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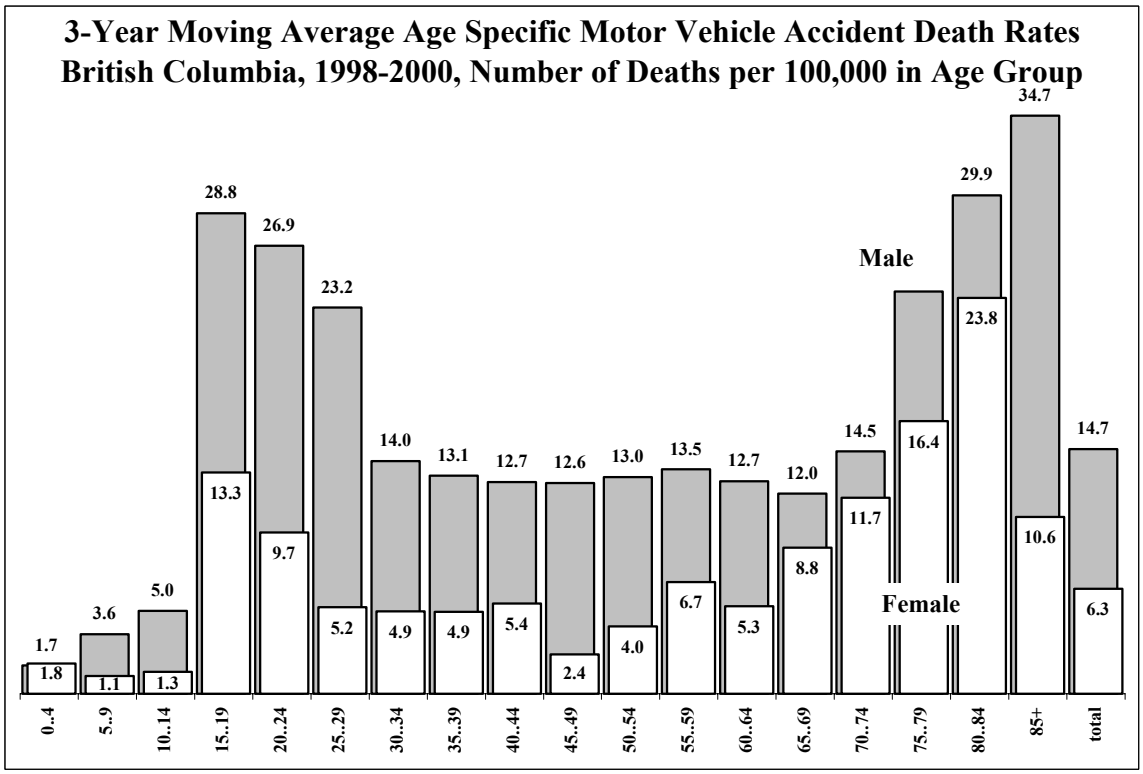
Research on Population, Community Change and Land Use

Street Smart:

Demographics and Trends in Motor Vehicle Accident Mortality In British Columbia, 1988 to 2000

by David Baxter



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Summary

The number of deaths in motor vehicle accidents in British Columbia has declined dramatically over the past decade, from 606 deaths in 1988 to only 375 in 2000. Even more significant was the decline in the number of these mortalities per 100,000 population, which dropped by 53%, from 19.5 motor vehicle mortalities per 100,000 population in 1988 to 9.2 per 100,000 in 2000.

Given the small numbers now involved in motor vehicle accident mortality, it is prudent to use moving averages to identify long-term trends. During the 1988 to 1990 period, there was an average of 626 deaths per year due to motor vehicle accidents: by the 1998 to 2000 period, this average had dropped to 421 per year. Over the same period, the average annual mortality rate due to motor vehicle accidents dropped from 19.6 deaths from this cause per 100,000 population to 10.4 per 100,000.

In spite of the over represented claims for demographic determinism, virtually none of this decline was the result of demographic change. It is true that demographic change matters: the aging of the province's population and the increase in female share of the population over the past decade both contributed to a reduction in the number and rate of motor vehicle accident mortality from what would have otherwise occurred.

It is also true that this demographic change did not account for any noticeable part of the reduction in motor vehicle accident mortality. The decline in the number and rate of deaths due to motor vehicle accidents was almost entirely attributable to behavioural change, as represented by dramatic declines in the age specific rates of motor vehicle accident mortality for both genders, with reductions in excess of fifty percent in many age groups.

Behavioural change alone would have reduced the motor vehicle accident mortality rate by 46% over the past decade: the observed decline was 47% decline. The result of this change was that by the end of the 1990s, the highest age specific motor vehicle accident mortality rates were for males 75 years of age and older, followed in turn by males aged 15 to 29, females aged 70 to 84, males aged 30 to 74, females aged 15 to 29, females aged 30 to 69, with children under the age of 15 having the lowest age specific mortality rates.

The dramatic reduction in motor vehicle mortality rates over the past decade shows that demographics are not destiny, that we can do something about the motor vehicle mortality in specific, and about age related patterns of behaviour in general. Better road and vehicle construction; better laws and better enforcement; better training, education and socialization; better emergency response and better medical technology all contributed to reductions in motor vehicle mortality rates over the past decade.

The acknowledgement that we can affect life cycle behaviour is great importance for two reasons. First, the significant gap between male and female age specific motor vehicle mortality rates shows that there is still significant room for reduction in mortality rates. The second is that if rates do not continue to decline, the projected growth and aging of province's population will mean that the annual number and rate of deaths in motor vehicle accidents will reverse its historical declining trend, and will increase over the coming decade. The status quo, while much better than it was a decade ago, is not good enough for the future, given the devastating costs of motor vehicle accident to those responsible, their innocent victims, and to society as a whole.

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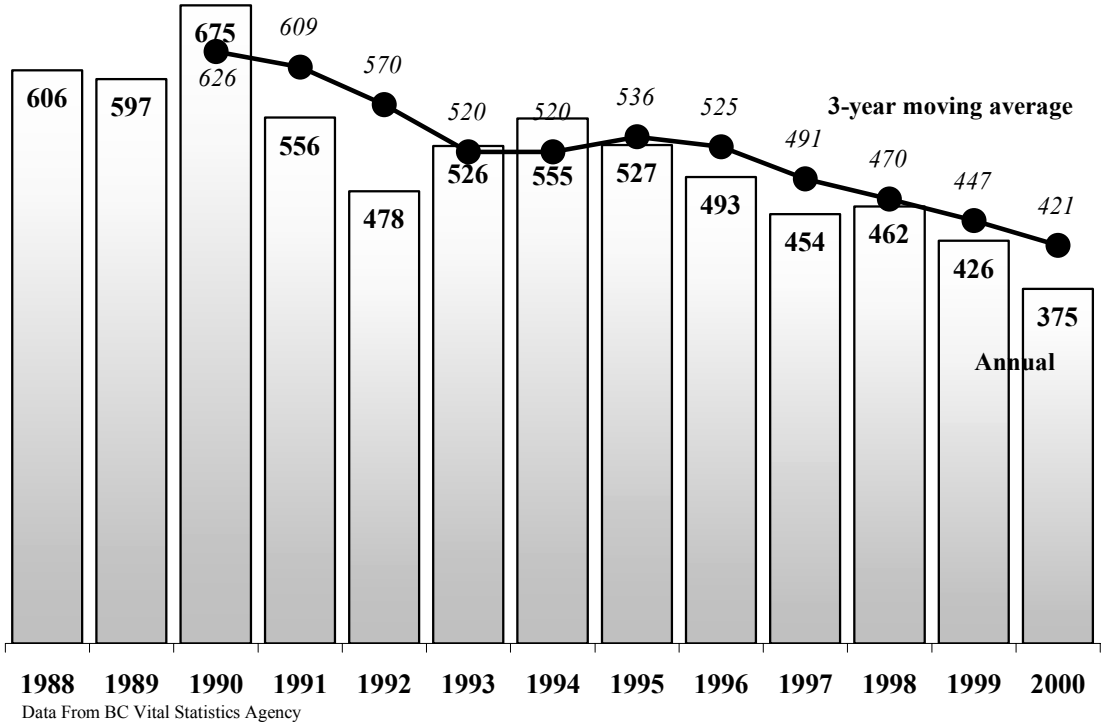
Demographics and Trends in Motor Vehicle Accident Mortality In British Columbia, 1988 to 2000

by David Baxter, June 2001

I. Introduction.

Recently released data from the BC Vital Statistics Agency show that the number of deaths in motor vehicle accidents in British Columbia has declined dramatically over the past decade, from 606 deaths as a result of motor vehicle accidents occurring in 1988 to only 375 in 2000 (Figure 1)[1]. Even when adjusted for year to year fluctuations using a three year moving average, the decline in annual mortality is impressive, falling by a third from the 1998-1990 average of 626 per year to 421 for the 1998-2000 period.

Figure 1: Annual Deaths in Motor Vehicle Accidents, British Columiba, 1988 to 2000



Data From BC Vital Statistics Agency

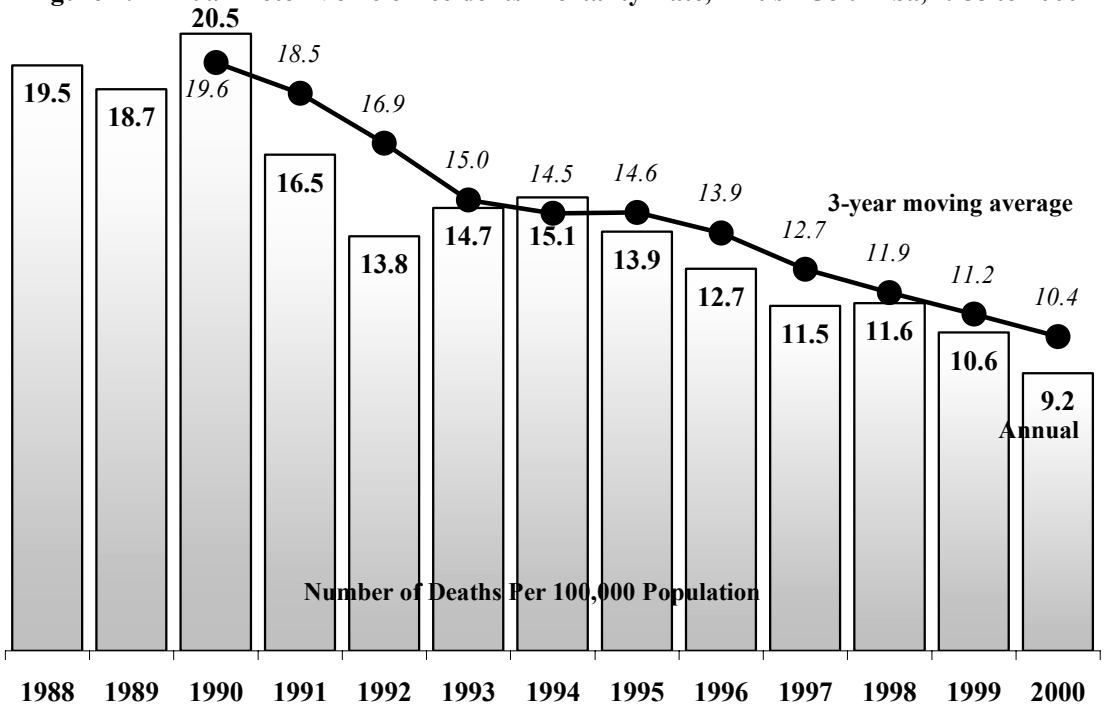
Given the cost, in lives and resources, of motor vehicle accident mortality, this decline, and the reasons for it, are of significant importance. The purpose of this report is to examine the pattern of change that has occurred in motor vehicle accident mortality in British Columbia, and specifically the extent to which demographic change has, or more accurately, as is shown in the following pages, has not, contributed to the steady decline in the number of people killed each year in motor vehicle accidents.

II. An Overview of Trends in Motor Vehicle Accident Mortality in British Columbia

While perhaps obvious, it nonetheless needs to be stated: the declining annual number of motor vehicle accident deaths is not the result of a declining population. Over the same twelve year period that the number of deaths in motor vehicle accidents declined by 38% (from 606 in 1988 to 375 in 2000), the population of the province increased by 30% (from 3,113,665 in 1988 to 4,063,760 in 2000)[2]. The result was a 53% decline in the motor vehicle accident mortality rate

(the number of deaths each year per 100,000 people in the population) from 19.5 deaths per 100,000 population in 1988 to 9.2 deaths per 100,000 in 2000 (Figure 2). Using a three-year moving average to adjust for year-to-year variation shows a decline of similar magnitude, with the 1998 to 2000 average of 10.4 deaths per 100,000 being only 53% of the 1988 to 1990 average of 19.6 per 100,000.

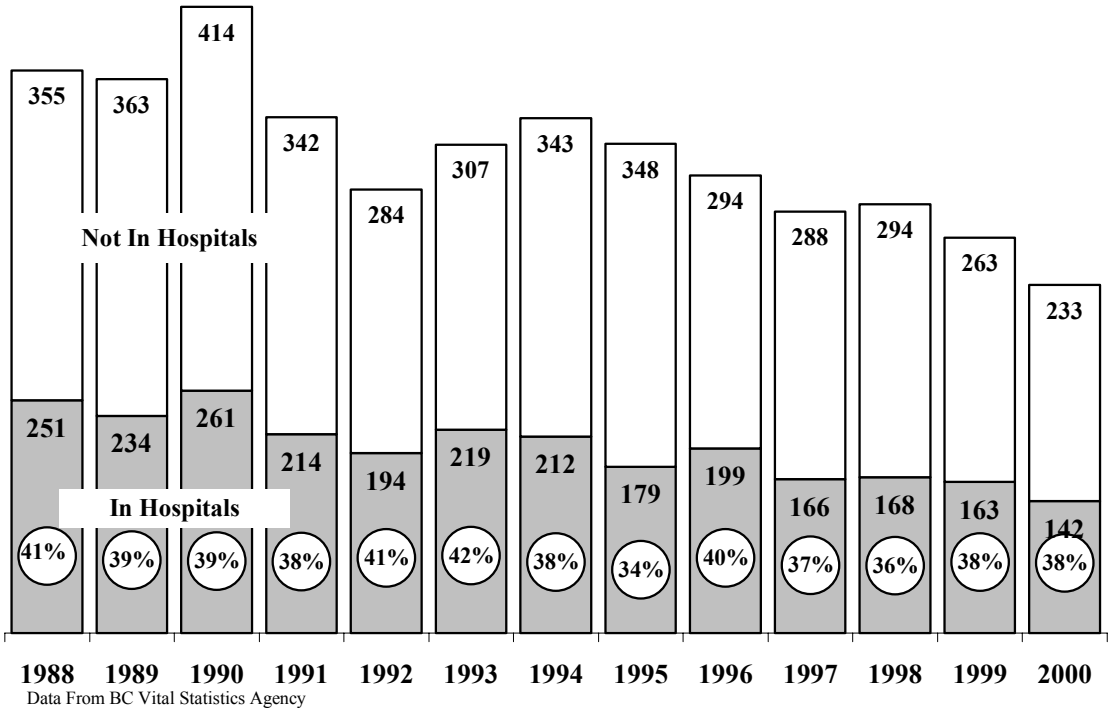
Figure 2: Annual Motor Vehicle Accidents Mortality Rate, British Columiba, 1988 to 2000



While the number of motor vehicle accident deaths occurring both in hospitals[3] and not in hospitals have both declined, the drop in in-hospital deaths has been greater (Figure 3). The 142 in-hospital deaths due to motor vehicle accidents in 2000 was 57% of the 251 in-hospital deaths from this cause that occurred in 1988; the 233 deaths not in hospitals due to motor vehicle accidents that occurred in 2000 were 66% of the 355 deaths not in hospitals due to this cause that occurred in 1988. This pattern has shifted the proportion of motor vehicle accident mortalities that have occurred in hospitals: in 1988, 41% of all motor vehicle accident mortalities occurred in hospitals, compared to only 38% in 2000. On a moving average basis, in-hospital mortality of motor vehicle accident victims has declined from the 1988 to 1990 average of 40% to 37% for the 1998 to 2000 period.

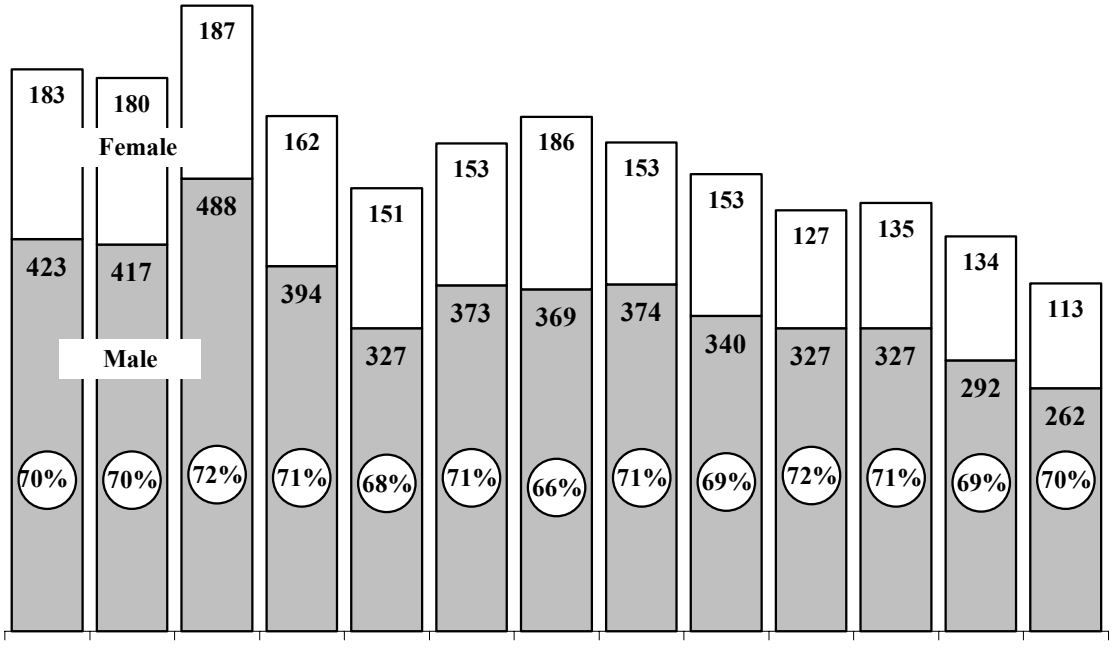
There has been a virtually identical decline in the number of motor vehicle accident mortalities of both males and females over the past decade (Figure 4). Males account for a disproportionate share of motor vehicle accident mortalities, with the 262 deaths of males due to this cause accounting for the same 70% of 2000's total of 375 deaths as the 423 in 1988 accounted for of that year's total of 606 deaths due to this cause. Male motor vehicle accident victims are slightly more likely to die outside of hospitals than female victims: while accounting for 70% of all victims of motor vehicle accidents over the 1988 to 2000 period, males accounted for only 68% of the in-hospital deaths and 71% of the not-in-hospital deaths.

Figure 3: Annual Deaths in Motor Vehicle Accidents by Location, British Columbia, 1988-2000



Data From BC Vital Statistics Agency

Figure 4: Annual Deaths in Motor Vehicle Accidents by Gender, British Columbia, 1988 to 2000



Data From BC Vital Statistics Agency

Figure 5: Deaths in Motor Vehicle Accidents, Age Groups, British Columbia, 1988-2000

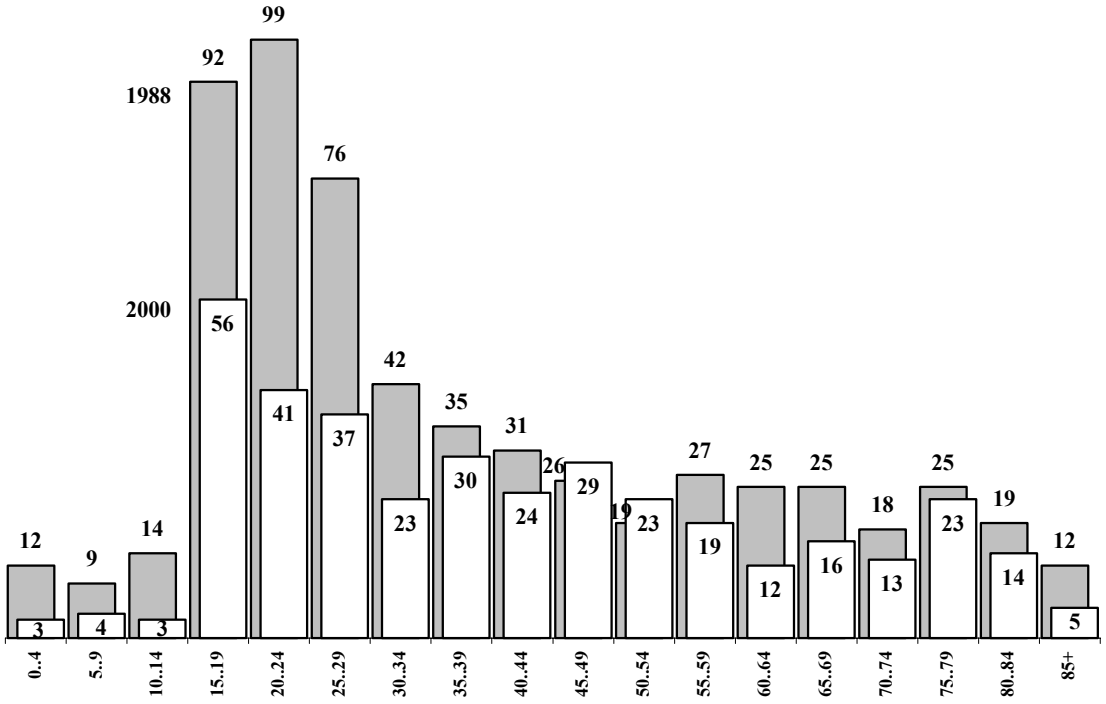
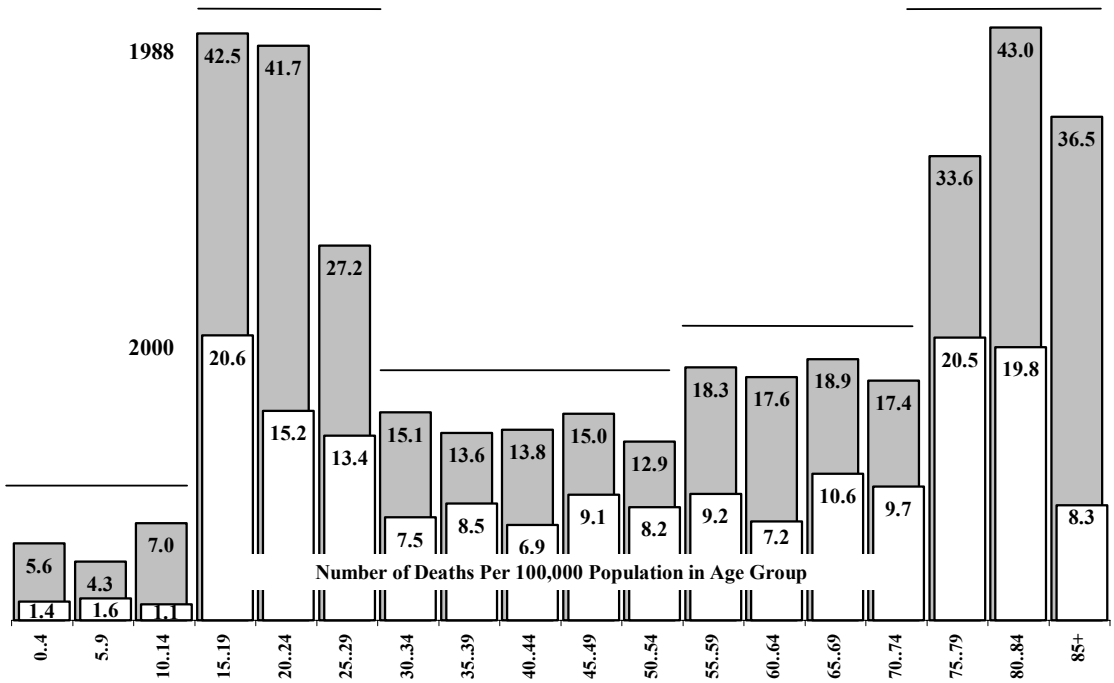


Figure 6: Motor Vehicle Accident Death Rates, Age Groups, British Columbia, 1988-2000



III. The Life Cycle Pattern of Motor Vehicle Accident Mortality in British Columbia

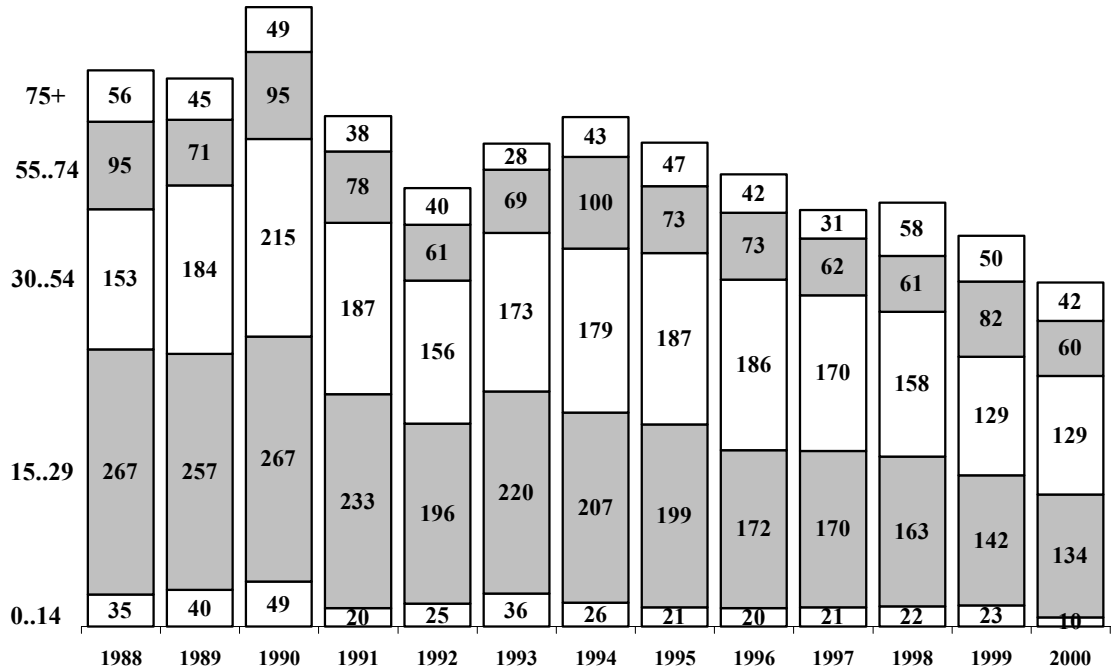
A. The General Life Cycle Pattern.

To introduce the life cycle pattern of motor vehicle mortality, the number and age specific rates for 1988 and 2000 are compared, then the pattern of change within the 1988 to 2000 period is considered. There is a popular preconception about the age specific pattern of motor vehicle mortality, that it is something that predominantly involves young adults. To some extent, this is supported by the data, as the 15 to 29 age group reported the highest number of deaths due to this cause in both 1988 and 2000 (Figure 5). The steep jump in the number of deaths in this age group from the lows of the 0 to 14 age group, and then the slow decline from age 30 on, describes a pattern that one might easily anticipate based on assumptions about age related behaviour.

Upon closer examination of the data, however, a different age related pattern emerges. The number of deaths in an age group is determined by both age related behaviour and the number of people in the age group. To separate the life cycle pattern from the age distribution, it is necessary to calculate the age specific mortality rate (the number of deaths in a year per 100,000 people in the age group). As Figure 6 shows, the age groups where the highest rate of motor vehicle accident mortality occurs are the 15 to 29 **and** 75 and older age groups. In both 1988 and 2000, the rate of the 75 and older age group equaled or exceed that of the young adult age group.

Before examining the trends in mortality due to motor vehicle accidents for the major age groups, it is important to note that in many of the age groups the number of deaths each year is mercifully small. This means that a small numerical change from one year to the next will be expressed as significant changes in rates per thousand, as even 1 additional death will lead to a 20% to 33% increase in the rate. Grouping the data into major age groups, as is done in this section, will reduce such year-to-year variance to a small degree. To clearly identify longer term patterns, in subsequent sections a three-year moving average will be used with detailed age groups.

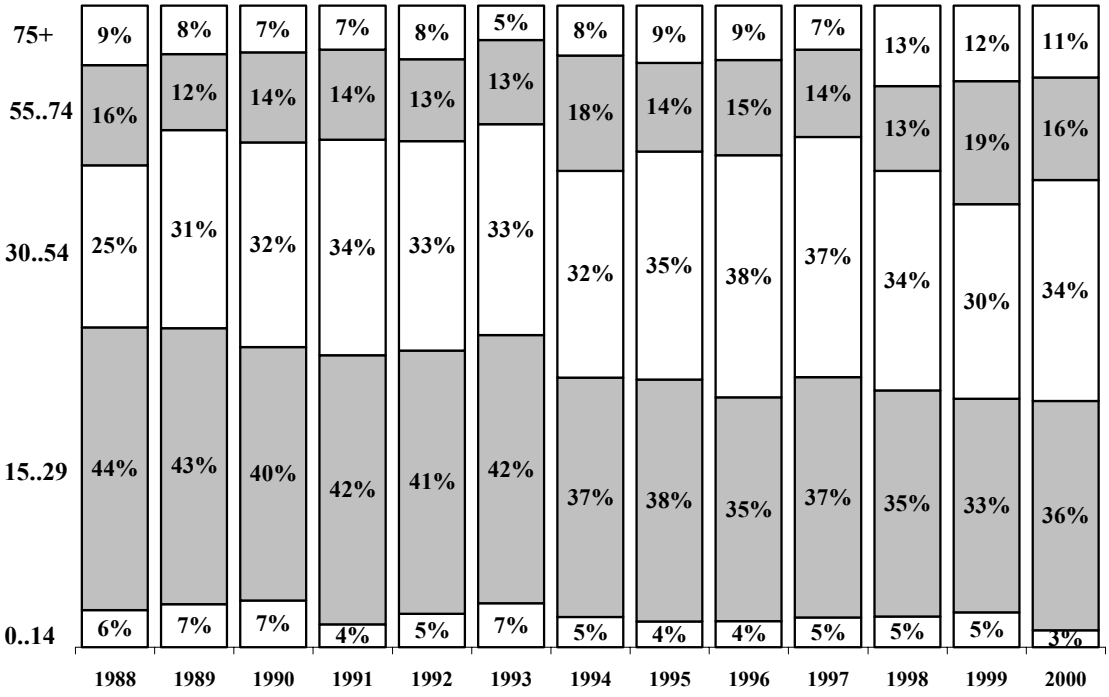
Figure 7: Motor Vehicle Accident Deaths, Major Age Groups, British Columbia, 1988-2000



The age specific pattern of mortality rates indicates 5 major age groupings that can be used to summarize the historical trends in the age composition of mortality due to this cause over the past decade. The first age group is the 0 to 14 age group, where the lowest rates occurred in both 1998 and 2000; this is followed by the relatively high mortality rate 15 to 29 age group and then by the relatively low rate 30 to 54 age group. From age 55 on, there is a general pattern of increase in age specific mortality due to motor vehicle accidents, with a fourth age group being the 55 to 74 age group, followed by the fifth age group, the relatively high mortality rate 75 plus age group.

There was a general declining trend in the number of deaths for all age groups, with both 1999 and 2000 setting or equaling decade lows in the number of deaths in motor vehicle accidents for the 0 to 14, 15 to 29, and 30 to 54 age groups (Figure 7). In the older age groups, while 2000 saw relatively low numbers of mortalities due to this cause, 1999 recorded much higher values in the range observed earlier in the decade. This resulted in a change in the age composition of motor vehicle accident mortality, with the 75 plus age group increasing its share of all deaths, from the 8% range at the close of the 1980s to the 12% range at the end of the 1990s (Figure 8). The most noticeable shift was the increase in the 30 to 54 age group's share from the 25% to 32% range in the late 1980s to the 30% to 34% range in the late 1990s. This increase in share was generally matched by a decline in the 15 to 29 age group's share from the 40% to 44% range in 1988-1990 to the 33% to 36% range in 1998-2000.

Figure 8: Motor Vehicle Accident Deaths, %, Major Age Groups, British Columbia, 1988-2000



Part of the increase in the 30 and older age group's share of all motor vehicle accident mortalities was the result of a shift in the age composition of the province's population. The 30 to 54 age group increased from 35% of the province's population in 1988 to 40% in 2000 and the 75 plus age group's share increased from 5% to 6% (Figure 9). Over the same period, the 15 to 29 age group's share declined from 24% to 20%, the 0 to 14 age group's from 20% to 18%, and the 55 to 74 age group's share from 17% to 16%.

The other reason for the shifting in the age composition of motor vehicle accident mortality is that the decline in age specific mortality rates was not uniform across all age groups: the 43% decline

in the rate for the 30 to 54 age group from 14.2 deaths per 100,000 people in the age group in 1998 to 8.3 per 100,000 in 2000 was the smallest relative decline for all age groups, while the 76% decline from 5.6 to 1.4 for the 0 to 14 age group was the largest decline.

Figure 9: Population Age Composition, %, Major Age Groups, British Columbia, 1988-2000

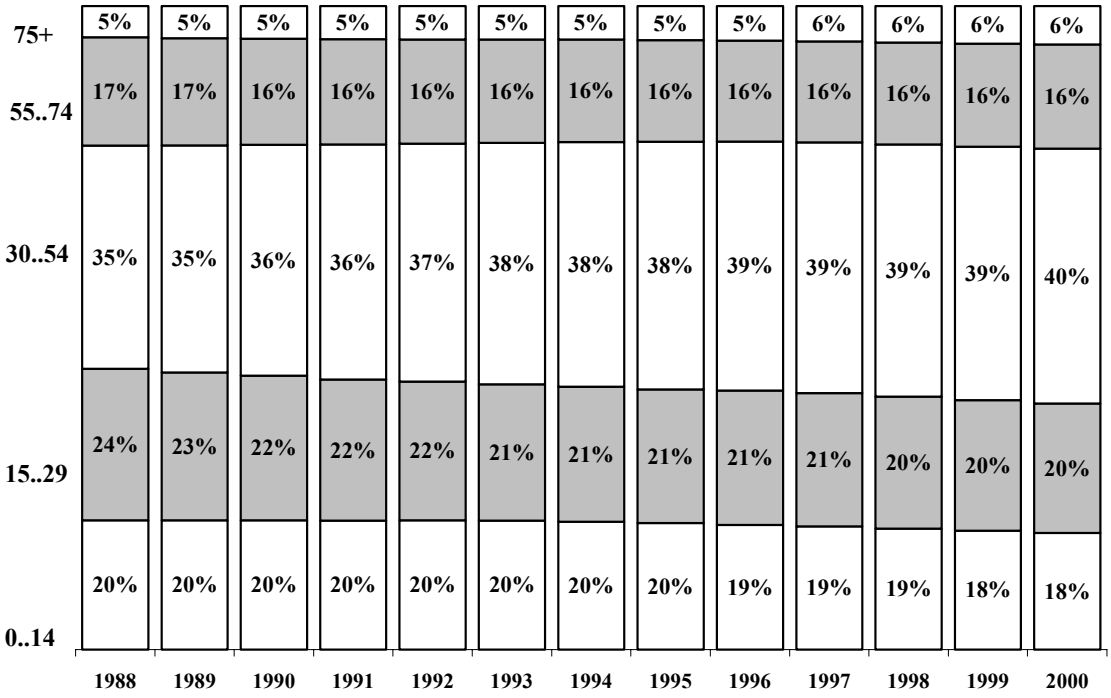


Figure 10: Motor Vehicle Accident Death Rates, Major Age Groups, B.C., 1988 & 2000

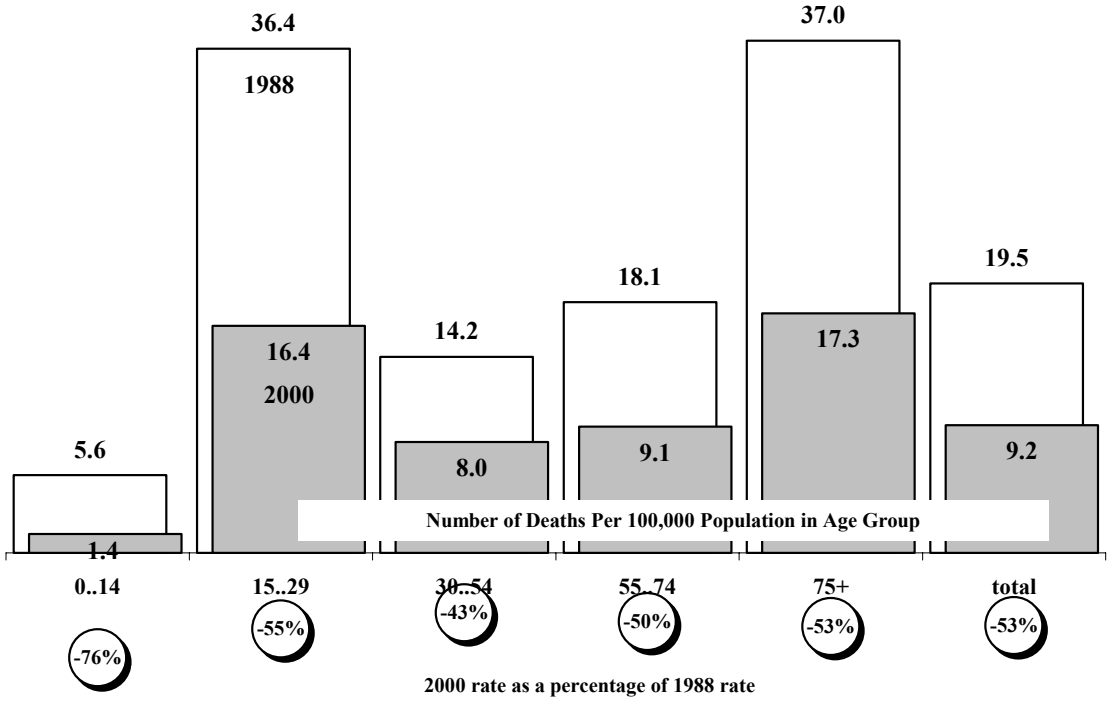


Figure 11: Three Year Moving Average Age Specific Motor Vehicle Accident Death Rates, British Columbia, 1988-1990 & 1998-2000, Number of Deaths per 100,000 in Age Group

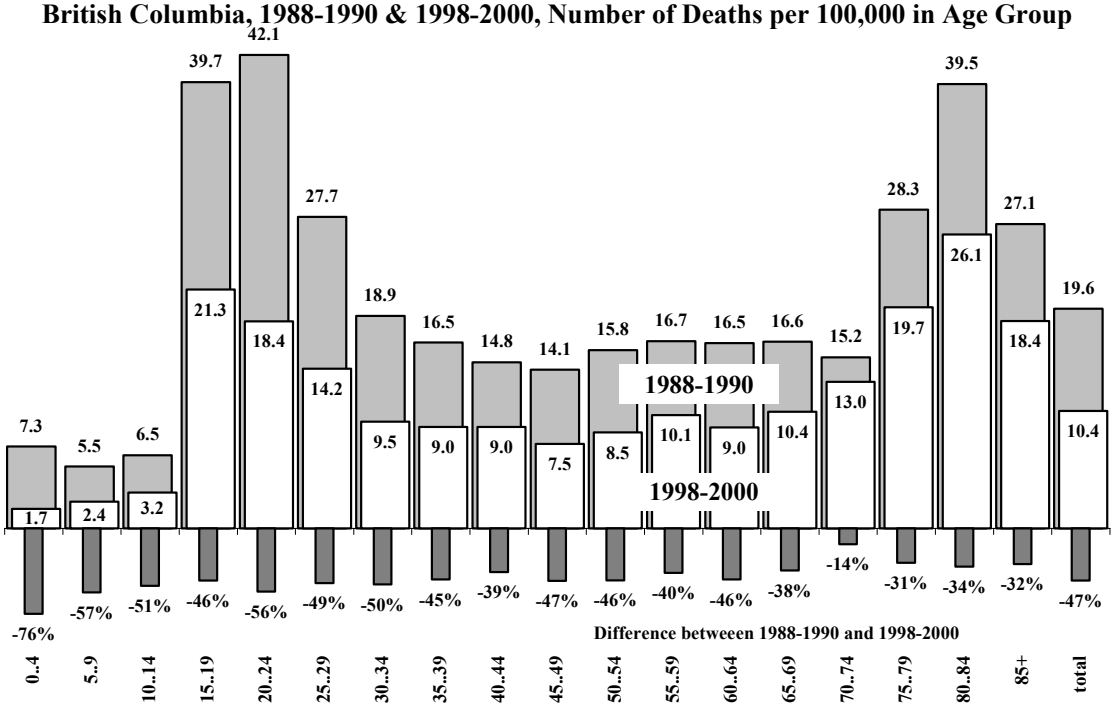
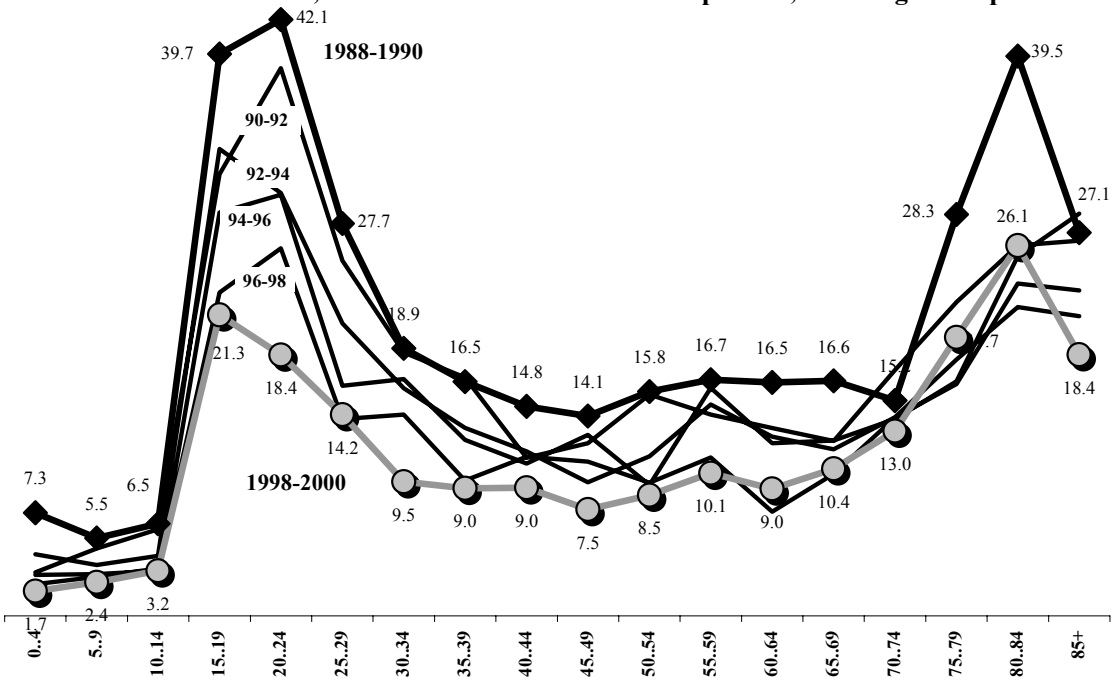


Figure 12: Three Year Moving Average Age Specific Motor Vehicle Accident Death Rates, British Columbia, 1988 to 2000 Number of Deaths per 100,000 in Age Group



The general life cycle pattern of age specific motor vehicle accident mortality rates, and its change over the 1988 to 2000 period, are clearly shown in the three year moving averages of mortality by five-year age groups on Figures 11 and 12. The general u-shaped life cycle pattern, with high age specific mortality rates in the 15 to 29 and 75 to 85 age groups is well defined in both the 1988 to 1990 and 1998 to 2000 data (Figure 11). By the end of the 1990s, the 80 to 84 age group had the highest age specific motor vehicle accident mortality rate, 26.1 deaths per 100,000 people in the age group, compared to the 21.3 per 100,000 rate of the 15 to 19 age group. The lowest motor vehicle accident mortality rate in 1998-2000 was the 0 to 4 age group, with 1.7 deaths per 100,000 people of this age; the lowest rate in the adult age groups was the 7.5 deaths per 100,000 of the 45 to 49 age group. Figure 11 also clearly shows the decline in age specific rates for all age groups over the 1988 to 2000 period: the greatest declines were in the youngest age groups, with the 1998 to 2000 moving averages for the 0 to 14 age group falling by between 51% and 76%. The smallest declines in age specific rates occurred in the 70 and older age groups, were declines of between 14% and 34% were observed.

Even though the use of moving averages reduces the impact of individual abnormal years, it must be noted that very small numbers are involved in the calculation of these rates, and hence comparison of any two individual years may indicate a change that is not part of a longer-term pattern. Figure 12 shows the changes in rates within the 1988-1990 to 1998-2000 period. In the under 40 age groups, there was a constant decline, with 1998-2000 marking the period low and 1988-1990 marking the period high. In the 40 and older age groups, however, there was both a greater degree of variation and reversal in direction of change. In the 60 to 64, 65 to 69, and 70 to 84 age groups, 1998-2000 does not mark the period low: thus it is not possible to conclude that the 75 to 85+ age groups have become the highest motor vehicle accident mortality rate age group, merely that these age groups are right up there with the 15 to 29 age groups.

B. Demographic Change and the Life Cycle.

There are three demographic factors that can change the total number of deaths over time: population growth, a change in the gender composition of the population (as males and females have significantly different motor vehicle accident mortality rates), and a change in the age composition of the population (as there is a life cycle pattern to age specific mortality rates). It is possible to use the available data to determine the degree to which each of these three factors contributed to the decline in the number of deaths due to motor vehicle accidents in British Columbia over the past 12 years.

To do so requires use of age and gender specific motor vehicle accident mortality rates, and the age and gender composition of the population, over the 1988 to 2000 period. Figure 13 shows the three-year moving average of male and female age specific mortality rates due to motor vehicle accidents for 1988-1990. Note the different age specific patterns for males and females. In 1988-1990, the highest motor vehicle accident rates were for males aged 15 to 29 (in the range of 42.5 to 67.3 per 100,000) followed by males aged 75 to 85 plus (31.7 to 51.8 per 100,000). The rates for females were lower in every age group, with the highest rates for females found in the 75 to 85 plus age groups (ranging from 21.6 to 31.3 deaths per 100,000 people in the age groups), followed by the 15 to 29 age group (12.6 to 21.8 deaths per 100,000).

To measure the role that demographic change played in the change in mortality due to motor vehicle accidents, it is necessary to first assume that the life cycle or behavioural pattern represented by these age and gender specific rates remained constant over the 1988 to 2000 period. The impact of population growth, changes in the gender composition of the population and changes in the age composition of the population are then introduced and their impact on the number of deaths measured.

Figure 13: 3-Year Moving Average Age&Gender Specific Motor Vehicle Accident Death Rates
British Columbia, 1988-1990, Number of Deaths per 100,000 in Age Group

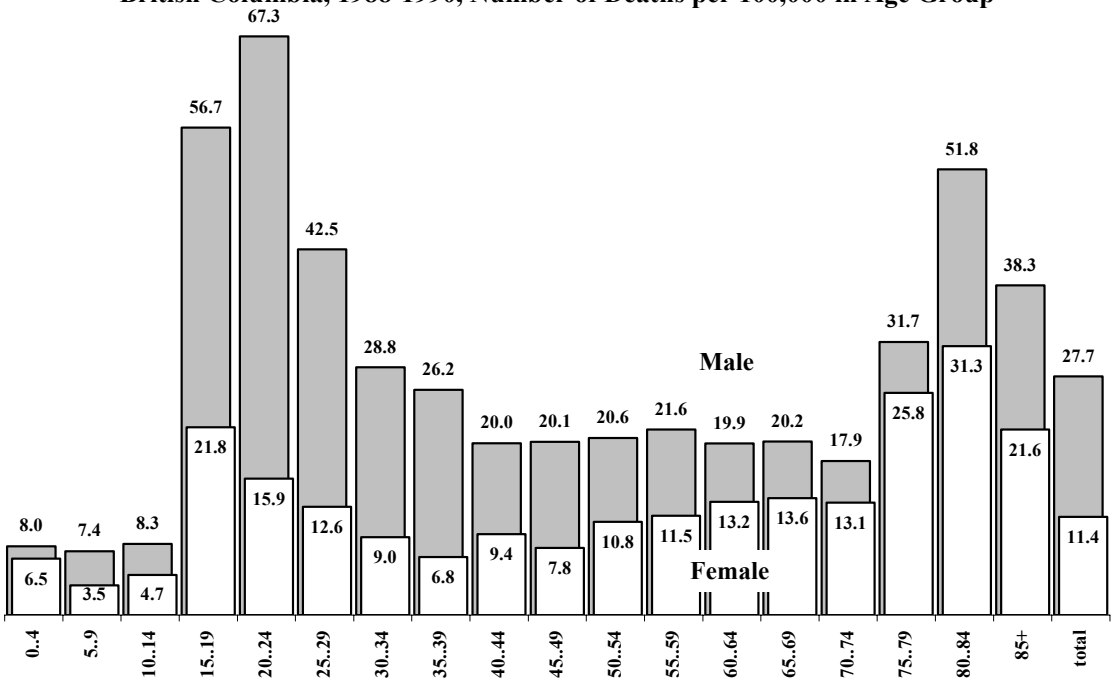
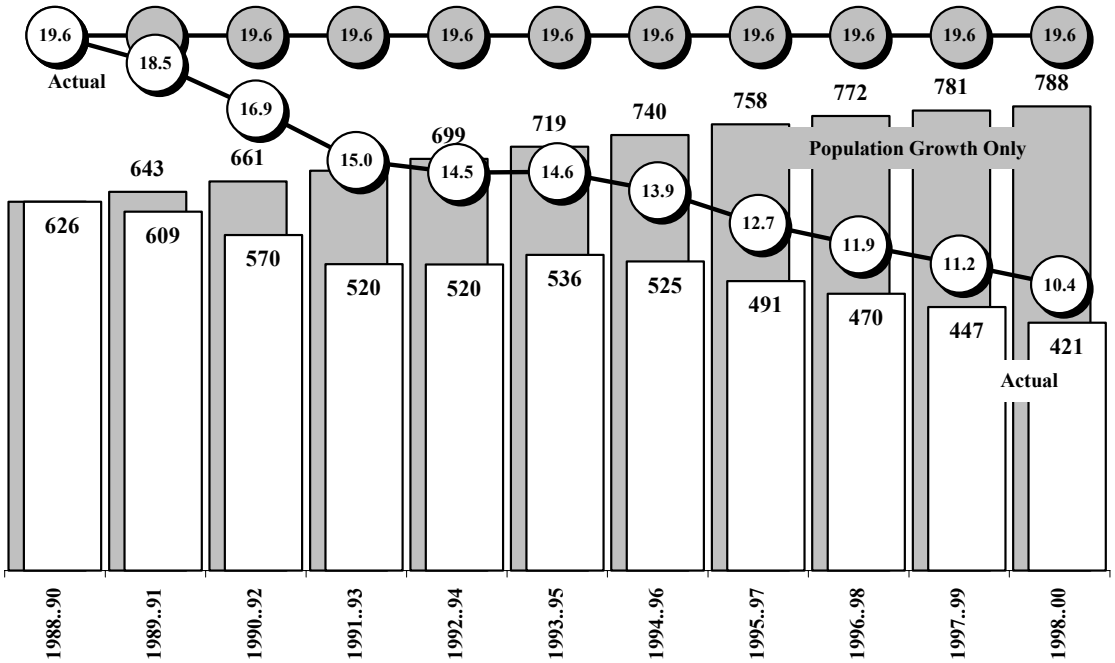


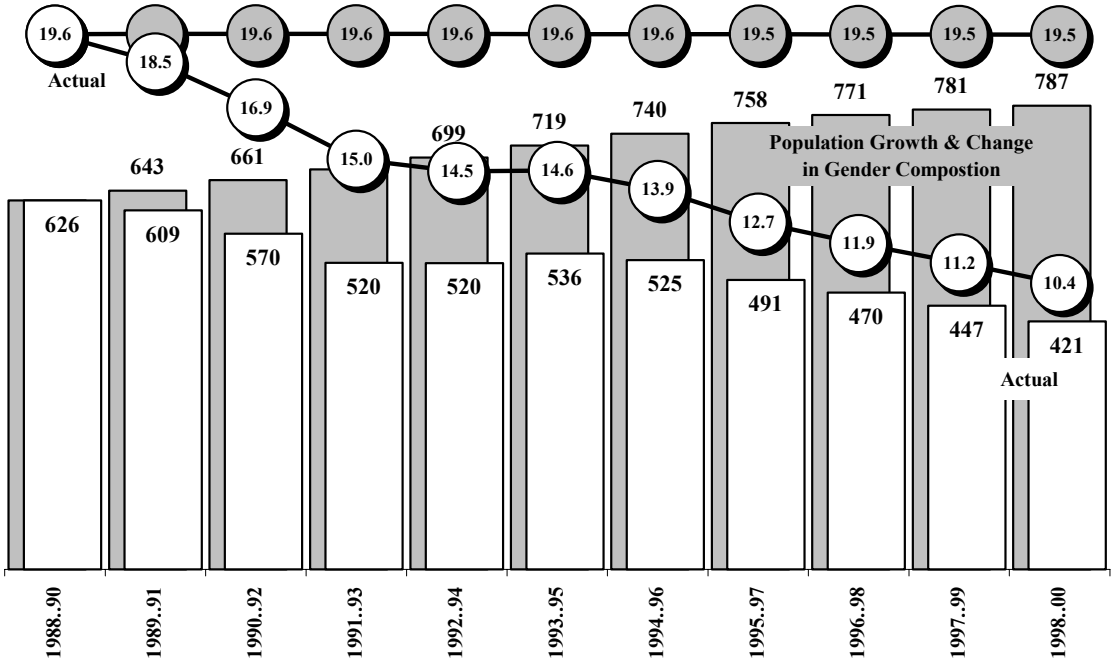
Figure 14: 3-Year Moving Average Motor Vehicle Accident Deaths, Number and Rate
British Columbia, Actual and Constant Rates with Population Growth



The basis of comparison for the impact of demographic change on motor vehicle accident mortality is the observed one third decline in the number of deaths from a 1988 to 1990 average of 626 per year to an average of 421 per year during the 1998 to 2000 period, and the 47% decline in the overall mortality rate from 19.6 per 100,000 population in 1988-1990 to 10.4 in 1998-2000 (Figure 14). The first aspect of demographic change to be addressed is the impact of population growth alone on motor vehicle accident mortality, measured by holding the percentage distribution of population by age group and gender and the age and gender specific motor vehicle accident mortality rates constant at their 1988-1990 average level. Under such conditions, the 25.9% increase in population (from a 1988-1990 average of 3,201,864 to a 1998-2000 average of 4,029,799) would lead to a 25.9% increase in the number of motor vehicle mortalities (from 626 in 1988-1990 to 788 in 1998-2000), and no change in the 19.6 deaths per 100,000 population.

Clearly something other than population growth determined the number of motor vehicle mortalities in British Columbia, as the number of deaths and the mortality rate both dropped during this period of population growth. One of the things that happened is that the number of women in the province increased by 26.2% (from 1,606,458 to 2,027,416) over the period, a greater increase than the 25.5% increase in the number of men (from 1,595,406 to 2,002,383). As women have a lower motor vehicle mortality rate, this change in gender composition will have an impact on the level and rate of motor vehicle mortality: as Figure 15 shows, the impact is negligible. Accounting for population growth and the increase in the relative number of women from 50.2% of the population at the beginning of the period to 50.3% at the end would have resulted in 787 deaths due to motor vehicle accidents in 1998-2000, compared to the 788 that population growth alone would have resulted in, and a overall mortality rate of 19.5 per 100,000. The direction of the impact is correct, but its magnitude is insignificant.

Figure 15: 3-Year Moving Average Motor Vehicle Accident Deaths, Number and Rate
British Columbia, Actual and Constant Rates with Population Growth by Gender



The final demographic factor that could have affected both the level and the rate of motor vehicle accident mortality is a shift in the age composition of the population, something that definitely occurred over the 1988-1990 to 1998-2000 period (Figures 16 to 19).

Figure 16: BC Female Population, Percentage Age Composition, 1998-1990 and 1998-2000

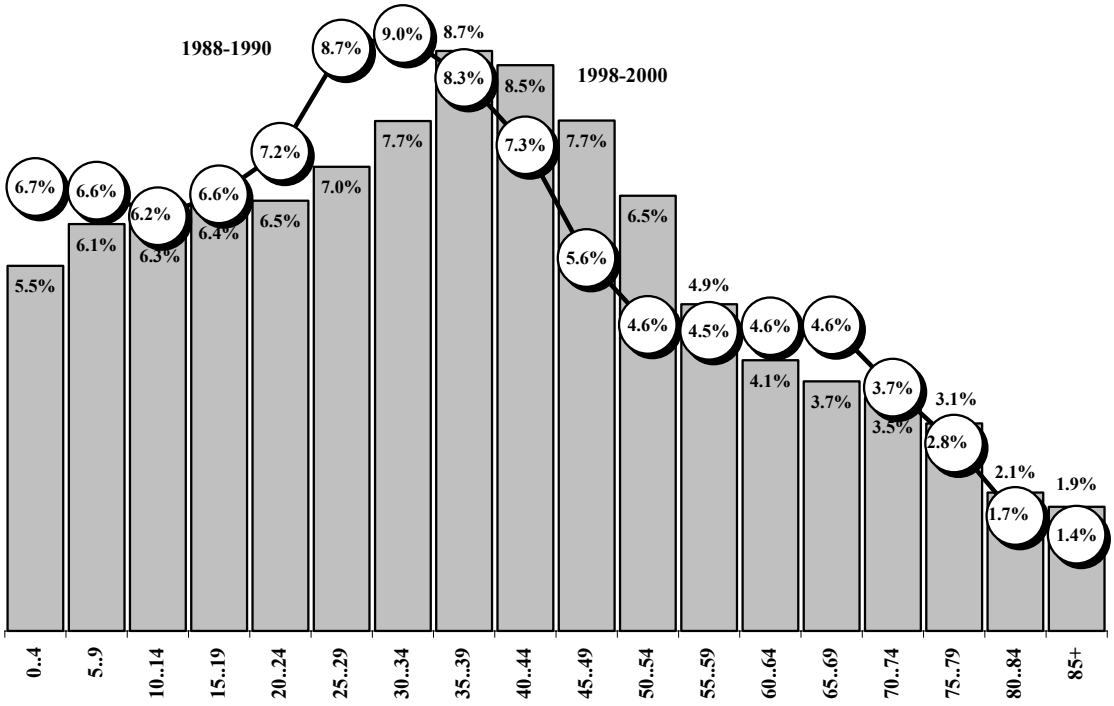


Figure 17: BC Female Population, Age Composition, 1998-1990 and 1998-2000

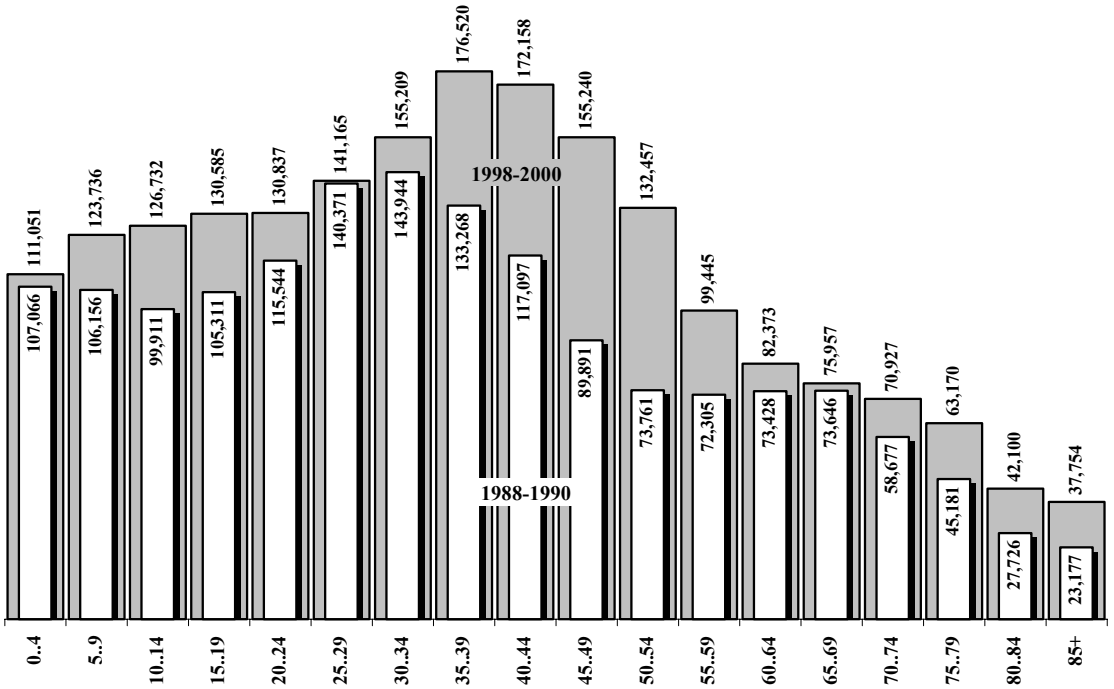


Figure 18: BC Male Population, Percentage Age Composition, 1998-1990 and 1998-2000

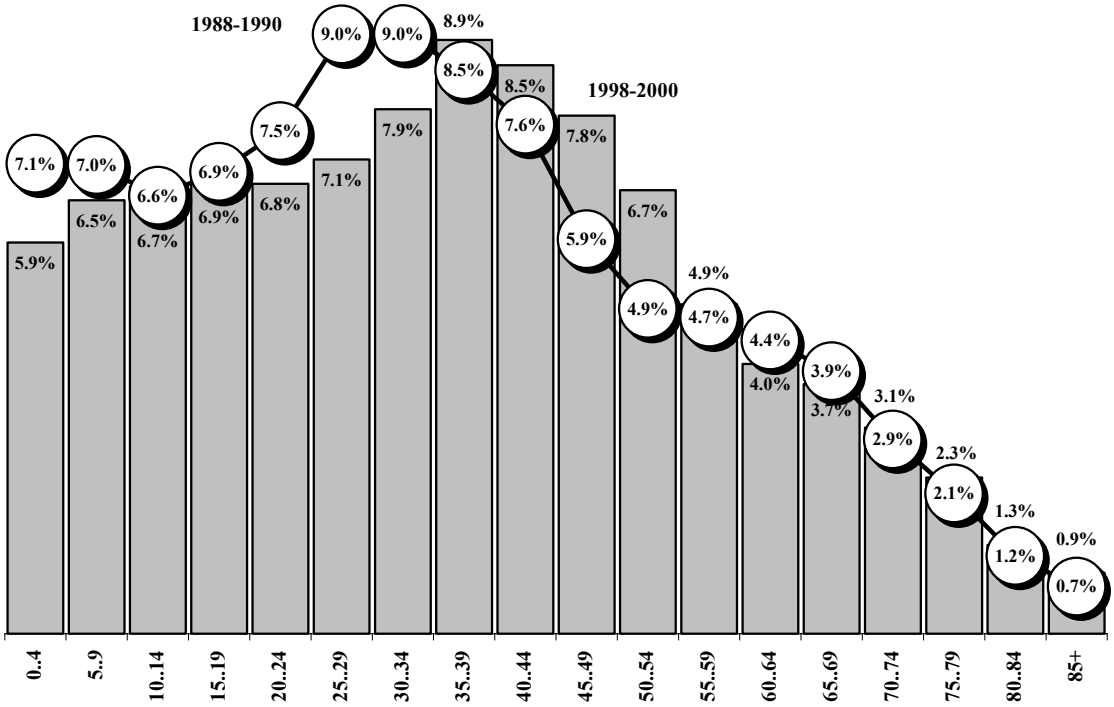
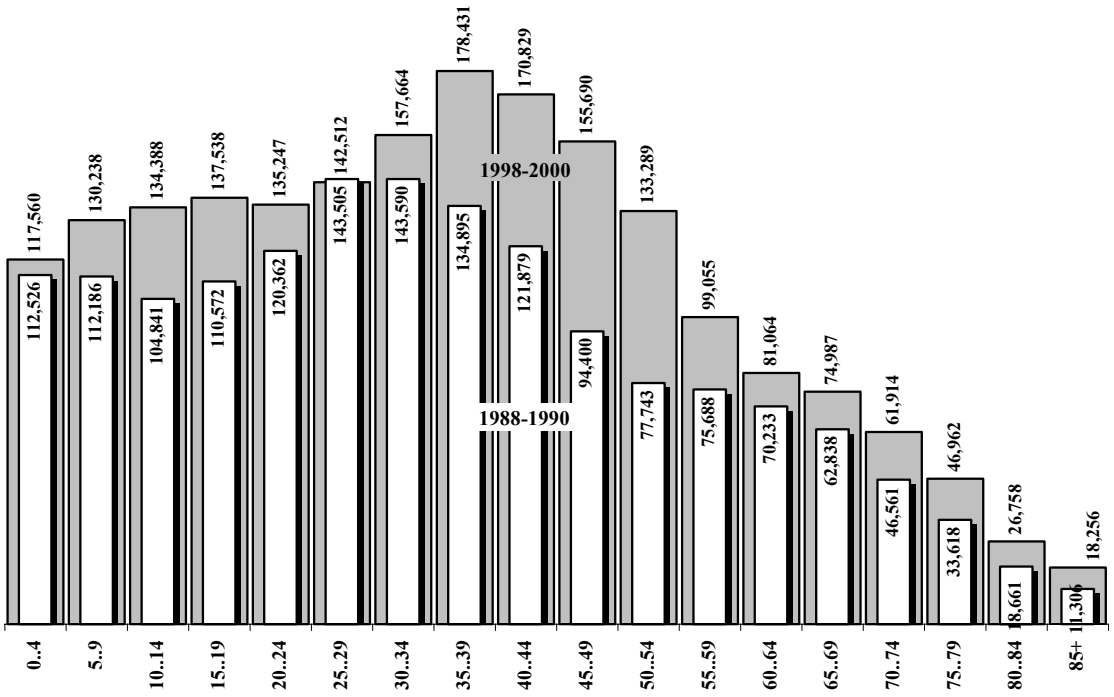


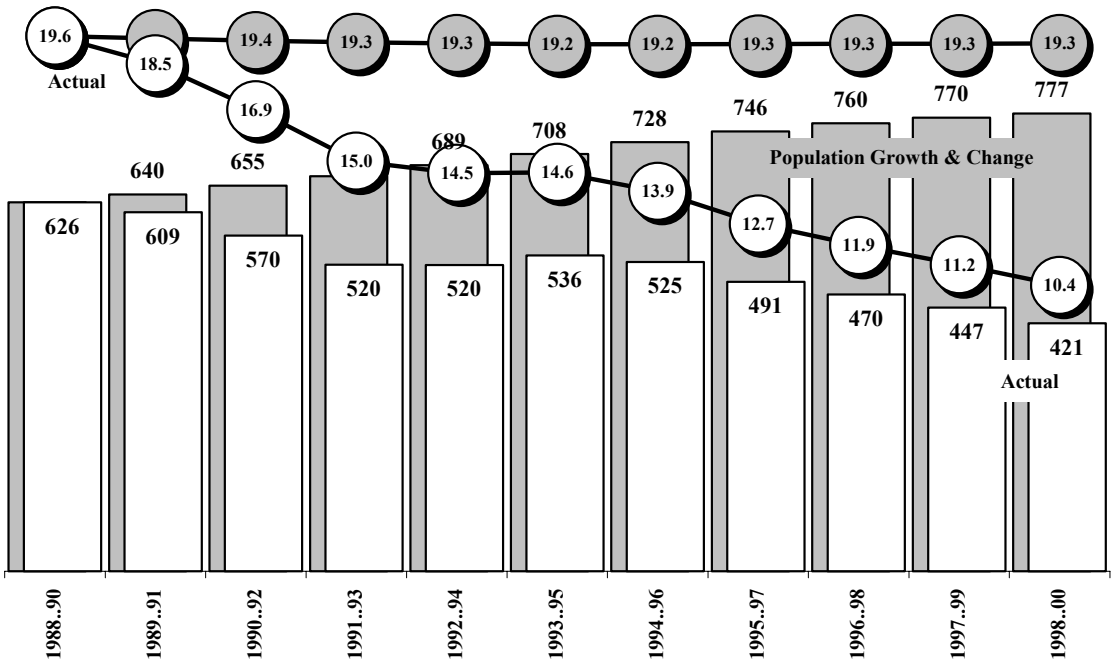
Figure 19: BC Male Population, Age Composition, 1998-1990 and 1998-2000



The aging of the post war baby boom generation out of the relatively high motor vehicle accident mortality rate young adult age groups into lower mortality rate older age groups is shown on Figures 16 and 18. In the case of the female population, the percentage of the population in the 15 to 34 age groups all declined between 1988-1990 (when these age groups accounted for a combined total of 31.5% of the population) and 1998-2000 (when they accounted for 27.6%). In contrast, the percentage of the population in each of the 35 to 54 age groups increased from a total of 25.8% of the population to 31.4%. A similar pattern occurred in the male population, where the 15 to 34 age groups' share of the total population fell from 32.4% in 1988-1990 to 28.7% in 1998-2000 and the 35 to 54 age groups' share increased from 26.9% to 31.9%.

For both genders, this shift meant that a greater portion of the population was in lower mortality rate age groups at the end of the 1990s than was at the end of the 1980s, which would lead, all other things equal, to a reduction the overall mortality rate per 100,000 population. From this correct conclusion, it is easy to jump to the wrong conclusion that the demographic shift will also lead to a decline in the total number of motor vehicle accident deaths. Such a demographic shift will only result in a decline in the total number of deaths **if** it is accompanied by a reduction in the number of people in the high-risk age groups. This did not happen in British Columbia between 1988-1990 and 1998-2000. The number of people in every age group in the female population, and in all but one in the male population, increased between the end of the 1980s and of the 1990s (Figures 17 and 19). The reason that the percentage of the population in the older age groups increased was that they increased faster than the younger age groups. As a result, while it is reasonable to anticipate that the overall motor vehicle accident mortality **rate would decline** between 1988-1990 and 1998-2000, the fact that all age groups increased in size means that, with constant age specific mortality rates, the number of **deaths would increase**. As Figure 20 shows, if 1988-1990 average age and gender specific mortality rates were applied to the actual population size and composition by gender and age for each year from 1988-1990 to 1998-200, the overall mortality rate would have declined from 19.6 to 19.3 per 100,000, but the number of deaths would have increased from 626 to 777.

Figure 20: 3-Year Moving Average Motor Vehicle Accident Deaths, Number and Rate
BC, Actual and Constant Rates with Population Growth, Change in Gender&Age Composition

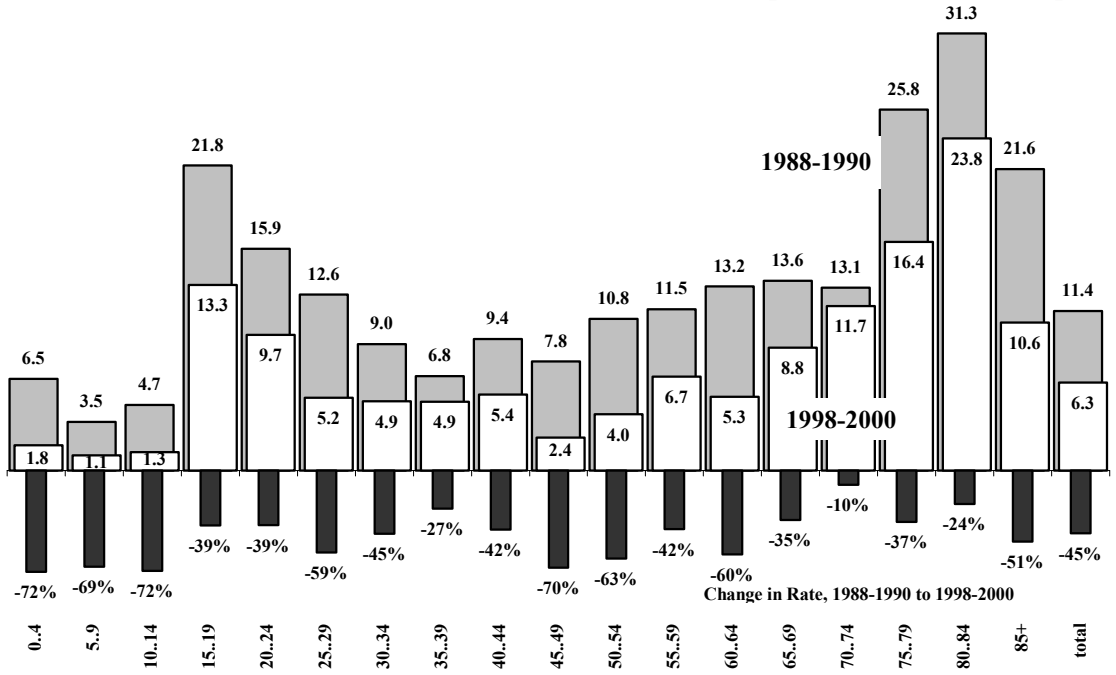


Demographic change had an insignificant, almost immeasurable, impact on motor vehicle accident mortality in British Columbia over the past decade. Holding age and gender specific rates constant, considering only the impact of population growth and changes in its age and gender composition, shows that demographic change would have led a reduction on the motor vehicle accident mortality rate from 19.6 per 100,000 in 1988-1990 to 19.3 in 1998-2000: the rate actually fell to 10.4 per 100,000. Thus demographic change accounted for 3% (the 0.3 change in the rate from 19.6 to 19.3) of the total change from 19.6 to 10.4 per 100,000.

If demographic change has been insignificant as a factor in changes in motor vehicle accident mortality in British Columbia over the past decade, what has caused the decline in both the rate and number of deaths? The short answer is behavioural change: the long answer requires an analysis of what behavioural change involves and what brought it about. Considering the short answer first (the long answer is considered in the concluding section of this report) the extent to which the incidence of mortality due to motor vehicle accidents has declined is reflected in the change in the age and gender specific rates of mortality due to motor vehicle accidents.

The overall motor vehicle accident mortality rate for women declined by 45%, from an average of 11.4 deaths per 100,000 women per year in the 1988-1990 period to 6.3 per 100,000 in the 1998-2000 period. The **life cycle pattern** of mortality rates remained the same – the highest rates for women were in the 70 plus population, and the second highest were in the 15 to 29 age group in both time periods. The percentage change, however, was greatest in the under 15 and 40 to 64 age groups, deepening the difference between the mortality rates of young and old female adults and those of children and the 40 to 64 age group.

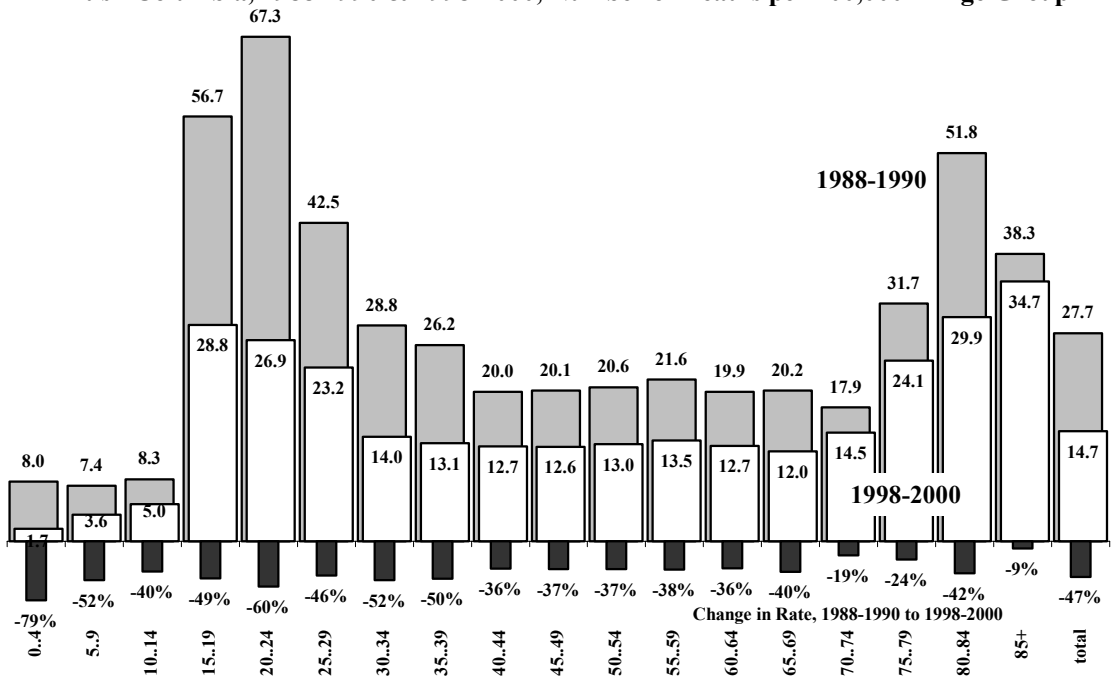
Figure 21: 3-Year Moving Average Female Age Specific Motor Vehicle Accident Death Rates British Columbia, 1988-1990 & 1998-2000, Number of Deaths per 100,000 in Age Group



There was a much greater change in the pattern of male age-specific motor vehicle accident mortality rates over the past decade (Figure 24). While the general u-shape of these rates remained, there was a noticeable shift in rates from younger to older age groups. In 1988-1990, the highest male rates were in the 15 to 29 age groups (in the range of 42.5 to 67.3 per 100,000), followed by the 75 to 85 plus age groups (in the range of 31.7 to 51.8 per 100,000). In 1998-

2000, this was reversed, with the highest rates being in the 75 to 85 plus age groups (in the range of 24.1 to 34.7 per 100,000), and the second highest rates occurring in the 15 to 29 age groups (28.8 to 23.2 per 100,000). The declines in male age specific mortality rates were greatest in the under 40 population, bring these rates closer to those of females in the same age groups (having said this, male rates in these ages are still 70% greater, and overall male rates are 88% greater, than the corresponding rates for females). The result is that by the end of the 1990s, the highest age specific mortality rates were for males 75 years of age and older, followed by males aged 15 to 29, then females 70 to 84, by males aged 30 to 74, by females aged 15 to 29, then females aged 30 to 69, then children under the age of 15.

Figure 22: 3-Year Moving Average Male Age Specific Motor Vehicle Accident Death Rates British Columbia, 1988-1990 & 1998-2000, Number of Deaths per 100,000 in Age Group



The extent to which this decline in age specific mortality rates – this change in behaviour – contributed to the decline in the decline in motor vehicle accident mortality can be measured in the same fashion as was done for the measurement of the impact of demographic change. The approach is to apply the age and gender specific motor vehicle accident mortality rates for each year, and apply them to a standard population, that of the province in the 1988-1990 period. This approach, referred to as age-standardization (although as applied here it also standardizes for the gender composition) answers the question of what would have happened if the population did not change over the period, but behavioural did.

The result would have been a reduction in the number of deaths from an average of 626 in 1988-1990 to 335 in 1998-2000, and, more significantly, in the overall mortality rate from 19.6 deaths per 100,000 population to 10.5 per 100,000 (Figure 23). Behavioural change alone would have reduced the motor vehicle accident mortality rate by 46%: the observed decline was 47% decline, to 10.4 deaths per 100,000. Yes, demographic change matters: aging and the increase in female share of the population both contributed to a reduction in the number and the rate of motor vehicle accident deaths from what would have otherwise occurred. No, demographic change did not have a noticeable impact: 98% of the reduction in the overall mortality rate due to motor vehicle accidents in the province of British Columbia over the past decade was the result of changes in the age and gender specific rates of motor vehicle accident mortality.

Figure 23: 3-Year Moving Average Motor Vehicle Accident Deaths, Number and Rate BC, Age Standardized (Constant Population, Actual Change in Age& Gender Specific Rates)

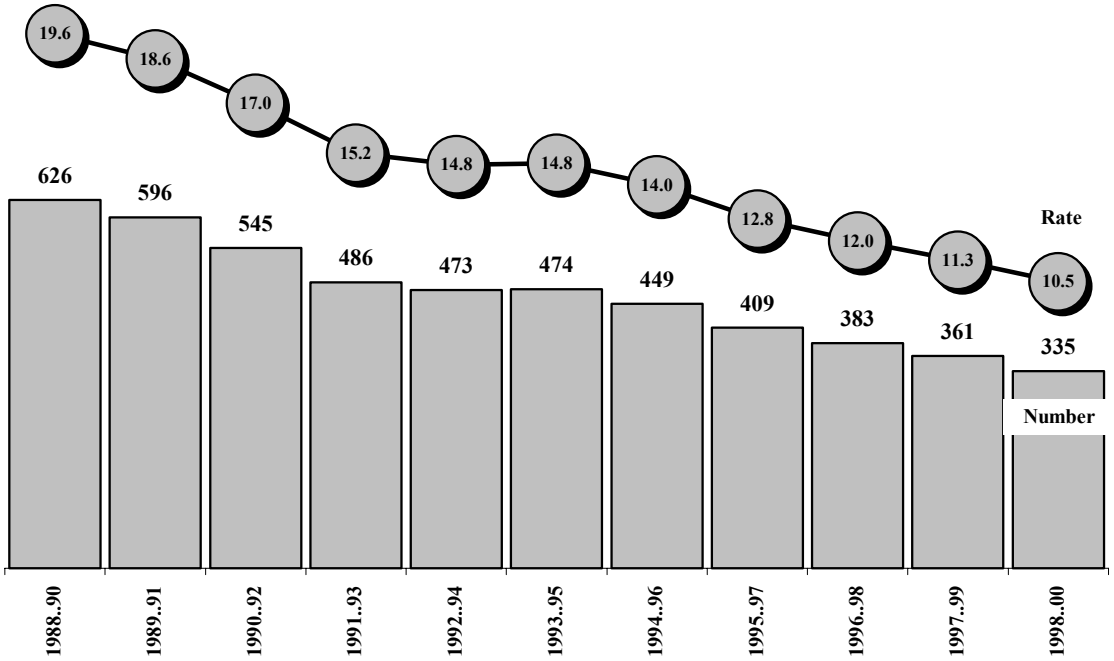
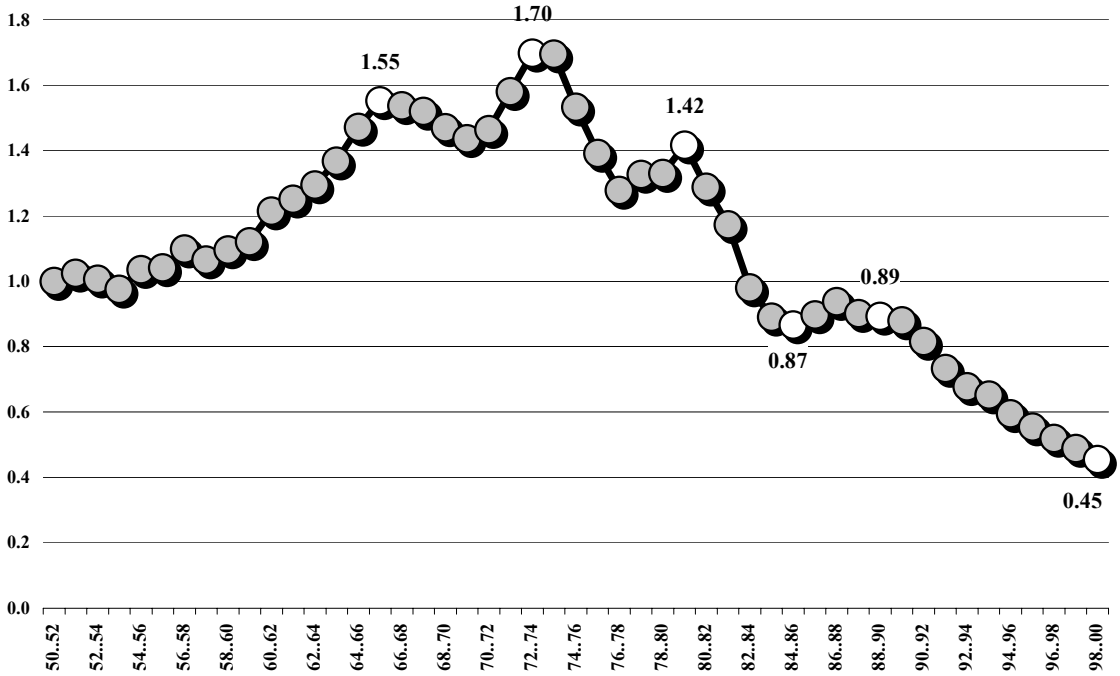


Figure 24: Change in Age Standardized Motor Vehicle Accident Mortality Rates, British Columbia, 1950 to 2000, 1950 = 1.0



C. Long Term Behavioural Change.

Age standardization not only permits measurement of the degree to which behaviour (i.e., age and gender specific rates) causes change over time, it also permits comparison of behaviour between regions with quite different population characteristics. In terms of long term trends in British Columbia, linking the BC Vital Statistics data presented here for the 1988 to 2000 period to Statistics Canada[4] age standardized rates for the 1950 to 1997 period shows that the past decade's decline in age standardized motor vehicle mortality rates is part of a long run pattern of behavioural change that started in the mid-1970s (Figure 24). The 1998-2000 three year moving average age standardized motor vehicle mortality rate of 10.5 deaths per 100,000 population was 45% of the 23.0 deaths per 100,000 people that was recorded in the 1950-1952 period. From 1950-1952 to 1972-1974, the age standardized rate of motor vehicle accidents increased by 70%, to 39.1 deaths per 100,000 people: adjusting for demographic differences, there was a 70% greater death rate due to motor vehicle accidents in 1972-1974 than there was 25 years earlier.

Over the past twenty five years, the age standardized mortality rate has fallen by 75%, with 1998-2000's age standardized rate of 10.5 deaths per 100,000 being 27% of the 39.1 per 100,000 rate of 1972-1974. Twenty-five years ago, behavioural patterns generated a motor vehicle accident mortality rate that was 3.7 times greater than it is today. While the fastest declines were observed during the 1973-1975 to 1976-1978 and 1979-1981 to 1983-1985 periods, the longest period of continuous decline has been that which commenced in 1986-1988 and which continues today.

It had been hoped that this report could compare data to 2000 for British Columbia to other provinces, but when the vital statistics agencies of both Alberta and Ontario were unable to provide comparable data, these hopes had to be abandoned. The Statistics Canada data cited above do permit comparison of motor vehicle accident mortality rates for provinces, although such comparisons will be somewhat dated as these data terminate with 1997 and involve use of a different standard age, and hence different values for age standardized rates. Nonetheless, they clearly show that the trend in British Columbia is part of a nation-wide pattern.

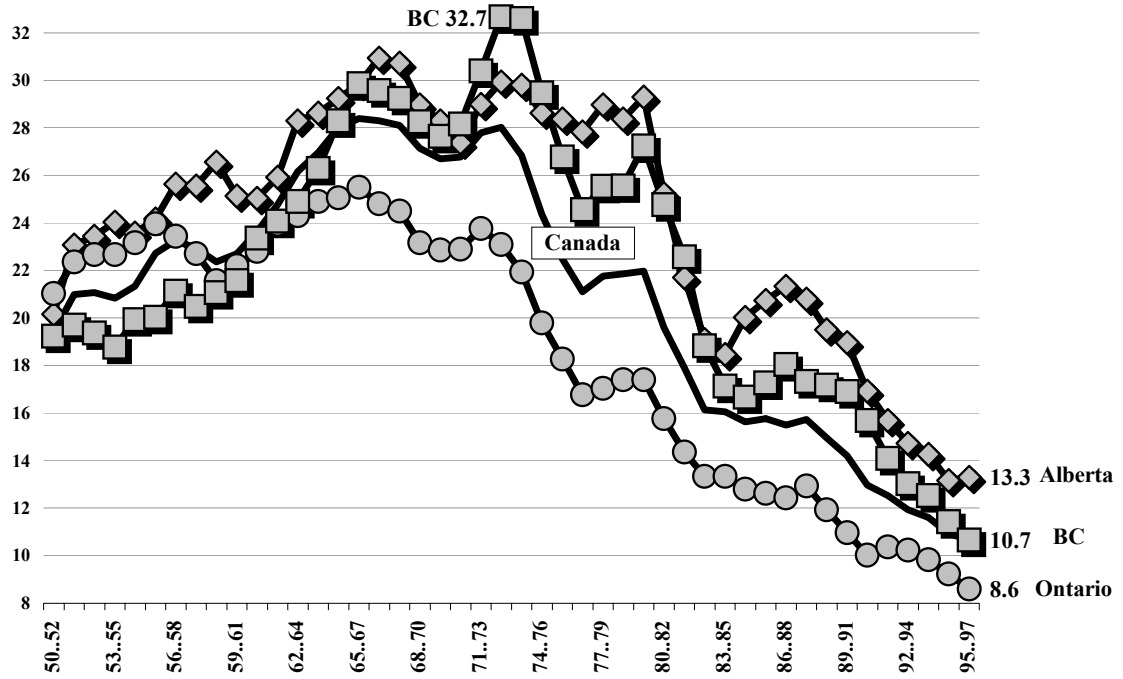
Figure 25 shows three-year average age standardized motor vehicle mortality rates for the provinces of Alberta, British Columbia and Ontario, plus the rate for Canada as a whole. They all started the early 1950s with average age standardized mortality rates in the 19 to 21 deaths per 100,000 population range, saw the rates increase for 15 to 20 years, and then all experienced a significant decline. Thus it can be concluded that not only is the decline age standardized motor vehicle accident rates for British Columbia part of a long term trend in the province, it is part of a long term national trend.

Having noted these similarities, it is also important to comment on the differences. The age standardized mortality rates all followed the same pattern from 1950-1952 to 1965-1967: then Ontario began to see declines in its rate that, while following the general pattern for the other two provinces and the country, took it well below the national average. By 1995-1997, the age standardized motor vehicle mortality rate in Ontario was 8.6 per 100,000, 41% of its 1950-1952 average of 21.0 death per 100,000. British Columbia's age standardized rate did not decline by as great a percentage, with its 1995-1997 rate of 10.7 deaths per 100,000 being 55% of its 1950-1952 rate of 19.2 (this is the same relative decline as occurred to the national average). Alberta experienced the smallest relative decline of the three, with its 1995-1997 rate of 13.3 per 100,000 being 66% of its 1950-1952 rate of 19.4 per 100,000.

The highest rate and greatest decline during the period occurred in British Columbia: the 67% decline from the record high of an age standardized rate of 32.7 motor vehicle accident deaths per 100,000 population recorded in 1972-1974 to 10.7 in 1995-1997 is unmatched either nationally or

in the other two provinces. However, the 66% decline for Ontario, from 25.5 per 100,000 in 1965-1967 to 8.6 per 100,000 in 1995-1997 almost matches the decline that B.C. experienced. Alberta experienced a 57% decline, from 30.9 deaths in motor vehicle accidents per 100,000 population in 1966-1968 to 13.3 in 1995-1997.

Figure 25: Age Standardized Motor Vehicle Accident Mortality Rates, Canada and Selected Provinces, 1950 to 1997, National Standardization



Of the ten provinces, the highest age standardized motor vehicle accident mortality rates in 1995-1997 were found in Saskatchewan, followed, in descending order, by New Brunswick, Prince Edward Island, Alberta, Nova Scotia, Manitoba, Quebec, British Columbia, Ontario, and finally Newfoundland. Considering the three provinces for which data are presented on Figure 25, the age standardized rates indicate that, if the three provinces had exactly the same population, in terms of both size and composition, Alberta would have 24% more motor vehicle accident mortalities each year than would British Columbia, and 55% more than Ontario would have.

The three year 1995-1997 average age specific mortality rates for these three provinces show that the higher than average age standardized motor vehicle accident rate for Alberta is the result generally higher rates in all age groups, rather than dramatically different rates in isolated age groups (Figure 26). All three provinces demonstrate the u-shaped pattern of age specific motor vehicle accident mortality rates, with the highest rates in the 15 to 29 and 70 plus age groups: in all but one age group (30 to 34) Alberta has the highest age specific mortality rates. British Columbia has the lowest age specific rates in the 0 to 14 and 60 to 84 age groups, while Ontario has the lowest rates in the 15 to 59 age groups (with the exception of the 50 to 54 age group).

The use of age standardized and age specific motor vehicle accident mortality rates permit measurement of the spatial and temporal differences in mortality adjusted for population differences. It does not permit measurement of the impact that population differences have on the annual number of motor vehicle accident mortalities: with exactly the same behavioural pattern (i.e., age specific motor vehicle accident mortality rates) a province with a relatively large portion of its population in the 15 to 29 and/or 70 to 84 population will have a greater number of motor vehicle accidents than one with a relatively small portion of its population in these age groups.

Figure 26: Three Year Average Age Specific Motor Vehicle Accident Mortality Rates Alberta, British Columbia and Ontario, 1995-1997

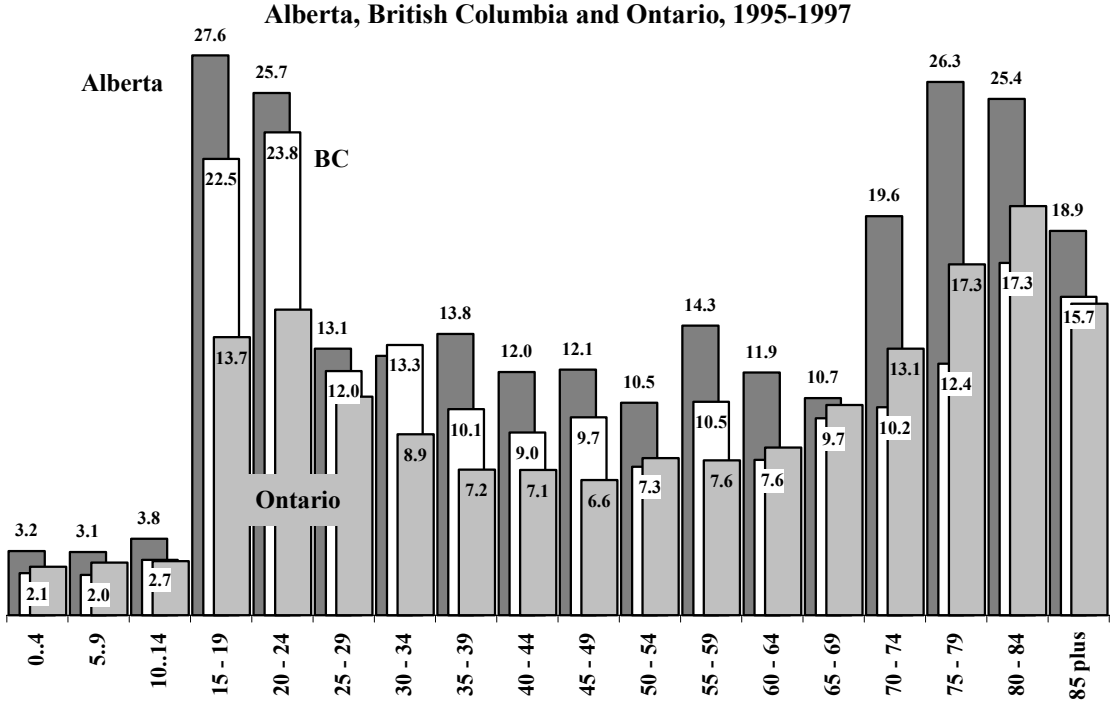
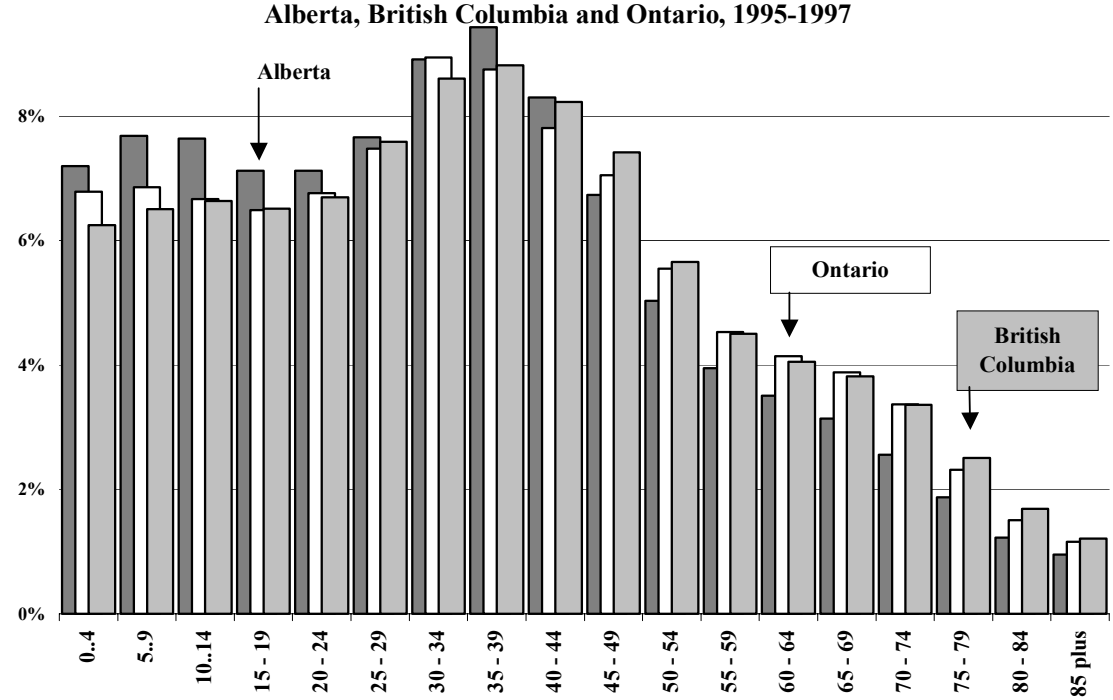
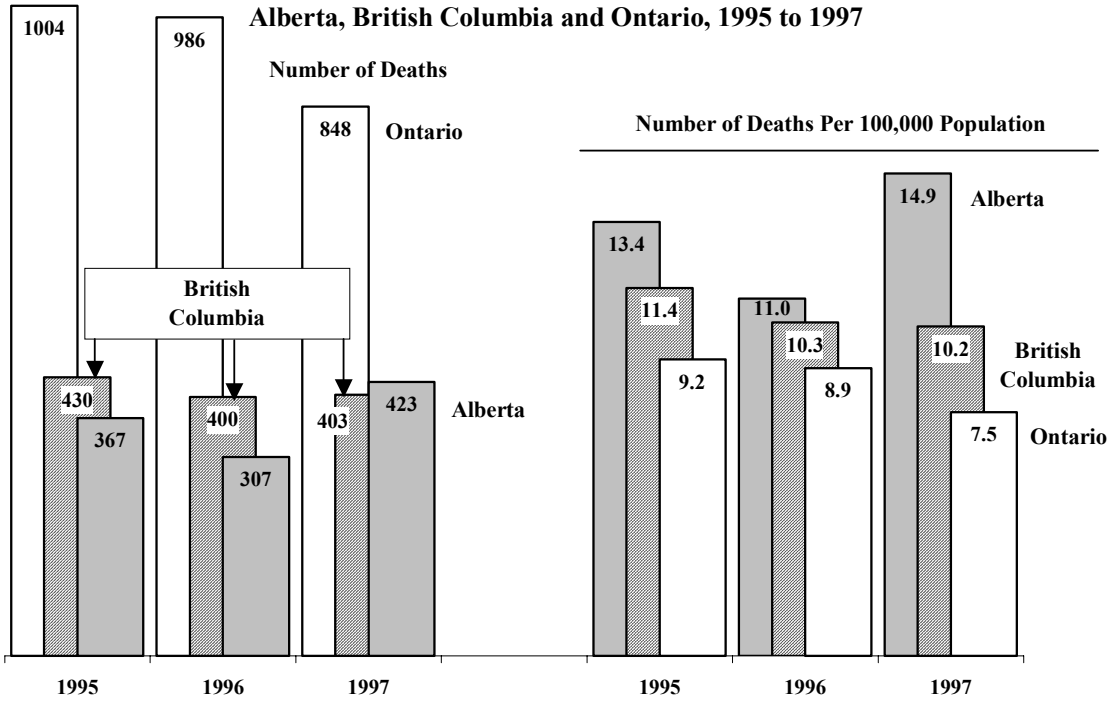


Figure 27: Percentage Distribution of the Population By Age Group, Alberta, British Columbia and Ontario, 1995-1997



The age profile of Alberta's population is distinct from those of British Columbia and Ontario (Figure 27): Alberta has a greater percentage of its population in every age group under the age of 45 than either British Columbia or Ontario. Conversely, of the three, Alberta has the smallest percentage of its population in every age group 45 years of age and older. In total, in the 1995 to 1997 period an average of 77.1% of Alberta's population was under the age of 45, compared to 66.5% in Ontario and 65.8% in British Columbia. Alberta's higher percentage in the young adult age groups is, in the context of motor vehicle mortality, somewhat offset by its smaller percentage in the 70 and older age groups.

Figure 28: Motor Vehicle Accident Mortality and Overall Rates
Alberta, British Columbia and Ontario, 1995 to 1997



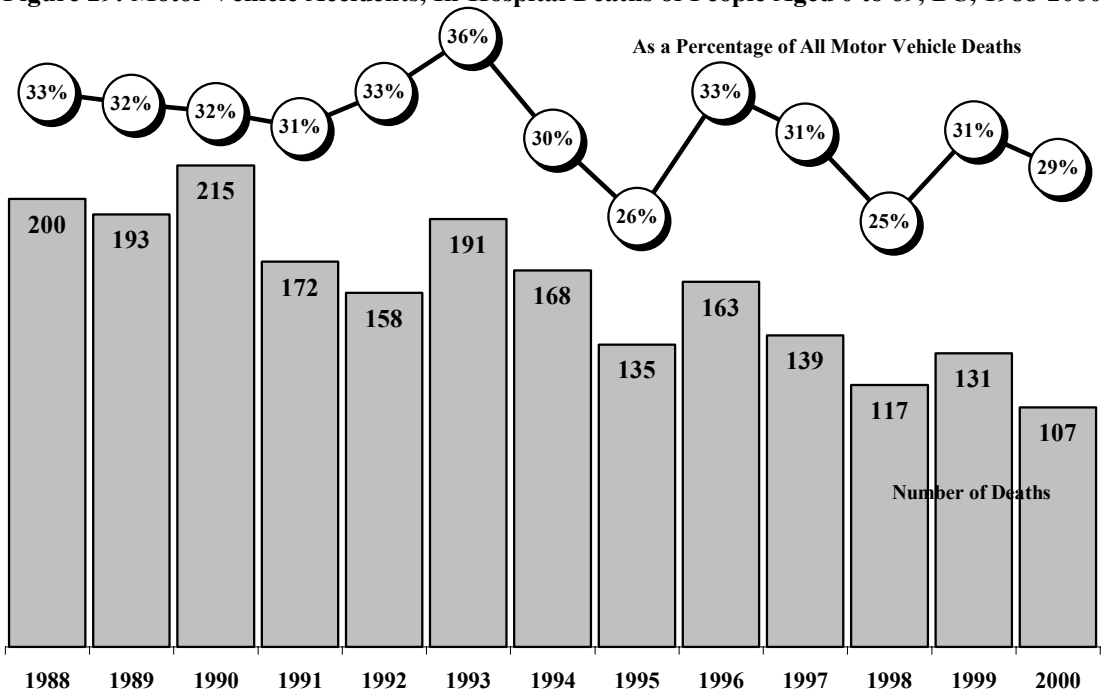
The result of differences in behaviour, demographics and population size is differences in the annual number of deaths due to motor vehicle accidents (Figure 28). Ontario, with the largest population, has the largest number of deaths in spite of its low age standardized mortality rate: having said this, of the three provinces it has the smallest number of deaths each year per 100,000 population (not age standardized). In spite of its smaller population, and because of its higher age specific mortality rates and its younger population, Alberta has the highest annual number of deaths per 100,000 population: in 1997, even with a population that was three quarters the size of the population of British Columbia, Alberta had more death than this province (423 to 403).

D. An Example of the Consequences of Changing Motor Vehicle Mortality Rates

Before turning to a consideration of behavioural change in the concluding section of this report, one last aspect of the data warrants brief examination. The number of in-hospital deaths of people aged 0 to 69 has declined faster than the total number of deaths due to motor vehicle accidents, recording a 47% drop from 200 in 1988 to 107 in 2000 (Figure 29). This led to a decline in these deaths as a percentage of all motor vehicle accident deaths from a 33% share during the closing years of the 1980s to a 29% share in the closing years of the 1990s.

This has had a significant impact on the potential number of donors for organ transplant programmes, as traditionally in-hospital deaths of people in this age group from this cause have played a major role in the supply of organs for donation. The reliance on this age group and this cause is that there was a comparatively low risk that donation would be precluded due to the presence of other diseases or organ failure: the reliance on in-hospital deaths is the necessity that donors be on a ventilator and meet brain death criteria in order for transplants to occur.

Figure 29: Motor Vehicle Accidents, In-Hospital Deaths of People Aged 0 to 69, BC, 1988-2000



While the process of donation and transplantation has improved significantly over the past decade, so too has the demand for organs for donation. When combined with the almost 50% decline in the number of these in-hospital deaths, the constraints on organ transplant rates have increased almost constantly over the past decade.

To deal with these constraints, donor organizations have had to increasingly rely on donation that resulted from in-hospital mortalities of victims of cerebrovascular disease: changing patterns of mortality has meant that this source of potential donors has also come to face increasing constraints. While the number of deaths from cerebrovascular disease in British Columbia increased by 20% between 1988 and 2000, all of the increase was in the 75 and older age group. The number of such deaths of people aged 0 to 69 decreased by 25%, both in total (from 346 to 261) and in-hospital deaths (from 307 to 231). The result is a decline in the number of in-hospital deaths of people aged 0 to 69 from 16% of all deaths due to this cause to only 10%.

While changes in population health may provide the opportunity for more donations from persons in older age groups in the future, the 50% decline in the number of in-hospital deaths due to motor vehicle accidents and the 25% decline in the number of in-hospital deaths due to cerebrovascular disease of people aged 0 to 69 has placed very significant constraints on the ability of organ donation and transplant organizations to reduce the size of transplant waiting lists.

IV. Conclusions: Behavioural Change and Motor Vehicle Accident Mortality.

The demonstrated decline in age and gender specific motor vehicle mortality rates in British Columbia is an extremely positive finding: it shows that actions to change behaviour do work, and that demographics are not destiny. Effectively, all of the reduction in both total mortality and mortality per 100,000 population was the result of the emergence, over the past decade, of different, in both degree and pattern, age and gender specific mortality rates.

Having rejected demographics as the panacean explanation of any noticeable part of the change, it is necessary to avoid postulating that any one other factor was the source of what has been lumped together here as behavioural change. Much, much more data on the nature and cause of motor vehicle accidents, on emergency response and treatment, on motor vehicle design, and on driver behaviour will have to be examined before any conclusions may be drawn as to why the change in rates occurred. It is nonetheless useful to consider some of the forces that will be shown to have played a role in bringing about the changes in behaviour that lead to the decline in motor vehicle accident motor vehicle accident mortality rates.

Paramount among these factors will be the enactment and enforcement of laws with respect to motor vehicle driver and passenger behaviour, particularly with respect to driving while under the influence of alcohol, speeding and the use of seat belts. A recent study by the United States National Safety Council, for example, shows the impact of the enactment and enforcement of seat belt laws: the conclusion of the study was that the failure to use seatbelts accounted for more than a 600% difference in motor vehicle accident mortality rates for teenagers:

> "teenagers in Montana are seven times as likely as teenagers in California to die in a crash while not wearing seat belts. The annual rate of such fatal accidents is 33.4 per 100,000 residents in Montana and 4.7 per 100,000 in California. … The police are not allowed to stop motorists for seat belt violations in Montana, and surveys find that only about three-quarters of all people wear seat belts in that state. In California, 9 out of 10 people wear them, the highest in the country."[5]

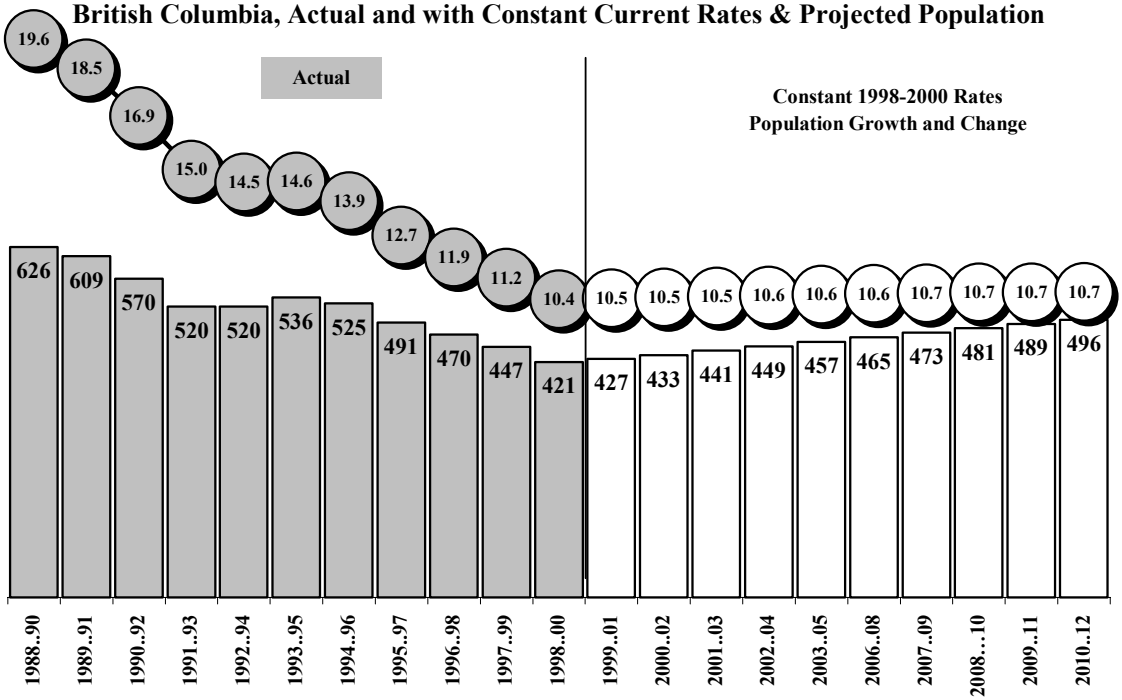
It is important that the existence and enforcement of such laws be placed in the context of the change in general driving attitudes that goes with their widespread application. Thus, just as smoking has increasingly become seen, within many groups, as anti-social and hence unacceptable behaviour, so too has driving under the influence, speeding, and driving without wearing a seatbelt. Habit and peer pressure that may have started with specific safety oriented programmes and laws have changed the norm in how people drive: behaviour has in fact changed. The data clearly show that today's driver, young or old, male or female, is not the driver of a decade ago.

The engineering of roads and vehicles has also moved in the direction of greater safety in traffic, with better design of ramps, roadways and curves; better lighting and traffic control; and better design of vehicles, including seatbelts, anti-locking brakes, and impact absorption all reducing the incidence of both accidents and of mortality when accidents occur. Improved emergency response and treatment also means that, when an accident occurs, there is a greater chance (and it will always be to some degree a chance) that persons injured will survive. Another, and most likely minor, factor will be the decline in the populations, and particularly in the younger adult populations, in rural areas where accidents happen far from emergency response, and all too often at high speeds: urbanization will have contributed, to some extent, to the reduction in the propensity of people to be involved in motor vehicle accidents that result in fatalities.

The degree to which these factors resulted in the reduction of motor vehicle accident mortality over the past decade will require significant research effort: such research will not be merely academic, but of vital importance. The reasons is that, while motor vehicle accident mortality rates have declined by 50% over the past decade, there is still much room for reduction. The rates for young adult males, when compared to those for their female counterparts, demonstrate that age specific mortality rates can be brought down much further, that behaviour can be further modified. As even the current rates involve 375 deaths per year, such reductions will be of importance, both for those whose behaviour is responsible for the motor vehicle accidents and those who a its innocent victims.

Further reductions in age specific mortality rates will be much more difficult to attain than they were in the past. Each measure designed to reduce motor vehicle accidents succeeds with those most susceptible to behaviour modification: those whose behaviour remains unchanged will require even greater effort. To reach those who are currently immune means that even more effective measures must be pursued: research will be necessary to identify what additional measures will be required.

Figure 30: 3-Year Moving Average Motor Vehicle Accident Deaths, Number and Rate
British Columbia, Actual and with Constant Current Rates & Projected Population



In order to continue to see the number of deaths in motor vehicle accidents continue to decline, maintaining the status quo will not be good enough. The demographic reality is that the status quo, in terms of current age and gender specific motor vehicle accident mortality rates, will lead to an increase in the annual number of deaths in motor vehicle accidents, as the bulge in the British Columbia's population that is currently in the 33 to 62 age group, will enter the stage in the life cycle where age specific mortality rates increase from their adult lows.

The extent to which demographic change, will lead to increased motor vehicle accident mortality, in both absolute and relative terms, can be demonstrated by applying the 1998-2000 age and gender specific motor vehicle accident mortality rates to the BC Statistics current population projection for British Columbia. The annual number of deaths would immediately increase from its 1998-2000 annual average of 421 to an average of 496 per year by the 2008-2010, while the mortality rate would increase from its current 10.5 deaths per 100,000 population per year to 10.7 per 100,000 (Figure 30).

British Columbia has been successful in reducing the annual number, and rate, of motor vehicle accident mortality. This demonstrates that it is possible to modify behaviour to reduce motor vehicle deaths: the difference between rates for males and females shows that there is room for even further reductions. What will happen without further efforts will be a reversal of the declines in mortality that have been achieved.

Endnotes:

[1] Data provided by the British Columbia Vital Statistics Agency. The author thanks the agency and its staff for their timely, generous and thoughtful assistance in tabulating and providing the data.

Motor vehicle accident mortality includes deaths within the International Classification of Disease categories ICD-9 codes (to 1999) E8100-E8259, E9290 and ICD-10 codes (year 2000) include V020-V049, V090-V093, V120-V149, V190-V196, V200-V249, V260-V349, V360-V449, V460-V549, V560-V649, V660-V749, V760-V799, V803-V805, V820-V821, V823-V839, V840-V875, V877-V8999, Y850.

These mortalities include those resulting from both traffic and non-traffic accidents. Motor vehicle traffic accidents (E810-E819) include those involving collision with train (E810); re-entrant collision with another motor vehicle (E811); all other collision with another motor vehicle (E812); collision with other non-motor vehicle (E813); collision with pedestrian (E814); other motor vehicle traffic accident involving collision on the highway (E815); motor vehicle traffic accident due to loss of control without collision on the highway (E816); non-collision motor vehicle traffic accident while boarding or alighting (E817); other non-collision motor vehicle traffic accident (E818; and motor vehicle traffic accident of unspecified nature (E819). Motor vehicle non-traffic accidents (E820-E825) include those involving motor-driven snow vehicle (E820); other off-road motor vehicle (E821); collision with moving object (E822); collision with stationary object (E823; other motor vehicle non-traffic accident while boarding or alighting (E824); other motor vehicle non-traffic accident of other and unspecified nature (E825); and other road vehicle accidents not elsewhere classified (E829)

[2] All BC population data and projections, for both size and composition, unless otherwise noted are from British Columbia Statistics web site, www.bcstats.gov.bc.ca accessed May 21, 2001.

[3] Hospitals include all medical care institutions, including acute care, extended care, residential care and nursing home facilities.

[4] Statistics Canada, "Age-Standardized Mortality Rates 1950 to 1997", Health Statistics at a Glance, (Statistics Canada, Ottawa, 1999) Table 00060114.

[5] As cited in Matthew Wald, "Low Seat Belt Use Linked to Teenage Death Rate Rates", The New York Times, May 21, 2001.