually low death rates among New Wave immigrant women.

	Canadian Born		Old Wave		New Wave	
Age	Male	Female	Male	Female	Male	Female
15-24	16.14	3.13	9.47	3.99	4.01	0.94
25-34	21.01	3.60	14.63	2.05	4.56	0.72
35-44	21.78	4.80	11.91	4.25	3.42	1.09
45-54	21.25	5.44	15.63	2.62	5.64	1.95
55-64	23.36	7.71	15.50	6.25	8.98	1.31
65-74	24.04	11.09	18.72	9.23	8.18	2.69
75+	54.43	32.27	57.62	48.32	50.01	21.05
GM	*3.45*	*1.00*	*2.45*	*0.85*	*1.07*	*0.28*

Table 17 contains four equations. The first two pertain to all 20 nationality groups, while the remaining two exclude the Canadian born (i.e. 19 immigrant groups). The age pattern of effects indicate a cross-over at about age 45, whereby foreign born persons share above average risks; and at ages below 45, immigrants enjoy below average rates of death from “other accidents and violence.” Concerning gender, male risk exceeds that of

females by a considerable margin. Being married entails a significant level of "protection" against premature death from this type of mortality (lambdas of -.621 and -.449). When all groups are considered, there are 9 significant group effects on the chances of premature death. Here, the Canadian born is used as the reference group, which means this is the standard population for comparison purposes. Of these nine significant terms, only the Irish Republic migrants show elevated risks (.809); the remaining groups all show negative terms, meaning a lower relative risk than the Canadian born. Of these low-risk groups, the most pronounced are immigrants from Africa (-1.800), South/Central America/Mexico (-1.350), and Other Asia (-1.142). The Chinese, Portuguese, Italians, English and "Other Countries," also show negative risks, but not anywhere near the levels of the former groups. Of the regional effects, the Prairies and British Columbia represent high mortality areas, while Atlantic, Quebec and Ontario, show reduced conditional chances of mortality. The effect of CMA residence on the risk of death is negative; however, SES shows no significant influence on mortality. Thus, it appears that SES is of no substantive importance in this particular type of mortality.

As far as the immigrants are concerned, the group main effects are expressed as deviations from the overall average death rate comprising immigrants only (i.e. excluding the Canadian born). What emerges from this equation is a clear differential in risk based largely on Old Wave-New Wave demarcation. Of the group terms that are statistically significant, the New Wave (excepting Chinese), all show strong negative coefficients, while Old Wave groups demonstrate positive net effects. However, a large number of group terms are insignificant, indicating that as far as immigrants are concerned, their net

risk levels do not differ from the overall average. It is interesting to note that of all the regional terms, only that for Ontario is statistically important in this case, the effect being negative (-.199). Thus, the previously reported regional effects were largely dictated by the influence of the Canadian born population. Ontario then, is a low risk area for immigrants. This part of Canada attracts and retains the majority of immigrants to Canada. Thus immigrant communities are viable and strong in this part of the nation. The presence of multiethnicities in Ontario may be a factor in explaining the low risk level for immigrants in this area of Canada. Prairies and British Columbia share risk levels that are not different from the overall immigrant average risk level. In other words, immigrants in these geographic localities have an average risk of premature death from "other accidents and violence."

Of importance to this analysis is the negative coefficients associated with CMA locality. Residents of large urban areas have a clear advantage in terms of survival probabilities than those from non-CMA locations. Recall that this term is viewed as a rough proxy for ethnic immigrant community. In accordance with the hypothesis, and to the extent that this is a suitable proxy for ethnic community, there is indirect evidence here for the protective effect of community as far as risk of death is concerned for immigrants. Neither country of origin nor SES is statistically important, however. Perhaps this should not be surprising. Many mishaps that lead to premature death have little to do with background cultural influences---i.e. cultural factors related to the home nation of immigrants. Moreover, SES is unlikely to be a factor in this type of mortality, primarily because so much of it takes place at relatively old age---among 70 year olds

and beyond. At that point in life, SES may play a minor role in accounting for things like mishaps in the home due to frailty or old age.

Table 17: Log-linear equations for other forms of accidental and violent mortality

	All Groups		Immigrants Only	
Effects	(1)	(2)	(3)	(4)
Intercept	-8.9328	-8.4586	-9.0141	-9.0562
Canadian Born		ref		---
USA		.151		.345*
EW Germany		-.104		.289*
Irish Rep.		.809*		1.113*
EW/Sc/NIr.		-.171*		.070
Greece		-.474		-.247
Italy		-.217*		.067
Portugal		-.443*		-.196
Hungary		-.015		.287
Poland		.110		.396*
USSR		.063		.335*
Czechoslovakia		.108		.428*
Sweden		.124		.416
Other Scandinavia		-.075		.247
China		-.318*		-.072
Japan		-.189		.155
Other Asia		-1.142*		-.828*
Africa		-1.800*		-1.567*
SCAm/Carib/Mex.		-1.350*		-1.141*
(Other Countries)		-.236*		.537
Age 15-24	-.498*	-1.063*	-.799*	-1.111*
25-34	-.286*	-.292*	-.603*	-.526*
35-44	-.240*	-.041	-.509*	-.323*
45-54	-.222*	.026	-.200*	-.026
55-64	-.058*	.144*	.047	.169*
65-74	.111*	.187*	.302*	.294*
75+ (Ref)	(1.193)	(1.039)	(1.762)	(1.432)
Male vs. (Female)	.583*	.646*	.399*	.496*
Married vs. (Other)		-.621*		-.449*
Atlantic Region		-.079*		.044
Quebec		-.193*		.093
Ontario		-.148*		-.199*
West		.107*		.006
(British Columbia)		.313		.056
CMA (ethnic community		-.209*		-.207*
SES Index		.00272		.00319
Origin				-.00003
Acculturation Index				-.00249**
Duration Index				.03138**
L^2M/ df	72110.59/ 4845	10,771.63/ 4842	2868.99/ 4574	2330.56/ 4546
Pseudo R^2	.96	.99	.95	.98

Notes: "---" means Canadian born excluded from this equation.
See footnotes in Tables 3 and 15.
p < = .05 ** p <= .10.

Interestingly, both acculturation and duration since immigration emerge as statistically important factors in this type of mortality. The greater the level of acculturation, the lower the risk; and the greater the duration of stay in Canada since the time of immigration, the greater the conditional risk of death. Thus, acculturation is beneficial in this regard in diminishing risk. The fact that duration effect is positive is consistent with the selectivity thesis of mortality. The positive coefficient, interpreted in reverse, suggests that the shorter the time since immigration, the lower the chance of death. Presumably, the lowered risk early in the immigration experience is partly a reflection of positive health selectivity. However, this interpretation is difficult to prove in a direct manner, as explained earlier in this study.

It was decided to combine the twenty nationality groups into the now familiar classification of Canadian born, Old Wave, and New Wave immigrants, to gain a more complete perspective on this analysis. Table 18 shows four equations: Canadian born only; all immigrants; Old Wave, and New Wave, respectively. For the Canadian born equation, the regional effects are quite consistent with our earlier observations, that the Prairies and British Columbia represent two geographic localities entailing above average death risks. CMA continues to be a significant predictor (-0.216) while SES remains insignificant.

In equation two, the group coefficients indicate that New Wave migrants enjoy a considerable advantage over the Old Wave immigrants in averting death from the present category of mortality in this analysis (-.852). In terms of age effects, at ages 45 and above, mortality probabilities of New Wave immigrants are greater. Gender effects are also stronger for New Wave migrants, while the marriage effect is weaker for this group.

There are two significant regional effects in the New Wave immigrant equation: that of Quebec, whose independent effect serves to raise the risk of premature death; and that of Ontario, whose effect is lower the risk. Both effects are substantial in magnitude. Importantly, the CMA effects in the two migrant categories are negative, lending support to the protective effects of the ethnic community thesis. Unlike the result in the preceding table, this time, once immigrants are separated on the basis of Old or New Wave, there is a significant country of origin effect on the conditional risk of death. Thus, the higher the death rate of the country of origin, the higher the mortality risk of corresponding immigrants in Canada. SES, in this analysis, however, continues to be irrelevant in statistical terms. And neither acculturation, nor duration of residence explain variation in mortality risk in these equations. Partitioning the data in this manner has allowed a more comprehensive view of how New Wave and Old Wave migrants differ in their probabilities of premature death from "other accidents and violence."

Table 18: Log-linear equations for other forms of accidental and violent mortality

Effects	Canadian Born + immigrants	Immigrants	Old Wave	New Wave
Intercept	-8.8913	-8.8847	-9.1541	-9.5562
Old Wave		.852*		
(New Wave)		-.852		
Age 15-24	-1.092*	-1.305*	-1.189*	-.938*
25-34	-.291*	-.698*	-.355*	-.827*
35-44	-.020	-.303*	-.026	-.741*
45-54	.035	.022	.091	.057
55-64	.172*	.243*	.172	.323
65-74	.223*	.570*	.372*	.448
(75+)	.973	1.471	.935	1.678
Male vs. (Female)	.672*	.540*	.512*	.613*
Married vs. (Other)	-.651*	-.424*	-.484*	-.216*
Atlantic Region	-.089*	-.017	.057	-.054
Quebec	-.235*	.128	-.151	.703*
Ontario	-.151**	-.201*	-.095	-.632*
West	.115*	.097	.111	.144
(BC)	.360	-.007	.078	-.161
CMA (ethnic community	-.216*	-.196*	-.182*	-.591*
SES Index	.02555	.03785	.02622	-.01003
Origin		.00184**	.00379*	.01882*
Acculturation Index		.00528*	.00004	.00309
Duration Index		.05633*	.01099	.08048
L^2M/ df	856.46/ 265	681.90/ 539	403.54/ 262	197.25/ 266
Pseudo R^2	.78	.76	.71	.99

Notes: See footnotes in Table 3 and 15.

*p < = .05 ** p < = .10.

8.6 Chronic/Degenerative Disease Mortality

8.6.1 Ischemic Heart Disease

The leading cause of death for Canada and most other industrialized societies is diseases of the circulatory system (World Health Organization, 1995). During 1992 there were over 76, 211Canadians who died from this type of disease. The death rate was 268.01 per 100,000 population. By comparison, Finland, had in 1993, one of the highest death rates in the world from this ailment. Though it recorded 24, 582 deaths, its rate was

485.14 per 100,000. In the United States, there occurred during 1991, over 920, 482 deaths from circulatory complications, accounting for a death rate of 365.01 per 1000 population. Within this class of mortality, Ischemic heart disease is the most lethal kind of circulatory disease. The term “ischemia” (as in “ischemic heart disease”) means deficiency of blood in the heart due to functional constriction or actual obstruction of blood vessels (Dorland’s Pocket Medical Dictionary, 1977). This sub-category of circulatory disease represents a major cause of premature death in most of the industrialized world. Obstruction of the blood vessels is a function of other complications, most importantly perhaps, the accumulation of plaque in the blood vessels due to prolonged high levels of low density lipoproteins in the blood system (LDLs). This condition is often referred to as having too high a level of "bad" cholesterol; and this is partly related to poor diet, lack of sufficient exercise, as many other potential risk factors, including smoking. The Canadian crude death rate for ischemic heart disease in 1991 was 153.22 per 100,000, while for the United States and Finland it was 192.50, and 280.94, respectively (World Health Organization, 1995). Thus, by comparison, Canada’s overall mortality rate from ischemic heart disease is in the intermediate range.

The World Health Organization statistics are based on the total Canadian population as the denominator for the crude ischemic heart disease death rate reported above. Since the present analysis is based on the population aged 15 and over, the population denominators are different; therefore, the crude death rates shown below cannot be compared directly to the World Health Organization figures for Canada. Below, the overall Canadian ischemic heart disease crude death rate is 203.65 per 100,000 population. The male overall rate is about 30 per cent greater than that of

females. Concerning the three broad nativity groups in this investigation, the Old Wave immigrants have a death rate of 381.07, while Canadian born show a rate of almost 191 per 100,000. New Wave immigrants enjoy a very low ischemic heart disease death rate, with 45.14 per 100,000 population. The male death rates across these three groups surpass their female counterparts by a range of 13 to 50 percent. For instance, among the Canadian born, the ratio is 1.38; that of Old Wave it is 1.13; and of New Wave, 1.50. Undoubtedly, part of these differences is accounted by group variations in age compositions.

	Male	Female	Total
Canadian Born	222.23	161.05	190.97
Old Wave	405.92	357.37	381.07
New Wave	54.02	36.56	45.14
Total	*232.24*	*176.27*	*203.65*

Using the geometric mean as a standardized measure of mortality, the rank order of death differentials due to ischemic heart disease follows a more predictable pattern. The figures below indicate that the Canadian born males share the highest statndardized risk (59.91 per 100,000), followed by Old Wave (47.26), and New Wave males, respectively (27.42). Among women, the geometric means are 20.82 for those born in Canada it is 12. 63 for the Old Wave; and 11.72 for New Wave migrants.

	Canadian Born		Old Wave		New Wave	
Age	Male	Female	Male	Female	Male	Female
15-24	.42	.26	.36	.36	.12	.06
25-34	2.74	.84	3.16	.19	.74	.08
35-44	24.32	3.68	14.47	1.63	4.72	.31
45-54	110.72	24.46	64.02	10.07	30.36	5.30
55-64	360.51	108.93	244.32	63.18	120.11	39.82
65-74	904.47	384.97	678.79	280.16	351.59	139.69
75+	2700.81	2045.89	2969.83	2620.40	1110.31	816.92
GM	*59.91*	*20.82*	*47.26*	*12.63*	*27.42*	*11.72*

The age-specific death rates follow a rising pattern of risk. They change minimally from age 15 to about 45, but increase exponentially thereafter. For Canadian born men, the rise in risk begins approximately ten years earlier than among immigrant men. For instance, male Canadian born age-specific death rate turn above 100 at age 45-54; for the two male immigrant categories this takes place at ages 55-64. It is not until 75+ that one notes a crossover in death rates, with the Old Wave men exceeding Canadian born males death rates. A rather similar pattern of rates is noticeable among females. Like their male counterparts, the female migrant rates exceed 100 per 100,000 population at a later age--- i.e. at 65-74, while for native born Canadians, this occurs at ages 55-64.

Table 19 shows log-linear equations for Ischemic heart disease mortality. Models (1) and (2) look at the overall age pattern of mortality for the population as a whole and for the immigrants as a whole, respectively. The immigrant age-specific risk, net of gender, is lower than that of the overall population's at ages below 55. At ages beyond 55, however, the immigrant population has higher death rates of ischemic heart disease. The gender effect on mortality is somewhat weaker among the immigrants. Concerning nationality group differentials in death risk, equation number 2 demonstrates that ten out of 19 groups have lower mortality risks than the Canadian born standard population. Of these, the Germans, the Greeks, Italians, Portuguese, Japanese, and "other countries"---all part of the Old Wave class of immigrants---maintain below average chances of ischemic heart disease mortality. The New Wave groups---the Chinese, the Other Asians, Africans, South Central American/Mexicans, enjoy notably low odds of premature mortality from this type of disease.

Model (4) concerns immigrants only. In this case, the group main effects are expressed as deviations from the overall average death rate for the immigrants as a whole. With the exception of the South European groups (Greeks, Italians, Portuguese), the Japanese, and "other countries," the rest of the Old Wave migrant groups all show above average rates of mortality. Among the high mortality groups, the Irish Republic and Czechoslovakians are particularly prone to dying from ischemic heart disease. The case of the Southern Europeans is generally well known in the literature. Powels has shown that Greeks in Australia enjoy "the best of both worlds", to indicate that these migrants actually gain by their move to Australia in socioeconomic and health terms. The Greeks tend to maintain their home based diet of mostly vegetables, fruits, olive oil and little animal fats. It would seem that the so-called "Mediterranean diet" is at the core of the Southern European groups' relative advantage in survival from this major disease. Thus, to some extent, the group effects on the conditional risk of death in this analysis are reflective of group variations in traditional diets. Those immigrant groups from world regions where the diet is characterized by less animal fat consumption and more of vegetables and fruits tend to enjoy relatively low odds of ischemic heart disease mortality. On the other hand, groups from countries in which the diet is mainly based on meat tend to exhibit higher relative risks (e.g., Eastern European groups).

Table 19: Log-linear equations for Ischemic Heart Disease mortality

	Canadian Born + Immigrants		Immigrants Only	
Effects	(1)	(2)	(3)	(4)
Intercept	-6.34613	-6.32001	-6.03401	-6.02394
Canadian Born		**ref**		
USA		.162*		.264*
EW Germany		-.141*		.057*
Irish Rep.		1.091*		1.285*
EW/Sc/Nir.		.081*		.229*
Greece		-.532*		-.229*
Italy		-.342*		-.038
Portugal		-.422*		-.111*
Hungary		.096		.305*
Poland		.034		.216*
USSR		.141*		.275*
Czechoslovakia		.204*		.414*
Sweden		.337*		.371*
Other Scandinavia		.154*		.278*
China		-.767*		-.595*
Japan		-.378*		-.287*
Other Asia		-.824*		-.565*
Africa		-.766*		-.471*
SCAm/Car/Mex.		-1.787*		-1.496*
(Other Countries)		-.1281*		-.124
Age 15-24	-4.772*	-5.040*	-5.083*	-5.169*
25-34	-3.137*	-3.121*	-3.208*	-3.051*
35-44	-1.138*	-1.132*	-1.430*	-1.226*
45-54	.427*	.542*	.301*	.394*
55-64	1.699*	1.789*	1.783*	1.809*
65-74	2.732*	2.759*	2.917*	2.826*
(75+)	4.189	4.203	4.720	4.417
Male vs. (Female)	.271*	.366*	.194*	.298*
Married vs. (Other)		-.281*		-.300*
Atlantic Region		.019*		-.198*
Quebec		.062*		-.034
Ontario		.118*		.088*
Prairies		-.045*		.144*
(BC)		-.154		-.396
CMA (ethnic community		-.047*		-.049*
SES Index		.00489		.02318*
Origin				-.00002**
Acculturation Index				.00077*
Duration Index				.02419*
L^2M/ df	26557.05/ 4854	11894.30/ 4828	12420.91/ 4574	5831.99/ 4546
Pseudo R^2	.83	.95	.76	.90

Notes: See footnotes in Tables 3 and 15.
p < = .05 ** p< = .10

Immigrant risk of dying from this ailment is greatest in the Prairie region, and least in British Columbia and the Atlantic locality. As predicted, CMA location has an inverse and significant relationship with the expected odds of death. Interestingly, and unexpectedly, SES shows a positive effect. This will be examined further later, to see whether the association may be conditioned by Old or New Wave group membership. The country of origin is inversely related to the chances of premature death from ischemic heart disease. The greater the corresponding country of origin death rate, the lower the death rate of the immigrants. This suggests that immigrants enjoy an advantage in survival probabilities from this disease, as compared to the home nations. Acculturation entails a rise in risk. The greater the level of cultural acculturation, the higher the chance of death from this disease. The influence of duration on the criterion variable is positive. This is consistent with a selectivity explanation. That is, a longer duration of residence in Canada has an eroding effect of the protective influence of health selectivity. Viewed in the obverse, the earlier the time since immigration, the lower the risk. The Prairies and Ontario show positive effects on the risk of death for the immigrants.

Table 20 elaborates on some of the above results. Concerning SES, it is clearly inversely related for the Canadian born. But for immigrants, the association is either positive (i.e., Old Wave) or insignificant (i.e., New Wave). Similarly, the country of origin effect is only significant for Old Wave migrants. Acculturation and duration have different direction of effect, depending on the immigrant category. Among the Old Wave, the more acculturated one is, the lower the risk; and the longer one resides in Canada, the greater the odds of death. For the New Wave, however, acculturation is

positively related, and duration negatively associated with mortality. These different patterns of effects indicate that the situation with respect to death risk for immigrants is not uniform. The designation of Old and New Wave helps to see this clearly. Since the New Wave immigrants are relatively recent immigrants to Canada, the duration variable must be negative, as insufficient time has passed for this association to turn positive. The negative effect thus captures the initial effects of health selectivity that confers recent immigrants a health advantage against ischemic heart disease mortality. Moreover, acculturation effects on mortality likely take a long period of time to materialise. The association is likely not linear. From the results here, the suggestion seems to be that there is a threshold point at which the influence of duration changes from positive to negative. For relatively new immigrants the relationship is positive. Only after a long period of time has passed will the association become negative. This is why the Old Wave show a negative coefficient for the duration effect, and a positive one for the New Wave.

Table 20: Log-linear equations for Ischemic Heart Disease mortality

Effects	Canadian Born	All Immigrants	Old Wave	New Wave
Intercept	-6.41872	-6.11240	-6.31423	-5.29714
Old Wave		.995*		
(New Wave)		-.995		
Age 15-24	-5.033*	-4.801*	-5.228*	---
25-34	-3.128*	-3.036*	-3.726*	-3.743*
35-44	-.989*	-1.601*	-1.999*	-2.259*
45-54	.591*	-.008	-.179	-.651*
55-64	1.798*	1.681*	1.772*	1.055*
65-74	2.752*	2.903*	3.367*	2.249*
(75+)	4.009	4.865	5.993	3.349
Male vs. (Female)	.387*	.437*	.610*	.325*
Married vs. (Other)	-.266*	-.280*	-.365*	-.112*
Atlantic Region	.057*	-.458*	-.224*	.352*
Quebec	.106*	.121*	-.338*	.308*
Ontario	.167*	.107*	.170*	-.453*
Prairies	-.127*	.331*	.307*	-.100
(BC)	-.203	-.101	.085	-.107
CMA (ethnic community	-.034*	-.012**	-.048*	-.222*
SES Index	-.02223*	.11892*	.05335*	.03023
Origin		-.00038*	-.00081*	.00043
Acculturation Index		.00269*	-.00504*	.00479*
Duration Index		.01733	.14460*	-.13056*
L^2M/ df	4212.41/ 265	2692.47/ 539	1328.26/ 262	432.63/ 221
Pseudo R^2	.64	.81	.77	.52

Notes: --- means category excluded due to insufficient number of cases.
See footnotes in Tables 3 and 15.

* p < = .05 ** p < = .10

8.6.2 Other Heart Disease

By this designation, it is meant heart ailments other than the ischemic type, examples being: "other" types of heart disease mortality include: chronic rheumatic heart disease, acute rheumatic fever, hypertensive disease; diseases of pulmonary circulation system, and other forms of heart disease. The table below shows the number of such deaths in

Canada during 1990-92 by gender and nativity class, as well as the corresponding crude death rates per 100,000 population.

	Male		Female		Total	
	Number	Rate	Number	Rate	Number	Rate
Canadian Born	12562	49.97	13696	52.15	26258	51.08
Old Wave	3844	96.12	4962	118.33	8806	107.49
New Wave	378	15.20	399	15.50	777	15.36
Total	*16,784*	*53.07*	*19,057*	*57.69*	*35,846*	*55.43*

Although the females have greater death rates than the males, the group with the highest other heart disease (OHD) death rates is the Old Wave immigrants. Females from this designation share a rate of 118.33, and males 96.12. Unusually low rates are seen in connection with New Wave immigrants, their rates being only around 15 per 100,000. Of course, some of these differences are masked by group variation in age compositions. Therefore, it will be instructive to examine group specific differences in OHD mortality by age category, and look at the geometric means of age-specific death rates. This information is presented below.

	Canadian Born		Old Wave		New Wave	
Age	Male	Female	Male	Female	Male	Female
15-24	1.49	.66	1.82	.73	.22	.05
25-34	2.43	1.43	1.38	1.49	1.18	.43
35-44	5.92	3.20	4.35	1.63	2.12	.47
45-54	19.51	8.69	11.75	6.28	6.72	4.74
55-64	62.49	30.17	40.41	19.59	25.53	15.75
65-74	174.95	101.54	122.25	84.21	59.05	42.31
75+	717.08	693.58	807.62	872.30	424.12	364.39
GM	*22.87*	*12.77*	*17.56*	*10.68*	*8.14*	*3.78*

As was the case with IHD mortality rates, the age patter of OHD rises almost imperceptibly from age 15 to 54, at which point it begins to rise in an exponential fashion. The highest risk occurs among those aged 65 and older. At the oldest age

category, 75+, Old Wave females have the most elevated rate, followed by Old Wave males. The New Wave immigrants, of either sex, share a much lower level of risk, while the Canadian born are closer to the risk levels of the Old Wave. The age-specific death rates indicate that most of the mortality differentials across the nationality groups is likely to be found in the post retirement ages.

Table 21 concerns itself with the first step in the multivariate analyses of OHD. Equations (1) and (3) compare the overall age patter of OHD mortality for all groups combined and the immigrants alone. Below age 55 the immigrants show a lower net risk of death; but this changes in the opposite direction thereafter, where the chance of death for them is greater as compared to the overall population of Canada. Interestingly, once other variables are introduced in the analysis (i.e. equations (2) and (4)), this pattern of age specific differences no longer exists; and in fact, there now emerges a more favourable pattern of age-specific risk for the migrants. Only at the oldest age category is their risk above the general population. When the Canadian born population is used as the reference group, 11 of the 19 immigrant categories show significant effects on the conditional chance of dying from OHD. Of the Old Wave immigrant subgroups, the risk is relatively low for the Italians (-.254) the Japanese (-.151), and for "other countries" (-.989). Among the New Wave, the Chinese show an above average risk of OHD mortality (.372). However, as it has been observed on other occasions, immigrants from Other Asia, Africa, and South Central America/Mexico share reduced chances of premature death from this ailment. If one looks at equation (4), which considers only the immigrant sub-populations, excluding the Canadian born, the pattern of differentials is much more consistent with the New Wave advantage in risk. For instance, the six significant Old

Wave group effects (i.e. USA, Irish Republic, Portugal, Czechoslovakia, Other Scandinavia, “other countries”) are all positive, meaning a risk level above the overall average for immigrants as a whole. On the other hand, Other Asia, Africa, and South Central America/Mexico continue to demonstrate an advantaged risk profile, while the Chinese no longer show a significant deviation in risk from the average.

Table 21: Log-linear equations for Other Heart Disease mortality

	Canadian Born + Immigrants		Immigrants Only	
Effects	(1)	(2)	(3)	(4)
Intercept	-7.46652	-7.72365	-7.47000	-7.44133
Canadian Born		**ref**		
USA		.015		.121*
EW Germany		.265*		-.065
Irish Rep.		-.011		1.209*
EW/Sc/Nir.		1.263*		.085
Greece		.182*		-.163
Italy		-.254*		.092
Portugal		.036		.320*
Hungary		.105		.113
Poland		.115		-.100
USSR		.072		-.001
Czechoslovakia		.243*		.228*
Sweden		.255*		.216
Other Scandinavia		.388*		.221*
China		.372*		-.035
Japan		-.151*		-.211
Other Asia		-.206		-.569*
Africa		-.762*		-.781*
SCAm/Car/Mex.		-.902*		-.796*
(Other Countries)		-.989*		.302
Age 15-24	-2.798*	-3.108*	-2.975*	-3.019*
25-34	-2.226*	-2.193*	-2.314*	-2.084*
35-44	-1.412*	-1.294*	-1.625*	-1.410*
45-54	-.284*	-.159*	-.339*	-.247*
55-64	.907*	1.014*	.909*	.899*
65-74	2.016*	2.053*	2.101*	1.965*
(75+)	3.797	3.687	4.243	3.896
Male vs. (Female)	.101*	.212*	.032*	.162*
Married vs. (Other)		-.341*		-.344*
Atlantic Region		.177*		.084
Quebec		.013		-.057
Ontario		-.288*		-.356*
Prairies		.022		.203*
(BC)		.076		.129
CMA (ethnic community		-.084*		-.085*
SES Index		.02019*		.01756
Origin				-.00006**
Acculturation Index				.00113*
Duration Index				-.02673**
L^2M/ df	10445.60/ 4854	4732.84/ 4824	5576.15/ 4574	3113.18/ 4546
3113.18/ 4546	.58	.76	.75	.99

Notes: See footnotes in Tables 3 and 15. * p < = .05 ** p < = .10

Surprisingly, the SES effect is positive in equation (2). From the results in model (4), however, it is clear that this result is largely dictated by the influence of the Canadian born population, as when this group is removed from the analysis (i.e., in model (4)), the effect of SES is no longer significant. Furthermore, this implies that among the immigrant population of Canada SES, as measured here, plays no substantive role in accounting for variability in OHD. For the immigrants, Ontario (-.356) represents a low risk area, while Prairies has the opposite effect on their chance of OHD mortality. As will be seen later, this effect is largely due to the Old Wave's high mortality risk in this part of Canada (see Table 22). The effect of CMA location is consistent with the hypothesis that the urban ethnic community is a protective source against the conditional risk of premature death among immigrants in general (-.085). While the sex differential in risk is weaker in the immigrant equation, the marital status effect is virtually identical across the two models in Table 21.

Table 22 looks at four separate models: the Canadian born, the immigrants, the Old Wave, and the New Wave, respectively. The immigrants equation contains a group term: Old Wave vs. New Wave, to examine the relative risk of Old as compared to New Wave immigrants. In fact, it is evidently clear that Old Wave share a substantially greater risk than Old Wave migrants. Taking the exponent of the corresponding coefficients gives a relative risk of 2.19 for the Old Wave. That is, the net chance of premature death from OHD among Old Wave is over twice that of the New Wave migrants. However, marriage appears to be of greater relevance in terms of protection against OHD mortality among the Old Wave, as their coefficient for this term is somewhat greater (-.401) than

among the New Wave or the Canadian born. The regional effects are not uniform across groups. For instance, the Atlantic location is positive for the Canadian born, negative for immigrants as a whole and for Old Wave, but positive for New Wave. In Quebec, both Canadian born and Old Wave immigrants enjoy a reduced conditional risk, this region is of no consequence to the New Wave immigrants. The most consistent regional effect is that of Ontario, where its entails a net reduction in OHD mortality for all three nativity categories in this analysis, though the effect is more substantial for the New Wave. As indicated earlier, the Prairies region is a problematic area for the Old Wave migrants. To a lesser extent, British Columbia is also a high mortality risk area, in this case for all three subgroups (though the effects are relatively small as compared to Prairies). CMA locality shows a consistently significant negative effect across all three groups.

Table 22: Log-linear equations for Other Heart Disease mortality

Effects	Canadian Born	All Immigrants	Old Wave	New Wave
Intercept	-7.47712	-7.32362	-7.39105	-6.61164
Old Wave		.783*		
(New Wave)		-.783		
Age 15-24	-3.109*	-2.936*	-2.857*	-3.544*
25-34	-2.203*	-2.157*	-2.029*	-1.630*
35-44	-1.266*	-1.441*	-1.490*	-1.604*
45-54	-.129*	-.200*	-.287*	-.141
55-64	1.035*	1.158*	1.122*	1.104*
65-74	2.062*	2.110*	2.157*	2.079*
(75+)	3.610	3.466	3.384	3.736
Male vs. (Female)	.231*	.186*	.193*	.172*
Married vs. (Other)	-.332*	-.357*	-.401*	-.205*
Atlantic Region	.199*	-.228*	-.221*	.803*
Quebec	-.044*	.027*	-.202*	.029
Ontario	-.233*	-.332*	-.279*	-.718*
Prairies	-.063*	.466*	.532*	-.218*
(BC)	.141	.067	.170	.104
CMA (ethnic community	-.075*	-.076*	-.093*	-.193*
SES Index	-.00068	.14997*	.16903*	-.08876
Origin		.00072*	.00091*	.00040**
Acculturation Index		-.00437*	-.00114*	.00757*
Duration Index		.04389*	.08215*	-.16740*
L^2M/df	1214.77/ 265	1202.40/ 539	652.53/ 262	355.42/ 260
Pseudo R^2	.72	.73	.73	.76

Notes: See footnotes in Tables 3 and 15.

* p < = .05 ** p < = .10

As far as SES is concerned, its influence is unimportant for the Canadian born and for the New Wave migrants. However, it exerts a significant positive effect on the chance of death for Old Wave. To better examine this unexpected effect, it was decided to fit a number of models to the Old Wave data to better ascertain the role of SES and of region on mortality risk. The suspicion is that that region and SES may be collinear. Table OHD3 shows four equations. Model (1) includes both SES and region in the equation. Here, SES continues to be positive and significant; and the regional variables

are not substantially different from the values reported in the previous table. The second model looks at the possible effect of removing SES on the regional variables. Doing so makes no difference on the direction and pattern of regional effects. The third model fitted to the data removes region but keeps SES in. Here SES is positive but insignificant. Finally, the last equation in the table is devoid of both region and SES terms. As can be seen here, this has no real effects on the direction and pattern of other variables in the model. Of importance in this analysis is the change in the direction of the "origin" effect on the risk of death. It begins being positive in model (2), but turns negative in the subsequent two models. This is consistent with the earlier results for this variable shown in Table 23. Both acculturation and duration indexes are negative and statistically significant.

Table 23: Log-linear equations for Other Heart Disease mortality: Old Wave Immigrants

Effects	(1)	(2)	(3)	(4)
Intercept	-7.37972	-7.36572	-7.33311	-7.30193
Age 15-24	-2.491*	-2.791*	-2.312*	-2.304*
25-34	-1.982*	-2.001*	-1.569*	-1.393*
35-44	-1.573*	-1.361*	-1.416*	-1.393*
45-54	-.464*	-.121	-.485*	-.454*
55-64	.859*	1.119*	.384*	.391*
65-74	1.920*	2.039*	1.494*	1.478*
(75+)	3.731	3.116	2.637	3.675
Male vs. (Female)	.206*	.207*	.280*	.282*
Married vs. (Other)	-.346*	-.428*	-.461*	-.465*
Atlantic Region	-.279*	-.207*		
Quebec	-.196*	-.206*		
Ontario	-.307*	-.247*		
Prairies	.449*	.526*		
(BC)	.333	.134		
CMA (ethnic community	-.037*	-.096*	-.125*	-.125*
SES Index	.13826*		.03006	
Origin		.00103*	-.00100*	-.0096*
Acculturation Index		-.00922*	-.01898*	-.1849*
Duration Index		.08405*	-.12274*	-.11973**
L^2M/ df	751.40/ 265	685.58/ 263	1244.07/266	1245.17/ 267
Pseudo R^2	.69	.72	.50	.49

Notes: See footnotes in Tables 3 and 15.

* p < = .05 ** p < = .10

8.6.3 Cerebrovascular Disease

Cerebral thrombosis, cerebral embolism, intracerebral haemorrhage, and subarachnoid haemorrhage due to ruptured aneurysm are the major pathological categories of cerebrovascular disease (Poskanzer, 1986:1256). Cerebrovascular disease mortality rates have been declining in Canada and the United States since the 1960s (Blackburn and Luepker, 1986). Prolonged alcohol abuse, smoking, diabetes, and hypertension, are associated risk factors for this disease (Fielding, 1986; Rankin and Ashley, 1986; Kuller, La Porte and Orchard, 1986; Tyroler, 1986). According to the tabular data below, during the early 1990s in Canada, the overall crude death rate for this disease was 9.57 per

100,000 population. Females had a somewhat higher death rate than males: 11.59 and 7.46, respectively. In absolute terms, the number of cases of cerebrovascular disease mortality in Canada during 1990-92 was 6,188. The majority of the cases were Canadian born decedents (4,215 or 68 %); though the crude death rates are highest for Old Wave females (29.02) and males (17.03), respectively (see table below).

	Male		Female		Total	
	Number	Rate	Number	Rate	Number	Rate
Canadian Born	1648	6.56	2567	9.77	4215	6.52
Old Wave	681	17.03	1217	29.02	1898	23.17
New Wave	30	1.21	45	1.75	75	1.48
Total	2359	7.46	3829	11.59	6188	9.57

Given the sparseness of cases by nativity, and the fact that this disease afflicts mostly the elderly, one would anticipate few deaths in the younger ages, and a heavy concentration of deaths in the older ages. In fact, the tabulation below confirms this expectation. For such sparse data, it is meaningless to compute the geometric mean of death rates. A more appropriate approach here is to simply focus on the differences in age-specific death rates across gender and nativity. From these computations, it is clear that with the exceptions of the Old Wave rates at ages 75+, the Canadian born share disadvantages in the age-specific risk of dying from this disease. However, given the heavy concentration of deaths in the 75+ age category, in the overall sense, the higher mortality of the Old Wave immigrants in the preceding table (i.e. crude death rate) is explainable by their high mortality rates at ages 75+.

	Canadian Born		Old Wave		New Wave		Differences			
Age	Male	Female	Male	Female	Male	Female	CBm-OWm	CBm-NWm	CBf-OWf	CBf-NWf
15-24	0	0	0	0	0	0	0	0	0	0
25-34	0	0	0	0	0	0	0	0	0	0
35-44	0	0	0	0	0	0	0	0	0	0
45-54	1.00	0	0	0	00	0	1.00	1.00	1.00	0.00
55-64	3.17	1.70	1.85	1.00	1.00	0	1.32	0.70	0.70	0.70
65-74	17.99	7.42	10.83	4.62	2.73	2.69	7.16	15.26	2.80	4.73
75+	133.08	163.44	179.37	244.30	50.01	53.94	46.35	83.01	80.86	109.50

The multivariate analysis for this cause of death had to be modified to take into account the small number of cases and the lack of cases in some age groups. Table 24 contains four equations. The first model concerns the Canadian born only, and the remaining three are based on the immigrants (i.e., Old Wave and New Wave). As was noted previously, in all four models, the age effects turn positive starting at age 65. This indicates that the risk of cerebrovascular mortality is predominantly (though not exclusively) a phenomenon of advanced age. Interestingly, in these equations the gender effect is positive, indicating that once other variables are statistically controlled, it is males, rather than women, that share the greater risk of cardiovascular disease mortality. The married show a consistent advantage against this type of mortality across all four equations, the effect being somewhat stronger for the immigrants. For the Canadian born, Ontario shows a greater risk for this disease, while Prairies and British Columbia share relatively low risk levels. CMA is of no significance statistically for the Canadian born population. Similarly, SES is not of statistical relevance for this population. In fact, this conclusion can be extended to the immigrants as well.

The immigrant equations indicate that there are strong regional effects on the conditional risk of cerebrovascular mortality. The Atlantic and Quebec areas of Canada

are associated with reduced risk levels, while Ontario and Prairies share high chances of immigrant mortality from this cause of death. Surprisingly, CMA shows a positive and significant coefficient on the conditional. Moreover, among the linear covariates, only the acculturation index appears to be of importance in explaining immigrant mortality risk from the disease in question. There is no effect on the risk of country of origin, nor duration, and SES. The only significant predictor in equation (4) is the acculturation index. The greater the degree of cultural acculturation, the lower the chances of dying from this disease. The causal mechanisms for this effect may involve a modulation of some risk factors for cerebrovascular disease. With increasing levels of acculturation, immigrants may avoid or curtail, for example, alcohol and cigarette consumption, both being long term factors in the etiology of this disease.

Table 24: Log-linear equations for Cerebrovascular Disease mortality

Effects	Canadian Born	Immigrants (1)	Immigrants (2)	Immigrants (3)
Intercept	-5.46776	-5.47711	-5.47521	-5.46612
Old Wave		.250*	.284*	.712*
(New Wave)		-.250*	-.284*	-.712*
Age 15-24	---	---	---	---
25-34	---	---	---	---
35-44	-3.445*	---	---	---
45-54	-2.039*	-2.245*	-2.257*	-1.776*
55-64	-.044	-2.133*	-2.128*	-1.950*
65-74	1.585*	.749*	.773*	.666*
75+ (Ref)	3.943	3.629	3.612	3.060
Male vs. (Female)	.189*	.167*	.167*	.126
Married vs. (Other)	-.517*	-.586*	-.585*	-.617*
Atlantic Region	-.076		-.387	-.415*
Quebec	-.019		-.445*	-.457*
Ontario	.481*		.439*	.475*
Prairies	-.128*		.477*	.465*
(BC)	-.258		-.084	-.068
CMA (ethnic community	.024	.134*	.154*	.143*
SES Index	.189	.09118		.07852
Origin				.00009
Acculturation Index				-.02271*
Duration Index				-.13160
L^2M / df	531.01/ 187	173.62/ 310	144.48/ 306	139.36/303
Pseudo R^2	.72	.99	.99	.99

Notes --- means age group excluded due to no cases in this age category.
See footnotes in Tables 3 and 15.

* p < = .05 ** p < = .10.

8.6.4 Chronic Liver Disease and Cirrhosis

The most important risk factor (though not exclusively) for the development of chronic liver disease and cirrhosis is prolonged abuse of alcohol (Rankin and Ashley, 1986). As shown below, in Canada, during 1990-92 there were just under 6,500 deaths due to this chronic disease. The male death rate exceeded that of females by approximately a factor of two (13.85 vs. 6.40 per 100,000).

	Male		Female		Total	
	Number	Rate	Number	Rate	Number	Rate
Canadian Born	3,455	13.74	1,688	6.43	5,143	10.01
Old Wave	845	21.13	382	9.11	1,227	14.98
New Wave	81	3.26	44	5.13	125	7.41
Total	*4,381*	*13.85*	*2144*	*6.40*	*6,495*	*10.05*

The risk of death from this disease is far from uniform. Below the age of 45, relatively few people die from liver disease. And this is true of both sexes across the three designations of nativity. However, persons born in Canada share a greater overall risk, a pattern that is also evident across all age categories from 15 though 75+. The corresponding age-specific death rates are quite low for New Wave migrants, while those of their Old Wave counterparts fall in the intermediate range.

	Canadian Born		Old Wave		New Wave	
Age	Male	Female	Male	Female	Male	Female
15-24	0.14	0.08	0.18	0.11	0.07	0.24
25-34	0.79	0.62	0.40	0.56	0.30	0.03
35-44	5.37	2.57	4.99	1.75	1.30	0.31
45-54	17.68	6.78	13.63	5.50	4.84	.084
55-64	39.21	14.12	31.40	10.51	9.93	4.81
65-74	55.19	21.62	51.21	20.22	22.71	10.07
75+	53.21	27.45	52.90	25.19	14.00	15.79
GM	*7.35*	*3.56*	*6.35*	*3.16*	*2.35*	*1.04*

The multivariate analyses in Table 25 suggest that immigrant males have a higher level of mortality form this condition than do the Canadian born males. The coefficient for immigrants in equation (4) for gender is 0.621 as opposed to 0.557 for Canadian born men. This deficit in survival is also noted in connection with marital status. That is, married immigrants have a greater mortality risk than married Canadian born (-0.308 vs. –0.460). For the immigrants as a whole, there are no significant regional effects on the death rate for cirrhosis of the liver. Living in a CMA for immigrants produces an

increased chance of mortality, which is slightly higher than for the Canadian born. In this case, SES is significantly related to Canadian born mortality risk (negative), but it has no effect on the risk of the immigrants. The "origin" effect on mortality suggests that immigrants from countries that have a high death rate from this disease tend to have a lower rate of mortality in Canada. In other words, the risk reduces for the immigrants as compared to their home based rates. Increasing levels of acculturation are associated with a rise in cirrhosis mortality among immigrants. However, duration of residence shows an inverse association with the death rate for immigrants.

Table 25: Log-linear equations for Cirrhosis of the Liver mortality

Effects	Canadian Born	Immigrants (1)	Immigrants (2)	Immigrants (3)
Intercept	-8.88405	-8.46214	-8.46223	-8.39467
Old Wave		.886*	.973*	.766*
(New Wave)		-.886*	-.973*	-.766*
Age 15-24	-4.239*	-3.498*	-3.587*	-3.441*
25-34	-2.014*	-2.091*	-2.204*	-2.111*
35-44	-.091*	-.452*	-.581*	-.525*
45-54	1.045*	.664*	.541*	.481*
55-64	1.669*	1.537*	1.467*	1.352*
65-74	1.868*	1.973*	2.054*	1.920*
(75+)	1.762	1.867	2.310	2.324
Male vs. (Female)	.557*	.522*	.589*	.621*
Married vs. (Other)	-.460*	-.359*	-.362*	-.308*
Atlantic Region	-.179*	.123	-.034	-.037
Quebec	.080*	.024	*.051	.079
Ontario	.239*	.058	.035	.052
Prairies	-.094*	.145	.112	.045
(BC)				
CMA (ethnic community	.123*	.099*	.084*	.113*
SES Index	-.16901*	.03000	.03311	-.05002
Origin			-.00034*	-.00054*
Acculturation Index				.00768*
Duration Index				-.05067*
L^2M/df	802.30/ 265	595.96 /542	584.47/ 541	567.94/ 539
Pseudo R^2	.62	.52	.53	.54

Notes: See footnotes in Tables 3 and 15.

* p < = .05 ** p < = .10.

If we look at New Wave and Old Wave immigrants separately (see Table 26), now the CMA effect differs: it is negative for the more recent arrivals, but positive for the more established migrants in Canada. SES has a significant (inverse) effect only for the Old Wave, the effect being insignificant for the New Wave. However, "origin" shows a consistent negative influence on the death risk for both groups of migrants. Acculturation becomes insignificant in these separate group analyses. And duration is now only significant for the Old Wave immigrants: the longer the duration in Canada, the lower the risk.

Table 26: Log-linear Equations for Diabetes mortality

Effects	Old Wave	New Wave
Intercept	-8.47712	-8.52364
Age 15-24	---	
25-34	---	---
35-44	-1.438*	-1.797*
45-54	-.539*	-.907*
55-64	.154*	.195
65-74	.652*	1.309*
(75+)	1.171	1.200
Male vs. (Female)	.700*	.385*
Married vs. (Other)	-.330*	-.262*
Atlantic Region	---	
Quebec	-.103	.541*
Ontario	.169*	--1.023*
Prairies	.089.	.142
(BC)	-.155	.340
CMA (ethnic community	.101*	-.160*
SES Index	-.17654*	-.01465
Origin	-.00068*	-.00348*
Acculturation Index	.00561	.00179
Duration Index	-.07665*	-.20553
L^2M/ df	291.53/ 145	101.57/ 144
Pseudo R^2	.62	.99

Notes: --- means age group excluded due to no cases in this age category.
See footnotes in Tables 3 and 15.

* p < = .05 ** p < = .10.

8.6.5 Diabetes

According to Kuller, La Porte and Orchard (1986), diabetes is a major disease, affecting a large proportion of the population. As stated by these researchers, Diabetes is a chronic disease in which "there is a deficiency in the action of the hormone insulin, an abnormal insulin, resistance to its action, or a combination of deficits. Two major forms of the disease are recognized: Insulin-dependent diabetes mellitus (IDDM), which comprises about 10 percent of all cases, and non-insulin-dependent diabetes mellitus (NIDDM), which accounts for about 90 percent of the cases" (p. 1225). As can be seen below, in Canada the crude death rates for males and females during 1990-92 were 19.22 and 20.68 per 100,000 population, respectively; and the overall rate was 19.96. People with diabetes have increased risk of premature death compared to the general population, as a result of this disease's effects on the functioning of vital organs, primarily the kidneys and the cardiovascular system.

	Male		Female		Total	
	Number	Rate	Number	Rate	Number	Rate
Canadian Born	4,700	18.70	5,046	19.21	9,746	18.96
Old Wave	1,194	29.86	1,582	37.73	2,776	33.88
New Wave	184	7.63	202	7.85	386	7.63
Total	*6,078*	*19.22*	*6,830*	*20.68*	*12,908*	*19.96*

Concerning crude rate differentials by nativity, among the males the Old Wave migrants suffer a disproportionate incidence of diabetes, with a corresponding rate of 29.86 per 100,000. The Canadian born males follow, with a rate of 18.70. New Wave migrants show a characteristically low death rate (7.63). The female death rates for this disease surpass those of their male counterparts. The largest discrepancy occurs among Old Wave immigrants.

These differentials may change once group differences in age distribution are considered. Indeed, as demonstrated below with the geometric means (GM) of the three nativity groups, once compositional discrepancies are taken into account, the rank order of differences in overall risk sees the Canadian born as having higher death rates than both Old and New Wave immigrants. And this is true of both sexes. The age-specific death rates show that in virtually all age categories, except in the oldest, the Canadian born population has the highest levels of diabetes-related mortality and the New Wave the lowest.

	Canadian Born		Old Wave		New Wave	
Age	Male	Female	Male	Female	Male	Female
15-24	.21	.28	.18	.11	.04	.02
25-34	1.03	.70	.79	.56	.04	.01
35-44	2.93	1.44	1.54	.25	.16	.16
45-54	8.14	5.62	3.88	1.34	3.22	1.67
55-64	26.49	18.51	15.77	9.23	11.82	7.00
65-74	76.57	51.61	44.79	39.95	47.24	37.61
75+	230.12	210.80	231.68	258.34	188.05	161.81
GM	*8.17*	*6.11*	*5.42*	*2.94*	*1.95*	*1.21*

Tables 27 and 28 display multivariate equations for diabetes mortality. In the first of these tables, the Canadian born show reduced relative risks if they reside in a CMA and with increasing levels of SES. The immigrants demonstrate the usual rank order of effects, with the Old Wave having significantly greater rates of diabetes mortality than their more recent counterparts. Only "origin" and acculturation show significant influences on the death rate from this disease among immigrants (model (4)). In Table 28, the two immigrant populations are treated separately. Both groups are more likely to die from diabetes complications if they are in Quebec. But for the Old Wave, Ontario and Prairies also entail an increased relative risk, whereas for the New Wave, Ontario is

associated with reduced mortality chances from this disease. None of the various linear covariates are significant for the New Wave immigrants, while for the Old Wave migrants, CMA exerts a negative effect on mortality risk, as do the effects of "origin," acculturation, and duration of residence in Canada. All this suggests that diabetes varies considerably among the established immigrants and not sufficiently so in more recent newcomers.

Table 27: Log-linear equations for Diabetes mortality

Effects	Canadian Born	Immigrants (1)	Immigrants (2)	Immigrants (3)
Intercept	-8.57112	-8.51274	-8.50000	-8.49271
Old Wave		.652*	.658*	.782*
(New Wave)		-.652*	-.658*	-.782*
Age 15-24	-3.624*	---	---	---
25-34	-2.072*	-2.641*	-2.669*	-2.772*
35-44	-1.068*	-1.997*	-2.068*	-2.116*
45-54	.075	-1.013*	-1.139*	-1.158*
55-64	1.204*	.602*	.508*	.548*
65-74	2.170*	1.792*	1.809*	1.849*
(75+)	3.315	1.260	3.559	3.679
Male vs. (Female)	.213*	.126*	.203*	.212*
Married vs. (Other)	-.293*	-.288*	-.286*	-.276*
Atlantic Region	.105*	-.264*	-.193	-.208
Quebec	.260*	.291*	.239*	.279*
Ontario	.175*	.032	.027	.028
Prairies	-.217*	.235*	.185*	.182*
(BC)	-.323	-.294	-.258	-.284
CMA (ethnic community	-.054*	.058*	.023	.038
SES Index	-.04354*	-.00059	.00809	-.02808
Origin			-.00030*	-.00032*
Acculturation Index				.00388*
Duration Index				.03065
L^2M/ df	682.58/ 265	628.37/ 463	609.95/ 462	603.71/ 460
Pseudo R^2	.62	.54	.56	.56

Notes: --- means age group excluded due to no cases in this age category.
See footnotes in Tables 3 and 15.

* p < = .05 ** p < = .10.

Table 28: Log-linear equations for Diabetes mortality

Effects	Old Wave	New Wave
Intercept	-8.01641	-9.47622
Age 15-24	---	---
25-34	-1.837*	---
35-44	-1.635*	-3.509*
45-54	-1.279*	-1.096*
55-64	.387*	.157
65-74	1.455*	1.659*
(75+)	2.913	2.789
Male vs. (Female)	.138*	.184*
Married vs. (Other)	-.329*	-.106*
Atlantic Region	-.172	---
Quebec	.204*	.419*
Ontario	.110*	-.411*
Prairies	.235*	-.024
(BC)	-.377	.016
CMA (ethnic community	.-.071*	-.121
SES Index	-.05156	-.09429
Origin	-.00081*	.00050
Acculturation Index	-.00719*	.00721
Duration Index	-.05428**	-.03986
L^2M/ df	355.63/ 223	104.55/ 144
Pseudo R^2	.53	.99

Notes: --- means age group excluded due to no cases in this age category.
See footnotes in Tables 3 and 15.

* p < = .05 ** p < = .10.

8.6.6 Stomach Cancer

Some change in diet is to be expected with the process of acculturation. Usually immigrants continue their home based diets during the initial years of relocation; but with the passage of time in the adopted country, they are likely to incorporate into their diet a variety of foods from their new society. This seems inevitable, and constitutes an important aspect of the acculturation process. High rates of stomach cancer among immigrants are likely the result of changes in dietary habits. In fact, the epidemiological literature suggests that indeed a change in dietary habits is often a factor in stomach

cancer (Thomas, 1986: 1152). As shown in the table below, immigrants who have been in Canada for a longer period of time (i.e., Old Wave) have considerably higher stomach cancer death rates than the Canadian born. On the other hand, immigrants that are more recent to this country have quite low mortality from this cause of death.

	Male		Female		Total	
	Number	Rate	Number	Rate	Number	Rate
Canadian Born	2,596	10.33	1,654	6.30	4,252	8.27
Old Wave	1,114	27.84	654	15.60	1,768	21.58
New Wave	116	4.67	82	3.19	199	3.93
Total	*3,828*	*12.11*	*2,391*	*7.24*	*6,219*	*19.24*

While males have higher crude death rates from stomach cancer, as a whole, the largest mortality disadvantage for this cause of death is seen for the Old Wave immigrants, with a crude rate of 21.85 per 100,000 population. This is almost three times the rate of Canadian Born persons, and about four times the rate of New Wave immigrants. Since the age distribution differences among these populations is substantial, we need to examine age-specific death rates to gain a clear picture of the differences.

	Canadian Born		Old Wave		New Wave	
Age	Male	Female	Male	Female	Male	Female
15-24	.02	.06	.18	.07	.11	.47
25-34	.18	.24	.40	.37	.59+	.43
35-44	1.51	.81	2.18	1.13	1.46	1.55
45-54	5.28	2.80	10.25	2.88	3.22	1.67
55-64	19.14	7.82	27.16	9.23	11.82	5.25
65-74	45.42	21.10	58.19	24.04	29.07	14.77
75+	108.74	55.53	145.09	83.64	68.02	39.46
GM	*3.08*	*2.26*	*6.24*	*2.88*	*3.56*	*2.87*

The age-specific death rates of stomach cancer are consistently greater for the Old Wave immigrants. Canadian Born rates are intermediate to Old and New Wave rates.

Nevertheless, the geometric means indicate that on the whole immigrants do not fare as well as the Canadian Born, as far as stomach cancer is concerned. In all cases, immigrant geometric means exceed the Canadian Born average for both males and females. This pattern of differences may indicate problems related to dietary change among immigrants. While immigrants may retain certain aspects of their cultures in their adopted society, it appears that some dietary convergence does indeed occur. As demonstrated by these death rates, the change is to the detriment of the migrants. Whether this phenomenon is a carry-over effect from their home countries is difficult to prove; however, the fact that New Wave have the lowest risk and Old Wave the largest, is indicative of an acculturation effect. However, this interpretation needs to be scrutinized against the results from a multivariate analysis, which is presented below in tables Table 29 and 30.

In the first of these tables four equations are shown: one for the Canadian born, and the rest are different specifications for the immigrants, involving different predictor variables. What can be said of these results? One obvious conclusion is that the Old Wave share a significantly greater risk of stomach cancer mortality as compared to the New Wave migrants, their relative risk in equation (4) being about 13 per cent greater (i.e. exponent of 0.887 = 1.127). But what about the comparison of the immigrants to the Canadian born? It is interesting to note in equation (4) that across all age, sex and marital status categories the regression coefficients are lower for the immigrants. This contradicts our earlier observations. Why the difference in results? The answer lies in the fact that in the present analysis more variables have been taken into account, thus allowing for a more complete analysis.

Table 29: Log-linear equations for Stomach Cancer mortality

Effects	Canadian Born	Immigrants (1)	Immigrants (2)	Immigrants (3)
Intercept	-9.17801	-8.32415	-7.33941	-8.30192
Old Wave		.691*	.686*	.887*
(New Wave)		-.691*	-.686*	-.887
Age 15-24	-4.378*	---	---	---
25-34	-2.553*	-2.547*	-2.463*	-2.539*
35-44	-.870*	-1.318*	-1.255*	-1.371*
45-54	.364*	-.371*	-.309*	-.403*
55-64	1.583*	.592*	.622*	.627*
65-74	2.488*	1.389*	1.324*	1.419*
(75+)	3.370	2.255	2.085	2.267
Male vs. (Female)	.398*	.433*	.369*	.374*
Married vs. (Other)	-.121*	-.129*	-.130*	-.131*
Atlantic Region	.353*	-.468*	-.441*	-.450*
Quebec	.274*	.225*	.229*	.172*
Ontario	-.259*	.154*	.134*	.122*
Prairies	-.069	.264*	.256*	.291*
(BC)	-.299	-.175	.178	-.135
CMA (ethnic community	-.041*	.160*	.146*	.116*
SES Index	.01922	.00628	.01818	.08777*
Origin			.00149*	.00159*
Acculturation Index				-.00437*
Duration Index				.04076*
L^2M/ df	296.92/ 265	506.16/ 463	503.14/ 462	491.10/ 460
Pseudo R^2	.56	.52	.52	.53

Notes: --- means age group excluded due to no cases in this age category.
See footnotes in Tables 3 and 15.

* p < = .05 ** p < = .10.

Of some interest is the observation concerning region of residence in Canada. As can be seen in Table 29, immigrants in Ontario and the Prairies have greater rates of stomach cancer mortality than in any other region of Canada. Why this is so certainly requires further investigation. Also important is the finding with respect to CMA residence, which shows an immigrant disadvantage in risk. Also interesting is the finding that with increasing SES, the risk of death from stomach cancer goes up among immigrants. Could this possibly reflect changes in dietary habits with increasing wealth

in the new country? The effect of "origin" is consistent with expectation: the higher the level of stomach cancer mortality among the populations of origin, the higher the mortality from this cause among the immigrants, suggesting a link in dietary habits between origin and immigrant population. For instance, a diet high in salt may be carried over to the new world by the immigrants, thus accounting for higher mortality. It also appears that with increased duration in Canada the relative risk of mortality from stomach cancer goes up. But acculturation in this case is related to reductions in risk. This may indicate two complementary processes. On the one hand, with duration, selection effects for health reduce and mortality risk goes up, while on the other, acculturation implies improved dietary habits and hence a reduced mortality risk. Clearly, this is an intricate phenomenon in need of further investigation.

Table 30 looks at New Wave and Old Wave immigrants separately. As can be seem here, for the Old Wave acculturation is significant, the effect being to reduce mortality risk. This accords with the earlier result. Duration of residence in Canada is also consistent, showing a significant positive effect on the relative risk of death. However, SES and origin factors are statistically insignificant. It is interesting that CMA effect is positive and significant for the Old Wave but negative and significant for the New Wave migrants. This suggests that living in a CMA is beneficial for newcomers insofar as stomach cancer is concerned. The only significant effect of the linear covariates for the New Wave migrants is the "origin" effect. That is, recent immigrants whose countries of origin have high rates of stomach cancer mortality also experience relatively high death rates of this disease in Canada. All the other effects in the table are indicative of Old

Wave showing higher death risks as compared to the New Wave immigrants (i.e. age, sex, marital status and region effects).

Table 30: Log-linear Equations for Stomach Cancer mortality

Effects	Old Wave	New Wave
Intercept	-8.44495	-10.14431
Age 15-24	---	---
25-34	-2.992*	-1.677*
35-44	-1.567*	-.959*
45-54	-.486*	-.343
55-64	.671*	.444*
65-74	1.669*	1.279*
(75+)	-2.705	1.256
Male vs. (Female)	.498*	.076
Married vs. (Other)	-.141*	-.072
Atlantic Region	-.413*	---
Quebec	-.037	.537*
Ontario	.209*	-.417*
Prairies	.318*	.074
(BC)	-.077	-.194
CMA (ethnic community	.114*	-.315*
SES Index	.06555	.06685
Origin	-.00050	.006085*
Acculturation Index	-.01096*	-.00079
Duration Index	.05859*	-.10797
L^2M/ df	267.28/ 223	153.73/ 175
Pseudo R^2	.62	.88

Notes: --- means age group excluded due to no cases in this age category.
See footnotes in Tables 3 and 15.

* p < = .05 ** p < = .10.

8.6.7 Lung Cancer

Lung cancer is a major killer. In Canada, it accounts for over 14,000 deaths annually. It is generally agreed in medical and epidemiological circles that prolonged use of tobacco is the leading cause of lung cancer. The crude death rates from lung cancer by gender and nativity are shown below for the period of 1990-92.

	Male		Female		Total	
	Number	Rate	Number	Rate	Number	Rate
Canadian Born	22,909	91.13	10,912	41.55	33,821	65.80
Old Wave	5,535	138.40	2,292	54.66	7,827	95.54
New Wave	441	17.74	211	8.20	652	12.89
Total	*28,885*	*91.34*	*13,424*	*40.64*	*42,300*	*65.42*

The Age-specific pattern of death from lung cancer conforms to expectation, in that the risk increases exponentially with advancing age, particularly after the early forties. This is essentially true in the case of both men and women, though the risk is considerably greater for males. The two extreme subgroups for these rates are represented by Canadian born males (as having the highest lung cancer mortality) and by New Wave females (as having the lowest age-specific risks). In general, differences between the Canadian Born and the Old Wave immigrants are smaller than that between Canadian Born and New Wave immigrants. As demonstrated by the geometric means, the overall lung cancer death risk follows the now familiar pattern by nativity: Canadian born show the highest rates, followed by Old Wave, and finally, by the New Wave immigrants.

	Canadian Born		Old Wave		New Wave	
Age	Male	Female	Male	Female	Male	Female
15-24	.10	.02	.18	.07	.11	.02
25-34	.69	1.02	.59	.19	.29	.01
35-44	7.74	6.87	4.10	4.13	1.63	1.40
45-54	54.52	36.63	34.01	17.92	10.21	6.69
55-64	223.81	99.77	151.97	55.65	49.18	14.88
65-74	464.52	164.98	351.51	127.82	123.56	40.29
75+	676.73	187.26	640.07	191.23	302.08	110.50
GM	*21.28*	*10.67*	*17.56*	*7.52*	*7.20*	*2.15*

Tables 31 and 32 display log linear multivariate results for lung cancer mortality. Looking at equation (4), we see that the relative risk is about 30 per cent greater for Old Wave immigrants as compared to their more recent counterparts. All of the age effects

are greater for the Canadian born population as compared to those for immigrants. But immigrant men have a slightly greater risk of lung cancer than do Canadian born men (about 3 %). There is no difference in risk by marital status between immigrants as a whole and the Canadian born (both coefficients are identical, -0.155). Immigrants have a greater risk of dying form lung cancer in Quebec, Ontario and the Prairie region, while in the Atlantic and in British Columbia their risk is reduced. As compared to the Canadian born population, the risk for the migrants is greater in Ontario and Prairies. The effect of living in a CMA serves to raise the relative risk of death from lung cancer for both Canadian born and immigrants as a whole, though the influence of CMA is larger for the Canadian born.

Table 31: Log-linear Equations for Lung Cancer mortality

Effects	Canadian Born	Immigrants (1)	Immigrants (2)	Immigrants (3)
Intercept	-7.33127	-6.95905	-6.91001	-6.90025
Old Wave		.779*	.736*	.771*
(New Wave)		-.779*	-.736*	-.771*
Age 15-24	-5.719*	---	---	---
25-34	-2.919*	-3.887*	-3.809*	-3.878*
35-44	-.698*	-1.753*	-1.666*	-1.717*
45-54	1.121*	-.101	-.029	-.040
55-64	2.288*	1.316*	1.326*	1.349*
65-74	2.857*	2.038*	1.948*	1.987*
(75+)	3.070	2.387	-1.579	2.299
Male vs. (Female)	.533*	.654*	.561*	.566*
Married vs. (Other)	-.155*	-.160*	-.163*	-.155-
Atlantic Region	.052*	-.233*	-.256*	-.258*
Quebec	.276*	.083*	.113*	.134*
Ontario	.017	.095*	.089*	.093*
Prairies	-.274*	.208*	.220*	.216*
(BC)	-.077	-.153	-.166	-.185
CMA (ethnic community	.042*	.026*	.026*	.035*
SES Index	-.11645*	-.03271	-.02505	-.03599
Origin			.00068*	.00067*
Acculturation Index				.00179
Duration Index				.01866
L^2M/ df	1831.08/ 265	966.26/ 463	949.27/ 462	946.15/ 460
Pseudo R^2	.53	.71	.72	.73

Notes: --- means age group excluded due to no cases in this age category.
See footnotes in Tables 3 and 15.

* p < = .05 ** p < = .10.

Looking at the linear covariates, the only significant effect is in connection with the "origin" variable. That is, immigrants from populations having high lung cancer death rates also share a high mortality risk in Canada from this disease. If we separate the analysis on the basis of New versus Old Wave designation, Table 32 some interesting differences between these two categories of immigrants. While for the Old Wave being in a CMA increases the mortality risk, it reduces it considerably for the New Wave

migrants. SES is inversely related for Old Wave, but not significant for the New Wave. Origin effects increase the mortality risk for Old Wave; but this variable has not effect on New Wave mortality risk for lung cancer. The effect of duration is not significant among the Old Wave migrants, though for the New Wave it is significant, denoting a negative effect on the risk of death with increased duration of residence of Canada. This result may be indicative of a curvilinear functional form of duration on lung cancer mortality. It may be that in this case the risk increases with duration up to a point and then reduces beyond that point, as immigrants become more established in their new environment. This interpretation remains speculative, of course, and will require further study.

Table 32: Log-linear equations for Lung Cancer mortality

Effects	Old Wave	New Wave
Intercept	-6.95006	-8.957547
Age 15-24	---	---
25-34	-3.606*	-3.739*
35-44	-1.1678*	-1.622*
45-54	-.000	-.330
55-64	1.323*	.984*
65-74	1.870*	2.129*
(75+)	1.581	2.578
Male vs. (Female)	.512*	.412*
Married vs. (Other)	-.183*	-.087
Atlantic Region	-.241*	-.028
Quebec	.041	.267*
Ontario	.133*	-.251*
Prairies	.231*	.128
(BC)	-.164	-.116
CMA (ethnic community	.032*	-.439*
SES Index	-.06669*	.05591
Origin	.00104*	.00081
Acculturation Index	-.00176	-.00075
Duration Index	.01668	-.12959*
L^2M / df	546.11/ 223	259.83/ 221
Pseudo R^2	.62	.77

Notes: --- means age group excluded due to no cases in this age category.
See footnotes in Tables 3 and 15.
p < = .05 ** p < = .10.

8.6.8 Other Cancers

There are many other types of cancer, which in this study have been combined under one residual category, "other cancers." Due to the heterogeneity of these cancers, it is not possible to say very much in detail about this class of mortality in this analysis. The table below shows that Old Wave males have a higher death rate than Canadian born men, but almost a factor of two. The Old Wave female immigrants also have high death rates as

compared to their Canadian born counterparts. The death rates for the New Wave are considerable lower than either the Canadian born or the Old Wave immigrants.

	Male		Female		Total	
	Number	Rate	Number	Rate	Number	Rate
Canadian Born	42,212	167.92	43,397	165.23	85,609	166.55
Old Wave	12,085	302.18	11,901	283.80	23,986	292.77
New Wave	1,195	48.07	1,203	46.74	2,398	47.39
Total	*55,492*	*175.48*	*56,501*	*171.05*	*111,993*	*173.22*

The age pattern of other cancer mortality indicates an exponential rise in risk with advancing age. The differences by age across nativity and sex are fairly predictable: Canadian born males and Old Waves males form the highest rates across age categories, followed by Canadian born females and Old Wave females. The lowest age-specific rates are shown for the New Wave immigrants.

	Canadian Born		Old Wave		New Wave	
Age	Male	Female	Male	Female	Male	Female
15-24	6.14	3.97	4.73	1.81	3.12	2.59
25-34	10.04	10.97	9.88	10.23	4.12	3.32
35-44	25.66	40.36	23.43	39.17	12.86	14.74
45-54	95.19	118.33	74.77	108.46	34.66	42.10
55-64	313.95	276.82	243.26	238.08	113.01	114.65
65-74	705.85	518.54	596.01	464.97	301.63	183.34
75+	1,703.40	1,172.10	1,819.72	1,259.92	748.21	510.41
GM	*92.24*	*86.06*	*80.35*	*72.95*	*39.35*	*34.43*

What do the multivariate results indicate? Tables 33 and 34 show that the Old Wave immigrants share approximately a 72 per cent greater mortality risk than their New Wave counterparts. Concerning the first of these two tables, "origin" and "duration" variables show net inverse associations with mortality risk, while CMA has a positive influence. Immigrants have high death rates in Quebec, Ontario and the Prairie region as compared to British Columbia and the Atlantic region. Looking at Table 34, we see that

the effect of marriage is insignificant for the New Wave immigrants. There are also differences in regional effects for these two subgroups. For instance, in the Atlantic region, New Wave immigrants have an increase risk of death, while this is negative in the case of Old Wave immigrants. However, in Ontario, the results are in the opposite direction for these two groups. CMA reduces the risk for New Wave, while it increases it for Old Wave. SES is inversely and significantly related for New Wave, but it has no effect on Old Wave mortality risk. The effect of "origin" is important in both cases, to raise mortality. Acculturation and duration indexes are inversely related to death risk for the Old Wave. However, in the case of New Wave immigrants only duration is significant (negative).

Table 33: Log-linear Equations for Other Cancer mortality

Effects	Canadian Born	Immigrants (1)	Immigrants (2)	Immigrants (3)
Intercept	-6.40761	-5.82300	-5.79922	-5.79026
Old Wave		.704*	.678*	.583*
(New Wave)		-.704*	-.678*	-.582*
Age 15-24	-2.945*	-2.957*	-2.947*	-2.897*
25-34	-2.111*	-2.116*	-2.101*	-2.080*
35-44	-.919*	-.873*	-.850*	-.841*
45-54	.246*	.066	.090*	.084*
55-64	1.203*	1.167*	1.185*	1.163*
65-74	1.870*	1.923*	1.916*	1.866*
(75+)	2.656	2.790	2.707	2.705
Male vs. (Female)	.142*	.171*	.154*	.170*
Married vs. (Other)	-.100*	-.106*	-.104*	-.088*
Atlantic Region	.034*	-.372*	-.391*	-.403*
Quebec	.121*	.209*	.225*	.299*
Ontario	.079*	.086*	.090*	.095*
Prairies	-.085*	.289*	.297*	.267*
(British Columbia)	-.149	-.212	-.221	-.258
CMA (ethnic community	.014*	.053*	.057*	.068*
SES Index	-.06560*	.05698*	.05924*	.02065
Origin			.00007*	-.00001
Acculturation Index				-.00465*
Duration Index				-.01622*
L^2M/ df	2224.94/ 265	2598.13/ 542		2536.61/ 539
Pseudo R^2	.62	.73	.74	

Notes: --- means age group excluded due to no cases in this age category.
See footnotes in Tables 3 and 15.

* p < = .05 ** p < = .10.

Table 34: Log-linear equations for Other Cancer mortality

Effects	Old Wave	New Wave
Intercept	-5.83617	-7.66778
Age 15-24	-2.721*	-2.533*
25-34	-1.657*	-2.128*
35-44	-.705*	-.758*
45-54	.105*	.050
55-64	1.024*	1.142*
65-74	1.647*	1.846*
(75+)	2.307	2.381
Male vs. (Female)	.153*	.066*
Married vs. (Other)	-.135*	-.029
Atlantic Region	-.379*	.349*
Quebec	.086*	.407*
Ontario	.165*	-.445*
Prairies	.307*	.048
(BC)	-.179	-1.214
CMA (ethnic community	.037*	-.086*
SES Index	.01827	-.056*
Origin	.00011*	.00109*
Acculturation Index	-.00483*	.00224
Duration Index	-.04723*	-.08124*
L^2M / df	1493.20/ 262	740.97/ 260
Pseudo R^2	.56	.66

Notes: See footnotes in Tables 3 and 15.

* p < = .05 ** p < = .10.

8.7 Residual Causes of Death

As is true in the case of other cancers, the last category of disease examine in this study is a residual class, containing many undefined diseases and conditions. This category was included simply for the same of completeness of the analysis. Therefore, interpretations of results can only be stated as broad generalizations.

	Male		Female		Total	
	Number	Rate	Number	Rate	Number	Rate
Canadian Born	68,384	272.04	64,897	247.10	133,281	259.29
Old Wave	20,753	518.91	23,768	566.79	44,521	543.42
New Wave	1,971	79.28	1,871	72.70	3,842	75.93
Total	*91,108*	*288.10*	*90,536*	*274.09*	*181,644*	*280.94*

First, as shown above, the crude death rates are consistent with pretty much of what has been shown thus far: Old Wave immigrants show high death rates overall, and New Wave migrants have lowest rates. This is generally true of both males and females. The age patterns of mortality (shown below) from residual causes conform to what has been observed in earlier analyses. The only exception is the crossover in death rates in the oldest age category, where Old Wave immigrant death rates exceed those of the Canadian born. Otherwise, the rank order of death rates is the same as established in most of this analysis: the Canadian born have the highest rates, followed by Old Wave, and then New Wave immigrants, respectively.

	Canadian Born		Old Wave		New Wave	
Age	Male	Female	Male	Female	Male	Female
15-24	15.81	9.31	11.29	4.72	5.12	2.36
25-34	36.24	14.78	27.87	12.09	10.16	6.21
35-44	60.88	24.38	42.12	18.90	21.81	7.29
45-54	100.93	58.88	71.02	37.42	36.01	18.96
55-64	271.18	155.03	177.81	104.20	97.41	66.95
65-74	873.27	487.46	604.82	374.24	324.34	224.31
75+	3,922.25	3,121.61	4,446.47	4,164.89	2,096.59	1,599.64
GM	*164.58*	*89.67*	*123.98*	*67.75*	*59.72*	*33.62*

Tables 35 and 36 show the multivariate results for residual mortality. In general, the results are consistent with earlier observations in connection with the other causes of death examined in this study. Looking at the linear covariates, CMA raises immigrant mortality, as does SES. Death rates are inversely related for immigrants who come from

high mortality populations. Duration of residence in Canada is positively related to mortality risk. The second of these tables separates the two groups. In this case, CMA raises the relative risk only for the Old Wave but not for New Wave immigrants, for whom the effect is negative. SES is now significant for both groups, but it shows a positive influence on the risk of death for the Old Wave migrants and negative for the newer class of migrants. The influence of country of origin is unimportant for the New Wave, while it reduces the risk for Old Wave immigrants. Acculturation is associated with reduced mortality among Old Wave but increased risk for the New Wave migrants. Finally, increased duration of residence in Canada is related to a reduction in risk for both immigrant groups.

Table 35: Log-linear equations for Residual causes of death

Effects	Canadian Born	Immigrants (1)	Immigrants (2)	Immigrants (3)
Intercept	-5.95617	-5.66821	-5.08482	-5.07132
Old Wave		.675*	.836*	.882*
(New Wave)		-.675*	-.836*	-.882*
Age 15-24	-2.643*	-2.993*	-3.029*	-3.076*
25-34	-1.577*	1.703	-1.709*	-1.750*
35-44	-.938*	-.975	-.997*	-1.023*
45-54	-.299*	-.385*	-.413*	-.417*
55-64	.608*	.666*	.631*	.653*
65-74	1.662*	1.749*	1.769*	1.809*
(75+)	3.187	3.641	3.748	3.803
Male vs. (Female)	.315*	.283*	.376*	.375*
Married vs. (Other)	-.383*	-.361*	-.362*	-.361*
Atlantic Region	.044*	-.477*	-.463*	-.469*
Quebec	.038*	.140*	.117*	.113*
Ontario	.136*	.060*	.086*	.083*
Prairies	-.130*	.399*	.373*	.378*
(BC)	-.088	-.122	-.113	-.105
CMA (ethnic community	-.003	.021*	.041*	.041*
SES Index	-.06091*	.04969*	.05288*	.05069*
Origin			-.07163*	-.06839*
Acculturation Index				.00032
Duration Index				.01572*
L^2M/ df	6871.92/ 265	3632.08/ 542	3544.85/ 541	3541.17/ 539
Pseudo R^2	.72	.81	.82	.83

Notes: See footnotes in Tables 3 and 15.

* p < = .05 ** p < = .10.

Table 36: Log-linear equations for Residual causes of death

Effects	Old Wave	New Wave
Intercept	-5.21528	-7.18219
Age 15-24	-2.971*	-2.704*
25-34	-1.485*	-1.573*
35-44	-.912*	-.949*
45-54	-.476*	-.504*
55-64	.439*	.559*
65-74	1.662*	1.864*
(75+)	3.743	3.307
Male vs. (Female)	.501*	.257*
Married vs. (Other)	-.424*	-.254*
Atlantic Region	-.376*	.345*
Quebec	-.222*	.251*
Ontario	.194*	-.395*
Prairies	.367-*	-.059
British Columbia (Ref)	.037	-.142
CMA (ethnic community	.029*	-.140*
SES Index	.07623*	-.10022*
Origin	-.15371*	.00000
Acculturation Index	-.01254*	.00347*
Duration Index	-.02472	-.144999*
L^2M / df	2046.35/ 262	685.28/ 261
Pseudo R^2	.78	.54

Notes: See footnotes in Tables 3 and 15.

* p < = .05 ** p < = .10.