SMALL-AREA DISABILITY-ADJUSTED LIFE YEARS: A NEW APPROACH TO THE SPATIO-TEMPORAL ANALYSIS OF PUBLIC HEALTH SURVEILLANCE DATA

by

VIVIANE DIAS LIMA

B.Sc., Escola Nacional de Ciências Estatísticas, 1996

M.Sc., Universidade Federal do Rio de Janeiro, 1997

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Abstract

When engaged in injury surveillance and regional health planning (*e.g.*, the allocation and distribution of health services and prevention initiatives) it is essential that the health status of regions be monitored over time. The conventional approach to monitoring the health impact of injuries has been to summarize the spatial variation of each region using measures such as mortality and incidence rates. While the use of such measures yields important surveillance information, it does not directly quantify the overall (*i.e.*, fatal and non-fatal) injury burden experienced by individual communities.

Although measures of incidence and burden can be derived for small regions, they are often based on a low number of observed injury cases. These low counts are frequently associated with high degrees of chance variation. Recently developed model-based disease mapping methods reduce the influence of chance variation and in so doing yield more reliable estimates of the underlying variation in injury incidence and burden.

In this thesis we describe how estimates of disability-adjusted life years (DALY) can be integrated into spatio-temporal Bayesian statistical methods to quantitatively describe how the burden of injuries varies between and within regions of British Columbia (BC) over time. As a demonstration, we examined administrative hospitalization data using the DALY methodology to calculate the incidence and burden of 13 external causes of injury at the provincial and health authority level from 1991-2000. To illustrate the small-area analysis of injury burden, we used the same data to describe the impact of road traffic accidents. Lastly, we

examined injuries due to adverse events to demonstrate the usefulness of administrative database screening to describe region-specific impacts of these injuries in BC.

Obtaining reliable small-area DALY estimates has the potential to dramatically improve our understanding of public health problems. As shown in this thesis, this methodology enables researchers to quantify the total number of healthy years lost for leading causes of injury. In addition to scientific gains, this information can be used to inform the setting of regional priorities related to the planning and delivery of health care and quantify the benefits of regional intervention programs in cost-effectiveness analyses.

Table of Contents

Abstract ii

List of Tables ix

List of Figures xiii

Acknowledgements xxi

Dedication xxiii

Chapter 1. Introduction 1

1.1 Research Objectives 8

1.2 Organization of Dissertation 10

Chapter 2. Literature Review 11

2.1 Measures of Population Health and Disease Mapping Methods 11

2.1.1 Summary Measures of Population Health 11

2.1.1.1 Health Expectancies 13

2.1.1.2 Health Gaps 15

2.1.1.3 Why Use DALYs and Not QALYs 18

2.1.1.4 How DALYs Have Been Used in the Literature 19

2.1.2 Small-Area Analysis and Disease Mapping 20

2.2 Issues in Medical Adverse Events Research 23

2.3 Validity and Reliability of the ICD9 E-Codes in Identifying External Causes of Injury 29

2.3.1 All Causes of Injuries Excluding Medical Adverse Events 30

2.3.2 Injuries Due To Medical Adverse Events 32

Chapter 3. Methods 39

3.1 Data 39

3.1.1 Definition of Study Regions 40

3.1.2 Definition of Study Population 43

3.1.3 Categories of External Cause and Nature of Injury 48

3.2 Bayesian Disease Mapping 51

3.2.1 Spatio-Temporal Modeling under a Full Bayesian Approach 55

3.3 Disability-Adjusted Life Years (DALY) 58

3.3.1 Assumptions Made in the Calculation of DALYs 60

3.3.1.1 Discounting Future Health Rate (r) 61

3.3.1.2 Age Weighting (β) 64

3.3.1.3 Comorbidities 66

3.3.1.4 Disability Weights (DW) 67

3.3.1.5 Calculating Duration for YLD (D) 76

3.3.1.6 Residual Category of Injury Sequela 82

3.3.1.7 Gender Difference in the Length of Life for Calculating YLL (L) 83

3.4 Small-Area Analysis of Disability-Adjusted Life Years (DALY) 85

3.5 Software 87

3.6 Outline of Data Analyses 88

3.6.1 Burden of Injuries in British Columbia and Its Health Authorities, 1991-2000 89

3.6.2 A Small-Area Analysis of the Incidence of Medical Adverse Events in British Columbia, 1991-2000 89

3.6.3 A Small-Area Analysis of the Burden Due To Road Traffic Accidents in British Columbia, 1991-2000 90

Chapter 4. Burden of Injuries in British Columbia and Its Health Authorities, 1991-2000 91

4.1 The Provincial Level Analysis 92

4.1.1 Conventional Mortality and Hospitalization Rates 92

4.1.2 Years of Life Lost (YLL) 97

4.1.3 Healthy Years Lost Due To Disability (YLD) 102

4.1.4 Disability-Adjusted Life Years (DALY) 107

4.1.5 Comparison of Contributions Associated With YLD and YLL (Ten-Year Combined) 111

4.1.6 Comparison of All Health Status Indicators (Ten-Year Combined) 115

4.2 The Health Authority Level Analysis 119

4.2.1 Conventional Mortality Rate 119

4.2.2 Conventional Hospitalization Rate 124

4.2.3 Disability-Adjusted Life Years (DALY) 129

Chapter 5. Small-area Analysis of the Burden Due to Road Traffic Accidents in British Columbia 136

5.1 Estimated Mortality and Hospitalization Rates 136

5.1.1 Comparison of the Annual Estimated Rates among Different Geographical Layers in the Provincial Health Care System 140

5.1.2 Mortality and Hospitalization Rate Ratios 147

5.2 Estimated Disability-Adjusted Life Years 154

Chapter 6. A Small-area Analysis of the Incidence of Medical Adverse Events in British Columbia 162

6.1 Descriptive Statistics for Medical Adverse Events 162

6.2 Estimated Medical Adverse Event Incidence Rates 164

6.2.1 Comparison of the Annual Estimated Rates among Different Geographical Layers in the Provincial Health Care System 168

6.2.1.1 Age Group 0-19 Years 170

6.2.1.2 Age Group 65-79 Years 176

Chapter 7. Discussion 182

7.1 Summary of Findings 182

7.2 Injury Viewed as a Public Health Issue 184

7.3 Methodological Considerations, Limitations and Recommendations for Future Research 192

7.3.1 Data Quality 192

7.3.2 Epidemiological Methodology 194

7.3.3 Statistical Methodology 201

7.3.4 General Issues 202

7.4 Conclusion 205

Bibliography 206

Appendix 229

A Acronyms 230

B Glossary 232

C Important ICD9-CM E-Codes 248

D Example of Disability Weight Spreadsheet Assuming Zero Disability Weight for the Residual Category of Injury Sequela 259

E Example of Duration Spreadsheet Assuming Zero Duration for the Residual Category of Injury Sequela 265

F Sensitivity Analyses 267

G Chapters' General Tables and Figures 291

H Diagnostic Plots 362

List of Tables

Table 1.1	List of ICD9-CM E-codes for External Causes of Injury (Mathers and Stevenson 1999; Murray and Lopez 1996).	6
Table 1.2	Health Status Section of the Health Indicators Project Framework (Statistics Canada 2004).	7
Table 2.1	Different Studies on Medical Adverse Events (adapted from Baker *et al.* 2004).	26
Table 2.2	List of Patient Safety Indicators (AHRQ 2003).	35
Table 2.3	Set of ICD9-CM E- and N-codes Defining the Patient Safety Indicator "Foreign Body Left During Procedure". (AHRQ 2003, pages 98-99)	37
Table 3.1	List of ICD9-CM N-Codes for Nature of Injury (Murray and Lopez 1996).	49
Table 3.2	Disability Weights by Nature of Injury and Age Category (Murray and Lopez 1996).	68
Table 3.3	Disability Weights for Each Age Group and Gender by Injury External Cause.	71
Table 3.4	Disability Weights (All Ages Combined) for Each Injury Sequela by Gender and Injury External Cause.	73
Table 3.5	Duration Assumptions by Type of Injury (Murray and Lopez 1996).	76
Table 3.6	Gender and Age Specific Life Expectancies for British Columbia (BC) in 2001.	78
Table 3.7	Durations for Each Age Group and Gender by Injury External Cause.	79

Table 3.8	Durations by Injury Sequela for the External Causes of Injury Drowning and Suffocation and Foreign Bodies. Males 0-19 years.	81
Table 3.9	Japanese Gender and Age Specific Life Expectancies for the Year 1990 Used in the Global Burden of Disease (GBD) Study.	84
Table 4.1	Ten-Year Mortality Rates by Gender, Age Group and External Cause of Injury, 1991-2000.	93
Table 4.2	Ten-Year Conventional Hospitalization Rates by Gender, Age Group and External Cause of Injury, 1991-2000.	94
Table 4.3	Total Years of Life Lost (YLL) by Gender, Age and External Cause of Injury, 1991-2000.	98
Table 4.4	Ten-Year Per Capita Years of Life Lost (or Per Capita YLL) per 1,000 Population by Gender, Age and External Cause of Injury for 1991-2000.	100
Table 4.5	Total Healthy Years Lost Due To Disability (YLD) by Gender, Age and External Cause of Injury, 1991-2000.	103
Table 4.6	Ten-Year Per Capita Healthy Years Lost Due To Disability (or Per Capita YLD) per 1,000 Population by Gender, Age and External Cause of Injury for 1991-2000.	105
Table 4.7	Total Disability Adjusted Life Years (DALY) by Gender, Age and External Cause of Injury, 1991-2000.	107
Table 4.8	Ten-Year Per Capita Disability-Adjusted Life Years (DALY) per 1,000 Population by Gender, Age and External Cause of Injury for 1991-2000.	109

Table 4.9	Percent Contribution of YLD to DALY (Ten-Year Combined) by Gender, Age and External Cause of Injury, 1991-2000.	112
Table 4.10	Ten-Year Age-Standardized Mortality Rate (ASMR) per 10,000 Population by Gender and Health Authority (HA), 1991-2000 (Canada 2001 Census).	120
Table 4.11	Ten-Year Age-Standardized Hospitalization Rates (ASHR) per 1,000 Population by Gender and Health Authority (HA), 1991-2000 (Canada 2001 Census).	124
Table 4.12	Ten-Year Age-Standardized Per Capita Disability-Adjusted Life Years (or age-Standardized Per Capita DALY or ASDALYR) per 1,000 Population by Gender and Health Authority, 1991-2000 (Canada 2001 Census).	130
Table 5.1	Regional Age-Specific Mortality Rates per 10,000 Population and Hospitalization Rates per 1,000 Population Due To Road Traffic Accidents in 2000 for Males and Females Aged 20-39 Years.	141
Table 5.2	Regional Per Capita Disability-Adjusted Life Years (DALY) per 1,000 Population Due To Road Traffic Accidents in 2000 for Males and Females Aged 20-39 Years.	155
Table 6.1	Estimated Provincial Annual Medical Adverse Event Incidence Rates (Age-Specific and Age-Standardized) per 100 Admissions by Gender for the Year 2000 (Standard Population: Hospital Admission Due To All Causes for Both Males and Females).	165

Table 6.2 Regional Medical Adverse Event Incidence Rate per 100 Admissions in 2000 for Males and Females Aged 0-19 and 65-79 Years. 169

List of Figures

Figure 1.1	Relationships among the Different Health Status Indicators Used in the Small-Area Analysis of Disability-Adjusted Life Years (DALY) Methodology.	5
Figure 2.1	Graphical Calculation of Quality-Adjusted Life Years (QALYs) (Gold, Stevenson, and Fryback 2002).	15
Figure 2.2	Graphical Calculation of Disability-Adjusted Life Years (DALYs) (Gold, Stevenson, and Fryback 2002).	18
Figure 3.1	Map of the Health Service Delivery Areas and Health Authorities of British Columbia.	42
Figure 3.2	Mid-Period Population Size by Health Service Delivery Areas during 1991-2000. Males and Females – All Age Groups.	44
Figure 3.3	Mid-Period Number of Admissions by Health Service Delivery Areas during 1991-2000. Males and Females – All Age Groups.	45
Figure 3.4	The Distribution of the Ten-Year Conventional Mortality Rate at the Provincial Level, by Gender and Age Group, and for All External Causes of Injury Combined.	47
Figure 3.5	Ten-Year Conventional Mortality Rate per 10,000 population Attributable To Road Traffic Accidents. Males, 20-39 Years, 1991-2000.	51

Figure 3.6	Annual number of deaths, estimated population and conventional mortality rate per 10,000 population attributable to road traffic accidents. Males, 20-39 years, 1991-2000.	53
Figure 3.7	Preference Values Intrinsic in the Calculation of Disability-Adjusted Life Years (DALY).	60
Figure 3.8	Effect of Time, in Years, on the Discrete Discounting Function.	62
Figure 3.9	Shape of Age Weighting Function for β in the Set $\{0.03,0.04,0.05\}$.	65
Figure 3.10	Example of How to Calculate the Weighted Life Expectancy.	78
Figure 3.11	Hypothetical Mortality Rate Posterior Distribution Density of Different Health Services Delivery Areas (HSDA).	87
Figure 4.1	Categories of external causes of injury.	91
Figure 4.2	Annual Age-Standardized Mortality Rate (ASMR) per 10,000 Population for Males and Females, 1991-2000 (Canada 2001 Census).	96
Figure 4.3	Annual Age-Standardized Hospitalization Rate (ASHR) per 1,000 Population for Males and Females, 1991-2000 (Canada 2001 Census).	97
Figure 4.4	Annual Age-Standardized Per Capita YLL (ASYLLR) per 1,000 Population for Males and Females, 1991-2000 (Canada 2001 Census).	101
Figure 4.5	Annual Age-Standardized Per Capita Healthy Years Lost Due To Disability (ASYLDR) per 1,000 population for Males and Females, 1991-2000 (Canada 2001 Census).	106
Figure 4.6	Annual Age-Standardized Per Capita DALY (ASDALYR) per 1,000 Population for Males and Females, 1991-2000 (Canada 2001 Census).	110

Figure 4.7	Percent Contribution of YLD to DALY (Ten-Year Combined) by Age and External Cause of Injury for Males, 1991-2000.	113
Figure 4.8	Percent Contribution of YLD to DALY (Ten-Year Combined) by Age and External Cause of Injury for Females, 1991-2000.	114
Figure 4.9	Ranking of External Causes of Injury within Each Age-Standardized Health Status Indicator for All Ten Years of Data Combined. Males, 1991-2000 (Canada 2001 Census).	117
Figure 4.10	Ranking of External Causes of Injury within Each Age-Standardized Health Status Indicator for All Ten Years of Data Combined. Females, 1991-2000 (Canada 2001 Census).	118
Figure 4.11	Annual Age-Standardized Mortality Rate (ASMR) per 10,000 Population by Injury and Health Authority for Males, 1991-2000 (Canada 2001 Census).	122
Figure 4.12	Annual Age-Standardized Mortality Rate (ASMR) per 10,000 Population by Injury and Health Authority for Females, 1991-2000 (Canada 2001 Census).	123
Figure 4.13	Annual Age-Standardized Hospitalization Rate (ASHR) per 1,000 Population by Injury and Health Authority for Males, 1991-2000 (Canada 2001 Census).	127
Figure 4.14	Annual Age-Standardized Hospitalization Rate (ASHR) per 1,000 Population by Injury and Health Authority for Females, 1991-2000 (Canada 2001 Census).	128

Figure 4.15	Annual Age-Standardized Per Capita DALY (ASDALYR) per 1,000 Population by Injury and Health Authority for Males, 1991-2000 (Canada 2001 Census).	133
Figure 4.16	Annual Age-Standardized Per Capita DALY (ASDALYR) per 1,000 Population by Injury and Health Authority for females, 1991-2000 (Canada 2001 Census).	134
Figure 5.1	Conventional and Estimated Annual Mortality Rates per 10,000 Population by Health Services Delivery Area for Road Traffic Accidents Experienced by Males and Females Aged 20-39 Years, 1991-2000.	138
Figure 5.2	Conventional and Estimated Annual Hospitalization Rates per 1,000 Population by Health Services Delivery Area for Road Traffic Accidents Experienced by Males and Females Aged 20-39 Years, 1991-2000.	139
Figure 5.3	Annual Road Traffic Accident Mortality Rate per 10,000 Population for Males Aged 20-39 Years at the Health Services Delivery Area, Health Authority and Provincial Levels, 1991-2000.	142
Figure 5.4	Annual Road Traffic Accident Hospitalization Rate per 1,000 Population for Males Aged 20-39 Years at the Health Services Delivery Area, Health Authority and Provincial Levels, 1991-2000.	143

Figure 5.5	Annual Road Traffic Accident Mortality Rate per 10,000 Population for Females Aged 20-39 Years, at the Health Services Delivery Area, Health Authority and Provincial Levels, 1991-2000.	145
Figure 5.6	Annual Road Traffic Accident Hospitalization Rate per 1,000 Population for Females Aged 20-39 Years, at the Health Services Delivery Area, Health Authority and Provincial Levels, 1991-2000.	146
Figure 5.7	Annual Ratio between the Mortality Rates of Each Health Services Delivery Area and British Columbia for Road Traffic Accidents in Males and Females Aged 20-39 Years, 1991-2000.	148
Figure 5.8	Map of the Annual Ratio between the Mortality Rates of Each Health Services Delivery Area and British Columbia for Road Traffic Accidents Experienced by Males and Females Aged 20-39 Years, 1991-2000.	149
Figure 5.9	Annual Ratio between the Hospitalization Rates for each Health Services Delivery Area and British Columbia for Road Traffic Accidents Experienced by Males and Females Aged 20-39 Years, 1991-2000.	152
Figure 5.10	Map of the Annual Ratio between the Hospitalization Rates of Each Health Services Delivery Area and British Columbia for Road Traffic Accidents Experienced by Males and Females Aged 20-39 Years, 1991-2000.	153

Figure 5.11	Annual Per Capita Disability-Adjusted Life Years per 1,000 Population for Road Traffic Accidents Experienced by Males Aged 20-39 Years at the Health Services Delivery Area, Health Authority and Provincial Levels, 1991-2000.	156
Figure 5.12	Annual Per Capita Disability-Adjusted Life Years per 1,000 Population for Road Traffic Accidents Experienced by Females Aged 20-39 Years at the Health Services Delivery Area, Health Authority and Provincial Levels, 1991-2000.	157
Figure 5.13	Annual Ratio between the Per Capita Disability-Adjusted Life Years of Each Health Services Delivery Area and British Columbia for Road Traffic Accidents Experienced by Males and Females Aged 20-39 Years.	158
Figure 5.14	Map of the Annual Ratio between the Per Capita Disability-Adjusted Life Years of Each Health Services Delivery Area and British Columbia for Road Traffic Accidents Experienced by Males and Females Aged 20-39 Years.	161
Figure 6.1	Annual Age-Specific Hospital Admission Rates per 1,000 Population for Both Genders Combined, 1991-2000.	163
Figure 6.2	Conventional and Estimated Annual Medical Adverse Event Incidence Rates per 100 Admissions by Health Services Delivery Area for Boys and Girls Aged 0-19 Years, 1991-2000.	166

Figure 6.3	Conventional and Estimated Annual Medical Adverse Event Incidence Rates per 100 Admissions by Health Services Delivery Area for Males and Females Aged 65-79 Years, 1991-2000.	167
Figure 6.4	Annual Medical Adverse Event Incidence Rates per 100 Admissions For Boys Aged 0-19 Years at the Health Services Delivery Area, Health Authority and Provincial Levels, 1991-2000.	171
Figure 6.5	Annual Medical Adverse Event Incidence Rates per 100 Admissions for girls Aged 0-19 Years at the Health Services Delivery Area, Health Authority and Provincial Levels, 1991-2000.	172
Figure 6.6	Annual Ratio between the Medical Adverse Event Incidence Rate of Each Health Services Delivery Area and British Columbia for Boys and Girls Aged 0-19 Years, 1991-2000.	173
Figure 6.7	Map of Annual Ratio between the Medical Adverse Event Incidence Rate of Each Health Services Delivery Area and British Columbia for Boys and Girls Aged 0-19 Years, 1991-2000.	175
Figure 6.8	Annual Medical Adverse Event Incidence Rates per 100 Admissions for Males Aged 65-79 Years at the Health Services Delivery Area, Health Authority and Provincial Levels, 1991-2000.	177
Figure 6.9	Annual Medical Adverse Event Incidence Rates per 100 Admissions for Females Aged 65-79 Years at the Health Services Delivery Area, Health Authority and Provincial Levels, 1991-2000.	178

Figure 6.10 Annual Ratio between the Medical Adverse Event Incidence Rate of Each Health Services Delivery Area and British Columbia for Males and Females Aged 65-79 Years, 1991-2000. 180

Figure 6.11 Map of Annual Ratio between the Medical Adverse Event Incidence Rate of Each Health Services Delivery Area and British Columbia for Males and Females Aged 65-79 Years, 1991-2000. 181

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Dedication

To my loving parents.

" If I speak in human and angelic tongues but do not have love, I am a resounding gong or a clashing cymbal.

And if I have the gift of prophecy and comprehend all mysteries and all knowledge; if I have all faith so as to move mountains but do not have love, I am nothing.

If I give away everything I own, and if I hand my body over so that I may boast but do not have love, I gain nothing.

Love is patient; love is kind. It is not jealous, (love) is not pompous, it is not inflated, it is not rude, it does not seek its own interests, it is not quick-tempered, it does not brood over injury, it does not rejoice over wrongdoing but rejoices with the truth.

It bears all things, believes all things, hopes all things, endures all things.

Love never fails. If there are prophecies, they will be brought to nothing; if tongues, they will cease; if knowledge, it will be brought to nothing.

For we know partially and we prophesy partially, but when the perfect comes, the partial will pass away.

When I was a child, I used to talk as a child, think as a child, reason as a child; when I became a man, I put aside childish things.

At present we see indistinctly, as in a mirror, but then face to face. At present I know partially; then I shall know fully, as I am fully known.

So faith, hope, love remain, these three; but the greatest of these is love." I Corinthians 13

Chapter 1

Introduction

One of the important roles of epidemiologists involved in public health surveillance is to monitor trends over time in disease mortality and morbidity rates for a collection of different communities (Schneider 2000). For many years, the conventional approach used to monitor the impact of diseases has been to summarize the spatial variation of each individual community using standardized mortality and incidence ratios. Typically, the individual ratios from each community are then integrated into a geographical map to provide a visual summary of the distribution of disease risk across the different communities. The information displayed in these maps is generally used to guide etiologic research, improve our understanding of the health needs of specific populations, guide future surveillance strategies, highlight areas of high and low risk, and inform policy formulation and resource allocation decisions (Elliott and Wartenberg 2004).

When researchers conduct disease mapping studies to assess the health status of communities, the health data are typically extracted from large geographically referenced datasets with aggregate counts of disease occurrence at the regional level. These counts are usually modelled using the Poisson distribution. However, when the focus of these studies is to assess spatial variation of rare diseases in small areas, the observed number of disease cases in any single region may be low, and in many situations, zero. In regions with a low population at risk, the counts are likely to be highly variable, which exposes conventional disease

incidence rates and ratios to larger degrees of chance variation (*i.e.,* these conventional measures of disease risk often fluctuate considerably over space and time) (Volinn *et al.* 1994; Elliott *et al.* 2001).

One approach to dealing with the high variation often associated with small-area studies involves the use of model-based disease mapping methods. Recent statistical advances in model-based disease mapping strategies have dramatically improved our ability to generate realistic assessments of the geographical variation of small-area disease risk through the use of data smoothing techniques. The application of data smoothing techniques reduces chance variation in estimated measures of disease risk and yields more reliable estimates of the underlying variation in disease risk in individual communities (Lawson *et al.* 1999).

Bayesian statistical methods are often applied to estimate the small-area disease risk in disease mapping studies, and one has the option of taking a full Bayesian approach or an empirical Bayesian approach (Bernardinelli and Montomoli 1992; Gelman *et al.* 1998; Carlin and Louis 2000). Although the empirical Bayesian approach appropriately estimates the parameters in a model in a timely manner, it does not provide precise estimation of the uncertainty of these parameters. Alternatively, the full Bayesian approach has the advantage of providing both satisfactory estimation of parameters and their uncertainty. However, implementing the full Bayesian approach can be computationally more demanding than the former approach.

When engaged in disease surveillance from a public health perspective, it is essential that the health status of communities be monitored repeatedly over time. The Bayesian spatio-temporal approaches to disease mapping is ideally suited to the information that results from such monitoring. Additionally, spatio-temporal Bayesian disease mapping can

accommodate the complex structure typically associated with regional public health data. In view of the apparent benefits of such approaches, the development of statistical methods to detect the spatio-temporal change in disease risk has advanced tremendously.

The use of spatio-temporal Bayesian methods for mapping disease risks has been proposed in the small-area analysis literature as an efficient method for capturing spatial and temporal effects, and spatial temporal interaction effects on risk (*e.g.*, see Elliott and Wartenberg 2004; Kleinschmidt *et al.* 2002; MacNab and Dean 2000, 2002; MacNab 2003a,b, 2004). The main focus of these studies has been to assess the distribution of disease occurrence in different communities using health status indicators such as morbidity and mortality rates and ratios. The development and assessment of community level health status indicators provides information that enables public health analysts to: (1) create and maintain up-to-date community specific health status profiles; (2) generate new hypotheses from information derived from analysis of spatial distributions of health problems; and (3) quantify the health impact of changes put in place to improve the quality of health care (Rothman and Greenland 1998).

Although health status indicators, such as morbidity and mortality rates and ratios, are important in public health surveillance, it is also important that the overall disease impact (or burden) on the quality of life of communities be quantified. The World Health Organization (WHO) Global Burden of Disease study (GBD) presents one of the methodologies currently described in the literature that can be used to assess the impact of disease on the quality of life of a population as a whole, or several different communities (Murray and Lopez 1996). This approach combines estimates of mortality and morbidity for populations into a single measure of disease burden called disability-adjusted life years (DALY) (Murray and Lopez

1996, 1997a,b,c,d; Begg and Tomijima 2005). DALYs are used as a summary measure of population health that reflects the impact of both mortality and non-fatal health decrements. DALYs quantify the gap in years between age at death and some standard age before which death is considered "premature" in addition to time lived in states other than excellent health. DALYs are obtained by summing years of life lost (YLL) from premature death and healthy years lost due to disability (YLD).

One of the innovative goals of this study is to integrate DALY estimates into public health surveillance as a new type of health status indicator at the community level that enables the quantification of the loss of healthy years due to premature death and disability resulting from diseases in a single measure of disease burden. Although previous studies using DALYs have been carried out at the national or regional level, DALYs have not been appropriately calculated at the small-area level. Spatio-temporal statistical models developed and presented in MacNab and Dean (2001) and MacNab (2003a), together with Markov Chain Monte Carlo (MCMC) methods for full Bayesian inference (implemented via the Gibbs sampling algorithm (Gelman *et al.*1998; Carlin and Louis 2000; Spiegelhalter *et al.* 2003)) will be used to estimate DALYs and other health status indicators at the small-area level. Figure 1.1 illustrates the different health status indicators that will be examined in this study, and the basic sources of information that each of them provides. The solid lines were used to indicate which measures (*e.g.* counts) were further used to calculate other health status indicators, whereas the broken lines were used to remind the reader that individual measures can also be used individually as health status indicator.

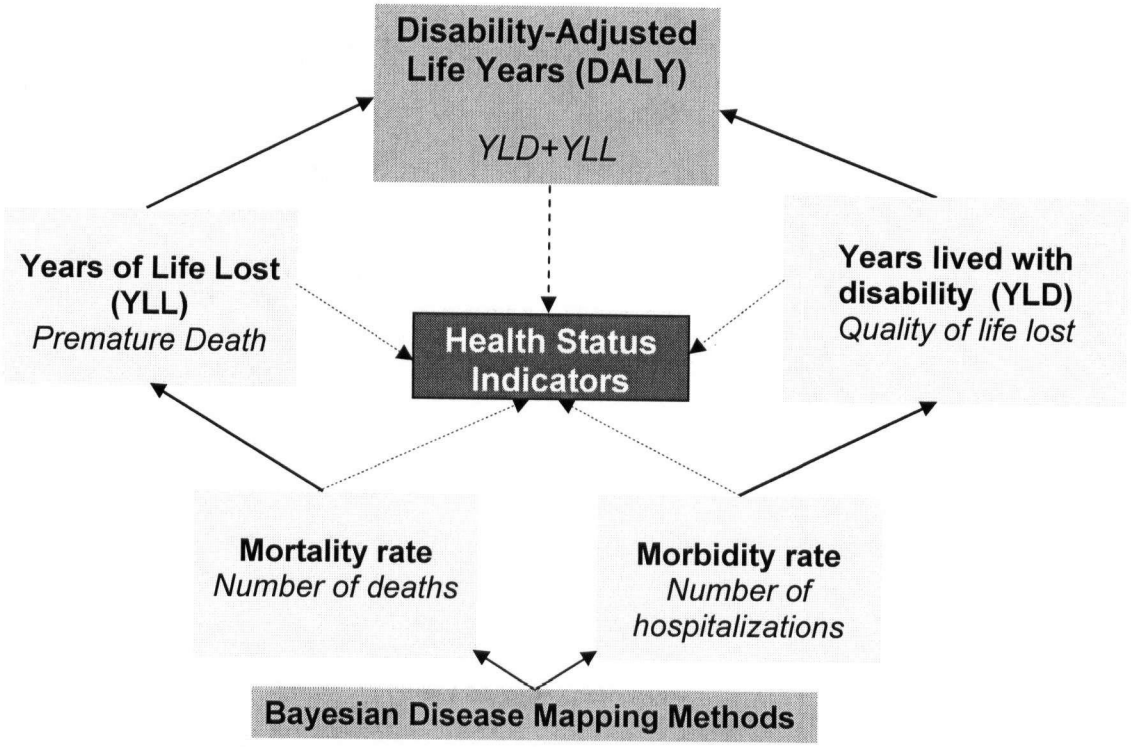


Figure 1.1. Relationships among the Different Health Status Indicators Used in the Small-Area Analysis of Disability-Adjusted Life Years (DALY) Methodology.

In this study, the small-area analysis of disability-adjusted life years (DALY) methodology will be demonstrated in an analysis of injury surveillance data from British Columbia (BC). The results of this analysis will inform stakeholders in the public health arena of the impact (*i.e.,* burden) of injuries in the communities of BC. For example, the results of this analysis could be used to answer the following questions: What are the leading causes of injury in a specific community?; What are the impacts of injuries sustained on the community's quality of life?; Which types of injuries result in either long-term or short-term disability?; and What is the incidence of each type of injury over time for a specific community?

In this study, the classification of nature of injury (*e.g.*, spinal cord injuries, fractures) and external cause of injury (*e.g.*, road traffic accidents, suicide and self-inflicted injuries) will be based on the international classification of disease system (ICD) (CDC, 2003). The ICD Version 9 external codes with clinical modifications (ICD9-CM E-codes), including a description of injury types, can be found in Table 1.1. All external causes of injury defined by an E-code in Table 1.1 will be included in the analyses.

Table 1.1. List of ICD9-CM E-codes for External Causes of Injury (Mathers, Vos, and Stevenson 1999; Murray and Lopez 1996).

External Causes of Injury	ICD9-CM E-codes
Unintentional Injuries	E800–E949
1. Road traffic accidents	E810–E819, E826–E829, E929.0
2. Other transport injuries	E800–807,E820–E825,E830–E848,E929.1
3. Poisoning	E850–E869, E929.2
4. Falls	E880–E885,E886.9, E887–E888, E929.3
5. Burns/fires/scalds	E890–E899, E924.0, E924.8, E924.9, E929.4
6. Drowning	E910
7. Sports injuries	E886.0, E917.0, E927
8. Natural and environmental factors	E900–E909, E929.5
9. Machinery injuries	E919, E920.0, E920.1, E920.4
10. Suffocation and foreign bodies	E911–E915
11. Adverse effects of medical treatment (or medical adverse events)	E870–E876, E878–E879, E930–E949
a. Surgical/medical misadventure	E870–E876
b. Surgical and medical procedures as the cause of abnormal reaction of patient or later complication, without mention of misadventure at time of procedure	E878–E879
c. Adverse effects of drugs in therapeutic use	E930–E949
12. Other unintentional injuries (excluding medical adverse event)	E916, E917.1–E917.9, E918, E920.2, E920.3, E920.5–E920.9, E921–E923, E924.1, E925–E926, E928, E929.8
Intentional Injuries	E950–E979, E990–E999
1. Suicide and self-inflicted injuries	E950–E959
2. Other intentional injuries: homicide and violence; legal intervention; and injury resulting from operations of war	E960–E979, E990–E999

The material presented in this thesis is intended to explain a new methodology, but also to produce useful information about injuries in BC. On a technical note, it is important to mention that all health status indicators examined in this study were previously incorporated in the methodology of the Health Indicators Project, a collaboration that started in 1998 between the Canadian Institute for Health Information (CIHI) and Statistics Canada. The main objective of this initiative was the identification of information requirements that if addressed could help improve and maintain population health across Canada at the regional, provincial and national levels (CIHI 2004a). The section of the Health Indicators Project framework relevant to this study is displayed in Table 1.2.

Table 1.2. Health Status Section of the Health Indicators Project Framework (CIHI 2004a).

Health Status			
Well-Being	Health Conditions	Human Function	Deaths
• Self-rated health • Changes over time in self-rated health • Self-esteem	• Body mass index (BMI) • Arthritis/rheumatism • Diabetes • Asthma • High blood pressure • Chronic pain – affects activities • Chronic pain - severity • Depression • Low birth weight Cancer incidence, age-standardized rates: • All cancer incidence • Lung cancer incidence • Colorectal cancer incidence • Breast-female cancer incidence • Prostate cancer incidence • Injury hospitalization • Food and waterborne diseases • Injuries	• Functional health • Two-week disability days • Activity limitation • Conditions causing activity limitation • Disability-free life expectancy • Disability-adjusted life expectancy • Disability-adjusted life years (DALY) • Health expectancy	• Infant mortality • Perinatal mortality • Life expectancy Mortality crude counts/rates, age-standardized rates: • Total mortality • Circulatory disease deaths • Cancer deaths • Respiratory disease deaths • Suicide • Unintentional injury deaths • AIDS deaths Potential years of life lost (PYLL) • Total PYLL • Cancer PYLL • Circulatory PYLL • Respiratory PYLL • Unintentional injuries PYLL • Suicide PYLL • AIDS PYLL

Note: Health status indicators used in this study are highlighted.

1.1 Research Objectives

Injuries have a negative impact on the health of populations. Estimates of the magnitude of this negative impact and its variation between and within jurisdictions can provide useful information for researchers and policy makers. One objective of this study is to present and implement a methodology for estimating the magnitude of the burden of injuries and its variation between and within regions of BC over time. The methodology used to assess the impact of injuries is based primarily on the calculation of disability-adjusted life years (DALYs) that are then utilized in a Bayesian-based approach to disease mapping and estimation of small-area variation. Two specific examples are presented in this study: road traffic accidents and medical adverse events (or medical AEs or AEs). The former (road traffic accidents) has features that are in many ways typical of unintentional injuries. The latter (medical AEs) was discovered to have a surprisingly large incidence in our study population during initial exploratory analysis; however, the presence of many atypical features complicated the calculation of DALYs (see more details in Chapter 7). As such, the DALY measure was not utilized in the analysis of injuries due to medical AEs.

The main research objective of this study is therefore to apply Bayesian disease mapping methods to a measure of disability-adjusted life years (DALY).

- The methodology is illustrated by examining patterns, variations, and trends in small-area disability-adjusted life years (DALY) for injuries due to road traffic accidents in British Columbia from 1991 to 2000.

In addition to the main objective, the secondary research objectives of this study are:

(a) To describe the impact of injury at the provincial and health authority levels.

- The burden of unintentional and intentional injuries is assessed at the provincial and health authority levels using the disability-adjusted life years (DALY) measure.

(b) To assess the regional variation and temporal trends in injury rates due to medical adverse events.

- Patterns, variations, and trends in small-area incidence of injuries due to medical adverse events in British Columbia from 1991-2000 are presented and discussed.

In addition, this study also explores the following methodological issues involving the measurement of disability-adjusted life years (DALY):

(a) The impact of different values of the discount rate for future health on the calculation of disability-adjusted life years (DALY).

(b) The robustness of disability-adjusted life years (DALY) when different choices of disability weights (weights reflect the severity of injury) are used for those injury sequelae in which no weights have been published previously.

1.2 Organization of Dissertation

The organization of this study is as follows. In Chapter 2 we present a systematic review of all the pertinent literature that was used to develop the epidemiological and statistical methods demonstrated in this study. Chapter 3 discusses in detail the epidemiological aspects inherent in the calculation of disability-adjusted life years (DALY) and introduces the spatio-temporal model as a tool to analyse injury surveillance data via a full Bayesian approach. The provincial and regional analyses, based on conventional estimates of injury incidence and burden, are presented in Chapter 4. In Chapter 5, we present the results for the small-area analysis of injury burden attributable to road traffic injuries. The small-area analysis of injuries due to medical adverse events is shown in Chapter 6. Chapter 7 contains the conclusion of the study and includes a discussion of the results and associated limitations, identification of areas of future research, and suggestions to stakeholders on the possible uses of our results in public health injury prevention.

Chapter 2

Literature Review

In this chapter we present a systematic review of pertinent literature that was used to develop the epidemiological and statistical methods described in this study. Additionally, the International Classification of Disease System (ICD) Version 9 coding system, used in the literature to identify injuries at the population level, will also be described.

2.1 Measures of Population Health and Disease Mapping Methods

This section presents an overview of well-known methods for measuring population health. These include methods of health-adjusted life years (HALYs) such as quality-adjusted life years (QALYs) and disability-adjusted life years (DALYs). In addition, we review the up-to-date work in disease mapping methods that has been previously reported in the small-area analysis literature.

2.1.1 Summary Measures of Population Health

For many years, one of the main objectives in several public health studies has been to describe the distribution of disease occurrence in the population using measures of disease frequency (*e.g.*, incidence rates, standardized mortality rates.). The main goal of these studies

has been to provide summary information about the population health necessary to public health planners and other stakeholders responsible for managing and allocating health care resources. However, in this thesis, the term summary measures of population health (SMPH) is employed to define those measures that combine information on both mortality and non-fatal health outcomes to represent the health of a particular population in a single number that is expressed in time units (Begg and Tomijima 2005; Gold, Stevenson, and Fryback 2002; Field and Gold 1998; Murray *et al.* 2002; Murray, Salomon, and Mathers 2000; Iburg and Kamper-Jorgense 2002). There are several scenarios where a SMPH can be useful. For instance:

- To compare the health of populations across different regions at different points in time;
- To identify and quantify health inequalities within or between populations;
- To provide an estimate of the effect of fatal and non-fatal health outcomes on the health of a population;
- To provide information to guide the setting of priorities in the planning and delivery of health care for a given population; and
- To quantify the benefits of health interventions in cost-effectiveness analyses (Murray *et al.* 2002).

Two classes of summary measures of population health have been developed: health expectancies and health gaps. Both classes of measures use time (lived in health states, or time lost as a result of premature death) as a common metric for measuring the impact of mortality and non-fatal health outcomes (Gold, Stevenson, and Fryback 2002).

2.1.1.1 Health Expectancies

Health expectancies are population indicators that estimate the average time (in years) that a person could expect to live in a defined health state. Following the work by Gold, Stevenson, and Fryback (2002), we also refer to measures based on health expectancies that incorporate estimates of mortality and morbidity as quality-adjusted life years (QALYs).

Economists, operational researchers and psychologists developed QALYs in the late 1960s primarily for use in cost-effectiveness analysis. QALYs are constructed using health-related quality of life (HRQL) weights that are attached to individual descriptions of health. These HRQL weights are not linked to any particular disease/condition/disability; rather, they are derived from values elicited from individuals regarding either their own health state, or the health states of others. The universe of health states that individuals experience is vast, and the challenge of any health status measure is to capture the complexity of these states, in a valid and consistent manner, across different individuals. Descriptive health status measures that have been applied in studies using QALYs include the Health Utility Index (HUI) (Manuel, Schultz, and Kopec 2002; Torrance *et al.* 1995; Torrance 1986; Torrance, Boyle, and Horwood 1982), the Quality of Well-Being Scale (QWB) (Kaplan 1988), EQ-5D (EuroQoL) (EuroQol Group 1990), and the Health and Activity Limitation Index (HALex) (Erickson 1998). Since the health attributes described in each of these instruments vary, each instrument portrays a different picture of health status, making comparisons complicated across conditions or populations.

By convention, since QALYs are a measure of health expectancy, the maximal value 1.0 represents full health for one year, and the minimal value 0 represents death. Note that some of these health expectancy measures are constructed in a way that allows for negative values that

reflect health states worse than death. The most commonly used methods to generate preferences or values for HRQL in QALY studies include the standard gamble (SG), rating scale (RS) and time trade-off (TTO) (Torrance *et al.* 1995; Torrance 1986, 1987; Torrance, Boyle, and Horwood 1982). These techniques ask respondents to value health states by making explicit what they would be willing to sacrifice (in terms of time, or risk of death) in order to return from the health state being described (or experienced) to perfect health.

In order to have a better understanding of the calculation of QALYs, we refer to Figure 2.1 (Gold, Stevenson, and Fryback 2002). In this figure, the trajectory of an individual HRQL from "now" to that person's death is shown by the solid line. The life path declines for some years, followed by a brief recovery. Next, the person suffers a major event from which he/she briefly recovers some HRQL, however, the recovery does not last long and it is followed by an irregular decline until an abrupt drop representing death. The area under the curve represents the QALYs accumulated by the person over this portion of his/her life. The area of each rectangle is the product of an HRQL weight and the time in which the person is assumed to experience that HRQL level.

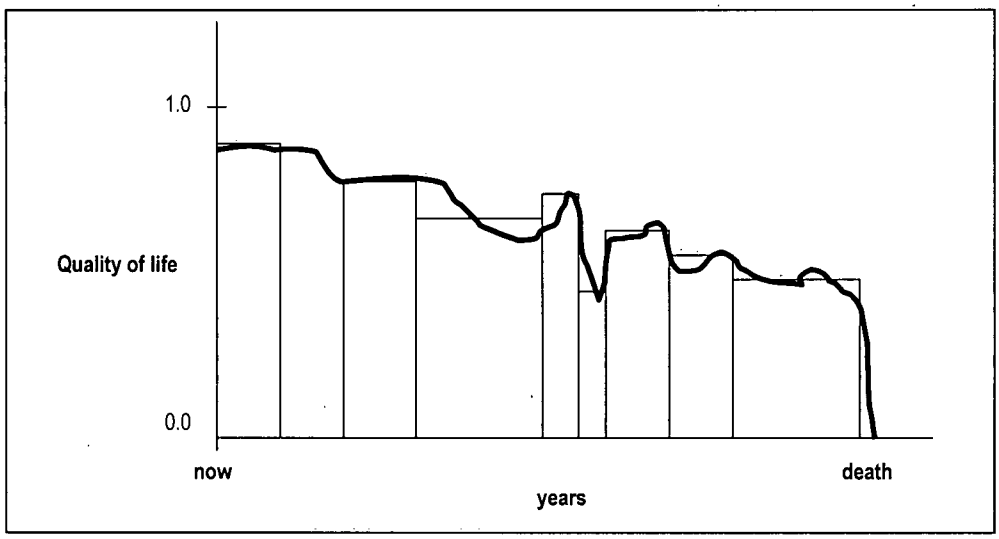


Figure 2.1. Graphical Calculation of Quality-Adjusted Life Years (QALYs) (Gold, Stevenson, and Fryback 2002).

2.1.1.2 Health Gaps

Measures of potential years of life lost due to premature mortality have been used for many years to measure the mortality burden of various causes of death. These measures calculate the gap, in years, between age at death and some standard age before which death is considered "premature" (usually 75 years). Health gaps extend the notion of mortality gaps to include time lived in states other than excellent health. The use of time-based health gap measures provides a common metric for population health research that can be used with different outcomes of interest. Additionally, a common metric approach facilitates the integration of economic evaluations of interventions with the monitoring of health system outcomes and assessments of the overall health burden of diseases/injuries/health determinants in the population. The most widely used health gap measure is the disability-adjusted life years (DALY) (Murray and Lopez 1996, 1997a,b,c,d).

In the early 1990's, researchers at Harvard University and at the World Health Organization conducted the first global burden of disease (GBD) study using DALYs to quantify the global burden of premature death and functional disability caused by disease/injury. There were four main objectives associated with the original GBD study (Murray and Lopez 1996, 1):

- "To facilitate the inclusion of non-fatal health outcomes in debates on international health policy, which were all too often focused on mortality in children under 5 years of age";
- "To decouple epidemiological assessment from advocacy so that estimates of the mortality or disability from a condition are developed as objectively as possible";
- "To allow estimates of health impact to be mapped to causes, whether in terms of disease and injury, or risk factors and broader social determinants";
- "To quantify the burden of disease using a measure that could also be used for cost-effectiveness analysis".

In the first GBD study, Murray and colleagues relied on secondary data and expert opinion to identify different diseases/injuries, and to describe the long-range of disability associated with these diseases/injuries. The DALY valuation employed in the GBD study was based on a person trade-off (PTO) health state valuation technique that explicitly addresses trade-offs between life and HRQL for people with different diseases/injuries. As mentioned previously, there are other health state valuation techniques besides PTO that have been extensively used in the literature, for example: standard gamble (SG), rating scale (RS) and time trade-off (TTO) (Torrance *et al.* 1995; Torrance 1986, 1987; Torrance, Boyle, and Horwood 1982).

PTO has been used in the literature as a method of health state valuation that focuses on social (as opposed to individual) preferences for different health care interventions. In

contrast to other methods, the respondents in studies using PTO are asked to make decisions about the health state preferences of other people instead of themselves. Generally speaking, "the PTO basically consists of asking how many outcomes of one kind (*e.g.*, outcome B) respondents consider to be equivalent in social value to X outcomes of another kind (*e.g.*, outcome A). For example, *'If there are x people in adverse health situation A and y people in adverse health situation B, and if you can only help (cure) one group (for example, owing to limited time or limited resources), which group would you choose to help?'* " (Green 2001, 234). PTO is a complex technique when compared to the other health state valuation methods, and in addition, little is known about its reliability and validity. In spite of these limitations, the researchers involved in the GBD study identified the PTO assessment as the best technique to address their study objectives.

DALY is a measure of health gap, where a value of 1.0 represents full disability (or death) and a value of 0 represents no disability (or full health). The computation of DALYs is shown in Figure 2.2 (Gold, Stevenson, and Fryback 2002). Note that there is a point called *max* that represents the *ideal* gender-specific life expectancy. To compute DALYs, the area lost from the ideal lifetime, living to the maximum life expectancy in full health, is approximated by summing the areas of the rectangles, or by calculating the area above the life path extended to the *ideal* life expectancy. The work in this study follows the convention of using gender-specific life expectancies.

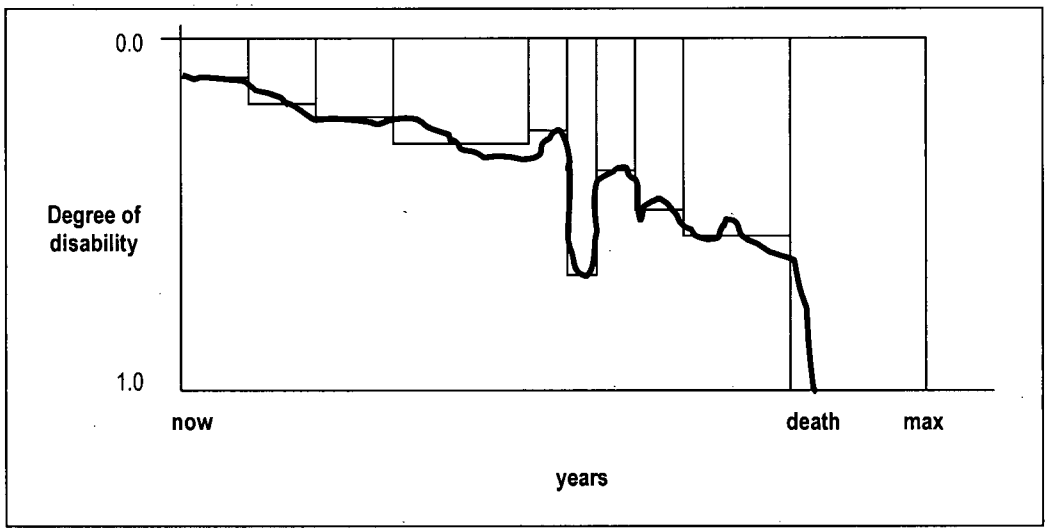


Figure 2.2. Graphical Calculation of Disability-Adjusted Life Years (DALYs) (Gold, Stevenson, and Fryback 2002).

2.1.1.3 Why Use DALYs and Not QALYs

To study the burden of injury we can either use prevalence or incidence measures. To estimate the fatal burden of injury (*i.e.*, the years of life lost (YLL)) we used the mortality rate and the number of years lost due to premature death. When calculating YLL, it is therefore necessary to adopt an incidence perspective. However, to calculate the non-fatal burden of injury (*i.e.*, the healthy years lost due to disability (YLD)) we can use either incidence or prevalence measurements. In order to use a prevalence measure to calculate YLD, we need to estimate the prevalence of different sequelae at a point in time (we may have to adjust this prevalence for any seasonal variation if present) and multiply it by one year, or alternatively use the incidence of each sequela and multiply it by the duration of disability (if the assumption of a steady-state population holds).

In this burden of injury study, an incidence perspective has been chosen since: (a) Incidence-based databases are available for both hospitalization (a morbidity measure) and mortality; (b) The method to calculate time lived with disability is consistent with the method for calculating time lost due to premature mortality (*i.e.*, the sum of two incidence measures); (c) Using an incidence measure allows us to capture any epidemiological trend in spatial clusters of new cases; and (d) Statistical models based on incidence information will be used to develop a surveillance system to capture change, identify clusters and flag abrupt jumps of new cases of injury.

2.1.1.4 How DALYs Have Been Used in the Literature

DALYs have been assessed and used in various burden of disease/injury studies, starting with the collaboration between researchers at Harvard University and the WHO for the World Bank's 1993 "World Development Report" (World Bank 1993), which throughout this thesis we refer to as the global burden of disease (GBD) study (Murray and Lopez 1996, 1997a,b,c,d). Following this study, there have been other important burden of disease studies undertaken in Australia (Mathers *et al.* 2000, 2001), Victoria (in Australia) (Taylor 2001; Victorian Department of Human Services 1999a,b), New Zealand (Government of New Zealand 2001) and the Netherlands (Melse *et al.* 2000; Stouthard, Essink-Bot, and Bonsel 2000; Stouthard *et al.* 1997). Some of the most recent studies include the WHO Global Burden of Disease project estimates for the years 2000, 2001 and 2002 (WHO 2004c).

In addition to reports and papers describing the burden of disease/injury studies, in recent years, researchers have published papers specifically examining the strengths and limitations

associated with the use of DALYs (Murray and Acharya 1997; Bonneux 2002; Ezzati *et al.* 2002; Hollinghurst, Bevan, and Bowie 2000; Jelsma, De Weerdt, and De Cock 2002; Williams 1999; Murray and Lopez 2000; Sayers and Fliedner 1997; Arnesen and Kapiriri 2004). The strengths of the DALY approach to measuring burden of disease were described in previous sections of this study. However, there are some limitations related to methodological assumptions to carry out the DALY calculations. Two of these limitations, related to the age and time of illness adjustment, are further discussed in the Methods chapter of this study. The disability weights associated with the extent of loss due to physical functioning are also a concern when applying this method. These weights were developed for the GBD study using expert opinion and secondary data. The question is: How universal are these weights? A study from the Netherlands went one step further than the original GBD study, and changed the way the GBD weights were calculated to identify different levels of severity within each condition. Unfortunately, the Netherlands study did not obtain disability weights for as many categories of injury sequelae as the GBD study, because not all sequela described in the GBD study were considered important to public health in terms of morbidity, mortality and cost. As we are interested in the same categories of injury sequelae as the GBD study, we elected to use the GBD weights from the WHO report on the Global Burden of Injury in 2000 (Mathers *et al.* 2001) for the analyses presented in this study.

2.1.2 Small-Area Analysis and Disease Mapping

For many years researchers have recognized that disease occurrence is not randomly distributed in time and space. Additionally, the practice of mapping diseases at the small-area

level has increased tremendously over the years (Diehr *et al.* 1992; Howe 1989; Elliott *et al.* 2001; Volinn *et al.* 1994). However these maps are usually unreliable if based on conventional rates because areas with a small population at risk are more likely to have extreme rates due to chance variation, especially when examining rare diseases.

One of the main reasons for using disease mapping methods is to smooth and remove the random variation in conventional rates to provide more statistically reliable assessments of the geographical variation of these rates. Bayesian statistical methods applied to disease mapping have advanced tremendously in the past decade, with several important papers having been published on the use of these methods (Elliott *et al.* 2001; Clayton, Bernardinelli, and Montomoli 1993; Mollié 1996; Besag, York, and Mollie 1991; MacNab and Dean 2000, 2001, 2002; Manton *et al.* 1989; MacNab 2002, 2003a,b, 2004; Lawson *et al.* 1999; Richardson 1992; Kleinschmidt *et al.* 2002). These papers have used Bayesian disease mapping methods for descriptive purposes, for surveillance and identification of high disease/injury incidence areas, in ecological analyses, and to inform decisions involving health policy and resource allocation. However, it is important to mention that small-area analysis and disease mapping methods have not yet been applied to the study of medical adverse events, or incorporated into the calculation of disability-adjusted life years.

Kleinschmidt *et al.* (2002) used Bayesian disease mapping methods to study spatial and temporal variations in small-area malaria incidence rates from mid-1986 to mid-1999 in two districts in northern KwaZulu Natal, South Africa. By modeling the spatial variation of time trends in incidence rates, the authors explored whether the additional cases of malaria were coming mainly from areas that always had the highest transmission levels, or whether they were originating from previously low-transmission or malaria-free sub-regions. The authors

showed that the malaria incidence increased in the period of study, and based on the geographical distribution of the malaria incidence, the number of areas of high incidence increased as well. In addition, it was shown that the spatial distribution of the rise in malaria incidence was uneven, and the additional cases of malaria were coming from the geographic expansion of high-malaria-risk areas.

Sun *et al.* (2000) used a Bayesian hierarchical model in disease mapping to study the spatio-temporal distribution of lung cancer mortality rates in the state of Missouri from 1973 to 1992, for males in the age groups 45-54, 55-64, 65-74 and 75 and older. The main results were: (1) The lung cancer mortality rates increased over time for the two older age groups; (2) There were geographical clusters of lower rates in the north and higher rates in the southeast of Missouri for the two older age groups; and (3) When controlled for age, the lung cancer mortality rates increased more rapidly in the southeast and south central regions of Missouri.

MacNab (2004) applied Bayesian spatial and ecological regression models to analyse small-area variation in hospitalization rates due to motor vehicle accident injury among male children and youth (aged 0–24 years), from 1990 to 1999, in 83 local health areas in British Columbia. The author demonstrated how Bayesian modeling techniques could be implemented to assess potential risk factors measured at the regional level. Some of the risk factors at the regional level were neighbourhood socio-economic disadvantage score, medical services availability and utilisation, crime rates, excess speeding charges and seatbelt violation rate. The results of this study indicated that significant spatial variation in motor vehicle accident (MVA) hospitalization rate existed after adjusting for several risk factors. In addition, the author found that: (1) MVA hospitalization rate was inversely associated with

socio-economic status (SES) across all age groups; higher in communities with lower SES; (2) For the age group 1-14 years, crime rates were associated with a higher MVA hospitalization rate; and (3) For the age group 20-24 years, seatbelt violations and excess speeding were associated with a higher MVA hospitalization rate.

In another study, MacNab (2003a) showed that Bayesian hierarchical Poisson random effects spatio-temporal models could be used in injury surveillance and prevention programs. Information derived from such models could then be used by high-risk regions to help develop and evaluate prevention programs, and to assist in health planning and resource allocation. For example, MacNab (2003a) examined hospitalization rates due to motor vehicle accident (MVA) injury from 1987 to 1996 among male children and youth aged 0–24, in 20 health regions in British Columbia. The fitted model captured inequalities in MVA hospitalization rates, and showed that during the ten years of study, the spatial distribution of areas with higher MVA hospitalization rates shifted from the northeast to the central-interior and southwest of BC.

2.2 Issues in Medical Adverse Events Research

Before proceeding with the literature review of studies examining the validity and reliability of the ICD9 E-Codes used in this thesis, it is important to familiarize the reader with critical issues in medical adverse events (or medical AE or AE) research. First, it is often difficult to define, classify, identify, describe and analyse AEs. As an example of the variety of published definitions, Walshe (2000) summarized a selection of definitions of medical AE

reported in the literature (see Walshe (2000) for referenced literature). The definitions included:

1 "Any response to medical care in the hospital that is unintended, undesirable and harmful to the patient." (*McLamb and Huntley 1967)*

2 "A potentially compensable event is a disability caused by healthcare management:

• Disability—is a temporary or permanent impairment of physical or mental function (including disfigurement) or economic loss.

• Causation—is established when the disability is more probably than not attributable to health care management.

• Healthcare management—includes both actions and inactions of any health care provider or attendant." (*Mills 1978)*

3 "Adverse patient occurrences (APOs) ... refer to untoward patient events which, under optimal conditions, are not a natural consequence of the patient's disease or treatment. The common thread of all APOs is that they are events which health professionals agree are not desirable outcomes of medical management." (*Craddick and Bader 1983)*

4 "An unintended injury caused by medical management rather than by the disease process. The injury is sufficiently serious to lead to prolongation of hospitalisation or temporary or permanent impairment or disability in the patient." (*Harvard Medical Practice Study 1990)*

5 "An unintended injury or complication, which results in disability, death or

prolonged hospital stay and is caused by health care management." (*Wilson, Runciman and Gibberd 1995)*

6 "An untoward or undesirable occurrence in the healthcare process which has or potentially has some negative impact on a patient or patients and results or may result from some part of the healthcare process." (*Walshe 1998)*

Additionally, a medical AE has been defined as an injury that is caused by medical management, which prolongs hospitalization or produces disability (Karson and Bates 1999; Brennan *et al.* 1991; Wilson *et al.* 1995; Michel *et al.* 2004, Samore *et al.* 2004). Table 2.1 illustrates several other important studies using variants of this AE definition.

Second, although methods used to estimate the incidence of medical adverse events have developed tremendously, most AEs are still not detected (Baker *et al.* 2004; CIHI 2004b; Weingart *et al.* 2000; Kohn, Corrigan, and Donaldson 2000). There are 3 methods to assess the magnitude of AEs: (1) voluntary reporting; (2) direct observation of health care personnel during routine clinical care; and (3) computerized screening algorithms utilized by nurses combined with retrospective physician chart review. Although each of these methods has advantages and disadvantages, method (3) has been applied in most studies on adverse events. For example, the studies described in Table 2.1 all utilized variants of method (3) to estimate AE incidence in in-hospital patients.

Table 2.1 Different Studies on Medical Adverse Events (adapted from Baker *et al.* 2004).

Study	Setting (year)	Exclusion of low-risk patients	AE definition	Window of scrutiny before index admission	Window of scrutiny after index admission	% of patients with >=1 AE
Baker *et al.* 2004 n = 3,745	20 Canadian hospitals (2000)	Yes	Unintended injury or complication that resulted in disability, death or prolonged hospital stay and was caused by health care management rather than by the underlying disease process	12 months	AE must have occurred during index admission, but it could be detected up to 12 months afterward	7.5
Thomas *et al.* 2000 n = 14,700	28 hospitals in Utah and Colorado (1992)	No	Injury caused by medical management rather than by the disease process and resulted in prolonged length of stay or disability at discharge	6 months if patient <65 yr; 12 months if >=65 yr	None: AE must have been detected during index admission	2.9 (3.2‡)
Wilson *et al.* 1995 n = 14,179	28 hospitals in New South Wales and South Australia (1992)	Partial (did not exclude obstetrics patients)	Unintended injuries or complications resulting in death, disability or prolonged hospital stay that arise from health care management	6 months if patient <65 yr; 12 months if >=65 yr	AE must have occurred during index admission but could be detected afterward	16.6 (10.6‡)
Brennan *et al.* 1991; Leape *et al* 1991 n = 30,195	51 hospitals in New York (1984)	No	Unintended injury that was caused by medical management and that resulted in measurable disability	Unlimited	Unknown	3.7
Vincent, Neale, and Woloshynowych 2001 n = 1,014	2 hospitals in London, England (1999–2000)	No	Unintended injury caused by medical management rather than by disease process	Unlimited	AE must have occurred during index admission but could be detected afterward	10.8
Davis *et al.* 2002, 2003(a,b) n = 6,579	13 hospitals in New Zealand (1998)	Partial (did not exclude obstetrics patients)	Unintended injuries or complications resulting in death, disability or prolonged hospital stay that arise from health care management	Unlimited	AE must have occurred during index admission but could be detected afterward	12.9¶

‡ From Thomas et al.In this study, American and Australian investigators harmonized the inclusion criteria and AE definitions between the 2 studies and then re-analyzed the Australian data.This yielded an adjusted AE rate of 10.6%, as compared with 16.6% using the original Australian study methods.

¶ Represents an unweighted estimate of prevalence.

Note that Table 2.1 shows a high variability across studies in the percentage of hospital separations in which an AE occurred, ranging from 2.9% (Utah and Colorado study, UTCOS) to 16.6% in a study in Australia (Quality in Australian Health Care Study, QAHCS). Next, we present in more detail the results of several recent studies on adverse events conducted in Canada.

In a recent national study conducted in Canada, 20 hospitals were selected in the 5 most populous provinces (British Columbia, Alberta, Ontario, Quebec and Nova Scotia) (Baker *et al.* 2004). The definition of a medical AE in this study was any unintended injury or complication resulting in death, disability or prolonged hospital stay that arose from health care management, as opposed to original patient illness. The criteria to identify these medical AEs involved a two-stage process. The first stage consisted of nurses and health records professionals screening each selected hospital chart for the presence of an AE (total of 1,527 out of 3,745 charts). The second stage consisted of physicians screening the selected charts identified in the first stage to confirm the AE. The overall AE rate was 7.5% (95% CI [5.7%, 9.3%]); the risk of AE in men and women was not statistically different; teaching hospitals had higher rates of AE; older patients were more likely to experience an AE; the longer mean length of stay was associated with those patients who experienced an AE; surgical procedures were associated with higher rates of AE; and 36.9% (95% CI [32.0%, 41.8%]) of AEs were considered preventable.

Forster, Asmis *et al.* (2004) were interested in evaluating characteristics of adverse events affecting patients admitted to a teaching hospital in Ottawa to determine the incidence, preventability, severity, type and timing of adverse events. The definition of a medical AE in this study was poor patient outcomes due to medical care. The incidence of AE was 12.7%

(95% CI [10.1%, 16.0%]); the rate of preventable AE was 4.8% (95% CI [3.2%, 7.0%]); 61% (95% CI [49%, 72%]) of patients experienced the adverse event before the index hospitalization; most AEs were due to drug treatment, operative complications and nosocomial infections; overall risk of AE was significantly associated with patient age, admitting service (medicine, surgery obstetrics or gynecology) and admission status (elective or emergency). When only in-hospital AEs were considered, the risk remained significantly associated with age but was no longer associated with admission status, and it was less strongly associated with admitting service.

Forster, Clark *et al.* (2004) conducted a study at the Ottawa Hospital (a multi-site tertiary-care teaching hospital) to determine the incidence, severity, preventability, and ameliorability of AEs in patients discharged from the general internal medicine service, during a 14-week interval in 2002. The definition of a medical AE in this study was adverse outcomes that were caused by medical care. After discharge, 23% (95% CI [19%, 28%]) of patients experienced at least 1 AE; the AE severity ranged from symptoms only (68% of the AEs) or symptoms associated with a non-permanent disability (25%), to permanent disability (3%) or death (3%); 12% (95% CI [9%, 16%]) of AEs were considered either preventable or ameliorable; and most AEs were due to adverse drug events (72%), therapeutic errors (16%) and nosocomial infections (11%).

Wanzel *et al.* (2000) prospectively monitored complications for all patients admitted to the general surgery service at the Wellesley Central Hospital (Toronto), over a 2-month period in 1996. They were interested in determining the incidence and nature of complications on a general surgery service, and comparing these results with pre-existing institutional recording and reporting methods. They found that 39% of the 192 patients

suffered a total of 144 complications with 1% of complications being fatal, 7% life threatening, 63% of moderate severity, and 29% trivial. Approximately 18% of the 144 complications were considered potentially attributable to error. Seventy eight percent of the complications occurred during or after a surgical operation and were related either directly or indirectly to the surgical operation. Lastly, 6% of complications were not documented in the progress notes of the patients' charts.

The third important issue in AE research involves the financial expense and time required to conduct an investigation of AE incidence using these commonly used methods. Recently, several methodological studies were published that explored the use of computerized database screening to detect medical AEs. The interest in using computerized database screening has been increasing because it is inexpensive, rapid and it can be applied, for example, to screen medical billings and patient records in hospitals. Section 2.3 presents a review of such studies.

2.3 Validity and Reliability of the ICD9 E-Codes in Identifying External Causes of Injury

The success of the proposed statistical framework depends on the quality of data available for analysis. For this reason, it is imperative to review the injury research literature in which the validity and reliability of ICD9 E-codes have been assessed. ICD9 E-codes (see Table 1.1) have occasionally been used in studies conducted at the population level to identify all external causes of injury, excluding medical adverse events (AEs). However, studies done at

the population level to identify injuries due to AEs using ICD9 E-codes appear to be very rare. For clarity, the first part of this section of the study concentrates on studies excluding AEs, and the second part focus on studies specifically examining AEs. In section 2.3.2 we review the few studies in which computerized database screening was employed to examine outcomes related to adverse events.

2.3.1 All Causes of Injury Excluding Medical Adverse Events

The number of studies using computerized screening in conjunction with the International Classification of Diseases (ICD) coding system as a method to determine the incidence of selected injuries (excluding AEs) has increased over the years (Barss *et al.* 1998; Christoffel and Gallagher 1999). Despite the rise in popularity of this methodological approach, investigations assessing the quality of data in these types of studies have been limited. Studies have been conducted in several countries, including Canada, Australia and the United States, that assessed the reliability of injury ICD9 E-codes (excluding AEs) in death certificates and in hospital separation records using the kappa statistic (Landis and Koch 1977). The kappa statistic in these studies varied from 0.40 (fair agreement) to 0.98 (almost perfect agreement) (LeMier, Cummings, and West 2001; Ribbeck *et al.* 1992; Owen, Bolenbaucher, and Moore 1999; MacIntyre, Ackland, and Chandraraj 1997; Schwartz *et al.* 1995; Bota, Therrien, and Rowe 1997; Lu, Lee, and Chou 2000; to name a few). For example, Bota, Therrien, and Rowe (1997) assessed the reliability of cause-of-injury information using the ICD9 E-code system to track injuries in an emergency department in

Ontario (Canada) using codes assigned by several different health professionals (nurses, physicians and nosologists). The values for the kappa statistic in this study showed almost perfect agreement and ranged from 0.88 to 0.92, depending on the examining health professional.

As mentioned previously, the kappa statistic varied substantially from one reliability study to another. The main differences between these studies included: the familiarity and experience of coders; how committed the study specific hospital institutions and vital statistics agencies were in maintaining the quality of ICD9 E-code systems used in database production; and most importantly, how detailed these E-codes were. The use of more detailed E-codes was related to lower reliability (*e.g.*, detailed E-codes such as E810.1 as opposed to non-specific E-codes as E810). In our study, however, we are only working with non-specific ICD9 E-codes, with the exception of a small proportion of records using complete E-codes to identify the late effects of injury (E929), injuries resulted from striking against or struck accidentally by objects or persons (E917), and injuries caused by cutting and piercing instruments or objects (E920).

In several other studies, the validity of using the injury ICD9 E-codes (excluding AEs) in hospital separation records or in death certificates was assessed (MacIntyre, Ackland, and Chandraraj 1997; Winn, Agran, and Anderson 1995; Nelson *et al.* 1993; LeMier, Cummings, and West 2001; Sniezek, Finklea, and Graitcer 1989; to name a few). These studies indicated that non-specific E-codes provided high sensitivity and positive predicted value. In LeMier, Cummings, and West (2001), the authors assessed the validity of using ICD9 E-codes to ascertain the mechanism of injury in hospital discharge records. For non-specific E-codes, the sensitivity ranged from 91.6% (for firearm injuries) to 98.9% (for

poisoning injuries), and the positive predicted value ranged from 87.6% (for motor vehicle accident) to 94.2% (for poisoning injuries). Moyer, Boyle, and Pollock (1989) studied the validity of injury ICD9 E-codes for motor vehicle crash deaths, suicides and homicides in death certificates. The sensitivity and specificity for non-specific E-codes were both higher than 90%.

2.3.2 Injuries Due To Medical Adverse Events

Recently, alternative approaches combining computerized database screening and the ICD coding system have been used in studies to identify injuries due to medical adverse events. These studies have mainly focused on using ICD N-codes (*i.e.*, ICD9 codes describing the actual bodily harm caused by the external cause of injury) in contrast to using ICD E-codes and we could find very few studies in which the ICD9 E-codes were used to identify medical adverse events (Karson and Bates 1999; Agency for Healthcare Research and Quality (AHRQ) 2003; Kalish *et al.* 1995; Zhan and Miller 2003a,b; to name a few).

In the study by Samore *et al.* (2004), the definition of an adverse event was linked to "any patient harm caused by device-related medical or surgical management rather than the patient's illness." (Samore *et al.* 2004, 326) and was referred to as an AMDE. One of the methods used to detect a medical AE was the use of ICD9-CM E-codes. The ICD9-CM E-codes used were E996.0-E996.7, E878.1, E878.2 and E879.4 (a subset of codes defining a medical AE in this dissertation. See page 6). The authors screened all records for at least one of these ICD9-CM E-codes, and then randomly sampled 141 of these records and found that 72% had a confirmed AMDE (*i.e.,* the presence of 1 or more of these ICD9 E-codes). In the

records that failed to confirm an AMDE, a procedure-associated AE that was not device related was identified. This study demonstrated the feasibility of using ICD9-CM E-codes for surveillance in terms of identifying this type of AE and suggests that the method be further explored as a means of increasing patient safety.

In the paper by Hunter and Bains (1999), the authors were interested in answering the question "has the quality of health care been compromised by system-wide changes in Ontario's health care system?" (Hunter and Bains 1999, 1). To accomplish this goal, they quantified the rates of AEs among Ontario residents admitted to hospital or undergoing day surgery from 1992 to 1997 using data processed by the Canadian Institute for Health Information (CIHI) and maintained by the Ontario Health Planning Database. The definition of adverse events used in this paper was the same as the one used in this study (*i.e.*, AE was defined as an adverse event, a postoperative complication, or a medical/surgical misadventure defined by the ICD9 E-codes E870-E876, E878-E879 and E930-E949). They found that the rates of AE's in the hospital admitted and day surgery populations increased from 1992 to 1997. The rates were higher among the hospital admitted population. More specifically, from 1992 to 1997 the AE rates in the hospital admitted population due to misadventures (E870-E876) increased from 0.18 to 0.30 per 100 admissions, complications (E878-E879) increased from 3.30 to 5.00 per 100 admissions, and adverse drug reactions (E930-E949) increased from 1.04 to 1.62 per 100 admissions. The authors concluded that either there was no substantial impact on the quality of care as measured by the rate of adverse events or coding practices may have changed. However, there was a worrying increase in the trend in hospital complication rates, and they suggested that further study was necessary to understand these trends.

Next we review several studies that investigated the validity and reliability of using of these computerized screening systems to flag injuries due to medical adverse events mentioned in the AHRQ's report on patient safety indicators (AHRQ 2003).

The Agency for Healthcare Research and Quality (AHRQ) recently developed and released patient safety indicators (PSIs) that can be derived from hospital inpatient discharge data. According to the AHRQ, these indicators represent an important new tool available to researchers conducting research aimed at improving patient safety (AHRQ 2003). As Zhan and Miller (2003a) mentioned, there have been few studies that used PSIs to screen for patient safety problems (Iezzoni *et al.* 1992; Miller *et al.* 2001). The PSIs developed by AHRQ consist of 20 hospital-level and 6 area-level indicators, and five of these indicators use ICD9-CM E-codes in combination with N-codes as part of their formulation (see Table 2.2). Even though patient safety indicators are a positive step towards the broader use of hospital inpatient discharge data to flag patient safety problems and monitor the quality of medical care, there are still problems regarding the validity and reliability of these indicators in terms of detecting AEs. In particular, the PSIs that use E- and N-codes have been shown to have substantial reliability (average kappa was 0.67), but low construct and coding validity (AHRQ 2003). We believe that the lack of validity and reliability of these PSIs is because they are based on both N- and E-codes instead of just E-codes. The N-codes in this situation offer a very broad characterization of the AE, whereas E-codes, which are very specific, can offer a narrower characterization of the same problem (see Table 2.3 for an example of how unnecessary mixing E- and N-codes is in identifying AEs).

Table 2.2. List of Patient Safety Indicators (AHRQ 2003).

	Patient Safety Indicator (PSI)	Hospital-level	Area-level	Use of ICD9-CM	Summary
1	Accidental puncture or laceration	Yes	Yes	Yes Required for numerator and denominator definitions	This indicator is intended to flag cases of complications that arise due to technical difficulties in medical care - specifically, those involving an accidental puncture or laceration.
2	Postoperative pulmonary embolism (PE) or deep vein thrombosis (DVT)	Yes			
3	Complications of anesthesia	Yes		Yes Required for numerator definition	This indicator is intended to capture cases flagged by E-codes and complications codes for adverse effects from the administration of therapeutic drugs, as well as the overdose of anesthetic agents used primarily in therapeutic settings.
4	Postoperative respiratory failure	Yes			
5	Death in low-mortality diagnosis-related groups (DRGs)	Yes			
6	Postoperative sepsis	Yes			
7	Decubitus ulcer	Yes			
8	Postoperative wound dehiscence	Yes	Yes		
9	Failure to rescue	Yes			
10	Selected infections due to medical care	Yes	Yes		
11	Foreign body left during procedure	Yes	Yes	Yes Required for numerator definition	This indicator is intended to flag cases of a foreign body accidentally left in a patient during a procedure. This indicator is defined on both a hospital level (by restricting cases to those flagged by a secondary diagnosis or procedure code) and an area level (by including all cases).
12	Transfusion reaction	Yes	Yes	Yes Required for numerator definition	This indicator is intended to flag cases of major reactions due to transfusions (ABO and Rh). This indicator is defined both on a hospital level (by including cases based on secondary diagnosis associated with the same hospitalization) and on an area level (by including all cases of transfusion reactions).

Table 2.2. (continued) List of Patient Safety Indicators (AHRQ 2003).

	Patient Safety Indicator (PSI)	Hospital-level	Area-level	Use of ICD9-CM	Summary
13	Iatrogenic pneumothorax	Yes	Yes		
14	Birth trauma—injury to neonate	Yes			
15	Postoperative hemorrhage or hematoma	Yes			
16	Obstetric trauma—Cesarean delivery	Yes			
17	Postoperative hip fracture	Yes		Yes Required as an exclusion criteria in the denominator	This indicator is intended to capture cases of in-hospital fracture - specifically, hip fractures. This indicator limits diagnosis codes to secondary diagnosis codes to eliminate fractures that were present on admission.
18	Obstetric trauma—vaginal delivery with instrument	Yes			
19	Postoperative physiologic and metabolic derangement	Yes			
20	Obstetric trauma—vaginal delivery without instrument	Yes			

Table 2.3. Set of ICD9-CM E- and N-codes Defining the Patient Safety Indicator "Foreign Body Left During Procedure". (AHRQ 2003, pages 98-99)

Foreign Body Left During Procedure
Numerator:
Discharges with ICD-9-CM codes for foreign body left in during procedure in any secondary diagnosis field per 1,000 surgical discharges.
ICD-9-CM diagnosis codes (ICD9-CM N-codes)
998.4 Foreign body accidentally left during a procedure 998.7 Acute reactions to foreign substance accidentally left during a procedure
ICD-9-CM external codes (ICD9-CM E-codes)
Foreign body left in during:
E871.0 Surgical operation E871.1 Infusion or transfusion E871.2 Kidney dialysis or other perfusion E871.3 Injection or vaccination E871.4 Endoscopic examination E871.5 Aspiration of fluid or tissue, puncture, and catheterization E871.6 Heart catheterization E871.7 Removal of catheter or packing E871.8 Other specified procedures E871.9 Unspecified procedure
Denominator:
All medical and surgical discharges defined by specific diagnosis related groups (DRGs) (see denominators for decubitus ulcer for medical discharges and complications of anaesthesia for surgical discharges).

Zhan and Miller (2003a) conducted a literature review to identify studies on patient safety research that used administrative data. The authors concluded that since 1970 few studies have used administrative data in patient safety research. For example: a number of studies examined small-area variation in health care and clinical practice patterns; some studies in outcome research were carried out using Medicare data; and some studies reported using administrative data to assess quality and patient safety. More recently, these authors reported that investigators had also utilized patient safety indicators (PSIs) developed by the Agency for Healthcare Research and Quality (AHRQ).

In a separate paper, Zhan and Miller (2003b) used patient safety indicators (PSIs) and administrative data to assess excessive length of stay (LOS), charges, and deaths attributed to medical injuries during hospitalization. In their study, they used PSIs to identify medical injuries in 7.45 million hospital discharge abstracts from 994 acute-care hospitals across 28 states in the year 2000. They identified a large number of cases that they considered likely to be medical injuries resulting from failures in the process of care in hospitals and found that the rates for the PSIs were relatively lower than typically reported in other studies. They concluded that PSIs represent a promising tool for evaluating patient safety, however, additional analyses are required to fully understand the potential benefits and problems associated with the use of these indicators.

Chapter 3

Methods

In this chapter we: (1) Describe the data analysed in the demonstration of the analytical methodology presented in this study; (2) Describe the spatio-temporal hierarchical statistical model and Bayesian disease mapping theory underlying the data analysis; (3) Review the statistical assumptions associated with the small-area analysis, including assumptions used in estimating disability-adjusted life years (DALYs); and (4) Document the procedure developed to incorporate spatio-temporal Bayesian disease mapping methods into the calculation of disability-adjusted life years (DALYs).

3.1 Data

To calculate the health status indicators shown in Figure 1.1, injury mortality data, including population estimates, were obtained from the British Columbia (BC) Vital Statistics Agency. In addition, injury hospitalization data and number of admissions were provided by the University of British Columbia's Centre for Health Services and Policy Research (CHSPR).

3.1.1 Definition of Study Regions

The analyses presented in this study were conducted using the following geographical boundaries defined by the BC Ministry of Health: Sixteen health service delivery areas (HSDA) nested within five health authority areas (HA) (see Figure 3.1).

The level of health authority (HA) represents the primary layer in the provincial health care system that is responsible for "identifying regional health needs; planning appropriate programs and services, and ensuring programs and services are properly funded and managed" (Government of British Columbia 2004). The BC geographical health authorities are the: Interior health authority, Fraser health authority, Vancouver Coastal health authority, Vancouver Island health authority and Northern health authority.

The next layer in the provincial health administration system is the health service delivery area (HSDA). The HSDAs are responsible for "managing the delivery of health services in their respective areas, meeting performance objectives set by health authorities, ensuring community input into health service planning and evaluation, and evaluating health status and plan performance" (Government of British Columbia 2004).

These geographically-based HSDAs were used to define place of residence of deceased or hospitalized individuals. It is important to recognize that in some areas of British Columbia in which there are not many hospitals or health care professionals qualified to perform certain specialized procedures, some patients travel to Vancouver (in the Vancouver Coastal health authority) or Alberta (neighbouring province to the east of British Columbia) for treatment. The immediate consequence is that the place of residence may not be the same as the place of care (or place of injury for that matter). If the analyses presented in this study

were re-run using place of injury or care, then it is possible that the values and interpretation of the health status indicators would be different from the analyses presented in this study. Since place of residence was used to group individuals into levels of health administration areas, the health status indicators in this study should be interpreted as the impact of injury on the HA or HSDA of residence.

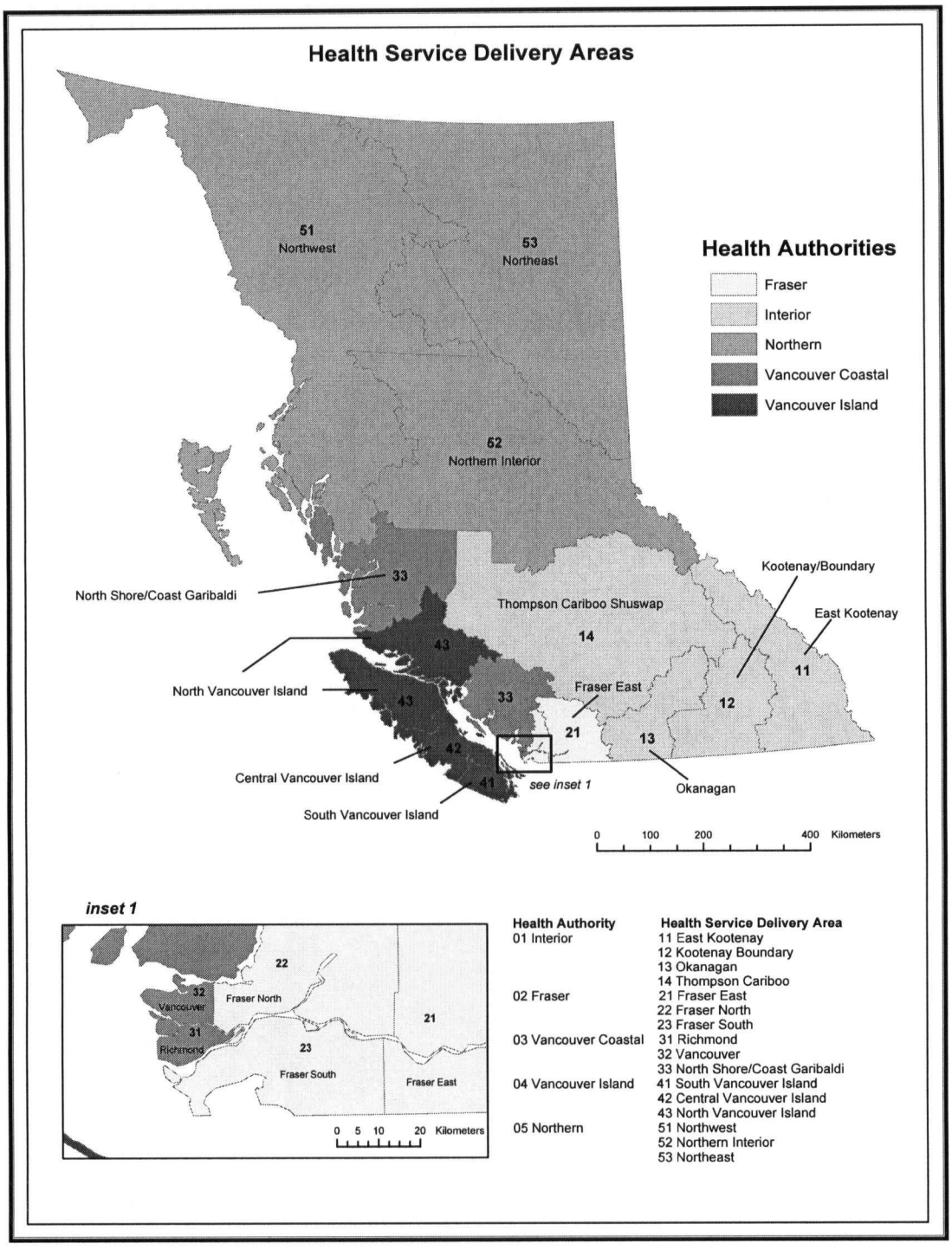


Figure 3.1. Map of the Health Service Delivery Areas and Health Authorities of British Columbia.

3.1.2 Definition of Study Population

Hospitalization Data. Individuals were included in this investigation if they were hospitalized in BC during the period 1991-2000, and had a hospitalization diagnosis included in the ICD9-CM E-codes classification system listed in Table 1.1. The data on hospitalization included all hospital discharge data from any hospital in BC whose level of care was either acute care or day surgery. The data obtained for hospitalization consisted mainly of BC residents (the average percentage of residents was 99.9% in the 10 years of study). The remaining patients (0.1%) included in the hospital data were people not registered to the Medical Services Plan of BC (MSP) and visitors to BC that were hospitalized during 1991-2000.

Mortality Data. This set of data included any person who died during the period 1991-2000, and had as cause of death any of the ICD9-CM E-codes listed in Table 1.1. The data obtained for mortality only included residents of British Columbia in the period 1991-2000.

Population Data. To calculate the annual incidence rates for all injuries (excluding medical AEs), we used the annual BC population size estimates during 1991-2000 as a denominator. Figure 3.2 maps the mid-period population sizes of each HSDA during 1991-2000. Most of the areas in the southwest of BC are those with the population higher than the median population.

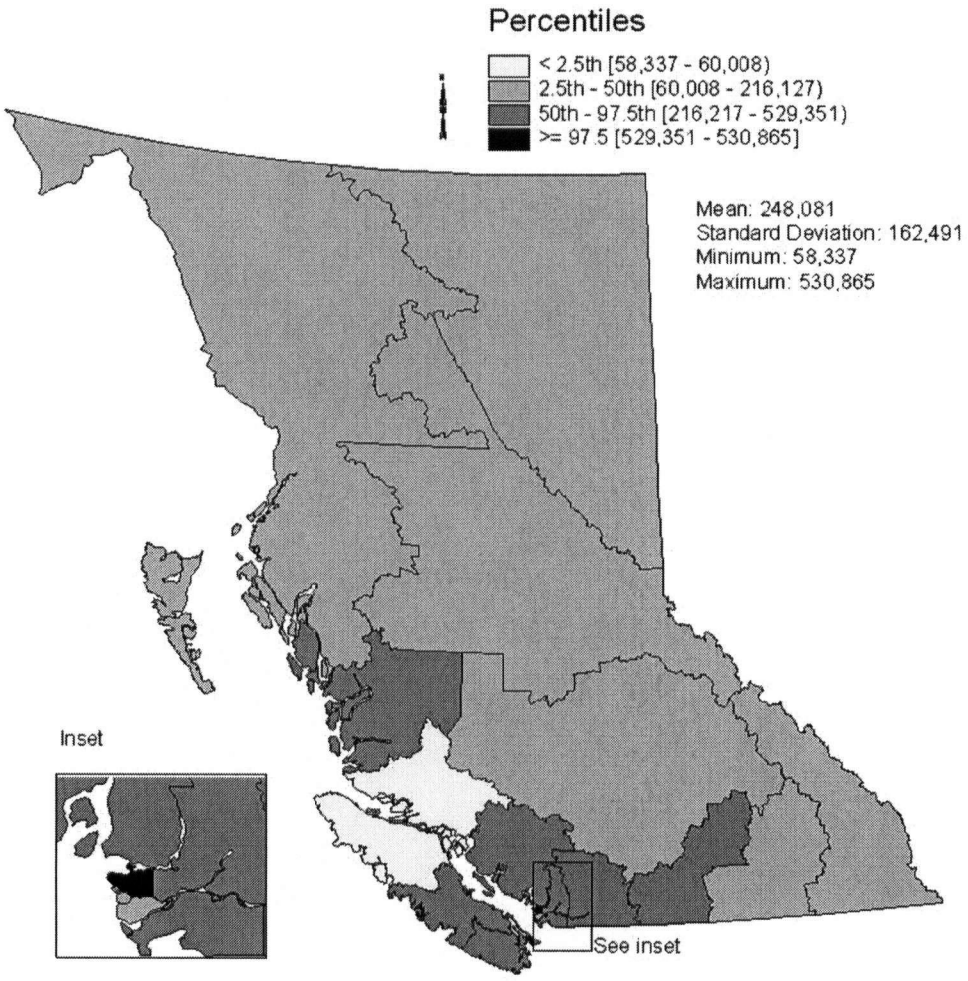


Figure 3.2. Mid-Period Population Size by Health Service Delivery Areas during 1991-2000. Males and Females – All Age Groups.

Admission Data. The number of admissions to any hospital in BC was used as the denominator in calculations of incidence rates of injuries due to medical AEs, whose level of care was either acute care or day surgery, in the period 1991-2000. Figure 3.3 maps the mid-period number of admissions of each HSDA during 1991-2000. Most of the areas in the central and southwest of BC are those with the number of admissions higher than the median number of admissions.

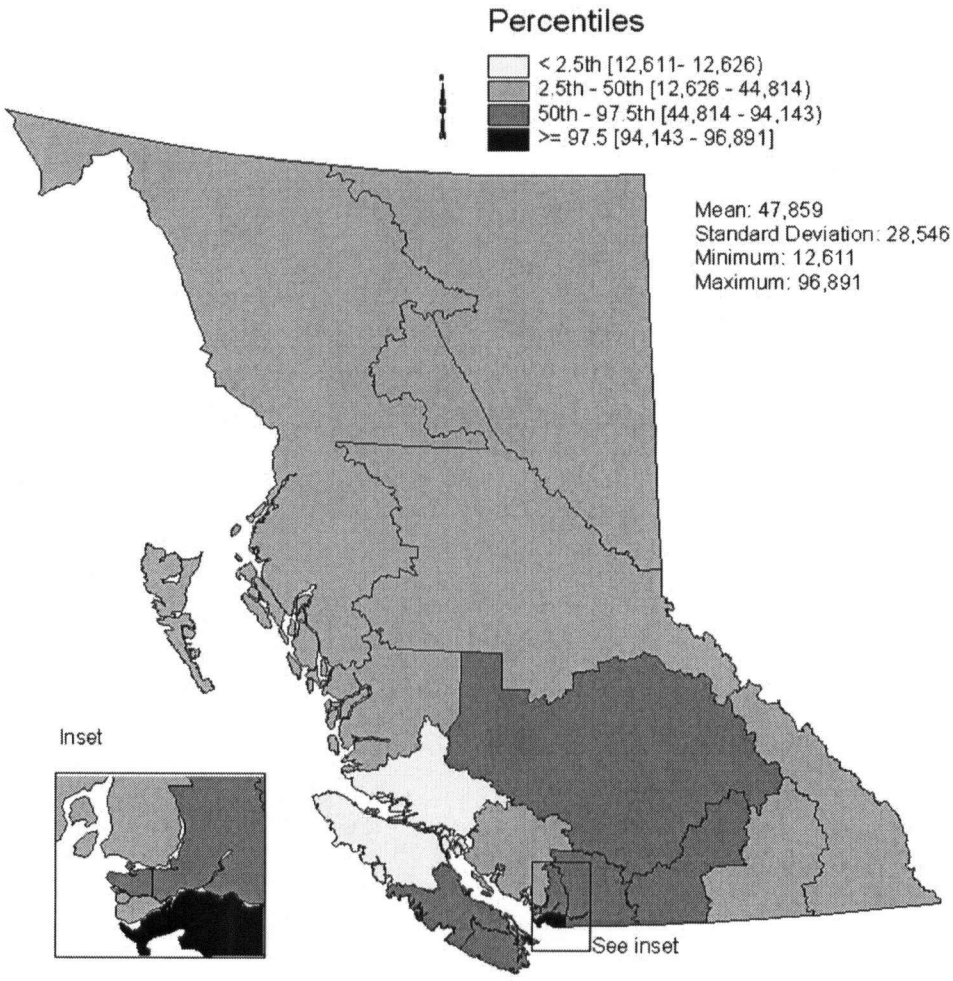


Figure 3.3. Mid-Period Number of Admissions by Health Service Delivery Areas during 1991-2000. Males and Females – All Age Groups.

Case or Event Definition. The unit of analysis was person incident (or event). The definition for an injury was an event that led to death or that was non-fatal but severe enough to require hospital treatment. In order to organize the hospitalization data we adopted the following rules to define different events and the date of each event:

- If a patient at *different admission dates* had the same ICD9-CM code in his/her chart, we considered these codes as separate events. This rule allows for multiple events per person.

- If a patient during the *same admission* had the same ICD9-CM code repeated in his/her chart, we counted as one event the first occurrence of these codes.
- If a patient was *transferred* between hospitals, the admission date was the date of first admission.

Age Groups. We performed the analysis separately for males and females. In addition, because we did not have sufficient cases for certain age groups in the hospitalization and mortality data, we used the overall BC mortality rate by age group for all external causes of injury combined to decide on the best way to create appropriate age groups (Figure 3.4). Given that we need a sufficient number of deaths and hospitalizations in each injury category in order to use the proposed methodology, and based on the distribution of observed mortality rates by age group as shown in Figure 3.4, we decided that the new age groupings would be 0-19, 20-39, 40-64, 65-79 and 80 or more years of age.

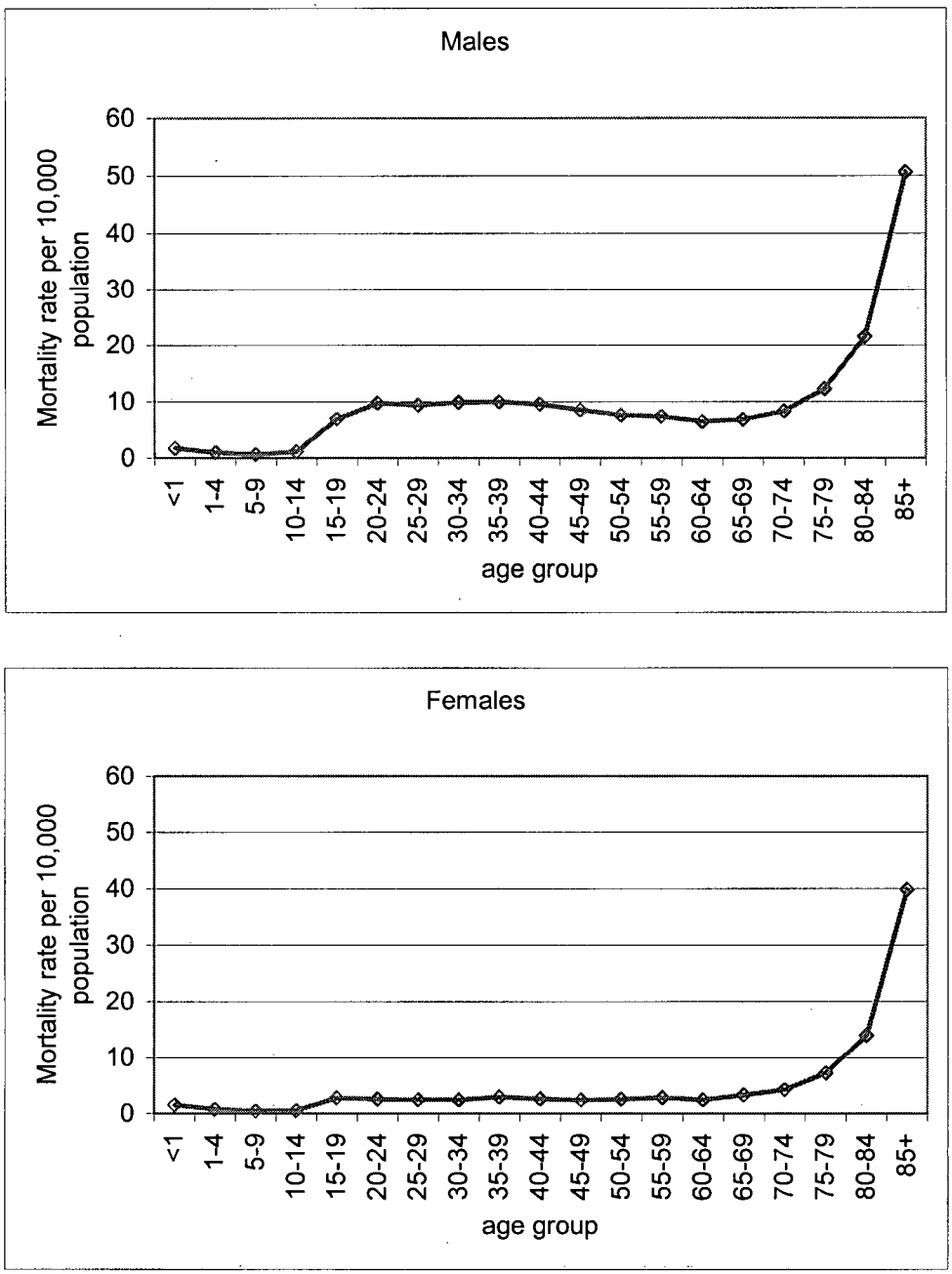


Figure 3.4. The Distribution of the Ten-Year Conventional Mortality Rate at the Provincial Level, by Gender and Age Group, and for All External Causes of Injury Combined.

3.1.3 Categories of External Cause and Nature of Injury

The International Classification of Diseases, Ninth Revision, Clinical Modification, External coding scheme (*i.e.,* ICD9-CM E-codes) was used in the hospital separation data for all years during the period 1991-2000, and mortality data for all years of study except the year 2000. For the year 2000, the ICD tenth revision coding system was used by the Vital Statistics Agency of British Columbia. The translation from ICD10 into ICD9 was provided by the Vital Statistics Agency of British Columbia. The specific external causes of injury considered in the analyses at the provincial and HA levels are listed in Table 1.1. A detailed explanation of the ICD9-CM E-codes in Table 1.1 can be found in the Glossary (see Appendix B).

The Category of Other Unintentional Injuries (Excluding Medical AE) in Table 1.1. An explanation of the unintentional injuries included in this category can be found in the Glossary (see Appendix B). In this study, we ran the analyses at the provincial and HA levels including *other unintentional injuries (excluding medical AE).* However, it is difficult to interpret the results of this category of injury because it involves an array of different unintentional injuries.

E-Code Categories E850-E858. The ICD9 E-codes E850-E858 are E-codes classified in Table 1.1 as unintentional poisoning. These E-codes are defined by accidental poisoning by drugs, medicinal substances, and biologicals. It includes accidental drug overdose; wrong drug given or taken in error; drug taken unintentionally; and accidents in the use of drugs and biologicals in medical and surgical procedures (see Appendix B for more detail). These E-codes were excluded from the

category *injury due to adverse effects of drugs in therapeutic use* mainly because the difficulty in identifying, for example, whether the accidental poisoning was caused by a wrong prescribed dosage of the substance or not. The frequency of E-codes in this category in both data sets (mortality and hospitalization) can be found in Table G.1 in Appendix G.

Nature of Injury. Nature of injury is defined by ICD9-CM N-codes describing the actual bodily harm caused by the external cause of injury, such as an intracranial injury. The ICD9-CM N-codes for nature of injuries are presented in Table 3.1.

Table 3.1. List of ICD9-CM N-Codes for Nature of Injury (Murray and Lopez 1996).

Injury Nature	ICD9-CM N-Codes
Fractured skull	800 - 801
Fractured face bones	802
Fractured vertebral column	805
Injured spinal cord	806 and 952
Fractured rib or sternum	807
Fractured pelvis	808
Fractured clavicle, scapula or humerus	810 - 812
Fractured radius or ulna	813
Fractured hand bones	814 - 817
Fractured femur	820 - 821
Fractured patella, tibia or fibula	822 - 823
Fractured ankle	824
Fractured foot bones	825 - 826
Other dislocation	830, 833 - 834, 836 - 839
Dislocated shoulder, elbow or hip	831, 832, 835
Sprains	840 - 848

Injury Nature	ICD9-CM N-Codes
Intracranial injury	850 - 854
Internal injuries	860 - 869
Open wound	870, 872 - 884, 890 - 894
Injury to eyes	871, 950
Amputated thumb	885
Amputated finger	886
Amputated arm	887
Amputated toe	895
Amputated foot	896, 897.0 - 897.1
Amputated leg	897.2 - 897.3
Crushing	925 - 929
Burns < 20%	940 - 947, 948.0 - 948.1
Burns > 20% and < 60%	948.2 - 948.5
Burns > 60%	948.6 - 948.9
Injured nerves	951, 953 - 957
Poisoning	960 - 979, 980 - 989
Residual	900 - 924, 930 - 939

Following the recommendations of Murray and Lopez (1996), a number of other N-codes for ill-defined or minor categories have been distributed across the nature of injury categories in Table 3.1 according to the following rules:

(1) The N-codes *803* (other and unqualified skull fractures) and *804* (multiple fractures involving skull or face with other bones) should be proportionately redistributed across the N-codes 801 and 802;

(2) The N-code *809* (ill-defined fractures of trunk) should be proportionately redistributed across the N-codes 807 and 808;

(3) The N-codes *818* (ill-defined fractures of upper limb) and *819* (multiple fractures involving both upper limbs, and upper limb with rib(s) and sternum) should be proportionately redistributed across the N-codes 810 – 817;

(4) The N-codes *827* (other, multiple and ill-defined fractures of lower limb) and *828* (multiple fractures involving both lower limbs, lower with upper limb, and lower limb(s) with rib(s) and sternum) should be proportionately redistributed across the N-codes 822 – 826;

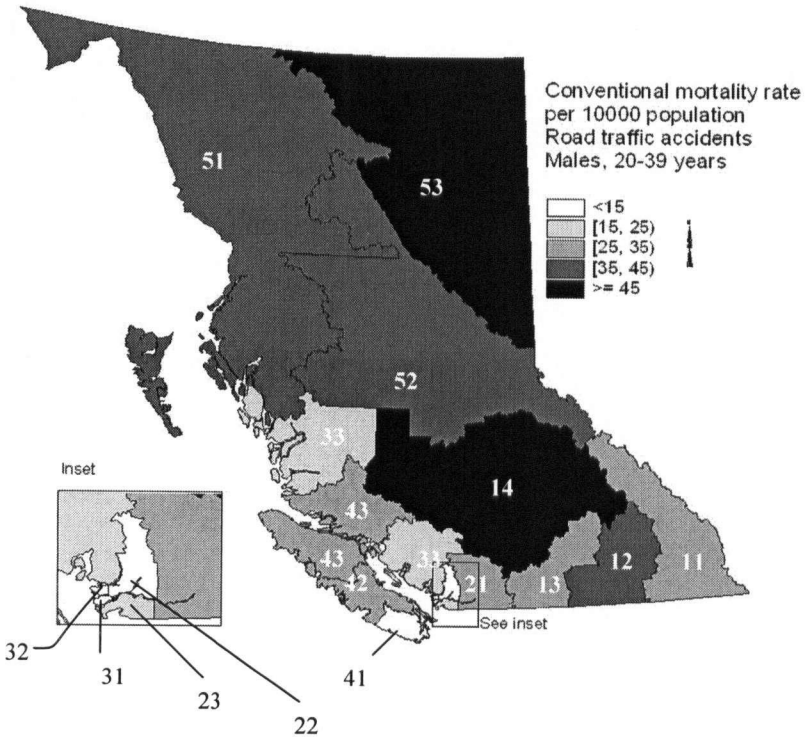
(5) The N-codes *897.4 – 897.7* (traumatic amputation of leg(s) - unilateral, level not specified, and bilateral (any level)) should be proportionately redistributed across the N-codes 895, 896 and 897.0 – 897.3;

(6) The N-code *949* (burn, unspecified) should be proportionately redistributed across the N-codes 940 – 948; and

(7) The N-codes *958 – 959* (certain traumatic complications and unspecified injuries) and *990 – 999* (other and unspecified effects of external causes) should be proportionately redistributed across all N-code categories after the previous steps.

3.2 Bayesian Disease Mapping

The analysis of geographical variation in disease risk has been one of the main roles of epidemiologists engaged in public health surveillance. In several studies to date, the ultimate goal of the analyses has been to produce disease maps to: (1) identify areas of high and low disease risk; (2) detect spatial clusters of disease incidence; and (3) provide etiological clues based on the distribution of disease risk. For example, Figure 3.5 contains a typical example of disease map that can be found in the literature illustrating the spatial distribution of disease incidence.



HSDA	Deaths	Population at mid period (1995)	Rate per 10,000 population
11	28	11,123	25.2
12	41	10,741	38.2
13	119	38,229	31.1
14	155	30,326	51.1
21	102	35,189	29.0
22	121	85,363	14.2
23	188	84,301	22.3
31	32	23,065	13.9
32	100	106,807	9.4
33	72	37,766	19.1
41	85	57,980	14.7
42	94	31,161	30.2
43	25	9,562	26.1
51	60	15,482	38.8
52	108	25,757	41.9
53	57	11,399	50.0

Figure 3.5. Ten-Year Conventional Mortality Rate per 10,000 population Attributable To Road Traffic Accidents. Males, 20-39 Years, 1991-2000.

Two important limitations are associated with the map displayed in Figure 3.5. First, the map is based on the conventional mortality rate. Although many studies have used conventional rates and ratios to produce maps such as the one in Figure 3.5, mapping conventional measures of risk can lead to erroneous conclusions, especially in the case of rare diseases and a small population at risk. In such situations, it becomes difficult to distinguish whether differences observed among the spatial units are due to chance, or whether they are indeed true differences. Second, this map shows the conventional mortality rate spatial pattern for all years combined during the period 1991-2000. Consequently, the information on disease risk that could have been obtained annually is lost. Historically, in most disease mapping studies, the approach used to model temporal spatial data has been to either analyse the data cross-sectionally, or to initially pull the temporal data together, and then proceed with the analysis. Consider now, examining over time the same data presented in Figure 3.5. More specifically, Figure 3.6 illustrates the temporal variability in the conventional mortality rate, along with other temporal data on road traffic accidents that occurred between 1991 and 2000 in 3 health services delivery areas in BC - Northeast (with a low population at risk), Simon Fraser (with a median population at risk) and Vancouver (with a high population at risk).

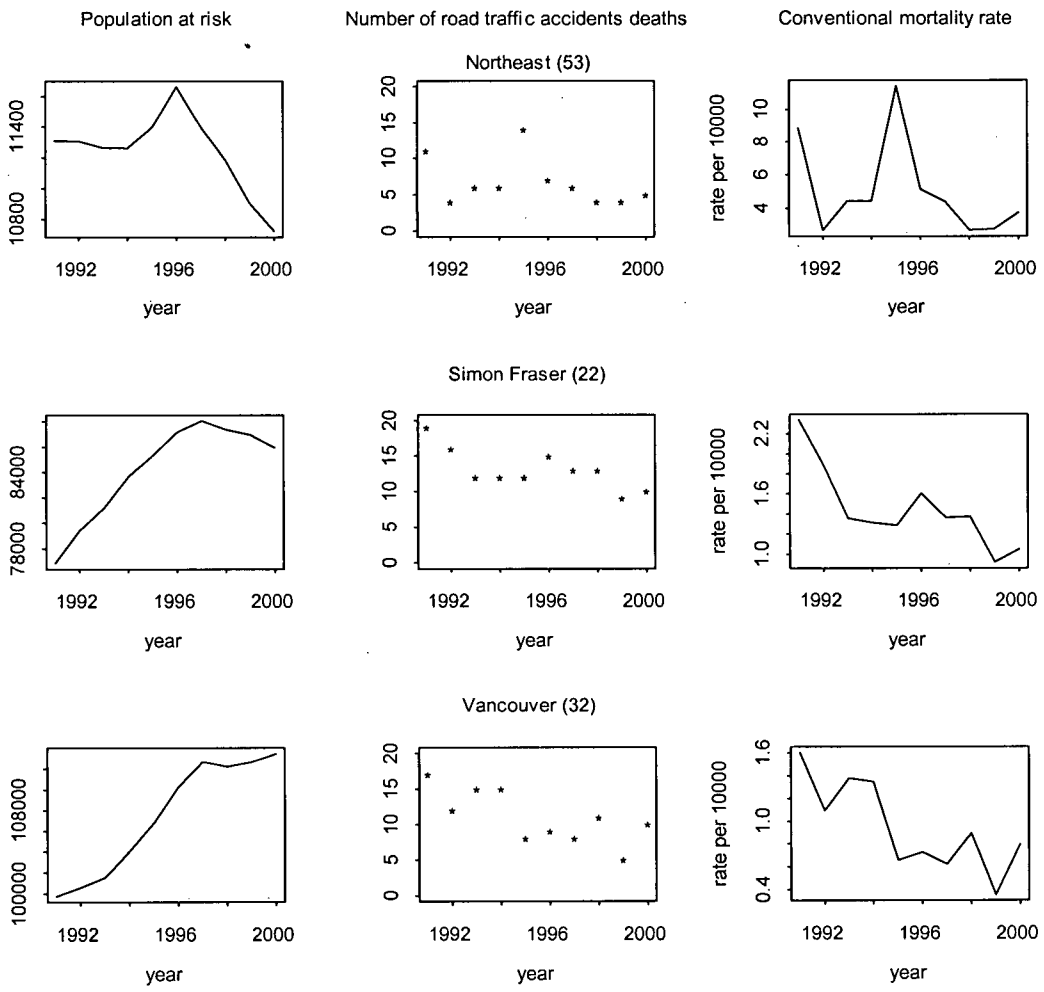


Figure 3.6. Annual number of deaths, estimated population and conventional mortality rate per 10,000 population attributable to road traffic accidents. Males, 20-39 years, 1991-2000.

In Figure 3.6, note that the scales of the population trend and conventional mortality rate plots are very different for small, medium and large regions. There appears to be greater variation in the conventional mortality rate in the HSDA with a low population at risk (Northeast); to see the variability for each HSDA'rate, look at the minimum and maximum values for the rate. Additionally, when we compare the sizes of the population at risk

between the three HSDAs, it appears that as the population at risk increases, the variability associated with the mortality rate decreases. As in the spatial context, the annual conventional rates are also subject to chance variation. To conclude, the mortality trends of the geographical units described in Figure 3.6 appear to be quite different. This difference is due to a subtle source of variation induced by unobserved risk factors, called systematic variation, which influences the spatio-temporal pattern of injury incidence among geographical units.

In view of the previous modelling concerns, to analyse spatio-temporal data appropriately, it is important to apply a disease mapping methodology that simultaneously accounts for the spatial variability, temporal variability and the interaction between space and time in the statistical model. To date there have been a small number of developments in the spatio-temporal modeling of disease rates, such as the models shown in Bernardinelli *et al.* (1995), Knorr-Held and Besag (1998), Sun *et al.* (2000), Böhning, Dietz and Schlattaman (2000), and MacNab (2003a,b,2004). It is also important to chose a disease mapping methodology that is capable of separately modeling the systematic variability induced by unmeasured covariates (or risk factors) not included in the analysis, and the chance variability produced by rare events in regions with a small population at risk. In this study, the chosen spatio-temporal model is based on the Bayesian hierarchical model presented in MacNab (2003a), where the systematic and chance variations are modelled via random spatial and temporal effects.

3.2.1 Spatio-Temporal Modeling under a Full Bayesian Approach

The model described in this section was developed by MacNab and Dean (2001) in a small-area study of infant mortality rates in the province of British Columbia, Canada. The model was later extended by MacNab (2003a) to adjust for potential age confounder. In this thesis, the spatio-temporal modelling was carried out separately for each gender × age group combination. Let Y_{it} represent the number of (injured or diseased) cases in HSDA i (i=1,...,16) and year t (t=1991,...,2000). We assume that conditioned on the random effects the number of (injured or diseased) cases has a Poisson distribution with intensity given by μ_{it}. Thus, in the first level of the Bayesian hierarchical (mixed effects) Poisson model, one assumes that given the vector of random effects $\boldsymbol{b}$, Y_{it}'s are (conditionally) independent, *i.e.*, $Y_{it}|\boldsymbol{b} \overset{\text{ind}}{\sim} \text{Poisson}(\mu_{it})$, with μ_{it} representing the expectancy of Y_{it} given the vector of random effects $\boldsymbol{b}$.

To analyse the incidence rates, one assumes:

$$\log(\mu_{it}) = \log(n_{it}) + \log(m) + S_0(t-\bar{t}) + \varphi_i + RS_i(t-\bar{t}) \qquad (3.1)$$

where $\bar{t} = \frac{\sum_{l=1}^{10} t_l}{10}$ is the average time; $\log(n_{it})$ is an offset, *i.e.*, a covariate having a known coefficient; m is a fixed effect representing the provincial mean rate; $S_0(t-\bar{t}) = \sum_{k=1}^{4} \alpha_{0,k} B_k(t-\bar{t})$, where $\alpha_{0,k}$ (k=1,2,3,4) represent fixed spline coefficients, is a "global" fixed cubic B-spline representing the provincial rate trend; φ_i is a random spatial effect that allows for spatially structured variation in rates that arise from unobserved risk

factors or latent effects; and $RS_i(t-\bar{t}) = \sum_{k=1}^{4} \beta_{i,k} B_k(t-\bar{t})$, where $\beta_{i,k}$ (i=1,…,16 and k=1,2,3,4) , is a family of random cubic B-splines representing the temporal trend for the i^{th} HSDA relative to the "global" spline. Here $\{B_k(t-\bar{t})\}_{k=1}^{4}$ represents a set of basis functions of an order three B-spline basis function generated without intercept, and with one inner knot at the mid-period (MacNab and Dean 2001). The motivation for using splines to model the BC and the local temporal trends is the possibility of modelling the non-linear temporal effects without making strong assumptions about the parametric form of the trends (MacNab and Dean 2001; MacNab 2003a). Furthermore, by modelling the local trends using a family of random splines, we allow the shape of the temporal trends to vary among different HSDAs. As a result, we gain more precision and stability when estimating each region's rate over time because the model pools information across time and space to fit local trends.

In this study, we assume independence priors for all random effects:

(i) $\varphi = (\varphi_1,\ldots,\varphi_{16})^t \sim MVN(0, \sigma_\varphi^2 I_{16})$, i=1,…, 16, I_{16} is a 16×16 identity matrix, and σ_φ^2 represents the overall variability/dispersion between regions;

(ii) $\boldsymbol{\beta}_k \sim N(0, \sigma_k^2 I_{16})$, k=1,2,3,4, and I_{16} is a 16×16 identity matrix; and

(iii) ρ =covariance(β_{ik}, φ_i) (*i.e.*, since we assume that φ_i and $\beta_{i,k}$ are not independent)

In MacNab (2003a), inferences for the spatio-temporal model (3.1) were made via an empirical Bayesian approach using the penalized quasi-likelihood (PQL) estimation method (Breslow and Clayton 1993; MacNab and Dean 2000). While the empirical Bayesian approach appropriately estimates the model parameters in a timely basis, this approach does not provide precise estimation of the uncertainty of these parameters, requiring the use of

methods such as a parametric bootstrap for proper inference on random effects (MacNab *et al.* 2004). In this study, inferences for model (3.1) are based on a full Bayesian approach using Markov Chain Monte Carlo (MCMC) simulation procedures via Gibbs sampling algorithms (Bernardinelli and Montomoli 1992; Gelman *et al.* 1998; Carlin and Louis 2000, MacNab 2003b; MacNab *et al.* 2004). Additionally, goodness-of-fit plots are used to assess how well the systematic and random variations were modelled (see Appendix G).

For full Bayesian analysis the following hyperpriors that are commonly seen in disease mapping literature are used in this study (MacNab *et al.* 2004):

$$\alpha_{0,k} \sim N(0, 0.0001),\ k = 1,2,3,4$$

$$m \sim Uniform(0,1)$$

$$\rho \sim Uniform(-1,1)$$

$$\tau_\varphi = \frac{1}{\sigma_\varphi^2} \sim Gamma(0.0001, 0.0001), \text{ and}$$

$$\tau_k = \frac{1}{\sigma_k^2} \sim Gamma(0.0001, 0.0001),\ k = 1,2,3,4.$$

In this study, therefore, the following important quantities are obtained from the full Bayesian analysis of the spatio-temporal model (3.1):

(i) The estimated non-linear trend of the provincial level rate, $\exp(\log(m) + S_0(t))$; and

(ii) The estimated non-linear trend for the ratio between each HSDA's rate and the provincial rate, $\exp(\varphi_i + RS_i(t))$.

In summary, there are several advantages associated with the full Bayesian approach used in this study. In particular, this approach has (i) the advantage of providing both satisfactory estimation of parameters and their uncertainty; (ii) it allows each estimated

parameter in model (3.1), as well as each estimated measure (*e.g.*, rates, ratios and counts) to have a posterior statistical distribution. Inferences for model (3.1) are then based on posterior summary statistics such as the: posterior mean, posterior standard deviation, posterior median, posterior mode and 0.025 and 0.975 posterior quantiles; and (iii) based on the posterior distribution of injury (mortality or hospitalization) counts, it is possible to calculate the posterior distribution of DALYs, as is shown later in this chapter.

3.3 Disability-Adjusted Life Years (DALY)

The DALY methodology extends the concept of potential years of life lost due to premature death to include equivalent years of "healthy" life lost by being in states other than good health. One DALY represents one lost year of healthy life. Thus the DALY represents the number of years of life lost (YLL) summed with a measure of healthy years lost due to disability (YLD) based on the severity and duration of the sequelae, age and gender of the injured person. The parameters to obtain DALY are explained in more detail in the next section. Here, we only present the simplified formulae to calculate YLD, YLL and DALY.

The DALY for each external cause of injury is calculated as:

$$DALY = YLD + YLL \tag{3.2}$$

YLD is the morbidity component of DALY, also known as the non-fatal burden component, and the simplified formula to calculate YLD is given by:

Without discounting rate: $YLD = I \times DW \times D$

$$\text{With discounting rate: } YLD = I \times DW \times \frac{1}{r} \times \left(1 - e^{-(r \times D)}\right) \tag{3.3}$$

where I = number of hospitalizations, DW = disability weights, D = average duration of disability, and r = discount of future health rate.

YLL is the mortality component of DALY, or the fatal burden component. The simplified formula to calculate YLL is given by:

$$\text{Without discounting rate: } YLL = N \times L$$

$$\text{With discounting rate: } YLL = N \times \frac{1}{r} \times \left(1 - e^{-(r \times L)}\right) \tag{3.4}$$

where N = number of deaths, L = life expectancy (at age of death), and r = discount of future health rate.

For more information on general formulae to calculate YLD and YLL please see Begg and Tomijima (2005) or Murray and Lopez (1996). The next section explains the assumptions made to calculate DALYs in this study.

3.3.1 Assumptions Made in the Calculation of DALYs

To calculate DALYs, there are several parametric assumptions that must be made in order to obtain YLL and YLD (see Figure 3.7).

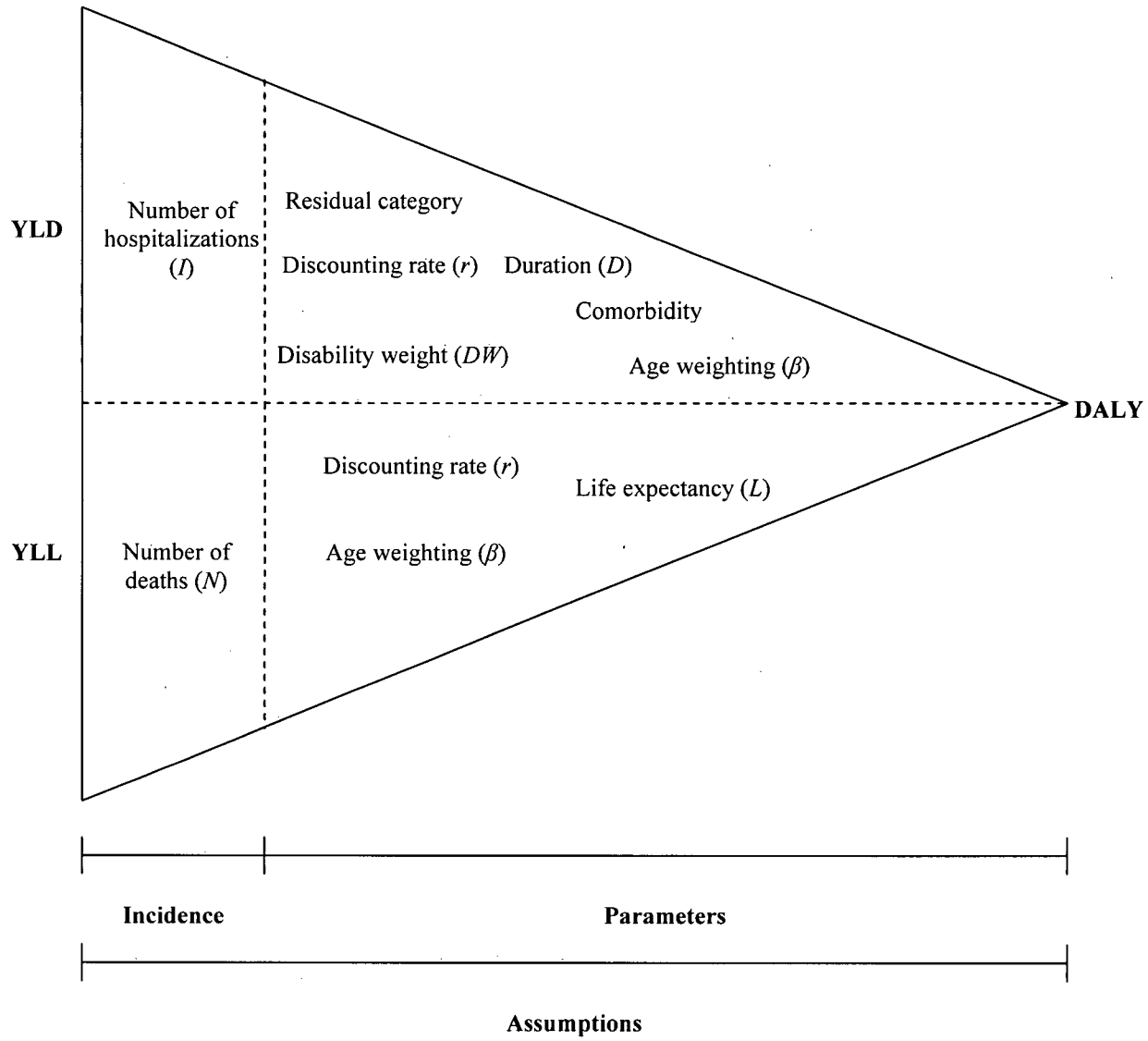


Figure 3.7. Parameters Intrinsic in the Calculation of Disability-Adjusted Life Years (DALY).

To obtain YLL values for the discounting rate, life expectancy and age weights must be chosen. For calculating YLD, values for the discounting rate, age weights, disability weights and durations have to be chosen. In addition to making choices concerning parameters intrinsic to DALY calculations, decisions must be made regarding the control for comorbid conditions as well as assumptions about the unknown disability weights and durations for the residual category of injury sequela. The following sections discuss these choices in detail.

3.3.1.1 Discounting Future Health Rate (*r*)

Discounting refers to the practice of valuing the same thing in the future as less valuable than in the present. For a better justification of using discount rates in this study, we should consider several aspects inherent in their use. One aspect is the economic perception involved in discounting. For example, suppose that you have to choose between receiving a guaranteed amount in dollars today or the possibility of the same amount in a year from now, which would you choose? Discounting says that most people would choose to receive the amount today. Suppose that instead of receiving the same amount in one year, you will receive 50% more because of the interest rates, what would you choose? Some people might prefer to receive the amount in one year. There are several factors involved in the decision of an individual who prefers to receive money today as opposed to in the future. These factors include uncertainty of what the future holds in terms of economy; monetary conditions; or the possibility of not being alive or fully capable of utilizing this money in the future. In this study, however, we are not focusing on an individual's discount rates for future health, but

rather on societal discount rates for future health, where the preference affects decisions for a society as a whole as compared to preferences affecting each individual.

The subject of discounting is complex and there are several papers describing arguments in favour and against its use (Murray and Lopez 1996; Murray and Acharya 1997; Williams 1999). In this study we decided to include discounting in the calculation of DALYs by age, gender, external cause of injury, and region. The next question that must be addressed is how much discounting we should use. It is necessary to find a balance between the sacrifices of future generations and gains of current generations. In this study as well as in others, discounting is best described as an exponential decay function over time. For example, Figure 3.8 illustrates the effect of time on discounting using a discrete form of discounting function as $\left(\frac{1}{1+r}\right)^t$ where t denotes time in years, and the discounting rates (r) assume the values 3%, 6% and 10%.

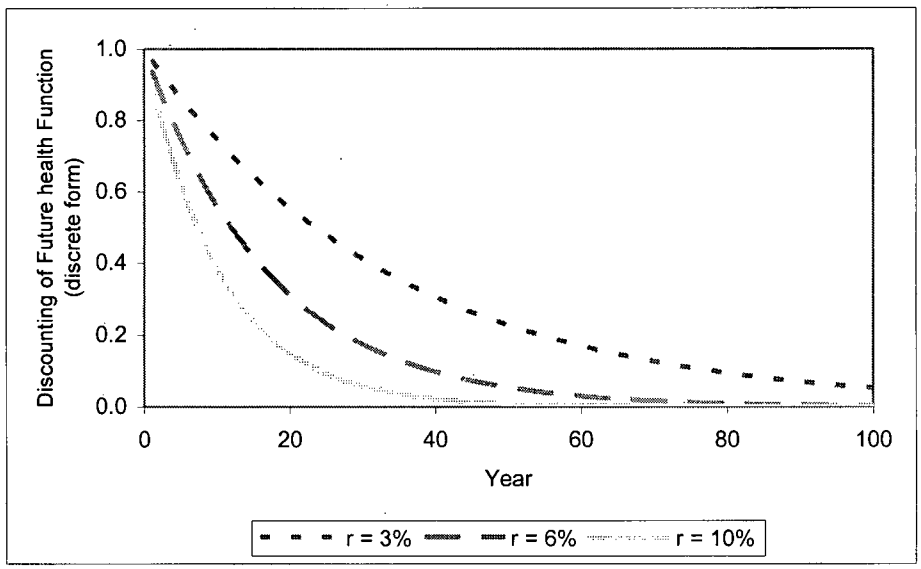


Figure 3.8. Effect of Time, in Years, on the Discrete Discounting Function.

Figure 3.8 demonstrates that a year of healthy life gained in 10 year's time is worth 26% less than one gained now if we use a discounting rate of 3%. However, if we adopted a discounting rate of 10%, a year of healthy life gained in 10 year's time is worth 61% less than one gained now.

Although researchers in the GBD study used a discount rate of 3%, they also advised other researchers to look at higher values. However, it is important to mention that there is no solid theoretical reasoning to use a 3% discount rate. The effect of discounting on the value of YLL, YLD and DALY is illustrated in the Appendix F under "Sensitivity Analysis for Discounting of Future Health Rate". The relevance of performing this sensitivity analysis was to emphasize the importance of understanding the impact of each different discounting rate on YLL, YLD and DALY for injuries in BC. The discount rates used in this sensitivity analysis were 0%, 3%, 6% and 10%. If we use no (r = 0%) or a high value (r = 10%) for discounting, in the first choice, the future is valued exactly as the present, and the second choice says that healthy life gained in future is much less worthy than if we gained it now. The decision then should be made between a discounting value of 3% or 6%. Although the value of 3% for discount is somewhat arbitrary, it has been extensively used in several economic evaluations and cost-effectiveness analyses. In this study we therefore assumed a discounting of future health rate equal to 3% after considering what value of discounting is conventionally used in the literature (Murray and Acharya 1997; Murray and Lopez 1996; World Bank 1993); and after reviewing the results obtained in the sensitivity analysis presented in Appendix F.

3.3.1.2 Age Weighting (β)

The GBD study weighted a year of healthy life lived by a young adult more highly than a year lived by a young child or an elderly person (Murray and Lopez 1996). Although age weighting and discounting appear similar in nature, the processes are distinct and care should be taken not to confuse them. The development of age-dependent weights is based on the belief that there is a social preference to value life differently depending on age. For example, one justification for valuing the life of a young adult more highly than an older adult is because there are limited resources (*e.g.*, monetary and human resources) associated with the health care system. Or possibly, because society is willing to invest more resources on preventing death at young ages than preventing a death at any later age; or because young adults have been educated and are ready to contribute economically and productively to society for (potentially) a greater amount of time (Murray and Lopez 1996).

The implementation of age weighting is one of the most controversial elements in the calculation of DALYs. There are several arguments in favour (*e.g.*, years of productive adult life should receive greater importance) and in opposition to these weights (*e.g.*, on equity and empirical grounds). In Murray *et al.* (2002) and Anand and Hanson (1997), the authors point out that the methodology to obtain age weights is still in an experimental stage, and that the weights published to date should be treated with caution. Given the current controversy involving the use of age-based weights, it is worth examining how the use of age weights can influence the final results in a burden of disease study.

For the GBD study, Murray and Lopez (1996) assumed an arbitrary continuous age-weighting function $g(C, age, \beta)$ for the weights at each age of the form:

$$g(C, age, \beta) = C \times age \times e^{-\beta \times age} \tag{3.5}$$

where β determines the importance of age weights (*i.e.*, the preference of valuing the lives of young adults higher than the lives of children and elderly); and C is an adjustment constant. As pointed out in the literature, values for β are purely arbitrary and values of C differ according to different study populations. In the GBD study, β was equal to 0.04 and C equal to 0.1658, and it was emphasized that if the age weighting function changed, the constant C would have to change as well. The general formula for the function (3.5) for varying values for β in {0.03,0.04,0.05} without the influence of C is shown in Figure 3.9.

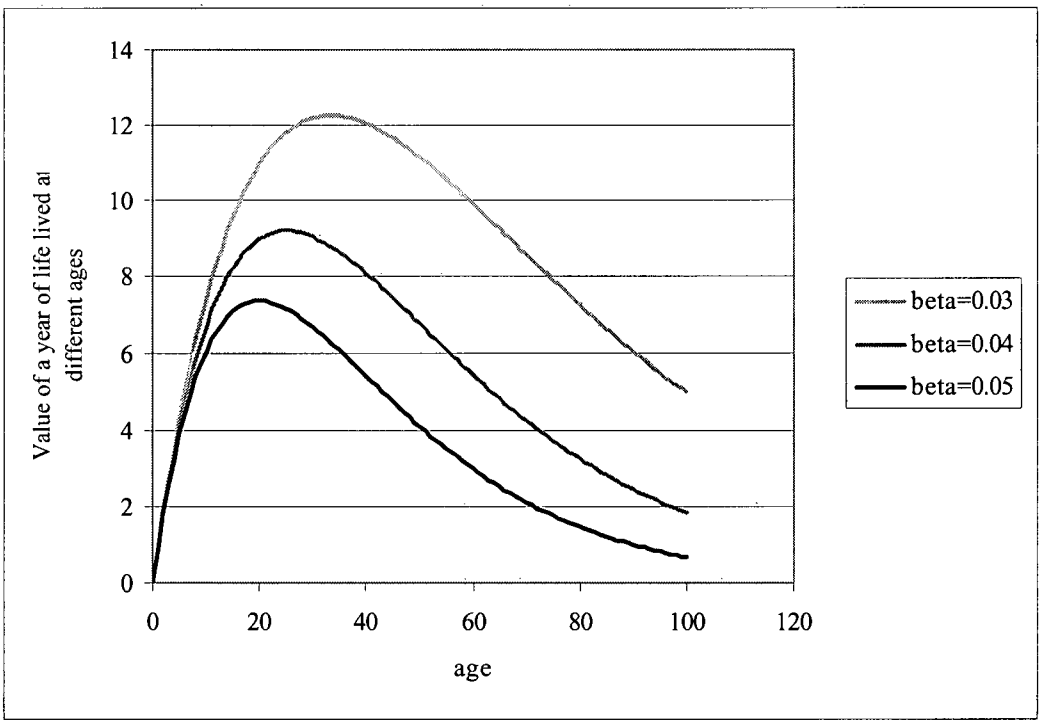


Figure 3.9. Shape of Age Weighting Function for β in the Set {0.03,0.04,0.05}.

For example, for β=0.04, the value of a year of life lived by a 30-year old person is 2.21 times higher than a 5-year old, 1.01 times higher than a 20-year old, 1.12 times higher than a 40-year old, and 1.66 times higher than a 60-year old. However, if a lower β is used, say β=0.03, then the value of an year of life lived by a 30-year old person is 2.83 times higher than a 5-year old, 1.11 times higher than a 20-year old, 1.01 times higher than a 40-year old, and 1.23 higher times than a 60-year old.

If age weighting is used, then the formulas (3.3 and 3.4) should be slightly modified, and the DALYs should be calculated as the sum of two continuous functions (f_1 and f_2) involving both YLD and YLL and the age weighting function $g(C, age, \beta)$, such as (see Murray and Lopez (1996) for more details):

$$DALY = f_1(g(C, age, \beta), YLD) + f_2(g(C, age, \beta), YLL) \quad (3.6)$$

Because of $g(C, age, \beta)$, the shape of the DALY function (3.6) for different age weights is very similar to shape of formula (3.5) as shown in Figure 3.9. The main concern involving the use of age weights is which age weight value (β) should be used in this study context. Until the choice of specific age weights can be based on more solid theoretical grounds, we have elected to adopt uniform age weights across all age groups.

3.3.1.3 Comorbidities

Studies to date have not explicitly attempted to adjust disability weights for comorbidities with the exception of the Australian and Victorian Burden of Disease Study (Mathers *et al.* 2000; Victorian Department of Human Services 1999b). In addition, it is important to mention that no

study has mentioned adjustment for durations of comorbidities. In this study, even after recognizing the importance of controlling for prevalent comorbid conditions, no attempt was made to adjust for comorbidities because the available data did not provide information on prevalent diseases for individuals in the study. However, we did adjust for coexisting comorbidities due to injury in the same individual. The details of how we implemented this procedure is presented in the sections on disability weights and durations (see sections 3.3.1.4 and 3.3.1.5).

3.3.1.4 Disability Weights (*DW*)

Population burden due to a particular injury is calculated using disability weights. Disability weights used in DALYs are developed via the application of a specific and deliberative form of the person trade-off (PTO) method for measuring social preferences for different health state choices. The final weights used in the GBD study were based on the application of the PTO protocol to a particular reference group of experts convened at the World Health Organization with representatives from each region in the world. The resulting disability weights quantify societal preferences for health states in relation to the societal "ideal" of optimal health defined by this group of experts. Separate weights have been developed for treated and untreated forms of each disability. The disability weights for the GBD study can be found in Murray and Lopez (1996).

Two assumptions intrinsic to the calculation of the GBD disability weights had an effect on the results of this study: (1) the weights were stationary over time; and (2) the same disability weight was assigned to everyone who had the same injury sequela, regardless of differences in the level of disability. Table 3.2 presents the disability weights for nature of

injury for treated cases as every individual in the hospitalization data was treated. Also in this table, it should be noted that for certain sequelae there are weights for short-term and long-term disabilities.

Table 3.2. Disability Weights by Nature of Injury and Age Category (Murray and Lopez 1996).

Nature of injury	ICD9-CM N-Codes	Disability weights	
		Treated	GBD assumptions
Fractured skull - short term	800 – 801	0.431	85% of incident cases
Fractured skull - life long	800 – 801	0.410	For ages 60+ the DW is 0.404. 15% of incident cases
Fractured face bones	802	0.223	100% of incident cases
Fractured vertebral column – short term	805	0.266	100% of incident cases
Injured spinal cord - life long	806 and 952	0.725	100% of incident cases
Fractured rib or sternum – short-term	807	0.199	100% of incident cases
Fractured pelvis - short-term	808	0.247	100% of incident cases
Fractured clavicle, scapula or humerus - short-term	810 – 812	0.153	For ages greater than 15 years the DW is 0.136 100% of incident cases
Fractured radius or ulna – short-term	813	0.180	100% of incident cases
Fractured hand bones	814 – 817	0.100	100% of incident cases
Fractured femur - short-term	820 – 821	0.372	95% of incident cases
Fractured femur - life long	820 – 821	0.272	5% of incident cases
Fractured patella, tibia or fibula - short-term	822 – 823	0.271	100% of incident cases
Fractured ankle - short-term	824	0.196	100% of incident cases
Fractured foot bones	825 – 826	0.077	100% of incident cases
Other dislocation	830, 833 – 834, 836 - 839	0.074	100% of incident cases
Dislocated shoulder, elbow or hip - short-term	831, 832, 835	0.074	100% of incident cases
Sprains	840 – 848	0.064	100% of incident cases
Intracranial injury - short-term	850 – 854	0.359	95% of incident cases
Intracranial injury - life long	850 – 854	0.350	For ages 60+ the DW is 0.404. 5% of incident cases.
Internal injuries - short-term	860 – 869	0.208	100% of incident cases
Open wound	870, 872 – 884, 890 - 894	0.108	100% of incident cases
Injury to eyes - life long	871, 950	0.301	For ages 5-14 DW is 0.300 and for ages 15+ the DW is 0.298. It 100% of incident cases
Amputated thumb - life long	885	0.165	100% of incident cases
Amputated finger - life long	886	0.102	100% of incident cases
Amputated arm - life long	887	0.257	100% of incident cases
Amputated toe - life long	895	0.102	100% of incident cases
Amputated foot - life long	896, 897.0 – 897.1	0.300	100% of incident cases

Table 3.2. (continued) Disability Weights by Nature of Injury and Age Category (Murray and Lopez 1996).

Nature of injury	ICD9-CM N-Codes	Disability weights	
		Treated	GBD assumptions
Amputated leg - life long	897.2 – 897.3	0.300	100% of incident cases
Crushing - short-term	925 – 929	0.218	100% of incident cases
Burns < 20% - short-term	940 – 947, 948.0 – 948.1	0.158	0% of incident cases
Burns < 20% - life long	940 – 947, 948.0 – 948.1	0.001	100% of incident cases
Burns > 20% and < 60% - short term	948.2 – 948.5	0.441	0% of incident cases
Burns > 20% and < 60% - life long	948.2 – 948.5	0.255	100% of incident cases
Burns > 60% - short-term	948.6 – 948.9	0.441	0% of incident cases
Burns > 60% - life long	948.6 – 948.9	0.255	100% of incident cases
Injured nerves - life long	951, 953 – 957	0.064	100% of incident cases
Poisoning - short-term	960 – 979, 980 – 989	0.611	For ages 15+ the DW is equal to 0.608 100% of incident cases
Residual	900 – 924, 930 – 939	-	Need to be accessed

As an example, in Table 3.2, the weight for poisoning of 0.611 means that, on average, society judges a year of disability arising from an open wound (weight of 0.108) to be preferable to a year of disability due to poisoning. Similarly, a year with a disability resulting from poisoning (weight of 0.611) is considered preferable to a year with disability from a spinal cord injury (weight of 0.725). Note that there are some unexpected disability weights in Table 3.2, such as the extremely low weight of 0.001 for *Burns <20% - life long*; or the high weight of 0.611 for *poisoning*. It is hard to imagine a situation of a person that a year of disability due to poisoning been considered much worse than living an entire year with disability due to burns (note that all disability weights for burns were less than the disability weight for poisoning). Although it is beyond the scope of this study to develop new disability weights for all categories of nature of injury in Table 3.2, we will proceed with the DALY calculation based on the disability weights obtained for the GBD study, and in the discussion of this study we will propose other methods to obtain alternative disability weights.

It was mentioned previously that adjustment of the disability weights for comorbidities was not carried out in this study. However, the data obtained for this study does allow for the identification of individuals with more than one nature of injury (or injury sequela). Therefore, a multiplicative functional form was used to calculate the weights for comorbid injury sequelae (Torrance *et al.* 1995; Torrance 1986; Torrance, Boyle, and Horwood 1982). Consider for example, a person with two injuries (*e.g.*, fractured skull and open wound), with the *DW*s for these sequelae being DW_1 and DW_2. The overall disability weight for this individual is calculated as $DW_{12}=1-(1-DW_1)*(1-DW_2)$. If instead we used an additive functional form, ignoring the dependence between sequelae, the combined disability weight is obtained as $DW_{12}=DW_1+DW_2$, which clearly is a very strong assumption about the level of disability for that person. In addition, the additive functional form is not desirable because it allows for disability weights greater than one (*e.g.*, when a person has several injury sequelae). The overall disability weight for each specific external cause of injury by gender is given in Table 3.3. Note that the disability weights in Table 3.3 are based on a weighted average of the adjusted disability weights for comorbid injury sequelae. A hypothetical example of the worksheet to calculate the disability weights for any external cause of injury is given in the Appendix D.

Table 3.3 Weighted Average Disability Weights for Each Age Group and Gender by Injury External Cause.

Description	Disability weight by age group - Males				
	0 - 19	20 - 39	40 - 64	65 - 79	80+
Road Traffic Accidents	0.262	0.247	0.244	0.260	0.264
Other transport injuries	0.233	0.218	0.218	0.245	0.262
Poisoning	0.625	0.642	0.636	0.620	0.624
Falls	0.224	0.203	0.223	0.270	0.300
Burns/Fires/Scalds	0.022	0.039	0.049	0.053	0.053
Drowning	0.289	0.277	0.216	0.366	0.170
Sports Injuries	0.195	0.137	0.115	0.131	0.158
Natural and environmental factors	0.253	0.249	0.257	0.290	0.324
Machinery injuries	0.144	0.145	0.142	0.134	0.129
Suffocation and foreign bodies	0.218	0.269	0.283	0.198	0.247
Other unintentional injuries‡	0.154	0.147	0.165	0.179	0.200
Suicide and self-inflicted injuries	0.546	0.556	0.598	0.559	0.492
Other intentional injuries	0.249	0.258	0.303	0.334	0.387

Description	Disability weight by age group - Females				
	0 - 19	20 - 39	40 - 64	65 - 79	80+
Road Traffic Accidents	0.262	0.242	0.241	0.247	0.252
Other transport injuries	0.225	0.220	0.224	0.261	0.279
Poisoning	0.631	0.652	0.644	0.625	0.615
Falls	0.220	0.197	0.220	0.272	0.308
Burns/Fires/Scalds	0.025	0.050	0.046	0.060	0.048
Drowning	0.258	0.165	0.185	0.161	0.172
Sports Injuries	0.165	0.130	0.123	0.160	0.197
Natural and environmental factors	0.240	0.264	0.253	0.280	0.215
Machinery injuries	0.126	0.127	0.120	0.161	0.190
Suffocation and foreign bodies	0.282	0.260	0.212	0.245	0.207
Other unintentional injuries‡	0.167	0.124	0.129	0.169	0.227
Suicide and self-inflicted injuries	0.624	0.624	0.648	0.620	0.554
Other intentional injuries	0.401	0.365	0.414	0.419	0.420

‡ Excludes medical adverse events

Based on Table 3.3, note how variable the disability weight is for each combination of gender × age group × external cause of injury. For example, consider the range of disability weights for poisoning and burns/fires/scalds; note that the disability weight for poisoning is in average more

than 11 times higher than the average disability weight for burns/fires/scalds. In order to understand the source of such difference, we present Table 3.4, where the highlighted cells contain the percentage distribution of people in the study population classified according to each combination of gender × injury sequela × disability weight (for nature of injury; see Table 3.2 page 68), and that contributed to more than 50% of the overall disability weight of each external cause of injury.

For example, based on Table 3.4, note that more than 90% of males that had poisoning as external cause of injury received a disability weight equal to 0.608 (primarily due to the injury sequela poisoning), and more than 90% of males that had burns/fires/scalds as external cause of injury received a disability weight equal to 0.001 (primarily due to the injury sequela burns < 20%). Thus, after adjusting for comorbid injury sequelae in the same individual, the overall disability weight for the external cause of injury poisoning in males was 0.633 and for burns/fires/scalds in males was 0.037. In addition, note that for those external causes of injury with similar distribution of injury sequelae for males and females (*e.g.*, natural and environmental factors), the resulting DWs are very similar; whereas for external causes of injury in which the distribution of injury sequela is very different between males and females (*e.g.*, other intentional injuries), the resulting DWs are apparently different.

Table 3.4. Disability Weights (All Ages Combined) for Each Injury Nature by Gender and Injury External Cause.

Injury Sequelae	Average DW (GBD)	External Cause of Injury							
		Road Traffic Accidents		Other transport injuries		Poisoning		Falls	
		M	F	M	F	M	F	M	F
Fractured skull	0.419								
Fractured face bones	0.223								
Fractured vertebral column	0.266			5.6					
Injured spinal cord	0.725								
Fractured rib or sternum	0.199	6.6	7.6						
Fractured pelvis	0.247								
Fractured clavicle, scapula or humerus	0.139		6.2						
Fractured radius or ulna	0.180	5.9	6.6	7.9	8.5			15.0	14.7
Fractured hand bones	0.100								
Fractured femur	0.322				8.1			14.3	29.7
Fractured patella, tibia or fibula	0.271	6.0		7.1	7.3				
Fractured ankle	0.196			7.1	8.4			8.1	9.9
Fractured foot bones	0.077								
Other dislocation	0.074								
Dislocated shoulder, elbow or hip	0.074								
Sprains	0.064								
Intracranial injury	0.367	13.6	12.6	7.0	7.5			8.3	
Internal injuries	0.208	8.8	7.6	7.3					
Open wound	0.108	14.9	12.8	11.9	11.5			7.1	
Injury to eyes	0.298								
Amputated thumb	0.165								
Amputated finger	0.102								
Amputated arm	0.257								
Amputated toe	0.102								
Amputated foot	0.300								
Amputated leg	0.300								
Crushing	0.218								
Burns < 20%	0.001								
Burns > 20% and < 60%	0.255								
Burns > 60%	0.255								
Injured nerves	0.064								
Poisoning	0.608					97.5	98.1		
Weighted Average DW (adjusted to injury sequela)		0.251	0.248	0.224	0.231	0.633	0.637	0.237	0.263

Table 3.4. (continued) Disability Weights (All Ages Combined) for Each Injury Sequela by Gender and Injury External Cause.

Injury Sequelae	Average DW (GBD)	External Cause of Injury							
		Burns/Fires/ Scalds		Drowning		Sports Injuries		Natural and environmental factors	
		M	F	M	F	M	F	M	F
Fractured skull	0.419								
Fractured face bones	0.223								
Fractured vertebral column	0.266								
Injured spinal cord	0.725			10.8					
Fractured rib or sternum	0.199								
Fractured pelvis	0.247								
Fractured clavicle, scapula or humerus	0.139								
Fractured radius or ulna	0.180			9.3					
Fractured hand bones	0.100								
Fractured femur	0.322								
Fractured patella, tibia or fibula	0.271								
Fractured ankle	0.196				11.8	9.4			
Fractured foot bones	0.077								
Other dislocation	0.074					19.3	16.5		
Dislocated shoulder, elbow or hip	0.074								
Sprains	0.064					28.3	34.4		
Intracranial injury	0.367			16.7	23.3				
Internal injuries	0.208								
Open wound	0.108			17.1	18.1			41.1	42.1
Injury to eyes	0.298								
Amputated thumb	0.165								
Amputated finger	0.102								
Amputated arm	0.257								
Amputated toe	0.102								
Amputated foot	0.300								
Amputated leg	0.300								
Crushing	0.218								
Burns < 20%	0.001	91.1	90.8						
Burns > 20% and < 60%	0.255								
Burns > 60%	0.255								
Injured nerves	0.064								
Poisoning	0.608							15.8	14.2
Weighted Average DW (adjusted to injury sequela)		0.037	0.041	0.275	0.221	0.149	0.143	0.258	0.252

Table 3.4. (continued) Disability Weights (All Ages Combined) for Each Injury Sequela by Gender and Injury External Cause.

Injury Sequelae	Average DW (GBD)	External Cause of Injury									
		Machinery injuries		Suffocation and foreign bodies		Other unintentional injuries		Suicide and self-inflicted injuries		Other intentional injuries	
		M	F	M	F	M	F	M	F	M	F
Fractured skull	0.419										
Fractured face bones	0.223									27.0	
Fractured vertebral column	0.266										
Injured spinal cord	0.725										
Fractured rib or sternum	0.199										
Fractured pelvis	0.247										
Fractured clavicle, scapula or humerus	0.139										
Fractured radius or ulna	0.180										
Fractured hand bones	0.100	15.7	11.5			11.4					
Fractured femur	0.322										
Fractured patella, tibia or fibula	0.271										
Fractured ankle	0.196										
Fractured foot bones	0.077										
Other dislocation	0.074										
Dislocated shoulder, elbow or hip	0.074										
Sprains	0.064										
Intracranial injury	0.367									10.0	
Internal injuries	0.208				37.8						
Open wound	0.108	36.1	45.1	22.3	20.5	31.0	39.8			20.5	14.6
Injury to eyes	0.298			48.6							
Amputated thumb	0.165										
Amputated finger	0.102										
Amputated arm	0.257										
Amputated toe	0.102										
Amputated foot	0.300										
Amputated leg	0.300										
Crushing	0.218										
Burns < 20%	0.001										
Burns > 20% and < 60%	0.255										
Burns > 60%	0.255										
Injured nerves	0.064					9.0	14.0				
Poisoning	0.608							75.5	88.1		37.7
Weighted Average DW (adjusted to injury sequela)		0.143	0.129	0.262	0.243	0.155	0.146	0.566	0.629	0.268	0.388

3.3.1.5 Calculating Duration for YLD (*D*)

Duration in this section refers to the average duration of disability measured in years. To calculate the durations required to determine the values of YLD, it is necessary to first distinguish short-term duration from long-term duration (or life long duration - LL) of disability. Table 3.5 displays both types of durations for each of injury considered in the original GBD study (Murray and Lopez 1996). To calculate the life long durations, we used the BC life expectancy of 2001 (see Appendix G). A hypothetical example of a worksheet to calculate the durations for any external cause of injury is given in the Appendix E.

Table 3.5. Duration Assumptions by Type of Injury (Murray and Lopez 1996).

Nature of injury	ICD9-CM N-Codes	Duration (years)	
		Treated	GBD assumptions
Fractured skull - short-term	800 - 801	0.107	85% of incident cases
Fractured skull - life long	800 - 801	LL	15% of incident cases
Fractured face bones	802	0.118	100% of incident cases
Fractured vertebral column - short-term	805	0.140	100% of incident cases
Injured spinal cord - life long	806 and 952	LL	100% of incident cases
Fractured rib or sternum - short-term	807	0.115	100% of incident cases
Fractured pelvis - short-term	808	0.126	100% of incident cases
Fractured clavicle, scapula or humerus - short-term	810 - 812	0.112	100% of incident cases
Fractured radius or ulna - short-term	813	0.112	100% of incident cases
Fractured hand bones	814 - 817	0.070	100% of incident cases
Fractured femur - short-term	820 - 821	0.139	95% of incident cases
Fractured femur - life long	820 - 821	LL	5% of incident cases
Fractured patella, tibia or fibula - short-term	822 - 823	0.090	100% of incident cases
Fractured ankle - short-term	824	0.096	100% of incident cases
Fractured foot bones	825 - 826	0.073	100% of incident cases
Other dislocation	830, 833 - 834, 836 - 839	0.019	100% of incident cases
Dislocated shoulder, elbow or hip - short-term	831, 832, 835	0.035	100% of incident cases

Table 3.5. (continued) Duration Assumptions by Type of Injury (Murray and Lopez 1996).

Nature of injury	ICD9-CM N-Codes	Duration (years)	
		Treated	GBD assumptions
Sprains	840 - 848	0.038	100% of incident cases
Intracranial injury - short-term	850 - 854	0.067	95% of incident cases
Intracranial injury - life long	850 - 854	LL	5% of incident cases.
Internal injuries - short-term	860 - 869	0.042	100% of incident cases
Open wound	870, 872 - 884, 890 - 894	0.024	100% of incident cases
Injury to eyes - life long	871, 950	LL	100% of incident cases
Amputated thumb - life long	885	LL	100% of incident cases
Amputated finger - life long	886	LL	100% of incident cases
Amputated arm - life long	887	LL	100% of incident cases
Amputated toe - life long	895	LL	100% of incident cases
Amputated foot - life long	896, 897.0 - 897.1	LL	100% of incident cases
Amputated leg - life long	897.2 - 897.3	LL	100% of incident cases
Crushing - short-term	925 - 929	0.094	100% of incident cases
Burns < 20% - short-term	940 - 947, 948.0 - 948.1	0.083	0% of incident cases
Burns < 20% - life long	940 - 947, 948.0 - 948.1	LL	100% of incident cases
Burns > 20% and < 60% - short-term	948.2 - 948.5	0.279	0% of incident cases
Burns > 20% and < 60% - life long	948.2 - 948.5	LL	100% of incident cases
Burns > 60% - short-term	948.6 - 948.9	0.279	0% of incident cases
Burns > 60% - life long	948.6 - 948.9	LL	100% of incident cases
Injured nerves - life long	951, 953 - 957	LL	100% of incident cases
Poisoning - short-term	960 - 979, 980 - 989	0.008	100% of incident cases
Residual	900 - 924, 930 - 939	-	Need to be accessed

Note 1: The durations are for all age groups or otherwise indicated.

Note 2: LL stands for life long duration, and it will be calculated based on the life expectancy for British Columbia in 2001, and it is specific to age and gender.

The calculation of BC life expectancies was primarily based on a life table model called the Coale and Demeny West Level 26 (Coale and Guo 1989). First, an abridged life table was calculated using the age groups 0, 1-4, 5-9,..., 80-84, 85+ (see Table G.2 in Appendix G). Life expectancies for the age groups 0-19, 20-39, 40-64, 65-79 and 80+ were then generated by calculating a weighted average of the life expectancies in the abridged life tables. The process is shown in Figure 3.10 and the final life expectancies for BC in 2001 are given in Table 3.6.

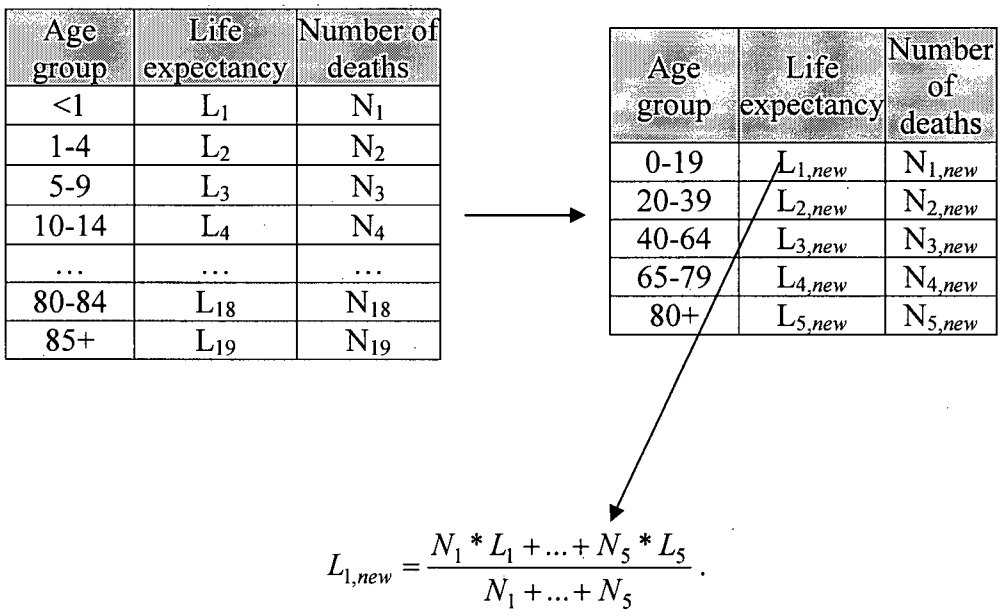


Figure 3.10. Example of How to Calculate the Weighted Life Expectancy.

Table 3.6. Gender and Age Specific Life Expectancies for British Columbia (BC) in 2001.

Age group	Life expectancies BC - 2001	
	Males	Females
0-19	71.62	78.15
20-39	50.21	54.95
40-64	28.75	32.89
65-79	13.89	16.86
80+	7.42	9.00

The final weighted average duration for each external cause of injury is given in Table 3.7.

Table 3.7. Weighted Average Durations for Each Age Group and Gender by Injury External Cause.

Description	Duration by age group - Males				
	0 - 19	20 - 39	40 - 64	65 - 79	80+
Road traffic accidents	1.743	1.832	0.973	0.483	0.258
Other transport injuries	3.332	3.669	2.565	0.620	0.317
Poisoning	0.972	0.666	0.298	0.060	0.039
Falls	1.020	1.400	0.637	0.311	0.178
Burns/fires/scalds	70.415	47.294	26.520	12.869	6.911
Drowning	9.306	7.245	1.049	3.546	0.092
Sports injuries	1.543	0.572	0.359	0.204	0.175
Natural and environmental factors	2.560	2.296	1.611	0.798	0.038
Machinery injuries	16.785	11.819	7.066	4.045	2.628
Suffocation and foreign bodies	25.931	28.652	15.815	1.889	0.899
Other unintentional injuries‡	16.331	11.989	6.900	3.311	1.525
Suicide and self-inflicted injuries	1.212	1.163	0.565	0.213	0.061
Other intentional injuries	1.766	1.653	0.972	0.445	0.443

Description	Duration by age group - Females				
	0 - 19	20 - 39	40 - 64	65 - 79	80+
Road traffic accidents	1.712	1.887	0.946	0.392	0.208
Other transport injuries	6.491	3.195	1.297	0.690	0.437
Poisoning	0.725	0.450	0.103	0.010	0.011
Falls	0.889	0.964	0.380	0.232	0.166
Burns/fires/scalds	76.263	51.097	30.469	15.343	8.466
Drowning	6.567	0.072	0.078	0.084	0.060
Sports injuries	1.065	0.515	0.327	0.330	0.188
Natural and environmental factors	3.245	1.508	1.109	0.390	0.233
Machinery injuries	15.894	15.488	9.407	4.779	1.018
Suffocation and foreign bodies	21.923	13.107	6.781	0.702	1.354
Other unintentional injuries‡	13.970	13.821	8.566	2.682	0.695
Suicide and self-inflicted injuries	0.479	0.637	0.398	0.258	0.146
Other intentional injuries	2.650	1.443	1.018	0.354	0.242

‡ Excludes medical adverse events

Note how different the durations are for each combination of gender × age group × duration (for nature of injury; see Table 3.3 page 76). Observe that the durations for burns/fires/scalds are much higher than the duration of other injuries. The reason for this is because several sequelae under this external cause of injury ended up being classified as life long. Another

example is related to the long average durations (adjusted for comorbid injury sequelae) for males aged 0-19 years for drowning (9.306 years) and suffocation and foreign bodies (25.931 years). To understand the source of such difference we present Table 3.8. This table shows how different the distribution of injury sequelae is for these two external causes of injury; and pay special attention to the proportion of individuals with life long injury sequelae, which explains the differences in the final durations for these two external causes of injury.

Table 3.8. Durations by Injury Sequela for the External Causes of Injury Drowning and Suffocation and Foreign Bodies. Males 0-19 years.

Injury Sequelae	External Cause of Injury			
	Drowning		Suffocation and foreign bodies	
	Distribution (%)	Unadjusted Duration (GBD)	Distribution (%)	Unadjusted Duration (GBD)
Fractured skull - short-term				
Fractured skull - life longs				
Fractured face bones	3.2	0.118	3.2	0.118
Fractured vertebral column - short-term	3.2	0.140		
Injured spinal cord - life long	12.9	71.620		
Fractured rib or sternum - short-term				
Fractured pelvis - short-term				
Fractured clavicle, scapula or humerus - short-term	3.2	0.112	3.2	0.112
Fractured radius or ulna - short-term	9.7	0.112		
Fractured hand bones			1.1	0.070
Fractured femur - short-term	6.1	0.139		
Fractured femur - life long	0.3	71.620		
Fractured patella, tibia or fibula - short-term	3.2	0.090	1.1	0.090
Fractured ankle - short-term	6.5	0.096	1.1	0.096
Fractured foot bones	6.5	0.073		
Other dislocation	9.7	0.019	2.1	0.019
Dislocated shoulder, elbow or hip - short-term			1.1	0.035
Sprains				
Intracranial injury - short-term	13.0	0.067	1.0	0.067
Intracranial injury - life long	1.0	71.620	0.1	71.620
Internal injuries - short-term			11.7	0.042
Open wound	16.1	0.024	37.2	0.024
Injury to eyes - life long			36.2	71.620
Amputated thumb - life long				
Amputated finger - life long				
Amputated arm - life long				
Amputated toe - life long				
Amputated foot - life long				
Amputated leg - life long				
Crushing - short-term				
Burns < 20% - life long				
Burns > 20% and < 60% - life long				
Burns > 60% - life long				
Injured nerves - life long				
Poisoning - short-term			1.1	0.008
Weighted Average Duration (unadjusted to injury sequela)	10.229		25.969	
Weighted Average Duration (adjusted to injury sequela)	9.306		25.931	

3.3.1.6 Residual Category of Injury Sequela

Residual categories are natures of injury with no published disability weights or durations. The residual categories presented in Tables 3.1 are based on the ICD9 N-codes 900-924 (*injury to blood vessels; late effects of injuries, poisonings, toxic effects, and other external causes; superficial injury; contusion with intact skin surface*), 930-939 (*effects of foreign body entering through orifice*), 958-959 *(certain traumatic complications and unspecified injuries*) and 990-999 (*other and unspecified effects of external causes*). Note that the injury ICD9 N-codes included in the residual category are considered in the ICD9 classification system as of secondary importance when compared to the ICD9 N-codes not included in this category.

The recommendation of the WHO regarding the cases of injuries classified according to the categories 900-924 and 930-939 is to distribute these cases proportionately among all other nature of injuries codes for which disability weights or durations have been developed, and then proceed with the calculation of the disability weights and durations for each external cause of injury.

For the nature of injury categories 958-959 and 990-999 there was no clear recommendation from the WHO as to what disability weights to use. For this reason, a sensitivity analysis was conducted to understand how different disability weights assigned to these N-codes influenced the DALYs across different external causes of injury (see Appendix F - "Sensitivity Analysis for Disability Weights for the Residual Category of Injury Sequela"). The disability weights for the residual category of injury were 0, 0.25 and 0.50. This sensitivity analysis demonstrated that using different weights for the ICD9 N-codes

codes 958-959 and 990-999 did not affect the ranking (of importance) of different external causes of injury used in this study. For this reason, zero disability weights for these N-codes were used in this study to calculate the overall disability weight for each external cause of injury.

3.3.1.7 Gender Difference in the Length of Life for Calculating YLL (*L*)

When used to estimate burden of disease, DALYs represent a measure of the gap between a population's health status and some ideal life expectancy. The ideal life expectancy used in this study as a reference when assessing the length of life lost was a life expectancy of 82.5 years at birth for women and a life expectancy of 80 years at birth for men (see Table G.3 in Appendix G). These life expectancies were used in the GBD study and are based on the Japanese population, which in 1990 had the highest life expectancy in the world. The main reason for using the same life expectancy as in the GBD study is to facilitate comparisons across different burden of disease/injury studies. The same process exemplified in the Figure 3.9 was applied in the calculation of Japanese life expectancies for the age groups 0-19, 20-39, 40-64, 65-79 and 80+. The final life expectancies are reported in Table 3.9.

Table 3.9. Japanese Gender and Age Specific Life Expectancies for the Year 1990 Used in the Global Burden of Disease (GBD) Study.

Age group	Life expectancies Japan - 1990	
	Males	Females
0-19	72.16	76.93
20-39	49.49	51.43
40-64	25.52	28.90
65-79	11.53	13.47
80+	4.95	5.55

In summary, the key assumptions and decisions made with respect to estimation of the DALY parameters throughout section 3.3.1 were: a discounting future health rate (r) equal to 3%; age weighting was not utilized; coexisting injury sequelae were adjusted for in the calculation of disability weights (DW) and durations (D); short-term durations were obtained from the original GBD study (Murray and Lopez 1996); life long durations were based on the gender-specific life expectancies for British Columbians in 2001; and the gender-specific life expectancies (L) used in the calculation of years of life lost (YLL) were obtained from the original GBD study (Murray and Lopez 1996). Note that these choices apply to all chapters of this study that deal with DALYs.

3.4 Small-Area Analysis of Disability-Adjusted Life Years (DALY)

This section incorporated Bayesian disease mapping into the calculation of disability-adjusted life years (DALY). From the mortality and hospitalization rates estimated using the linear spatio-temporal Bayesian disease mapping model (3.1) in section 3.2, we calculated the fitted number of deaths (N_{it}) and hospitalizations (I_{it}) separately for the age groups 0-19, 20-39, 40-64, 65-79 and 80+ (j=1,…,5).

After combining the results for the estimated number of hospitalizations (I_{ijt}) and deaths (N_{ijt}) for each age group j (j=1,…,5), the corresponding YLD estimate for each external cause of injury, for the i^{th} HSDA, the j^{th} age group, and the t^{th} year, was derived as:

$$\mathrm{YLD}_{ijt} = I_{ijt} \times DW_j \times \frac{1}{0.03} \times \left(1 - \exp(-0.03 \times D_j)\right) \tag{3.7}$$

where DW_j represents the disability weight and D_j represents the average duration of disability (measured in years) for the j^{th} age group.

The corresponding YLL estimate for each external cause of injury, for the i^{th} HSDA, the j^{th} age group, and the t^{th} year, was derived as:

$$\mathrm{YLL}_{ijt} = N_{ijt} \times \frac{1}{0.03} \times \left(1 - \exp(-0.03 \times L_j)\right) \tag{3.8}$$

where L_j represents the life expectancy (at age of death) for the j^{th} age group.

Therefore the DALY estimate for each external cause of injury, for the i^{th} HSDA, the j^{th} age group, and the t^{th} year, was derived as:

$$DALY_{ijt} = YLL_{ijt} + YLD_{ijt} \quad (3.9)$$

Comparison and inference were based on the following sample posterior summary statistics: posterior mean, posterior standard deviation, posterior median, posterior mode and 0.025 and 0.975 quantiles.

In this study, confidence intervals[1] were derived for the estimates of all health status indicators in Figure 1.1 – mortality and hospitalization rates, YLL, YLD and DALY. Note that Through the use of posterior inference, it is possible to test, for example, whether the indicators of different HSDAs are statistically different; or whether the indicators of a specific HSDA are different than its HA's indicators; or whether the indicators of each HA are statistically different than the provincial indicators; and so on. The confidence intervals for these indicators were based on their respective posterior distributions (see a hypothetical example in Figure 3.11). Thus, the confidence intervals of the indicators that we were interested in comparing were visually inspected to determine if they overlapped; if they did not overlap then the indicator estimates were considered statistically different. Note that multiple-comparison corrections to the level of 5% should be applied when several statistical tests are being performed simultaneously (Rothman and Greenland 1998).

[1] In this thesis, Bayesian confidence sets (or credible intervals) calculated based on the 0.025 and 0.975 quantiles were referred to as the frequentist 95% confidence intervals. We adopted this rule since most readers of this thesis will be familiar with the frequentist notion of confidence intervals.

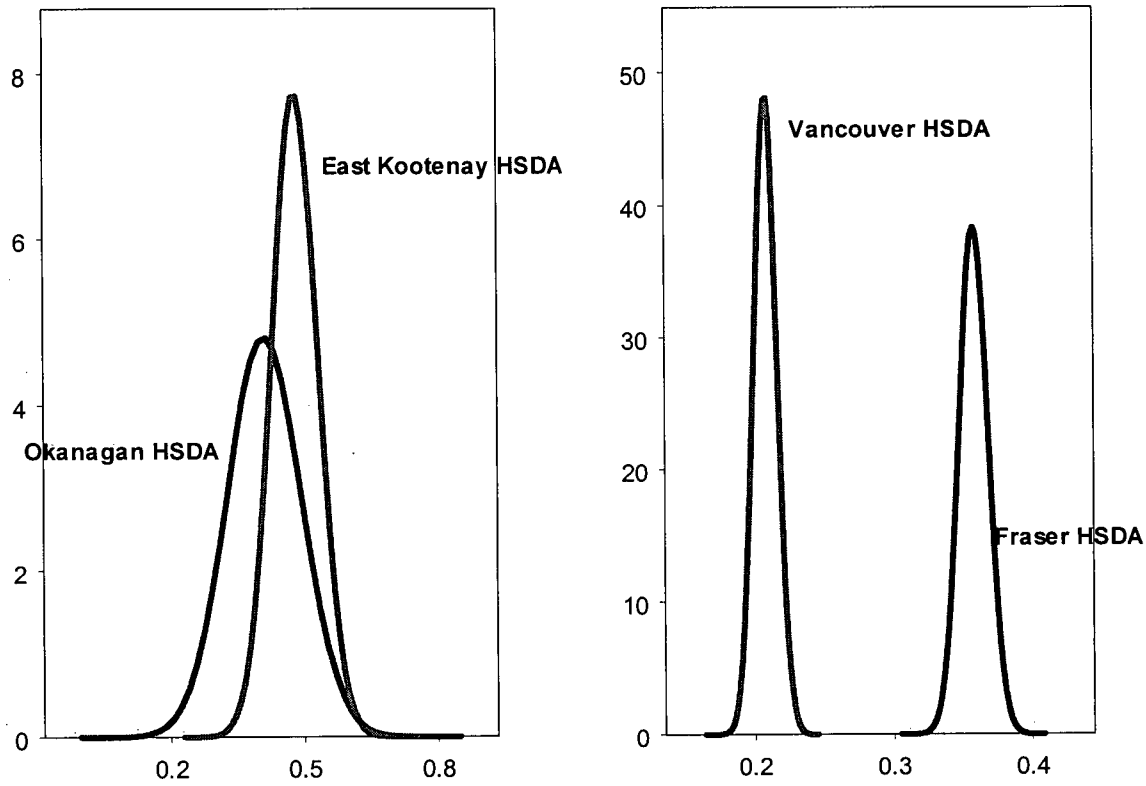


Figure 3.11. Hypothetical Mortality Rate Posterior Distribution Density of Different Health Services Delivery Areas (HSDA).

3.5 Software

We used the software SAS version 8.0 (SAS Institute Inc. 1999), Microsoft Excel 2000 and Microsoft Access 2000 to read the original ASCII data files, clean, explore, manipulate, organize and store the data for all the subsequent analyses. We used the software WinBUGS version 1.4 (Spiegelhalter *et al.* 2003) to run Markov Chain Monte Carlo (MCMC) methods

(using in particular the Gibbs sampling algorithm) to estimate the model parameters in Section 3.2. Convergence of each parameter estimate was assessed using the Gelman-Rubin statistic (Gelman *et al.* 1998; Carlin and Louis 2000) and by plotting the density of each of the MCMC chains of each parameter estimate. Diagnostic plots for the residuals and other plots for the health status indicators were done using the software Splus 2000 (Venables and Ripley 1997). Patterns of the health status indicators at the HSDA level were explored using maps produced by the Geographical Information System (GIS) using ESRI ArcView's ArcMap 8.3 (Environmental Systems Research Institute Inc. 2003).

3.6 Outline of Data Analyses

In this section we explain in more detail how we addressed the main and secondary objectives of this study. The small-area analyses performed in this study controlled for age by analysing the data separately for each age group. The reason we decided to proceed in this way was the difficulty in achieving adequate convergence using MCMC methods (using in particular the Gibbs sampling algorithm) in the software WinBUGS adjusting for the age effect in the statistical model. We believe this problem is due to a slow mixing of our Markov chains largely because of the high-dimension parametric space and high posterior correlation between our different parameters (Bernardinelli and Montomoli 1992).

Per capita measures were obtained using mid-period (1995) population estimates; and age-standardized measures were obtained by direct standardization using as standard

population the 2001 Canadian Census population. For more details on age-standardization and definition of per capita quantities see Glossary in Appendix B.

3.6.1 Burden of Injuries in British Columbia and Its Health Authorities, 1991-2000

Chapter 4 of this study contains the results for all health status indicators (Figure 1.1) at the provincial and health authority levels, during the period 1991-2000 specific to gender, age group, and external cause of injury. The results of each indicator are shown for the 10 years of data aggregated and over time. A detailed explanation of which ICD9-CM E-code categories contributed the most to the DALY of each external cause of injury at the provincial level are summarized in Appendix C.

3.6.2 A Small-Area Analysis of the Incidence of Medical Adverse Events in British Columbia, 1991-2000

Chapter 5 contains the results of the analysis of small-area variation in injury incidence due to medical adverse events using the spatio-temporal Bayesian disease mapping model as described in section 3.2. For illustrational purposes, we present the results of the small-area analysis for the age groups 0-19 years and 65-79 years. It is novel to the literature on medical adverse events to assess the impact of injuries due to AEs among children and youth (ages between 0 and 19 years), at the population level, and over an extensive period of time. In

addition, we present the results for the age group 65-79 years, because this age group had the highest impact of injuries due to AE during the entire study period. The results for the other age groups are presented in Appendix G.

3.6.3 A Small-Area Analysis of the Burden Due To Road Traffic Accidents in British Columbia, 1991-2000

In Chapter 6, we illustrate the small-area analysis of DALY. As opposed to previous sections, we focused our examination on the age group and external cause of injury that contributed most to provincial and community level years of healthy life lost as a result of disability and death; *i.e.,* road traffic accidents, in males and females, between the ages 20 and 39 years.

Chapter 4

Burden of Injuries in British Columbia and Its Health Authorities, 1991-2000

In this chapter, the health status indicators presented in Figure 1.1 were used to assess the burden of injuries from 1991 to 2000 in the province of British Columbia as a whole as well as in its individual health authorities (HA). The injury categories examined in this chapter are shown in Figure 4.1. For a detailed explanation of which ICD9-CM E-code categories contributed the most to the DALY of each external cause of injury please refer to Appendix C. For a description of the method used for standardization of rates and for the calculation of per capita values, please refer to the Glossary in Appendix B.

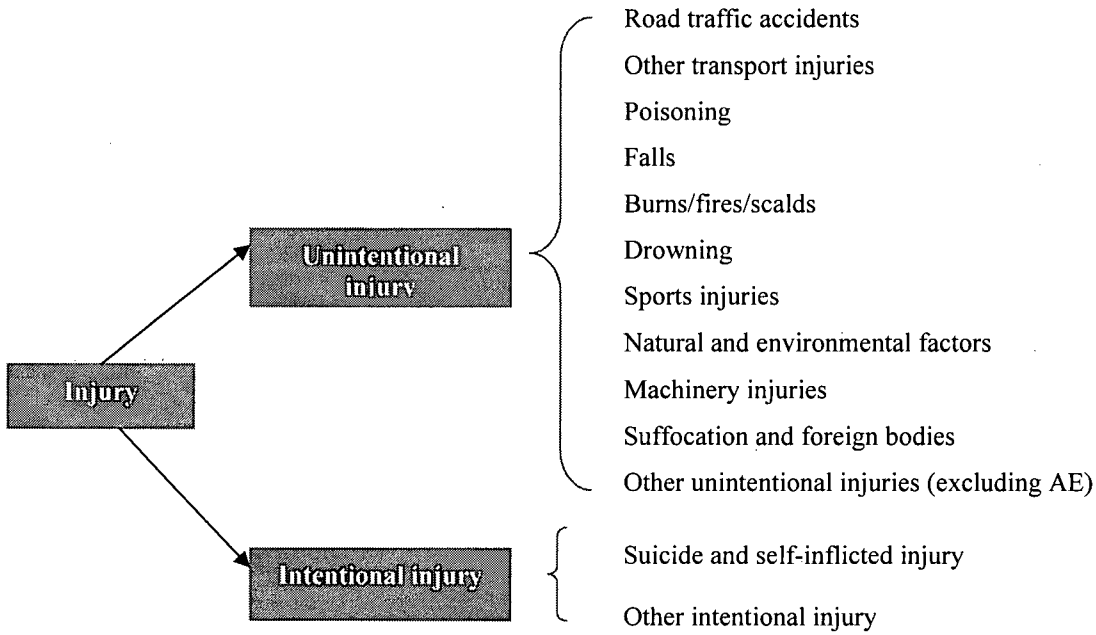


Figure 4.1. Categories of external causes of injury.

4.1 The Provincial Level Analysis

4.1.1 Conventional Mortality and Hospitalization Rates

From 1991 to 2000, injuries, excluding medical AEs, killed nearly 20,500 people in British Columbia; 70% of whom were males. For males, the categories of external cause of injury contributing more than 60% of the total number of deaths were suicide and self-inflicted injuries, road traffic accidents and poisoning (mainly due to drug abuse). For females, falls, road traffic accidents and suicide and self-inflicted injuries contributed to more than 60% of the total number of deaths. Table 4.1 shows the ten-year mortality rate associated with each external cause of injury examined in this study. The injury related mortality rates were remarkably different for males and females and across all age groups. The age group 80+ had the highest injury mortality rate over the 10-year period while the age group 20-39 for males and the age group 65-79 for females had the second highest mortality rates. Observe that for males between the ages 20 and 64 years, the mortality rate due to poisoning during 1991-2000 was much higher than the other age groups. The main mechanism associated with these later deaths was related to drug abuse. Also of note in Table 4.1 is the instability in mortality rates associated with rare events for several external causes of injury such as sports injuries (males and females), natural and environmental factors, other transport injuries, machinery injuries and other external injuries (excluding AE) (females). For example, because the total number of deaths associated with sports injuries (29 deaths for both genders over 10 years) was small, the mortality rate varied considerably depending on the size of the population at risk in each age group.

Table 4.1. Ten-Year Mortality Rates by Gender, Age Group and External Cause of Injury, 1991-2000.

Description	Mortality rate per 10,000 population (1991-2000)				
	Males				
	0 - 19	20 - 39	40 - 64	65 - 79	80+
Road traffic accidents	10.93	22.58	12.88	14.29	31.51
Other transport injuries	1.40	3.92	3.65	2.39	3.78
Poisoning	0.97	24.44	20.60	4.42	2.52
Falls	0.85	2.59	4.39	23.62	202.65
Burns/fires/scalds	0.87	0.83	1.33	2.51	4.28
Drowning	1.64	2.77	1.77	2.27	3.53
Sports injuries	0.08	0.20	0.07	0.12	0.25
Natural and environmental factors	0.14	0.98	1.15	1.02	2.52
Machinery injuries	0.24	1.11	1.38	1.08	0.76
Suffocation and foreign bodies	0.77	0.98	1.38	2.99	13.11
Other unintentional injuries‡	0.47	1.94	2.22	1.20	2.52
Suicide and self-inflicted injuries	4.17	25.72	26.08	22.84	39.32
Other intentional injuries	1.78	7.16	4.76	2.63	2.77
Total	24.30	95.21	81.67	81.38	309.52

Description	Mortality rate per 10,000 population (1991-2000)				
	Females				
	0 - 19	20 - 39	40 - 64	65 - 79	80+
Road traffic accidents	5.57	7.20	5.68	10.84	16.35
Other transport injuries	0.40	0.52	0.40	0.50	0.58
Poisoning	0.56	7.18	5.39	2.50	2.63
Falls	0.29	0.44	1.56	15.53	198.05
Burns/fires/scalds	0.48	0.37	0.58	1.30	3.65
Drowning	0.65	0.28	0.61	0.80	1.46
Sports injuries	0.02	0.03	0.02	0.00	0.29
Natural and environmental factors	0.06	0.27	0.24	0.25	1.02
Machinery injuries	0.02	0.05	0.05	0.10	0.00
Suffocation and foreign bodies	0.33	0.18	0.43	2.30	10.51
Other unintentional injuries‡	0.10	0.20	0.13	0.25	0.44
Suicide and self-inflicted injuries	1.44	6.31	8.14	7.14	8.61
Other intentional injuries	1.71	2.93	2.15	1.65	3.21
Total	11.64	25.97	25.37	43.15	246.80

‡ Excludes medical adverse events

In 1991-2000, over 614,000 hospitalizations were attributable to injuries in British Columbia, of which 58% occurred in males. Falls plus road traffic accidents accounted for 52% of the total number of hospitalizations for males, and 66% of total number of hospitalizations for females. Table 4.2 shows the ten-year hospitalization rate associated with each external cause of injury. The hospitalization rates were different between males and females and across the age groups. In general, males had higher hospitalization rates than females. The age group 80+ had the highest hospitalization rate over the 10-year period, while the age groups 20-39 for males and 65-79 for females had the second highest hospitalization rate.

Table 4.2. Ten-Year Conventional Hospitalization Rates by Gender, Age Group and External Cause of Injury, 1991-2000.

Description	Hospitalization rate per 1,000 population (1991-2000)				
	Males				
	0 - 19	20 - 39	40 - 64	65 - 79	80+
Road traffic accidents	40.5	58.4	34.2	33.2	45.8
Other transport injuries	7.0	9.5	6.0	4.0	4.5
Poisoning	3.5	3.1	2.9	3.9	7.5
Falls	44.5	34.1	45.3	102.4	366.6
Burns/fires/scalds	5.5	3.8	3.3	3.5	5.8
Drowning	0.5	0.1	0.1	0.2	0.2
Sports injuries	16.0	20.7	10.8	4.8	4.8
Natural and environmental factors	2.1	1.9	2.1	1.9	2.8
Machinery injuries	3.0	11.5	10.4	7.4	3.2
Suffocation and foreign bodies	4.4	1.6	2.5	5.8	10.2
Other unintentional injuries[‡]	15.6	26.8	18.4	8.2	7.6
Suicide and self-inflicted injuries	4.7	18.1	11.3	5.2	7.8
Other intentional injuries	10.8	28.2	11.9	4.1	3.8
Total	158.0	217.8	159.2	184.6	470.6

[‡] Excludes medical adverse events

Table 4.2. (continued) Ten-Year Conventional Hospitalization Rates by Gender, Age Group and External Cause of Injury, 1991-2000.

Description	Hospitalization rate per 1,000 population (1991-2000)				
	Females				
	0 - 19	20 - 39	40 - 64	65 - 79	80+
Road traffic accidents	26.8	29.5	22.6	31.3	32.2
Other transport injuries	2.1	2.0	1.5	2.0	3.4
Poisoning	3.0	2.6	2.5	4.4	7.4
Falls	26.2	16.8	37.1	161.2	623.1
Burns/fires/scalds	3.1	1.3	1.5	2.5	5.4
Drowning	0.2	0.0	0.0	0.1	0.1
Sports injuries	5.2	6.7	4.4	4.6	7.9
Natural and environmental factors	1.8	1.1	1.3	1.3	2.3
Machinery injuries	0.7	0.8	0.8	0.5	0.5
Suffocation and foreign bodies	3.5	0.8	1.6	3.5	7.1
Other unintentional injuries‡	6.2	6.4	4.5	3.6	6.7
Suicide and self-inflicted injuries	14.8	28.7	16.2	4.5	4.2
Other intentional injuries	4.2	8.3	4.2	2.7	3.4
Total	97.8	104.9	98.1	222.1	703.7

‡ Excludes medical adverse events

Next we show the annual age-standardized mortality rate (ASMR) per 10,000 population and the annual age-standardized hospitalization rate (ASHR) per 1,000 population associated with road traffic accidents, poisoning (mainly due to drug abuse), falls, suicide and self-inflicted injuries and other intentional injuries during 1991-2000 (Figures 4.2 and 4.3). These five external categories of injury were chosen because, as mentioned above, they accounted for more than 60% of the total number of hospitalizations and deaths for males and females, thus producing annual ASMR and ASHR susceptible to lower chance variation than the other external causes of injury.

The annual ASMRs for the categories falls and other intentional injuries were similar for males and females (see Figure 4.2). The ASMR for falls was slightly higher in females

compared to males. For males, the ASMR of suicide and self-inflicted injuries was consistently higher than the ASMR of road traffic accidents during the entire study period.

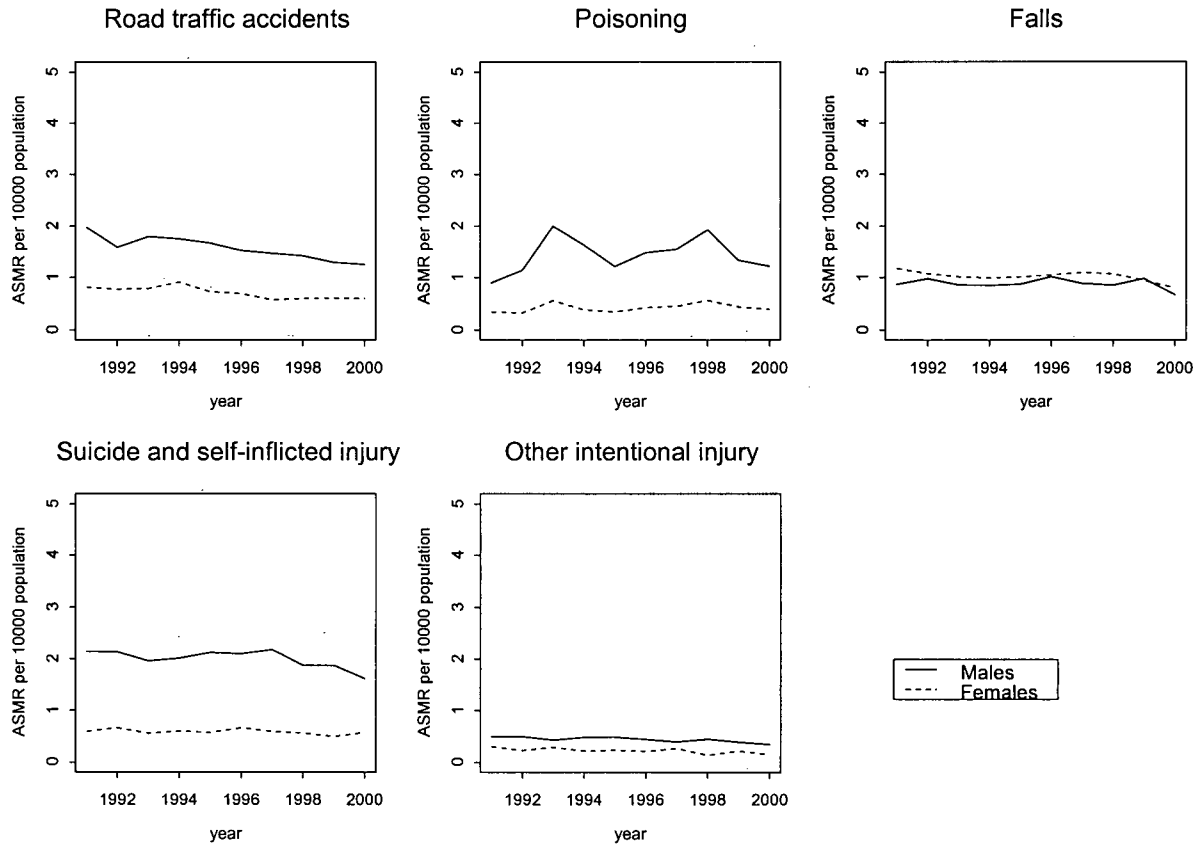


Figure 4.2. Annual Age-Standardized Mortality Rate (ASMR) per 10,000 Population for Males and Females, 1991-2000 (Canada Census 2001).

Over the years, the annual ASHR of suicide and self-inflicted injury, as well as of falls, was higher for females than males (see Figure 4.3). In addition, the annual ASHR for poisoning was very similar for males and females. Note as well that the annual ASHR due to falls was higher than any of the other annual ASHRs.

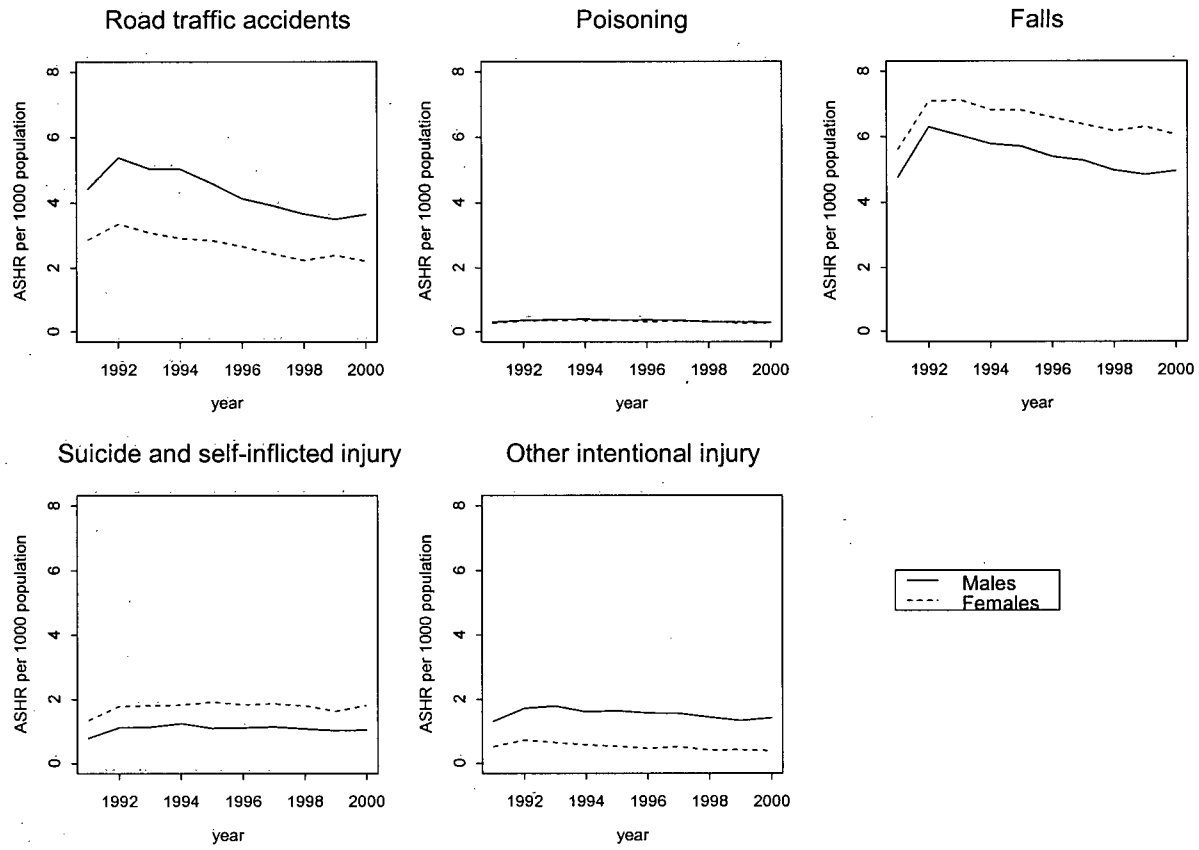


Figure 4.3. Annual Age-Standardized Hospitalization Rate (ASHR) per 1,000 Population for Males and Females, 1991-2000 (Canada Census 2001).

4.1.2 Years of Life Lost (YLL)

Years of life lost or YLL is the mortality component of DALY and is also known as the fatal burden from injury. From 1991 to 2000, fatal injuries were responsible for 287,272 years of life lost in males and 102,737 years of life lost in females, which represents 61% of the DALY for all injuries combined over all age groups for males, and 56% of the DALY for all

injuries combined over all age groups for females. The burden from fatal injuries (YLL) was 2.8 times higher for males than for females in 1991-2000. Suicide and self-inflicted injuries had the highest ten-year burden of the fatal injuries (YLL) experienced by males (27% of all YLL), and road traffic injuries the highest ten-year burden for females (28% of all YLL) (see Table 4.3).

Table 4.3. Total Years of Life Lost (YLL) by Gender, Age and External Cause of Injury, 1991-2000.

Description	YLL (1991-2000)					
	Males					
	0 - 19	20 - 39	40 - 64	65 - 79	80+	All ages
Road traffic accidents	16,318	35,758	12,822	2,329	575	67,802
Other transport injuries	2,095	6,213	3,638	390	69	12,405
Poisoning	1,446	38,697	20,507	721	46	61,418
Falls	1,269	4,099	4,369	3,850	3,697	17,284
Burns/fires/scalds	1,298	1,315	1,320	409	78	4,420
Drowning	2,449	4,383	1,765	370	64	9,032
Sports injuries	118	309	71	19	5	523
Natural and environmental factors	207	1,547	1,141	166	46	3,106
Machinery injuries	354	1,753	1,373	175	14	3,670
Suffocation and foreign bodies	1,151	1,547	1,373	487	239	4,797
Other unintentional injuries‡	708	3,068	2,211	195	46	6,228
Suicide and self-inflicted injuries	6,226	40,734	25,964	3,723	717	77,365
Other intentional injuries	2,656	11,344	4,743	429	51	19,222
Total	36,294	150,768	81,299	13,265	5,647	287,272

‡ Excludes medical adverse events

Table 4.3. (continued) Total Years of Life Lost (YLL) by Gender, Age and External Cause of Injury, 1991-2000.

Description	YLL (1991-2000)					
	Females					
	0 - 19	20 - 39	40 - 64	65 - 79	80+	All ages
Road traffic accidents	8,015	11,269	6,069	2,404	573	28,330
Other transport injuries	570	812	425	111	20	1,939
Poisoning	810	11,243	5,760	554	92	18,460
Falls	420	681	1,662	3,446	6,941	13,150
Burns/fires/scalds	690	577	619	288	128	2,301
Drowning	931	446	657	177	51	2,262
Sports injuries	30	52	19	0	10	112
Natural and environmental factors	90	419	251	55	36	852
Machinery injuries	30	79	58	22	0	189
Suffocation and foreign bodies	480	288	464	510	368	2,110
Other unintentional injuries‡	150	314	135	55	15	671
Suicide and self-inflicted injuries	2,071	9,880	8,698	1,584	302	22,535
Other intentional injuries	2,461	4,586	2,300	366	113	9,826
Total	16,750	40,648	27,118	9,572	8,649	102,737

‡ Excludes medical adverse events

Table 4.4 illustrates the ten-year (*i.e.,* 1991-2000) per capita years of life lost (or per capita YLL) per 1,000 population for the different categories of external causes by gender and age group. Per capita YLL was obtained dividing the YLL by the mid-period (1995) population estimates. For males and females, the age groups 20-39 and 80+, respectively, had the highest ten-year per capita burden from fatal injuries. For falls, the age group 80+ years had a very high ten-year per capita YLL for both genders.

Table 4.4. Ten-Year Per Capita Years of Life Lost (or Per Capita YLL) per 1,000 Population by Gender, Age and External Cause of Injury for 1991-2000.

Description	Per capita YLL per 1,000 population (1991-2000) Males				
	0 - 19	20 - 39	40 - 64	65 - 79	80+
Road traffic accidents	32.24	58.21	22.97	13.93	14.49
Other transport injuries	4.14	10.12	6.52	2.33	1.74
Poisoning	2.86	63.00	36.73	4.31	1.16
Falls	2.51	6.67	7.83	23.02	93.19
Burns/fires/scalds	2.57	2.14	2.36	2.45	1.97
Drowning	4.84	7.14	3.16	2.21	1.62
Sports injuries	0.23	0.50	0.13	0.12	0.12
Natural and environmental factors	0.41	2.52	2.04	0.99	1.16
Machinery injuries	0.70	2.85	2.46	1.05	0.35
Suffocation and foreign bodies	2.27	2.52	2.46	2.91	6.03
Other unintentional injuries‡	1.40	4.99	3.96	1.17	1.16
Suicide and self-inflicted injuries	12.30	66.32	46.51	22.26	18.08
Other intentional injuries	5.25	18.47	8.50	2.56	1.27
Total	71.70	245.45	145.63	79.32	142.33

Description	Per capita YLL per 1,000 population (1991-2000) Females				
	0 - 19	20 - 39	40 - 64	65 - 79	80+
Road traffic accidents	16.72	18.87	10.98	12.01	8.36
Other transport injuries	1.19	1.36	0.77	0.55	0.30
Poisoning	1.69	18.82	10.42	2.77	1.34
Falls	0.88	1.14	3.01	17.21	101.30
Burns/fires/scalds	1.44	0.97	1.12	1.44	1.87
Drowning	1.94	0.75	1.19	0.89	0.75
Sports injuries	0.06	0.09	0.03	0.00	0.15
Natural and environmental factors	0.19	0.70	0.45	0.28	0.52
Machinery injuries	0.06	0.13	0.10	0.11	0.00
Suffocation and foreign bodies	1.00	0.48	0.84	2.55	5.37
Other unintentional injuries‡	0.31	0.53	0.24	0.28	0.22
Suicide and self-inflicted injuries	4.32	16.54	15.73	7.91	4.40
Other intentional injuries	5.13	7.68	4.16	1.83	1.64
Total	34.93	68.05	49.05	47.81	126.23

‡ Excludes medical adverse events

Next we show the trend in the annual age-standardized per capita YLL (ASYLL) per 1,000 population for each external cause of injury during 1991-2000 (Figure 4.4). The categories of external causes of injuries presented in Figure 4.4 are the same as in Figures 4.2 and 4.3.

Figure 4.4. Annual Age-Standardized Per Capita YLL (ASYLL) per 1,000 Population for Males and Females, 1991-2000 (Canada Census 2001).

The gender difference in the annual ASYLL for falls and other intentional injuries were relatively small compared to injury the categories suicide and self-inflicted injuries, poisoning and road traffic accidents where the gender difference is more pronounced. It is also worth noting that the ASYLL for road traffic accidents in males has decreased

considerably since 1991. In addition, note the bimodality of the ASYLL trend for poisoning in males and females during 1991-2000.

4.1.3 Healthy Years Lost Due To Disability (YLD)

Healthy years lost due to disability or YLD is the disability component of DALY and is also known as the non-fatal burden from injury. From 1991 to 2000, non-fatal injuries were responsible for 182,416 healthy years lost due to disability in males, and 79,260 healthy years lost due to disability in females, which translates into 39% of the DALY for all injuries and ages combined for males, and 44% of the DALY for all injuries and ages combined for females. The burden from non-fatal injuries (YLD) was 2.3 times higher for males than the YLD for females in 1991-2000. For males, other unintentional injuries (excluding AE) had the highest ten-year burden from non-fatal injuries (28% of all YLD), followed by road traffic accidents (16.5% of all YLD). For females road traffic accidents had the highest ten-year non-fatal burden (21.4% of all YLD), followed by other unintentional injuries (excluding AE) (17.4% of all YLD) (see Table 4.5).

It is important to mention that the higher YLD for the category other unintentional injuries (excluding AE) was primary due to the ICD9 E-codes (a) E916.0: struck accidentally by falling object such as: rock, snowslide (nowhere else specified), stone, tree, object falling from machine not in operation or from stationary vehicle; (b) E917.9: struck accidentally by an air rifle; (c) E918.0: caught accidentally in or between objects; (d) E920.3, E920.8: cutting and piercing instruments or objects mainly: knives, swords and daggers, and other cutting

and piercing objects (*e.g.*, broken glass, nail, tin can lid, splinter, etc.); and (e) E929.8: late effect of other accidents (nowhere else specified).

Table 4.5. Total Healthy Years Lost Due To Disability (YLD) by Gender, Age and External Cause of Injury, 1991-2000.

Description	YLD (1991-2000)					
	Males					
	0 - 19	20 - 39	40 - 64	65 - 79	80+	All ages
Road traffic accidents	9,129	15,767	4,468	691	123	30,178
Other transport injuries	2,598	4,403	1,800	100	15	8,916
Poisoning	1,050	802	309	24	7	2,193
Falls	5,051	5,835	3,549	1,429	775	16,639
Burns/fires/scalds	1,799	2,305	1,657	333	76	6,170
Drowning	551	139	18	42	0	750
Sports injuries	2,385	986	247	21	5	3,644
Natural and environmental factors	673	634	467	73	1	1,848
Machinery injuries	2,900	10,177	5,268	634	41	19,021
Suffocation and foreign bodies	8,705	4,977	4,943	351	88	19,064
Other unintentional injuries‡	15,751	24,395	10,546	771	89	51,552
Suicide and self-inflicted injuries	1,548	7,078	2,117	104	9	10,856
Other intentional injuries	2,332	7,193	1,931	102	26	11,584
Total	54,474	84,691	37,318	4,676	1,257	182,416

Table 4.5. (continued) Total Healthy Years Lost Due To Disability (YLD) by Gender, Age and External Cause of Injury, 1991-2000.

Description	YLD (1991-2000)					
	Females					
	0 - 19	20 - 39	40 - 64	65 - 79	80+	All ages
Road traffic accidents	5,611	7,807	2,813	603	115	16,949
Other transport injuries	1,322	812	240	73	28	2,475
Poisoning	660	447	92	6	4	1,208
Falls	2,421	1,879	1,709	2,030	2,182	10,221
Burns/fires/scalds	1,112	981	744	365	133	3,335
Drowning	160	0.2	0.3	0.2	0.1	161
Sports injuries	435	264	97	49	20	865
Natural and environmental factors	645	255	196	28	8	1,132
Machinery injuries	523	773	427	73	6	1,802
Suffocation and foreign bodies	7,631	1,323	1,122	120	134	10,330
Other unintentional injuries‡	5,657	5,355	2,393	311	72	13,788
Suicide and self-inflicted injuries	2,107	6,751	2,293	142	23	11,317
Other intentional injuries	2,047	2,561	967	79	23	5,677
Total	30,330	29,209	13,095	3,878	2,749	79,260

‡ Excludes medical adverse events

Table 4.6 contains the ten-year per capita healthy years lost due to disability (or per capita YLD) per 1,000 population for different categories of external causes by gender and age group. For males and females, the age groups 20-39 and 0-19, respectively, had the highest ten-year per capita burden from non-fatal injuries (see Table 4.6).

Table 4.6. Ten-Year Per Capita Healthy Years Lost Due To Disability (or Per Capita YLD) per 1,000 Population by Gender, Age and External Cause of Injury for 1991-2000.

Description	Per capita YLD per 1,000 population (1991-2000) Males				
	0 - 19	20 - 39	40 - 64	65 - 79	80+
Road traffic accidents	18.04	25.67	8.00	4.13	3.11
Other transport injuries	5.13	7.17	3.22	0.60	0.37
Poisoning	2.07	1.31	0.55	0.14	0.18
Falls	9.98	9.50	6.36	8.54	19.54
Burns/fires/scalds	3.55	3.75	2.97	1.99	1.92
Drowning	1.09	0.23	0.03	0.25	0.00
Sports injuries	4.71	1.60	0.44	0.13	0.13
Natural and environmental factors	1.33	1.03	0.84	0.44	0.03
Machinery injuries	5.73	16.57	9.44	3.79	1.04
Suffocation and foreign bodies	17.20	8.10	8.85	2.10	2.23
Other unintentional injuries‡	31.12	39.72	18.89	4.61	2.25
Suicide and self-inflicted injuries	3.06	11.52	3.79	0.62	0.23
Other intentional injuries	4.61	11.71	3.46	0.61	0.65
Total	107.62	137.88	66.85	27.96	31.69

Description	Per capita YLD per 1,000 population (1991-2000) Females				
	0 - 19	20 - 39	40 - 64	65 - 79	80+
Road traffic accidents	11.70	13.07	5.09	3.01	1.68
Other transport injuries	2.76	1.36	0.43	0.36	0.41
Poisoning	1.38	0.75	0.17	0.03	0.05
Falls	5.05	3.15	3.09	10.14	31.84
Burns/fires/scalds	2.32	1.64	1.35	1.82	1.94
Drowning	0.33	0.00	0.00	0.00	0.00
Sports injuries	0.91	0.44	0.18	0.24	0.29
Natural and environmental factors	1.35	0.43	0.35	0.14	0.11
Machinery injuries	1.09	1.29	0.77	0.36	0.09
Suffocation and foreign bodies	15.92	2.22	2.03	0.60	1.95
Other unintentional injuries‡	11.80	8.96	4.33	1.56	1.05
Suicide and self-inflicted injuries	4.39	11.30	4.15	0.71	0.34
Other intentional injuries	4.27	4.29	1.75	0.39	0.34
Total	63.26	48.90	23.68	19.37	40.11

‡ Excludes medical adverse events

Figure 4.5 shows the annual trends in age-standardized per capita YLD (ASYLD) per 1,000 population for the same injury categories described in Figures 4.2 through 4.4.

Figure 4.5. Annual Age-Standardized Per Capita Healthy Years Lost Due To Disability (ASYLD) per 1,000 population for Males and Females, 1991-2000 (Canada Census 2001).

The annual ASYLD of suicide and self-inflicted injury for most years in 1991-2000 was slightly higher for females than males. The annual ASYLD for poisoning (mainly due to drug abuse) was very similar for males and females, and it was much lower than the ASYLD of the other external causes of injury. In addition, the ASYLD of road traffic accidents, for both males and females, has been decreasing significantly since 1991.

4.1.4 Disability-Adjusted Life Years (DALY)

The total burden due to injury (or lost years of healthy life) was assessed by calculating DALY via the formula DALY=YLD+YLL. From 1991 to 2000, fatal and non-fatal injuries were responsible for 469,688 lost years of healthy life in males and 181,997 lost years of healthy life in females. The total burden from injuries (DALY) was 2.6 times higher for males than the DALY for females in 1991-2000. Road traffic accidents represented the highest ten-year total burden from injuries (DALY) for males (21% of all DALY) and females (25% of all DALY). Suicide and self-inflicted injuries had the second highest ten-year DALY for both males and females (see Table 4.7).

Table 4.7. Total Disability Adjusted Life Years (DALY) by Gender, Age and External Cause of Injury, 1991-2000.

Description	DALY (1991-2000) Males					
	0 - 19	20 - 39	40 - 64	65 - 79	80+	All ages
Road traffic accidents	25,447	51,525	17,289	3,020	698	97,980
Other transport injuries	4,693	10,616	5,438	490	84	21,321
Poisoning	2,496	39,500	20,817	745	53	63,611
Falls	6,320	9,934	7,918	5,279	4,472	33,923
Burns/fires/scalds	3,098	3,620	2,976	742	154	10,590
Drowning	3,000	4,522	1,783	412	64	9,782
Sports injuries	2,503	1,295	319	41	10	4,167
Natural and environmental factors	880	2,181	1,608	239	47	4,955
Machinery injuries	3,254	11,930	6,641	810	55	22,690
Suffocation and foreign bodies	9,856	6,524	6,316	838	327	23,861
Other unintentional injuries‡	16,459	27,463	12,757	966	135	57,781
Suicide and self-inflicted injuries	7,774	47,812	28,081	3,827	727	88,221
Other intentional injuries	4,988	18,537	6,674	531	76	30,806
Total	90,768	235,459	118,616	17,941	6,904	469,688

‡ Excludes medical adverse events

Table 4.7. (continued) Total Disability Adjusted Life Years (DALY) by Gender, Age and External Cause of Injury, 1991-2000.

Description	DALY (1991-2000)					
	Females					
	0 - 19	20 - 39	40 - 64	65 - 79	80+	All ages
Road traffic accidents	13,625	19,077	8,883	3,007	688	45,280
Other transport injuries	1,892	1,624	666	183	49	4,414
Poisoning	1,471	11,690	5,852	559	96	19,668
Falls	2,841	2,561	3,371	5,476	9,122	23,371
Burns/fires/scalds	1,802	1,557	1,363	653	261	5,636
Drowning	1,091	446	657	177	51	2,423
Sports injuries	465	316	117	49	30	977
Natural and environmental factors	735	674	448	83	44	1,984
Machinery injuries	553	852	485	95	6	1,991
Suffocation and foreign bodies	8,111	1,611	1,586	630	502	12,440
Other unintentional injuries‡	5,807	5,669	2,529	367	87	14,459
Suicide and self-inflicted injuries	4,178	16,631	10,991	1,727	325	33,852
Other intentional injuries	4,508	7,148	3,267	444	136	15,503
Total	47,080	69,857	40,213	13,450	11,397	181,997

‡ Excludes medical adverse events

Table 4.8 contains the ten-year per capita DALY per 1,000 population for each of the different categories of external causes of injury by gender and age group. The age groups 20-39 for males and 80+ for females were found to have the highest ten-year per capita total burden from injuries. For every 1,000 people monitored over 10 years (*i.e.*, 10,000 years of life observed), 383.33 DALYs (*i.e.*, approximately 383 lost years of healthy life due to injury) were lost for males in the age group 20-39 years, and 166.34 DALYs (*i.e.*, approximately 166 lost years of healthy life due to injury) were lost for females in the age group 80+ years.

Table 4.8. Ten-Year Per Capita Disability-Adjusted Life Years (DALY) per 1,000 Population by Gender, Age and External Cause of Injury for 1991-2000.

Description	Per capita DALY per 1,000 population (1991-2000)				
	Males				
	0 - 19	20 - 39	40 - 64	65 - 79	80+
Road traffic accidents	50.27	83.88	30.97	18.06	17.60
Other transport injuries	9.27	17.28	9.74	2.93	2.11
Poisoning	4.93	64.31	37.29	4.46	1.34
Falls	12.49	16.17	14.18	31.57	112.73
Burns/fires/scalds	6.12	5.89	5.33	4.44	3.89
Drowning	5.93	7.36	3.19	2.46	1.63
Sports injuries	4.95	2.11	0.57	0.24	0.25
Natural and environmental factors	1.74	3.55	2.88	1.43	1.19
Machinery injuries	6.43	19.42	11.90	4.84	1.39
Suffocation and foreign bodies	19.47	10.62	11.31	5.01	8.25
Other unintentional injuries‡	32.52	44.71	22.85	5.78	3.41
Suicide and self-inflicted injuries	15.36	77.84	50.30	22.89	18.31
Other intentional injuries	9.85	30.18	11.96	3.18	1.92
Total	179.33	383.33	212.48	107.28	174.02

Description	Per capita DALY per 1,000 population (1991-2000)				
	Females				
	0 - 19	20 - 39	40 - 64	65 - 79	80+
Road traffic accidents	28.42	31.94	16.07	15.02	10.04
Other transport injuries	3.95	2.72	1.20	0.92	0.71
Poisoning	3.07	19.57	10.58	2.79	1.40
Falls	5.93	4.29	6.10	27.35	133.14
Burns/fires/scalds	3.76	2.61	2.46	3.26	3.81
Drowning	2.27	0.75	1.19	0.89	0.75
Sports injuries	0.97	0.53	0.21	0.24	0.44
Natural and environmental factors	1.53	1.13	0.81	0.42	0.64
Machinery injuries	1.15	1.43	0.88	0.47	0.09
Suffocation and foreign bodies	16.92	2.70	2.87	3.15	7.33
Other unintentional injuries‡	12.11	9.49	4.57	1.83	1.28
Suicide and self-inflicted injuries	8.71	27.84	19.88	8.62	4.75
Other intentional injuries	9.40	11.97	5.91	2.22	1.98
Total	98.19	116.95	72.73	67.17	166.34

‡ Excludes medical adverse events

Figure 4.6 (see below) illustrates the annual trend in age-standardized per capita DALY (ASDALY) per 1,000 population during 1991-2000 for the same injury categories as those presented in previous sections examining ASMR, ASHR, ASYLD and ASYLL. Note that the pattern of the annual ASDALY for each injury category was very similar to the pattern of the ASYLL, and for all these injuries, the annual ASDALY was higher in males than in females. The difference in the annual ASDALY between males and females was the highest for suicide and self-inflicted injury followed by road traffic accidents (see Figure 4.6).

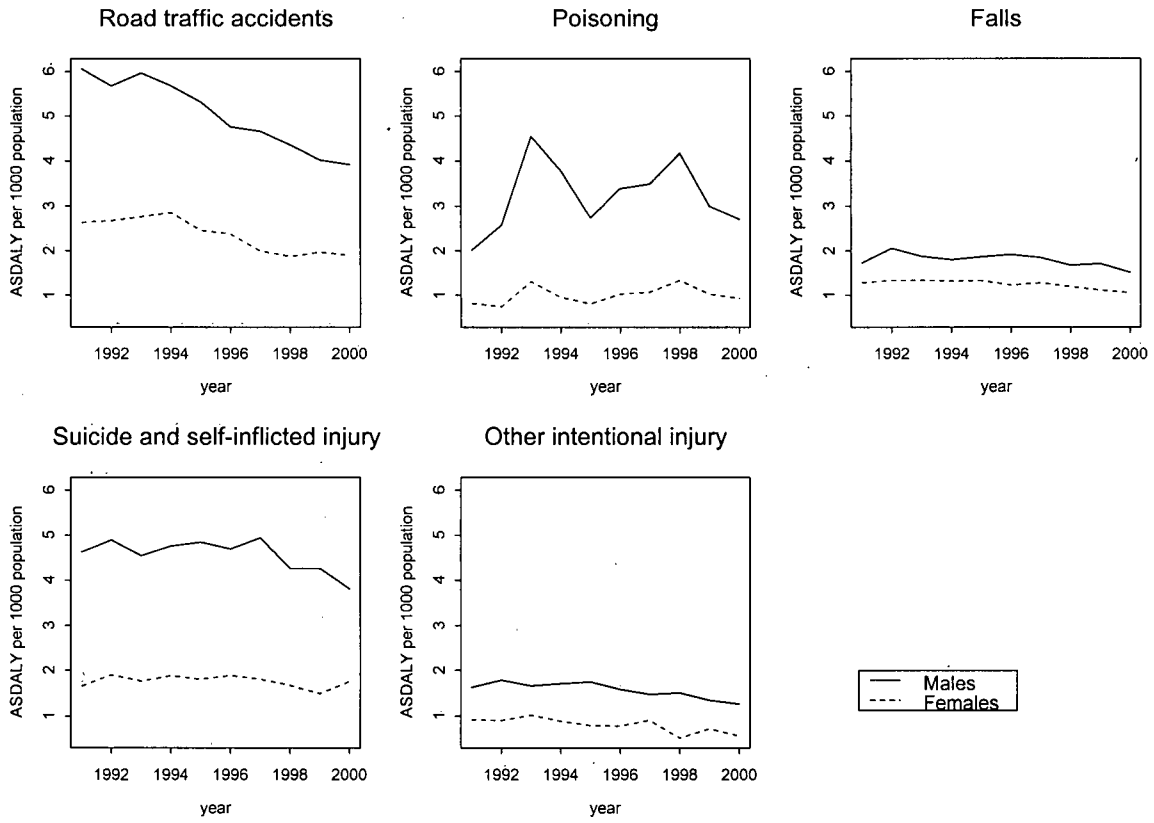


Figure 4.6. Annual Age-Standardized Per Capita DALY (ASDALY) per 1,000 Population for Males and Females, 1991-2000 (Canada Census 2001).

4.1.5 Comparison of Contributions Associated With YLD and YLL (Ten-Year Combined)

To compare the relative contributions of YLD and YLL to DALY totals, we calculated the percent contribution of the non-fatal burden to the total burden from injuries $\left(i.e., 100 \times \frac{\text{YLD}}{\text{DALY}}\right)$ by gender, age group and external cause of injury for ten years of data (see Table 4.9). This percentage-based approach is different than that used in the WHO GBD study, which relied on an assessment of the ratio $\frac{YLD}{YLL}$ instead. However, because the YLL for some injuries was equal to zero, it was not possible to adopt the ratio-based approach in this study.

Table 4.9. Percent Contribution of YLD to DALY (Ten-Year Combined) by Gender, Age and External Cause of Injury, 1991-2000.

Description	% of YLD contribution to DALY (1991-2000)					
	Males					
	0 - 19	20 - 39	40 - 64	65 - 79	80+	All ages
Road traffic accidents	35.9	30.6	25.8	22.9	17.7	30.8
Other transport injuries	**55.4**	41.5	33.1	20.4	17.6	41.8
Poisoning	42.1	2.0	1.5	3.2	13.5	3.4
Falls	**79.9**	**58.7**	44.8	27.1	17.3	49.0
Burns/fires/scalds	**58.1**	**63.7**	**55.7**	44.8	49.3	**58.3**
Drowning	18.4	3.1	1.0	10.1	0.2	7.7
Sports injuries	**95.3**	**76.1**	**77.6**	**52.4**	**53.5**	**87.5**
Natural and environmental factors	**76.5**	29.1	29.0	30.7	2.9	37.3
Machinery injuries	**89.1**	**85.3**	**79.3**	**78.3**	**75.0**	**83.8**
Suffocation and foreign bodies	**88.3**	**76.3**	**78.3**	41.9	27.0	**79.9**
Other unintentional injuries‡	**95.7**	**88.8**	**82.7**	**79.8**	**66.0**	**89.2**
Suicide and self-inflicted injuries	19.9	14.8	7.5	2.7	1.3	12.3
Other intentional injuries	46.8	38.8	28.9	19.3	33.7	37.6
Total	**60.0**	36.0	31.5	26.1	18.2	38.8

Description	% of YLD contribution to DALY (1991-2000)					
	Females					
	0 - 19	20 - 39	40 - 64	65 - 79	80+	All ages
Road traffic accidents	41.2	40.9	31.7	20.0	16.7	37.4
Other transport injuries	**69.9**	**50.0**	36.1	39.6	**58.1**	**56.1**
Poisoning	44.9	3.8	1.6	1.0	3.7	6.1
Falls	**85.2**	**73.4**	**50.7**	37.1	23.9	43.7
Burns/fires/scalds	**61.7**	**63.0**	**54.6**	**55.9**	**51.0**	**59.2**
Drowning	14.7	0.1	0.1	0.1	0.1	6.6
Sports injuries	**93.5**	**83.4**	**83.4**	**100.0**	**66.2**	**88.5**
Natural and environmental factors	**87.8**	37.8	43.9	33.4	17.8	**57.1**
Machinery injuries	**94.6**	**90.8**	**88.0**	**76.6**	**100.0**	**90.5**
Suffocation and foreign bodies	**94.1**	**82.1**	**70.7**	19.1	26.6	**83.0**
Other unintentional injuries‡	**97.4**	**94.5**	**94.6**	**84.9**	**82.4**	**95.4**
Suicide and self-inflicted injuries	**50.4**	40.6	20.9	8.2	7.2	33.4
Other intentional injuries	45.4	35.8	29.6	17.7	17.1	36.6
Total	**64.4**	41.8	32.6	28.8	24.1	43.6

‡ Excludes medical adverse events

The shaded cells in Table 4.9 highlight injury types with percentages of YLD > YLL. Note that in page 102 we explained which type of injury belongs to the category other unintentional injuries (excluding AE). Figures 4.7 and 4.8 contain plots of the percent contribution of YLD to DALY (ten-year combined) for each external cause of injury by age group for men and women. The detailed explanation of each external cause of injury in Figures 4.7 and 4.8 is presented in the Glossary in Appendix B.

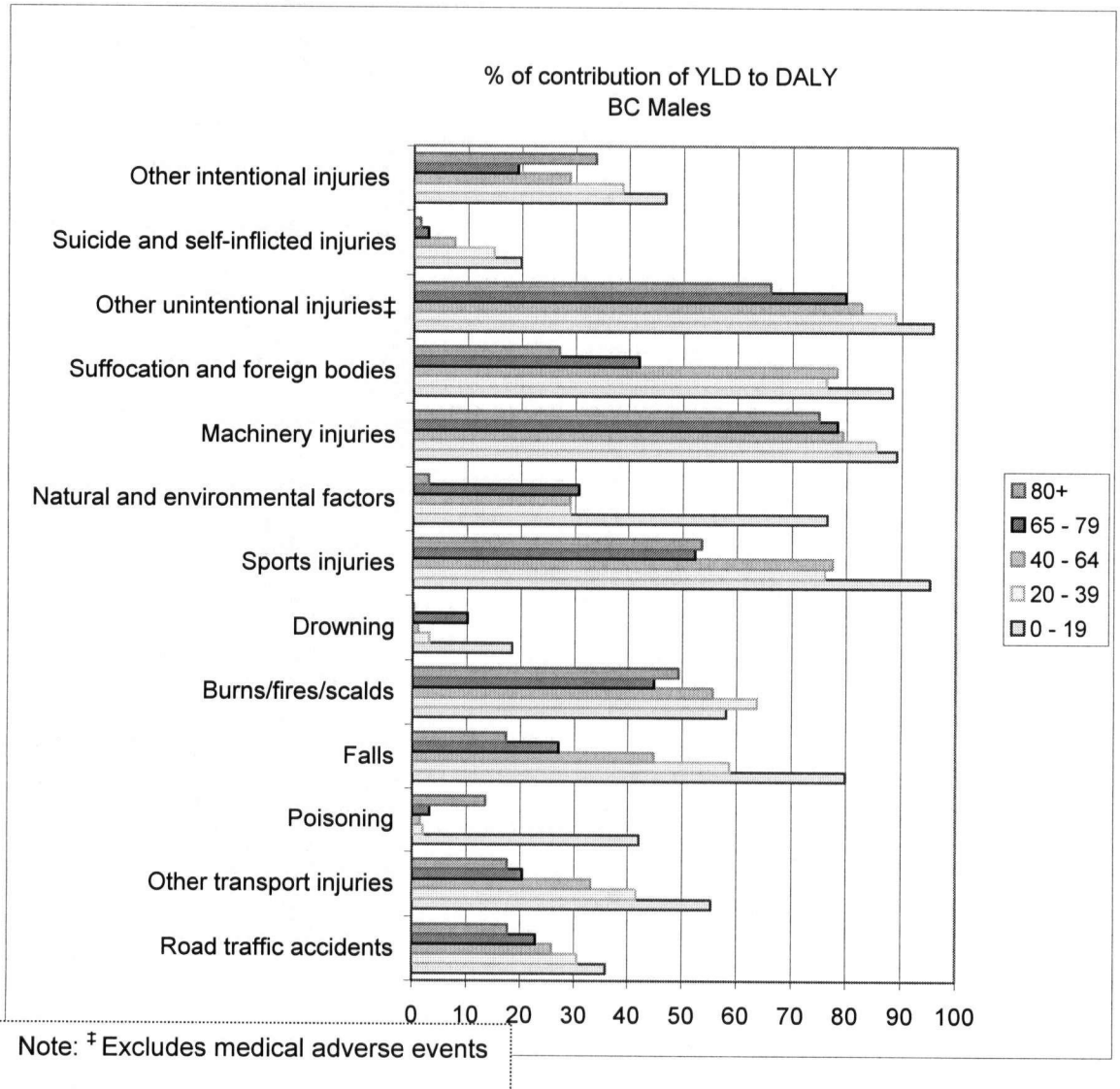


Figure 4.7. Percent Contribution of YLD to DALY (Ten-Year Combined) by Age and External Cause of Injury for Males, 1991-2000.

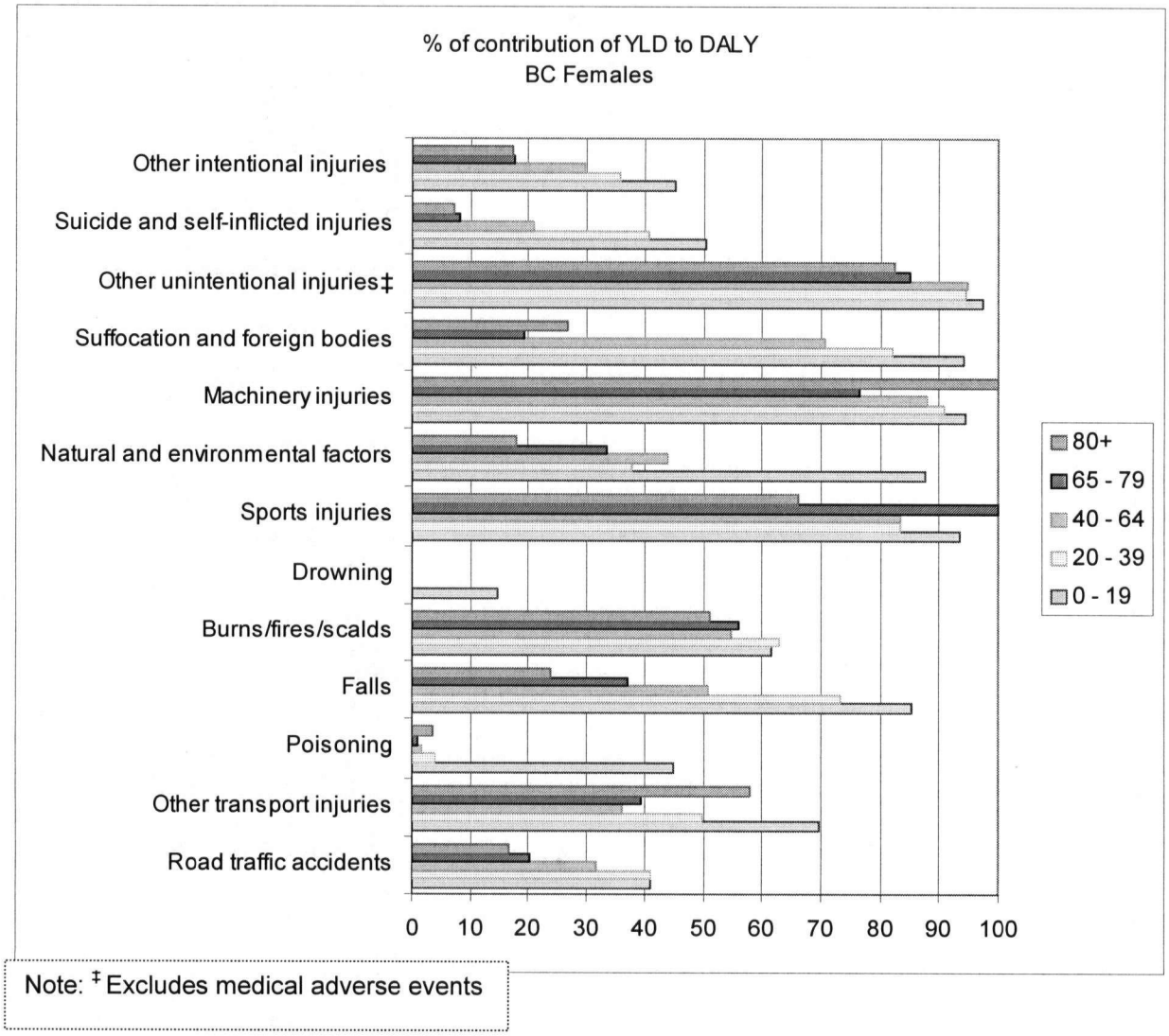


Figure 4.8. Percent Contribution of YLD to DALY (Ten-Year Combined) by Age and External Cause of Injury for Females, 1991-2000.

In summary, the preceding results indicated that the burden imposed by fatal and non-fatal injuries had very different age structures, and varied across gender and external cause of injuries. In addition, considering all external causes, the fatal burden of injuries (*i.e.*, YLL) contributed the most to the total burden (DALY) from injuries in both males (61.2%) and females (56.4%).

4.1.6 Comparison of All Health Status Indicators (Ten-Year Combined)

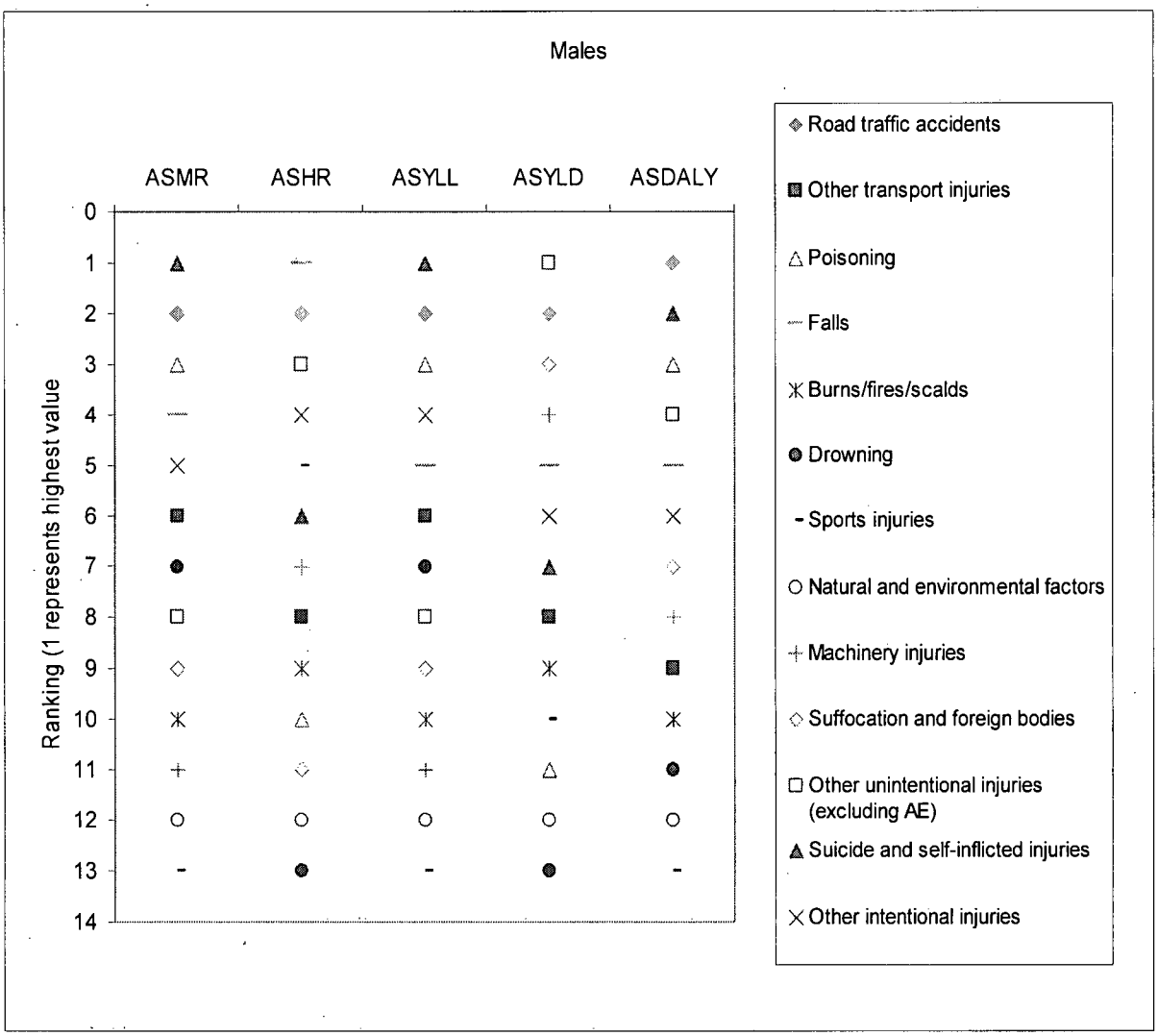
In this section of the study, the relative rankings of the external causes of injury (*i.e.*, from highest value (1) to lowest value (13)) are presented for each health status indicator by gender for the period 1991-2000 (see Figures 4.9 and 4.10).

From Figures 4.9 and 4.10, it can be seen that for males in BC, suicide and self-inflicted injuries and falls had the highest ASMR and ASHR, respectively. For females, falls had both the highest ASMR and ASHR. For both males and females, road traffic accidents had the highest total burden from injuries (ASDALY), and the second highest ASMR and ASHR. These results indicate that the injury identified as having the largest impact on the health of the BC population changes depending on which health status indicator is examined.

The variation in the ranking of different external causes of injury reveals important areas of inequality in health status, since each health status indicator provide different information about the impact of injury in a population. DALY quantifies *how many years* a given population has lost due to premature death and disability resulted from an injury, in addition to provide information on the relative importance of mortality and morbidity in the total burden of each external cause of injury. This information can be useful to identify areas of larger health gains from interventions directed at reducing the overall burden of injury (*e.g.*, when deciding among different interventions for different external causes of injury, which intervention will produce the larger DALY gain per dollar spent?). In contrast, rates quantify the scale of the problem by measuring *how many people* have died or been hospitalized in a given time period due to injury. This information can be useful for service

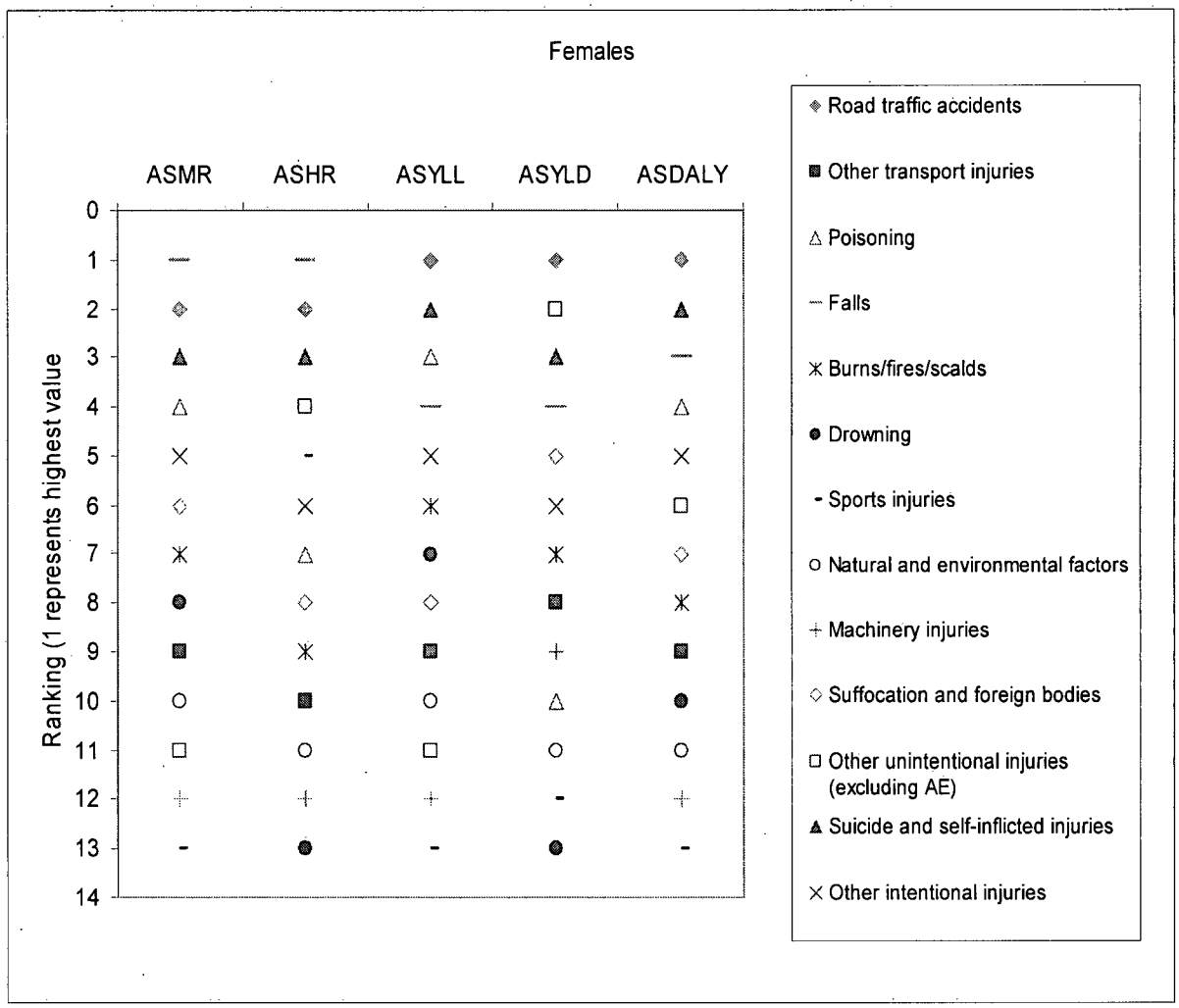
planning and evaluate coverage of current services (*e.g.*, are the available number of hospital beds sufficient for the demand?).

For example, consider the ranking of falls and road traffic accidents for females according to the five different health status indicators in Figure 4.10. Note that falls had the highest ASMR and ASHR, whereas road traffic accidents had the highest ASYLL, ASYLD and ASDALY during 1991-2000. It is important to mention that this change in ranking is due to the assumptions made about the quantities life expectancy, disability weights, durations and discounting rate necessary to calculate YLL, YLD and DALY; and also to the fact that those individuals who died or were hospitalized due to falls tended to be older than individuals that suffered a road traffic accident (Tables 4.1 and 4.2, pages 93-95), which resulted in a higher number of healthy years lost due to premature mortality and disability attributed to road traffic accidents.



Note: Ranking (1) was given to the injury with the highest value for a particular health status indicator. ASMR: age-standardized mortality rate per 10,000 population; ASHR: age-standardized hospitalization rate per 1,000 population; ASYLL: age-standardized years of life lost per 1,000 population; ASYLD: age-standardized per capita healthy years lost due to disability per 1,000 population; ASDALY: age-standardized per capita DALY per 1,000 population; Standard population: Canada Census 2001.

Figure 4.9. Ranking of External Causes of Injury within Each Age-Standardized Health Status Indicator for All Ten Years of Data Combined. Males, 1991-2000.



Note: Ranking (1) was given to the injury with the highest value for a particular health status indicator. ASMR: age-standardized mortality rate per 10,000 population; ASHR: age-standardized hospitalization rate per 1,000 population; ASYLL: age-standardized years of life lost per 1,000 population; ASYLD: age-standardized per capita healthy years lost due to disability per 1,000 population; ASDALY: age-standardized per capita DALY per 1,000 population; Standard population: Canada Census 2001.

Figure 4.10. Ranking of External Causes of Injury within Each Age-Standardized Health Status Indicator for All Ten Years of Data Combined. Females, 1991-2000.

4.2 The Health Authority Level Analysis

4.2.1 Conventional Mortality Rate

The external causes of injury responsible for the highest age-standardized mortality rate (ASMR) per 10,000 population varied considerably across health authorities (HA) (see Table 4.10). The highlighted cells in Table 4.10 identify the external causes of injury for which the ASMR of the HA was higher than the ASMR of BC. In addition, cells with the ASMR in bold text represent the HA with the maximum ASMR for each external cause of injury.

For males, the highest ASMRs across different injury categories were concentrated in the Northern HA, whereas for females the highest ASMRs appeared more spread out (see Table 4.10). As in the BC level analysis, there were injury categories associated with rare mortality events (*e.g.*, sports injuries, natural and environmental factors, machinery injuries), which made the associated mortality rates susceptible to substantial regional chance variation.

Table 4.10. Ten-Year Age-Standardized Mortality Rate (ASMR) per 10,000 Population by Gender and Health Authority (HA), 1991-Canada Census 2001.

Description	Age-standardized mortality rate per 10,000 population (1991-2000)					
	Males					
	Interior	Fraser	Vancouver Coastal	Vancouver Island	Northern	BC
Road traffic accidents	25.824	6.172	9.025	13.141	**30.005**	15.649
Other transport injuries	4.040	0.282	1.847	3.072	**8.519**	3.009
Poisoning	8.138	3.035	**23.497**	13.413	9.220	14.507
Falls	9.118	7.754	10.041	9.865	**11.191**	8.965
Burns/fires/scalds	1.636	0.703	1.020	1.126	**3.048**	1.233
Drowning	2.642	0.281	1.731	2.577	**3.442**	2.104
Sports injuries	0.183	0.019	0.189	0.031	**0.226**	0.117
Natural and environmental factors	1.879	0.156	0.480	0.549	**2.694**	0.843
Machinery injuries	1.656	0.014	0.199	0.984	**3.043**	0.951
Suffocation and foreign bodies	1.412	0.780	1.719	1.461	**2.352**	1.501
Other unintentional injuries‡	2.522	0.048	0.823	1.987	**3.641**	1.580
Suicide and self-inflicted injuries	**24.415**	5.089	18.798	22.029	23.254	20.035
Other intentional injuries	4.287	2.098	4.749	3.629	**6.338**	4.402
Total	87.751	26.431	74.118	73.863	**106.972**	74.895

‡ Excludes medical adverse events

Note: The highlighted cells represent the external causes of injury in which the ASMR of the HA was higher than the ASMR of British Columbia. The cells with ASMR in bold text represent the HA with the maximum ASMR for each external cause of injury.

Table 4.10. (continued) Ten-Year Age-Standardized Mortality Rate (ASMR) per 10,000 Population by Gender and Health Authority (HA), 1991-2000 (Canada Census 2001).

Description	Age-standardized mortality rate per 10,000 population (1991-2000)					
	Females					
	Interior	Fraser	Vancouver Coastal	Vancouver Island	Northern	BC
Road traffic accidents	**11.797**	6.113	5.135	5.551	11.642	7.048
Other transport injuries	0.726	0.279	0.404	0.324	**0.935**	0.450
Poisoning	3.343	3.039	**6.792**	4.046	3.466	4.278
Falls	11.555	8.019	9.471	**13.150**	12.784	10.284
Burns/fires/scalds	0.806	0.700	0.301	0.849	**1.308**	0.694
Drowning	0.834	0.277	0.571	**0.918**	0.548	0.584
Sports injuries	0.032	0.020	0.042	**0.058**	0.000	0.032
Natural and environmental factors	0.456	0.155	0.081	0.255	**0.637**	0.235
Machinery injuries	**0.158**	0.014	0.000	0.024	0.142	0.047
Suffocation and foreign bodies	0.802	0.780	1.098	**1.288**	0.269	0.940
Other unintentional injuries‡	0.225	0.047	0.172	0.220	**0.423**	0.167
Suicide and self-inflicted injuries	6.009	5.067	6.449	**7.147**	4.073	5.880
Other intentional injuries	**3.057**	2.091	1.900	2.247	2.435	2.249
Total	**39.801**	26.602	32.414	36.077	38.661	32.888

‡ Excludes medical adverse events

Note: The highlighted cells represent the external causes of injury in which the ASMR of the HA was higher than the ASMR of British Columbia. The cells with ASMR in bold text represent the HA with the maximum ASMR for each external cause of injury.

The annual ASMR per 10,000 population from 1991 to 2000 by gender for each HA and BC for the same external causes of injury as in the BC level analysis are presented in Figures 4.11 and 4.12. Note that the annual ASMRs for the external causes of injury in these figures appear susceptible to large chance variation, and it was difficult to see any pattern over time for these ASMRs. However, it was clear that for both genders, road traffic accidents in the Northwest and Interior HAs had ASMRs consistently higher than BC and the

other health regions during 1991-2000. In addition, poisoning (mainly due to drug abuse) afflicted mainly males in this province especially in the Vancouver Coastal HA.

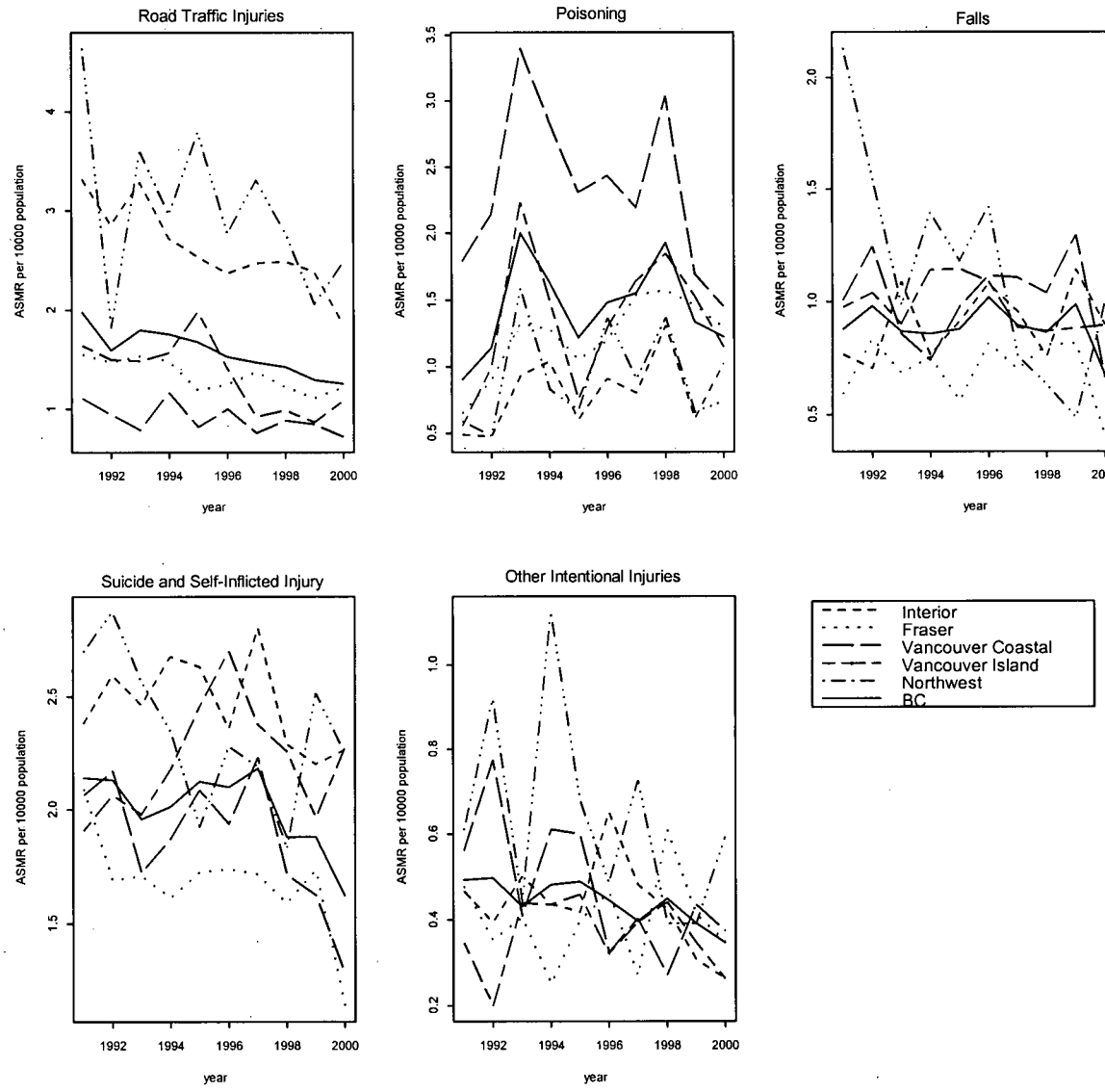


Figure 4.11. Annual Age-Standardized Mortality Rate (ASMR) per 10,000 Population by Injury and Health Authority for Males, 1991-2000 (Canada Census 2001).

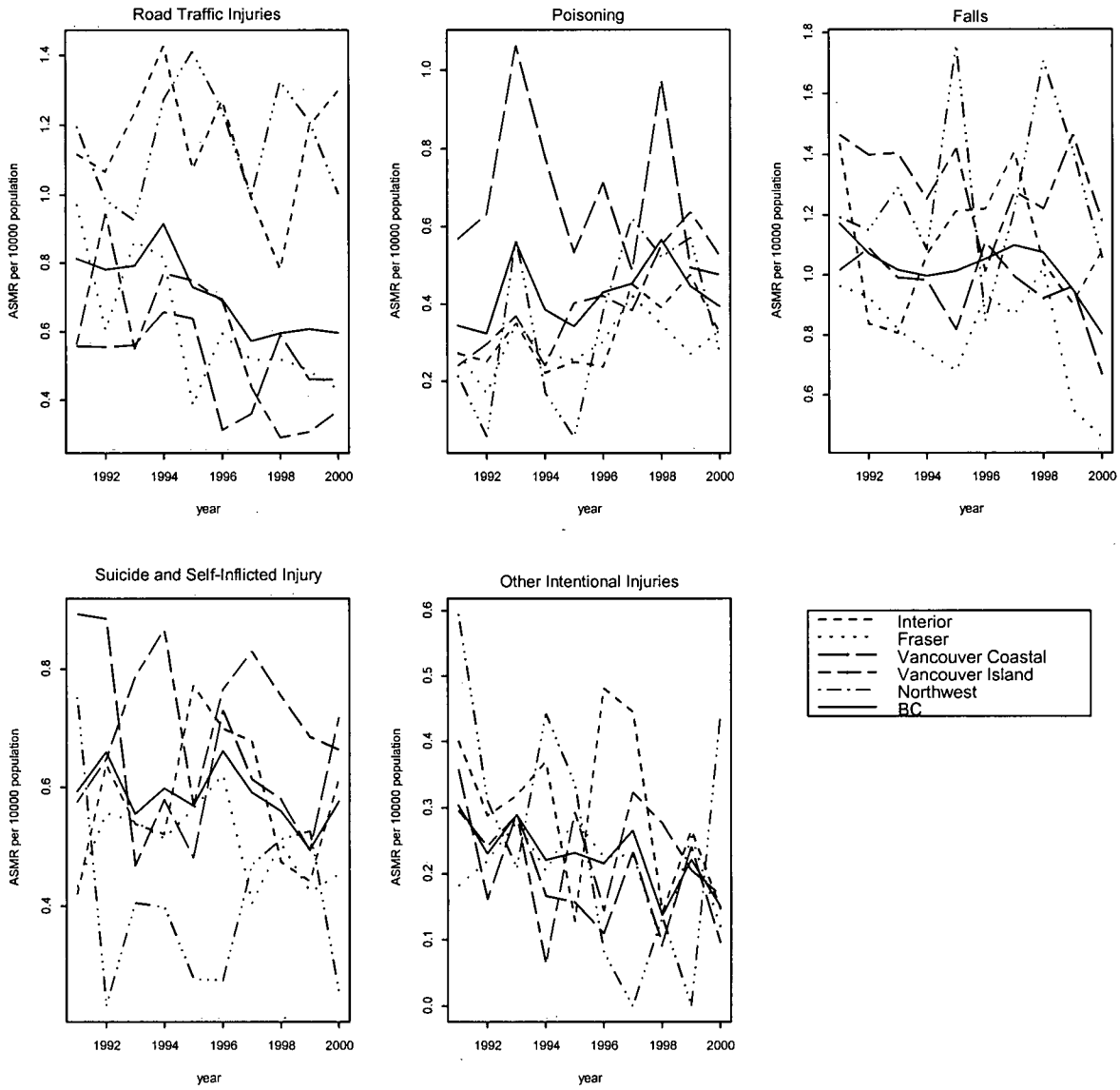


Figure 4.12. Annual Age-Standardized Mortality Rate (ASMR) per 10,000 Population by Injury and Health Authority for Females, 1991-2000 (Canada Census 2001).

4.2.2 Conventional Hospitalization Rate

The external causes of injury responsible for the highest age-standardized hospitalization rate (ASHR) per 1,000 population varied considerably across HAs (Table 4.11). For males and females, the highest ASHRs were concentrated in the Northern HA for all injury categories. The Interior HA also had a high ASHR for sports injuries.

Table 4.11. Ten-Year Age-Standardized Hospitalization Rates (ASHR) per 1,000 Population by Gender and Health Authority (HA), 1991-2000 (Canada Census 2001).

Description	Age-standardized hospitalization rate per 1,000 population (1991-2000)					
	Males					
	Interior	Fraser	Vancouver Coastal	Vancouver Island	Northern	BC
Road traffic accidents	62.88	38.41	28.50	42.58	**66.31**	42.95
Other transport injuries	12.03	5.05	2.94	7.19	**16.28**	7.02
Poisoning	3.69	2.69	3.43	3.23	**4.68**	3.31
Falls	64.98	49.60	44.81	56.51	**74.28**	54.05
Burns/fires/scalds	4.75	3.18	3.16	4.20	**9.41**	4.13
Drowning	0.27	0.20	0.17	0.28	**0.34**	0.23
Sports injuries	**18.12**	12.99	11.28	16.37	16.88	14.36
Natural and environmental factors	3.49	1.36	1.17	1.93	**4.79**	2.03
Machinery injuries	12.68	7.25	3.71	8.74	**17.26**	8.29
Suffocation and foreign bodies	3.93	3.15	2.43	3.17	**4.26**	3.20
Other unintentional injuries‡	28.25	14.79	11.25	20.21	**37.00**	18.85
Suicide and self-inflicted injuries	11.35	11.02	8.94	12.32	**12.29**	10.84
Other intentional injuries	15.74	13.20	13.85	15.76	**27.38**	15.36
Total	242.17	162.89	135.67	192.48	**291.18**	184.63

‡ Excludes medical adverse events

Note: The highlighted cells represent the external causes of injury in which the ASHR of the HA was higher than the ASHR of British Columbia. The cells with ASHR in bold text represent the HA with the maximum ASHR for each external cause of injury.

Table 4.11. (continued) Ten-Year Age-Standardized Hospitalization Rates (ASHR) per 1,000 Population by Gender and Health Authority (HA), 1991-2000 (Canada Census 2001).

Description	Age-standardized hospitalization rate per 1,000 population (1991-2000)					
	Females					
	Interior	Fraser	Vancouver Coastal	Vancouver Island	Northern	BC
Road traffic accidents	39.38	24.06	18.55	24.80	**44.03**	27.08
Other transport injuries	3.04	1.34	1.12	2.15	**3.69**	1.94
Poisoning	3.80	2.53	2.88	2.87	**4.69**	3.04
Falls	77.19	61.80	54.35	66.89	**95.98**	62.20
Burns/fires/scalds	2.25	1.93	1.66	1.95	**3.93**	2.05
Drowning	**0.13**	0.07	0.06	0.11	0.06	0.09
Sports injuries	**8.01**	4.25	4.08	6.06	7.62	5.48
Natural and environmental factors	2.27	1.14	0.85	1.37	**2.50**	1.39
Machinery injuries	0.79	0.59	0.47	0.85	**1.77**	0.73
Suffocation and foreign bodies	2.47	2.25	1.78	2.40	**2.91**	2.21
Other unintentional injuries‡	7.57	4.43	3.94	5.59	**9.40**	5.49
Suicide and self-inflicted injuries	18.59	17.96	13.32	19.33	**24.05**	18.12
Other intentional injuries	5.75	3.94	4.27	4.78	**12.74**	5.31
Total	171.25	126.29	107.34	139.14	**213.38**	135.12

‡ Excludes medical adverse events

Note: The highlighted cells represent the external causes of injury in which the ASHR of the HA was higher than the ASHR of British Columbia. The cells with ASHR in bold text represent the HA with the maximum ASHR for each external cause of injury.

Similar to Figures 4.11 to 4.12, Figures 4.13 to 4.14 present the annual ASHRs for all injuries from 1991 to 2000 for each HA and BC as a whole. In contrast to the plots for ASMR, the larger sample size associated with the number of hospitalizations for each injury made it easier to see the pattern over time of the ASHR for some external causes of injury. It is apparent that for road traffic accidents and falls in both genders, the Northwest and Interior HAs had ASHR higher than both the province as whole and the other health regions for all

years. The Northwest HA also had a high ASHR due to other intentional injuries for both males and females. In general, for both males and females, the ASHR for road traffic accidents, falls, and other intentional injuries has been decreasing since 1991 in BC and in most HAs. For suicide and self-inflicted injuries, the ASHR for females has been increasing since 1991 in the Northwest HA.

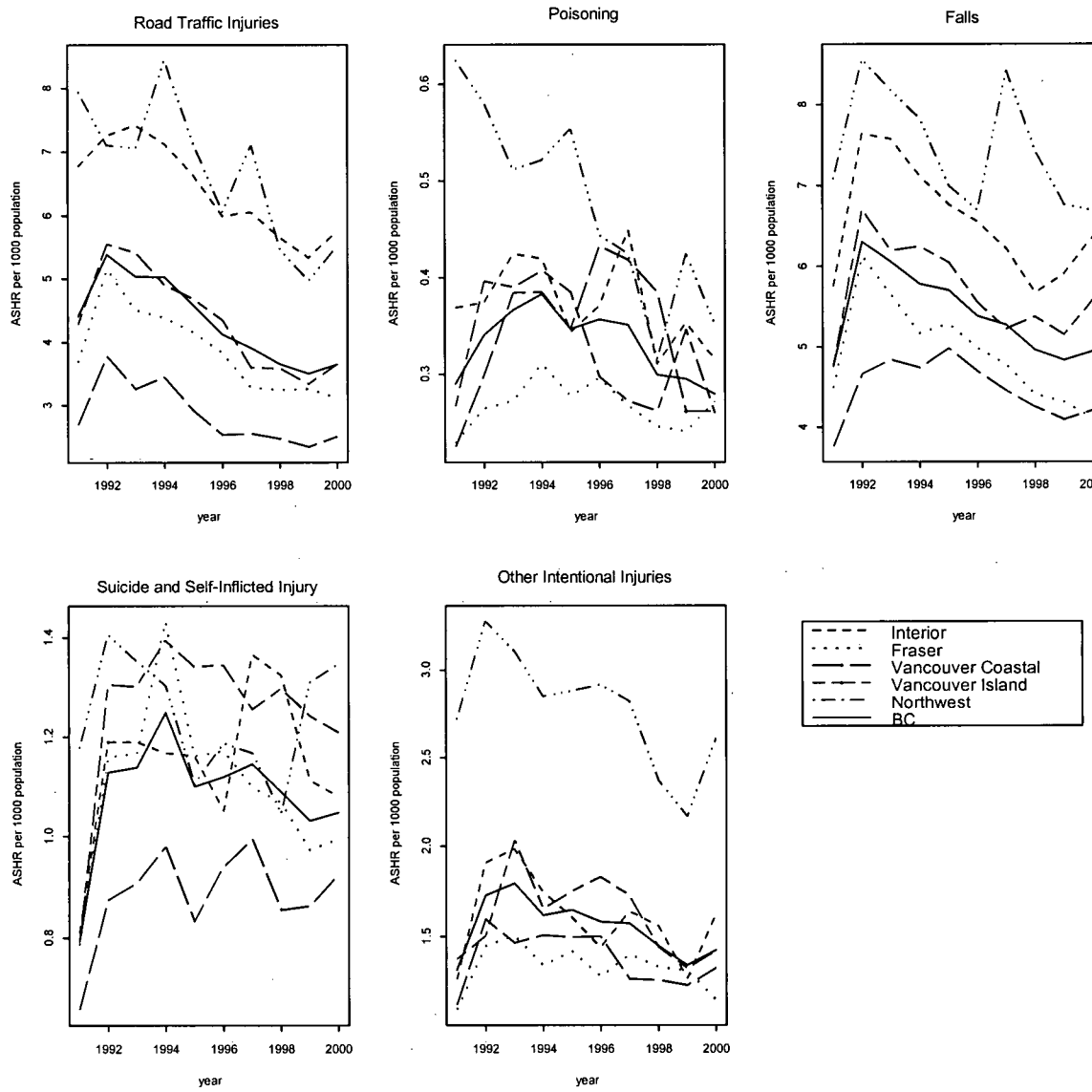


Figure 4.13. Annual Age-Standardized Hospitalization Rate (ASHR) per 1,000 Population by Injury and Health Authority for Males, 1991-2000 (Canada Census 2001).

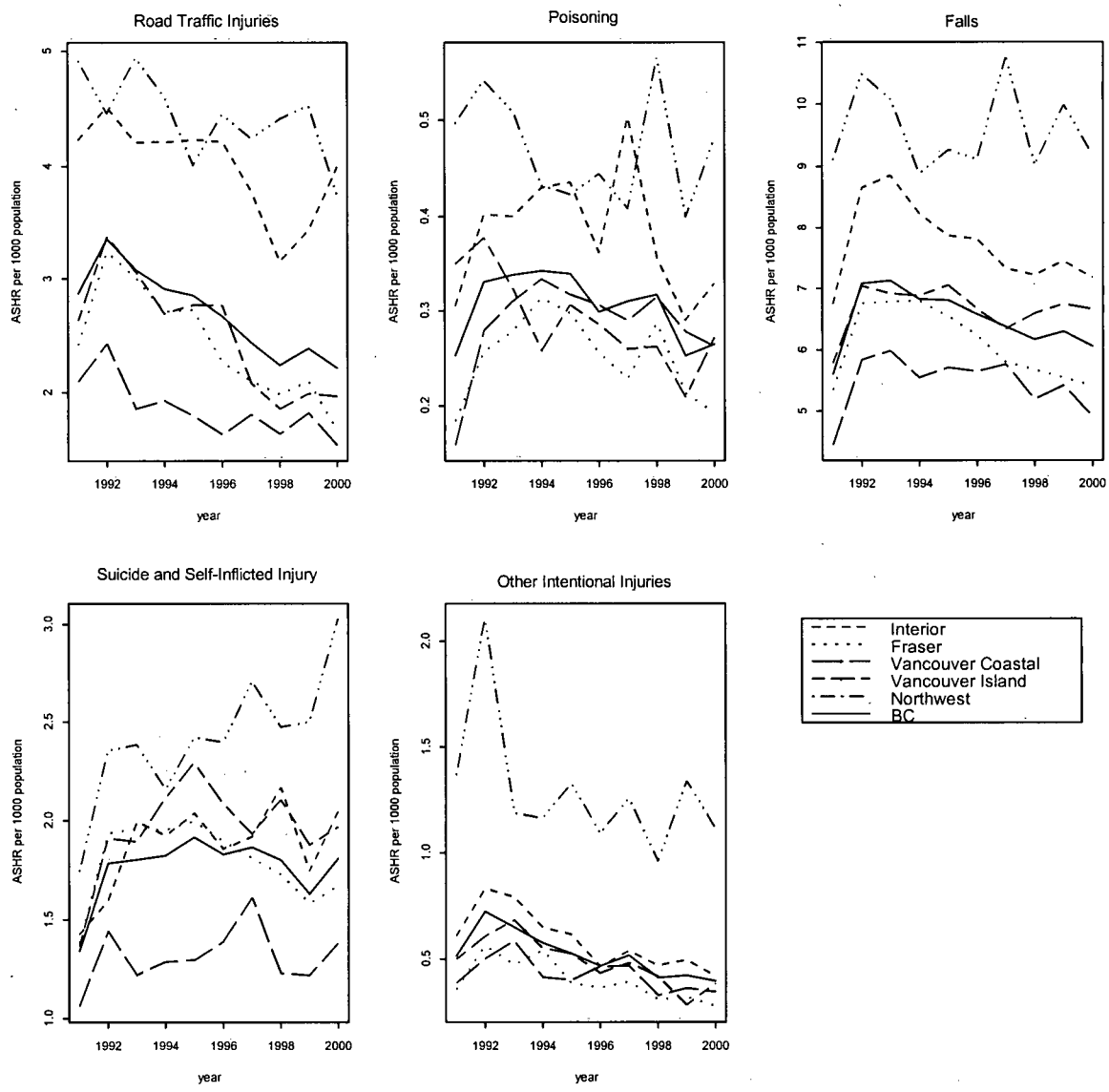


Figure 4.14. Annual Age-Standardized Hospitalization Rate (ASHR) per 1,000 Population by Injury and Health Authority for Females, 1991-2000 (Canada Census 2001).

4.2.3 Disability-Adjusted Life Years (DALY)

This section of the results presents the age-standardized per capita disability-adjusted life years (ASDALY) per 1,000 population for each HA and BC (see Table 4.12). For males during 1991-2000, for every 1,000 population, 364.60 DALYs (or approximately 365 lost years of healthy life due to injury) were lost in the Northern HA due to injuries (primarily due to mortality), followed by 307.82 DALYs (or approximately 308 lost years of healthy life due to injury) lost in the Interior HA due to injuries (primarily due to mortality). For females, in 1991-2000, per 1,000 population, 131.95 DALYs (or approximately 132 lost years of healthy life due to injury) were lost in the Northern HA due to injuries (primarily due to mortality) and 117.10 DALYs (or approximately 117 lost years of healthy life due to injury) were lost in the Interior HA due to injuries (primarily due to mortality).

For males and females in the Interior, Fraser and Northern HAs, road traffic accidents had the highest ASDALY (see Table 4.12). In the Vancouver Island HA, the ASDALY was the highest for suicide and self-inflicted injuries. The Vancouver Costal HA had the highest ASDALY for poisoning (mainly due to drug abuse) (for males) and suicide and self-inflicted injuries (for females). In addition, note the high variability in ASDALY for some external causes of injury across different HAs. For example, the ASDALY for road traffic accidents ranged from 29 to 88 per 1,000 population in males and from 15 to 39 per 1,000 population in females. With regard to poisoning, the ASDALY ranged from 19 to 52 per 1,000 population for males and from 7 to 16 per 1,000 population for females.

Table 4.12. Ten-Year Age-Standardized Per Capita Disability-Adjusted Life Years (or age-Standardized Per Capita DALY or ASDALY) per 1,000 Population by Gender and Health Authority, 1991-2000 (Canada Census 2001).

Description	Age-standardized per capita DALY per 1,000 population (1991-2000)					
	Males					
	Interior	Fraser	Vancouver Coastal	Vancouver Island	Northern	BC
Road traffic accidents	80.65	42.93	29.14	44.95	**87.67**	49.82
Other transport injuries	16.37	7.52	5.64	11.64	**28.16**	10.98
Poisoning	19.17	27.91	**51.50**	30.33	20.56	32.45
Falls	20.13	15.28	18.05	19.64	**21.44**	18.01
Burns/fires/scalds	7.05	4.01	4.46	5.42	**12.58**	5.59
Drowning	6.63	3.62	3.75	6.16	**8.32**	5.02
Sports injuries	**2.87**	1.82	1.92	2.17	2.55	2.16
Natural and environmental factors	5.62	1.25	1.52	2.09	**6.56**	2.59
Machinery injuries	18.60	9.93	4.84	12.29	**25.08**	11.69
Suffocation and foreign bodies	15.03	12.30	10.24	12.99	**15.73**	12.68
Other unintentional injuries‡	44.72	22.74	17.79	32.81	**57.19**	29.72
Suicide and self-inflicted injuries	**55.74**	38.18	41.47	51.25	54.50	45.49
Other intentional injuries	15.25	14.02	15.68	13.99	**24.26**	15.56
Total	307.82	201.50	205.99	245.75	**364.60**	241.77

‡ Excludes medical adverse events

Note: The highlighted cells represent the external causes of injury in which the ASDALY of the HA was higher than the ASDALY of British Columbia. The cells with ASDALY in bold text represent the HA with the maximum ASDALY for each external cause of injury.

Table 4.12. (continued) Ten-Year Age-Standardized Per Capita Disability-Adjusted Life Years (or age-Standardized Per Capita DALY or ASDALY) per 1,000 Population by Gender and Health Authority, 1991-2000 (Canada Census 2001).

Description	Age-standardized per capita DALY per 1,000 population (1991-2000)					
	Females					
	Interior	Fraser	Vancouver Coastal	Vancouver Island	Northern	BC
Road traffic accidents	37.02	19.51	15.47	20.69	**39.07**	23.22
Other transport injuries	3.69	1.40	1.49	2.02	**5.02**	2.26
Poisoning	7.27	7.18	**15.71**	9.70	8.94	10.04
Falls	14.93	10.70	11.59	14.73	**17.42**	12.88
Burns/fires/scalds	3.49	2.78	1.66	3.16	**5.99**	2.96
Drowning	1.80	0.73	1.08	**2.09**	1.18	1.28
Sports injuries	**0.73**	0.36	0.47	0.57	0.58	0.50
Natural and environmental factors	1.90	0.68	0.53	1.00	**2.15**	1.03
Machinery injuries	1.32	0.77	0.59	1.14	**2.55**	1.02
Suffocation and foreign bodies	6.50	6.45	5.29	**7.64**	7.10	6.51
Other unintentional injuries‡	10.26	5.76	5.56	7.78	**12.78**	7.40
Suicide and self-inflicted injuries	17.89	16.23	16.54	**20.88**	16.81	17.54
Other intentional injuries	10.30	6.71	6.49	7.63	**12.34**	7.92
Total	117.10	79.28	82.45	99.02	**131.95**	94.59

‡ Excludes medical adverse events

Note: The highlighted cells represent the external causes of injury in which the ASDALY of the HA was higher than the ASDALY of British Columbia. The cells with ASDALY in bold text represent the HA with the maximum ASDALY for each external cause of injury.

Tables G.10 and G.11 in Appendix G present the YLL, YLD and DALY by gender and external cause of injury for BC and each HA for the years 1991-2000. Tables G.10 and G.11 also display the percentage contribution of non-fatal burden to the total burden from injuries. For both males and females in all regions, the injuries with YLD>YLL were burns/fires/scalds, sports injuries, machinery injuries, suffocation and foreign bodies and

other unintentional injuries (excluding medical AE). In addition, for females, natural and environmental factors had YLD greater than YLL in all regions. Finally, for falls, the YLD was greater than YLL in the Interior HA (males), Fraser HA (males) and Northern HA (males and females).

Figures 4.15 to 4.16 present annual ASDALY from 1991 to 2000 for each HA and BC for the same injuries as in plots for ASMR and ASHR. For both males and females, the ASDALY for road traffic accidents tended to be higher for the Northwest and Interior HAs than for BC and the other HAs. Lost years of healthy life due to poisoning (mainly due to drug abuse) were more common in males in this province especially in the Vancouver Coastal HA. Additionally, individuals living in the Northern HA lost years of healthy life due to falls (females) and other intentional injury (mainly due to homicide) (males and females) in all years. For suicide and self-inflicted injury the Interior HA (males), the Northern HA (males), and the Vancouver Island HA (both males and females) had ASDALYs above the provincial ASDALY over the 10 years of observation. In addition, the ASDALY due to road traffic accidents appears to be decreasing for males in all regions and for females in all regions with the exception of the Northern and Interior HAs.

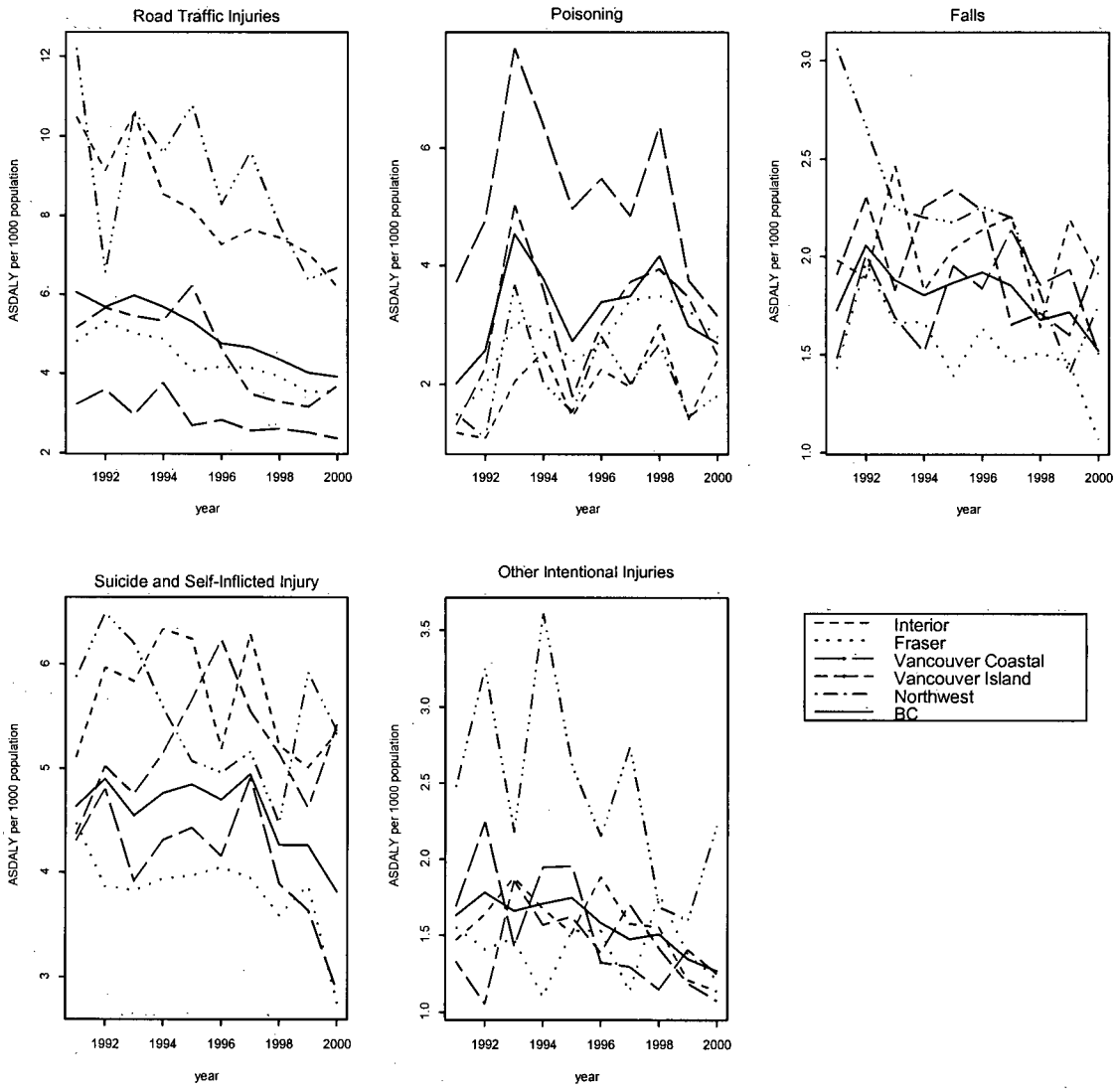


Figure 4.15. Annual Age-Standardized Per Capita DALY (ASDALY) per 1,000 Population by Injury and Health Authority for Males, 1991-2000 (Canada Census 2001).

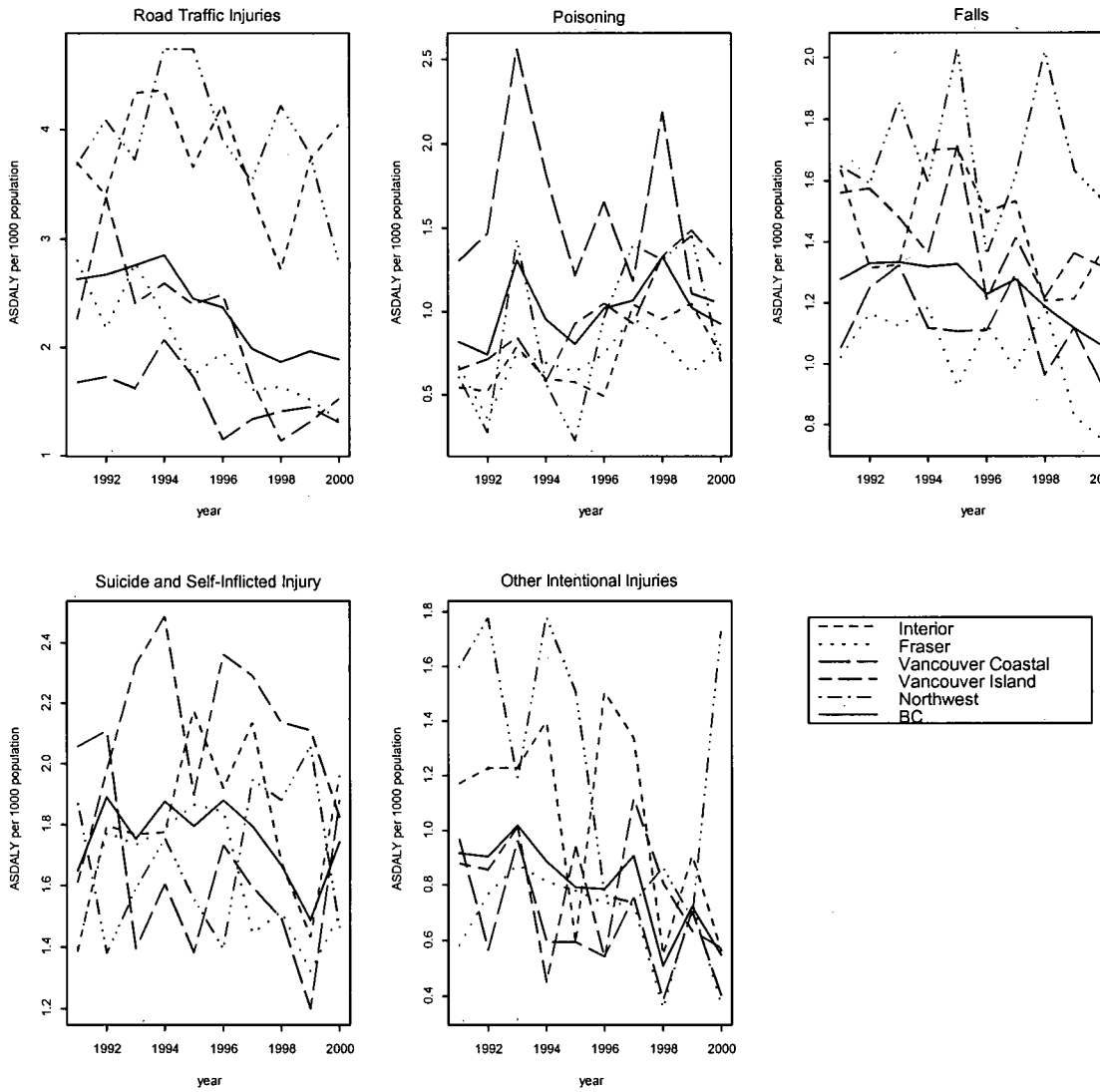


Figure 4.16. Annual Age-Standardized Per Capita DALY (ASDALY) per 1,000 Population by Injury and Health Authority for females, 1991-2000 (Canada Census 2001).

In summary, the results of this section of this study show that for both males and females, road traffic accidents represent the injury imposing the greatest impact on the quality of life of BC residents. In other words, BC residents are loosing more years of

healthy life due to disability and premature death from road traffic accidents than from any other single type of injury. In addition, road traffic accidents affect residents of Northern and Interior health authorities to greater extent than residents of other HAs.

Chapter 5

Small-area Analysis of the Burden Due to Road Traffic Accidents in British Columbia

Given the relatively high impact of road traffic accidents among males and females between 20 and 39 years of age, this injury category was selected to demonstrate the utility of Bayesian disease mapping methods to examine small-area patterns, variations, and trends in disability-adjusted life years (DALY). More generally, this type of analysis can be used for monitoring the dynamic evolution of patterns in the spatial distribution of injury incidence and burden over time. The results for the estimated parameters for model (3.1) (described in section 3.2.1), based on the hospitalization and death data of males and females, can be found in Appendix G.

5.1 Estimated Mortality and Hospitalization Rates

For the 10 years of observation (*i.e.*, 1991-2000), the estimated BC average mortality rate (parameter m in model 3.1, page 55) due to road traffic accidents was 4 per 10,000 population for males and 0.9 per 10,000 population for females. In the same period in BC, the estimated average hospitalization rate (parameter m) due to road traffic accidents was 7.6 per 1,000 population for males and 3.7 per 1,000 population for females.

To illustrate the model fitting for hospitalization and mortality data, respectively, we plotted the annual conventional and estimated rates by HSDA for males and females during 1991-2000 (Figures 5.1-5.2). In general, the conventional hospitalization and mortality rates fluctuated over the period of observation because of the increased influence of chance variation associated with small case numbers at the HSDA level. However, the estimated hospitalization and mortality rates once smoothed showed a clear trend during the period 1991-2000. In addition, Figure 5.1 shows a decreasing trend in the smoothed estimated mortality rates for most regions from 1991 to 2000, and Figure 5.2 shows moderate curvature in the trend of the smoothed estimated hospitalization rates for most regions from 1991 to 2000.

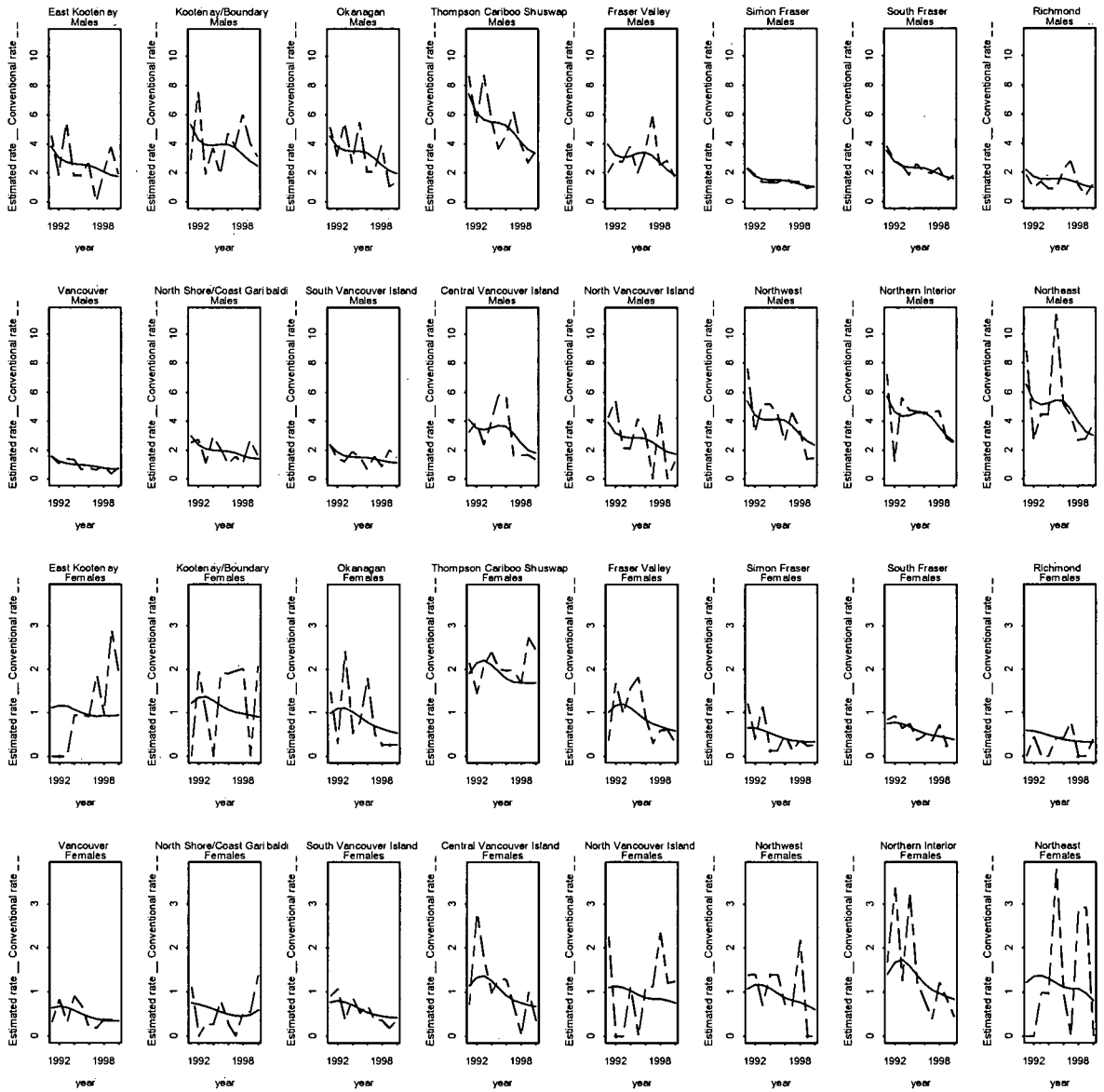


Figure 5.1. Conventional and Estimated Annual Mortality Rates per 10,000 Population by Health Services Delivery Area for Road Traffic Accidents Experienced by Males and Females Aged 20-39 Years, 1991-2000.

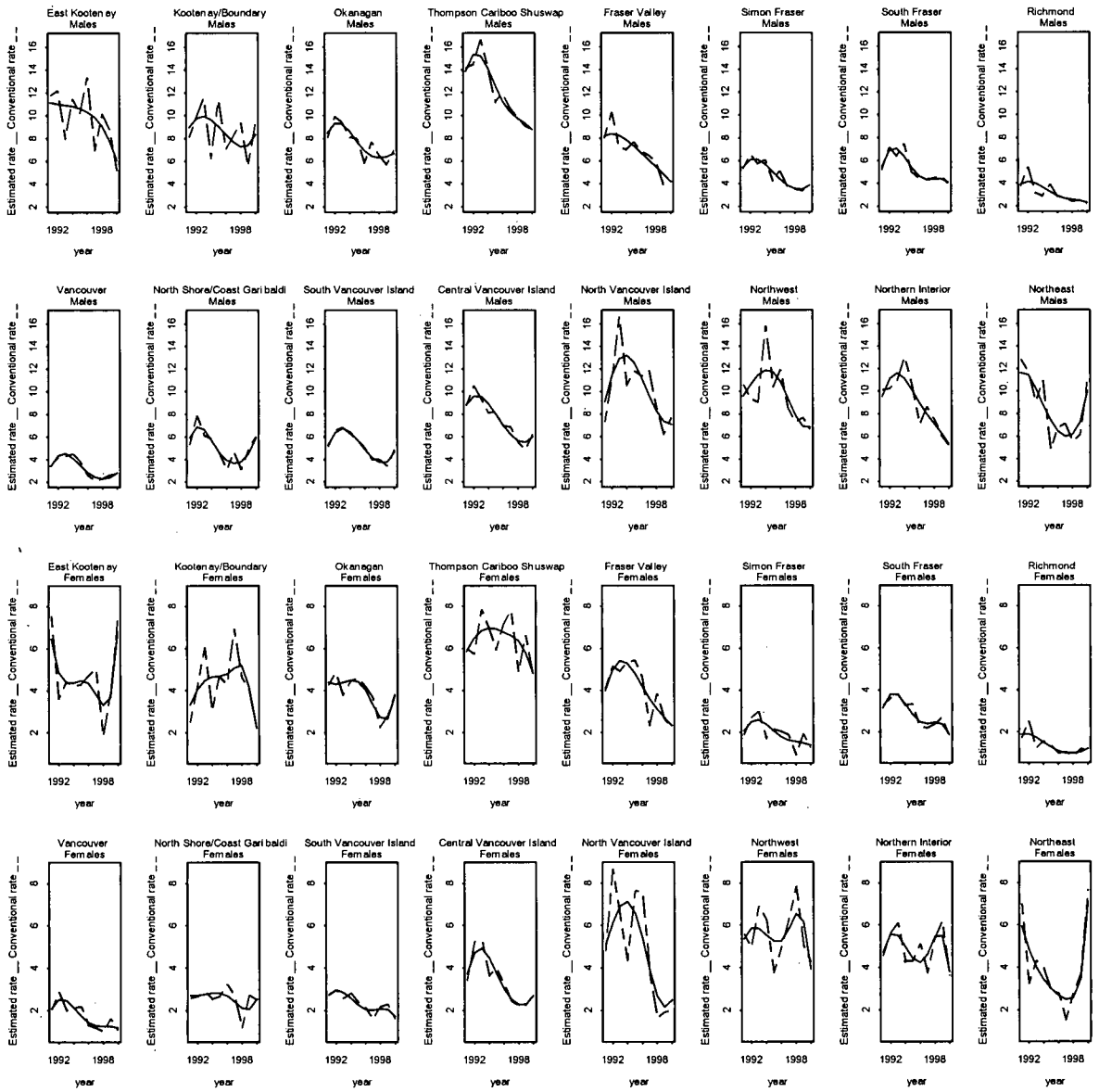


Figure 5.2. Conventional and Estimated Annual Hospitalization Rates per 1,000 Population by Health Services Delivery Area for Road Traffic Accidents Experienced by Males and Females Aged 20-39 Years, 1991-2000.

5.1.1 Comparison of the Annual Estimated Rates among Different Geographical Layers in the Provincial Health Care System

Table 5.1 shows the mortality and hospitalization rates in 2000 associated with road traffic accidents for males and females, respectively. The cells in Tables 5.1 with the rates in boldface represent the HAs with rates statistically higher or lower than the province of BC as a whole. Appendix G presents the estimated rates and confidence intervals set at the HSDA, HA and BC levels for all years.

Overall, Table 5.1 shows that in 2000, males living in the Thompson Cariboo Shuswap represented the HSDA with the highest hospitalization and mortality rates. The Vancouver and Richmond HSDAs had the lowest mortality and hospitalization rates, respectively. And for females in 2000, the Thompson Cariboo Shuswap HSDA had the highest mortality rate while the Northeast and East Kootenay HSDAs had the highest hospitalization rate. Richmond and Vancouver HSDAs had the lowest mortality and hospitalization rates, respectively.

Table 5.1. Regional Age-Specific Mortality Rates per 10,000 Population and Hospitalization Rates per 1,000 Population Due To Road Traffic Accidents in 2000 for Males and Females Aged 20-39 Years.

HSDA	Age-specific road traffic accident mortality rate per 10,000 population in 2000 [95% CI]		Age-specific road traffic accident hospitalization rate per 1,000 population in 2000 [95% CI]	
	Males	Females	Males	Females
Interior HA	**2.46 [2.22, 2.67]**	**1.01 [0.77, 1.16]**	**7.51 [7.32, 7.69]**	**4.41 [4.23, 4.57]**
East Kootenay	1.76 [1.02, 2.78]	0.93 [0.34, 2.59]	6.11 [4.85, 7.45]	7.36 [5.41, 8.38]
Kootenay/Boundary	2.49 [1.51, 3.87]	0.90 [0.35, 2.18]	8.37 [6.83, 10.0]	2.17 [1.54, 3.02]
Okanagan	1.95 [1.24, 2.73]	0.52 [0.15, 0.95]	6.69 [5.93, 7.47]	3.82 [3.22, 4.41]
Thompson Cariboo Shuswap	3.35 [2.26, 4.60]	1.68 [0.70, 3.58]	8.78 [7.79, 9.83]	4.68 [4.10, 5.58]
Fraser HA	**1.39 [1.27, 1.50]**	**0.42 [0.34, 0.50]**	**4.01 [3.92, 4.10]**	**1.86 [1.79, 1.93]**
Fraser Valley	1.81 [1.17, 2.63]	0.57 [0.20, 1.06]	4.18 [3.58, 4.83]	2.19 [1.86, 2.84]
Simon Fraser	1.01 [0.70, 1.40]	0.33 [0.11, 0.59]	3.84 [3.47, 4.24]	1.25 [1.15, 1.63]
South Fraser	1.61 [1.15, 2.17]	0.38 [0.13, 0.65]	4.12 [3.72, 4.56]	1.73 [1.61, 2.17]
Vancouver Coastal HA	**0.88 [0.79, 0.96]**	**0.41 [0.32, 0.47]**	**3.37 [3.28, 3.46]**	**1.64 [1.57, 1.71]**
Richmond	0.97 [0.56, 1.53]	0.31 [0.08, 0.68]	2.31 [1.85, 2.83]	1.10 [0.87, 1.59]
Vancouver	0.69 [0.45, 0.99]	0.33 [0.14, 0.58]	2.80 [2.52, 3.10]	1.06 [1.01, 1.39]
North Shore / Coast Garibaldi	1.40 [0.93, 2.09]	0.58 [0.24, 1.43]	5.93 [5.21, 6.70]	2.47 [2.07, 3.05]
Vancouver Island HA	**1.41 [1.27, 1.54]**	**0.61 [0.49, 0.70]**	**5.32 [5.17, 5.47]**	**2.30 [2.17, 2.43]**
South Vancouver Island	1.14 [0.76, 1.69]	0.41 [0.15, 0.74]	4.68 [4.15, 5.25]	1.60 [1.43, 2.06]
Central Vancouver Island	1.81 [1.12, 2.62]	0.66 [0.23, 1.22]	6.01 [5.24, 6.86]	2.71 [2.18, 3.28]
North Vancouver Island	1.75 [0.98, 2.79]	0.75 [0.25, 1.83]	7.10 [5.63, 8.73]	1.97 [1.62, 3.50]
Northern HA	**2.62 [2.35, 2.87]**	**0.75 [0.60, 0.86]**	**6.82 [6.59, 7.04]**	**4.94 [4.71, 5.17]**
Northwest	2.36 [1.43, 3.48]	0.60 [0.16, 1.21]	6.85 [5.70, 8.10]	4.25 [3.07, 4.92]
Northern Interior	2.61 [1.74, 3.65]	0.83 [0.32, 1.56]	5.36 [4.56, 6.23]	3.61 [3.14, 4.55]
Northeast	3.00 [1.84, 4.56]	0.81 [0.27, 1.81]	10.0 [8.41, 11.9]	7.69 [5.63, 8.83]
BC	**1.69 [1.20, 2.32]**	**0.66 [0.57, 0.74]**	**5.47 [4.26, 6.91]**	**3.12 [3.04, 3.18]**

Figures 5.3-5.4 show, respectively, the annual trends for road traffic accident mortality and hospitalization rates for males during 1991-2000. The display offered by these figures provides a graphical summary of the provincial temporal trend, the trend for health authorities with temporal trends over and above the provincial trend, as well as health service delivery areas with temporal trends greater or lower than their respective health authority trend.

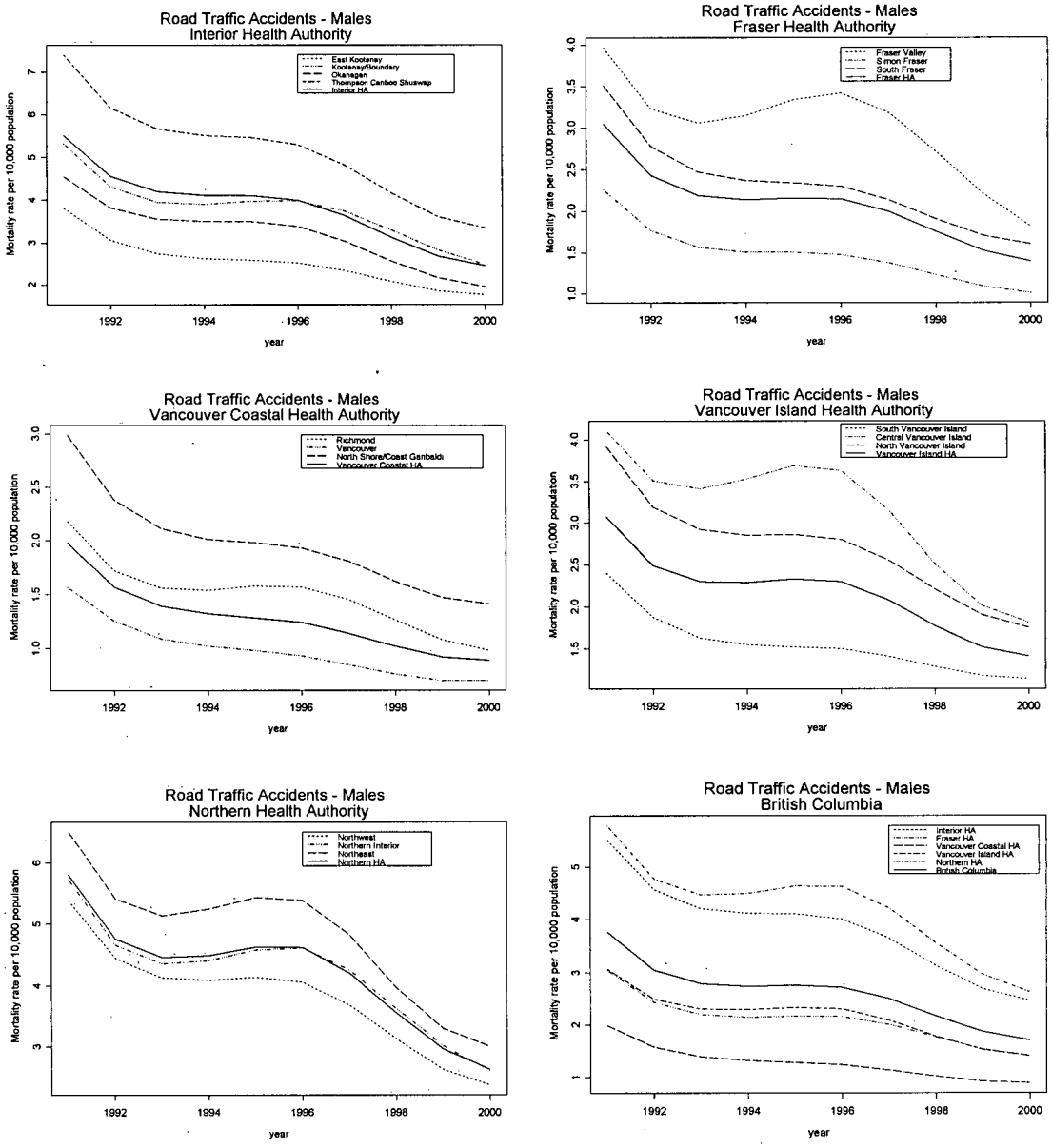


Figure 5.3. Annual Road Traffic Accident Mortality Rate per 10,000 Population for Males Aged 20-39 Years at the Health Services Delivery Area, Health Authority and Provincial Levels, 1991-2000.

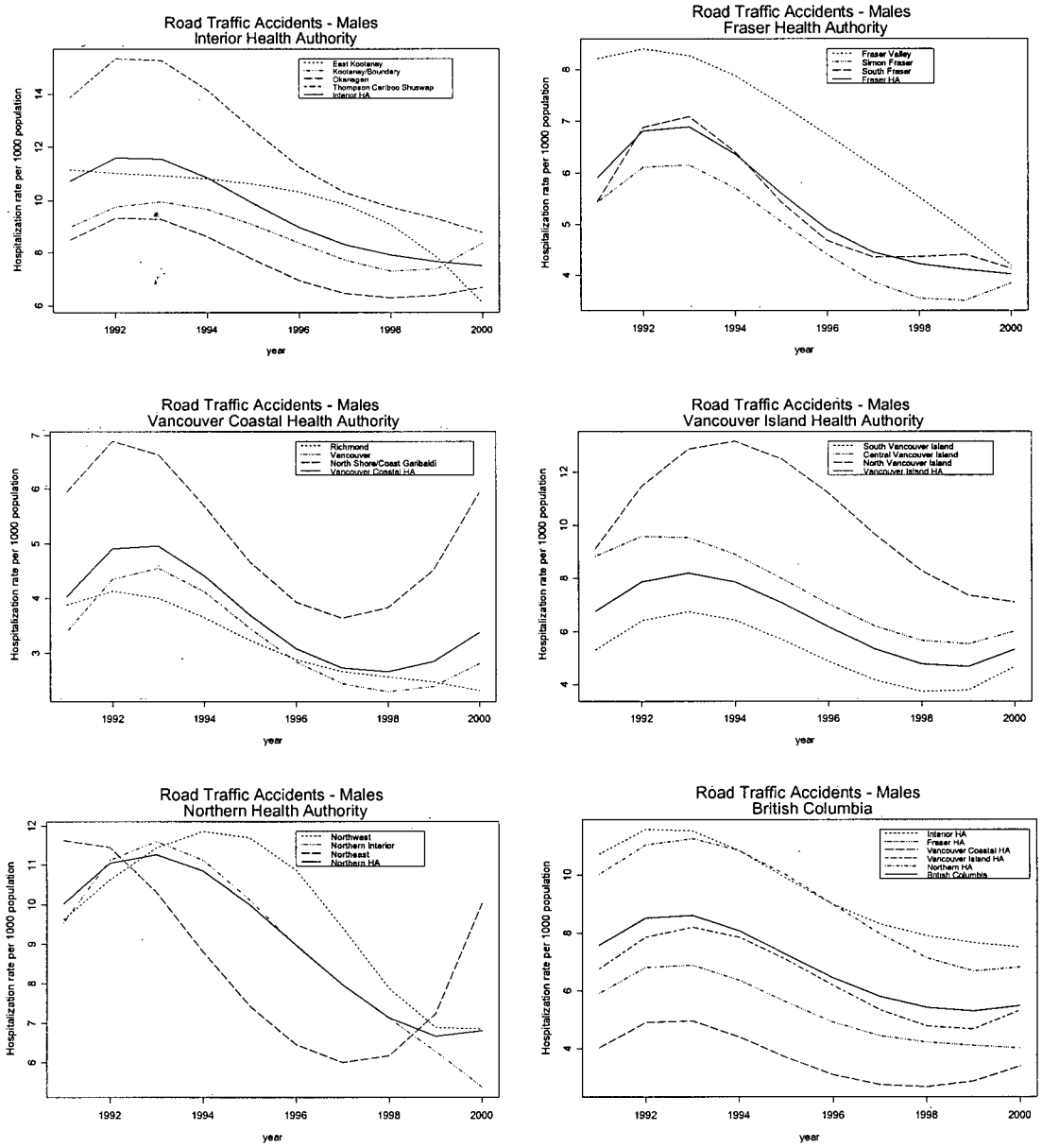


Figure 5.4. Annual Road Traffic Accident Hospitalization Rate per 1,000 Population for Males Aged 20-39 Years at the Health Services Delivery Area, Health Authority and Provincial Levels, 1991-2000.

In summary, based on Figures 5.3-5.4, it appears that the overall annual mortality and hospitalization rates for the province and the health authorities decreased in a non-linear fashion over the decade of observation. In 1991, note that the rates for most health service delivery areas and health authorities were further apart, and they became smaller as we approached the year 2000. In addition, though hospitalizations due to road traffic accidents appear to be declining for all health authorities, there are certain health service delivery areas for which this decline is far faster than the health authorities (*e.g.*, the East Kootenay, Fraser Valley, Richmond and Northern Interior HSDAs). There are also health service delivery areas with rates increasing during the last three years of study, such as the North Shore/Coast Garibaldi and Northeast HSDAs.

Next, Figures 5.5-5.6 show, respectively, the annual trend for road traffic accident mortality and hospitalization rates for females during 1991-2000. Similar to males, the overall annual mortality rates in females for both the province as a whole and individual health authorities decreased by means of a non-linear temporal trend over the decade of observation. In contrast to the overall annual mortality rates, the overall annual hospitalization rates had a flat trend, except for the Vancouver Island and Fraser health authorities. Note that in the Interior HA, the hospitalization trend of each HSDA was very distinct. In addition, there are certain health service delivery areas with rates increasing during the last three years of study, such as the North Shore/Coast Garibaldi HSDA (for both mortality and hospitalization rates), and the East Kootenay, Thompson Cariboo Shuswap, Richmond and Northeast HSDAs (for only the hospitalization rate).

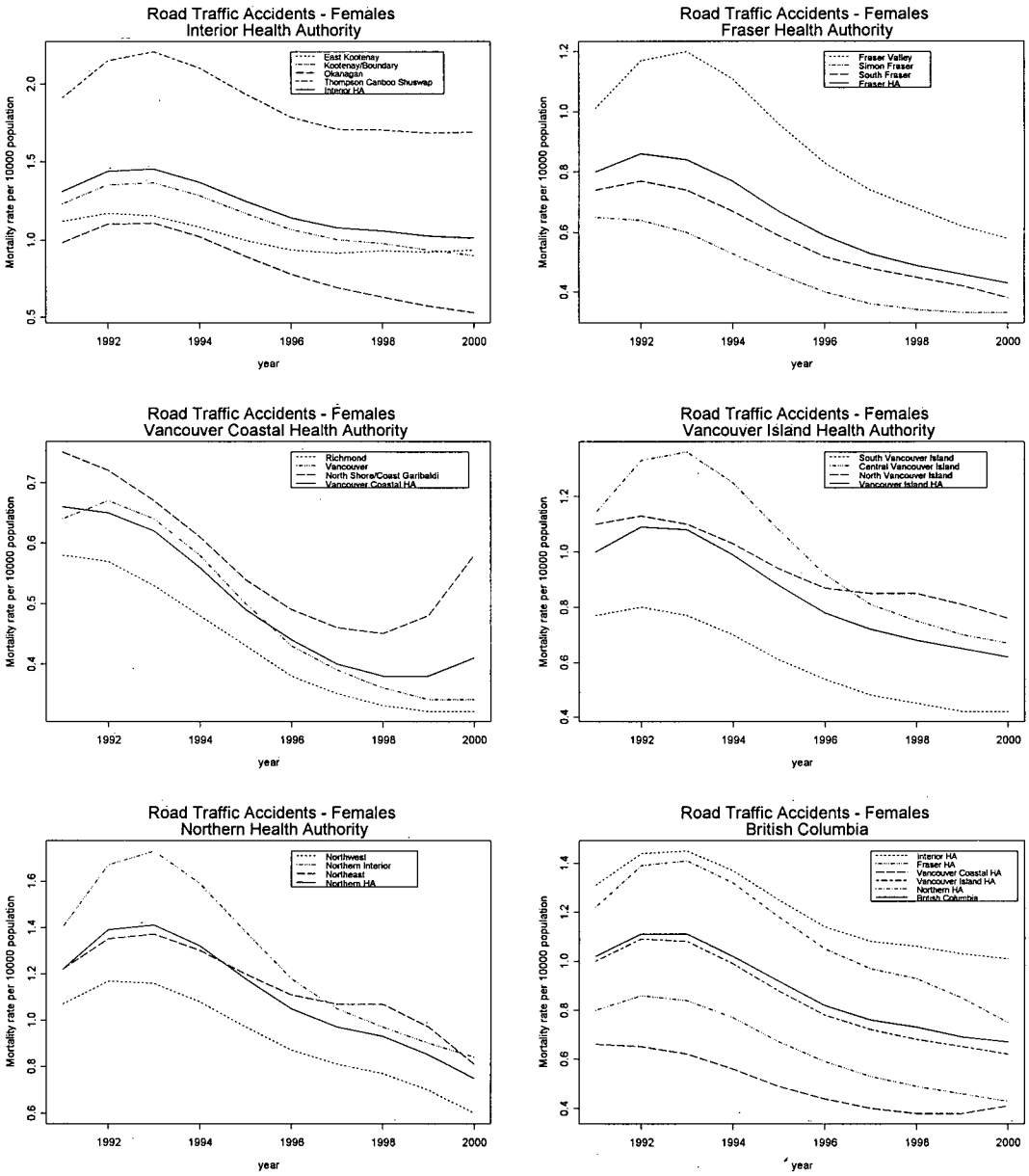


Figure 5.5. Annual Road Traffic Accident Mortality Rate per 10,000 Population for Females Aged 20-39 Years, at the Health Services Delivery Area, Health Authority and Provincial Levels, 1991-2000.

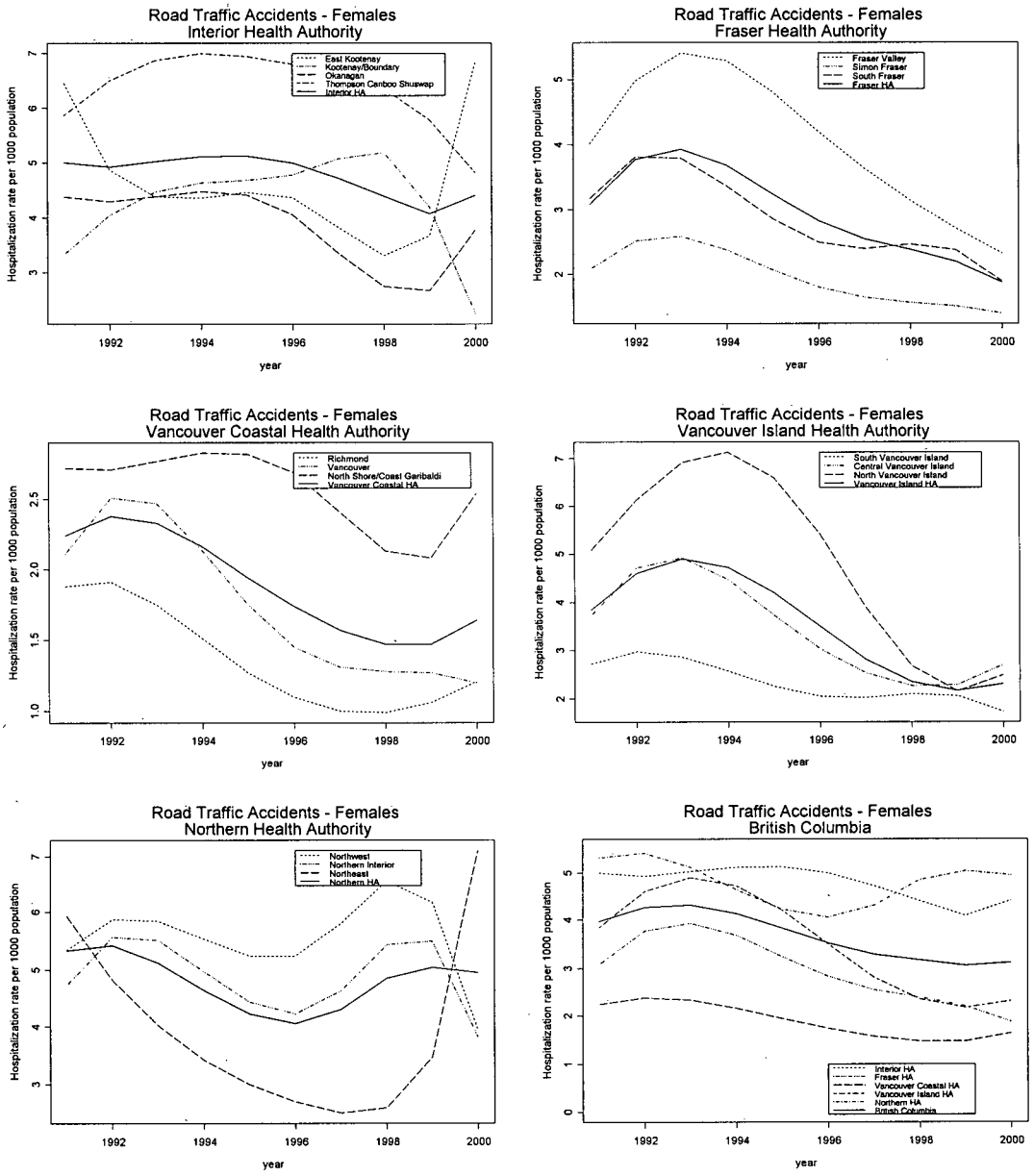


Figure 5.6. Annual Road Traffic Accident Hospitalization Rate per 1,000 Population for Females Aged 20-39 Years, at the Health Services Delivery Area, Health Authority and Provincial Levels, 1991-2000.

5.1.2 Mortality and Hospitalization Rate Ratios

To monitor emerging regional variations, one may plot injury rate ratios during 1991-2000 (Figure 5.7). This figure indicates which HSDAs had rates above (ratio>1) or below (ratio<1) the provincial rate during 1991-2000. For males and females, the ratio between the mortality rates of most HSDAs and BC was flat during 1991-2000. For females, the ratios for the East Kootenay, Kootenay/Boundary and Thompson Cariboo Schuswap HSDAs increased steadily during 1991-2000.

And to monitor emerging patterns over time, one may map injury rate ratios during 1991-2000 (Figure 5.8). The resulting maps provide a visual summary of the spatio-temporal pattern of the mortality ratio estimates during the 10-year study period. Overall, for males, the geographical pattern in the year 2000 was very similar to the pattern in 1991, with no abrupt change over the years. However, for females there was a gradual change in the geographical distribution of the mortality rate ratio from 1991 onward. Additionally, in 2000 more HSDAs had mortality rates higher than the provincial rate.

Additionally, for males in the year 2000, we observed that the Thompson Cariboo Shuswap (ratio=2.01, 95%CI [1.32,2.92]), Northern Interior (ratio=1.56, 95%CI [1.03,2.31]) and Northeast (ratio=1.80, 95%CI [1.11,2.80]) HSDAs had mortality rate ratios that were significantly higher than 1. The Simon Fraser (ratio=0.61, 95%CI [0.40,0.88]), Richmond (ratio=0.59, 95%CI [0.34,0.93]) and Vancouver (ratio=0.42, 95%CI [0.27,0.63]) HSDAs had mortality rate ratios that were significantly less than 1. For females in the year 2000, the Thompson Cariboo Shuswap HSDA (ratio=3.22, 95%CI [1.33,7.91]) had a mortality rate ratio significantly higher than 1.

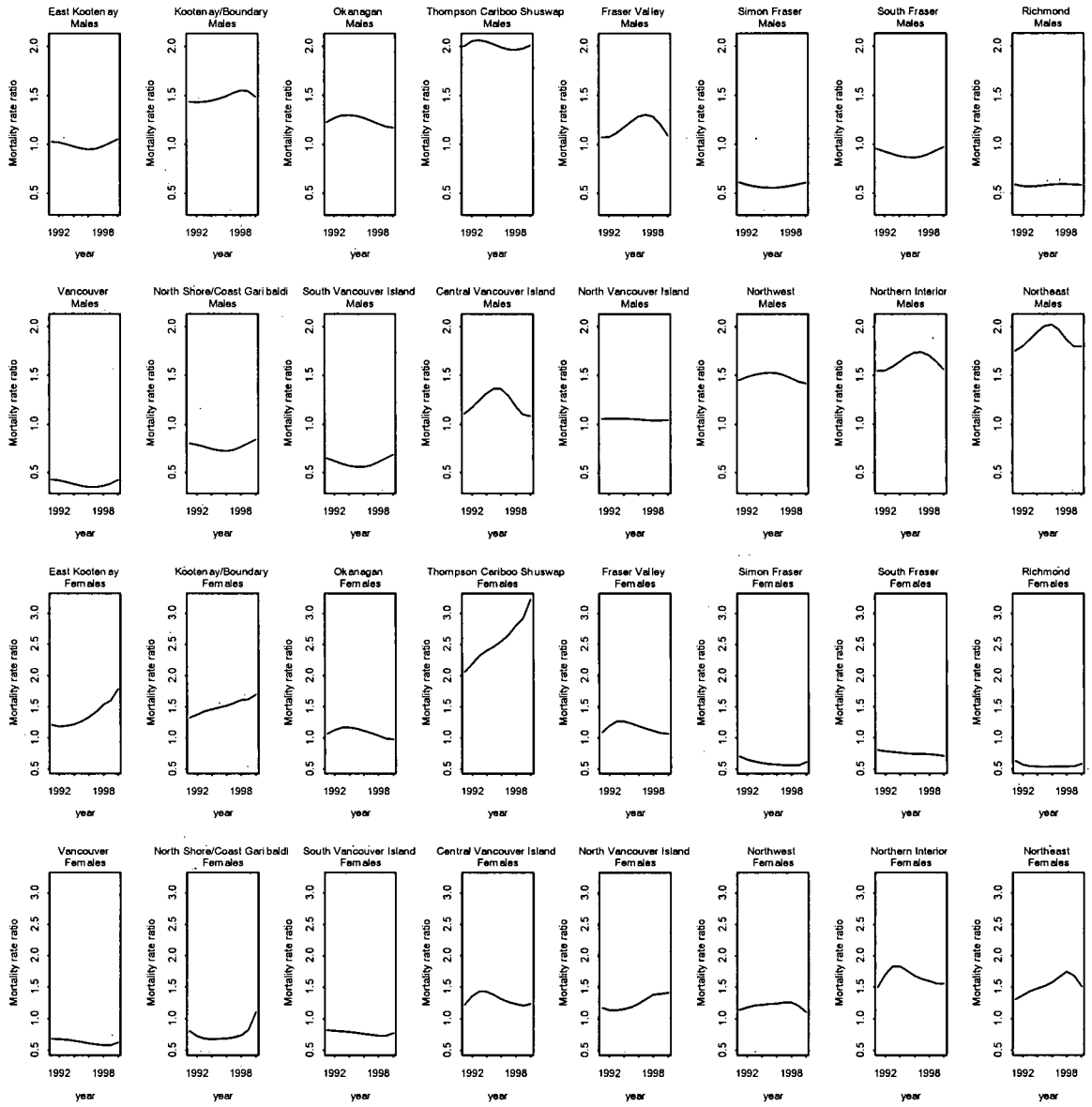


Figure 5.7. Annual Ratio between the Mortality Rates of Each Health Services Delivery Area and British Columbia for Road Traffic Accidents in Males and Females Aged 20-39 Years, 1991-2000.

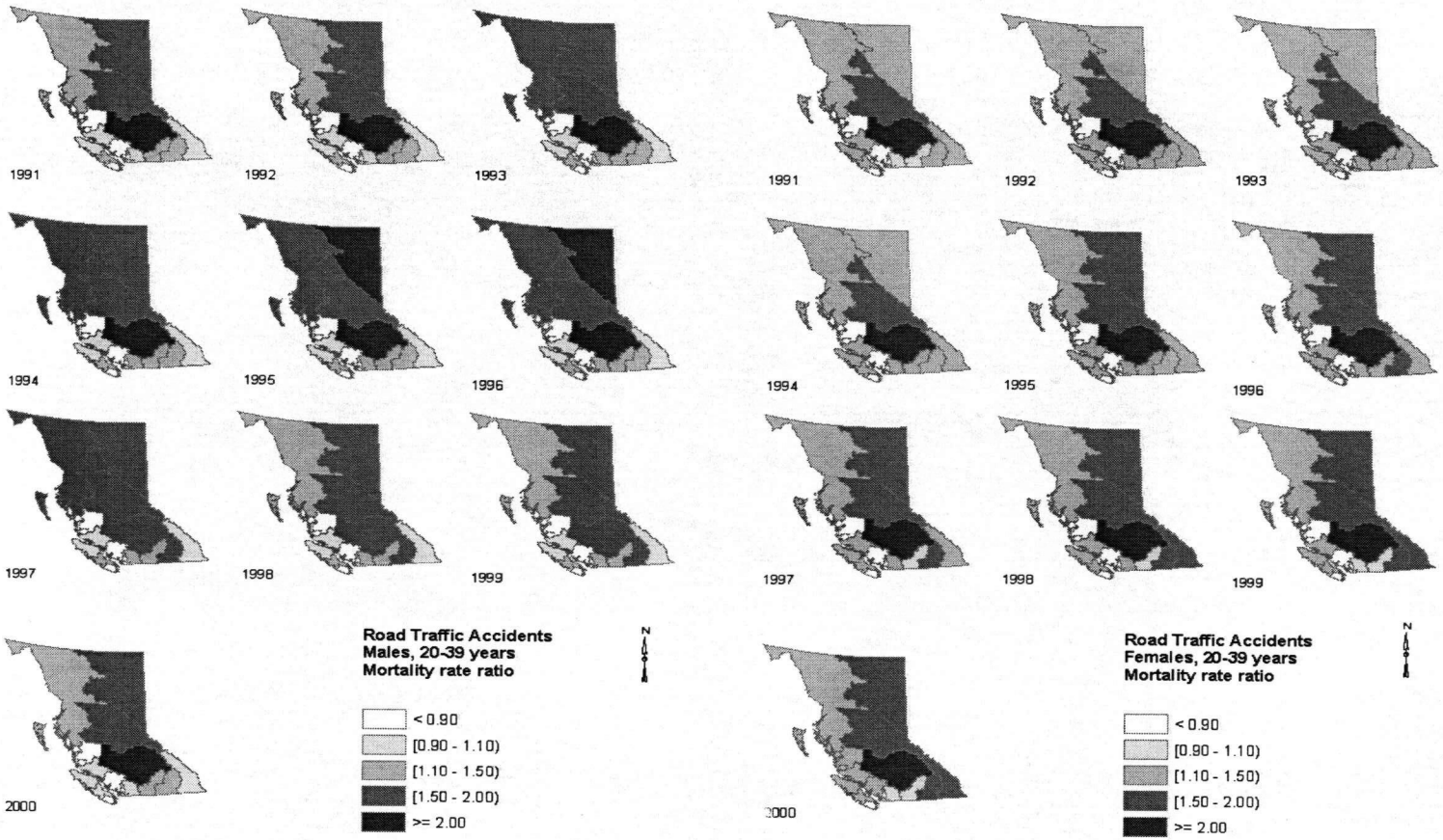


Figure 5.8. Map of the Annual Ratio between the Mortality Rates of Each Health Services Delivery Area and British Columbia for Road Traffic Accidents Experienced by Males and Females Aged 20-39 Years, 1991-2000.

Some results for the analysis of hospitalization data can be found in Figure 5.9. This figure contains annual plots of the ratio between the estimated hospitalization rate of each HSDA and the provincial hospitalization rate due to road traffic accidents for males and females aged 20-39 years.

For males and females, the ratios between the hospitalization rates of each HSDA and BC varied significantly between 1991 and 2000, with the exception of a few HSDAs (*e.g.*, the Simon Fraser and Richmond HSDAs).

Figure 5.10 contains maps of the annual hospitalization rate ratios for road traffic accidents experienced by males and females. For males, note that in contrast to the relatively unchanging mortality rate ratios, there was a gradual change in the geographical distribution of the hospitalization rate ratios from 1991 onward. For females, there was significant variation in the hospitalization rate ratios across most of the HSDAs between 1991 and 2000.

In summary, for males in the year 2000, the HSDAs Kootenay/Boundary (ratio=1.55, 95%CI [1.13,2.10]), Thompson Cariboo Shuswap (ratio=1.63, 95%CI [1.24,2.11]) and Northeast (ratio=1.86, 95%CI [1.38,2.47]) had hospitalization rate ratios significantly higher than 1. The HSDAs Simon Fraser (ratio=0.71, 95%CI [0.55,0.92]), South Fraser (ratio=0.77, 95%CI [0.59,0.99]), Richmond (ratio=0.43, 95%CI [0.31,0.57]) and Vancouver (ratio=0.52, 95%CI [0.40,0.67]) had hospitalization rate ratios significantly less than 1.

For females in the year 2000, the HSDAs Kootenay/Boundary (ratio=2.57, 95%CI [1.79,3.60]), Okanagan (ratio=1.42, 95%CI [1.03,1.93]), Thompson Cariboo Shuswap (ratio=1.82, 95%CI [1.30,2.45]), Northwest (ratio=1.48, 95%CI [1.00,2.10]), Northern Interior (ratio=1.44, 95%CI [1.02,1.96]) and Northeast (ratio=2.68, 95%CI [1.87,3.79]) had hospitalization rate ratios that were significantly higher than 1. The HSDAs Simon Fraser

(ratio=0.52, 95%CI [0.37,0.72]), South Fraser (ratio=0.71, 95%CI [0.50,0.96]), Richmond (ratio=0.45, 95%CI [0.29,0.66]), Vancouver (ratio=0.45, 95%CI [0.32,0.61]) and South Vancouver Island (ratio=0.65, 95%CI [0.46,0.90]) had hospitalization rate ratios significantly less than 1.

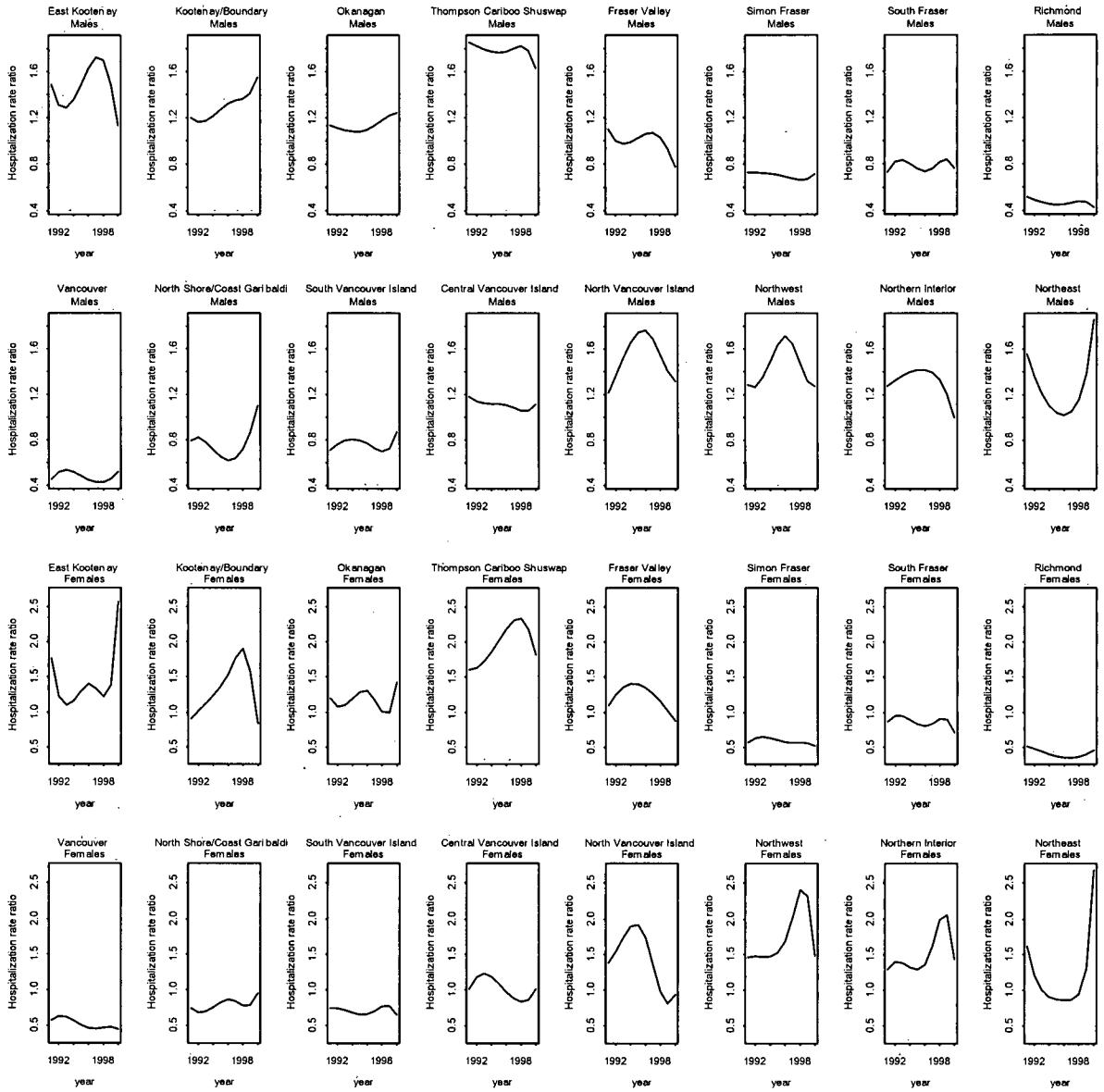


Figure 5.9. Annual Ratio between the Hospitalization Rates for each Health Services Delivery Area and British Columbia for Road Traffic Accidents Experienced by Males and Females Aged 20-39 Years, 1991-2000.

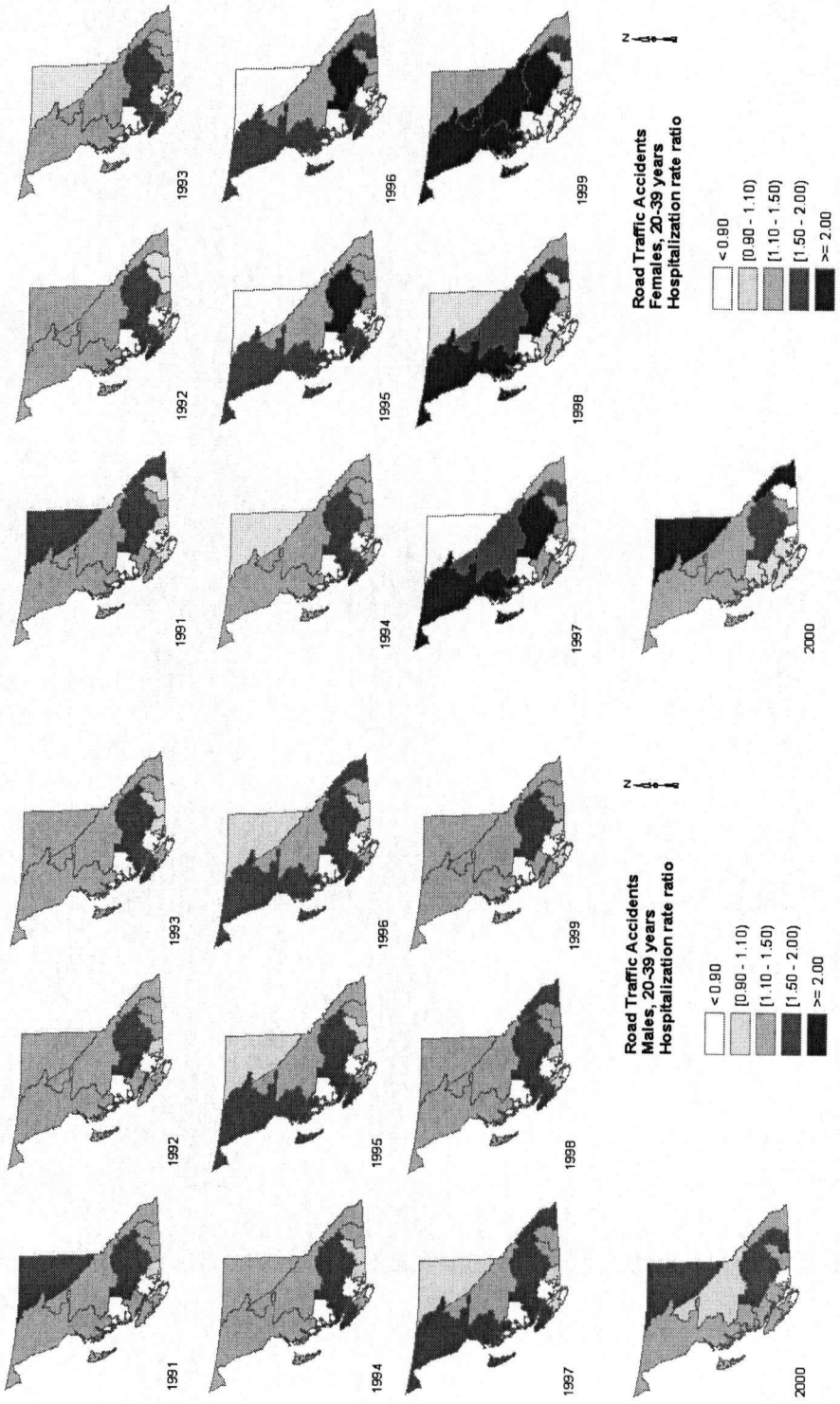


Figure 5.10. Map of the Annual Ratio between the Hospitalization Rates of Each Health Services Delivery Area and British Columbia for Road Traffic Accidents Experienced by Males and Females Aged 20-39 Years, 1991-2000.

5.2 Estimated Disability-Adjusted Life Years

Table 5.2 presents the per capita DALY per 1,000 population due to road traffic accidents for males and females. The cells in Table 5.2 with the per capita DALYs in boldface represent the HSDAs with per capita DALYs that were statistically higher or lower than their respective HA and BC. The HAs with the per capita DALYs statistically higher or lower than BC are also highlighted using boldface text. Appendix G contains the estimated per capita DALY and confidence intervals at the HSDA, HA and BC levels for all years.

In 2000, for males and females, the Thompson Cariboo Shuswap HSDA had the highest per capita DALYs, whereas the Vancouver and Richmond HSDAs had the lowest per capita DALYs for males and females, respectively.

Table 5.2. Regional Per Capita Disability-Adjusted Life Years (DALY) per 1,000 Population Due To Road Traffic Accidents in 2000 for Males and Females Aged 20-39 Years.

HSDA	Age-specific road traffic accident per capita DALY per 1,000 population in 2000 [95% CI]	
	Males	Females
Interior HA	**9.65 [9.05, 10.2]**	**4.61 [3.99, 5.02]**
East Kootenay	**7.23 [6.41, 7.90]**	5.48 [4.51, 5.88]
Kootenay/Boundary	10.1 [8.99, 11.0]	3.35 [2.58, 3.74]
Okanagan	**7.98 [7.34, 8.59]**	3.06 [2.70, 3.39]
Thompson Cariboo Shuswap	**12.5 [11.4, 13.4]**	**6.56 [5.21, 7.42]**
Fraser HA	**5.36 [5.05, 5.65]**	**1.95 [1.74, 2.15]**
Fraser Valley	6.53 [5.86, 7.10]	**2.54 [2.15, 2.87]**
Simon Fraser	**4.30 [3.97, 4.61]**	**1.47 [1.25, 1.68]**
South Fraser	5.97 [5.50, 6.38]	1.83 [1.59, 2.06]
Vancouver Coastal HA	**3.77 [3.53, 3.99]**	**1.81 [1.58, 1.98]**
Richmond	3.54 [3.09, 3.91]	1.36 [1.07, 1.59]
Vancouver	**3.03 [2.79, 3.25]**	1.41 [1.21, 1.59]
North Shore / Coast Garibaldi	6.24 [5.69, 6.68]	2.65 [2.14, 2.89]
Vancouver Island HA	5.98 [5.60, 6.32]	**2.63 [2.31, 2.87]**
South Vancouver Island	**5.01 [4.58, 5.36]**	**1.86 [1.57, 2.10]**
Central Vancouver Island	**7.31 [6.63, 7.94]**	2.95 [2.50, 3.30]
North Vancouver Island	**7.64 [6.79, 8.35]**	3.08 [2.41, 3.46]
Northern HA	**9.77 [9.07, 10.4]**	**4.16 [3.76, 4.49]**
Northwest	9.12 [8.20, 9.95]	3.32 [2.83, 3.73]
Northern Interior	9.09 [8.17, 9.90]	3.88 [3.31, 4.34]
Northeast	**12.1 [10.8, 13.2]**	**5.28 [4.58, 5.76]**
BC	5.96 [5.69, 6.22]	3.13 [2.88, 3.33]

Next, Figures 5.11-5.12 show the annual DALY trends for road traffic accidents per capita for males and females during 1991-2000. Observe that for males, the mortality trend for each region highly influenced the trend of the regional per capita DALY. For females, the trend in per capita DALY in each region was influenced by both mortality and hospitalization trends.

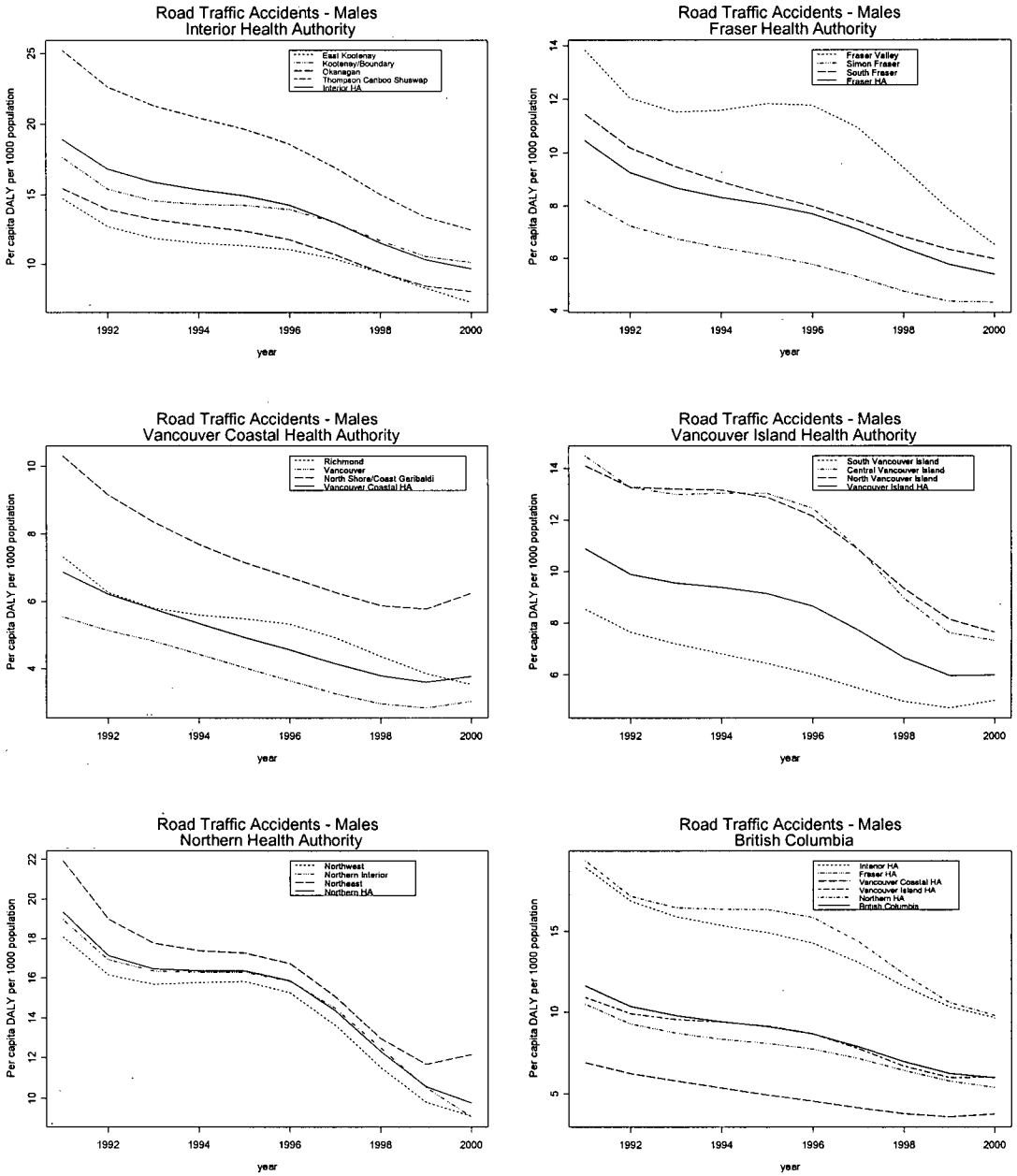


Figure 5.11. Annual Per Capita Disability-Adjusted Life Years per 1,000 Population for Road Traffic Accidents Experienced by Males Aged 20-39 Years at the Health Services Delivery Area, Health Authority and Provincial Levels, 1991-2000.

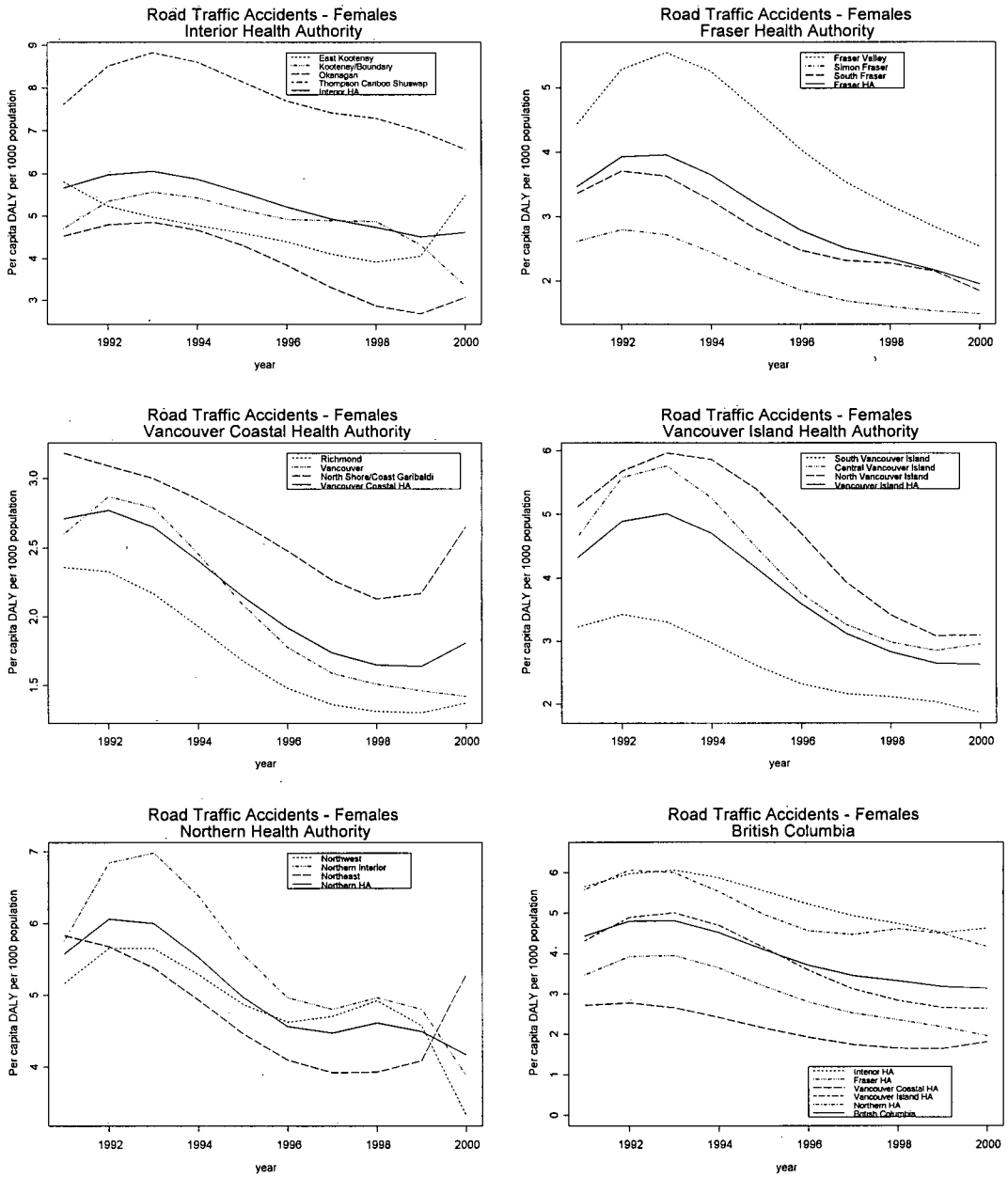


Figure 5.12. Annual Per Capita Disability-Adjusted Life Years per 1,000 Population for Road Traffic Accidents Experienced by Females Aged 20-39 Years at the Health Services Delivery Area, Health Authority and Provincial Levels, 1991-2000.

Figure 5.13 contains the per capita DALY plots for both genders, the ratio between the per capita DALY of each HSDA and the provincial per capita DALY. Note that for both genders in a few HSDAs, the per capita DALY ratio varied significantly during 1991-2000.

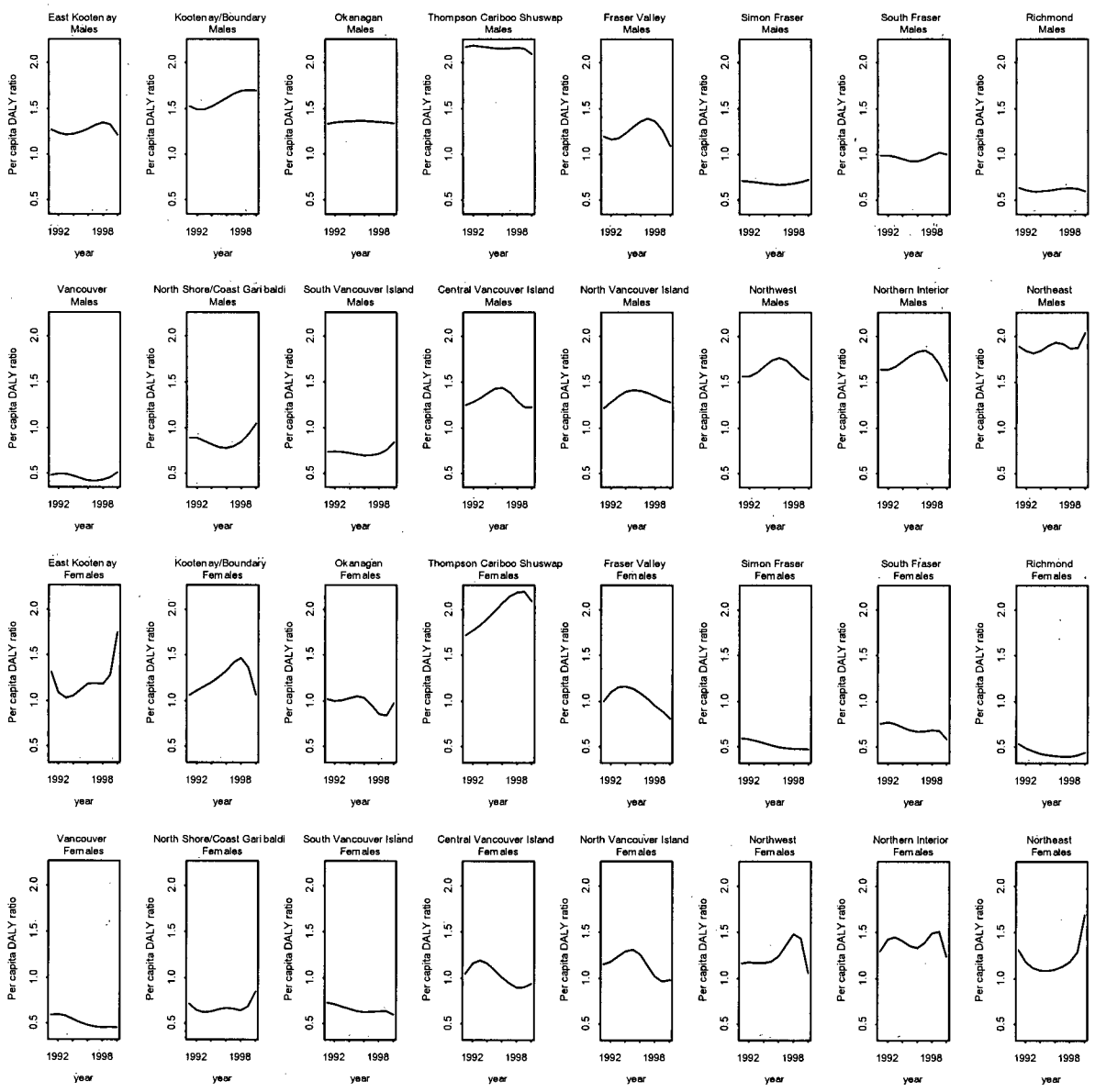


Figure 5.13. Annual Ratio between the Per Capita Disability-Adjusted Life Years of Each Health Services Delivery Area and British Columbia for Road Traffic Accidents Experienced by Males and Females Aged 20-39 Years.

To conclude the results presented in this chapter, Figure 5.14 maps the per capita DALY ratio during 1991-2000. Observe that these maps have a very different spatial pattern in comparison to the maps of rate ratios for mortality and hospitalization, and gradual changes are observed from 1991 to 2000 in the per capita DALY ratios for both males and females.

As mentioned in section 3.2, the main goal of using Bayesian disease mapping modeling approach in this study is to remove the chance variation among the spatial units, and at the same time model the systematic variability due to unmeasured risk factors, to then uncover the true underlying variation among different spatial units.

The variability in mortality rate among different regions might be explained by risk factors such as differences in mode of transport, road and climate conditions, driver's risk behaviours, number of hours or miles/kilometres travelled, socio-economic factors, and so on. We noticed that even though the mortality rate is decreasing for all regions, the mortality rate ratio showed a consistent pattern over time for most regions, which might be explained by the success of efforts to reduce road traffic accidents in different regions, and thus reducing the case fatality related to road traffic accidents.

Note that the hospitalization rates of different regions present a much higher variability over time than the mortality rates (see Tables G.12 and G.13 for the values of σ_{φ}). In addition, observe that in contrast to the mortality rate, the hospitalization rate is not decreasing in all regions, and the hospitalization rate ratio has been constantly changing over time. The risk factors that might have influenced the regional variability in hospitalization rates, beside the ones for mortality, have to do for example, with the annual supply level of

health services in different regions, such as the number of medical health professionals, hospital beds, ambulances, and efficiency in the delivery of emergency services.

In order to explain the regional variation in DALY, remember that DALY is a composite measure involving information on both premature mortality and years lived with disability. Note that the per capita DALY has been decreasing in all regions, and the per capita DALY ratio showed a varying pattern over time for most regions (showing that the DALY declining pace has been different among regions). Changes in the spatial distribution of DALY over time are largely related to the severity of the accident, type of sequelae caused by the accident, and possibly to the risk factors mentioned above.

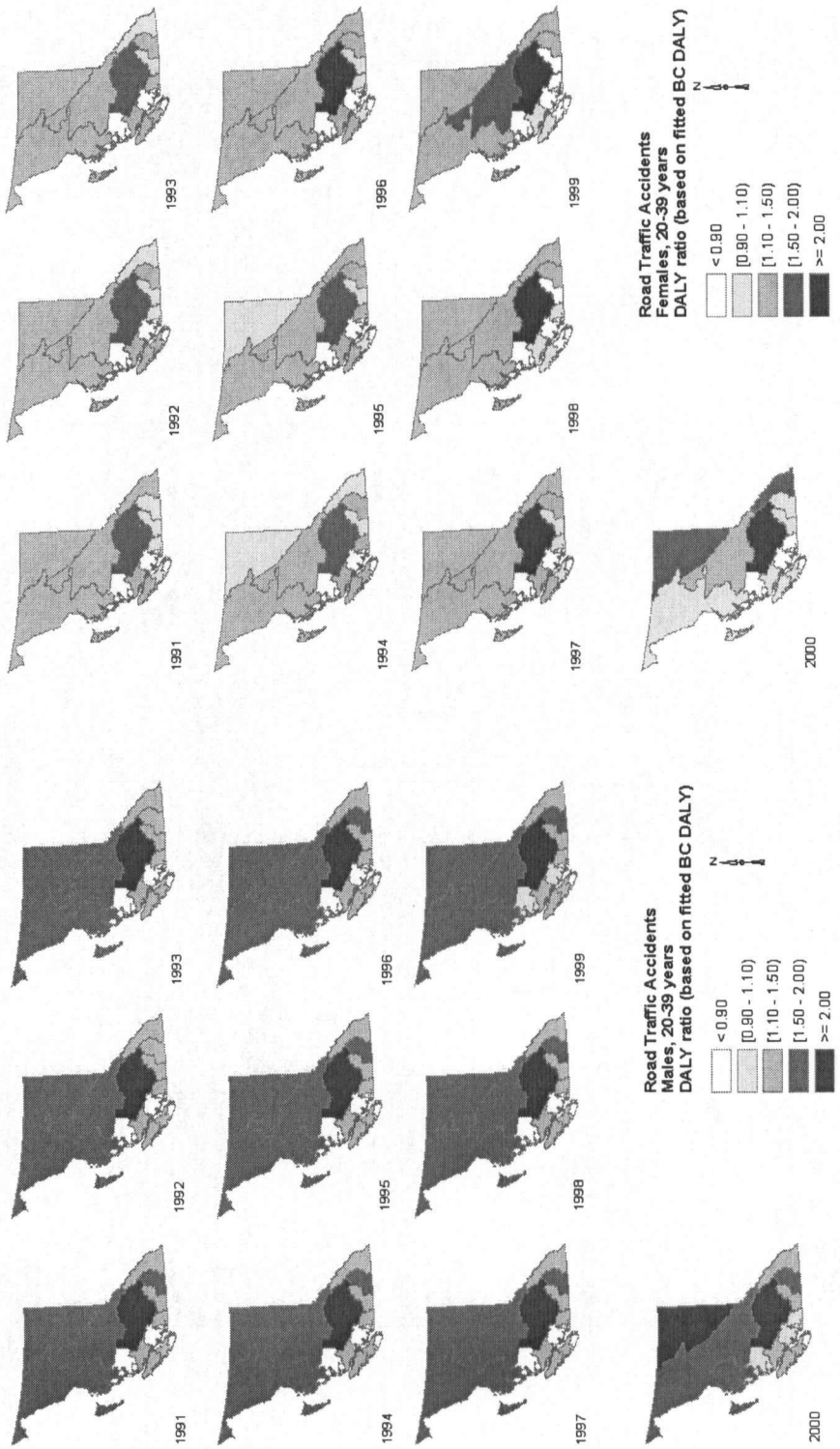


Figure 5.14. Map of the Annual Ratio between the Per Capita Disability-Adjusted Life Years of Each Health Services Delivery Area and British Columbia for Road Traffic Accidents Experienced by Males and Females Aged 20-39 Years.

Chapter 6

A Small-area Analysis of the Incidence of Medical Adverse Events in British Columbia

In this chapter we examine patterns, variations, and trends in small-area incidence of injuries due to medical adverse events in the 16 health service delivery areas (HSDA) of British Columbia. For illustrational purposes, we present the results of the small-area analysis for the age groups 0-19 years and 65-79 years. It is novel to the literature on medical adverse events to assess the impact of injuries due to AEs among children and youth (ages between 0 and 19 years), at the population level, and over an extensive period of time. In addition, we present the results for the age group 65-79 years, because this age group had the highest impact of injuries due to AE during the entire study period. The results and figures presented in this chapter for the other age groups can be found in Appendix G. In addition, the estimated parameters for model (3.1) (described in section 3.2.1), based on the AE incidence data of males and females for all other age groups, can be found in Appendix G.

6.1 Descriptive Statistics for Medical Adverse Events

During 1991-2000 there were 3.1 million hospital admissions (all causes) for males and 4 million hospital admissions (all causes) for females in BC. For the year 2000, the number of hospital admissions (all causes) was 312,832 for males and 399,699 for females. In addition,

the hospital admission rates due to all causes decreased for males and females during 1991-2000 (Figure 6.1).

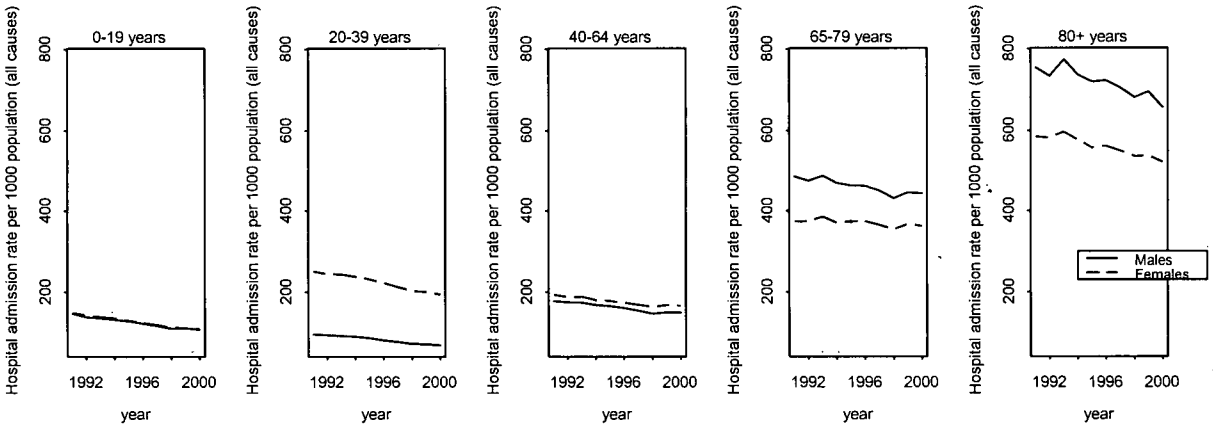


Figure 6.1. Annual Age-Specific Hospital Admission Rates per 1,000 Population for Both Genders Combined, 1991-2000.

In this study, a medical adverse event (or AE) is defined as an adverse event, a postoperative complication, or a medical/surgical misadventure defined by the ICD9 E-codes E870-E876, E878-E879 and E930-E949. Based on this definition there were 161,411 hospital separation records for males and 158,958 hospital separation records for females that contained at least one of the ICD9 E-codes defining an AE between the years 1991 and 2000. Although medical adverse events rarely result in death, during 1991-2000 there were 457 deaths among males and females with AEs as the underlying cause of death.

Table G.6-G.9 (see Appendix G) presents the distribution of in-hospital incidents associated with each of the ICD9 E-codes defining an AE during 1991-2000. The majority of medical adverse event incidents were associated with the E-codes E878-E879 (*i.e.*, surgical and medical procedures as the cause of abnormal reaction of patient or later complication,

without mention of misadventure at the time of procedure) for both males (88% of all medical AEs that occurred during hospital stay) and females (84% of all medical AEs that occurred during hospital stay). Moreover, the E-codes E878-E879 were also identified as being responsible for the majority of medical adverse events that resulted in death for both males (54% of all injury-related deaths) and females (52% of all injury-related deaths).

6.2 Estimated Medical Adverse Event Incidence Rates

Between 1991 and 2000, the estimated BC average AE incidence rate (parameter m) per 100 admissions varied from 1.40 [1.28, 1.53] (age group 0-19 years) to 6.28 [5.55, 7.07] (age group 65-79 years) for males, and from 1.11 [0.99, 1.24] (age group 0-19 years) to 5.87 [5.24, 6.55] (age group 65-79 years) for females. Table 6.1 shows the estimated provincial AE incidence rate per 100 admissions in 2000. Note that for only the age groups 0-19 and 20-39 years, and for all ages combined, was the estimated AE incidence rate statistically different between males and females, with males having a higher rate.

Table 6.1. Estimated Provincial Annual Medical Adverse Event Incidence Rates (Age-Specific and Age-Standardized) per 100 Admissions by Gender for the Year 2000 (Standard Population: Hospital Admission Due To All Causes for Both Males and Females).

Provincial estimated AE rate per 100 admissions (2000)			
Age	Males	Females	Both
0 - 19	1.93 [1.75, 2.11]	1.52 [1.35, 1.71]	1.70 [1.52, 1.88]
20 - 39	3.75 [3.27, 4.27]	2.02 [1.82, 2.24]	2.77 [2.45, 3.12]
40 - 64	4.94 [4.26, 5.69]	4.53 [4.04, 5.05]	4.71 [4.14, 5.33]
65 - 79	6.87 [5.93, 7.88]	5.68 [4.95, 6.53]	6.20 [5.38, 7.12]
80+	5.79 [4.85, 6.88]	4.65 [3.64, 5.86]	5.15 [4.17, 6.30]
Age-standardized	4.96 [4.41, 5.56]	3.91 [3.49, 4.36]	4.37 [3.89, 4.88]

To illustrate the impact of using a model fitting approach for the analysis of AE data we plotted the annual conventional and estimated AE incidence rates during 1991-2000 for the age groups 0-19 and 65-79 years (Figures 6.2 and 6.3, respectively). Observe that the conventional AE incidence rates fluctuated over the years due to chance variation and that the estimated AE rates show a smooth trend during the ten-year period. In addition, note how different the trends are between males and females, and between the age groups 0-19 and 65-79 years.

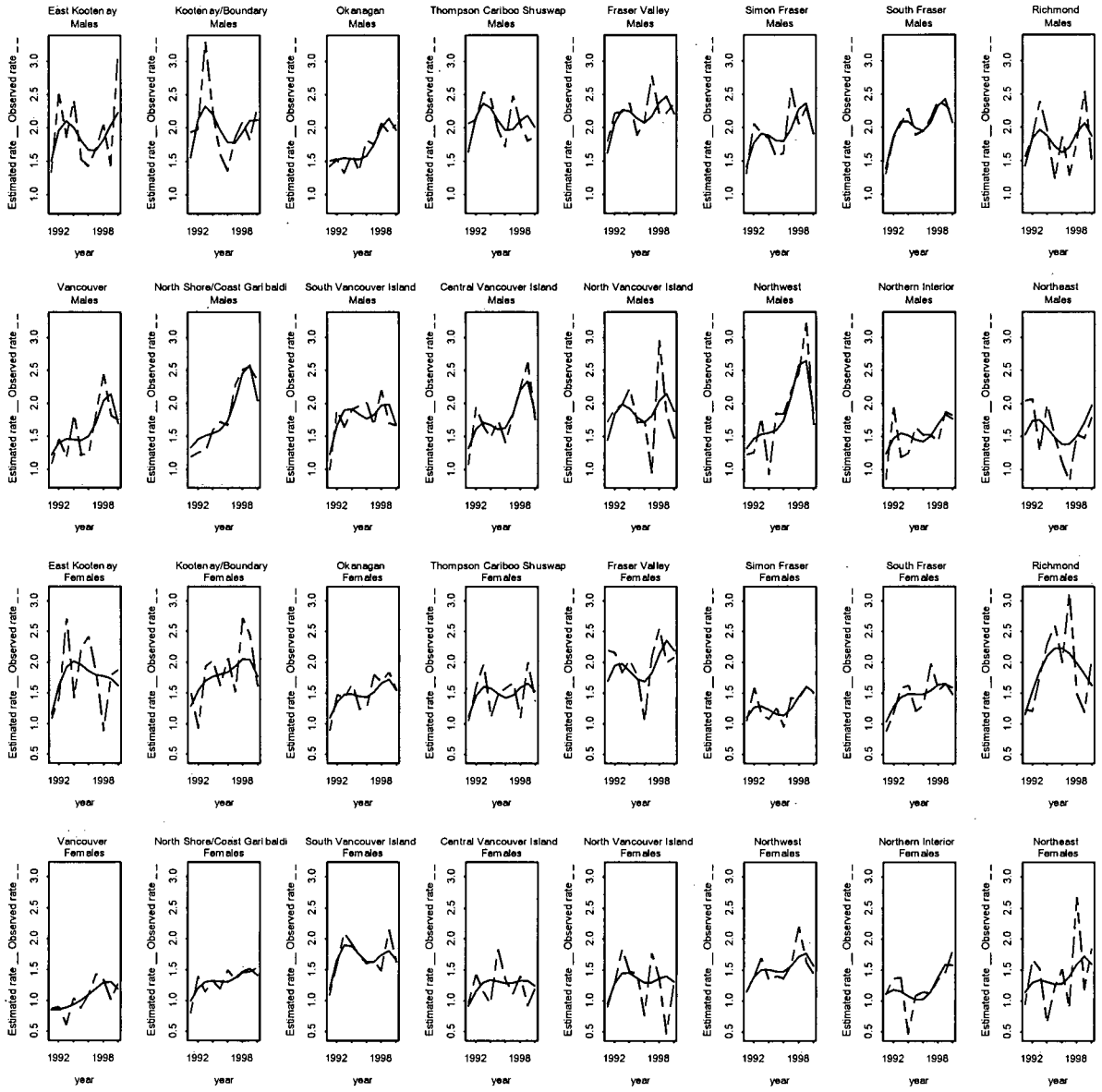


Figure 6.2. Conventional and Estimated Annual Medical Adverse Event Incidence Rates per 100 Admissions by Health Services Delivery Area for Boys and Girls Aged 0-19 Years, 1991-2000.

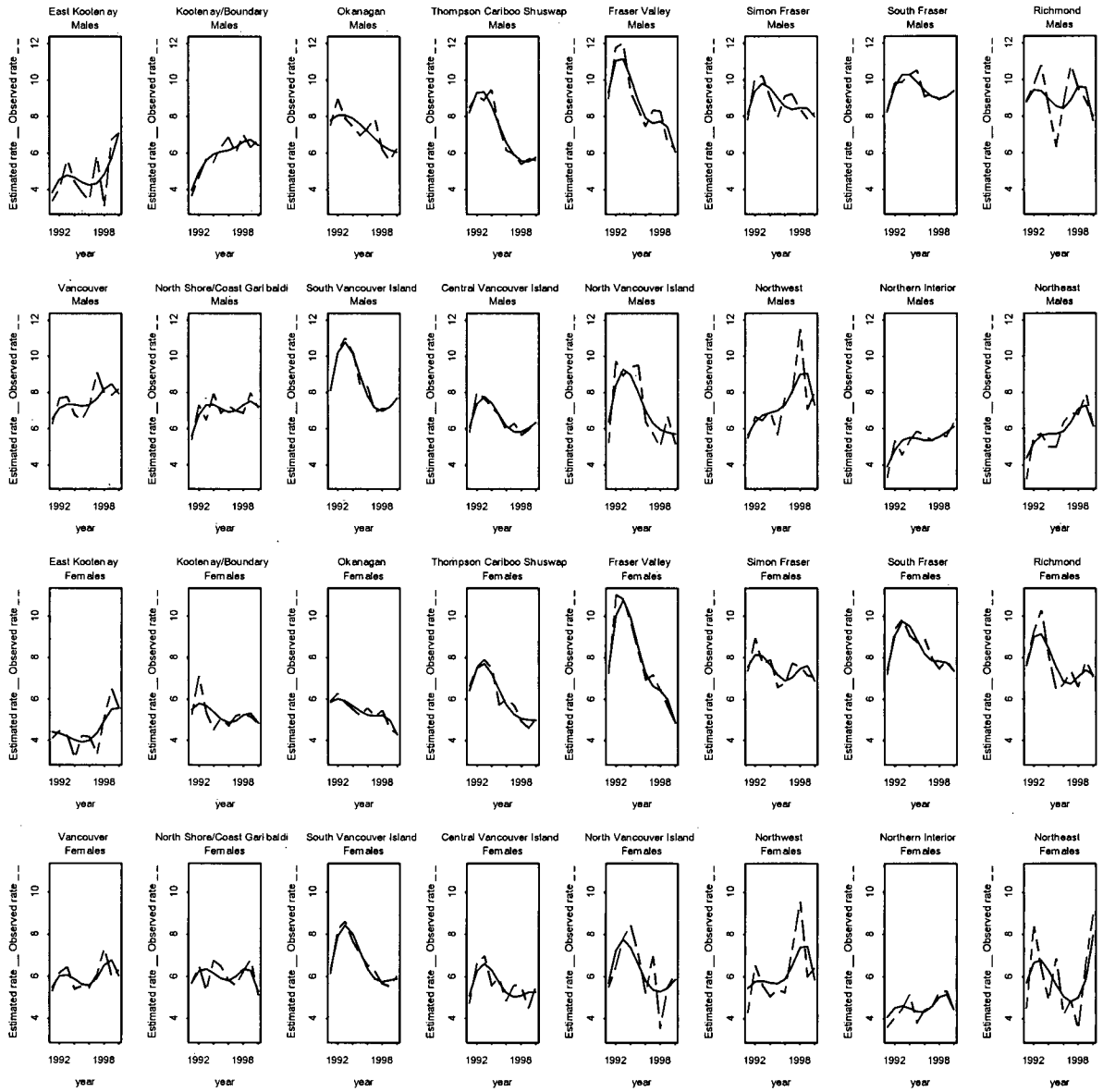


Figure 6.3. Conventional and Estimated Annual Medical Adverse Event Incidence Rates per 100 Admissions by Health Services Delivery Area for Males and Females Aged 65-79 Years, 1991-2000.

6.2.1 Comparison of the Annual Estimated Rates among Different Geographical Layers in the Provincial Health Care System

Table 6.2 shows the estimated AE incidence rates in 2000 for males and females in the age groups 0-19 and 65-79 years. The cells in Tables 6.2 with the rates in boldface represent the HSDAs that had rates statistically higher or lower than their respective HA and the province of BC as a whole. In addition, HAs with rates statistically higher or lower than the BC rate are also boldfaced.

Considering only the year 2000, Table 6.2 shows that for people between 0 and 19 years of age, the East Kootenay and Fraser Valley HSDAs had the highest AE incidence rates for boys and girls, respectively; and the South Vancouver Island and Vancouver HSDAs had the lowest AE incidence rates for boys and girls, respectively. Also note that the regions with a higher AE rate in 2000 tended to be clustered in the southeast regions of BC (boys and girls).

Moreover, Table 6.2 also shows that in 2000, for those aged 65 to 79 years, the South Fraser and Northeast HSDAs had the highest AE incidence rate for males and females, respectively; and the North Vancouver Island and Okanagan HSDAs had the lowest AE incidence rate for males and females, respectively. Observe that the regions with higher rates in 2000 are clustered in the urban health authorities located in the southwest of BC (males and females).

Table 6.2. Regional Medical Adverse Event Incidence Rate per 100 Admissions in 2000 for Males and Females Aged 0-19 and 65-79 Years.

HSDA	Medical AE rates per 100 admissions in 2000 [95% CI]		Medical AE rates per 100 admissions in 2000 [95% CI]	
	0-19 years		65-79 years	
	Boys	Girls	Males	Females
Interior HA	2.02 [1.95, 2.10]	1.57 [1.51, 1.62]	6.13 [6.01, 6.24]	**4.69 [4.58, 4.79]**
East Kootenay	2.22 [1.79, 2.81]	1.61 [1.28, 2.00]	7.08 [6.06, 8.22]	5.56 [4.62, 6.62]
Kootenay/Boundary	2.11 [1.70, 2.61]	1.77 [1.39, 2.19]	6.45 [5.56, 7.37]	4.84 [4.08, 5.67]
Okanagan	1.95 [1.66, 2.28]	1.53 [1.29, 1.80]	6.06 [5.59, 6.57]	4.29 [3.87, 4.72]
Thompson Cariboo Shuswap	2.00 [1.61, 2.39]	1.52 [1.28, 1.80]	5.76 [5.17, 6.39]	4.99 [4.44, 5.58]
Fraser HA	2.04 [1.98, 2.10]	1.65 [1.59, 1.70]	**8.10 [7.98, 8.21]**	6.62 [6.52, 6.73]
Fraser Valley	2.20 [1.87, 2.55]	**2.18 [1.84, 2.52]**	6.07 [5.48, 6.67]	4.86 [4.32, 5.44]
Simon Fraser	1.90 [1.65, 2.15]	1.51 [1.30, 1.73]	7.97 [7.44, 8.53]	6.86 [6.33, 7.40]
South Fraser	2.07 [1.82, 2.34]	1.47 [1.29, 1.68]	**9.37 [8.81, 9.96]**	**7.34 [6.84, 7.86]**
Vancouver Coastal HA	1.82 [1.75, 1.88]	1.31 [1.26, 1.37]	7.68 [7.54, 7.82]	5.96 [5.84, 6.08]
Richmond	1.86 [1.50, 2.25]	1.62 [1.30, 1.99]	7.74 [6.74, 8.81]	7.15 [6.23, 8.15]
Vancouver	1.69 [1.46, 1.94]	1.18 [1.01, 1.38]	7.92 [7.37, 8.49]	6.02 [5.53, 6.54]
North Shore / Coast Garibaldi	2.03 [1.71, 2.45]	1.40 [1.17, 1.67]	7.23 [6.54, 7.96]	5.29 [4.71, 5.91]
Vancouver Island HA	1.75 [1.68, 1.81]	1.47 [1.41, 1.53]	7.03 [6.90, 7.17]	5.66 [5.53, 5.78]
South Vancouver Island	1.66 [1.41, 1.92]	1.65 [1.43, 1.90]	7.69 [7.16, 8.24]	5.89 [5.43, 6.39]
Central Vancouver Island	1.84 [1.54, 2.18]	1.24 [1.02, 1.47]	6.34 [5.78, 6.93]	5.27 [4.74, 5.83]
North Vancouver Island	1.88 [1.44, 2.32]	1.30 [1.00, 1.64]	5.70 [4.53, 7.03]	5.85 [4.66, 7.27]
Northern HA	1.83 [1.75, 1.91]	1.57 [1.50, 1.63]	6.48 [6.24, 6.71]	5.52 [5.30, 5.74]
Northwest	1.85 [1.51, 2.25]	1.56 [1.26, 1.88]	7.32 [6.13, 8.64]	5.86 [4.75, 7.10]
Northern Interior	1.76 [1.45, 2.10]	1.57 [1.31, 1.90]	6.10 [5.21, 7.07]	4.42 [3.69, 5.25]
Northeast	1.97 [1.52, 2.44]	1.59 [1.26, 1.97]	6.14 [4.82, 7.61]	7.94 [6.34, 9.86]
BC	1.93 [1.75, 2.11]	1.52 [1.35, 1.71]	6.87 [5.93, 7.88]	5.68 [4.95, 6.53]

In the following two sub-sections we present a few figures comparing the annual trend of the AE incidence rates for males and females separately for the age groups 0-19 and 65-79 years, across the different levels of the geographical hierarchy.

6.2.1.1 Age Group 0-19 Years

Figures 6.4-6.5 compare the AE incidence trends during 1991-2000 at the HSDA, HA and BC levels for boys and girls, respectively. Overall, the fitted temporal splines capture moderate curvature in the underlying regional rates, as seen in Figures 6.4 and 6.5. Note that the overall annual AE incidence rates for the province, health authorities and most health service delivery areas tended to increase over the decade of observation. Also note that the AE incidence rates of most health service delivery areas followed the trend associated with their respective health authorities. There were however, several health service delivery areas for which the increase in AE incidence rate was far faster than that of their associated health authority (*e.g.*, the Okanagan (boys) and Kootenay/Boundary (girls) HSDAs).

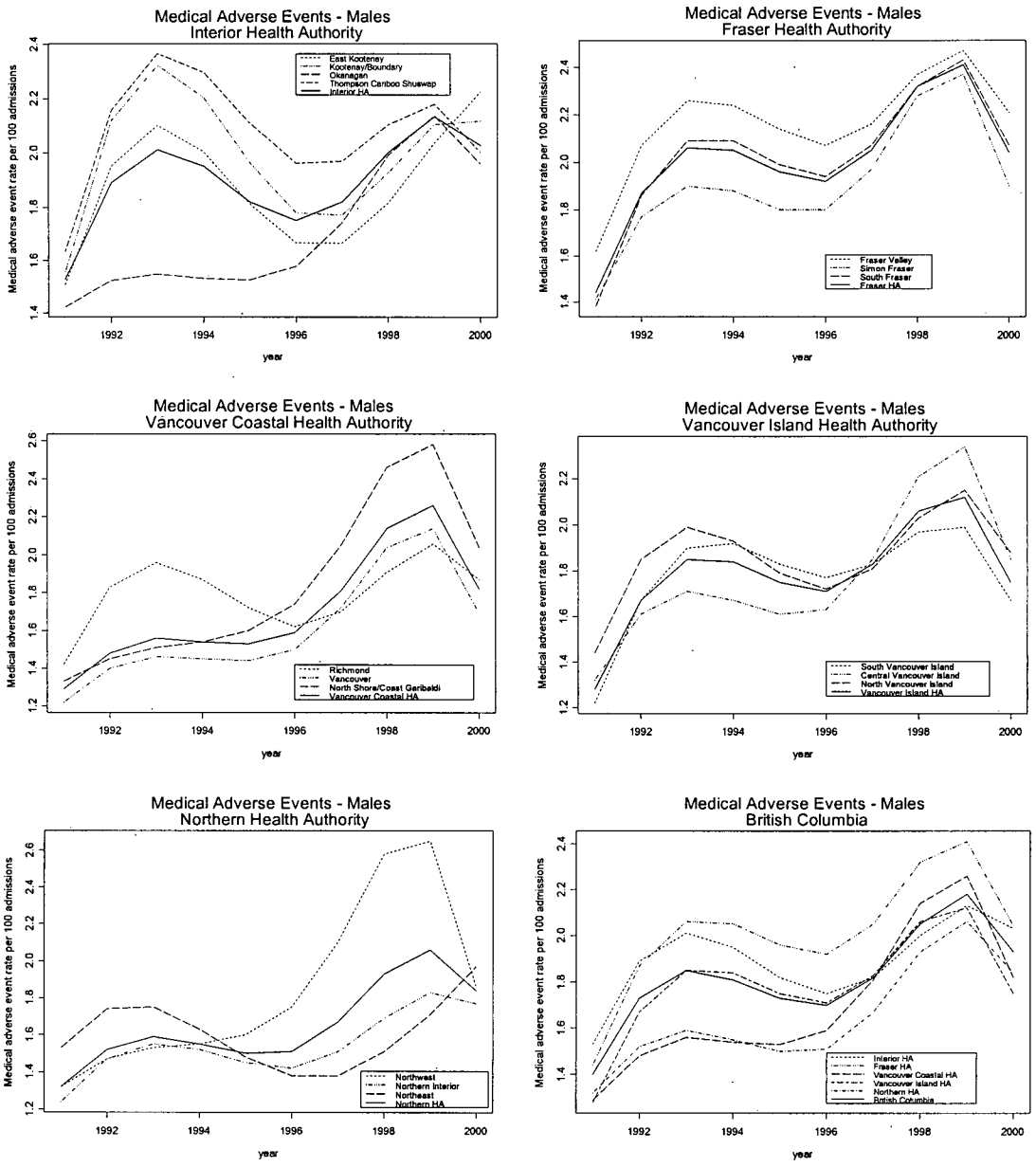


Figure 6.4. Annual Medical Adverse Event Incidence Rates per 100 Admissions For Boys Aged 0-19 Years at the Health Services Delivery Area, Health Authority and Provincial Levels, 1991-2000.

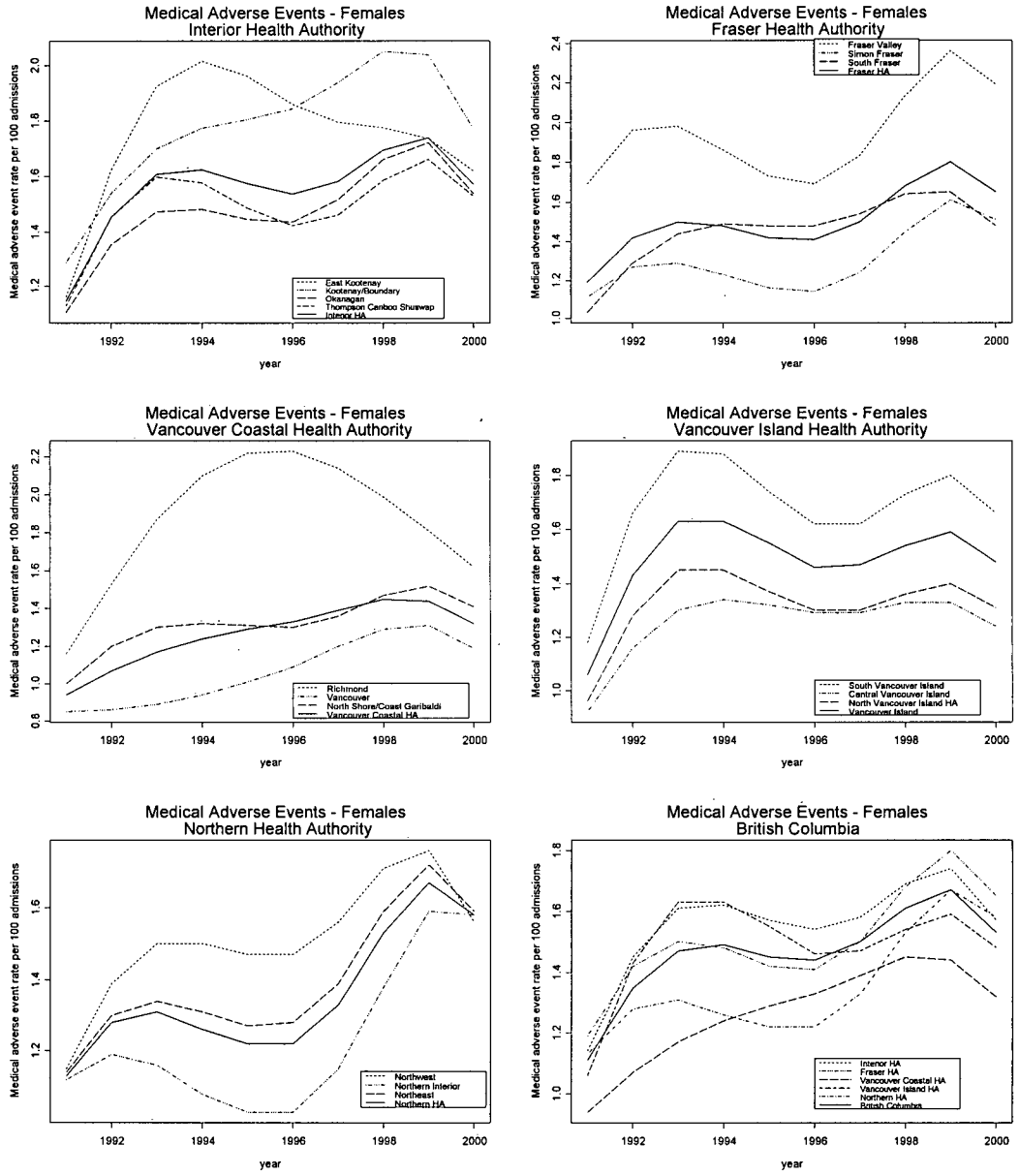


Figure 6.5. Annual Medical Adverse Event Incidence Rates per 100 Admissions for girls Aged 0-19 Years at the Health Services Delivery Area, Health Authority and Provincial Levels, 1991-2000.

Next, Figure 6.6 shows the HSDAs whose estimated AE incidence rates were above (ratio>1) or below (ratio<1) the provincial rate during 1991-2000 for boys and girls.

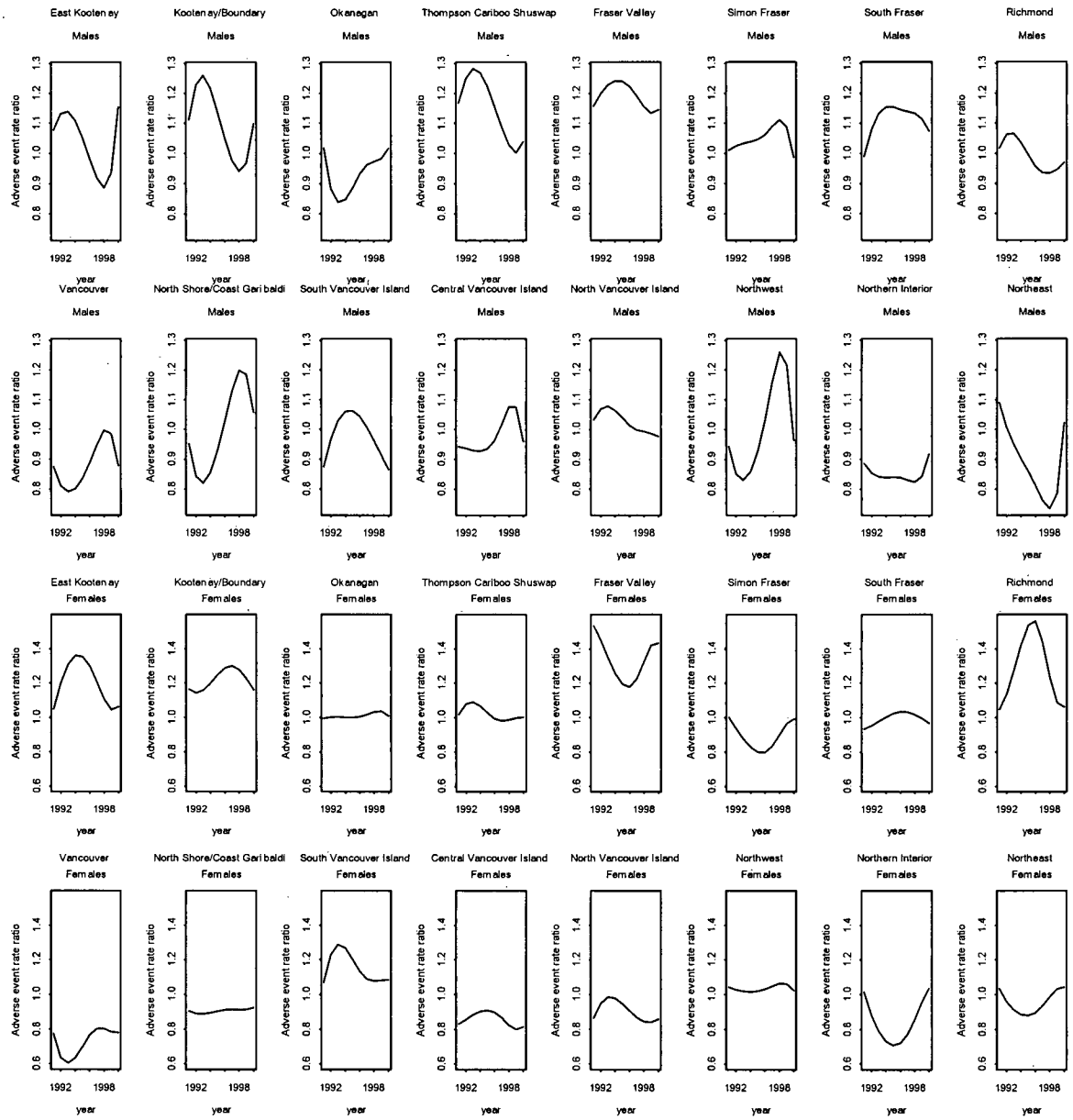


Figure 6.6. Annual Ratio between the Medical Adverse Event Incidence Rate of Each Health Services Delivery Area and British Columbia for Boys and Girls Aged 0-19 Years, 1991-2000.

To provide a visual summary of the spatio-temporal pattern of the AE incidence rate estimates during the 10-year study period, Figure 6.7 maps the annual ratio between the medical adverse events incidence rates of each HSDA and BC for boys and girls.

The map for boys shows a dramatic change in the geographical distribution of AE rate ratios observed in 1991-1999 and in 2000; the pattern of the AE rate ratio is more clearly seen in Figure 6.6, and the abrupt change in pattern especially seen in the Northern regions is worthy more investigation. Note that in contrast to the maps for boys, there was a gradual change in the geographical distribution of the AE rate ratio among girls. It is also important to note that because of the small-area problem (*i.e.*, small population at-risk) in the age group 0-19 years, it was difficult to find HSDAs in which the AE rate ratio was statistically different from 1.

In summary, Figure 6.7 shows that for boys in the year 2000, the East Kootenay (ratio = 1.15, 95%CI [0.94,1.46]), Fraser Valley (ratio = 1.15, 95%CI [0.97,1.34]) and South Fraser (ratio = 1.07, 95%CI [0.93,1.24]) HSDAs had AE rate ratios that were higher than 1 (however not statistically significant). The South Vancouver Island HSDA (ratio = 0.87, 95%CI [0.73,1.01]) had an AE rate ratio lower than 1 (however not statistically significant). For girls in the year 2000, the Fraser Valley HSDA (ratio = 1.43, 95%CI [1.20,1.69]) had AE rate ratio significantly higher than 1. The Kootenay/Boundary HSDA (ratio = 1.16, 95%CI [0.92,1.45]) also had an AE rate ratio that was higher than 1 (however not statistically significant). The Vancouver (ratio = 0.78, 95%CI [0.65,0.92]) and Central Vancouver Island (ratio = 0.81, 95%CI [0.67,0.97]) HSDAs had AE rate ratios that were significantly less than 1. The North Vancouver Island HSDA (ratio = 0.86, 95%CI [0.66,1.07]) had an AE rate ratio lower than 1 (however not statistically significant).

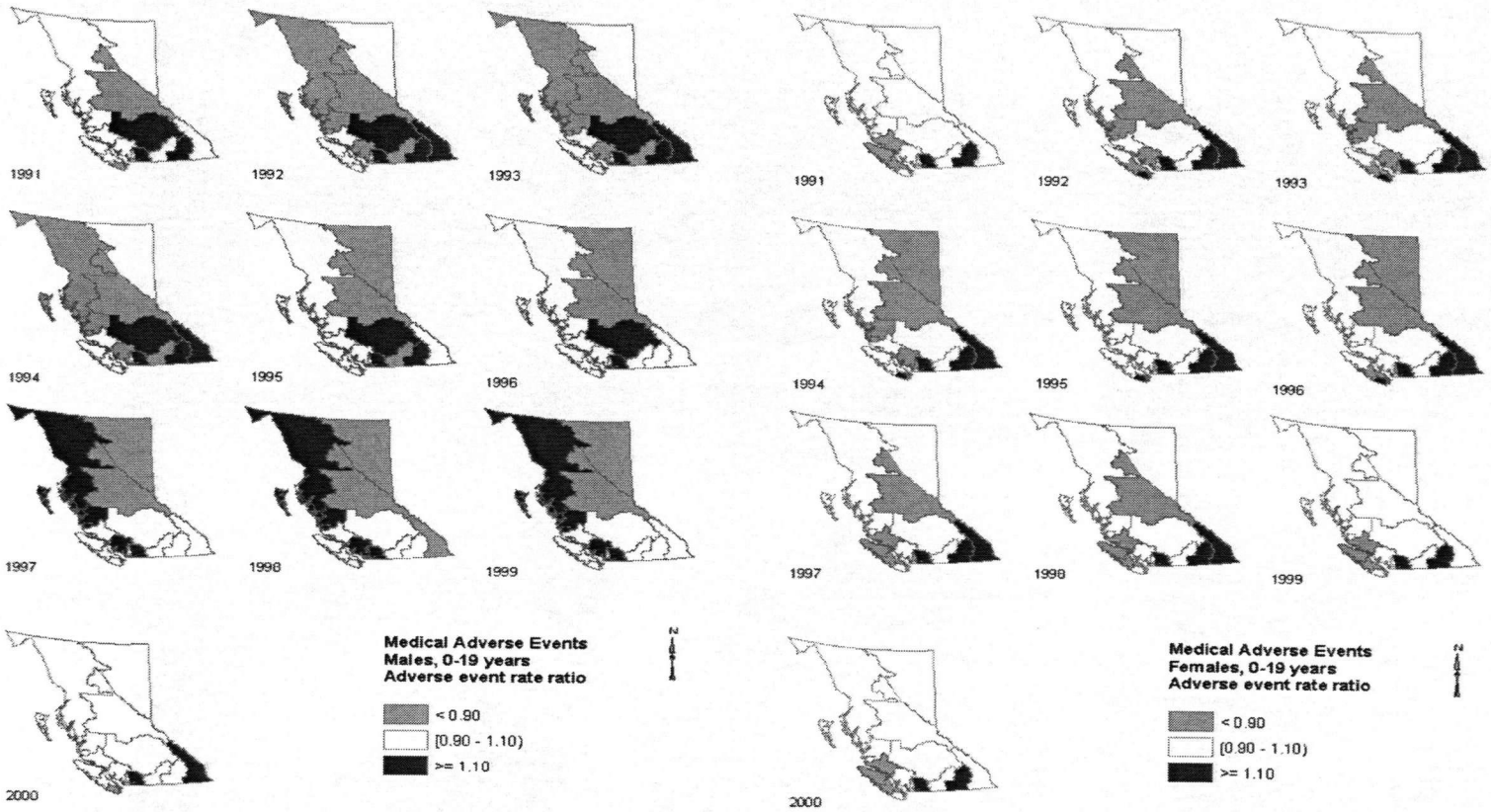


Figure 6.7. Map of Annual Ratio between the Medical Adverse Event Incidence Rate of Each Health Services Delivery Area and British Columbia for Boys and Girls Aged 0-19 Years, 1991-2000.

6.2.1.2 Age Group 65-79 Years

Figures 6.8-6.9 compare the AE incidence trends during 1991-2000 at the HSDA, HA and BC levels, for males and females respectively. The provincial AE incidence trend was mostly flat for males, and it decreased slightly for females. The annual AE incidence rates decreased during 1991-2000 for most health authorities by means of a non-linear temporal trend, with the exception of the Northern HA (both males and females) and Vancouver Coastal HA (for males), in which the AE incidence rates increased over the ten-year period. Observe that in the Northern health authority, the rates of all health service delivery areas increased more distinctively in males than in females from 1991 to 2000. Also note that in the Interior HA, the AE incidence trend of each HSDA was very distinct, with the rates for most health service delivery areas being further apart in 1991, and becoming more similar as we approached the year 2000. Finally, there were certain health service delivery areas for which the AE incidence rate declined far faster than their associated health authorities (*e.g.*, the Fraser Valley HSDA); and there were health service delivery areas with increasing rates over the last four years of the study (*e.g.*, the East Kootenay HSDA).

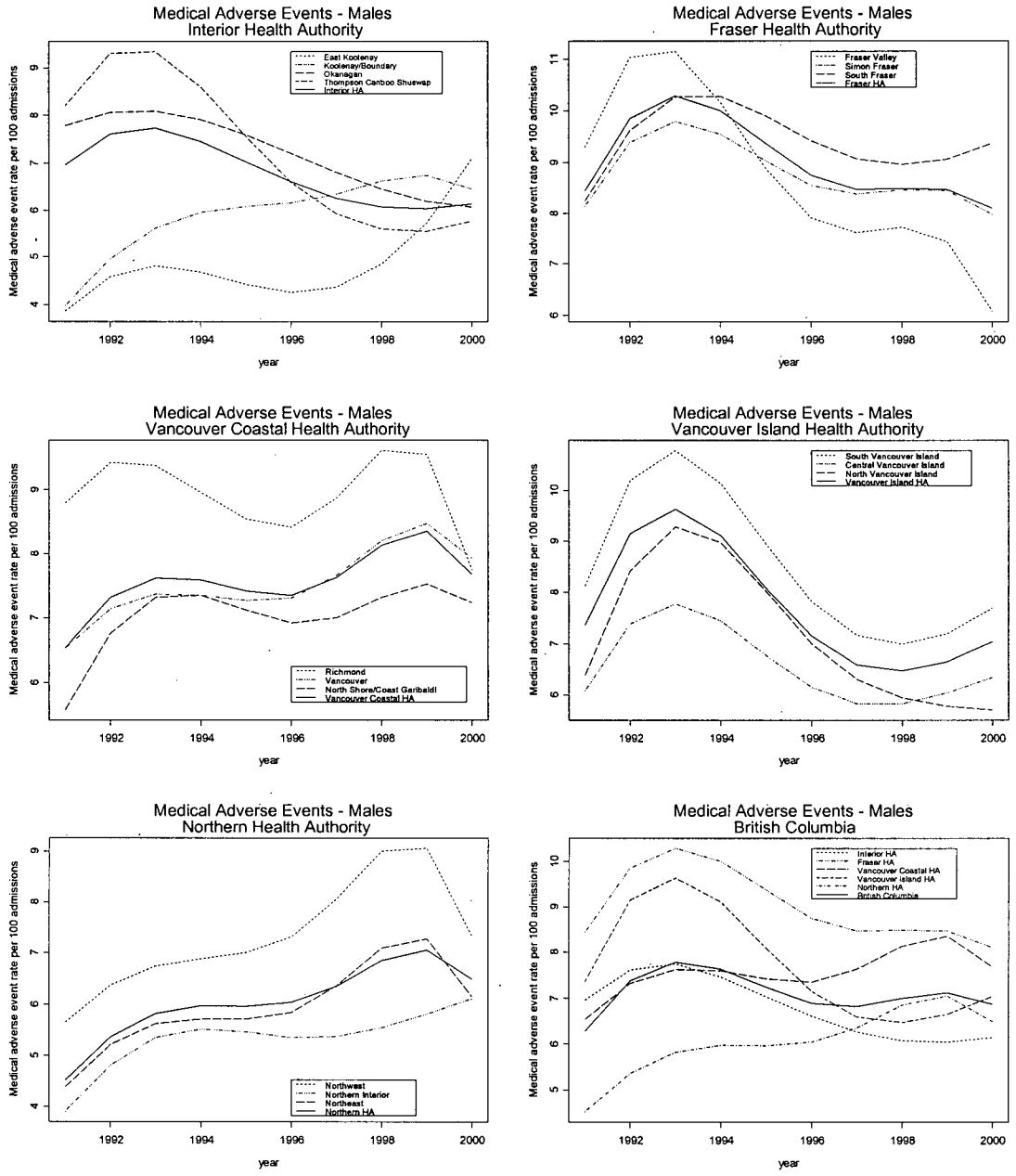


Figure 6.8. Annual Medical Adverse Event Incidence Rates per 100 Admissions for Males Aged 65-79 Years at the Health Services Delivery Area, Health Authority and Provincial Levels, 1991-2000.

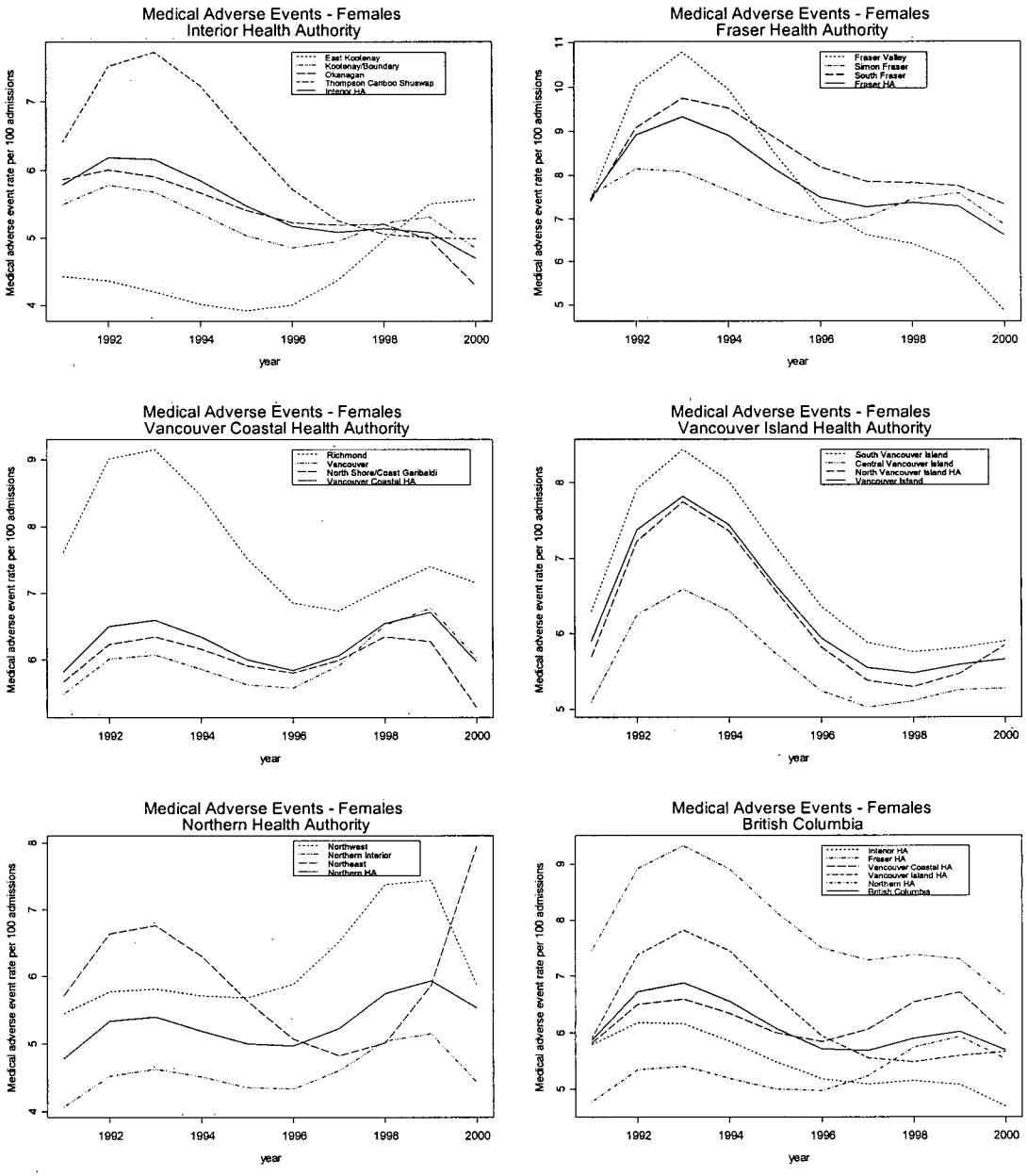


Figure 6.9. Annual Medical Adverse Event Incidence Rates per 100 Admissions for Females Aged 65-79 Years at the Health Services Delivery Area, Health Authority and Provincial Levels, 1991-2000.

Figure 6.10 shows the annual ratios between the AE incidence rate estimate of each HSDA and the provincial AE incidence rate for males and females in the age group 65-79 years. Once more, note how different these trends are between different HSDAs and between males and females within the same HSDA.

To conclude this chapter of the study, Figure 6.11 maps the AE rate ratio estimates of each HSDA relative to BC for males and females between 65 and 79 years of age. Note that for males in the year 2000, the South Fraser (ratio = 1.37, 95%CI [1.18,1.60]) and Richmond (ratio = 1.19, 95%CI [1.04,1.34]) HSDAs had AE rate ratios that were significantly higher than 1. The Thompson Cariboo Shuswap HSDA (ratio = 0.84, 95%CI [0.71,0.99]) had an AE rate ratio significantly less than 1. For females in the year 2000, the Simon Fraser (ratio = 1.21, 95%CI [1.04,1.42]), South Fraser (ratio = 1.30, 95%CI [1.11,1.50]), Richmond (ratio = 1.26, 95%CI [1.05,1.52]), and the Northeast (ratio = 1.40, 95%CI [1.10,1.79]) HSDAs had AE rate ratios that were significantly higher than 1. The Okanagan (ratio = 0.76, 95%CI [0.64,0.89]) and the Northern Interior (ratio = 0.78, 95%CI [0.63,0.96]) HSDAs had AE rate ratios that were significantly less than 1. In conclusion, observe that the regions with at higher rate ratio in 2000 for males and females in the age group 65-79 years tend to be clustered in the urban health authorities located in the southwest of BC.

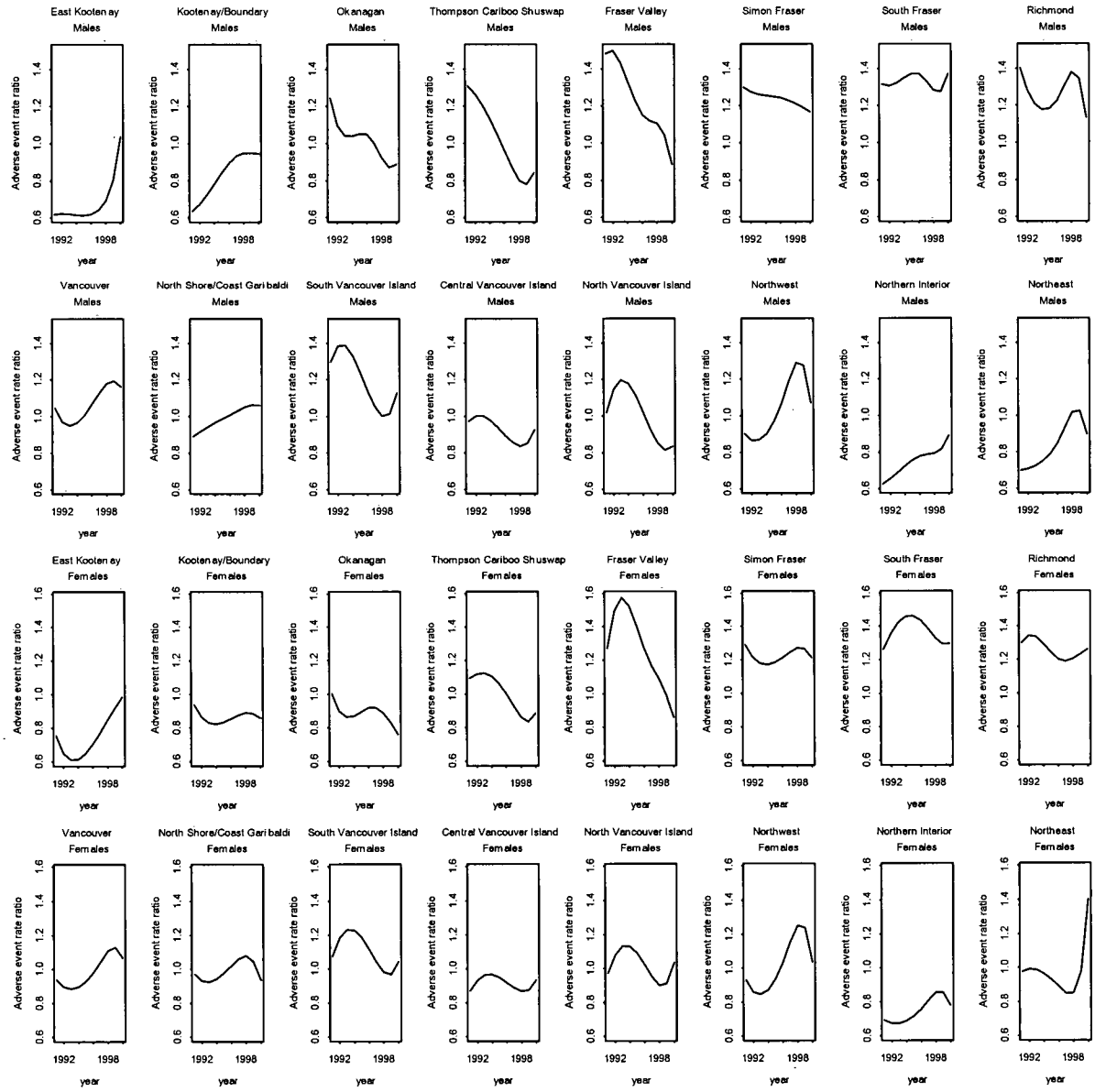


Figure 6.10. Annual Ratio between the Medical Adverse Event Incidence Rate of Each Health Services Delivery Area and British Columbia for Males and Females Aged 65-79 Years, 1991-2000.

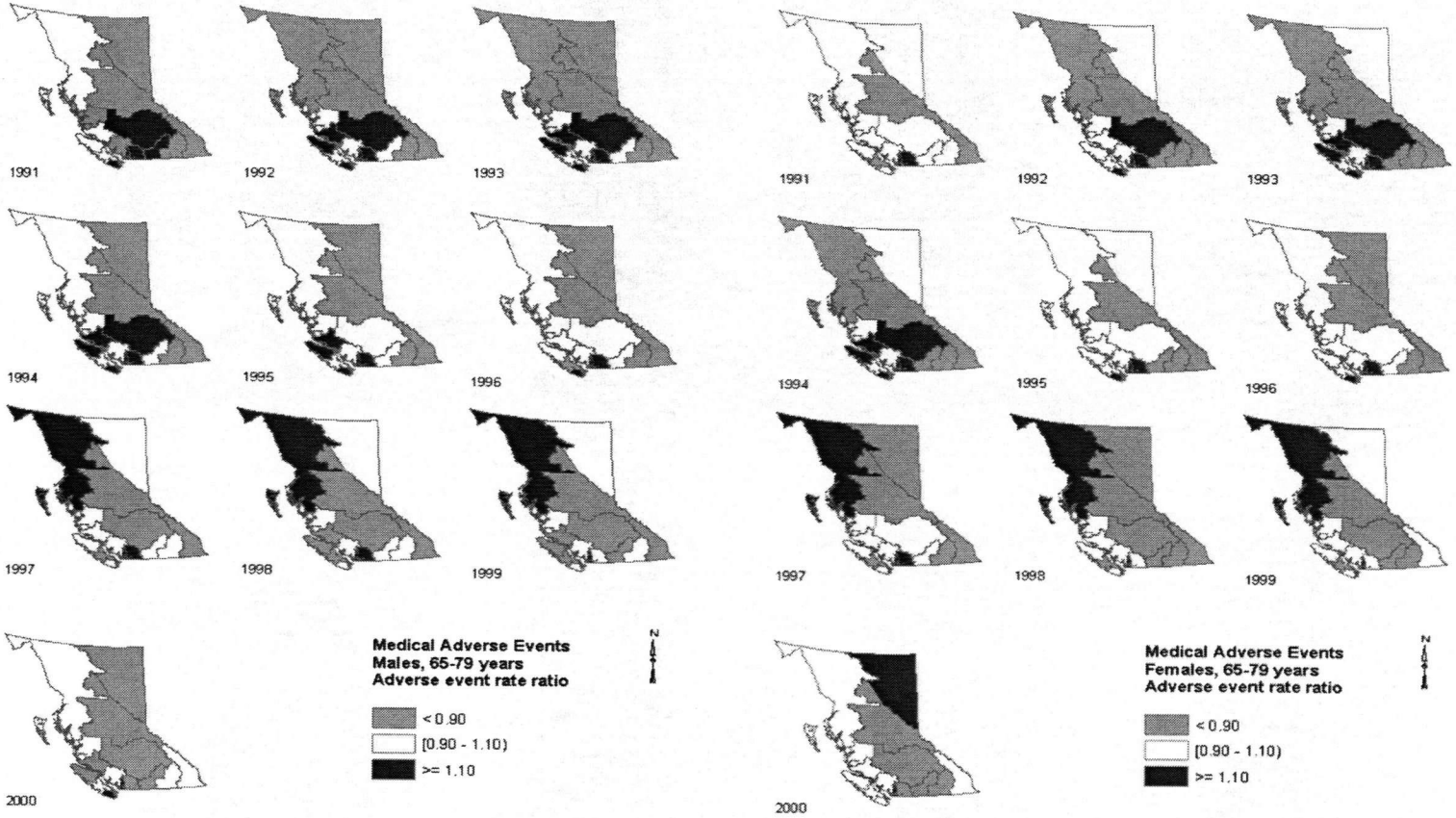


Figure 6.11. Map of Annual Ratio between the Medical Adverse Event Incidence Rate of Each Health Services Delivery Area and British Columbia for Males and Females Aged 65-79 Years, 1991-2000.

Chapter 7

Discussion

7.1 Summary of Findings

This study was motivated by the opportunity to demonstrate the utility associated with the integration of a recently developed statistical methodology, known as spatio-temporal Bayesian disease mapping, into the quantification of health status indicators derived from existing population health monitoring data collected by the province of British Columbia. In addition to mortality and hospitalization rates and rate ratios, the health status indicators examined in this study included measures associated with the impact on the quality of life of the population such as years of life lost (YLL or fatal burden), healthy years lost due to disability (YLD or non-fatal burden) and disability-adjusted life years (DALY or total burden). To provide an example particularly relevant to the public health field, we chose to apply this novel methodology to injury surveillance data to show that the injury impact varies according to different segments of the population. As a possible first step towards addressing the problem of injury, this study demonstrated how researchers can effectively utilize existing data available in administrative databases to answer important questions involving the epidemiology and impact of injury on individual communities within BC.

In Chapter 4, we provided an overall picture of the impact of different unintentional and intentional injuries in BC using health status indicators calculated at the

provincial and health authority levels. At the provincial level analysis, we found that over the ten years of study, among all external causes of injury afflicting males in BC, road traffic accidents, poisoning (mainly due to drug abuse) and suicide and self-inflicted injuries ranked the highest; and road traffic accidents, falls and suicide and self-inflicted injuries ranked the highest among all external causes of injury afflicting females in BC. In addition, the fatal burden (*i.e.*, years of life lost due to premature mortality) associated with injuries contributed at least 50% to the overall burden of this health determinant. In general, when all injuries were combined, males experienced a higher burden from injuries than females. Some gender specific age groups, such as 20-39 years (males) and 80+ years (females), had substantially higher ten-year per capita total burdens from injuries compared to other age groups. In addition, the health authority level analysis revealed that different injuries had different geographical distributions. For example, high injury incidence clusters were seen in the Interior and Northern health authorities of BC.

The next objective in this study was to investigate the impact of injuries at the health services delivery area level from 1991 to 2000, and to demonstrate the importance of employing statistical approaches over and above mapping conventional rates, ratios and DALYs. Investigating health impacts within specific regions (*i.e.*, health service delivery areas), which are much smaller in size than the health authorities, requires the application of Bayesian disease mapping methods to ensure reliable estimates of rates, ratios and DALYs. In Chapter 5, the small-area analysis of injuries due to road traffic accidents highlighted some high-risk health service delivery areas in the Northern and Interior health authorities. In addition, distinct geographic distributions of high and low incidence were observed for males and females between 20 and 39 years of age. In Chapter 6, we showed that medical AEs can

be effectively monitored using ICD9 E-codes identified in administrative data scanning. The results associated with AEs at the provincial level were consistent with other studies, however, it is important to note that this is the first research at the population level that used Bayesian disease mapping methods to assess the true (*i.e.,* clear of change and systematic variation) underlying differences in medical AE rates for all age and gender groups in all health services delivery areas of BC over an extensive period of time (from 1991 to 2000). Our study showed that the medical AE incidence was consistent over time and across different health regions, and contained significant differences across age groups.

7.2 Injury Viewed as a Public Health Issue

The relevance of this study to the field of public health can be traced to the Canadian Health Act of 1984 (c.6, s.3) (Department of Justice 2004), which states that:

> "*The primary objective of Canadian health care policy is to protect, promote and restore the physical and mental well-being of residents of Canada and to facilitate reasonable access to health services without financial or other barriers.*"

Thus, the methods presented in this study can be used to identify regions and sub-populations where health disparities exist and in so doing provide the first step towards promoting equal access to health for all of BC's residents.

Injury has become a major public health concern, with most injured victims being young adults at their most economically productive age. There is a high cost associated with injury: (1) extensive health care resources are expended to treat, care for, and rehabilitate

injured persons; (2) a high number of productive years of life are lost due to premature death and long-term disability; and (3) substantial physical and emotional costs associated with pain and suffering are experienced by injured persons and their families. It is expected, for example, that road traffic accidents will soon be considered a serious public health problem worldwide, as it has been projected that by 2020, road traffic accidents will be the third leading cause of death and disability in the world, after ischaemic heart disease (first) and unipolar major depression (second). Of note in 2000, road traffic accidents ranked the ninth highest burden among all health problems in the world (Murray and Lopez 1996; WHO 2004a; MacKenzie 2000). Many researchers have thus come to view injuries as a silent pandemic. Given the forecasted trends, the critical question is what can public health officials in BC do to make sure that the health care system, the economy and society at large are able to handle this population health problem?

The first two steps in dealing with the problem of injuries in BC are to define and measure the actual burden, intensity, distributional pattern and trend associated with injuries at the macro level (*i.e.*, provincial level), and then at the micro level (*i.e.*, regional level), since the latter is the level at which services are ultimately managed and delivered. Provincial and regional injury surveillance should be an integral component of our strategy to maintain and improve the health of British Columbians. This study has demonstrated that valuable surveillance information can be extracted from data that are readily available to researchers through existing administrative databases. Additionally, this study demonstrated how fundamental knowledge on the impact of a total of 13 unintentional and intentional injuries was obtained by using commonly employed health status indicators such as mortality and hospitalization rates, in conjunction with health status indicators measuring disease burden such as years of

life lost (YLL) from premature death, healthy years lost due to disability (YLD) and disability-adjusted life years (DALY). It is important to stress that each health status indicator provides different information in the assessment of the population's health. Rates quantify the scale of the problem, *i.e.*, these measure *how many people* have died or been hospitalized in a given time period due to injury. However, many injuries are non-fatal and consequently a proportion of those injured are left with short-term or long-term disabilities. To take into account the resulting disability-related reductions in quality of life, it is necessary to use measures such as YLL, YLD and DALY to quantify *how many years* a given population has lost due to injury.

The appropriate analysis (*e.g.*, using small area analysis methods) of surveillance data has the potential to efficiently produce important information for public health planners. For example, the methods outlined in this study could be used in the following ways:

(1) The creation and maintenance of community-specific health profiles that contain up-to-date information about current health status;

(2) The generation of etiological hypotheses could be facilitated by information derived from long-term analyses of spatial distributions of health problems;

(3) Subgroups within the BC population that are the most/least affected by injuries could be identified;

(4) Surveillance information could be used to capture change and flag abrupt jumps in injury incidence;

(5) Detailed information on the health profile of communities could be used by local health planners to help ensure that the quality and quantity of available health resources are appropriate for the local needs;

(6) Data obtained from surveillance systems could be used to detect the impact of changes put in place to improve quality of health care practices, as well as to monitor the effectiveness of future interventions; and

(7) Surveillance information could also be used by health care providers, planners and administrators to efficiently plan effective injury prevention and public health intervention strategies.

In order to develop more effective preventive strategies and reduce the impact of injuries on the population, we must improve the quality and quantity of available information. Prevention of injuries is a multidisciplinary undertaking involving collaboration among many different disciplines, agencies and government layers. When developing prevention strategies, it is imperative that researchers ask: *Who* is being injured? *Where* (*e.g.*, communities, or health regions) are the injury indicators the highest, and alternatively, the lowest? Furthermore, does the *present* magnitude of the health status indicators differ from *previous* levels? To answer these questions it is crucial that researchers conduct descriptive epidemiological studies that are focused on describing the distribution of injuries according to *person*, *place* and *time*.

In this study, complex statistical methods were used to analyse ten years of injury surveillance data for individual communities in BC. Some readers may ask: "Why it is necessary to use such statistical methodology instead of just using conventional estimates to calculate health status indicators?". This is a legitimate question and we reiterate with emphasis that small-area analyses based on conventional estimates of health status indicators can be misleading because conventional estimates of risk for areas with a small "population at risk" are influenced by chance variation (see for example the comparison between the conventional and fitted mortality rate for

road traffic accidents in the Northeast HSDA as shown in Figure 5.1, page 138). As demonstrated in this study, Bayesian spatio-temporal analysis of the injury data enabled us to quantify spatial variation and temporal trends in small-area risks and burden estimates.

The small-area analyses performed in this study provide descriptive information, which could be used by health planners to inform the development of future patient safety preventive initiatives. Although the incidence of injuries due to medical adverse events is growing, there is still insufficient information to gauge the full scale of the problem in BC (*e.g.,* which risk factors most influence the regional differences in AE incidence?). With this in mind, one important contribution of this study is the assessment of the magnitude of injuries due to medical adverse events (as defined by existing E-codes) at the community level across gender and age groups over time. In Chapter 6 we identified areas with a high incidence of injuries due to medical adverse events, we identified subgroups of the population more afflicted by these injuries, and we monitored injury clusters, changepoints and trends in different regions over time.

For example, in this study we have shown that injuries due to medical adverse events were not uncommon (the age-standardized BC rate for both males and females was 4.37 per 100 admissions), and the incidence was the highest among elderly patients (65-79 years of age). In-hospital management of elderly patients (65-79 years of age) is a challenge due to a higher than normal incidence of comorbidities and polypharmacy, and consequently increased likelihood of adverse events. (Gridelli 2004; Trinka 2003; Thomas and Brennan 2000). In 2000, the estimated elderly population in BC was just over 399,000 people, representing an increase of 15% compared to the year 1991 (Ministry of Management Services 2004). With an aging population, it is plausible to assume that a higher incidence

will be associated with medical adverse events taking place during hospitalization for this age group (note that this incidence is also likely to increase in out-patient care of seniors). If so, then this raises an important flag in terms of health care safety, and calls for the development of patient safety polices to deal with this particular problem (*e.g.*, implementation of a universal real-time electronic prescription database for seniors that flags inappropriate prescription combinations).

One important recommendation of this study is the development of standardized provincial and regional monitoring systems that facilitate the application of methodologies similar to the approaches demonstrated in this study. The application of such methods would improve our ability to detect and estimate rates of injuries due to adverse events at the small-area level. This approach would also minimize the incidence of false alarms associated with chance fluctuations in areas with small population at risk, which might be misinterpreted in a system based on conventional estimates of injury incidence. In addition, for those health services delivery areas with a higher incidence of injuries due to adverse events, our hierarchical model can be modified and extended to include hospital level data, which allows for the identification of problematic hospitals within those areas as well as the factors that increase their likelihood of a poor performance.

In Chapter 5 we demonstrated the importance of calculating the small-area burden of injuries using the disability-adjusted life years (DALY) measure for prevention and surveillance of injuries such as road traffic accidents. We found that the burden of this injury is strongly associated with premature mortality, especially among youth and adults. We showed that in most regions the incidence and burden of this external cause of injury is decreasing, however we also identified areas that are not doing so well. In these problematic

areas, more attention should be dedicated to looking for alternative methods to improve health outcomes. For example, in addition to reinforcing existing strategies already shown to be effective in preventing these injuries, new community-specific educational programs and bylaw regulations could be developed to help lower traffic fatalities in small communities within each health services delivery area.

Several other interesting results were obtained performing the provincial and HA level analyses. Our results showed that the mortality rate and the per capita years lost due to premature death attributable to poisoning was not uncommon among males with age between 20 and 39 years old in the Vancouver Coastal HA (for every 1,000 people monitored over 10 years, approximately 63 years were lost due to premature death). This is a significant result, which required a closer examination of the primary ICD9 E-codes associated with this external cause of injury. The ICD9 E-codes contributing to more than 50% of all poisoning related deaths were E850.0, E855.2, E858.8, E858.9, which are codes that refer to drug overdose mainly due to cocaine, heroin and central appetite depressants.

Additionally, we observed that burden associated with the category other unintentional injuries (excluding AE), mainly due to years lived with disability, was especially high for males younger than 65 years. It is important to recall that the higher YLD for this external cause of injury was primary due to ICD9 E-codes (a) E916.0: struck accidentally by falling object such as: rock, snowslide (nowhere else specified), stone, tree, object falling from machine not in operation or from stationary vehicle; (b) E917.9: struck accidentally by an air rifle; (c) E918.0: caught accidentally in or between objects; (d) E920.3, E920.8: cutting and piercing instruments or objects mainly: knives, swords and daggers, and other cutting and piercing objects (*e.g.*, broken glass, nail, tin can lid, splinter, etc.); and (e)

E929.8: late effect of other accidents (nowhere else specified). We believe that the YLD for this injury category was higher because of the combination of type of nature of injury (several individuals with life long sequelae) and age distribution of injured individuals (largely young individuals).

In conclusion, the extensive results presented throughout Chapters 4 to 6 demonstrate the type of benefits that can be realized by analysing data collected from the long-term monitoring of injuries in BC. We believe that the application of the solid methodology presented in this study to the analysis of such injury surveillance data has the potential to benefit the health system in many ways. Based on the differential regional impact of injuries using all the health status indicators presented in Figure 1.1, our results could be used as criteria to establish targets in promoting population health, as well as to prioritize and guide future research. Over time, important information and interventions will accumulate and fewer health care resources will be required to treat, care for, and rehabilitate injured persons; a lower number of productive years of life will be lost due to premature death and long-term disability; and lower costs will be associated with the pain and suffering experienced by injured persons and their families.

7.3 Methodological Considerations, Limitations and Recommendations for Future Research

7.3.1 Data Quality

The first assessment of data quality was conducted during the initial data cleaning process. During this process, a very small number of records were identified as having a mistake. For example, the same person was coded as both male and female, was listed as living at the same time in two different HSDAs, or the record was missing an ICD9 E- and/or N-code. To deal with this problem, it was decided that the most efficient (*i.e.*, least time consuming) solution was to remove these mistaken records, as they represented a very small percentage of our data (<1%).

The second assessment of data quality relates to how valid and reliable standard classification codes for mortality and morbidity are for assessing the health impact of different injuries (*e.g.*, the International Classification of Diseases System Version 9 external codes (ICD9 E-codes)). In this study, problematic classification codes (*e.g.*, coding disparities among different regions) could have directly affected health status indicators such as the mortality and hospitalization rates; and indirectly affected health status indicators such as the years of lost life (YLL) (based on mortality data), healthy years lost due to disability (YLD) (based on hospitalization data), and ultimately disability-adjusted life years (DALY) (based on both mortality and hospitalization data).

Years of lost life and mortality rates are affected by the classification of each external cause of injury using ICD9 E-codes included in the mortality data obtained from the BC Vital Statistics agency. In order to assess the quality of the mortality data, one needs to examine the reliability and validity of the completion of medical death certificates. One source of such information are annual reports published by the BC Vital Statistics agency which contain explanations of the procedures involved in completing these medical death certificates to assure data quality[2]. On the other hand, healthy years lost due to disability and hospitalization rates are influenced by the reliability and validity associated with the completion of hospital medical charts, and transcription into medical computerized records. With these problems in mind, we conducted a literature review on this topic and found that the more non-specific an injury E-code is, the more reliable and valid the assignment of the code in both death certificates and hospital records (*e.g.*, detailed E-codes such as E810.1 as opposed to non-specific E-codes as E810) (see for example LeMier, Cummings, and West 2001; MacIntyre, Ackland, and Chandraraj 1997). Regarding the accuracy and reliability of ICD9 N-codes 800-999 necessary to calculate disability weights and durations, the study by MacIntyre, Ackland and Chandraraj (1997) reported that the more non-specific an N-code in the hospital separation record was, the lower the frequency of mistakes in assigning these codes was. In this thesis, we only worked with non-specific ICD9 N- and E-codes, with the

[2] The physician in attendance at the last illness of the deceased person, or the coroner conducting an inquiry into the death of the person is required to complete a Medical Certification of Death. In addition, the registration of death is completed by the informant with assistance from the funeral home. Funeral Directors obtain the Medical Certification of Death, issue the burial permit and submit the Medical Certification of Death and the Registration of Death documents to the Agency to complete the registration (Vital Statistics Agency of British Columbia (2001)).

exception of a small proportion of records using complete E-codes to identify the late effects of injury (E929), injuries resulted from striking against or struck accidentally by objects or persons (E917), and injuries caused by cutting and piercing instruments or objects (E920).

Assessing the reliability and validity of ICD9 E-codes in data originating from hospital records and death certificates in BC is an important topic for future research. One possible approach to this type of investigation involves additional data linkage to other data sources (*e.g.*, Medical Service Plan billing data), which would yield the detailed information at the patient level necessary to compare injury codes between the different sources of data. Additionally, the data quality of electronic hospital medical records could be assessed through the selection of a sample of medical records, and later comparison of these records with the corresponding original medical charts. Ultimately in the latter case, one would be verifying whether what is described in the medical charts is properly transcribed in the selected medical records.

To conclude the discussion of data quality, the methodology presented in this study relies heavily on ICD9 N- and E-codes to identify injuries. Although we are not able to claim that the data collection system is error free, however we believe that as the procedures for the development and maintenance of surveillance systems mature, the quality, accuracy and consistency of data collection will undoubtedly improve.

7.3.2 Epidemiological Methodology

There are many ways to measure the impact of injuries on the health of populations using health status indicators such as those shown in Figures 1.1 and 1.2. One of the innovative

goals of this study was to integrate DALY estimates into public health surveillance as a new type of health status indicator that can be used at the community level. The resulting information can then be used to quantify the loss of healthy years due to premature death and disability in a single measure of disease burden. However, it is important to emphasize that commonly used health status indicators, such as mortality and morbidity rates, should not be blindly replaced by measures such as disability-adjusted life years (DALYs). Ultimately, the selection of a health status indicator should be based on the objectives of each study and the data resources available.

On important lesson learned while implementing this new methodology was that conducting a burden of disease study is a complex task. Every step in this analysis involves judgments, assumptions and familiarity with epidemiological theory. Of particular relevance are several preference measures intrinsic in the DALY calculation involving which values to assign to the discounting rate, life expectancy, age weights, disability weights and durations of injury sequela (for the residual and non-residual categories). These assumptions have practical and theoretical implications on the estimated burden associated with each external cause of injury.

The implications of using different preference measures on the estimation of disability-adjusted life years (DALYs) were assessed via three sensitivity analyses. The first sensitivity analysis explored the effect of using different sets of disability weights for the residual category of injury sequela on estimated DALYs. Conclusions regarding which external cause of injury imposed the greatest total burden on BC residents did not change despite higher weights being associated with larger DALYs; *i.e.,* the magnitude of change in these DALYs was not sufficient to change the ranking of DALYs for different external

causes of injury. The second sensitivity analysis explored the effect of using different values for the discounting of future health rate on estimated DALYs. This analysis showed that the results for DALY based on different discounting rates are substantively different (*e.g.*, for road traffic accident, the DALYs for males were 161,198 (r=0%), 97,980 (r=3%), 72,396 (r=6%), and 56,577 (r=10%)). Nonetheless, there is no convincing theoretical argument supporting any particular value of discounting, and as we explained in section 3.3.1.1 (page 61), in this study we based all our results on the conventional 3% discounting rate. However, further investigation of both theoretical and practical issues is recommended. The last sensitivity analysis explored the effect of using different values of age weighting on estimated DALYs. The effect of using (compared to not using) age weights was much smaller than the effect of changing the discounting rate on final estimates of DALYs. In the context of this study, uniform age weights were assumed due to concerns with the lack of solid theoretical grounds to make a better choice about which age weights to choose. However, it is important to mention that all three sensitivity analyses depend on the data being used, and we recommend that similar analyses be completed as a routine component of any burden of disease study.

In addition, there are several important assumptions intrinsic to calculating disability weights that influence the estimation of DALYs. One assumption is associated with the method of health state valuations chosen to obtain the disability weights. In the original global burden of disease study, researchers employed the person trade-off (PTO) technique to obtain health state valuations to assist in decisions in the health care setting at the population level (Murray and Lopez 1996). PTO is a method that estimates the social value of different health states. When applying this technique, respondents are asked to make choices in the

context of a decision involving individuals other than themselves (Green 2001; Pinto Prades 1997). This is an important distinction between PTO and other more frequently used methods such as the standard gamble (SG), visual analogue scale (VAS) and time trade-off (TTO), which ask respondents to make choices in terms of their own lives.

PTO has not been widely used in the literature because more work is required to confirm the reliability, practicality, consistency and validity of the valuations. For example, studies have shown that the quality weights (or preferences) used in the calculation of quality-adjusted life years depend on the technique employed to measure health preference. Different techniques (*e.g.*, PTO versus SG) tend to produce different quality weights, and potentially different disability weights when employed in studies involving the calculation of disability-adjusted life years (see for example Murray and Lopez 1996; Green 2000). Ideally, one should study how these disability weights would change when using methods other than PTO in health state valuations. More importantly, the conclusions drawn from the DALY analyses done in this study should be further investigated to see if they hold given the application of different weights (*e.g.*, weights obtained from SG).

Two other assumptions intrinsic to the disability weights had an effect on the results of this study: the weights were assumed to be stationary over time, and the level of disability of different individuals with the same injury sequela(e) was assumed to be the same. However, as mentioned in section 3.3.1.4 (page 67), the data obtained for this study allowed for the identification of individuals with more than one injury sequela and adjustment of their disability weights, thus differentiating the severity of the same injury among different individuals. Nonetheless, this methodology requires further development to understand how the use of

non-stationary weights might change various calculations and conclusions drawn from the final estimates of DALYs.

The estimated DALYs might also be influenced by accounting for other comorbid prevalent conditions, in addition to controlling for coexisting comorbidities due to injury in the same individual (as done in this study). To improve the precision of health status estimates in future analyses, it is recommended that researchers develop methods of controlling for comorbid prevalent conditions. In terms of this study, it would be valuable to evaluate the extent to which such an adjustment would change our final results.

At this time, we focus on how the handling of the residual categories (900-924, 930-939, 958-959 and 990-999)[3] might have influenced the estimated DALYs through the calculation of disability weights and durations. As explained in the notes related to Table 3.1 (page 49), the WHO redistributed the ICD9 N-codes for the residual categories proportionately across all categories of injury sequela with disability weight or duration. Currently, no study has developed specific durations and disability weights for the residual categories of injury sequelae. However, we don't agree with the WHO approach, because depending on the distribution of the ICD9 N-codes, the level of disability associated with each external cause of injury can be overestimated or underestimated. It would therefore be useful to develop disability weights and durations for these residual categories. In particular, this new development would make possible the calculation of DALYs for those external

[3] 900-924 and 930-939 (injury to blood vessels; late effects of injuries, poisonings, toxic effects, and other external causes; superficial injury; contusion with intact skin surface; effects of foreign body entering through orifice), 958-959 (Certain traumatic complications and unspecified injuries) and 990-999 (Other and unspecified effects of external causes).

causes of injury for which the distribution of ICD9 N-codes is highly concentrated in residual categories.

One limitation of this study is the inability to apply the DALY methodology to injuries due to medical adverse events. We believe that the approach used to calculate the disability weights and durations for the other external causes of injury should not be applied to injuries due to medical adverse events because most of the injury sequelae associated with medical AE were classified as one of the ICD9 N-codes in the residual category of injury sequela. In addition, in the calculation of disability weights and durations for medical AE it is essential to take into consideration other causes of illness, since most AEs happened because patients were hospitalized because of some type of underlying condition other than injury (*e.g.*, a cardiovascular disease), and during the course of treatment a medical AE occurred.

Thus, we believe that the methodology used to obtain disability weights and durations for injuries due to medical adverse events should be carefully re-addressed, since the original methodology used to obtain these quantities is no longer applicable. Contrary to the WHO and several other researchers, we do not believe that it is appropriate to proceed with the DALY calculation for injuries due to medical AEs when the overall disability weight and duration were obtained in the same way as the other external causes of injury. We feel that it is important that the DALY methodology be appropriately modified to allow for separate DALY calculations for injuries due to medical AEs. The benefits of this analysis would be considerable, as we would gain a better understanding of both short-term and long-term health outcomes, such as impairments, functional limitations (disability) and potential handicaps associated with medical AEs (*i.e.*, how many years in health states other than full health a patent would have to live).

In summary, the DALY methodology can be improved by developing more appropriate disability weights and durations that address the issues discussed in this section (*e.g.*, issues regarding the residual category of injury, comorbidity, the health states valuation method). If researchers continue to employ PTO methods to estimate the social value of different health states, it is important that health professionals from different health care settings be involved in this process so that more realistic weights are obtained. This would also facilitate the development of durations and weights that better reflect the reality of living in BC. When developing the new durations and weights, it is critical for researchers to fully understand the "natural history" of each of the injury sequela (injuries classified under the ICD9 N-Codes) in substantial detail, particularly the injury sequelae under the residual category. Thus, in spite of the potential for broad generalizability and applicability to other diseases and conditions, the DALY methodology presented in this study requires further refinement. Moreover, as we have demonstrated, the use of DALYs allows for an array of interesting results, however more research should be conducted to determine how researchers can realize the full potential of using DALYs in terms of policy making and health planning.

7.3.3 Statistical Methodology

Prior to applying the final statistical model used in this study, we experimented with a variety of spatio-temporal statistical models currently being used in Bayesian disease mapping. After examining measures of goodness-of-fit, residual plots, and diagnostic tools for full Bayesian analysis we decided to use model (3.1), as it best captured the health inequalities in BC, and offered a simple interpretation of the results. However, during our modelling process, we encountered the challenge of determining how big the number of cases in each HSDA × year combination should be in order to obtain adequate results.

For example, in this study the spatio-temporal modeling of the number of hospitalization cases due to road traffic accidents for the younger age group (0-19 years) was accomplished without any problems, however we encountered difficulty when modeling the number of deaths for this same age group due to the large number of zero cells at the small-area level. To overcome this small-area issue we need to develop statistical modelling approaches that can accommodate the considerable number of zeros typically found in this type of data. For example, instead of modeling the rates via Poisson random effects specification (as was done in this study), a worthwhile future extension of this work might be to consider the use of a zero-inflated mixed effects Poisson model (Lambert 1992; Lee *et al.* 2002; Yau and Lee 2001; Van den Broek 1995; Bohning *et al.* 1999).

Nevertheless, the small-area problem in Bayesian disease mapping does not impede the application of this methodology to external causes of injury, or diseases that have a satisfactory number of cases in each HSDA × year combination. We recommend that model (3.1) and its variants be tried before choosing a final model. This choice should be based on

full Bayesian convergence diagnostics and measures of goodness-of-fit such as the examination of posterior density plots, Gelman-Rubin convergence statistic, deviance information criterion (DIC), and residual plots (Gelman *et al.* 1998; Carlin and Louis 2000; Spiegelhalter *et al.* 2002, 2003).

In addition, for injuries or diseases in which the number of cases is sufficiently large in each HSDA × year combination, both the statistical and epidemiological analyses presented in this study can be repeated using a finer geographical classification of regions, such as at the local health area (LHA) level or even finer areas such as the micro-health area. These analyses would provide a deeper understanding of which small regions within each of the health services delivery areas are suffering more from the impact of injuries.

Finally, the statistical model presented in this study can be extended to accommodate ecological analyses based on risk factors other than gender and age. These ecological analyses could be conducted by including predisposing (*e.g.*, socio-demographic variables), enabling (*e.g.*, social support, availability of health services, other neighbourhood variables) and need (*e.g.*, comorbidities) risk factors associated with each injury that are theorized to explain a proportion the geographical variation in rates, ratios and burden (Andersen and Newman 1973). However, obtaining such risk estimates is challenging, since it would require extensive linkage to other databases (*e.g.*, Canadian Community Health Survey).

7.3.4 General Issues

Some researchers might suggest that our reliance solely on hospitalization data for the calculation of DALYs is a weakness since the analyses captures only those individuals who

were seriously injured enough to require hospitalization. In particular, patients with minor injuries treated in health care settings other than hospitals (*e.g.*, physician's offices) were not accounted for in this study. However, studies (assessing the burden from injuries) have shown that using hospitalization data is sufficient in terms of providing a valid estimate of the morbidity component of DALYs (Mathers *et al.* 2001). In a future work, data from the Medical Services Plan (MSP) payment information could also be used to identify those injury cases in which the patient did not need in-hospital care. However, the usefulness of incorporating this new source of data into the DALY calculation depends on how reliable, valid and complete the injury diagnostic codes are in the out-of-hospital setting.

In conclusion, the calculation of DALYs and associated health status indicators represents the first step in evaluating the impact of injuries in the communities of BC. In order to develop appropriate policies to address the problem of injuries, one should also conduct complementary studies that include assessments of the economic impact of injuries. In economic analyses, it would be important to assess the magnitude of direct health care costs such as the cost of medications, services involved in rehabilitation and treatment of injuries, as well as the magnitude of indirect costs such as the loss of productivity and income. In addition, the DALY analysis in this study can be extended to include projections of the total burden of injuries for future years. These projections could be used to inform decision makers of potential areas of high demand for hospital and rehabilitation services at the provincial and regional levels. Finally, in the future, DALY as a measure of cost/benefit per unit of injury burden avoided should be applied to rank health interventions in priority setting. Cost-effectiveness analysis of health interventions has gained popularity in the health policy and priority setting literature (World Bank 1993; Lyttkens 2003; Arnesen and Kapiriri

2003; Paalman *et al.* 1998; Jamison and Mosley 1991; Mahapatra 2002; to name a few). The importance of setting priorities arises from a scarcity of resources in dealing with the health needs of the population. Health policy makers, in general, are faced with having to manage resources so that they maximize health outcomes, even if it means allocating limited new resources or cutting back on the use of existing resources. However, needless to say this is a complex exercise, since policy makers have to base their decisions on: social, political and ethical issues; technical and practical feasibility; cost-effectiveness of interventions; and an array of other causes of disease with significant population burden.

One of the main challenges in priority setting using cost-effectiveness analysis is to find a measure of disease burden capable of providing valid and reliable information. It is important to acknowledge that even though DALY has been extensively advocated to be used in such analysis, caution is needed in the interpretation of the results. As mentioned in previous sections, there are several intrinsic preference values in the DALY calculation, such as choices of discounting, age weighting, life expectancy and disability weights. Thus, it is expected that decisions will change based on different combination of such preference values. As I see it, the potential of using DALY in priority setting decisions is enormous, however until DALY is considerably improved, we should limit its use as a measure to provide descriptive information about the mortality and morbidity health impacts of specific illnesses, until there is great clarity regarding the reasonable estimation of preference values and demonstration of DALY's utility with those agreed upon values.

7.4 Conclusion

The disability-adjusted life years (DALY) methodology provides important baseline information about the past and present differential impact of injuries on subgroups of the population; it also shows how variable the distribution of burden and incidence of different causes of injuries are among regions in BC. This information is important to motivate different researchers to include injuries in future decisions regarding health care interventions. Moreover, unique to this study, we have monitored the health status of the BC population at the small-area level using the latest statistical models in disease mapping. We demonstrated how practical and appealing the models used in this study were in obtaining smoothed injury incidence rates to be later used in calculating the injury burden at regional and provincial levels. Inferences drawn from these statistical models in disease mapping enabled us to assess whether the differences in health status indicators from one region to another were in fact statistically significant. In addition, the success in obtaining small-area estimates of rates, ratios and healthy years lost due to mortality and disability is a first step towards providing information to assist in health planning and priority setting at the regional and provincial levels.

Furthermore, we demonstrated the tremendous potential of using administrative data and data linkage to ascertain hospital separations and deaths using the International Classification of Disease System (ICD) Version 9 coding system. For some injuries, such as medical adverse events, we showed that the use of E-codes is an easy and inexpensive method to unambiguously identify these injuries.

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Appendices

A. Acronyms

B. Glossary

C. Important ICD9-CM E-Codes

D. Example of Disability Weight Spreadsheet Assuming Zero Disability Weight for the Residual Category of Injury Sequela

E. Example of Duration Spreadsheet Assuming Zero Duration for the Residual Category of Injury Sequela

F. Sensitivity Analyses

G. Chapters' General Tables and Figures

H. Diagnostic Plots

Appendix A

Acronyms

AE	Adverse event
ASDALY	Age-standardized per capita disability-adjusted life years per 1,000 population
ASHR	Age-standardized hospitalization rate per 1,000 population
ASMR	Age-standardized mortality rate per 10,000 population
ASYLD	Age-standardized per capita healthy years lost due to disability per 1,000 population
ASYLL	Age-standardized per capita years of life lost per 1,000 population
BC	British Columbia
DALY	Disability-adjusted life years
DALY[0,0]	Disability-adjusted life years for no age weighting and 0% discounting rate
DALY[0,3]	Disability-adjusted life years for no age weighting and 3% discounting rate
$DW_{residual}$	Disability weight for the residual category of injury
DW	Disability weight
GBD	Global Burden of Disease
HA	Health Authority
HALY	Health-adjusted life years
HRQL	Health related quality of life
HSDA	Health Services Delivery Area
ICD9-CM	International Classification of Disease version 9 with clinical modifications

ICD10 International Classification of Disease version 10

IQR Interquantile range

LOS Length of stay in a hospital

PHA Public health approach

QALY Quality-adjusted life years

SMR Standardized mortality rate

SHR Standardized hospitalization rate

SMPH Summary measures of population health

YLD Healthy years lost due to disability

YLL Years of life lost

WHO World Health Organization

Appendix B

Glossary

AGE-SPECIFIC PER CAPITA DISABILITY-ADJUSTED LIFE YEARS PER 1,000 POPULATION - The disability-adjusted life years (DALY) per 1,000 population by age and gender. The population used was the mid-period (1995) population estimates obtained from British Columbia Vital Statistics Agency.

AGE-SPECIFIC PER CAPITA HEALTHY YEARS LOST DUE TO DISABILITY PER 1,000 POPULATION - (See Age-specific per capita disability-adjusted life years per 1,000 population)

AGE-SPECIFIC PER CAPITA YEARS OF LIFE LOST PER 1,000 POPULATION - (See Age-specific per capita disability-adjusted life years per 1,000 population)

AGE STANDARDIZATION (Source: British Columbia Vital Statistics Agency) - Age standardization is a method of calculation that adjusts a statistical measure for differences in the age/gender structures between populations. With standardized measures, more meaningful comparisons can be made between genders, different time periods, or geographic areas, because the age standardized statistic is calculated as if all populations had the same age/gender population distribution.

AGE-STANDARDIZED MORTALITY RATE (ASMR) PER 10,000 POPULATION (Source: British Columbia Vital Statistics Agency) - A summary of age-adjusted mortality rates by age and gender, which have been standardized to a 'standard' population (2001 Canada Census) for the purpose of rate comparisons between genders, different time periods or different geographic locations. The ASMR is the theoretical number of deaths that would occur per 10,000 population, if the specific population had the same age structure as the standard population.

Next, we show an example of calculation of ASMR at HA level Note that the same method was used to calculate the ASMR at HA level is the same method to calculate the ASMR at HSDA and BC levels.

Table B.1. Example of calculation of ASMR for road traffic accident for the Interior HA. Males, 1991-2000.

		HA		
Age	**Standard**	**Estimated**	**Death**	**Observed**
Group	**Population**	**Population**	**Rate/10,000**	**Deaths**
i	π_i	p_i	m_i	d_i
0-19	3,983,130	506,158	1.88	171
20-29	4,194,045	614,251	3.79	343
40-64	4,867,020	558,254	2.14	215
65-79	1,344,430	167,236	2.24	81
80+	318,220	39,674	3.66	31
Total	14,706,845	1,885,573		841

For the Health Authority (HA):

$$ASMR = \frac{\sum_i m_i \times \pi_i}{\Pi} = \frac{1.88 \times 3{,}989{,}130 + \ldots + 3.66 \times 318{,}220}{14{,}706{,}845} = 2.58$$

where: p_i is the HA population in age group i

π_i is the standard population in age group i

Π is the total standard population, $\sum_i \pi_i$

d_i is the number of deaths in the HA in age group i

m_i is the mortality rate per 10,000 HA population in age group i, $\frac{d_i}{p_i} \times 10{,}000$

AGE-STANDARDIZED PER CAPITA DISABILITY-ADJUSTED LIFE YEARS (ASDALY) PER 1,000 POPULATION (See ASMR for details on calculation) - A summary of age-specific per capita DALYs by age and gender, which have been standardized to a 'standard ' population (2001 Canada Census) for the purpose of comparisons between genders, different time periods or different geographic locations. The ASDALY is the theoretical number of DALYs that would occur per 1,000 population, if the specific population had the same age structure as the standard population.

AGE-STANDARDIZED HOSPITALIZATION RATE (ASHR) PER 1,000 POPULATION - (See ASMR per 10,000 population)

AGE-STANDARDIZED PER CAPITA HEALTHY YEARS LOST DUE TO DISABILITY (ASYLD) PER 1,000 POPULATION - (See ASDALY per 1,000 population)

AGE-STANDARDIZED PER CAPITA YEARS OF LIFE LOST (ASYLL) PER 1,000 POPULATION - (See ASDALY per 1,000 population)

STANDARD POPULATION (Source: British Columbia Vital Statistics Agency) - A reference population of known age distribution used in the calculation of standardized indicators to adjust for variations in population age structures in different geographic areas or time periods. The 2001 Canadian Census is used as the standard population in the calculation of ASMR, ASHR, ASDALY, ASYLD and ASYLL. Please see Tables G.5 for the actual population numbers.

ICD9-CM E-CODES FOR EXTERNAL CAUSES OF INJURY (Source: ICD-9 Volume 1, Modified for US Purposes)

This document includes a modified version of Volume 1 of the International Classification of Diseases, Ninth Revision (ICD-9) (CDC 2003). The full version of this volume is no longer available in print. This version has been modified to more appropriately reflect US mortality use. This material was provided by NCHS, which is a subunit of CDC/ATSDR. It has been cleared for public distribution by CDC/ATSDR and will be authentic if gotten from ftp://ftp.cdc.gov. CDC/ATSDR takes all effort to assure the authenticity of electronically distributed documents.

Mortality Statistics Branch

National Center for Health Statistics

Centers for Disease Control and Prevention

6525 Belcrest Road

Hyattsville, MD 20782

(301) 436-8884

Road traffic accidents

Note: Other road vehicle accidents are transport accidents involving road vehicles other than motor vehicles. Another road vehicle is any device, except a motor vehicle, in, on, or by which any person or property may be transported on a highway. A streetcar is a device designed and used primarily for transporting persons within a municipality, running on rails, usually subject to normal traffic control signals, and operated principally on a right-of-way that forms part of the traffic way. A trailer being towed by a streetcar is considered a part of the streetcar. A pedal cycle is any road transport vehicle operated solely by pedals.

Includes: accidents involving other road vehicles being used in recreational or sporting activities.

Excludes: collision of other road vehicle [any] with: aircraft (E840.0-E845.9), motor vehicle (E813.0-E813.9, E820.0-E822.9), railway train (E801.0-E801.9).

ICD9-CM E-Codes	Description
E810	Motor vehicle traffic accident involving collision with train
E811	Motor vehicle traffic accident involving re-entrant collision with another motor vehicle
E812	Other motor vehicle traffic accident involving collision with motor vehicle
E813	Motor vehicle traffic accident involving collision with other vehicle
E814	Motor vehicle traffic accident involving collision with pedestrian
E815	Other motor vehicle traffic accident involving collision on the highway
E816	Motor vehicle traffic accident due to loss of control, without collision on the highway
E817	Noncollision motor vehicle traffic accident while boarding or alighting
E818	Other noncollision motor vehicle traffic accident
E819	Motor vehicle traffic accident of unspecified nature
E826	Pedal cycle accident
E827	Animal-drawn vehicle accident
E828	Accident involving animal being ridden
E829	Other road vehicle accidents
E929.0	Late effects of motor vehicle accident

Poisoning

Includes: accidental overdose of drug, wrong drug given or taken in error, and drug taken inadvertently, accidents in the use of drugs and biologicals in medical and surgical procedures.

Excludes: administration with suicidal or homicidal intent or intent to harm, or in circumstances classifiable to E980-E989 (E950.0-E950.5, E962.0, E980.0-E980.5), correct drug properly administered in therapeutic or prophylactic dosage, as the cause of adverse effect (E930.0-E949.9).

ICD9-CM E-Codes	Description
E850	Accidental poisoning by analgesics, antipyretics, and antirheumatics
E851	Accidental poisoning by barbiturates
E852	Accidental poisoning by other sedatives and hypnotics
E853	Accidental poisoning by tranquilizers
E854	Accidental poisoning by other psychotropic agents
E855	Accidental poisoning by other drugs acting on central and autonomic nervous system
E856	Accidental poisoning by antibiotics
E857	Accidental poisoning by other anti-infectives
E858	Accidental poisoning by other drugs
E860	Accidental poisoning by alcohol, not elsewhere classified
E861	Accidental poisoning by cleansing and polishing agents, disinfectants, paints, and varnishes
E862	Accidental poisoning by petroleum products, other solvents and their vapors, not elsewhere classified
E863	Accidental poisoning by agricultural and horticultural chemical and pharmaceutical preparations other than plant foods and fertilizers
E864	Accidental poisoning by corrosives and caustics, not elsewhere classified
E865	Accidental poisoning from poisonous foodstuffs and poisonous plants
E866	Accidental poisoning by other and unspecified solid and liquid substances
E867	Accidental poisoning by gas distributed by pipeline
E868	Accidental poisoning by other utility gas and other carbon monoxide
E869	Accidental poisoning by other gases and vapors
E929.2	Late effects of accidental poisoning

Falls

Excludes: falls (in or from): burning building (E890.8, E891.8),into fire (E890.0-E899), into water (with submersion or drowning) (E910.0-E910.9),machinery (in operation) (E919.0-E919.9),on edged, pointed, or sharp object (E920.0-E920.9),transport vehicle (E800.0-E845.9),vehicle not elsewhere classifiable (E846-E848).

ICD9-CM E-Codes	Description
E880	Fall on or from stairs or steps
E881	Fall on or from ladders or scaffolding
E882	Fall from or out of building or other structure
E883	Fall into hole or other opening in surface
E884	Other fall from one level to another
E885	Fall on same level from slipping, tripping, or stumbling
E886	Fall on same level from collision, pushing, or shoving, by or with other person
E887	Fracture, cause unspecified
E888	Other and unspecified fall
E929.3	Late effects of accidental fall

Medical adverse events

Misadventures to patients during surgical and medical care

Excludes: accidental overdose of drug and wrong drug given in error (E850.0-E858.9) surgical and medical procedures as the cause of abnormal reaction by the patient, without mention of misadventure at the time of procedure (E878.0-E879.9).

ICD9-CM E-Codes	Description
E870	Accidental cut, puncture, perforation, or hemorrhage during medical care
E871	Foreign object left in body during procedure
E872	Failure of sterile precautions during procedure
E873	Failure in dosage
E874	Mechanical failure of instrument or apparatus during procedure
E875	Contaminated or infected blood, other fluid, drug, or biological substance
E876	Other and unspecified misadventures during medical care

Surgical and medical procedures as the cause of abnormal reaction of patient or later complication, without mention of misadventure at the time of procedure

Includes: procedures as the cause of abnormal reaction, such as: displacement or malfunction of prosthetic device, hepatorenal failure, postoperative, malfunction of external stoma, postoperative intestinal obstruction, rejection of transplanted organ.

Excludes: anesthetic management properly carried out as the cause of adverse effect (E937.0-E938.9), infusion and transfusion, without mention of misadventure in the technique of procedure (E930.0-E949.9).

ICD9-CM E-Codes	Description
E878	Surgical operation and other surgical procedures as the cause of abnormal reaction of patient, or of later complication, without mention of misadventure at the time of operation
E879	Other procedures, without mention of misadventure at the time of procedure, as the cause of abnormal reaction of patient, or of later complication

Drugs, medicinal and biological substances causing adverse effects in therapeutic use

Includes: correct drug properly administered in therapeutic or prophylactic dosage, as the cause of any adverse effect including allergic or hypersensitivity reactions.

Excludes: accidental overdose of drug and wrong drug given or taken in error (E850.0-E858.9), accidents in the technique of administration of drug or biological substance such as accidental puncture during injection, or contamination of drug (E870.0-E876.9) administration with suicidal or homicidal intent or intent to harm, or in circumstances classifiable to E980-E989 (E950.0-E950.5, E962.0, E980.0-E980.5).

ICD9-CM E-Codes	Description
E930	Antibiotics
E931	Other anti-infectives
E932	Hormones and synthetic substitutes
E933	Primarily systemic agents
E934	Agents primarily affecting blood constituents
E935	Analgesics, antipyretics, and antirheumatics
E936	Anticonvulsants and anti-Parkinsonism drugs
E937	Sedatives and hypnotics
E938	Other central nervous system depressants and anesthetics
E939	Psychotropic agents
E940	Central nervous system stimulants
E941	Drugs primarily affecting the autonomic nervous system
E942	Agents primarily affecting the cardiovascular system
E943	Agents primarily affecting gastrointestinal system
E944	Water, mineral, and uric acid metabolism drugs
E945	Agents primarily acting on the smooth and skeletal muscles and respiratory system
E946	Agents primarily affecting skin and mucous membrane, ophthalmological, otorhinolaryngological, and dental drugs
E947	Other and unspecified drugs and medicinal substances
E948	Bacterial vaccines
E949	Other vaccines and biological substances

Other unintentional injuries (excluding road traffic accidents, poisoning, falls, and medical adverse events)

Railway accidents

Excludes: accidents involving railway train and aircraft (E840.0-E845.9), motor vehicle (E810.0-E825.9), watercraft (E830.0-E838.9).

ICD9-CM E-Codes	Description
E800	Railway accident involving collision with rolling stock
E801	Railway accident involving collision with other object
E802	Railway accident involving derailment without antecedent collision
E803	Railway accident involving explosion, fire, or burning
E804	Fall in, on, or from railway train
E805	Hit by rolling stock
E806	Other specified railway accident
E807	Railway accident of unspecified nature

Motor vehicle non-traffic accidents

Includes: accidents involving motor vehicles being used in recreational or sporting activities off the highway collision and non-collision motor vehicle accidents occurring entirely off the highway.

Excludes: accidents involving motor vehicle and aircraft (E840.0-E845.9), watercraft (E830.0-E838.9), accidents, not on the public highway, involving agricultural and construction machinery but not involving another motor vehicle (E919.0, E919.2, E919.7).

ICD9-CM E-Codes	Description
E820	Non-traffic accident involving motor-driven snow vehicle
E821	Non-traffic accident involving other off-road motor vehicle
E822	Other motor vehicle non-traffic accident involving collision with moving object
E823	Other motor vehicle non-traffic accident involving collision with stationary object
E824	Other motor vehicle non-traffic accident while boarding and alighting
E825	Other motor vehicle non-traffic accident of other and unspecified nature

Water transport accidents

Includes: watercraft accidents in the course of recreational activities.

Excludes: accidents involving both aircraft, including objects set in motion by aircraft, and watercraft (E840.0-E845.9).

ICD9-CM E-Codes	Description
E830	Accident to watercraft causing submersion
E831	Accident to watercraft causing other injury
E832	Other accidental submersion or drowning in water transport accident
E833	Fall on stairs or ladders in water transport
E834	Other fall from one level to another in water transport
E835	Other and unspecified fall in water transport
E836	Machinery accident in water transport
E837	Explosion, fire, or burning in watercraft
E838	Other and unspecified water transport accident

Air and space transport accidents

ICD9-CM E-Codes	Description
E840	Accident to powered aircraft at takeoff or landing
E841	Accident to powered aircraft, other and unspecified
E842	Accident to unpowered aircraft
E843	Fall in, on, or from aircraft
E844	Other specified air transport accidents
E845	Accident involving spacecraft

Vehicle accidents not elsewhere classifiable

ICD9-CM E-Codes	Description
E846	Accidents involving powered vehicles used solely within the buildings and premises of industrial or commercial establishment
E847	Accidents involving cable cars not running on rails
E848	Accidents involving other vehicles, not elsewhere classifiable

Accidents caused by burns/fires/scalds

Includes: asphyxia or poisoning due to conflagration or ignition burning by fire, secondary fires resulting from explosion.

Excludes: arson (E968.0) fire in or on: machinery (in operation) (E919.0-E919.9), transport vehicle other than stationary vehicle (E800.0-E845.9), vehicle not elsewhere classifiable (E846-E848).

ICD9-CM E-Codes	Description
E890	Conflagration in private dwelling
E891	Conflagration in other and unspecified building or structure
E892	Conflagration not in building or structure
E893	Accident caused by ignition of clothing
E894	Ignition of highly inflammable material
E895	Accident caused by controlled fire in private dwelling
E896	Accident caused by controlled fire in other and unspecified building or structure
E897	Accident caused by controlled fire not in building or structure
E898	Accident caused by other specified fire and flames
E899	Accident caused by unspecified fire

Natural and environmental factors

ICD9-CM E-Codes	Description
E900	Excessive heat
E901	Excessive cold
E902	High and low air pressure and changes in air pressure
E903	Travel and motion
E904	Hunger, thirst, exposure, and neglect
E905	Venomous animals and plants as the cause of poisoning and toxic reactions
E906	Other injury caused by animals
E907	Lightning
E908	Cataclysmic storms, and floods resulting from storms
E909	Cataclysmic earth surface movements and eruptions

Accidents caused by drowning, suffocation, and foreign bodies

ICD9-CM E-Codes	Description
E910	Accidental drowning and submersion
E911	Inhalation and ingestion of food causing obstruction of respiratory tract or suffocation
E912	Inhalation and ingestion of other object causing obstruction of respiratory tract or suffocation
E913	Accidental mechanical suffocation
E914	Foreign body accidentally entering eye and adnexa
E915	Foreign body accidentally entering other orifice

Other accidents

ICD9-CM E-Codes	Description
E916	Struck accidentally by falling object
E917	Striking against or struck accidentally by objects or persons
E918	Caught accidentally in or between objects
E919	Accidents caused by machinery
E920	Accidents caused by cutting and piercing instruments or objects (accidental injury by object or fall on object: edged, pointed, sharp)
E921	Accident caused by explosion of pressure vessel
E922	Accident caused by firearm missile
E923	Accident caused by explosive material
E924	Accident caused by hot substance or object, caustic or corrosive material, and steam
E925	Accident caused by electric current
E926	Exposure to radiation
E927	Overexertion and strenuous movements
E928	Other and unspecified environmental and accidental causes
E929.1, E929.4, E929.5, E929.8, E929.9	Late effects of accidental injury

Suicide and self-inflicted injuries

Includes: injuries in suicide and attempted suicide, self-inflicted injuries specified as intentional.

ICD9-CM E-Codes	Description
E950	Suicide and self-inflicted poisoning by solid or liquid substances
E951	Suicide and self-inflicted poisoning by gases in domestic use
E952	Suicide and self-inflicted poisoning by other gases and vapors
E953	Suicide and self-inflicted injury by hanging, strangulation, and suffocation
E954	Suicide and self-inflicted injury by submersion [drowning]
E955	Suicide and self-inflicted injury by firearms and explosives
E956	Suicide and self-inflicted injury by cutting and piercing instrument
E957	Suicide and self-inflicted injuries by jumping from high place
E958	Suicide and self-inflicted injury by other and unspecified means
E959	Late effects of self-inflicted injury

Other intentional injury

Homicide and injury purposely inflicted by other persons

Includes: injuries inflicted by another person with intent to injure or kill, by any means.

Excludes: legal intervention (E970-E978), operations of war (E990-E999).

ICD9-CM E-Codes	Description
E960	Fight, brawl, rape
E961	Assault by corrosive or caustic substance, except poisoning
E962	Assault by poisoning
E963	Assault by hanging and strangulation
E964	Assault by submersion [drowning]
E965	Assault by firearms and explosives
E966	Assault by cutting and piercing instrument
E967	Child battering and other maltreatment
E968	Assault by other and unspecified means
E969	Late effects of injury purposely inflicted by other person

Legal intervention

Excludes: injuries caused by civil insurrections (E990.0-E999).

ICD9-CM E-Codes	Description
E970	Injury due to legal intervention by firearms
E971	Injury due to legal intervention by explosives
E972	Injury due to legal intervention by gas
E973	Injury due to legal intervention by blunt object
E974	Injury due to legal intervention by cutting and piercing instrument
E975	Injury due to legal intervention by other specified means
E976	Injury due to legal intervention by unspecified means
E977	Late effects of injuries due to legal intervention
E978	Legal execution

Injury resulting from operations of war

Excludes: accidents during training of military personnel, manufacture of war material and transport, unless attributable to enemy action.

ICD9-CM E-Codes	Description
E990	Injury due to war operations by fires and conflagrations
E991	Injury due to war operations by bullets and fragments
E992	Injury due to war operations by explosion of marine weapons
E993	Injury due to war operations by other explosion
E994	Injury due to war operations by destruction of aircraft
E995	Injury due to war operations by other and unspecified forms of conventional warfare
E996	Injury due to war operations by nuclear weapons
E997	Injury due to war operations by other forms of unconventional warfare
E998	Injury due to war operations but occurring after cessation of hostilities
E999	Late effect of injury due to war operations

Appendix C

Important ICD9-CM E-Codes

Road traffic accidents

For road traffic accidents, all ages combined, the YLL contributed more to the DALY than the YLD. The important ICD9-CM E-codes contributing to YLL are:

• (E812.0, E812.1)

Agent: Motor vehicle traffic accident involving collision with another motor vehicle parked, stopped, stalled, disabled, or abandoned on the highway.

Host: The driver of the motor vehicle.

• (E814.7)

Agent: Collision between motor vehicle, of any kind, and pedestrian. The pedestrian was dragged, hit, or run over by the motor vehicle.

Host: Pedestrian.

• (E816.0, E816.1, E816.9)

Agent: Failure to make a curve; going out of control due to blow out; burst tire; overturning; driver falling asleep; driver inattention; excessive speed; and failure of mechanical part and as a consequence colliding with an object off the highway or overturning or stopping abruptly off the highway.

Host: The driver or a passenger or unspecified person of a motor vehicle other than a motorcycle.

• (E819.0, E819.1, E819.9)

Agent: Motor vehicle traffic accident of unspecified nature.

Host: A driver or passenger or an unspecified person of a motor vehicle other than a motorcycle.

Poisoning

For poisoning, all ages combined, the YLL contributed more to the DALY than the YLD. The important ICD9-CM E-codes contributing to YLL are:

• (E850.0)

Agent: Accidental poisoning by analgesics, antipyretics, and antirheumatics – specifically heroin /diacetylmorphine.

• (E854.1, E854.8, E855.2)

Agent: Accidental poisoning by other drugs acting on central and autonomic nervous system – specifically local anesthetics such as cocaine, lidocaine [lignocaine], procaine and tetracaine.

• (E858.8, E858.9)

Agent: Accidental poisoning by other drugs: central appetite depressants and other unspecified drugs.

• (E860.1, E860.2, E860.9)

Agent: Accidental poisoning by alcohol (other and unspecified ethyl alcohol and its products; methyl alcohol; unspecified alcohol).

• (E868.2)

Agent: Accidental poisoning by motor vehicle exhaust gas.

Fall

For falls, all ages combined, the YLL contributed more to the DALY than the YLD. The important ICD9-CM E-codes contributing to YLL are:

• (E887)

Agent: Fracture of cause unspecified.

• (E888)

Agent: Other and unspecified fall.

• (E880.9)

Agent: Fall on or from stairs or steps other than escalator and sidewalk curb.

• (E884.9)

Agent: Other fall from one level to another such as: embankment, haystack, stationary vehicle and tree.

Medical adverse events

For medical AE, all ages combined, the YLD contributed more to the DALY than the YLL. The important ICD9-CM E-codes contributing to YLD are:

• (E878, E879)

Agent: surgical and medical procedures as the cause of abnormal reaction of patient or later complication, without mention of misadventure at the time of procedure.

Other transport injuries

For other transport injuries, all ages combined, the YLL contributed more to the DALY than the YLD. The important ICD9-CM E-codes contributing to YLL are:

- (E805.2)

  Agent: Hit by rolling stock

  Host: Pedestrian

- (E822.7)

  Agent: Other motor vehicle non-traffic accident involving collision with moving object

  Host: Pedestrian

- (E830.0, E830.9)

  Agent: Accident to watercraft causing submersion

  Host: The occupant of a small boat (unpowered) or an unspecified person

- (E832.0)

  Agent: Other accidental submersion or drowning in a water transport accident

  Host: The occupant of a small boat (unpowered)

- (E841.3, E841.9)

  Agent: Accident to powered aircraft (unspecified)

  Host: Passenger on powered aircraft (not specified anywhere else) or other person

Burns/fires/scalds

For burns/fires/scalds, all ages combined, the YLD contributed more to the DALY than the YLL. The important ICD9-CM E-codes contributing to YLD are:

- (E890.3)

  Agent: Burning caused by conflagration

- (E894.0)

  Agent: Ignition of highly inflammable material

- (E924.0)

  Agent: Hot liquids and vapours including steam.

Drowning

For drowning, all ages combined, the YLL contributed more to the DALY than the YLD. The important ICD9-CM E-codes contributing to YLL are:

- (E910.1, E910.2, E910.8, E910.9)

  Agent: Accidental drowning and submersion while: water-skiing; engaged in other sport or recreational activity without diving equipment; in a quenching tank or swimming pool. Or an accidental drowning or submersion of an unspecified nature.

Sports injuries

For sports injuries, all ages combined, the YLD contributed more to the DALY than the YLL. The important ICD9-CM E-codes contributing to YLD are:

• (E886.0)

Agent: Fall on same level from colliding, or pushing, or shoving, by or with other person in sports

• (E917.0)

Agent: Striking against or struck accidentally by objects or persons in sports (*e.g.*, kicked or stepped on during game (football) (rugby), knocked down while boxing, struck by hit or thrown ball, or struck by hockey stick or puck)

• (E927.0)

Agent: Overexertion and strenuous movements from lifting, pulling, pushing, recreational activities and other activities.

Natural and environmental factors

For natural and environmental factors, all ages combined, the YLL contributed more to the DALY than the YLD. The important ICD9-CM E-codes contributing to YLL are:

• (E901.0, E901.9)

Agent: Excessive cold due to weather conditions or of unspecified origin

• (E904.3)

Agent: Exposure to weather conditions (not elsewhere classifiable) combined with hunger, thirst, exposure, and neglect.

• (E906.8)

Agent: other specified injury caused by animal (*e.g.*, butted by an animal, fallen on by horse or other animal (not being ridden), gored by animal, run over or stepped on by an animal not being ridden)

• (E909)

Agent: Cataclysmic earth surface movements and eruptions

Machinery injuries

For machinery injuries, all ages combined, the YLD contributed more to the DALY than the YLL. The important ICD9-CM E-codes contributing to YLD are:

• (E919.2, E919.4, E919.8)

Agent: Machinery, mainly: lifting machines and appliances; woodworking and forming machines; and other machines for manufacture of clothing, foodstuffs and beverages, paper; printing machines; recreational machinery and spinning, weaving and textile machines.

• (E920.1, E920.4)

Agent: Powered lawn mower or other hand tools and implements

Suffocation and foreign bodies

For suffocation and foreign bodies, all ages combined, the YLD contributed more to the DALY than the YLL. The important ICD9-CM E-codes contributing to YLD are:

- (E911.0)

  Agent: Injury caused by inhalation and ingestion of food causing obstruction of respiratory tract or suffocation.

- (E912.0)

  Agent: Inhalation and ingestion of an object causing obstruction of respiratory tract or suffocation

- (E914.0)

  Agent: Foreign body accidentally entering eye and adnexa.

- (E915.0)

  Agent: Foreign body accidentally entering other orifice than respiratory tract, eye or adnexa.

Other unintentional injuries excluding medical AE

For other unintentional injuries, all ages combined, the YLD contributed more to the DALY than the YLL. The important ICD9-CM E-codes contributing to YLD are:

- (E916.0)

  Agent: Struck accidentally by falling object such as: rock, snowslide (nowhere else specified), stone, tree, object falling from machine not in operation or from stationary vehicle.

- (E917.9)

  Agent: Struck accidentally by an air rifle.

- (E918.0)

  Agent: Caught accidentally in or between objects.

- (E920.3, E920.8)

  Agent: Cutting and piercing instruments or objects mainly: knives, swords and daggers, and other cutting and piercing objects (*e.g.*, broken glass, nail, tin can lid, splinter, etc.)

- (E929.8)

  Agent: Late effect of other accidents (excluding all the external causes mentioned above)

Suicide and self-inflicted injury

For suicide and self-inflicted injury, all ages combined, the YLL contributed more to the DALY than the YLD. The important ICD9-CM E-codes contributing to YLL are:

- (E950.0, E950.3, E950.4, E950.5)

  Agent: Suicide and self-inflicted poisoning by solid or liquid substances such as: analgesics, antipyretics, antirheumatics, tranquilizers, other psychotropic agents, and other specified or unspecified drugs and medicinal substances.

- (E952.0, E952.1)

  Agent: Suicide and self-inflicted poisoning by other gases and vapours such as motor vehicle exhaust gas and other carbon monoxide.

- (E953.0, E953.1, E953.8, E953.9)

  Agent: Suicide and self-inflicted injury by hanging, strangulation, suffocation and other unspecified means.

- (E955.4)

  Agent: Suicide and self-inflicted injury by firearms other than handgun, shotgun, hunting rifle and military firearms.

- (E957.0, E957.1)

  Agent: Suicide and self-inflicted injury by jumping from residential premises and other man-made structures.

Other intentional injury

For other intentional injury, all ages combined, the YLL contributed more to the DALY than the YLD. The important ICD9-CM E-codes contributing to YLL are mainly due to homicide and violence and they are:

- (E960.0)

  Agent: Homicide and injury inflicted by unarmed fight or brawl.

- (E963)

  Agent: Assault or homicidal attempt by hanging and strangulation such as garrotting or ligature, hanging, strangulation and suffocation.

- (E965.4)

  Agent: Assault by firearms other than handgun, shotgun, hunting rifle and military firearms. It also includes some cases of unspecified firearm.

- (E966)

  Agent: Assault or assassination attempt and homicidal attempt by cutting, puncturing and stabbing or by a piercing instrument classifiable under E920 (please see Glossary).

- (E968.8, E968.9)

  Agent: Assault or assassination attempt and homicidal attempt by other specified or unspecified means

Appendix D

Example of Disability Weight Spreadsheet Assuming Zero Disability Weight for the Residual Category of Injury Sequela

In this section we demonstrate the methodology used to calculate the overall disability weight by gender and age group for each of the external causes of injury in this study. As an example we decided to show the calculations for the disability weights for males that were hospitalized due to a road traffic accident.

Note that the tables corresponding to each of the steps that we describe next are named at the top of each page as **Table from Step ....** In practice all the steps described in this example were implemented as a macro in SAS version 8 and obtained automatically.

Step 1. We selected all males that suffered a road traffic accident and were hospitalized during 1991-2000, using the ICD9-CM E-codes E810-E819, E826-E829, E929.0;

Step 2. We classified these cases of hospitalization according to the nature of injuries described in Table 3.1 (page 49). The natures of injury described in page 50 (notes (1) to (6)) were proportionately redistributed according to the recommendations in this same page;

Step 3. In this step we redistributed the ICD9-N-codes 958 – 959, 990 – 999 (coded in table as N40-N41) proportionately across all categories that have disability weights (coded in table as N1-N33) as described in the recommendation in page 50. These ICD9-Ncodes represent natures of injury that have no disability weight assigned to. So at this time we calculated the

percentage of cases each of the 33 categories N1-N33 would receive from the categories N40-N41;

Step 4. We calculated how many cases each of the 33 categories N1-N33 would receive from the categories N40-N41 based on Step 3. In SAS we randomly selected these cases that would be assigned to each of these 33 categories of nature of injury;

Step 5. Now we added the original number of cases of hospitalization to the number of cases obtained in Step 4 to obtain the new cases of hospitalization for the categories N1-N33. ;

In SAS, we made a table with all the disability weights obtained from the global burden of disease (GBD) study specific to each age group (Murray and Lopez 1996). We also have these weights displayed in Table 3.2 (page 68). Note that some injuries can have long-term and short-term disability weights. We assigned the disability weights according to what is described in column "GBD assumptions" in Table 3.2:

(a) We adjusted the weight for individuals with more than one nature of injury (or sequela) using the formula $DW_{12...K}=1-(1-DW_1)*(1-DW_2)*\ldots *(1-DW_K)$, where the subscript K represents the number of injury sequela for each individual;

(b) Then, for each age group, we calculated the overall DW (Table 3.3) as a weighted average of the adjusted (to other injury sequelae) disability weights for each individual:

$$\frac{Individuals_1 * DW_{adj,1} + \ldots + Individuals_N * DW_{adj,N}}{Individuals_1 + \ldots + Individuals_N}$$

where $DW_{adj,N}$ represents the corresponding DW adjusted for multiple sequelae in the same individual, $Individuals_N$ represents the number of individuals with DW equal to $DW_{adj,N}$ and N is the total number of individuals with that particular $DW_{adj,N}$.

Table D.1. Table from Step 2.

Injury Nature	ICD9-CM N-Codes	Code	Original number of hospitalizations				
			0 - 19	20 - 39	40 - 64	65 - 79	80+
Fractured skull	800 - 801	N1	505	624	293	87	31
Fractured face bones	802	N2	660	1161	512	117	28
Fractured vertebral column	805	N3	535	1284	669	164	45
Injured spinal cord	806 and 952	N4	121	370	193	64	17
Fractured rib or sternum	807	N5	277	1218	1292	535	222
Fractured pelvis	808	N6	336	712	466	178	64
Fractured clavicle, scapula or humerus	810 - 812	N7	780	1151	749	192	68
Fractured radius or ulna	813	N8	1343	1105	574	132	29
Fractured hand bones	814 - 817	N9	322	839	389	52	14
Fractured femur	820 - 821	N10	638	854	452	175	111
Fractured patella, tibia or fibula	822 - 823	N11	691	1291	861	274	82
Fractured ankle	824	N12	363	835	466	98	30
Fractured foot bones	825 - 826	N13	148	485	258	41	8
Other dislocation	830, 833 - 834, 836 - 839	N14	122	448	244	35	5
Dislocated shoulder, elbow or hip	831, 832, 835	N15	115	404	213	37	9
Sprains	840 - 848	N16	399	1221	610	125	41
Intracranial injury	850 - 854	N17	2617	2864	1265	430	116
Internal injuries	860 - 869	N18	1177	1892	1125	391	117
Open wound	870, 872 - 884, 890 - 894	N19	2170	3676	1575	454	128
Injury to eyes	871, 950	N20	28	47	32	15	5
Amputated thumb	885	N21	0	3	5	0	0
Amputated finger	886	N22	8	13	12	0	0
Amputated arm	887	N23	0	6	5	0	0
Amputated toe	895	N24	0	6	1	0	0
Amputated foot	896, 897.0 - 897.1	N25	6	4	7	1	0
Amputated leg	897.2 - 897.3	N26	0	2	0	0	0
Crushing	925 - 929	N27	25	54	30	9	0
Burns < 20%	940 - 947, 948.0 - 948.1	N28	17	48	28	5	0
Burns > 20% and < 60%	948.2 - 948.5	N29	0	1	1	0	0
Burns > 60%	948.6 - 948.9	N30	0	1	0	0	0
Injured nerves	951, 953 - 957	N31	135	302	103	20	5
Poisoning	960 - 979, 980 - 989	N32	4	15	6	3	0
Residual	900 - 924, 930 - 939	N33	2424	4488	2395	684	247
Injuries in Note (7) (A.7)	958-959, 990-999	N40	581	1330	805	255	90
Injuries in Note (8) (A.8)	829,849,855-859,888-889,898-899,897.8-897.7	N41	0	1	1	1	0
Total			16,547	28,755	15,637	4,574	1,512
(A.7) + (A.8)			581	1,331	806	256	90
Total without (A.7) and (A.8)			15,966	27,424	14,831	4,318	1,422

Table D.2. Table from Step 3.

Injury Nature	ICD9-CM N-Codes	Code	Percentage without categories N40 and N41				
			% 0 - 19	% 20 - 39	% 40 - 64	% 65 - 79	% 80+
Fractured skull	800 - 801	N1	3.163	2.275	1.976	2.015	2.180
Fractured face bones	802	N2	4.134	4.234	3.452	2.710	1.969
Fractured vertebral column	805	N3	3.351	4.682	4.511	3.798	3.165
Injured spinal cord	806 and 952	N4	0.758	1.349	1.301	1.482	1.195
Fractured rib or sternum	807	N5	1.735	4.441	8.711	12.390	15.612
Fractured pelvis	808	N6	2.104	2.596	3.142	4.122	4.501
Fractured clavicle, scapula or humerus	810 - 812	N7	4.885	4.197	5.050	4.447	4.782
Fractured radius or ulna	813	N8	8.412	4.029	3.870	3.057	2.039
Fractured hand bones	814 - 817	N9	2.017	3.059	2.623	1.204	0.985
Fractured femur	820 - 821	N10	3.996	3.114	3.048	4.053	7.806
Fractured patella, tibia or fibula	822 - 823	N11	4.328	4.708	5.805	6.346	5.767
Fractured ankle	824	N12	2.274	3.045	3.142	2.270	2.110
Fractured foot bones	825 - 826	N13	0.927	1.769	1.740	0.950	0.563
Other dislocation	830, 833 - 834, 836 - 839	N14	0.764	1.634	1.645	0.811	0.352
Dislocated shoulder, elbow or hip	831, 832, 835	N15	0.720	1.473	1.436	0.857	0.633
Sprains	840 - 848	N16	2.499	4.452	4.113	2.895	2.883
Intracranial injury	850 - 854	N17	16.391	10.443	8.529	9.958	8.158
Internal injuries	860 - 869	N18	7.372	6.899	7.585	9.055	8.228
Open wound	870, 872 - 884, 890 - 894	N19	13.591	13.404	10.620	10.514	9.001
Injury to eyes	871, 950	N20	0.175	0.171	0.216	0.347	0.352
Amputated thumb	885	N21	0.000	0.011	0.034	0.000	0.000
Amputated finger	886	N22	0.050	0.047	0.081	0.000	0.000
Amputated arm	887	N23	0.000	0.022	0.034	0.000	0.000
Amputated toe	895	N24	0.000	0.022	0.007	0.000	0.000
Amputated foot	896, 897.0 - 897.1	N25	0.038	0.015	0.047	0.023	0.000
Amputated leg	897.2 - 897.3	N26	0.000	0.007	0.000	0.000	0.000
Crushing	925 - 929	N27	0.157	0.197	0.202	0.208	0.000
Burns < 20%	940 - 947, 948.0 - 948.1	N28	0.106	0.175	0.189	0.116	0.000
Burns > 20% and < 60%	948.2 - 948.5	N29	0.000	0.004	0.007	0.000	0.000
Burns > 60%	948.6 - 948.9	N30	0.000	0.004	0.000	0.000	0.000
Injured nerves	951, 953 - 957	N31	0.846	1.101	0.694	0.463	0.352
Poisoning	960 - 979, 980 - 989	N32	0.025	0.055	0.040	0.069	0.000
Residual	900 - 924, 930 - 939	N33	15.182	16.365	16.149	15.841	17.370
Injuries in Note (7) (A.7)	958-959, 990-999	N40	-	-	-	-	-
Injuries in Note (8) (A.8)	829,849,855-859,888-889,898-899,897.8-897.7	N41	-	-	-	-	-
		Total	100	100	100	100	100

Table D.3. Table from Step 4.

Injury Nature	ICD9-CM N-Codes	Code	Number cases of hospitalizations borrowed from N40 and N41				
			0 - 19	20 - 39	40 - 64	65 - 79	80+
Fractured skull	800 - 801	N1	18.4	30.3	15.9	5.2	2.0
Fractured face bones	802	N2	24.0	56.3	27.8	6.9	1.8
Fractured vertebral column	805	N3	19.5	62.3	36.4	9.7	2.8
Injured spinal cord	806 and 952	N4	4.4	18.0	10.5	3.8	1.1
Fractured rib or sternum	807	N5	10.1	59.1	70.2	31.7	14.1
Fractured pelvis	808	N6	12.2	34.6	25.3	10.6	4.1
Fractured clavicle, scapula or humerus	810 - 812	N7	28.4	55.9	40.7	11.4	4.3
Fractured radius or ulna	813	N8	48.9	53.6	31.2	7.8	1.8
Fractured hand bones	814 - 817	N9	11.7	40.7	21.1	3.1	0.9
Fractured femur	820 - 821	N10	23.2	41.4	24.6	10.4	7.0
Fractured patella, tibia or fibula	822 - 823	N11	25.1	62.7	46.8	16.2	5.2
Fractured ankle	824	N12	13.2	40.5	25.3	5.8	1.9
Fractured foot bones	825 - 826	N13	5.4	23.5	14.0	2.4	0.5
Other dislocation	830, 833 - 834, 836 - 839	N14	4.4	21.7	13.3	2.1	0.3
Dislocated shoulder, elbow or hip	831, 832, 835	N15	4.2	19.6	11.6	2.2	0.6
Sprains	840 - 848	N16	14.5	59.3	33.2	7.4	2.6
Intracranial injury	850 - 854	N17	95.2	139.0	68.7	25.5	7.3
Internal injuries	860 - 869	N18	42.8	91.8	61.1	23.2	7.4
Open wound	870, 872 - 884, 890 - 894	N19	79.0	178.4	85.6	26.9	8.1
Injury to eyes	871, 950	N20	1.0	2.3	1.7	0.9	0.3
Amputated thumb	885	N21	0.0	0.1	0.3	0.0	0.0
Amputated finger	886	N22	0.3	0.6	0.7	0.0	0.0
Amputated arm	887	N23	0.0	0.3	0.3	0.0	0.0
Amputated toe	895	N24	0.0	0.3	0.1	0.0	0.0
Amputated foot	896, 897.0 - 897.1	N25	0.2	0.2	0.4	0.1	0.0
Amputated leg	897.2 - 897.3	N26	0.0	0.1	0.0	0.0	0.0
Crushing	925 - 929	N27	0.9	2.6	1.6	0.5	0.0
Burns < 20%	940 - 947, 948.0 - 948.1	N28	0.6	2.3	1.5	0.3	0.0
Burns > 20% and < 60%	948.2 - 948.5	N29	0.0	0.0	0.1	0.0	0.0
Burns > 60%	948.6 - 948.9	N30	0.0	0.0	0.0	0.0	0.0
Injured nerves	951, 953 - 957	N31	4.9	14.7	5.6	1.2	0.3
Poisoning	960 - 979, 980 - 989	N32	0.1	0.7	0.3	0.2	0.0
Residual	900 - 924, 930 - 939	N33	88.2	217.8	130.2	40.6	15.6
Injuries in Note (7) (A.7)	958-959, 990-999	N40	-	-	-	-	-
Injuries in Note (8) (A.8)	829,849,855-859,888-889,898-899,897.8-897.7	N41	-	-	-	-	-
		Total	581	1,331	806	256	90

Table D.4. Table from Step 5.

Injury Nature	Code	New hospitalization total				
		0 - 19	20 - 39	40 - 64	65 - 79	80+
Fractured skull - short and long terms (already adjusted)	N1	523	654	309	92	33
Fractured face bones	N2	684	1217	540	124	30
Fractured vertebral column - short term	N3	554	1346	705	174	48
Injured spinal cord - life long	N4	125	388	203	68	18
Fractured rib or sternum - short term	N5	287	1277	1362	567	236
Fractured pelvis - short term	N6	348	747	491	189	68
Fractured clavicle, scapula or humerus - short term	N7	808	1207	790	203	72
Fractured radius or ulna - short term	N8	1392	1159	605	140	31
Fractured hand bones	N9	334	880	410	55	15
Fractured femur - short and long terms (already adjusted)	N10	661	895	477	185	118
Fractured patella, tibia or fibula - short term	N11	716	1354	908	290	87
Fractured ankle - short term	N12	376	876	491	104	32
Fractured foot bones	N13	153	509	272	43	9
Other dislocation	N14	126	470	257	37	5
Dislocated shoulder, elbow or hip - short term	N15	119	424	225	39	10
Sprains	N16	414	1280	643	132	44
Intracranial injury - short and long terms (already adjusted)	N17	2712	3003	1334	455	123
Internal injuries - short term	N18	1220	1984	1186	414	124
Open wound	N19	2249	3854	1661	481	136
Injury to eyes - life long	N20	29	49	34	16	5
Amputated thumb - life long	N21	0	3	5	0	0
Amputated finger - life long	N22	8	14	13	0	0
Amputated arm - life long	N23	0	6	5	0	0
Amputated toe - life long	N24	0	6	1	0	0
Amputated foot - life long	N25	6	4	7	1	0
Amputated leg - life long	N26	0	2	0	0	0
Crushing - short term	N27	26	57	32	10	0
Burns < 20% - life long	N28	18	50	30	5	0
Burns > 20% and < 60% - life long	N29	0	1	1	0	0
Burns > 60% - life long	N30	0	1	0	0	0
Injured nerves - life long	N31	140	317	109	21	5
Poisoning - short term	N32	4	16	6	3	0
Residual	N33	2512	4706	2525	725	263
Total		16,547	28,755	15,637	4,574	1,512
Total without residual		14,035	24,049	13,112	3,849	1,249

Appendix E

Example of Duration Spreadsheet Assuming Zero Duration for the Residual Category of Injury Sequela

In this section we demonstrate the methodology used to calculate the overall durations by gender and age group for each of the external causes of injury in this study. As an example we decided to show the calculations for the durations for males that were hospitalized due to a Road Traffic Accident.

In practice all the steps described in this example were implemented as a macro in SAS version 8 and obtained automatically.

Steps 1 to 5. Same as described in Appendix D (Example of disability weight spreadsheet assuming zero disability weight for the residual category of injury sequela);

In SAS, we made a table with all the durations obtained from the global burden of disease (GBD) study specific to each age group (Murray and Lopez 1996). We also have these durations displayed in Table 3.5 (page 76). Note that some injuries can have long-term and others can have short-term durations. We distributed the cases of injury according to what is described in column "GBD assumptions" in Table 3.5. Note that the long-term durations are based on the BC life expectancy as described in section 3.3.1.5 (page78).

(a) We adjusted the duration of individuals with more than one nature of injury (or sequela) by calculating an average between different durations;

(b) Then, for each age group, we calculated the overall D (Table 3.7, page 79) as a weighted average of the adjusted (to other injury sequelae) duration of disability of each individual:

$$\frac{Individuals_1 * D_{adj,1} + ... + Individuals_N * D_{adj,N}}{Individuals_1 + ... + Individuals_N}$$

where $D_{adj,N}$ represents the corresponding D adjusted for multiple sequelae in the same individual, $Individuals_N$ represents the number of individuals with D equal to $D_{adj,N}$ and N is the total number of individuals with that particular $D_{adj,N}$..

Appendix F

Sensitivity Analyses

In this appendix, we examine the robustness of DALY estimates for the following six categories of external cause of injury: road traffic accidents; poisoning; falls; other unintentional injuries (other transport injuries, burns/fires/scalds, drowning, sports injuries, natural and environmental factors, machinery injuries, suffocation and foreign bodies); suicide and self-inflicted injuries; and other intentional injuries (Figure 4.1, page 90).

The robustness of estimated disability-adjusted life years (DALY) was examined using two sensitivity analyses. The first sensitivity analysis was conducted to investigate the sensitivity of DALY estimates to different values of the discounting future health rate. The relevance of performing this sensitivity analysis was to emphasize the importance of understanding the impact of different discount rates on the calculation of DALY for injuries in BC. The discount rates examined in this sensitivity analysis were 0%, 3%, 6% and 10%. The literature recommends the use of a 3% discounting rate, however it is important to stress that there is no convincing theoretical argument for this choice. Based on the results of the sensitivity analysis conducted in this study, we decided to use a 3% discount rate in all DALY calculations presented this study.

The second sensitivity analysis was conducted to investigate the robustness of DALY to the impact of different disability weights used for the residual category of injury sequela in the DALY calculation. The importance of performing this sensitivity analysis resides in the fact that there are no such weights developed for BC, and future policy actions based on the results of this thesis could accommodate different scenarios (using different weights),

depending on what the demonstrated effects of weights are. We demonstrated that using different weights for the residual category of sequela did not affect the conclusions drawn from this study.

1. Sensitivity Analysis for the Discounting of Future Health Rate

To study the robustness of DALY to different discounting rates (0%, 3%, 6% and 10%), we compared: (1) the ranking of DALYs (for all external causes of injury combined) for each age group; (2) the ranking of DALYs (for all age groups combined) for each external cause of injury (road traffic accidents, poisoning, falls, other unintentional injuries (excluding medical AE), suicide and self-inflicted injuries and other intentional injuries); and (3) the logarithm of the YLD:YLL ratio for each external cause of injury and age group. Note that all sensitivity analyses were performed separately for males and females. Throughout this section we assumed fixed zero weight and duration for the residual category of injury.

The ten-year DALY (for all external causes of injury) for each age group and the ratio between DALYs for different values of discounting are presented in Figure F.1 and Table F.1. From this table and figure, we can see that the ten-year DALY by each age group, for both males and females, are very different depending on the magnitude of the discount rate used.

Table F.1. Ten-Year DALY by Discounting Rate, Gender and Age Group.

Description[1]	DALY (1991-2000) All Injuries Males				
	0 - 19	20 - 39	40 - 64	65 - 79	80+
Discount Rate (0%)	206,483	407,803	164,103	23,058	8,109
Discount Rate (3%)	126,119	255,416	125,069	20,262	7,622
Discount Rate (6%)	91,948	186,230	99,948	17,988	7,179
Discount Rate (10%)	68,669	140,441	78,660	15,579	6,649
3% vs 0% (ratio)	0.611	0.626	0.762	0.879	0.940
6% vs 3% (ratio)	0.729	0.729	0.799	0.888	0.942
10% vs 6% (ratio)	0.747	0.754	0.787	0.866	0.926

Description[1]	DALY (1991-2000) All Injuries Females				
	0 - 19	20 - 39	40 - 64	65 - 79	80+
Discount Rate (0%)	99,232	117,988	58,993	18,470	13,658
Discount Rate (3%)	59,310	75,620	44,241	16,060	12,802
Discount Rate (6%)	43,324	57,018	35,278	14,163	12,031
Discount Rate (10%)	32,880	44,968	28,054	12,218	11,119
3% vs 0% (ratio)	0.598	0.641	0.750	0.870	0.937
6% vs 3% (ratio)	0.730	0.754	0.797	0.882	0.940
10% vs 6% (ratio)	0.759	0.789	0.795	0.863	0.924

[1] For example, the ratio using a discount rate equal to 3% vs 0% was calculated using the formula

$$\left(\frac{DALY[0,3]}{DALY[0,0]}\right).$$

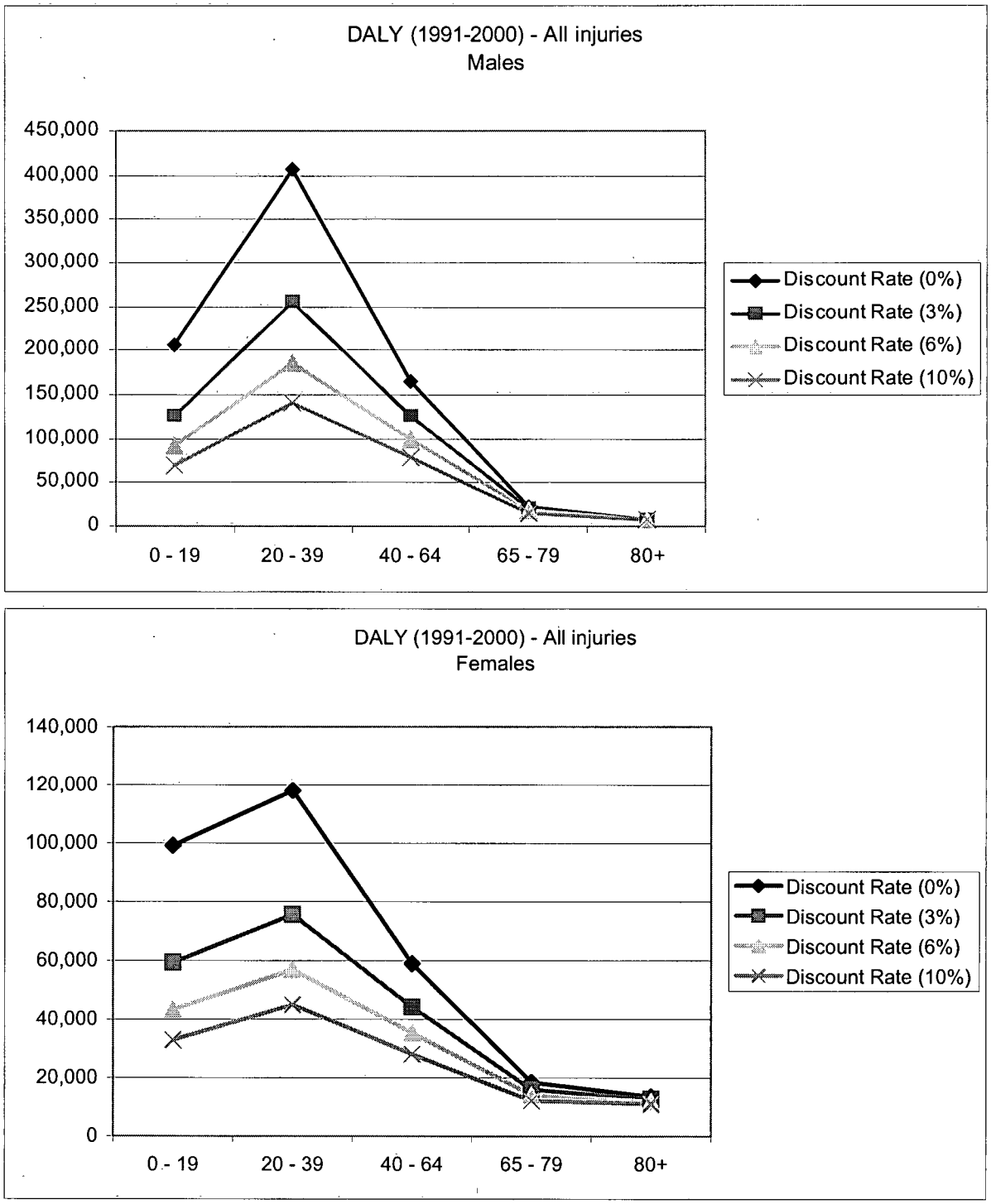

Figure F.1. Ten-Year DALY By Discounting Rate, Gender and Age Group.

Note that if the ratio between DALYs, $\left(\frac{DALY[0,r_1]}{DALY[0,r_2]}\right)$, is approximately one, it means that the DALYs for the two different discount rates are very similar in magnitude; the further this ratio is from one, the more different the DALYs are.

Depending on the age group, the ratio between DALYs for two different discount ratios ranged from 0.61 (ratio between DALY[0,3] and DALY[0,0] for males aged 0-19) to 0.94 (ratio between DALY[0,6] and DALY[0,3] for females aged 80+). In Table F.1, for both males and females, we observe that for younger age groups (those individuals whose age is less than 40 years, with the age group 0-19 having the largest difference) there is a large impact on DALY when the discount rate is increased from 0% to 3% (smaller ratios). For the later age groups (age $\geq$ 40 years), increasing the discount rate does not have a large impact on the value of DALY. However, as age increases within this older group, there is a small impact on the value of DALY when the discount rate is increased from 6% to 10%. For a quick visual summary (by age group) of the DALY ratios for successive discount rates see Figure F.2.

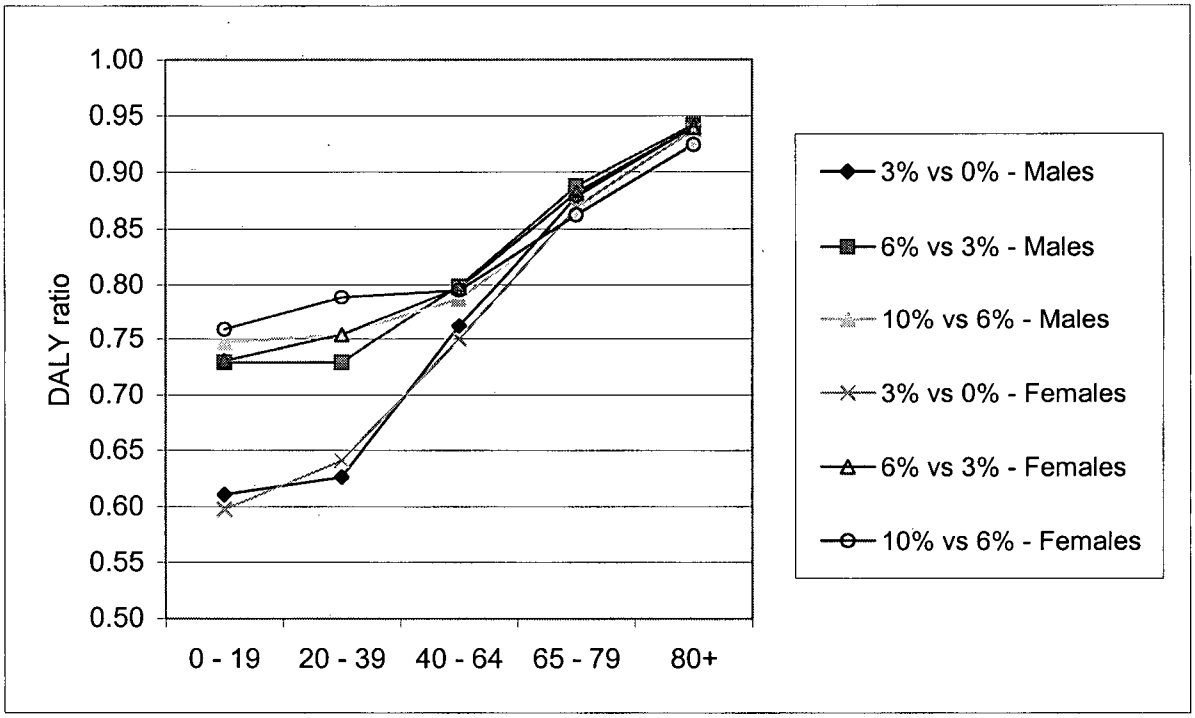

Figure F.2. Percentage of Change in Ten-Year DALY for Different Discounting Rates by Gender and Age Group.

In summary, we observed that use of a low discount rate increases the impact of the ten-year burden from injury in the younger age groups and as the discount rate increases, the impact of the ten-year burden from injury shifts to the older age groups.

Table F.2 shows that the ranking of DALY for each external cause of injury shifts depending on the magnitude of the discount rate.

Table F.2. Ranking of Ten-Year DALY by Discount Rate, Gender and External Cause of Injury. (Note: Changing ranks highlighted in colour)

Description	DALY (1991-2000) Males							
	Discount Rate (0%)	Ranking	Discount Rate (3%)	Ranking	Discount Rate (6%)	Ranking	Discount Rate (10%)	Ranking
Road traffic accidents	161,198	2	97,980	2	72,396	2	56,577	2
Poisoning	110,292	4	63,611	4	42,387	4	28,679	4
Falls	42,640	6	33,923	5	29,552	5	26,200	5
Other unintentional injuries‡	301,168	1	219,946	1	173,306	1	134,575	1
Suicide and self-inflicted injuries	146,784	3	88,221	3	62,007	3	44,917	3
Other intentional injuries	47,475	5	30,806	6	23,646	6	19,048	6

Description	DALY (1991-2000) Females							
	Discount Rate (0%)	Ranking	Discount Rate (3%)	Ranking	Discount Rate (6%)	Ranking	Discount Rate (10%)	Ranking
Road traffic accidents	72,637	2	45,280	2	34,639	2	28,032	2
Poisoning	34,746	4	19,668	5	13,104	5	8,980	6
Falls	26,926	5	23,371	4	21,246	4	19,328	4
Other unintentional injuries‡	97,520	1	70,360	1	54,983	1	42,437	1
Suicide and self-inflicted injuries	51,369	3	33,852	3	26,135	3	21,099	3
Other intentional injuries	25,145	6	15,503	6	11,708	6	9,363	5

‡ Excludes medical adverse events

There was variation in the ranking of DALYs when we increased the discount rate from 0% to 10%, especially for females. For males, the external causes of injury that were robust (*i.e.*, did not change in ranking) to changing values of discounting were road traffic accidents, poisoning, other unintentional injuries (excluding medical AE) and suicide and self-inflicted injuries which were the external causes of injury with the largest DALY. For females, the robust external causes of injury were the same as males with the exception of poisoning.

The ten-year DALY (for all ages combined) for each external cause of injury and the ratio between DALYs for different values of discounting are presented in Figure F.3 and Table F.3. This table and figure indicate that the ten-year DALY by each age group, for both males and females, is very different depending on the magnitude of the discount rate.

Table F.3. Ten-Year DALY by Discount Rate, Gender and External Cause of Injury.

Description[1]	DALY (1991-2000) All Injuries Males					
	Road traffic accidents	Poisoning	Falls	Other unintentional injuries[‡]	Suicide and self-inflicted injuries	Other intentional injuries
Discount Rate (0%)	161,198	110,292	42,640	301,168	146,784	47,475
Discount Rate (3%)	97,980	63,611	33,923	219,946	88,221	30,806
Discount Rate (6%)	72,396	42,387	29,552	173,306	62,007	23,646
Discount Rate (10%)	56,577	28,679	26,200	134,575	44,917	19,048
3% vs 0% (ratio)	0.608	0.577	0.796	0.730	0.601	0.649
6% vs 3% (ratio)	0.739	0.666	0.871	0.788	0.703	0.768
10% vs 6% (ratio)	0.782	0.677	0.887	0.777	0.724	0.806

Description[1]	DALY (1991-2000) All Injuries Females					
	Road traffic accidents	Poisoning	Falls	Other unintentional injuries[‡]	Suicide and self-inflicted injuries	Other intentional injuries
Discount Rate (0%)	72,637	34,746	26,926	97,520	51,369	25,145
Discount Rate (3%)	45,280	19,668	23,371	70,360	33,852	15,503
Discount Rate (6%)	34,639	13,104	21,246	54,983	26,135	11,708
Discount Rate (10%)	28,032	8,980	19,328	42,437	21,099	9,363
3% vs 0% (ratio)	0.623	0.566	0.868	0.721	0.659	0.617
6% vs 3% (ratio)	0.765	0.666	0.909	0.781	0.772	0.755
10% vs 6% (ratio)	0.809	0.685	0.910	0.772	0.807	0.800

[‡] Excludes medical adverse events

Depending on the external cause of injury, the ratio between DALYs for two different discount ratios ranged from 0.57 (ratio between DALY[0,3] and DALY[0,0] for males - poisoning) to 0.91 (ratio between DALY[0,10] and DALY[0,6] for females - falls). For both males and females, the largest impact on the value of DALYs was associated with increasing the discount rate from 0% to 3%. For both males and females, the smallest change in the value of DALY associated with increasing the value of discounting, was for falls (i.e., the ratios were closer to one).

As a visual summary of the DALY ratios for each external cause of injury by increasing amount of discounting can be found in Figure F.3.

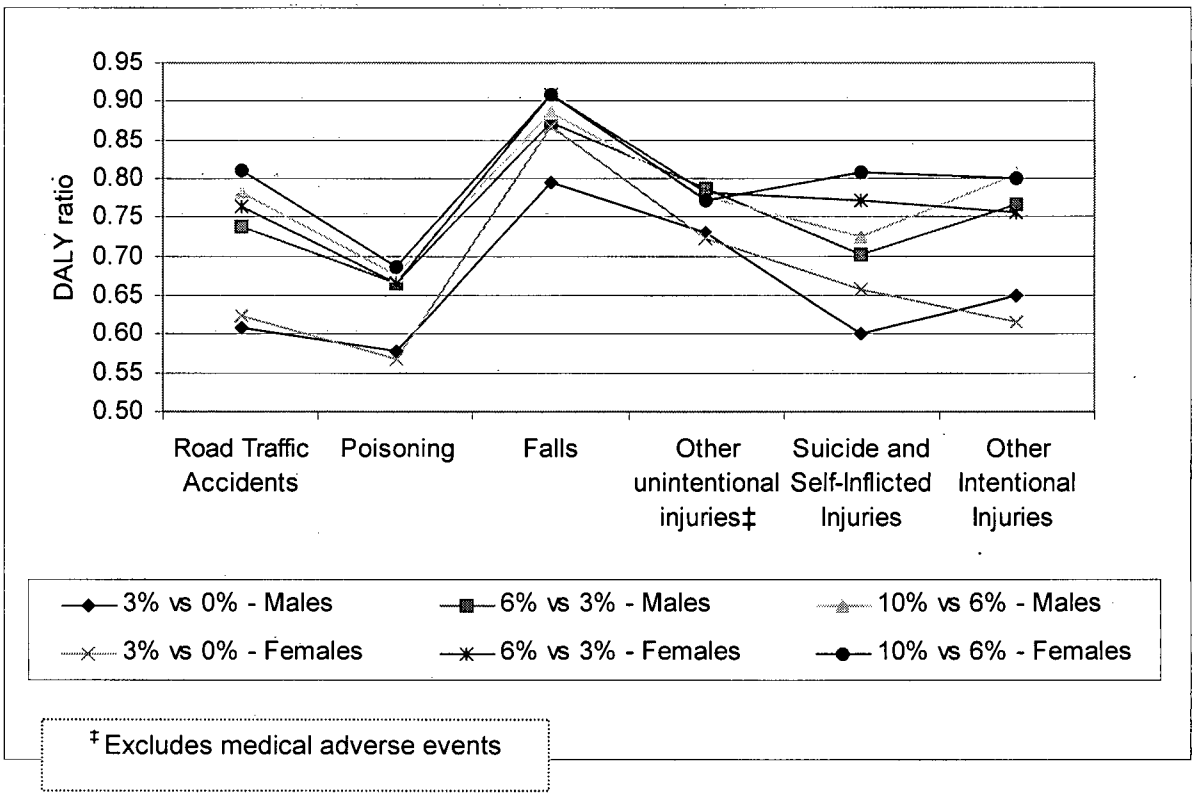

Figure F.3. Ten-Year DALY Ratio for Different Discount Rates by Gender and External Cause of Injury.

We also examined the influence of different discount rates on the natural logarithm of the ratio (YLD:YLL) [*i.e.*, $\ln\left(\frac{\text{YLD}}{\text{YLL}}\right)$]. This ratio is similar to the approach that the WHO Global Burden of Disease study adopted (Murray and Lopez 1996). In this study we applied the logarithm of this ratio to make the comparisons between YLD and YLL graphically clear. If this ratio is approximately zero, it means that YLD and YLL are very similar in magnitude; if this ratio is greater than zero it means that YLD > YLL; conversely, if the ratio is negative, YLD < YLL.

For each external cause of injury (all age groups combined), we observed that as the discounting rate increased, the proportion of the burden of injuries attributed to YLD also increased (Figure F.4).

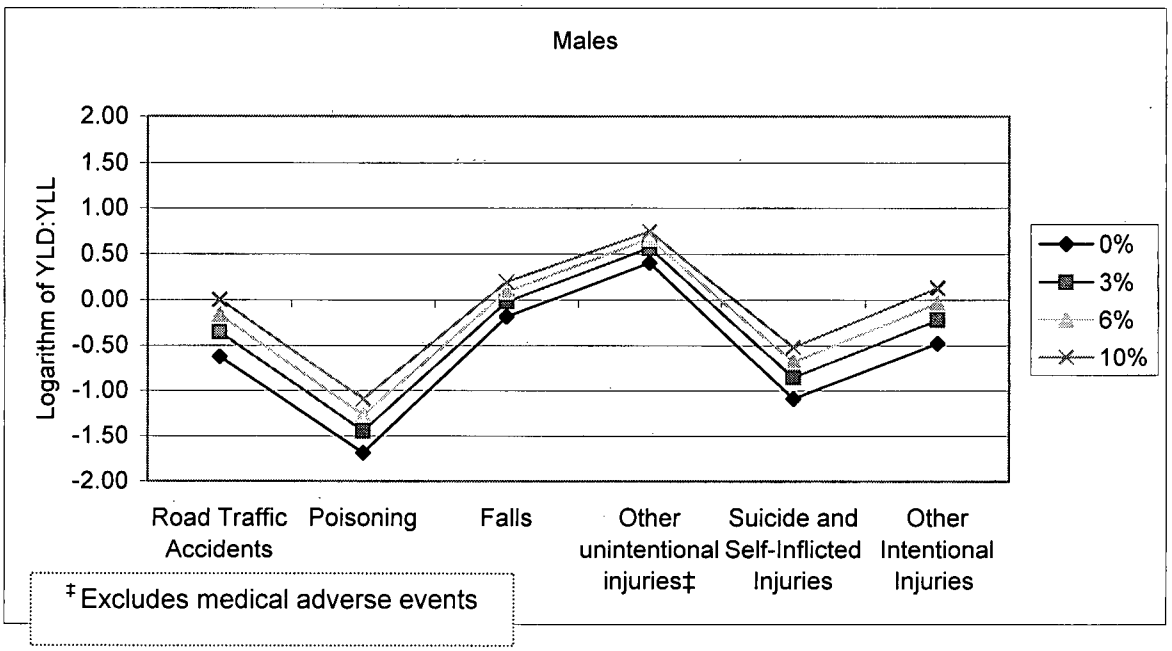

Figure F.4. Logarithm of the Ratio YLD:YLL by Discount Rate, Gender and External Cause of Injury.

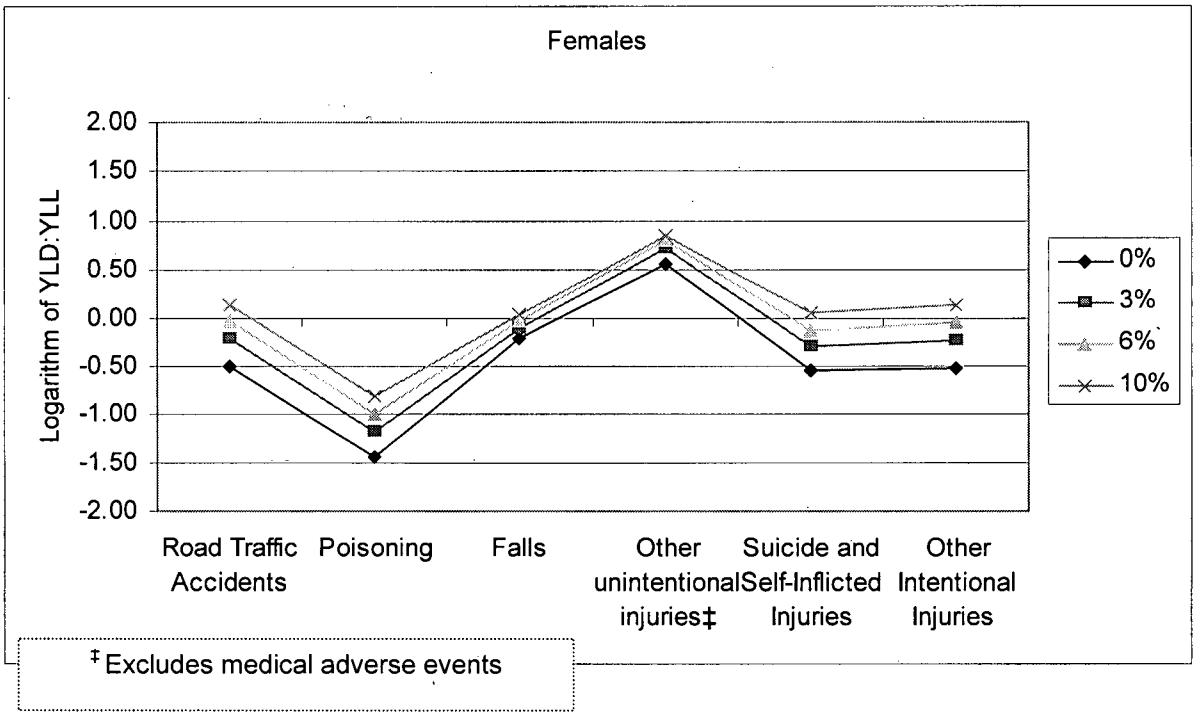

Figure F.4. (continued) Logarithm of the Ratio YLD:YLL by Discount Rate, Gender and External Cause of Injury.

Next, we calculated the YLD:YLL ratio for all external causes of injury combined for each age group separately. We observed that as the discount rate increased, the proportion of the burden of injuries due to YLD also increased. For the younger age groups, the ratio varied across different values of discounting. However, as age increased, the ratios became more similar for the different values of discount rate used (Figure F.5).

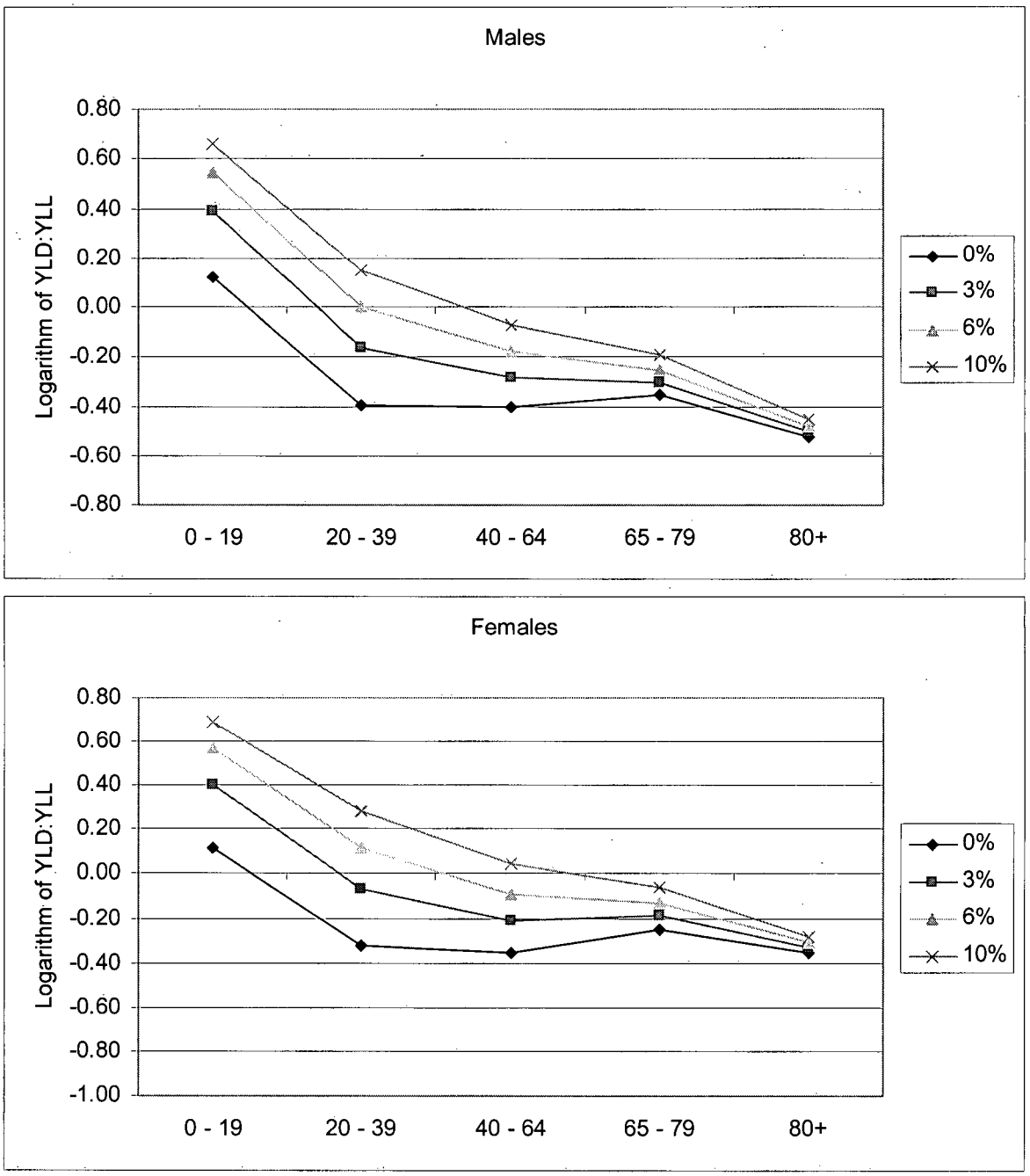

Figure F.5. Logarithm of the Ratio YLD:YLL by Discount Rate, Gender and Age Group.

Last, we observed that the values of the ratio $\ln\left(\frac{\text{YLD}}{\text{YLL}}\right)$ (for all external causes of injury and age combined) were constantly parallel between males and females, regardless of the value of discounting (Figure F.6).

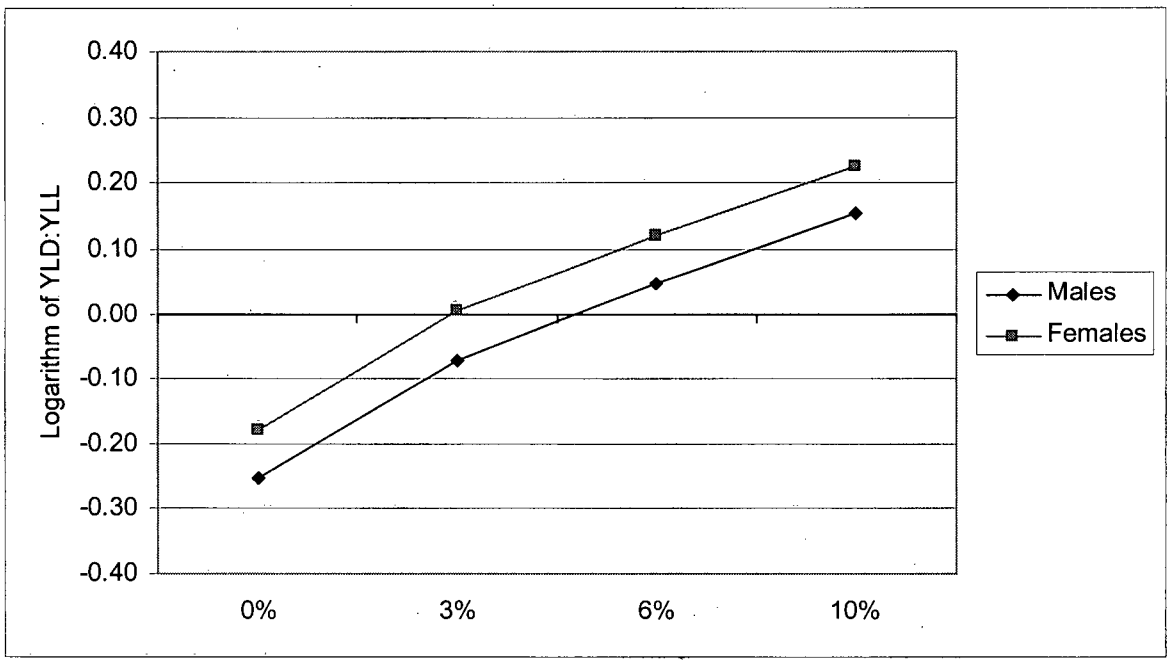

Figure F.6. Logarithm of the Ratio YLD:YLL by Discount Rate and Gender.

2. Sensitivity Analysis for Disability Weights for the Residual Category of Injury Sequela

The set of disability weights for the residual category of injury that we examined in this sensitivity analysis were {0, 0.25, 0.50}. Throughout the analysis we assumed a 3% discounting rate and for simplicity we refer to the disability weight for the residual category of injury as $DW_{residual}$. In Table F.4 we show the overall disability weight for each external cause of injury by age group and gender.

Table F.4. Influence of Different $DW_{residual}$ on the Disability Weights for each External Cause of Injury, by Gender and Age Group.

Zero weight for residuals					
Description	Disability weight by age group - Males				
	0 - 19	20 - 39	40 - 64	65 - 79	80+
Road traffic accidents	0.262	0.247	0.244	0.260	0.264
Poisoning	0.625	0.642	0.636	0.620	0.624
Falls	0.224	0.203	0.223	0.270	0.300
Other unintentional injuries‡	0.187	0.165	0.183	0.257	0.311
Suicide and self-inflicted injuries	0.546	0.556	0.598	0.559	0.492
Other intentional injuries	0.249	0.258	0.303	0.334	0.387

Description	Disability weight by age group - Females				
	0 - 19	20 - 39	40 - 64	65 - 79	80+
Road traffic accidents	0.262	0.242	0.241	0.247	0.252
Poisoning	0.631	0.652	0.644	0.625	0.615
Falls	0.220	0.197	0.220	0.272	0.308
Other unintentional injuries‡	0.191	0.192	0.225	0.304	0.336
Suicide and self-inflicted injuries	0.624	0.624	0.648	0.620	0.554
Other intentional injuries	0.401	0.365	0.414	0.419	0.420

‡Excludes medical adverse events

Table F.4. (continued) Influence of Different $DW_{residual}$ on the Disability Weights for each External Cause of Injury, by Gender and Age Group.

0.25 weight for residuals					
Description	Disability weight by age group - Males				
	0 - 19	20 - 39	40 - 64	65 - 79	80+
Road traffic accidents	0.318	0.305	0.301	0.316	0.327
Poisoning	0.629	0.647	0.638	0.623	0.625
Falls	0.237	0.228	0.251	0.305	0.342
Other unintentional injuries‡	0.250	0.210	0.241	0.338	0.396
Suicide and self-inflicted injuries	0.557	0.569	0.610	0.574	0.499
Other intentional injuries	0.289	0.301	0.357	0.413	0.458

Description	Disability weight by age group - Females				
	0 - 19	20 - 39	40 - 64	65 - 79	80+
Road traffic accidents	0.324	0.314	0.308	0.312	0.317
Poisoning	0.631	0.653	0.647	0.626	0.617
Falls	0.236	0.224	0.244	0.302	0.344
Other unintentional injuries‡	0.293	0.247	0.287	0.369	0.399
Suicide and self-inflicted injuries	0.630	0.630	0.652	0.626	0.563
Other intentional injuries	0.475	0.452	0.497	0.492	0.479

‡ Excludes medical adverse events

0.50 weight for residuals					
Description	Disability weight by age group - Males				
	0 - 19	20 - 39	40 - 64	65 - 79	80+
Road traffic accidents	0.365	0.356	0.351	0.365	0.383
Poisoning	0.632	0.652	0.641	0.626	0.626
Falls	0.250	0.251	0.277	0.338	0.381
Other unintentional injuries‡	0.310	0.253	0.297	0.417	0.479
Suicide and self-inflicted injuries	0.567	0.581	0.621	0.589	0.505
Other intentional injuries	0.325	0.338	0.405	0.485	0.523

Description	Disability weight by age group - Females				
	0 - 19	20 - 39	40 - 64	65 - 79	80+
Road traffic accidents	0.376	0.376	0.366	0.367	0.372
Poisoning	0.632	0.654	0.651	0.628	0.618
Falls	0.250	0.250	0.266	0.329	0.376
Other unintentional injuries‡	0.393	0.301	0.348	0.433	0.460
Suicide and self-inflicted injuries	0.635	0.636	0.656	0.631	0.571
Other intentional injuries	0.536	0.525	0.565	0.552	0.531

‡ Excludes medical adverse events

Tables F.5-F.7 document the variability of the disability weights for each external cause of injury, by gender and age group by using different values of $DW_{residual}$. In summary, it appears that the greatest amount of variation associated with increased $DW_{residual}$ is observed when we compare the final disability weights across external causes of injury. Comparatively less variation in the final disability weights was observed across age groups.

Table F.5. Variation in Disability Weight by Age Group, by Gender and External Cause of Injury.

Description	Variation in disability weight by age group - Males				
	0 - 19	20 - 39	40 - 64	65 - 79	80+
Road traffic accidents	0.052	0.055	0.054	0.053	0.059
Poisoning	0.003	0.005	0.003	0.003	0.001
Falls	0.013	0.024	0.027	0.034	0.041
Other unintentional injuries‡	0.061	0.044	0.057	0.080	0.084
Suicide and self-inflicted injuries	0.011	0.012	0.011	0.015	0.007
Other intentional injuries	0.038	0.040	0.051	0.076	0.068

Description	Variation in disability weight by age group - Females				
	0 - 19	20 - 39	40 - 64	65 - 79	80+
Road traffic accidents	0.057	0.067	0.062	0.060	0.060
Poisoning	0.000	0.001	0.003	0.002	0.001
Falls	0.015	0.027	0.023	0.028	0.034
Other unintentional injuries‡	0.101	0.055	0.061	0.064	0.062
Suicide and self-inflicted injuries	0.006	0.006	0.004	0.005	0.009
Other intentional injuries	0.068	0.080	0.076	0.067	0.056

‡ Excludes medical adverse events

Table F.6. Variation in Disability Weight among Age Groups, by Gender and External Cause of Injury.

Description	Variation in disability weight among age groups - Males		
	Zero weight	0.25 weight	0.50 weight
Road traffic accidents	0.009	0.010	0.012
Poisoning	0.009	0.010	0.011
Falls	0.040	0.049	0.058
Other unintentional injuries‡	0.061	0.077	0.094
Suicide and self-inflicted injuries	0.038	0.041	0.043
Other intentional injuries	0.057	0.072	0.088

Description	Variation in disability weight among age groups - Females		
	Zero weight	0.25 weight	0.50 weight
Road traffic accidents	0.009	0.006	0.005
Poisoning	0.015	0.015	0.015
Falls	0.046	0.051	0.056
Other unintentional injuries‡	0.067	0.063	0.064
Suicide and self-inflicted injuries	0.035	0.033	0.032
Other intentional injuries	0.023	0.017	0.016

‡ Excludes medical adverse events

Table F.7. Variation in Disability Weight across Injuries, by Gender and Age Group.

Description		Variation in disability weight across injuries				
		0 - 19	20 - 39	40 - 64	65 - 79	80+
0 weight	Males	0.187	0.201	0.200	0.163	0.138
0.25 weight		0.169	0.185	0.179	0.138	0.112
0.50 weight		0.154	0.171	0.161	0.118	0.093
0 weight	Females	0.199	0.211	0.204	0.171	0.144
0.25 weight		0.173	0.189	0.185	0.149	0.121
0.50 weight		0.155	0.173	0.169	0.132	0.102

Figure F.7 presents the ten-year DALY calculated using different values of $DW_{residual}$ by gender and age group.

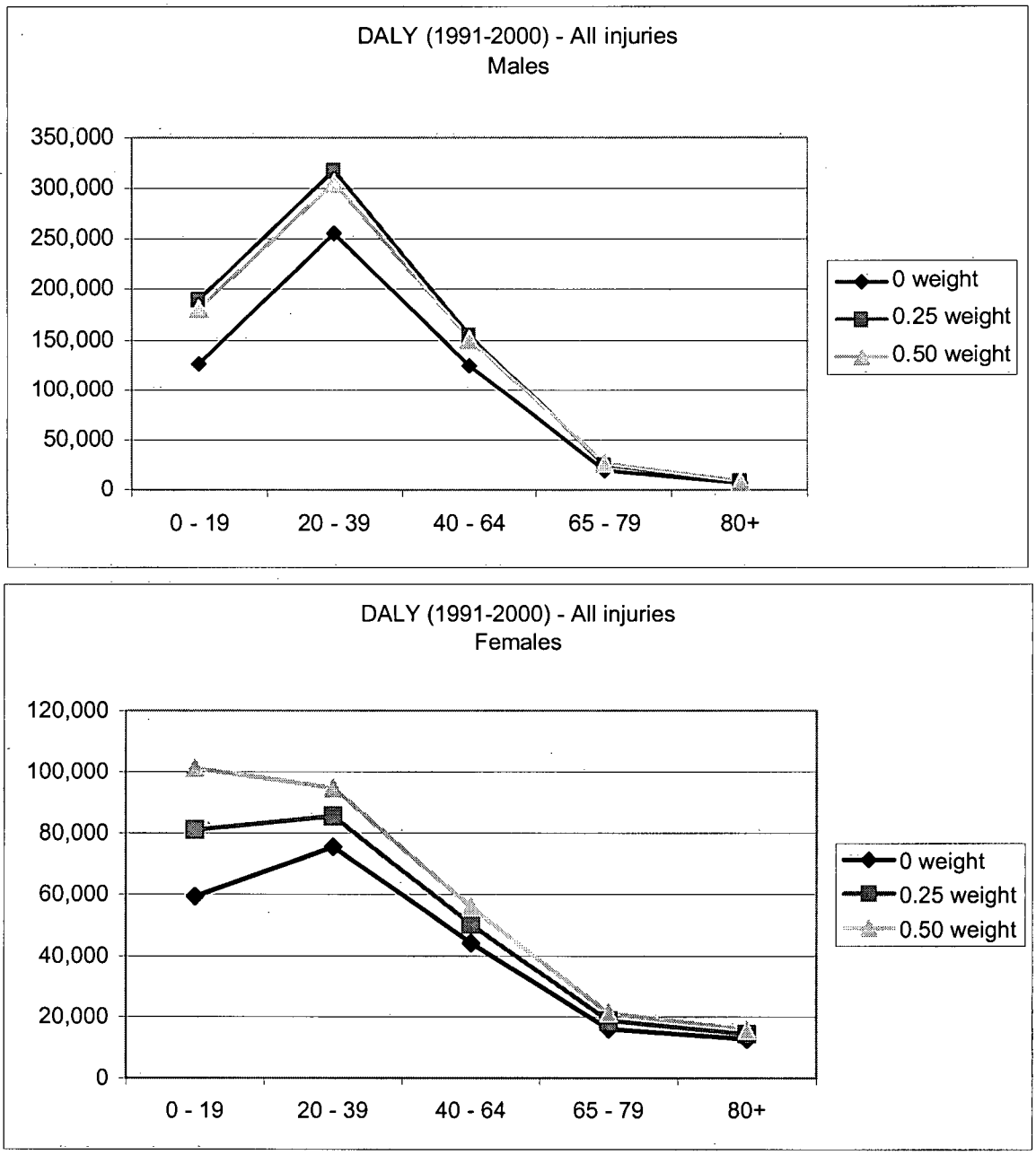

Figure F.7. Ten-Year DALY by $DW_{residual}$, Gender and Age Group.

Table F.8 displays the percentage change in ten-year DALY by age group using different values of $DW_{residual}$. Considering that we substantially increased the values of

$DW_{residual}$ from 0 to 0.25 and from 0.25 to 0.50, the ten-year DALY didn't increase as much as one might expect.

Table F.8. Ten-Year DALY by Age Group and Gender According To Different Values of $DW_{residual}$.

Description[1]	DALY (1991-2000) All Injuries				
	Males				
	0 - 19	20 - 39	40 - 64	65 - 79	80+
0 weight	126,119	255,416	125,069	20,262	7,622
0.25 weight	190,415	318,278	154,010	24,551	8,516
0.50 weight	181,807	304,946	151,526	26,772	9,507
0 vs 0.25 (ratio)	1.51	1.25	1.23	1.21	1.12
0.25 vs 0.50 (ratio)	0.95	0.96	0.98	1.09	1.12

Description[1]	DALY (1991-2000) All Injuries				
	Females				
	0 - 19	20 - 39	40 - 64	65 - 79	80+
0 weight	59,310	75,620	44,241	16,060	12,802
0.25 weight	81,059	85,537	50,251	18,822	14,348
0.50 weight	101,151	94,621	55,862	21,298	15,667
0 vs 0.25 (ratio)	1.37	1.13	1.14	1.17	1.12
0.25 vs 0.50 (ratio)	1.25	1.11	1.11	1.13	1.09

[1] For example the ratio using a $DW_{residual}$ equal to 0.25 vs 0 was calculated using the formula

$$\left(\frac{DALY[0,3] \text{ for } 0.25 \text{ weight}}{DALY[0,3] \text{ for } 0 \text{ weight}}\right).$$

In order to better understand the effect of different $DW_{residual}$ on the disability weights for each external cause of injury, we calculated the ratio between ten-year DALYs for different weights and present these ratios in Table F.9 and Figure F.8.

Table F.9. Ten-Year DALY by External Cause of Injury and Gender for Different Values of $DW_{residual}$.

Description[1]	DALY (1991-2000) All Injuries					
	Males					
	Road traffic accidents	Poisoning	Falls	Other unintentional injuries[‡]	Suicide and self-inflicted injuries	Other intentional injuries
0 weight	97,980	63,611	33,923	219,946	88,221	30,806
0.25 weight	104,891	63,625	35,700	370,331	88,461	32,762
0.50 weight	110,885	63,638	37,353	339,515	88,685	34,481
0.25 vs 0 (ratio)	1.071	1.000	1.052	1.684	1.003	1.063
0.50 vs 0.25 (ratio)	1.057	1.000	1.046	0.917	1.003	1.052

Description[1]	DALY (1991-2000) All Injuries					
	Females					
	Road traffic accidents	Poisoning	Falls	Other unintentional injuries[‡]	Suicide and self-inflicted injuries	Other intentional injuries
0 weight	45,280	19,668	23,371	70,360	33,852	15,503
0.25 weight	49,938	19,669	24,464	105,280	33,955	16,712
0.50 weight	53,858	19,671	25,478	137,838	34,050	17,704
0.25 vs 0 (ratio)	1.103	1.000	1.047	1.496	1.003	1.078
0.50 vs 0.25 (ratio)	1.078	1.000	1.041	1.309	1.003	1.059

[‡] Excludes medical adverse events

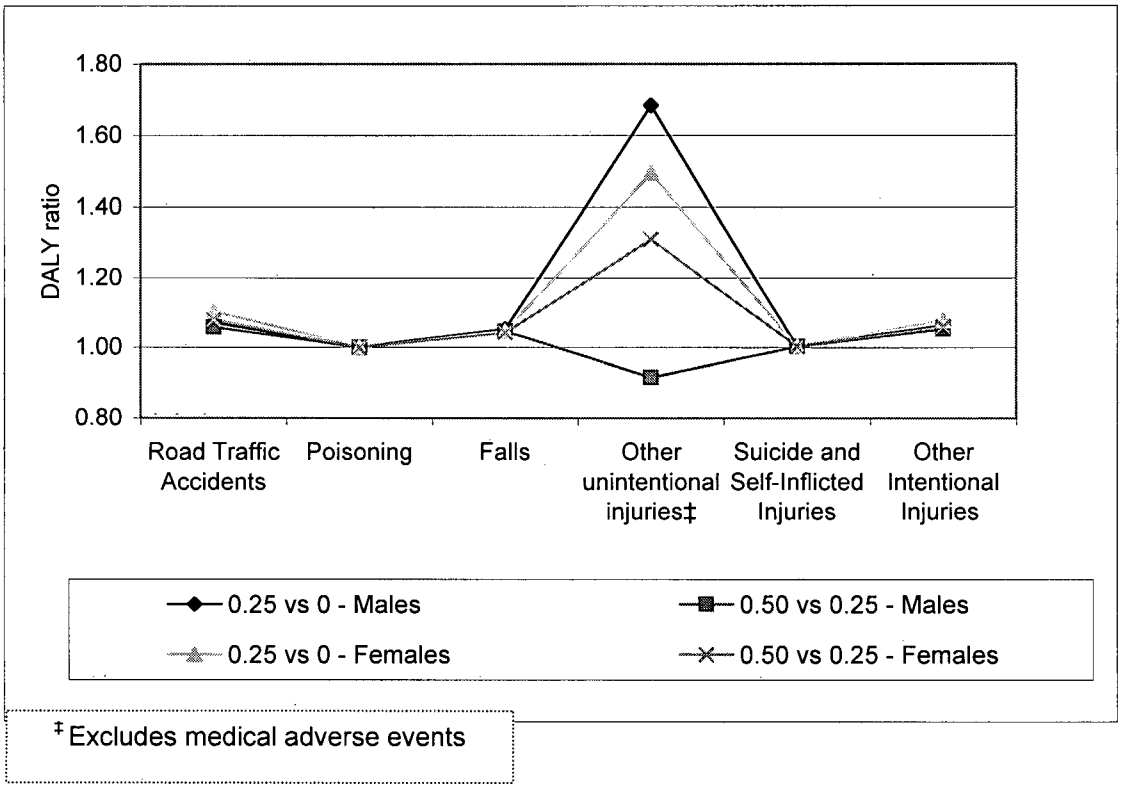

Figure F.8. Ten-Year DALY Ratio using Two Different $DW_{residual}$ by External Cause of Injury, Gender and Age Group.

We observed that even though the ten-year DALY for each external cause of injury (for all age groups combined) increased by increasing the values of the residual category of injury weight, the ratio between DALYs for two different $DW_{residual}$ was very small for most injuries. For the other unintentional injuries category, the ratio between DALYs of increasing weights of the residual category of injury was substantial. However, it should be noted that the ranking of the DALY for each external cause of injury didn't change when we increased the weights for the residual category of injury.

We also note that some external causes of injury are more affected by increasing the values of $DW_{residual}$ from 0 to 0.50. This is appears to be due in part to the fact that for these

external causes of injury (*e.g.*, other external causes of injury) more people are concentrated in the residual category of injury sequela. If we partitioned these external causes of injury into more specific external causes then we might not see the same variability in the final disability weights.

Overall this analysis suggests that the largest impact on DALY occurs when we increase the $DW_{residual}$ from 0 to 0.25. When increasing the values of $DW_{residual}$, the largest impact on DALY was in the age group 0-19 years for both males and females. For external causes of injury that contain a large number of people whose injuries are classified in the residual category (*e.g.*, other unintentional injuries excluding medical AE), the results should be interpreted cautiously if the appropriate disability weight for the residual category of injury were to be calculated and it turned out to be closer to 0.25 than 0. On the other hand, we demonstrated that the rank of the DALY among the external causes of injury did not change by increasing the value of $DW_{residual}$, therefore any conclusions based on ranks in this study would be the same if we use a weight equal to 0 or 0.25 or 0.50.

Considering that the main objective of this sensitivity analysis was to determine if the ranking of DALY for the different external causes of injury would change when different disability weights for the residual category of injury are used, we conclude that there is no impact on the final conclusions if a zero disability weight for the residual category of sequela of injury is chosen. However, more effort should be made in providing proper disability weights for each of the sequelae in this residual category.

Regarding the influence of the disability weight of the residual category of injury sequela, we conclude that for the data examined in this study, the use $DW_{residual}$ equal to zero does not affect the final conclusions. However, it is clear that depending on the magnitude of

$DW_{residual}$, the use of $DW_{residual}$ equal to zero influences the overall disability weight for each external cause of injury differently. The recommendation we give at this point in the development of this novel methodology is that any researcher engaging in a similar study should perform a sensitivity analysis to see how the use of different values of $DW_{residual}$ influences the results of their particular study.

Appendix G

Chapters' General Tables and Figures

Table G.1. Distribution of ICD9 E-Codes E850-E858 among the E-codes for Poisoning (E850-E869, E929.2).

Gender	Age Group	E-codes E850-E858	Hospitalizations	%	Deaths	%
Males	0-19	No	658	37.5	17	34.7
	0-19	Yes	1,095	62.5	32	65.3
	20-39	No	525	27.7	202	13.5
	20-39	Yes	1,371	72.3	1,299	86.5
	40-64	No	474	28.9	267	23.2
	40-64	Yes	1,164	71.1	883	76.8
	65-79	No	118	18.2	33	44.6
	65-79	Yes	529	81.8	41	55.4
	80+	No	37	12.4	4	40.0
	80+	Yes	261	87.6	6	60.0
Females	0-19	No	436	29.9	4	14.8
	0-19	Yes	1,024	70.1	23	85.2
	20-39	No	349	22.8	65	15.2
	20-39	Yes	1,183	77.2	364	84.8
	40-64	No	280	20.2	67	22.5
	40-64	Yes	1,106	79.8	231	77.5
	65-79	No	98	11.1	13	26.0
	65-79	Yes	784	88.9	37	74.0
	80+	No	42	8.3	3	16.7
	80+	Yes	465	91.7	15	83.3

Table G.2. Gender and Age Specific Life Expectancies for British Columbia in 2001.

Age group	Life expectancies – BC - 2001		Age group	Deaths (All causes) - BC - 2001	
	Males	Females		Males	Females
0	78.25	83.43	0	86	74
1-4	77.58	82.74	1-4	12	18
5-9	73.62	78.81	5-9	11	14
10-14	68.65	73.86	10-14	29	11
15-19	63.72	68.89	15-19	73	47
20-24	58.88	64.00	20-24	130	53
25-29	54.14	59.12	25-29	120	52
30-34	49.37	54.23	30-34	186	73
35-39	44.65	49.36	35-39	260	115
40-44	39.97	44.51	40-44	310	185
45-49	35.30	39.73	45-49	451	271
50-54	30.76	35.04	50-54	595	381
55-59	26.34	30.47	55-59	653	405
60-64	22.07	26.00	60-64	908	558
65-69	18.15	21.76	65-69	1,193	777
70-74	14.44	17.77	70-74	1,845	1,180
75-79	11.26	14.09	75-79	2,314	1,756
80-84	8.60	10.78	80-84	2,329	2,354
85+	6.56	8.19	85+	3,186	5,197

Age group	Life expectancies BC - 2001	
	Males	Females
0-19	71.62	78.15
20-39	50.21	54.95
40-64	28.75	32.89
65-79	13.89	16.86
80+	7.42	9.00

Table G.3. Japanese Life Expectancies and Number of Deaths for the Year 1990 Used in the Global Burden of Disease (GBD) Study.

Age group	Life expectancies - Japanese - 1990	
	Males	Females
<1	79.94	82.43
1-4	77.77	80.28
5-9	72.89	75.47
10-14	67.91	70.51
15-19	62.93	65.55
20-24	57.95	60.63
25-29	52.99	55.72
30-34	48.04	50.83
35-39	43.10	45.96
40-44	38.20	41.13
45-49	33.38	36.36
50-54	28.66	31.68
55-59	24.07	27.10
60-64	19.65	22.64
65-69	15.54	18.32
70-74	11.87	14.24
75-79	8.81	10.59
80-84	6.34	7.56
85+	3.54	4.25

Age group	Deaths (All causes) - Japanese - 1990	
	Males	Females
<1	3,126	2,493
1-4	1,409	958
5-9	845	533
10-14	761	482
15-19	3,207	1,149
20-24	3,469	1,329
25-29	2,918	1,361
30-34	3,267	1,774
35-39	5,454	3,103
40-44	9,777	5,543
45-49	14,230	7,511
50-54	20,178	10,099
55-59	32,953	14,619
60-64	42,779	19,990
65-69	42,701	27,272
70-74	51,781	38,083
75-79	69,379	56,213
80-84	67,974	71,646
85+	67,509	110,427

Source: Statistics and Information Department, Minister's Secretariat, Ministry of Health, Labour and Welfare. Japan

Age group	Deaths - 1990		Life expectancies - Japan - 1990	
	Males	Females	Males	Females
0-19	9,348	5,615	72.16	76.93
20-39	15,108	7,567	49.49	51.43
40-64	119,917	57,762	25.52	28.90
65-79	163,861	121,568	11.53	13.47
80+	135,483	182,073	4.95	5.55

Table G.4. Mid-Period Population by Health Authority and British Columbia.

Source: British Columbia Vital Statistics Agency

Region	Mid-period population (1995)					
	Males					
	0 - 19	20 - 39	40 - 64	65 - 79	80+	All ages
Interior HA	91,092	90,419	100,527	36,108	8,459	326,605
Fraser HA	173,570	204,853	173,788	48,443	11,325	611,979
Vancouver Coastal HA	103,637	167,638	139,793	38,550	9,760	459,378
Vancouver Island HA	86,037	98,703	100,575	36,390	8,778	330,483
Northern HA	51,822	52,638	43,571	7,745	1,352	157,128
British Columbia	506,158	614,251	558,254	167,236	39,674	1,885,573

Region	Mid-period population (1995)					
	Females					
	0 - 19	20 - 39	40 - 64	65 - 79	80+	All ages
Interior HA	85,874	89,676	99,477	40,195	12,214	327,436
Fraser HA	163,923	197,059	173,143	59,828	19,778	613,731
Vancouver Coastal HA	98,607	163,148	140,764	48,527	19,087	470,133
Vancouver Island HA	82,171	97,816	101,402	44,074	15,601	341,064
Northern HA	48,880	49,624	38,122	7,607	1,838	146,071
British Columbia	479,455	597,323	552,908	200,231	68,518	1,898,435

Table G.5. Canadian Population from 2001 Census.

Source: 2001 Canada Census

Age group	Male	Female
0 - 19	3,983,130	3,795,720
20 - 39	4,194,045	4,279,560
40 - 64	4,867,020	4,999,055
65 - 79	1,344,430	1,612,075
80+	318,220	613,820
All Ages	14,706,845	15,300,230

Table G.6. Distribution of ICD9 E-Codes Categories Defining a Medical Adverse Event. Hospitalizations, Males and Females, 1991-2000.

E-code category	Males		Females	
	Number of hospitalizations	% among all medical AEs	Number of hospitalizations	% among all medical AEs
E870-E876	11,912	7.4	14,645	9.2
E878-E879	142,214	88.1	133,920	84.2
E930-E949	7,285	4.5	10,393	6.5

Table G.7. Explanation and Distribution of ICD9 E-Codes Categories Defining a Medical Adverse Event by Age Group. Hospitalizations, Males, 1991-2000.

Age Group	ICD9-CM E-Codes	Hospitalizations	%	Description
Misadventures to patients during surgical and medical care				
0-19	E870	418	4.17	Accidental cut, puncture, perforation, or hemorrhage during medical care
20-39	E870	984	9.83	
40-64	E870	3,455	34.51	
65-79	E870	4,042	40.37	
80+	E870	1,114	11.13	
0-19	E871	15	4.17	Foreign object left in body during procedure
20-39	E871	57	9.83	
40-64	E871	89	34.51	
65-79	E871	69	40.37	
80+	E871	20	11.13	
0-19	E872	4	4.17	Failure of sterile precautions during procedure
20-39	E872	15	9.83	
40-64	E872	23	34.51	
65-79	E872	25	40.37	
80+	E872	14	11.13	
0-19	E873	5	4.17	Failure in dosage
20-39	E873	21	9.83	
40-64	E873	11	34.51	
65-79	E873	17	40.37	
80+	E873	3	11.13	
0-19	E874	114	4.17	Mechanical failure of instrument or apparatus during procedure
20-39	E874	72	9.83	
40-64	E874	83	34.51	
65-79	E874	80	40.37	
80+	E874	22	11.13	
0-19	E875	0	0.00	Contaminated or infected blood, other fluid, drug, or biological substance
20-39	E875	0	0.00	
40-64	E875	7	87.50	
65-79	E875	1	12.50	
80+	E875	0	0.00	
0-19	E876	147	12.99	Other and unspecified misadventures during medical care
20-39	E876	125	11.04	
40-64	E876	342	30.21	
65-79	E876	381	33.66	
80+	E876	137	12.10	
Surgical and medical procedures as the cause of abnormal reaction of patient or later complication, without mention of misadventure at the time of procedure				
0-19	E878	8,502	6.97	Surgical operation and other surgical procedures as the cause of abnormal reaction of patient, or of later complication, without mention of misadventure at the time of operation
20-39	E878	15,854	13.00	
40-64	E878	38,218	31.33	
65-79	E878	46,357	38.00	
80+	E878	13,047	10.70	
0-19	E879	1,626	8.04	Other procedures, without mention of misadventure at the time of procedure, as the cause of abnormal reaction of patient, or of later complication
20-39	E879	2,137	10.56	
40-64	E879	6,389	31.57	
65-79	E879	7,399	36.56	
80+	E879	2,685	13.27	

Table G.7. (continued) Explanation and Distribution of ICD9 E-Codes Categories Defining a Medical Adverse Event by Age Group. Hospitalizations, Males, 1991-2000.

Age Group	ICD9-CM E-Codes	Hospitalizations	%	Description
Drugs, medicinal and biological substances causing adverse effects in therapeutic use				
0-19	E930	175	21.79	Antibiotics
20-39	E930	137	17.06	
40-64	E930	243	30.26	
65-79	E930	194	24.16	
80+	E930	54	6.72	
0-19	E931	27	14.29	Other anti-infectives
20-39	E931	54	28.57	
40-64	E931	55	29.10	
65-79	E931	40	21.16	
80+	E931	13	6.88	
0-19	E932	29	12.29	Hormones and synthetic substitutes
20-39	E932	33	13.98	
40-64	E932	78	33.05	
65-79	E932	75	31.78	
80+	E932	21	8.90	
0-19	E933	89	13.59	Primarily systemic agents
20-39	E933	157	23.97	
40-64	E933	270	41.22	
65-79	E933	125	19.08	
80+	E933	14	2.14	
0-19	E934	31	5.31	Agents primarily affecting blood constituents
20-39	E934	39	6.68	
40-64	E934	181	30.99	
65-79	E934	251	42.98	
80+	E934	82	14.04	
0-19	E935	72	9.01	Analgesics, antipyretics, and antirheumatics
20-39	E935	132	16.52	
40-64	E935	281	35.17	
65-79	E935	225	28.16	
80+	E935	89	11.14	
0-19	E936	36	8.24	Anticonvulsants and anti-Parkinsonism drugs
20-39	E936	67	15.33	
40-64	E936	168	38.44	
65-79	E936	122	27.92	
80+	E936	44	10.07	
0-19	E937	15	12.10	Sedatives and hypnotics
20-39	E937	15	12.10	
40-64	E937	38	30.65	
65-79	E937	34	27.42	
80+	E937	22	17.74	
0-19	E938	67	15.95	Other central nervous system depressants and anesthetics
20-39	E938	55	13.10	
40-64	E938	119	28.33	
65-79	E938	141	33.57	
80+	E938	38	9.05	
0-19	E939	38	6.55	Psychotropic agents
20-39	E939	156	26.90	
40-64	E939	204	35.17	
65-79	E939	144	24.83	
80+	E939	38	6.55	

Table G.7. (continued) Explanation and Distribution of ICD9 E-Codes Categories Defining a Medical Adverse Event by Age Group. Hospitalizations, Males, 1991-2000.

Age Group	ICD9-CM E-Codes	Hospitalizations	%	Description
Drugs, medicinal and biological substances causing adverse effects in therapeutic use (continued)				
0-19	E940	0	0.00	Central nervous system stimulants
20-39	E940	0	0.00	
40-64	E940	1	25.00	
65-79	E940	1	25.00	
80+	E940	2	50.00	
0-19	E941	2	3.45	Drugs primarily affecting the autonomic nervous system
20-39	E941	7	12.07	
40-64	E941	14	24.14	
65-79	E941	24	41.38	
80+	E941	11	18.97	
0-19	E942	20	1.52	Agents primarily affecting the cardiovascular system
20-39	E942	14	1.07	
40-64	E942	187	14.25	
65-79	E942	637	48.55	
80+	E942	454	34.60	
0-19	E943	4	9.52	Agents primarily affecting gastrointestinal system
20-39	E943	9	21.43	
40-64	E943	11	26.19	
65-79	E943	12	28.57	
80+	E943	6	14.29	
0-19	E944	4	2.99	Water, mineral, and uric acid metabolism drugs
20-39	E944	11	8.21	
40-64	E944	31	23.13	
65-79	E944	60	44.78	
80+	E944	28	20.90	
0-19	E945	28	16.37	Agents primarily acting on the smooth and skeletal muscles and respiratory system
20-39	E945	17	9.94	
40-64	E945	27	15.79	
65-79	E945	69	40.35	
80+	E945	30	17.54	
0-19	E946	10	8.47	Agents primarily affecting skin and mucous membrane, ophthalmological, otorhinolaryngological, and dental drugs
20-39	E946	15	12.71	
40-64	E946	45	38.14	
65-79	E946	37	31.36	
80+	E946	11	9.32	
0-19	E947	43	8.05	Other and unspecified drugs and medicinal substances
20-39	E947	88	16.48	
40-64	E947	206	38.58	
65-79	E947	144	26.97	
80+	E947	53	9.93	
0-19	E948	41	87.23	Bacterial vaccines
20-39	E948	0	0.00	
40-64	E948	0	0.00	
65-79	E948	5	10.64	
80+	E948	1	2.13	
0-19	E949	18	47.37	Other vaccines and biological substances
20-39	E949	6	15.79	
40-64	E949	5	13.16	
65-79	E949	8	21.05	
80+	E949	1	2.63	

Table G.8. Explanation and Distribution of ICD9 E-Codes Categories Defining a Medical Adverse Event by Age Group. Hospitalizations, Females, 1991-2000.

Age Group	ICD9-CM E-Codes	Hospitalizations	%	Description
Misadventures to patients during surgical and medical care				
0-19	E870	364	2.90	Accidental cut, puncture, perforation, or hemorrhage during medical care
20-39	E870	2,933	23.36	
40-64	E870	4,024	32.05	
65-79	E870	3,781	30.11	
80+	E870	1,454	11.58	
0-19	E871	12	3.85	Foreign object left in body during procedure
20-39	E871	124	39.74	
40-64	E871	95	30.45	
65-79	E871	69	22.12	
80+	E871	12	3.85	
0-19	E872	0	0.00	Failure of sterile precautions during procedure
20-39	E872	8	8.70	
40-64	E872	17	18.48	
65-79	E872	36	39.13	
80+	E872	31	33.70	
0-19	E873	5	6.67	Failure in dosage
20-39	E873	10	13.33	
40-64	E873	34	45.33	
65-79	E873	12	16.00	
80+	E873	14	18.67	
0-19	E874	106	29.61	Mechanical failure of instrument or apparatus during procedure
20-39	E874	71	19.83	
40-64	E874	94	26.26	
65-79	E874	67	18.72	
80+	E874	20	5.59	
0-19	E875	1	33.33	Contaminated or infected blood, other fluid, drug, or biological substance
20-39	E875	0	0.00	
40-64	E875	1	33.33	
65-79	E875	1	33.33	
80+	E875	0	0.00	
0-19	E876	95	7.61	Other and unspecified misadventures during medical care
20-39	E876	247	19.78	
40-64	E876	346	27.70	
65-79	E876	377	30.18	
80+	E876	184	14.73	
Surgical and medical procedures as the cause of abnormal reaction of patient or later complication,				
0-19	E878	6,286	5.57	Surgical operation and other surgical procedures as the cause of abnormal reaction of patient, or of later complication, without mention of misadventure at the time of operation
20-39	E878	20,375	18.05	
40-64	E878	36,799	32.60	
65-79	E878	34,513	30.57	
80+	E878	14,920	13.22	
0-19	E879	1,158	5.51	Other procedures, without mention of misadventure at the time of procedure, as the cause of abnormal reaction of patient, or of later complication
20-39	E879	3,511	16.70	
40-64	E879	6,137	29.19	
65-79	E879	6,726	31.99	
80+	E879	3,495	16.62	

Table G.8. (continued) Explanation and Distribution of ICD9 E-Codes Categories Defining a Medical Adverse Event by Age Group. Hospitalizations, Females, 1991-2000.

Age Group	ICD9-CM E-Codes	Hospitalizations	%	Description
Drugs, medicinal and biological substances causing adverse effects in therapeutic use				
0-19	E930	142	13.02	Antibiotics
20-39	E930	275	25.21	
40-64	E930	326	29.88	
65-79	E930	241	22.09	
80+	E930	107	9.81	
0-19	E931	41	11.20	Other anti-infectives
20-39	E931	92	25.14	
40-64	E931	97	26.50	
65-79	E931	91	24.86	
80+	E931	45	12.30	
0-19	E932	30	7.85	Hormones and synthetic substitutes
20-39	E932	75	19.63	
40-64	E932	120	31.41	
65-79	E932	119	31.15	
80+	E932	38	9.95	
0-19	E933	71	6.07	Primarily systemic agents
20-39	E933	218	18.65	
40-64	E933	587	50.21	
65-79	E933	261	22.33	
80+	E933	32	2.74	
0-19	E934	12	2.05	Agents primarily affecting blood constituents
20-39	E934	50	8.56	
40-64	E934	141	24.14	
65-79	E934	254	43.49	
80+	E934	127	21.75	
0-19	E935	93	7.84	Analgesics, antipyretics, and antirheumatics
20-39	E935	287	24.20	
40-64	E935	368	31.03	
65-79	E935	279	23.52	
80+	E935	159	13.41	
0-19	E936	48	9.13	Anticonvulsants and anti-Parkinsonism drugs
20-39	E936	109	20.72	
40-64	E936	150	28.52	
65-79	E936	148	28.14	
80+	E936	71	13.50	
0-19	E937	10	6.67	Sedatives and hypnotics
20-39	E937	42	28.00	
40-64	E937	49	32.67	
65-79	E937	29	19.33	
80+	E937	20	13.33	
0-19	E938	60	10.73	Other central nervous system depressants and anesthetics
20-39	E938	141	25.22	
40-64	E938	157	28.09	
65-79	E938	143	25.58	
80+	E938	58	10.38	
0-19	E939	24	2.66	Psychotropic agents
20-39	E939	226	25.08	
40-64	E939	313	34.74	
65-79	E939	229	25.42	
80+	E939	109	12.10	

Table G.8. (continued) Explanation and Distribution of ICD9 E-Codes Categories Defining a Medical Adverse Event by Age Group. Hospitalizations, Females, 1991-2000.

Age Group	ICD9-CM E-Codes	Hospitalizations	%	Description
Drugs, medicinal and biological substances causing adverse effects in therapeutic use (continued)				
0-19	E940	0	0.00	Central nervous system stimulants
20-39	E940	1	25.00	
40-64	E940	1	25.00	
65-79	E940	2	50.00	
80+	E940	0	0.00	
0-19	E941	2	2.94	Drugs primarily affecting the autonomic nervous system
20-39	E941	18	26.47	
40-64	E941	17	25.00	
65-79	E941	21	30.88	
80+	E941	10	14.71	
0-19	E942	14	0.74	Agents primarily affecting the cardiovascular system
20-39	E942	14	0.74	
40-64	E942	186	9.83	
65-79	E942	817	43.16	
80+	E942	862	45.54	
0-19	E943	3	5.56	Agents primarily affecting gastrointestinal system
20-39	E943	7	12.96	
40-64	E943	21	38.89	
65-79	E943	18	33.33	
80+	E943	5	9.26	
0-19	E944	8	3.51	Water, mineral, and uric acid metabolism drugs
20-39	E944	14	6.14	
40-64	E944	44	19.30	
65-79	E944	101	44.30	
80+	E944	61	26.75	
0-19	E945	21	8.75	Agents primarily acting on the smooth and skeletal muscles and respiratory system
20-39	E945	48	20.00	
40-64	E945	56	23.33	
65-79	E945	82	34.17	
80+	E945	33	13.75	
0-19	E946	19	9.36	Agents primarily affecting skin and mucous membrane, ophthalmological, otorhinolaryngological, and dental drugs
20-39	E946	35	17.24	
40-64	E946	71	34.98	
65-79	E946	47	23.15	
80+	E946	31	15.27	
0-19	E947	52	7.54	Other and unspecified drugs and medicinal substances
20-39	E947	141	20.43	
40-64	E947	239	34.64	
65-79	E947	189	27.39	
80+	E947	69	10.00	
0-19	E948	28	84.85	Bacterial vaccines
20-39	E948	0	0.00	
40-64	E948	4	12.12	
65-79	E948	1	3.03	
80+	E948	0	0.00	
0-19	E949	23	34.85	Other vaccines and biological substances
20-39	E949	17	25.76	
40-64	E949	12	18.18	
65-79	E949	12	18.18	
80+	E949	2	3.03	

Table G.9. Distribution of ICD9 E-Codes Categories Defining a Medical Adverse Event. Deaths, Males and Females, 1991-2000.

E-code category	Males		Females	
	Number of deaths	% among all medical AE	Number of deaths	% among all medical AE
E870-E876	27	11.6	25	11.2
E878-E879	126	54.1	117	52.2
E930-E949	80	34.3	82	36.6
Total	233		224	

Table G.10. Burden of injuries at the Health Authority (HA) and BC Levels. Males, 1991-2000.

HA	Injury	Fatal burden		Non-fatal burden		Total burden		% of contribution of YLD to DALY
		YLL	ASYLLR	YLD	ASYLDR	DALY	ASDALYR	
Interior	Road traffic accidents	18,655	57.88	7,349	22.78	26,004	80.65	28.3
	Other transport injuries	2,692	8.42	2,555	7.95	5,247	16.37	48.7
	Poisoning	5,595	17.85	428	1.31	6,023	19.17	7.1
	Falls	3,305	9.45	3,510	10.67	6,815	20.13	51.5
	Burns/fires/scalds	1,069	3.26	1,226	3.79	2,294	7.05	53.4
	Drowning	1,992	6.16	156	0.47	2,148	6.63	7.2
	Sports injuries	134	0.42	811	2.46	946	2.87	85.8
	Natural and environmental factors	1,246	3.94	541	1.68	1,787	5.62	30.3
	Machinery injuries	1,075	3.39	4,847	15.21	5,921	18.60	81.9
	Suffocation and foreign bodies	841	2.53	4,024	12.51	4,865	15.03	82.7
	Other unintentional injuries‡	1,685	5.29	12,636	39.43	14,320	44.72	88.2
	Suicide and self-inflicted injuries	15,906	49.85	1,873	5.89	17,779	55.74	10.5
	Other intentional injuries	2,949	9.25	1,919	6.00	4,868	15.25	39.4
Fraser	Road traffic accidents	19,150	12.16	8,797	13.46	27,948	42.93	31.5
	Other transport injuries	2,726	0.58	2,115	3.26	4,841	7.52	43.7
	Poisoning	17,288	6.66	588	0.91	17,876	27.91	3.3
	Falls	4,268	5.65	4,889	7.88	9,157	15.28	53.4
	Burns/fires/scalds	932	1.22	1,540	2.47	2,472	4.01	62.3
	Drowning	2,088	0.66	238	0.37	2,326	3.62	10.2
	Sports injuries	77	0.01	1,102	1.69	1,179	1.82	93.5
	Natural and environmental factors	355	0.23	398	0.64	753	1.25	52.9
	Machinery injuries	823	0.04	5,512	8.61	6,336	9.93	87.0
	Suffocation and foreign bodies	1,400	0.99	6,220	10.01	7,619	12.30	81.6
	Other unintentional injuries‡	1,269	0.10	13,343	20.72	14,612	22.74	91.3
	Suicide and self-inflicted injuries	20,370	10.47	3,555	5.42	23,925	38.18	14.9
	Other intentional injuries	5,874	4.59	3,319	5.01	9,193	14.02	36.1
Vancouver Coastal	Road traffic accidents	9,371	19.11	4,864	10.03	14,235	29.14	34.2
	Other transport injuries	1,847	3.78	909	1.85	2,756	5.64	33.0
	Poisoning	25,965	50.41	512	1.09	26,477	51.50	1.9
	Falls	5,031	10.96	3,277	7.08	8,308	18.05	39.4
	Burns/fires/scalds	905	1.92	1,178	2.53	2,083	4.46	56.6
	Drowning	1,736	3.46	121	0.29	1,857	3.75	6.5
	Sports injuries	221	0.40	662	1.52	883	1.92	75.0
	Natural and environmental factors	494	0.95	262	0.58	756	1.52	34.6
	Machinery injuries	238	0.47	2,150	4.37	2,387	4.84	90.0
	Suffocation and foreign bodies	1,218	2.68	3,390	7.56	4,607	10.24	73.6
	Other unintentional injuries‡	860	1.67	7,629	16.12	8,490	17.79	89.9
	Suicide and self-inflicted injuries	18,525	37.16	2,203	4.30	20,728	41.47	10.6
	Other intentional injuries	5,448	10.57	2,561	5.11	8,010	15.68	32.0

Table G.10. (continued) Burden of injuries at the Health Authority (HA) and BC Levels. Males, 1991-2000.

HA	Injury	Fatal burden		Non-fatal burden		Total burden		% of contribution of YLD to DALY
		YLL	ASYLLR	YLD	ASYLDR	DALY	ASDALYR	
Vancouver Island	Road traffic accidents	9,776	29.37	5,169	15.58	14,944	44.95	34.6
	Other transport injuries	2,305	6.95	1,542	4.69	3,847	11.64	40.1
	Poisoning	9,591	29.16	383	1.17	9,974	30.33	3.8
	Falls	3,657	10.23	3,142	9.42	6,799	19.64	46.2
	Burns/fires/scalds	699	2.14	1,079	3.28	1,778	5.42	60.7
	Drowning	1,890	5.71	148	0.45	2,038	6.16	7.2
	Sports injuries	30	0.09	674	2.08	703	2.17	95.8
	Natural and environmental factors	366	1.12	312	0.96	678	2.09	46.1
	Machinery injuries	673	2.07	3,371	10.22	4,044	12.29	83.4
	Suffocation and foreign bodies	929	2.80	3,279	10.19	4,208	12.99	77.9
	Other unintentional injuries‡	1,368	4.19	9,401	28.63	10,769	32.81	87.3
	Suicide and self-inflicted injuries	14,842	44.96	2,096	6.29	16,938	51.25	12.4
	Other intentional injuries	2,600	7.94	2,014	6.05	4,615	13.99	43.7
Northern	Road traffic accidents	10,850	64.55	3,999	23.12	14,850	87.67	26.9
	Other transport injuries	2,836	17.75	1,795	10.41	4,631	28.16	38.8
	Poisoning	2,979	18.97	282	1.58	3,261	20.56	8.6
	Falls	1,024	9.79	1,821	11.65	2,845	21.44	64.0
	Burns/fires/scalds	816	5.41	1,147	7.17	1,963	12.58	58.4
	Drowning	1,326	7.81	87	0.51	1,413	8.32	6.2
	Sports injuries	61	0.39	396	2.15	457	2.55	86.6
	Natural and environmental factors	646	4.47	335	2.09	981	6.56	34.2
	Machinery injuries	861	5.68	3,140	19.40	4,002	25.08	78.5
	Suffocation and foreign bodies	410	3.04	2,151	12.69	2,562	15.73	84.0
	Other unintentional injuries‡	1,046	6.93	8,544	50.26	9,589	57.19	89.1
	Suicide and self-inflicted injuries	7,722	48.04	1,129	6.46	8,851	54.50	12.8
	Other intentional injuries	2,350	14.05	1,770	10.21	4,120	24.26	43.0
BC	Road traffic accidents	67,802	34.52	30,178	15.30	97,980	49.82	30.8
	Other transport injuries	12,405	6.41	8,916	4.56	21,321	10.98	41.8
	Poisoning	61,418	31.32	2,193	1.13	63,611	32.45	3.4
	Falls	17,284	9.29	16,639	8.72	33,923	18.01	49.0
	Burns/fires/scalds	4,420	2.35	6,170	3.24	10,590	5.59	58.3
	Drowning	9,032	4.63	750	0.39	9,782	5.02	7.7
	Sports injuries	523	0.26	3,644	1.89	4,167	2.16	87.5
	Natural and environmental factors	3,106	1.62	1,848	0.97	4,955	2.59	37.3
	Machinery injuries	3,670	1.92	19,021	9.77	22,690	11.69	83.8
	Suffocation and foreign bodies	4,797	2.54	19,064	10.14	23,861	12.68	79.9
	Other unintentional injuries‡	6,228	3.25	51,552	26.48	57,781	29.72	89.2
	Suicide and self-inflicted injuries	77,365	40.06	10,856	5.43	88,221	45.49	12.3
	Other intentional injuries	19,222	9.76	11,584	5.80	30,806	15.56	37.6

Table G.11. Burden of injuries at the Health Authority (HA) and BC Levels. Females, 1991-2000.

HA	Injury	Fatal burden		Non-fatal burden		Total burden		% of contribution of YLD to DALY
		YLL	ASYLLR	YLD	ASYLDR	DALY	ASDALYR	
Interior	Road traffic accidents	7,942	25.09	4,227	12.90	12,169	37.02	34.7
	Other transport injuries	499	1.58	725	2.17	1,224	3.69	59.2
	Poisoning	2,087	6.81	243	0.73	2,330	7.27	10.4
	Falls	2,722	8.66	2,185	6.61	4,907	14.93	44.5
	Burns/fires/scalds	519	1.61	641	1.94	1,160	3.49	55.2
	Drowning	563	1.75	40	0.12	603	1.80	6.7
	Sports injuries	26	0.09	216	0.64	242	0.73	89.2
	Natural and environmental factors	297	0.96	325	0.98	622	1.90	52.2
	Machinery injuries	106	0.34	323	0.99	429	1.32	75.3
	Suffocation and foreign bodies	320	1.05	1,845	5.49	2,165	6.50	85.2
	Other unintentional injuries‡	151	0.49	3,207	9.79	3,358	10.26	95.5
	Suicide and self-inflicted injuries	3,786	12.34	1,945	6.03	5,730	17.89	33.9
	Other intentional injuries	2,305	7.30	1,072	3.28	3,377	10.30	31.7
Fraser	Road traffic accidents	7,497	12.05	4,836	7.46	12,333	19.51	39.2
	Other transport injuries	363	0.57	540	0.83	903	1.40	59.8
	Poisoning	4,224	6.69	328	0.49	4,552	7.18	7.2
	Falls	3,027	5.72	2,887	4.98	5,914	10.70	48.8
	Burns/fires/scalds	724	1.21	974	1.57	1,699	2.78	57.4
	Drowning	412	0.65	53	0.08	465	0.73	11.3
	Sports injuries	5	0.01	223	0.35	228	0.36	97.8
	Natural and environmental factors	141	0.23	289	0.45	430	0.68	67.1
	Machinery injuries	26	0.04	469	0.74	495	0.77	94.7
	Suffocation and foreign bodies	577	0.98	3,549	5.47	4,126	6.45	86.0
	Other unintentional injuries‡	67	0.10	3,651	5.66	3,719	5.76	98.2
	Suicide and self-inflicted injuries	6,472	10.45	3,762	5.78	10,234	16.23	36.8
	Other intentional injuries	2,917	4.57	1,390	2.14	4,306	6.71	32.3
Vancouver Coastal	Road traffic accidents	4,661	9.77	2,755	5.69	7,417	15.47	37.2
	Other transport injuries	451	0.90	284	0.59	735	1.49	38.7
	Poisoning	7,836	15.19	251	0.52	8,086	15.71	3.1
	Falls	3,332	7.11	2,085	4.48	5,416	11.59	38.5
	Burns/fires/scalds	122	0.26	647	1.39	768	1.66	84.2
	Drowning	475	1.05	13	0.03	487	1.08	2.6
	Sports injuries	56	0.12	161	0.35	217	0.47	74.1
	Natural and environmental factors	91	0.18	154	0.35	245	0.53	62.8
	Machinery injuries	0	0.00	277	0.59	277	0.59	100.0
	Suffocation and foreign bodies	582	1.27	1,713	4.02	2,294	5.29	74.6
	Other unintentional injuries‡	212	0.40	2,420	5.16	2,631	5.56	92.0
	Suicide and self-inflicted injuries	6,011	12.28	2,160	4.26	8,171	16.54	26.4
	Other intentional injuries	2,121	4.12	1,127	2.36	3,248	6.49	34.7

Table G.11. (continued) Burden of injuries at the Health Authority (HA) and BC Levels. Females, 1991-2000.

HA	Injury	Fatal burden		Non-fatal burden		Total burden		% of contribution of YLD to DALY
		YLL	ASYLLR	YLD	ASYLDR	DALY	ASDALYR	
Vancouver Island	Road traffic accidents	4,201	12.35	2,821	8.34	7,022	20.69	40.2
	Other transport injuries	242	0.72	438	1.30	680	2.02	64.4
	Poisoning	3,064	9.07	211	0.63	3,274	9.70	6.4
	Falls	3,418	8.89	2,095	5.84	5,513	14.73	38.0
	Burns/fires/scalds	496	1.46	586	1.70	1,082	3.16	54.1
	Drowning	653	1.97	42	0.13	694	2.09	6.0
	Sports injuries	24	0.08	169	0.50	194	0.57	87.4
	Natural and environmental factors	137	0.40	198	0.59	334	1.00	59.1
	Machinery injuries	11	0.03	376	1.11	387	1.14	97.1
	Suffocation and foreign bodies	596	1.64	1,996	6.00	2,592	7.64	77.0
	Other unintentional injuries‡	138	0.40	2,482	7.38	2,620	7.78	94.7
	Suicide and self-inflicted injuries	4,886	14.62	2,118	6.27	7,004	20.88	30.2
	Other intentional injuries	1,679	5.00	881	2.63	2,559	7.63	34.4
Northern	Road traffic accidents	4,029	25.13	2,309	13.94	6,338	39.07	36.4
	Other transport injuries	385	2.31	488	2.71	873	5.02	55.9
	Poisoning	1,249	7.99	176	0.96	1,425	8.94	12.4
	Falls	652	9.32	969	8.10	1,621	17.42	59.8
	Burns/fires/scalds	440	2.77	487	3.22	927	5.99	52.5
	Drowning	159	1.11	14	0.07	173	1.18	8.0
	Sports injuries	0	0.00	96	0.58	96	0.58	100.0
	Natural and environmental factors	185	1.17	167	0.98	353	2.15	47.4
	Machinery injuries	46	0.31	357	2.24	402	2.55	88.7
	Suffocation and foreign bodies	35	0.26	1,227	6.84	1,262	7.10	97.2
	Other unintentional injuries‡	102	0.78	2,028	12.00	2,130	12.78	95.2
	Suicide and self-inflicted injuries	1,381	8.85	1,333	7.96	2,714	16.81	49.1
	Other intentional injuries	804	5.28	1,208	7.06	2,012	12.34	60.0
BC	Road traffic accidents	28,330	14.61	16,949	8.61	45,280	23.22	37.4
	Other transport injuries	1,939	1.00	2,475	1.26	4,414	2.26	56.1
	Poisoning	18,460	9.43	1,208	0.61	19,668	10.04	6.1
	Falls	13,150	7.40	10,221	5.49	23,371	12.88	43.7
	Burns/fires/scalds	2,301	1.22	3,335	1.74	5,636	2.96	59.2
	Drowning	2,262	1.20	161	0.08	2,423	1.28	6.6
	Sports injuries	112	0.06	865	0.44	977	0.50	88.5
	Natural and environmental factors	852	0.44	1,132	0.59	1,984	1.03	57.1
	Machinery injuries	189	0.10	1,802	0.93	1,991	1.02	90.5
	Suffocation and foreign bodies	2,110	1.14	10,330	5.37	12,440	6.51	83.0
	Other unintentional injuries‡	671	0.34	13,788	7.05	14,459	7.40	95.4
	Suicide and self-inflicted injuries	22,535	11.85	11,317	5.70	33,852	17.54	33.4
	Other intentional injuries	9,826	5.04	5,677	2.88	15,503	7.92	36.6

Table G.12. Estimates of the Spatio-Temporal Bayesian Disease Mapping Model for the Number of Hospitalizations and Deaths Due To Road Traffic Accidents. Males 20-39 Years.

Road traffic accidents						
Parameter	Death			Hospitalization		
	Lower Limit	Point Estimate	Upper Limit	Lower Limit	Point Estimate	Upper Limit
Mean Component of the Fixed Effects						
m	0.0003	0.0004	0.0005	0.0060	0.0076	0.0095
Coefficients for the B-Spline Basis - Fixed Effects						
α_{01}	-0.906	-0.518	-0.132	0.176	0.328	0.474
α_{02}	-0.468	-0.006	0.454	-0.489	-0.257	-0.026
α_{03}	-1.104	-0.745	-0.397	-0.518	-0.397	-0.278
α_{04}	-1.059	-0.799	-0.551	-0.457	-0.327	-0.200
Variance Components of the Random Effects						
σ_1	0.024	0.130	0.463	0.138	0.228	0.395
σ_2	0.039	0.117	0.911	0.250	0.355	0.671
σ_3	0.025	0.123	0.527	0.084	0.160	0.315
σ_4	0.024	0.126	0.359	0.143	0.217	0.367
σ_φ	0.271	0.396	0.741	0.300	0.427	0.634
ρ	-0.313	0.171	0.401	-0.312	-0.132	0.114

Table G.13. Estimates of the Spatio-Temporal Bayesian Disease Mapping Model for the Number of Hospitalizations and Deaths Due To Road Traffic Accidents. Females 20-39 Years.

Road traffic accidents						
Parameter	Death			Hospitalization		
	Lower Limit	Point Estimate	Upper Limit	Lower Limit	Point Estimate	Upper Limit
Mean Component of the Fixed Effects						
m	0.00006	0.00009	0.00013	0.0029	0.0037	0.0047
Coefficients for the B-Spline Basis - Fixed Effects						
α_{01}	-0.534	0.224	0.947	-0.034	0.252	0.520
α_{02}	-1.137	-0.402	0.338	-0.558	-0.248	0.072
α_{03}	-1.090	-0.428	0.232	-0.668	-0.325	0.026
α_{04}	-1.056	-0.542	-0.075	-0.485	-0.318	-0.151
Variance Components of the Random Effects						
σ_1	0.018	0.275	1.266	0.260	0.474	0.793
σ_2	0.019	0.198	0.980	0.343	0.567	0.893
σ_3	0.021	0.294	1.178	0.417	0.652	0.997
σ_4	0.022	0.290	1.025	0.158	0.284	0.464
σ_φ	0.046	0.346	0.760	0.303	0.454	0.695
ρ	-0.307	0.258	0.478	-0.241	0.049	0.337

Table G.14. Estimates of the Spatio-Temporal Bayesian Disease Mapping Model for the Number of Injuries Due To Medical Adverse Events. Males and Females 0-19 Years.

Medical Adverse Events						
Parameter	Males			Females		
	Lower Limit	Point Estimate	Upper Limit	Lower Limit	Point Estimate	Upper Limit
Mean Component of the Fixed Effects						
m	0.0128	0.0140	0.0153	0.0099	0.0111	0.0124
Coefficients for the B-Spline Basis - Fixed Effects						
α_{01}	0.333	0.554	0.776	0.276	0.505	0.746
α_{02}	-0.414	-0.209	-0.032	-0.264	0.001	0.275
α_{03}	0.419	0.615	0.808	0.372	0.525	0.678
α_{04}	0.212	0.321	0.423	0.220	0.324	0.429
Variance Components of the Random Effects						
σ_1	0.124	0.249	0.526	0.133	0.314	0.559
σ_2	0.035	0.160	0.423	0.210	0.376	0.682
σ_3	0.131	0.295	0.470	0.026	0.167	0.308
σ_4	0.027	0.114	0.224	0.022	0.105	0.167
σ_φ	0.051	0.116	0.178	0.112	0.159	0.272
ρ	-0.425	-0.345	0.101	-0.369	-0.251	0.203

Table G.15. Estimates of the Spatio-Temporal Bayesian Disease Mapping Model for the Number of Injuries Due To Medical Adverse Events. Males and Females 20-39 Years.

Medical Adverse Events						
Parameter	Males			Females		
	Lower Limit	Point Estimate	Upper Limit	Lower Limit	Point Estimate	Upper Limit
Mean Component of the Fixed Effects						
m	0.0285	0.0319	0.0354	0.0191	0.0207	0.0225
Coefficients for the B-Spline Basis - Fixed Effects						
α_{01}	0.374	0.548	0.720	0.360	0.515	0.675
α_{02}	-0.331	-0.210	-0.084	-0.553	-0.396	-0.263
α_{03}	0.057	0.219	0.381	0.041	0.152	0.261
α_{04}	0.041	0.163	0.291	-0.113	-0.022	0.077
Variance Components of the Random Effects						
σ_1	0.132	0.235	0.410	0.136	0.215	0.386
σ_2	0.026	0.123	0.246	0.056	0.203	0.378
σ_3	0.135	0.248	0.407	0.033	0.125	0.278
σ_4	0.110	0.193	0.326	0.049	0.140	0.253
σ_φ	0.135	0.177	0.267	0.091	0.142	0.212
ρ	-0.401	-0.310	-0.066	-0.401	-0.269	0.096

Table G.16. Estimates of the Spatio-Temporal Bayesian Disease Mapping Model for the Number of Injuries Due To Medical Adverse Events. Males and Females 40-64 Years.

Medical Adverse Events						
Parameter	Males			Females		
	Lower Limit	Point Estimate	Upper Limit	Lower Limit	Point Estimate	Upper Limit
Mean Component of the Fixed Effects						
m	0.0404	0.0450	0.0498	0.0395	0.0438	0.0484
Coefficients for the B-Spline Basis - Fixed Effects						
α_{01}	0.455	0.565	0.672	0.377	0.499	0.611
α_{02}	-0.379	-0.268	-0.163	-0.369	-0.193	-0.021
α_{03}	0.097	0.256	0.414	0.028	0.154	0.284
α_{04}	-0.044	0.094	0.235	-0.068	0.035	0.136
Variance Components of the Random Effects						
σ_1	0.055	0.113	0.264	0.050	0.166	0.298
σ_2	0.062	0.108	0.271	0.184	0.286	0.480
σ_3	0.179	0.257	0.427	0.134	0.192	0.337
σ_4	0.178	0.245	0.385	0.114	0.156	0.273
σ_φ	0.141	0.181	0.262	0.135	0.176	0.245
ρ	-0.411	-0.274	-0.162	-0.423	-0.364	-0.206

Table G.17. Estimates of the Spatio-Temporal Bayesian Disease Mapping Model for the Number of Injuries Due To Medical Adverse Events. Males and Females 65-79 Years.

Medical Adverse Events						
Parameter	Males			Females		
	Lower Limit	Point Estimate	Upper Limit	Lower Limit	Point Estimate	Upper Limit
Mean Component of the Fixed Effects						
m	0.0555	0.0628	0.0707	0.0524	0.0587	0.0655
Coefficients for the B-Spline Basis - Fixed Effects						
α_{01}	0.288	0.420	0.556	0.192	0.376	0.553
α_{02}	-0.246	-0.105	0.040	-0.406	-0.285	-0.178
α_{03}	0.006	0.181	0.355	-0.040	0.105	0.250
α_{04}	-0.051	0.089	0.229	-0.150	-0.033	0.094
Variance Components of the Random Effects						
σ_1	0.112	0.167	0.359	0.172	0.297	0.505
σ_2	0.138	0.233	0.379	0.050	0.111	0.288
σ_3	0.219	0.319	0.475	0.144	0.222	0.386
σ_4	0.185	0.230	0.375	0.131	0.166	0.330
σ_φ	0.170	0.213	0.288	0.134	0.176	0.293
ρ	-0.432	-0.381	-0.282	-0.380	-0.263	0.054

Table G.18. Estimates of the Spatio-Temporal Bayesian Disease Mapping Model for the Number of Injuries Due To Medical Adverse Events. Males and Females 80 or More Years.

Medical Adverse Events						
Parameter	Males			Females		
	Lower Limit	Point Estimate	Upper Limit	Lower Limit	Point Estimate	Upper Limit
Mean Component of the Fixed Effects						
m	0.0450	0.0529	0.0619	0.0437	0.0520	0.0618
Coefficients for the B-Spline Basis - Fixed Effects						
α_{01}	0.114	0.337	0.564	-0.173	0.173	0.495
α_{02}	-0.438	-0.190	0.052	-0.431	-0.166	0.102
α_{03}	0.006	0.196	0.401	-0.179	-0.016	0.159
α_{04}	-0.078	0.091	0.274	-0.322	-0.114	0.097
Variance Components of the Random Effects						
σ_1	0.181	0.281	0.575	0.303	0.447	0.946
σ_2	0.223	0.382	0.596	0.295	0.393	0.706
σ_3	0.149	0.300	0.511	0.077	0.254	0.443
σ_4	0.187	0.277	0.451	0.231	0.339	0.598
σ_φ	0.213	0.293	0.379	0.215	0.263	0.469
ρ	-0.425	-0.379	-0.240	-0.367	-0.213	0.062

Table G.19. Fitted Mortality Rate. Road Traffic Accidents, Males 20-39 Years.

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
11	1991	2.48	3.82	5.63
11	1992	2.01	3.07	4.36
11	1993	1.79	2.75	3.90
11	1994	1.71	2.63	3.74
11	1995	1.62	2.59	3.77
11	1996	1.55	2.53	3.74
11	1997	1.47	2.34	3.44
11	1998	1.30	2.08	3.03
11	1999	1.18	1.86	2.73
11	2000	1.03	1.76	2.78
12	1991	3.58	5.33	7.52
12	1992	2.95	4.31	5.93
12	1993	2.70	3.95	5.43
12	1994	2.69	3.90	5.35
12	1995	2.69	3.98	5.56
12	1996	2.67	3.98	5.65
12	1997	2.51	3.74	5.37
12	1998	2.20	3.30	4.89
12	1999	1.88	2.83	4.14
12	2000	1.52	2.49	3.87
13	1991	3.43	4.55	5.87
13	1992	2.99	3.82	4.76
13	1993	2.80	3.56	4.52
13	1994	2.79	3.50	4.39
13	1995	2.75	3.50	4.39
13	1996	2.62	3.39	4.32
13	1997	2.36	3.04	3.82
13	1998	1.92	2.57	3.28
13	1999	1.60	2.16	2.82
13	2000	1.24	1.96	2.74
14	1991	5.53	7.41	9.50
14	1992	4.85	6.16	7.55
14	1993	4.50	5.66	6.94
14	1994	4.46	5.51	6.72
14	1995	4.35	5.47	6.69
14	1996	4.14	5.30	6.56
14	1997	3.77	4.82	5.94
14	1998	3.19	4.16	5.22
14	1999	2.70	3.61	4.60
14	2000	2.27	3.35	4.60

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
1	1991	5.15	5.52	5.87
1	1992	4.32	4.56	4.79
1	1993	3.97	4.20	4.42
1	1994	3.90	4.11	4.31
1	1995	3.89	4.10	4.31
1	1996	3.78	4.00	4.21
1	1997	3.44	3.64	3.82
1	1998	2.95	3.13	3.31
1	1999	2.51	2.69	2.86
1	2000	2.23	2.46	2.68

HA: 1 Interior HA

HSDA: 11 East Kootenay
12 Kootenay/Boundary
13 Okanagan
14 Thompson Cariboo Shuswap

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
21	1991	2.85	3.97	5.24
21	1992	2.41	3.23	4.16
21	1993	2.33	3.06	3.90
21	1994	2.43	3.15	3.97
21	1995	2.55	3.34	4.31
21	1996	2.59	3.42	4.48
21	1997	2.42	3.19	4.13
21	1998	2.03	2.72	3.74
21	1999	1.61	2.21	3.03
21	2000	1.18	1.82	2.64
22	1991	1.70	2.26	2.93
22	1992	1.39	1.77	2.22
22	1993	1.22	1.57	1.96
22	1994	1.19	1.51	1.87
22	1995	1.17	1.51	1.89
22	1996	1.12	1.48	1.89
22	1997	1.06	1.38	1.74
22	1998	0.94	1.23	1.56
22	1999	0.82	1.09	1.41
22	2000	0.70	1.01	1.41
23	1991	2.79	3.51	4.40
23	1992	2.28	2.78	3.37
23	1993	2.01	2.47	2.97
23	1994	1.94	2.37	2.82
23	1995	1.87	2.34	2.84
23	1996	1.79	2.30	2.82
23	1997	1.71	2.14	2.60
23	1998	1.50	1.91	2.37
23	1999	1.33	1.71	2.13
23	2000	1.16	1.61	2.17

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
2	1991	2.86	3.05	3.23
2	1992	2.31	2.43	2.55
2	1993	2.08	2.19	2.30
2	1994	2.04	2.14	2.24
2	1995	2.06	2.16	2.26
2	1996	2.04	2.15	2.26
2	1997	1.90	2.00	2.10
2	1998	1.66	1.76	1.86
2	1999	1.44	1.53	1.62
2	2000	1.27	1.40	1.51

HA: 2 Fraser HA

HSDA: 21 Fraser Valley
22 Simon Fraser
23 South Fraser

Table G.19. (continued) Fitted Mortality Rate. Road Traffic Accidents, Males 20-39 Years.

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
31	1991	1.40	2.18	3.13
31	1992	1.15	1.72	2.46
31	1993	1.04	1.56	2.21
31	1994	1.03	1.54	2.17
31	1995	1.04	1.58	2.24
31	1996	1.02	1.57	2.28
31	1997	0.96	1.45	2.07
31	1998	0.82	1.26	1.80
31	1999	0.69	1.08	1.57
31	2000	0.56	0.98	1.53
32	1991	1.16	1.57	2.08
32	1992	0.96	1.25	1.60
32	1993	0.84	1.09	1.39
32	1994	0.79	1.02	1.28
32	1995	0.72	0.98	1.25
32	1996	0.66	0.93	1.21
32	1997	0.62	0.85	1.11
32	1998	0.53	0.76	0.99
32	1999	0.49	0.70	0.92
32	2000	0.46	0.70	1.00
33	1991	2.19	2.99	3.98
33	1992	1.79	2.38	3.09
33	1993	1.59	2.11	2.74
33	1994	1.52	2.01	2.61
33	1995	1.43	1.98	2.60
33	1996	1.35	1.93	2.58
33	1997	1.30	1.81	2.39
33	1998	1.19	1.62	2.16
33	1999	1.07	1.47	1.98
33	2000	0.93	1.41	2.09

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
3	1991	1.82	1.98	2.12
3	1992	1.47	1.57	1.67
3	1993	1.30	1.39	1.47
3	1994	1.23	1.32	1.39
3	1995	1.20	1.28	1.37
3	1996	1.15	1.24	1.33
3	1997	1.06	1.14	1.22
3	1998	0.95	1.02	1.09
3	1999	0.85	0.92	0.98
3	2000	0.79	0.89	0.97

HA: 3 Vancouver Coastal HA

HSDA: 31 Richmond
32 Vancouver
33 North Shore / Coast Garibaldi

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
41	1991	1.77	2.40	3.19
41	1992	1.43	1.87	2.40
41	1993	1.24	1.63	2.07
41	1994	1.16	1.55	1.96
41	1995	1.09	1.52	1.96
41	1996	1.05	1.50	1.96
41	1997	1.04	1.41	1.85
41	1998	0.95	1.29	1.72
41	1999	0.86	1.18	1.58
41	2000	0.77	1.14	1.70
42	1991	2.90	4.11	5.43
42	1992	2.59	3.51	4.51
42	1993	2.62	3.41	4.38
42	1994	2.73	3.53	4.53
42	1995	2.79	3.69	4.87
42	1996	2.69	3.63	4.94
42	1997	2.36	3.16	4.15
42	1998	1.83	2.51	3.27
42	1999	1.43	2.01	2.67
42	2000	1.13	1.81	2.63
43	1991	2.54	3.92	5.80
43	1992	2.07	3.19	4.65
43	1993	1.89	2.92	4.23
43	1994	1.83	2.85	4.15
43	1995	1.76	2.86	4.25
43	1996	1.72	2.80	4.21
43	1997	1.60	2.56	3.85
43	1998	1.37	2.21	3.31
43	1999	1.17	1.90	2.87
43	2000	0.98	1.75	2.80

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
4	1991	2.86	3.07	3.27
4	1992	2.34	2.49	2.64
4	1993	2.16	2.30	2.44
4	1994	2.16	2.29	2.42
4	1995	2.18	2.33	2.47
4	1996	2.14	2.30	2.44
4	1997	1.95	2.08	2.21
4	1998	1.64	1.77	1.88
4	1999	1.40	1.52	1.62
4	2000	1.27	1.41	1.54

HA: 4 Vancouver Island HA

HSDA: 41 South Vancouver Island
42 Central Vancouver Island
43 North Vancouver Island

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
51	1991	3.79	5.38	7.31
51	1992	3.25	4.45	5.88
51	1993	3.02	4.13	5.51
51	1994	2.98	4.09	5.42
51	1995	2.96	4.14	5.56
51	1996	2.85	4.06	5.52
51	1997	2.60	3.68	4.95
51	1998	2.17	3.12	4.24
51	1999	1.81	2.63	3.63
51	2000	1.44	2.37	3.49
52	1991	4.22	5.73	7.51
52	1992	3.58	4.66	5.92
52	1993	3.36	4.36	5.44
52	1994	3.44	4.41	5.46
52	1995	3.55	4.58	5.83
52	1996	3.52	4.61	6.01
52	1997	3.27	4.26	5.47
52	1998	2.74	3.62	4.77
52	1999	2.22	3.01	4.02
52	2000	1.75	2.61	3.65
53	1991	4.40	6.52	9.08
53	1992	3.81	5.41	7.32
53	1993	3.69	5.13	6.85
53	1994	3.82	5.24	6.95
53	1995	3.88	5.43	7.49
53	1996	3.78	5.38	7.55
53	1997	3.39	4.82	6.61
53	1998	2.75	3.97	5.41
53	1999	2.23	3.29	4.50
53	2000	1.84	3.00	4.56

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
5	1991	5.36	5.80	6.22
5	1992	4.45	4.76	5.06
5	1993	4.17	4.46	4.72
5	1994	4.23	4.49	4.75
5	1995	4.33	4.63	4.91
5	1996	4.29	4.62	4.92
5	1997	3.93	4.21	4.47
5	1998	3.30	3.55	3.78
5	1999	2.74	2.96	3.17
5	2000	2.35	2.63	2.87

HA: 5 Northern HA

HSDA: 51 Northwest
52 Northern Interior
53 Northeast

Table G.20. Fitted Mortality Rate. Road Traffic Accidents, Females 20-39 Years.

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
11	1991	0.60	1.12	1.98
11	1992	0.57	1.17	2.00
11	1993	0.49	1.16	2.01
11	1994	0.48	1.08	1.88
11	1995	0.48	1.00	1.74
11	1996	0.46	0.94	1.68
11	1997	0.45	0.92	1.74
11	1998	0.43	0.93	2.03
11	1999	0.42	0.92	1.94
11	2000	0.35	0.94	2.60
12	1991	0.70	1.23	2.12
12	1992	0.75	1.35	2.26
12	1993	0.71	1.37	2.37
12	1994	0.67	1.29	2.21
12	1995	0.61	1.17	2.01
12	1996	0.55	1.07	1.85
12	1997	0.51	1.01	1.83
12	1998	0.47	0.98	1.96
12	1999	0.45	0.94	1.83
12	2000	0.36	0.90	2.18
13	1991	0.61	0.99	1.49
13	1992	0.71	1.10	1.61
13	1993	0.69	1.11	1.69
13	1994	0.64	1.02	1.56
13	1995	0.56	0.90	1.36
13	1996	0.48	0.78	1.19
13	1997	0.40	0.69	1.06
13	1998	0.33	0.63	1.00
13	1999	0.29	0.57	0.92
13	2000	0.15	0.53	0.96
14	1991	0.97	1.91	3.14
14	1992	1.26	2.15	3.16
14	1993	1.35	2.21	3.29
14	1994	1.34	2.10	3.14
14	1995	1.26	1.94	2.88
14	1996	1.14	1.79	2.71
14	1997	1.04	1.71	2.65
14	1998	0.98	1.70	2.86
14	1999	0.95	1.68	2.80
14	2000	0.71	1.69	3.58

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
1	1991	1.12	1.31	1.47
1	1992	1.28	1.44	1.58
1	1993	1.30	1.45	1.59
1	1994	1.23	1.37	1.50
1	1995	1.11	1.25	1.37
1	1996	1.01	1.14	1.25
1	1997	0.95	1.08	1.19
1	1998	0.90	1.06	1.18
1	1999	0.87	1.03	1.15
1	2000	0.78	1.01	1.17

HA: 1 Interior HA

HSDA: 11 East Kootenay
12 Kootenay/Boundary
13 Okanagan
14 Thompson Cariboo Shuswap

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
21	1991	0.62	1.01	1.53
21	1992	0.76	1.17	1.76
21	1993	0.74	1.20	1.93
21	1994	0.69	1.11	1.75
21	1995	0.60	0.96	1.46
21	1996	0.51	0.83	1.27
21	1997	0.43	0.74	1.14
21	1998	0.36	0.68	1.08
21	1999	0.32	0.62	1.03
21	2000	0.20	0.58	1.06
22	1991	0.39	0.65	0.97
22	1992	0.40	0.64	0.93
22	1993	0.34	0.60	0.88
22	1994	0.30	0.53	0.79
22	1995	0.26	0.46	0.68
22	1996	0.22	0.40	0.60
22	1997	0.19	0.36	0.56
22	1998	0.16	0.34	0.54
22	1999	0.15	0.33	0.53
22	2000	0.11	0.33	0.59
23	1991	0.48	0.74	1.07
23	1992	0.51	0.77	1.07
23	1993	0.47	0.74	1.06
23	1994	0.43	0.67	0.95
23	1995	0.37	0.59	0.84
23	1996	0.32	0.52	0.75
23	1997	0.30	0.48	0.70
23	1998	0.26	0.45	0.69
23	1999	0.23	0.42	0.64
23	2000	0.13	0.38	0.66

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
2	1991	0.71	0.80	0.89
2	1992	0.78	0.86	0.94
2	1993	0.76	0.84	0.92
2	1994	0.69	0.77	0.83
2	1995	0.61	0.67	0.73
2	1996	0.53	0.59	0.64
2	1997	0.47	0.53	0.58
2	1998	0.43	0.49	0.55
2	1999	0.39	0.46	0.51
2	2000	0.35	0.43	0.51

HA: 2 Fraser HA

HSDA: 21 Fraser Valley
22 Simon Fraser
23 South Fraser

Table G.20. (continued) Fitted Mortality Rate. Road Traffic Accidents, Females 20-39 Years.

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
31	1991	0.24	0.58	1.00
31	1992	0.23	0.57	1.00
31	1993	0.19	0.53	0.97
31	1994	0.17	0.48	0.88
31	1995	0.17	0.43	0.78
31	1996	0.16	0.38	0.69
31	1997	0.14	0.35	0.64
31	1998	0.12	0.33	0.63
31	1999	0.12	0.32	0.60
31	2000	0.08	0.32	0.68
32	1991	0.38	0.64	0.96
32	1992	0.45	0.67	0.95
32	1993	0.42	0.64	0.94
32	1994	0.38	0.58	0.83
32	1995	0.32	0.50	0.72
32	1996	0.27	0.43	0.63
32	1997	0.24	0.39	0.57
32	1998	0.20	0.36	0.55
32	1999	0.19	0.34	0.52
32	2000	0.15	0.34	0.59
33	1991	0.42	0.75	1.17
33	1992	0.36	0.72	1.13
33	1993	0.27	0.67	1.09
33	1994	0.26	0.61	1.00
33	1995	0.26	0.54	0.88
33	1996	0.25	0.49	0.79
33	1997	0.23	0.46	0.75
33	1998	0.22	0.45	0.76
33	1999	0.23	0.48	0.81
33	2000	0.24	0.58	1.43

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
3	1991	0.54	0.66	0.76
3	1992	0.55	0.65	0.74
3	1993	0.52	0.62	0.71
3	1994	0.47	0.56	0.63
3	1995	0.42	0.49	0.55
3	1996	0.37	0.44	0.49
3	1997	0.34	0.40	0.45
3	1998	0.32	0.38	0.43
3	1999	0.32	0.38	0.43
3	2000	0.32	0.41	0.48

HA: 3 Vancouver Coastal HA

HSDA: 31 Richmond
32 Vancouver
33 North Shore / Coast Garibaldi

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
41	1991	0.47	0.77	1.13
41	1992	0.51	0.80	1.14
41	1993	0.47	0.77	1.12
41	1994	0.43	0.70	1.01
41	1995	0.38	0.61	0.89
41	1996	0.33	0.54	0.80
41	1997	0.27	0.48	0.74
41	1998	0.23	0.45	0.71
41	1999	0.22	0.42	0.68
41	2000	0.16	0.42	0.75
42	1991	0.69	1.14	1.78
42	1992	0.86	1.33	2.03
42	1993	0.84	1.36	2.22
42	1994	0.77	1.25	1.99
42	1995	0.66	1.08	1.64
42	1996	0.56	0.92	1.40
42	1997	0.47	0.81	1.26
42	1998	0.39	0.75	1.20
42	1999	0.36	0.70	1.14
42	2000	0.24	0.67	1.22
43	1991	0.58	1.10	1.94
43	1992	0.51	1.13	1.97
43	1993	0.45	1.10	1.95
43	1994	0.42	1.03	1.84
43	1995	0.42	0.94	1.66
43	1996	0.42	0.87	1.56
43	1997	0.40	0.85	1.60
43	1998	0.37	0.85	1.83
43	1999	0.36	0.81	1.69
43	2000	0.26	0.76	1.83

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
4	1991	0.87	1.00	1.11
4	1992	0.97	1.09	1.19
4	1993	0.96	1.08	1.18
4	1994	0.88	0.99	1.09
4	1995	0.78	0.88	0.97
4	1996	0.68	0.78	0.87
4	1997	0.62	0.72	0.80
4	1998	0.58	0.68	0.76
4	1999	0.55	0.65	0.73
4	2000	0.50	0.62	0.70

HA: 4 Vancouver Island HA

HSDA: 41 South Vancouver Island
42 Central Vancouver Island
43 North Vancouver Island

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
51	1991	0.61	1.07	1.77
51	1992	0.66	1.17	1.91
51	1993	0.63	1.16	1.94
51	1994	0.58	1.08	1.81
51	1995	0.53	0.97	1.62
51	1996	0.47	0.87	1.48
51	1997	0.42	0.81	1.42
51	1998	0.37	0.77	1.43
51	1999	0.31	0.70	1.29
51	2000	0.16	0.60	1.22
52	1991	0.80	1.40	2.25
52	1992	1.01	1.67	2.57
52	1993	1.02	1.73	2.88
52	1994	0.94	1.59	2.57
52	1995	0.83	1.38	2.11
52	1996	0.72	1.18	1.81
52	1997	0.61	1.05	1.62
52	1998	0.52	0.97	1.57
52	1999	0.48	0.90	1.49
52	2000	0.32	0.84	1.57
53	1991	0.68	1.22	2.09
53	1992	0.74	1.35	2.28
53	1993	0.71	1.37	2.43
53	1994	0.67	1.30	2.30
53	1995	0.63	1.20	2.12
53	1996	0.56	1.11	2.01
53	1997	0.53	1.07	2.10
53	1998	0.49	1.07	2.34
53	1999	0.44	0.97	2.02
53	2000	0.28	0.81	1.81

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
5	1991	1.04	1.22	1.38
5	1992	1.21	1.39	1.54
5	1993	1.22	1.41	1.56
5	1994	1.15	1.32	1.46
5	1995	1.03	1.18	1.30
5	1996	0.91	1.05	1.17
5	1997	0.83	0.97	1.09
5	1998	0.77	0.93	1.04
5	1999	0.72	0.85	0.96
5	2000	0.61	0.75	0.87

HA: 5 Northern HA

HSDA: 51 Northwest
52 Northern Interior
53 Northeast

Table G.21. Fitted Hospitalization Rate. Road Traffic Accidents, Males 20-39 Years.

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
11	1991	9.65	11.15	12.83
11	1992	9.92	11.02	12.17
11	1993	9.81	10.93	12.08
11	1994	9.82	10.81	11.85
11	1995	9.66	10.62	11.66
11	1996	9.26	10.32	11.44
11	1997	8.88	9.86	10.89
11	1998	8.06	9.09	10.26
11	1999	6.90	7.83	8.88
11	2000	4.85	6.12	7.46
12	1991	7.73	8.99	10.37
12	1992	8.74	9.76	10.87
12	1993	8.92	9.96	11.05
12	1994	8.75	9.67	10.62
12	1995	8.16	9.08	10.03
12	1996	7.44	8.38	9.35
12	1997	6.88	7.71	8.61
12	1998	6.44	7.30	8.26
12	1999	6.47	7.39	8.39
12	2000	6.84	8.37	10.08
13	1991	7.71	8.49	9.32
13	1992	8.75	9.34	9.97
13	1993	8.70	9.29	9.90
13	1994	8.13	8.62	9.14
13	1995	7.26	7.73	8.22
13	1996	6.47	6.95	7.44
13	1997	6.03	6.46	6.90
13	1998	5.82	6.30	6.80
13	1999	5.89	6.39	6.91
13	2000	5.94	6.70	7.47
14	1991	12.68	13.87	15.09
14	1992	14.45	15.32	16.23
14	1993	14.38	15.25	16.14
14	1994	13.42	14.14	14.89
14	1995	11.95	12.64	13.36
14	1996	10.55	11.25	11.98
14	1997	9.70	10.30	10.93
14	1998	9.08	9.75	10.44
14	1999	8.63	9.32	10.05
14	2000	7.80	8.78	9.83

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
1	1991	10.51	10.72	10.93
1	1992	11.44	11.59	11.74
1	1993	11.39	11.54	11.70
1	1994	10.72	10.85	10.98
1	1995	9.77	9.89	10.02
1	1996	8.86	8.98	9.11
1	1997	8.20	8.31	8.42
1	1998	7.78	7.91	8.03
1	1999	7.53	7.66	7.79
1	2000	7.33	7.51	7.69

HA: 1 Interior HA

HSDA: 11 East Kootenay
12 Kootenay/Boundary
13 Okanagan
14 Thompson Cariboo Shuswap

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
21	1991	7.39	8.21	9.11
21	1992	7.80	8.40	9.02
21	1993	7.67	8.27	8.87
21	1994	7.38	7.88	8.39
21	1995	6.86	7.33	7.82
21	1996	6.23	6.73	7.24
21	1997	5.69	6.13	6.58
21	1998	5.07	5.53	6.01
21	1999	4.45	4.89	5.35
21	2000	3.58	4.19	4.83
22	1991	5.00	5.44	5.88
22	1992	5.78	6.11	6.44
22	1993	5.82	6.15	6.49
22	1994	5.44	5.71	5.99
22	1995	4.80	5.06	5.33
22	1996	4.14	4.40	4.66
22	1997	3.65	3.87	4.10
22	1998	3.31	3.55	3.80
22	1999	3.26	3.51	3.77
22	2000	3.47	3.85	4.25
23	1991	4.99	5.45	5.95
23	1992	6.51	6.88	7.25
23	1993	6.71	7.09	7.47
23	1994	6.10	6.40	6.72
23	1995	5.16	5.44	5.73
23	1996	4.40	4.68	4.96
23	1997	4.11	4.35	4.59
23	1998	4.08	4.36	4.66
23	1999	4.09	4.40	4.72
23	2000	3.72	4.13	4.56

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
2	1991	5.80	5.91	6.01
2	1992	6.73	6.81	6.88
2	1993	6.81	6.89	6.97
2	1994	6.30	6.36	6.43
2	1995	5.54	5.61	5.67
2	1996	4.85	4.91	4.97
2	1997	4.40	4.45	4.50
2	1998	4.16	4.22	4.28
2	1999	4.05	4.11	4.17
2	2000	3.93	4.02	4.11

HA: 2 Fraser HA

HSDA: 21 Fraser Valley
22 Simon Fraser
23 South Fraser

Table G.21. (cont.) Fitted Hospitalization Rate. Road Traffic Accidents, Males 20-39 Years.

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
31	1991	3.31	3.88	4.51
31	1992	3.66	4.13	4.63
31	1993	3.55	4.00	4.48
31	1994	3.26	3.65	4.05
31	1995	2.87	3.23	3.61
31	1996	2.52	2.88	3.26
31	1997	2.34	2.66	3.01
31	1998	2.24	2.56	2.91
31	1999	2.15	2.47	2.82
31	2000	1.85	2.31	2.83
32	1991	3.08	3.39	3.70
32	1992	4.10	4.35	4.61
32	1993	4.29	4.55	4.82
32	1994	3.90	4.12	4.34
32	1995	3.25	3.45	3.65
32	1996	2.65	2.84	3.03
32	1997	2.29	2.44	2.61
32	1998	2.13	2.29	2.47
32	1999	2.21	2.39	2.57
32	2000	2.52	2.81	3.11
33	1991	5.29	5.94	6.60
33	1992	6.38	6.89	7.42
33	1993	6.14	6.64	7.17
33	1994	5.29	5.69	6.11
33	1995	4.30	4.66	5.05
33	1996	3.57	3.93	4.31
33	1997	3.33	3.64	3.97
33	1998	3.48	3.83	4.20
33	1999	4.11	4.52	4.97
33	2000	5.22	5.94	6.70

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
3	1991	3.94	4.03	4.12
3	1992	4.83	4.91	4.98
3	1993	4.88	4.96	5.03
3	1994	4.35	4.41	4.48
3	1995	3.63	3.69	3.75
3	1996	3.03	3.08	3.14
3	1997	2.69	2.73	2.78
3	1998	2.61	2.66	2.71
3	1999	2.79	2.85	2.90
3	2000	3.29	3.38	3.46

HA: 3 Vancouver Coastal HA

HSDA: 31 Richmond
32 Vancouver
33 North Shore / Coast Garibaldi

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
41	1991	4.82	5.31	5.83
41	1992	6.01	6.41	6.81
41	1993	6.33	6.75	7.19
41	1994	6.08	6.43	6.80
41	1995	5.36	5.70	6.06
41	1996	4.54	4.88	5.23
41	1997	3.89	4.16	4.45
41	1998	3.43	3.74	4.05
41	1999	3.47	3.79	4.12
41	2000	4.16	4.68	5.26
42	1991	7.96	8.83	9.79
42	1992	8.90	9.58	10.26
42	1993	8.86	9.54	10.23
42	1994	8.34	8.91	9.48
42	1995	7.47	7.99	8.55
42	1996	6.52	7.03	7.59
42	1997	5.75	6.20	6.70
42	1998	5.16	5.66	6.18
42	1999	5.01	5.53	6.08
42	2000	5.24	6.01	6.86
43	1991	7.76	9.11	10.52
43	1992	10.25	11.46	12.71
43	1993	11.60	12.89	14.26
43	1994	12.00	13.19	14.43
43	1995	11.34	12.51	13.77
43	1996	10.04	11.21	12.48
43	1997	8.65	9.66	10.76
43	1998	7.27	8.28	9.38
43	1999	6.38	7.36	8.43
43	2000	5.63	7.10	8.74

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
4	1991	6.60	6.76	6.91
4	1992	7.75	7.86	7.98
4	1993	8.08	8.20	8.32
4	1994	7.76	7.86	7.96
4	1995	6.98	7.08	7.19
4	1996	6.08	6.18	6.28
4	1997	5.26	5.34	5.43
4	1998	4.69	4.78	4.87
4	1999	4.58	4.68	4.77
4	2000	5.17	5.33	5.47

HA: 4 Vancouver Island HA

HSDA: 41 South Vancouver Island
42 Central Vancouver Island
43 North Vancouver Island

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
51	1991	8.45	9.62	10.92
51	1992	9.70	10.63	11.64
51	1993	10.45	11.44	12.49
51	1994	10.96	11.86	12.79
51	1995	10.77	11.70	12.65
51	1996	9.90	10.87	11.89
51	1997	8.61	9.42	10.29
51	1998	7.09	7.88	8.75
51	1999	6.14	6.90	7.73
51	2000	5.71	6.86	8.10
52	1991	8.58	9.54	10.56
52	1992	10.32	11.13	11.93
52	1993	10.79	11.60	12.43
52	1994	10.46	11.13	11.85
52	1995	9.47	10.12	10.80
52	1996	8.33	8.97	9.64
52	1997	7.42	7.97	8.54
52	1998	6.53	7.13	7.76
52	1999	5.72	6.29	6.91
52	2000	4.56	5.37	6.24
53	1991	10.07	11.63	13.40
53	1992	10.30	11.45	12.71
53	1993	9.25	10.31	11.43
53	1994	7.94	8.81	9.72
53	1995	6.63	7.44	8.30
53	1996	5.70	6.46	7.30
53	1997	5.32	6.00	6.73
53	1998	5.37	6.18	7.00
53	1999	6.27	7.25	8.27
53	2000	8.41	10.04	11.90

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
5	1991	9.77	10.02	10.26
5	1992	10.86	11.05	11.23
5	1993	11.08	11.27	11.47
5	1994	10.67	10.85	11.01
5	1995	9.84	10.00	10.17
5	1996	8.81	8.98	9.14
5	1997	7.82	7.97	8.11
5	1998	6.99	7.14	7.29
5	1999	6.52	6.68	6.83
5	2000	6.59	6.82	7.05

HA: 5 Northern HA

HSDA: 51 Northwest
52 Northern Interior
53 Northeast

Table G.22. Fitted Hospitalization Rate. Road Traffic Accidents, Females 20-39 Years.

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
11	1991	5.13	6.46	7.90
11	1992	4.14	4.87	5.68
11	1993	3.63	4.39	5.21
11	1994	3.70	4.36	5.05
11	1995	3.82	4.46	5.15
11	1996	3.67	4.37	5.13
11	1997	3.22	3.83	4.51
11	1998	2.66	3.32	4.05
11	1999	2.94	3.67	4.50
11	2000	5.42	6.82	8.39
12	1991	2.56	3.33	4.20
12	1992	3.42	4.05	4.76
12	1993	3.77	4.47	5.26
12	1994	3.98	4.64	5.34
12	1995	4.01	4.68	5.42
12	1996	4.06	4.78	5.58
12	1997	4.34	5.07	5.88
12	1998	4.29	5.19	6.19
12	1999	3.40	4.20	5.10
12	2000	1.55	2.23	3.03
13	1991	3.80	4.38	5.05
13	1992	3.90	4.30	4.71
13	1993	3.98	4.39	4.82
13	1994	4.12	4.48	4.86
13	1995	4.06	4.42	4.81
13	1996	3.68	4.06	4.47
13	1997	3.05	3.36	3.69
13	1998	2.41	2.74	3.08
13	1999	2.33	2.66	3.01
13	2000	3.22	3.78	4.41
14	1991	5.13	5.87	6.69
14	1992	5.96	6.50	7.07
14	1993	6.29	6.87	7.47
14	1994	6.48	6.99	7.53
14	1995	6.43	6.94	7.49
14	1996	6.25	6.80	7.39
14	1997	6.13	6.63	7.15
14	1998	5.79	6.36	6.98
14	1999	5.23	5.79	6.40
14	2000	4.11	4.82	5.58

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
1	1991	5.00	4.84	5.16
1	1992	4.93	4.82	5.03
1	1993	5.03	4.91	5.14
1	1994	5.12	5.01	5.22
1	1995	5.13	5.02	5.23
1	1996	5.00	4.88	5.11
1	1997	4.72	4.62	4.82
1	1998	4.40	4.27	4.51
1	1999	4.08	3.96	4.19
1	2000	4.41	4.24	4.57

HA: 1 Interior HA

HSDA: 11 East Kootenay
12 Kootenay/Boundary
13 Okanagan
14 Thompson Cariboo Shuswap

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
21	1991	3.40	4.01	4.66
21	1992	4.52	4.98	5.46
21	1993	4.92	5.41	5.96
21	1994	4.86	5.29	5.76
21	1995	4.40	4.81	5.24
21	1996	3.79	4.20	4.63
21	1997	3.28	3.63	3.99
21	1998	2.76	3.14	3.54
21	1999	2.36	2.71	3.08
21	2000	1.87	2.33	2.84
22	1991	1.80	2.08	2.36
22	1992	2.30	2.52	2.74
22	1993	2.37	2.59	2.83
22	1994	2.20	2.38	2.57
22	1995	1.90	2.07	2.25
22	1996	1.63	1.79	1.97
22	1997	1.48	1.63	1.78
22	1998	1.38	1.55	1.73
22	1999	1.32	1.49	1.67
22	2000	1.15	1.38	1.63
23	1991	2.81	3.17	3.56
23	1992	3.55	3.81	4.10
23	1993	3.53	3.79	4.09
23	1994	3.15	3.36	3.59
23	1995	2.66	2.86	3.07
23	1996	2.30	2.50	2.70
23	1997	2.23	2.40	2.59
23	1998	2.25	2.47	2.70
23	1999	2.15	2.38	2.62
23	2000	1.62	1.89	2.17

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
2	1991	3.08	2.99	3.17
2	1992	3.77	3.70	3.84
2	1993	3.93	3.86	4.00
2	1994	3.68	3.62	3.74
2	1995	3.24	3.19	3.30
2	1996	2.83	2.77	2.88
2	1997	2.55	2.50	2.60
2	1998	2.39	2.33	2.44
2	1999	2.20	2.14	2.25
2	2000	1.87	1.79	1.94

HA: 2 Fraser HA

HSDA: 21 Fraser Valley
22 Simon Fraser
23 South Fraser

Table G.22. (cont.) Fitted Hospitalization Rate. Road Traffic Accidents, Females 20-39 Years.

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
31	1991	1.47	1.88	2.34
31	1992	1.60	1.91	2.26
31	1993	1.45	1.75	2.08
31	1994	1.26	1.51	1.77
31	1995	1.05	1.27	1.52
31	1996	0.89	1.10	1.32
31	1997	0.82	1.00	1.22
31	1998	0.78	0.99	1.24
31	1999	0.82	1.06	1.33
31	2000	0.87	1.21	1.59
32	1991	1.86	2.11	2.36
32	1992	2.32	2.51	2.71
32	1993	2.27	2.47	2.67
32	1994	1.98	2.13	2.30
32	1995	1.60	1.75	1.89
32	1996	1.31	1.45	1.59
32	1997	1.19	1.31	1.43
32	1998	1.15	1.28	1.42
32	1999	1.13	1.27	1.42
32	2000	1.01	1.20	1.40
33	1991	2.28	2.72	3.19
33	1992	2.41	2.71	3.04
33	1993	2.45	2.77	3.11
33	1994	2.53	2.83	3.13
33	1995	2.52	2.82	3.13
33	1996	2.38	2.69	3.02
33	1997	2.14	2.41	2.69
33	1998	1.84	2.13	2.45
33	1999	1.78	2.08	2.41
33	2000	2.08	2.54	3.05

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
3	1991	2.24	2.15	2.31
3	1992	2.38	2.32	2.44
3	1993	2.33	2.27	2.39
3	1994	2.16	2.11	2.20
3	1995	1.94	1.90	1.99
3	1996	1.74	1.70	1.79
3	1997	1.57	1.53	1.61
3	1998	1.47	1.42	1.51
3	1999	1.47	1.42	1.52
3	2000	1.64	1.57	1.71

HA: 3 Vancouver Coastal HA

HSDA: 31 Richmond
32 Vancouver
33 North Shore / Coast Garibaldi

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
41	1991	2.36	2.72	3.12
41	1992	2.70	2.97	3.25
41	1993	2.59	2.86	3.15
41	1994	2.35	2.57	2.80
41	1995	2.06	2.26	2.48
41	1996	1.84	2.05	2.28
41	1997	1.82	2.02	2.23
41	1998	1.86	2.10	2.36
41	1999	1.82	2.06	2.33
41	2000	1.43	1.73	2.06
42	1991	3.16	3.72	4.32
42	1992	4.24	4.71	5.22
42	1993	4.42	4.92	5.46
42	1994	4.07	4.47	4.92
42	1995	3.36	3.73	4.13
42	1996	2.68	3.03	3.40
42	1997	2.24	2.53	2.84
42	1998	1.95	2.27	2.64
42	1999	1.95	2.29	2.68
42	2000	2.18	2.70	3.28
43	1991	4.02	5.07	6.28
43	1992	5.22	6.13	7.11
43	1993	5.92	6.92	8.02
43	1994	6.21	7.13	8.12
43	1995	5.68	6.60	7.63
43	1996	4.56	5.42	6.35
43	1997	3.22	3.89	4.61
43	1998	2.05	2.68	3.41
43	1999	1.62	2.16	2.77
43	2000	1.63	2.49	3.50

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
4	1991	3.84	3.68	3.99
4	1992	4.60	4.48	4.72
4	1993	4.90	4.76	5.03
4	1994	4.72	4.59	4.84
4	1995	4.20	4.07	4.32
4	1996	3.50	3.38	3.61
4	1997	2.81	2.71	2.90
4	1998	2.35	2.25	2.44
4	1999	2.17	2.08	2.25
4	2000	2.31	2.18	2.44

HA: 4 Vancouver Island HA

HSDA: 41 South Vancouver Island
42 Central Vancouver Island
43 North Vancouver Island

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
51	1991	4.45	5.34	6.36
51	1992	5.16	5.87	6.61
51	1993	5.12	5.84	6.62
51	1994	4.91	5.53	6.18
51	1995	4.64	5.24	5.87
51	1996	4.58	5.24	5.93
51	1997	5.11	5.80	6.51
51	1998	5.67	6.55	7.53
51	1999	5.28	6.17	7.13
51	2000	3.07	3.93	4.92
52	1991	4.02	4.73	5.48
52	1992	4.99	5.56	6.15
52	1993	4.93	5.51	6.14
52	1994	4.51	4.97	5.47
52	1995	4.00	4.43	4.88
52	1996	3.75	4.22	4.69
52	1997	4.17	4.63	5.09
52	1998	4.85	5.43	6.07
52	1999	4.87	5.49	6.17
52	2000	3.14	3.81	4.55
53	1991	4.72	5.93	7.29
53	1992	4.08	4.82	5.67
53	1993	3.33	4.02	4.78
53	1994	2.87	3.42	4.03
53	1995	2.48	2.99	3.55
53	1996	2.16	2.69	3.25
53	1997	2.02	2.49	2.99
53	1998	2.04	2.58	3.19
53	1999	2.74	3.47	4.29
53	2000	5.64	7.10	8.83

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
5	1991	5.33	5.11	5.53
5	1992	5.42	5.27	5.56
5	1993	5.12	4.98	5.26
5	1994	4.64	4.53	4.75
5	1995	4.22	4.11	4.33
5	1996	4.05	3.94	4.17
5	1997	4.30	4.19	4.41
5	1998	4.85	4.71	5.00
5	1999	5.04	4.88	5.19
5	2000	4.95	4.71	5.18

HA: 5 Northern HA

HSDA: 51 Northwest
52 Northern Interior
53 Northeast

Table G.23. Fitted Per Capita DALY. Road Traffic Accidents, Males 20-39 Years.

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
11	1991	13.32	14.74	15.95
11	1992	11.69	12.76	13.73
11	1993	10.89	11.89	12.80
11	1994	10.56	11.54	12.43
11	1995	10.34	11.36	12.27
11	1996	10.04	11.06	11.98
11	1997	9.45	10.37	11.21
11	1998	8.54	9.36	10.09
11	1999	7.49	8.23	8.90
11	2000	6.41	7.23	7.90
12	1991	15.90	17.68	19.26
12	1992	14.04	15.41	16.63
12	1993	13.33	14.56	15.68
12	1994	13.09	14.31	15.42
12	1995	12.93	14.24	15.42
12	1996	12.58	13.95	15.18
12	1997	11.75	13.04	14.16
12	1998	10.54	11.72	12.69
12	1999	9.51	10.55	11.41
12	2000	9.00	10.11	11.02
13	1991	14.33	15.46	16.47
13	1992	13.15	13.95	14.70
13	1993	12.49	13.25	13.92
13	1994	12.09	12.82	13.47
13	1995	11.67	12.42	13.08
13	1996	11.04	11.79	12.45
13	1997	10.02	10.69	11.31
13	1998	8.79	9.39	9.97
13	1999	7.85	8.39	8.89
13	2000	7.35	7.99	8.60
14	1991	23.52	25.21	26.85
14	1992	21.42	22.63	23.80
14	1993	20.20	21.31	22.38
14	1994	19.40	20.44	21.41
14	1995	18.60	19.66	20.67
14	1996	17.52	18.61	19.62
14	1997	15.97	16.95	17.87
14	1998	14.12	15.02	15.90
14	1999	12.57	13.41	14.22
14	2000	11.46	12.50	13.48
21	1991	12.76	13.84	14.86
21	1992	11.25	12.04	12.79
21	1993	10.80	11.52	12.19
21	1994	10.88	11.59	12.26
21	1995	11.02	11.83	12.53
21	1996	10.89	11.77	12.54
21	1997	10.14	10.93	11.63
21	1998	8.68	9.45	10.06
21	1999	7.21	7.85	8.40
21	2000	5.87	6.53	7.11
22	1991	7.67	8.22	8.73
22	1992	6.88	7.25	7.61
22	1993	6.43	6.76	7.08
22	1994	6.10	6.41	6.70
22	1995	5.78	6.11	6.42
22	1996	5.42	5.76	6.07
22	1997	4.96	5.27	5.55
22	1998	4.44	4.72	4.99
22	1999	4.07	4.34	4.59
22	2000	3.98	4.31	4.61
23	1991	10.71	11.45	12.11
23	1992	9.68	10.19	10.65
23	1993	9.05	9.49	9.92
23	1994	8.51	8.91	9.31
23	1995	8.01	8.43	8.84
23	1996	7.53	7.98	8.41
23	1997	7.04	7.43	7.82
23	1998	6.47	6.84	7.19
23	1999	5.97	6.34	6.68
23	2000	5.51	5.97	6.39

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
1	1991	17.97	18.94	19.86
1	1992	16.24	16.85	17.45
1	1993	15.31	15.91	16.47
1	1994	14.84	15.37	15.89
1	1995	14.38	14.93	15.47
1	1996	13.68	14.26	14.81
1	1997	12.55	13.04	13.52
1	1998	11.07	11.56	12.03
1	1999	9.85	10.31	10.75
1	2000	9.06	9.65	10.21

HA: 1 Interior HA

HSDA: 11 East Kootenay
12 Kootenay/Boundary
13 Okanagan
14 Thompson Cariboo Shuswap

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
2	1991	9.99	10.47	10.93
2	1992	8.94	9.26	9.56
2	1993	8.40	8.69	8.97
2	1994	8.06	8.32	8.57
2	1995	7.78	8.05	8.31
2	1996	7.41	7.70	7.98
2	1997	6.86	7.12	7.37
2	1998	6.14	6.40	6.65
2	1999	5.51	5.76	5.98
2	2000	5.06	5.37	5.66

HA: 2 Fraser HA

HSDA: 21 Fraser Valley
22 Simon Fraser
23 South Fraser

Table G.23. (continued) Fitted Per Capita DALY. Road Traffic Accidents, Males 20-39 Years.

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
31	1991	6.53	7.33	8.05
31	1992	5.65	6.26	6.77
31	1993	5.25	5.80	6.28
31	1994	5.06	5.59	6.06
31	1995	4.92	5.48	5.97
31	1996	4.75	5.32	5.82
31	1997	4.40	4.92	5.37
31	1998	3.92	4.37	4.77
31	1999	3.46	3.86	4.21
31	2000	3.10	3.54	3.91
32	1991	5.11	5.54	5.92
32	1992	4.82	5.13	5.39
32	1993	4.56	4.82	5.04
32	1994	4.20	4.43	4.65
32	1995	3.79	4.03	4.27
32	1996	3.40	3.65	3.88
32	1997	3.05	3.27	3.48
32	1998	2.77	2.97	3.17
32	1999	2.66	2.85	3.03
32	2000	2.80	3.04	3.25
33	1991	9.50	10.31	11.03
33	1992	8.58	9.16	9.70
33	1993	7.84	8.36	8.82
33	1994	7.19	7.69	8.13
33	1995	6.63	7.15	7.63
33	1996	6.17	6.71	7.21
33	1997	5.76	6.26	6.71
33	1998	5.41	5.87	6.28
33	1999	5.34	5.77	6.16
33	2000	5.70	6.24	6.69

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
3	1991	6.46	6.87	7.24
3	1992	5.94	6.21	6.45
3	1993	5.54	5.77	5.98
3	1994	5.12	5.34	5.54
3	1995	4.71	4.93	5.15
3	1996	4.32	4.56	4.78
3	1997	3.95	4.15	4.35
3	1998	3.61	3.80	3.98
3	1999	3.43	3.61	3.79
3	2000	3.53	3.78	3.99

HA: 3 Vancouver Coastal HA

HSDA: 31 Richmond
32 Vancouver
33 North Shore / Coast Garibaldi

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
41	1991	7.87	8.53	9.10
41	1992	7.18	7.64	8.04
41	1993	6.80	7.19	7.55
41	1994	6.46	6.81	7.15
41	1995	6.05	6.43	6.80
41	1996	5.61	6.01	6.40
41	1997	5.11	5.48	5.82
41	1998	4.63	4.97	5.28
41	1999	4.38	4.72	5.02
41	2000	4.58	5.01	5.36
42	1991	13.33	14.48	15.57
42	1992	12.40	13.26	14.09
42	1993	12.17	12.99	13.69
42	1994	12.20	13.04	13.75
42	1995	12.04	13.03	13.88
42	1996	11.36	12.45	13.35
42	1997	10.04	10.88	11.64
42	1998	8.33	8.96	9.56
42	1999	7.05	7.62	8.16
42	2000	6.63	7.32	7.94
43	1991	12.63	14.10	15.38
43	1992	12.11	13.27	14.32
43	1993	12.11	13.20	14.18
43	1994	12.08	13.16	14.10
43	1995	11.74	12.88	13.83
43	1996	10.99	12.15	13.14
43	1997	9.78	10.85	11.76
43	1998	8.43	9.34	10.14
43	1999	7.34	8.14	8.83
43	2000	6.79	7.64	8.36

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
4	1991	10.34	10.89	11.41
4	1992	9.49	9.89	10.26
4	1993	9.18	9.55	9.90
4	1994	9.02	9.38	9.71
4	1995	8.75	9.14	9.50
4	1996	8.23	8.65	9.02
4	1997	7.37	7.72	8.05
4	1998	6.34	6.66	6.97
4	1999	5.66	5.97	6.24
4	2000	5.61	5.99	6.32

HA: 4 Vancouver Island HA

HSDA: 41 South Vancouver Island
42 Central Vancouver Island
43 North Vancouver Island

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
51	1991	16.51	18.11	19.56
51	1992	14.92	16.14	17.24
51	1993	14.55	15.68	16.67
51	1994	14.67	15.77	16.77
51	1995	14.64	15.82	16.88
51	1996	14.01	15.25	16.36
51	1997	12.54	13.63	14.63
51	1998	10.55	11.51	12.38
51	1999	8.98	9.81	10.55
51	2000	8.20	9.12	9.95
52	1991	17.50	18.98	20.33
52	1992	15.83	16.92	17.94
52	1993	15.35	16.34	17.28
52	1994	15.29	16.27	17.17
52	1995	15.20	16.27	17.23
52	1996	14.71	15.84	16.82
52	1997	13.48	14.48	15.38
52	1998	11.57	12.48	13.26
52	1999	9.72	10.53	11.23
52	2000	8.17	9.09	9.90
53	1991	19.77	21.93	23.88
53	1992	17.42	19.00	20.44
53	1993	16.30	17.77	19.06
53	1994	15.90	17.38	18.70
53	1995	15.61	17.27	18.68
53	1996	14.98	16.72	18.15
53	1997	13.58	15.06	16.35
53	1998	11.74	12.96	14.07
53	1999	10.59	11.67	12.66
53	2000	10.88	12.16	13.25

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
5	1991	18.20	19.36	20.46
5	1992	16.34	17.14	17.92
5	1993	15.72	16.45	17.14
5	1994	15.66	16.36	17.03
5	1995	15.57	16.35	17.07
5	1996	15.02	15.86	16.62
5	1997	13.64	14.36	15.02
5	1998	11.67	12.31	12.89
5	1999	10.00	10.57	11.11
5	2000	9.07	9.78	10.43

HA: 5 Northern HA

HSDA: 51 Northwest
52 Northern Interior
53 Northeast

Table G.24. Fitted Per Capita DALY. Road Traffic Accident, Females 20-39 Years.

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
11	1991	5.16	5.81	6.30
11	1992	4.57	5.23	5.78
11	1993	4.28	4.97	5.56
11	1994	4.12	4.78	5.33
11	1995	4.00	4.60	5.08
11	1996	3.82	4.40	4.84
11	1997	3.48	4.11	4.55
11	1998	3.20	3.92	4.33
11	1999	3.34	4.05	4.52
11	2000	4.52	5.49	5.88
12	1991	4.03	4.71	5.22
12	1992	4.63	5.35	5.91
12	1993	4.79	5.57	6.16
12	1994	4.70	5.43	6.02
12	1995	4.47	5.15	5.69
12	1996	4.28	4.92	5.43
12	1997	4.25	4.89	5.36
12	1998	4.19	4.87	5.32
12	1999	3.66	4.32	4.79
12	2000	2.59	3.35	3.74
13	1991	4.11	4.53	4.89
13	1992	4.38	4.80	5.16
13	1993	4.39	4.85	5.23
13	1994	4.24	4.67	5.02
13	1995	3.94	4.32	4.63
13	1996	3.50	3.85	4.13
13	1997	2.99	3.30	3.57
13	1998	2.56	2.86	3.13
13	1999	2.38	2.68	2.94
13	2000	2.70	3.06	3.40
14	1991	6.54	7.61	8.53
14	1992	7.62	8.52	9.35
14	1993	7.91	8.83	9.60
14	1994	7.79	8.61	9.30
14	1995	7.42	8.15	8.76
14	1996	6.99	7.70	8.27
14	1997	6.70	7.42	8.00
14	1998	6.42	7.29	7.91
14	1999	6.12	6.98	7.65
14	2000	5.22	6.56	7.43

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
1	1991	5.14	5.66	6.10
1	1992	5.55	5.97	6.36
1	1993	5.64	6.06	6.44
1	1994	5.49	5.87	6.20
1	1995	5.19	5.55	5.86
1	1996	4.86	5.22	5.50
1	1997	4.57	4.93	5.22
1	1998	4.31	4.74	5.05
1	1999	4.08	4.51	4.84
1	2000	3.99	4.62	5.03

HA: 1 Interior HA

HSDA: 11 East Kootenay
12 Kootenay/Boundary
13 Okanagan
14 Thompson Cariboo Shuswap

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
21	1991	4.00	4.43	4.79
21	1992	4.81	5.28	5.67
21	1993	4.98	5.54	5.95
21	1994	4.74	5.25	5.62
21	1995	4.24	4.66	5.01
21	1996	3.69	4.04	4.35
21	1997	3.21	3.54	3.82
21	1998	2.83	3.17	3.45
21	1999	2.51	2.84	3.12
21	2000	2.16	2.54	2.87
22	1991	2.34	2.62	2.88
22	1992	2.54	2.80	3.04
22	1993	2.47	2.72	2.95
22	1994	2.23	2.45	2.66
22	1995	1.93	2.13	2.31
22	1996	1.68	1.85	2.02
22	1997	1.51	1.68	1.84
22	1998	1.41	1.59	1.75
22	1999	1.35	1.52	1.68
22	2000	1.25	1.48	1.68
23	1991	3.06	3.36	3.62
23	1992	3.44	3.71	3.96
23	1993	3.34	3.63	3.88
23	1994	3.00	3.25	3.47
23	1995	2.60	2.81	3.01
23	1996	2.28	2.48	2.66
23	1997	2.13	2.32	2.49
23	1998	2.08	2.28	2.45
23	1999	1.95	2.15	2.33
23	2000	1.60	1.84	2.06

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
2	1991	3.22	3.47	3.70
2	1992	3.72	3.93	4.13
2	1993	3.73	3.96	4.17
2	1994	3.45	3.65	3.82
2	1995	3.03	3.20	3.36
2	1996	2.63	2.79	2.94
2	1997	2.37	2.51	2.65
2	1998	2.19	2.35	2.49
2	1999	2.01	2.17	2.32
2	2000	1.74	1.95	2.16

HA: 2 Fraser HA

HSDA: 21 Fraser Valley
22 Simon Fraser
23 South Fraser

Table G.24. (continued) Fitted Per Capita DALY. Road Traffic Accident, Females 20-39 Years.

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
31	1991	1.96	2.36	2.74
31	1992	1.93	2.33	2.71
31	1993	1.77	2.17	2.54
31	1994	1.57	1.93	2.24
31	1995	1.37	1.68	1.94
31	1996	1.22	1.48	1.71
31	1997	1.11	1.36	1.57
31	1998	1.06	1.31	1.52
31	1999	1.05	1.30	1.51
31	2000	1.07	1.37	1.60
32	1991	2.31	2.60	2.86
32	1992	2.62	2.87	3.09
32	1993	2.54	2.79	3.01
32	1994	2.25	2.46	2.65
32	1995	1.91	2.09	2.25
32	1996	1.62	1.78	1.92
32	1997	1.44	1.59	1.73
32	1998	1.35	1.51	1.65
32	1999	1.30	1.46	1.60
32	2000	1.21	1.42	1.60
33	1991	2.81	3.18	3.51
33	1992	2.71	3.09	3.45
33	1993	2.61	3.00	3.36
33	1994	2.50	2.85	3.17
33	1995	2.38	2.67	2.94
33	1996	2.22	2.48	2.71
33	1997	2.02	2.27	2.49
33	1998	1.87	2.13	2.35
33	1999	1.89	2.17	2.41
33	2000	2.15	2.65	2.90

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
3	1991	2.42	2.71	2.97
3	1992	2.51	2.77	3.00
3	1993	2.40	2.65	2.89
3	1994	2.20	2.41	2.61
3	1995	1.96	2.15	2.31
3	1996	1.75	1.92	2.06
3	1997	1.59	1.74	1.87
3	1998	1.49	1.65	1.79
3	1999	1.49	1.64	1.78
3	2000	1.58	1.81	1.99

HA: 3 Vancouver Coastal HA

HSDA: 31 Richmond
32 Vancouver
33 North Shore / Coast Garibaldi

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
41	1991	2.90	3.22	3.50
41	1992	3.12	3.42	3.69
41	1993	3.00	3.30	3.57
41	1994	2.71	2.97	3.22
41	1995	2.37	2.61	2.83
41	1996	2.10	2.32	2.52
41	1997	1.94	2.16	2.35
41	1998	1.88	2.11	2.31
41	1999	1.81	2.03	2.23
41	2000	1.58	1.86	2.10
42	1991	4.12	4.64	5.07
42	1992	5.01	5.58	6.06
42	1993	5.10	5.76	6.26
42	1994	4.67	5.26	5.71
42	1995	4.02	4.48	4.87
42	1996	3.37	3.76	4.11
42	1997	2.89	3.26	3.59
42	1998	2.61	2.98	3.31
42	1999	2.49	2.85	3.17
42	2000	2.50	2.95	3.31
43	1991	4.47	5.12	5.61
43	1992	5.02	5.68	6.23
43	1993	5.27	5.96	6.55
43	1994	5.19	5.86	6.43
43	1995	4.78	5.40	5.90
43	1996	4.12	4.70	5.15
43	1997	3.36	3.94	4.38
43	1998	2.76	3.41	3.79
43	1999	2.45	3.08	3.49
43	2000	2.41	3.09	3.47

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
4	1991	3.96	4.32	4.63
4	1992	4.58	4.89	5.17
4	1993	4.68	5.01	5.30
4	1994	4.40	4.70	4.96
4	1995	3.89	4.16	4.41
4	1996	3.33	3.59	3.82
4	1997	2.87	3.12	3.33
4	1998	2.57	2.83	3.04
4	1999	2.39	2.65	2.87
4	2000	2.31	2.63	2.87

HA: 4 Vancouver Island HA

HSDA: 41 South Vancouver Island
42 Central Vancouver Island
43 North Vancouver Island

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
51	1991	4.61	5.17	5.60
51	1992	5.08	5.66	6.13
51	1993	5.01	5.65	6.16
51	1994	4.70	5.29	5.76
51	1995	4.34	4.87	5.29
51	1996	4.13	4.62	5.01
51	1997	4.22	4.70	5.09
51	1998	4.42	4.92	5.30
51	1999	4.10	4.57	4.95
51	2000	2.84	3.33	3.73
52	1991	4.98	5.76	6.38
52	1992	6.03	6.84	7.50
52	1993	6.07	6.98	7.64
52	1994	5.59	6.38	6.98
52	1995	4.95	5.57	6.09
52	1996	4.44	4.96	5.40
52	1997	4.30	4.80	5.21
52	1998	4.45	4.96	5.37
52	1999	4.31	4.80	5.21
52	2000	3.32	3.88	4.34
53	1991	5.14	5.83	6.36
53	1992	4.95	5.68	6.25
53	1993	4.60	5.38	6.00
53	1994	4.18	4.93	5.51
53	1995	3.76	4.46	4.98
53	1996	3.41	4.10	4.61
53	1997	3.17	3.92	4.42
53	1998	3.09	3.93	4.39
53	1999	3.35	4.09	4.58
53	2000	4.58	5.29	5.76

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
5	1991	5.07	5.58	6.00
5	1992	5.59	6.06	6.46
5	1993	5.49	6.00	6.42
5	1994	5.08	5.53	5.91
5	1995	4.58	4.97	5.31
5	1996	4.19	4.56	4.88
5	1997	4.11	4.47	4.77
5	1998	4.19	4.61	4.90
5	1999	4.11	4.49	4.78
5	2000	3.77	4.17	4.50

HA: 5 Northern HA

HSDA: 51 Northwest
52 Northern Interior
53 Northeast

Table G.25. Fitted Mortality and Hospitalization Rates, and Per Capita DALY at the BC Level. Road Traffic Accidents, Males and Females 20-39 Years.

Males

Mortality rate per 10000 population

Year	Quantile 0.025	Fitted rate	Quantile 0.975
1991	2.82	3.76	4.95
1992	2.30	3.05	3.95
1993	2.09	2.79	3.64
1994	2.04	2.74	3.60
1995	2.03	2.76	3.67
1996	1.98	2.72	3.64
1997	1.84	2.50	3.33
1998	1.58	2.16	2.87
1999	1.38	1.86	2.46
2000	1.21	1.70	2.32

Hospitalization rate per 1000 population

Year	Quantile 0.025	Fitted rate	Quantile 0.975
1991	5.98	7.58	9.51
1992	6.71	8.52	10.63
1993	6.77	8.61	10.75
1994	6.33	8.08	10.11
1995	5.69	7.26	9.15
1996	5.03	6.44	8.13
1997	4.56	5.80	7.29
1998	4.28	5.42	6.78
1999	4.19	5.30	6.57
2000	4.26	5.48	6.92

Per capita DALY per 1000 population

Year	Quantile 0.025	Fitted rate	Quantile 0.975
1991	11.17	11.59	11.98
1992	10.10	10.33	10.56
1993	9.55	9.78	10.00
1994	9.22	9.42	9.61
1995	8.89	9.10	9.30
1996	8.41	8.64	8.87
1997	7.66	7.85	8.04
1998	6.74	6.94	7.14
1999	6.02	6.22	6.40
2000	5.70	5.97	6.23

Females

Mortality rate per 10000 population

Year	Quantile 0.025	Fitted rate	Quantile 0.975
1991	0.92	1.02	1.11
1992	1.03	1.11	1.18
1993	1.03	1.11	1.18
1994	0.96	1.02	1.08
1995	0.85	0.92	0.98
1996	0.76	0.82	0.88
1997	0.70	0.76	0.82
1998	0.66	0.73	0.79
1999	0.62	0.69	0.76
2000	0.57	0.67	0.74

Hospitalization rate per 1000 population

Year	Quantile 0.025	Fitted rate	Quantile 0.975
1991	3.90	3.97	4.04
1992	4.21	4.26	4.31
1993	4.26	4.31	4.36
1994	4.08	4.13	4.17
1995	3.79	3.83	3.88
1996	3.48	3.52	3.57
1997	3.25	3.29	3.33
1998	3.13	3.17	3.22
1999	3.01	3.06	3.11
2000	3.05	3.12	3.19

Per capita DALY per 1000 population

Year	Quantile 0.025	Fitted rate	Quantile 0.975
1991	4.15	4.43	4.69
1992	4.60	4.80	5.00
1993	4.61	4.82	5.02
1994	4.34	4.52	4.69
1995	3.93	4.10	4.26
1996	3.54	3.72	3.87
1997	3.30	3.45	3.60
1998	3.13	3.33	3.49
1999	3.00	3.18	3.34
2000	2.89	3.13	3.34

Table G.26. Fitted Medical Adverse Event Rate. Males 0-19 Years.

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
11	1991	1.51	1.24	1.84
11	1992	1.95	1.67	2.27
11	1993	2.10	1.76	2.49
11	1994	2.00	1.69	2.34
11	1995	1.81	1.54	2.09
11	1996	1.67	1.42	1.93
11	1997	1.67	1.39	1.97
11	1998	1.82	1.45	2.21
11	1999	2.04	1.65	2.45
11	2000	2.23	1.80	2.81
12	1991	1.56	1.28	1.92
12	1992	2.12	1.82	2.47
12	1993	2.32	1.94	2.78
12	1994	2.20	1.86	2.61
12	1995	1.96	1.67	2.28
12	1996	1.78	1.51	2.05
12	1997	1.77	1.48	2.08
12	1998	1.93	1.56	2.34
12	1999	2.10	1.72	2.52
12	2000	2.12	1.70	2.62
13	1991	1.42	1.22	1.67
13	1992	1.52	1.35	1.71
13	1993	1.55	1.34	1.77
13	1994	1.53	1.35	1.73
13	1995	1.53	1.36	1.69
13	1996	1.58	1.41	1.75
13	1997	1.74	1.55	1.95
13	1998	1.99	1.74	2.26
13	1999	2.14	1.88	2.41
13	2000	1.96	1.66	2.28
14	1991	1.64	1.38	1.95
14	1992	2.16	1.94	2.40
14	1993	2.37	2.11	2.64
14	1994	2.30	2.06	2.55
14	1995	2.11	1.92	2.32
14	1996	1.96	1.77	2.17
14	1997	1.97	1.76	2.19
14	1998	2.10	1.84	2.40
14	1999	2.18	1.90	2.48
14	2000	2.00	1.62	2.39

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
1	1991	1.47	1.53	1.58
1	1992	1.85	1.89	1.94
1	1993	1.96	2.01	2.06
1	1994	1.91	1.95	2.00
1	1995	1.78	1.82	1.86
1	1996	1.71	1.75	1.79
1	1997	1.78	1.82	1.86
1	1998	1.94	2.00	2.06
1	1999	2.07	2.13	2.19
1	2000	1.95	2.03	2.10

HA: 1 Interior HA

HSDA: 11 East Kootenay
12 Kootenay/Boundary
13 Okanagan
14 Thompson Cariboo Shuswap

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
21	1991	1.62	1.37	1.90
21	1992	2.07	1.85	2.29
21	1993	2.26	2.02	2.52
21	1994	2.24	2.02	2.48
21	1995	2.14	1.95	2.35
21	1996	2.07	1.88	2.30
21	1997	2.16	1.95	2.39
21	1998	2.37	2.10	2.65
21	1999	2.47	2.19	2.76
21	2000	2.21	1.88	2.56
22	1991	1.41	1.24	1.61
22	1992	1.77	1.61	1.93
22	1993	1.90	1.73	2.10
22	1994	1.88	1.72	2.05
22	1995	1.80	1.66	1.95
22	1996	1.80	1.65	1.95
22	1997	1.97	1.81	2.14
22	1998	2.28	2.06	2.51
22	1999	2.37	2.14	2.61
22	2000	1.90	1.66	2.16
23	1991	1.38	1.20	1.56
23	1992	1.86	1.72	2.01
23	1993	2.09	1.92	2.27
23	1994	2.09	1.93	2.25
23	1995	1.99	1.86	2.14
23	1996	1.94	1.80	2.10
23	1997	2.07	1.92	2.22
23	1998	2.32	2.13	2.53
23	1999	2.43	2.22	2.65
23	2000	2.07	1.83	2.35

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
2	1991	1.40	1.44	1.49
2	1992	1.84	1.87	1.91
2	1993	2.02	2.06	2.10
2	1994	2.01	2.05	2.08
2	1995	1.93	1.96	1.99
2	1996	1.89	1.92	1.96
2	1997	2.02	2.05	2.09
2	1998	2.27	2.32	2.36
2	1999	2.37	2.41	2.46
2	2000	1.98	2.04	2.10

HA: 2 Fraser HA

HSDA: 21 Fraser Valley
22 Simon Fraser
23 South Fraser

Table G.26. (continued) Fitted Medical Adverse Event Rate. Males 0-19 Years.

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
31	1991	1.42	1.18	1.72
31	1992	1.83	1.58	2.12
31	1993	1.96	1.66	2.31
31	1994	1.87	1.60	2.17
31	1995	1.72	1.47	1.96
31	1996	1.62	1.37	1.85
31	1997	1.70	1.44	1.96
31	1998	1.91	1.58	2.28
31	1999	2.06	1.72	2.43
31	2000	1.87	1.51	2.25
32	1991	1.22	1.04	1.42
32	1992	1.40	1.26	1.55
32	1993	1.46	1.30	1.62
32	1994	1.45	1.31	1.60
32	1995	1.44	1.31	1.57
32	1996	1.50	1.36	1.64
32	1997	1.72	1.56	1.88
32	1998	2.04	1.83	2.27
32	1999	2.14	1.93	2.38
32	2000	1.69	1.46	1.95
33	1991	1.33	1.10	1.55
33	1992	1.45	1.28	1.64
33	1993	1.51	1.30	1.74
33	1994	1.54	1.35	1.76
33	1995	1.60	1.43	1.79
33	1996	1.74	1.56	1.95
33	1997	2.05	1.83	2.29
33	1998	2.46	2.14	2.80
33	1999	2.58	2.25	2.93
33	2000	2.04	1.71	2.45

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
3	1991	1.24	1.29	1.34
3	1992	1.45	1.48	1.52
3	1993	1.51	1.56	1.60
3	1994	1.50	1.54	1.58
3	1995	1.50	1.53	1.56
3	1996	1.55	1.59	1.62
3	1997	1.77	1.81	1.85
3	1998	2.08	2.14	2.20
3	1999	2.20	2.26	2.31
3	2000	1.75	1.82	1.88

HA: 3 Vancouver Coastal HA

HSDA: 31 Richmond
32 Vancouver
33 North Shore / Coast Garibaldi

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
41	1991	1.22	1.04	1.42
41	1992	1.67	1.50	1.84
41	1993	1.90	1.71	2.10
41	1994	1.92	1.74	2.11
41	1995	1.83	1.67	2.02
41	1996	1.77	1.61	1.97
41	1997	1.83	1.65	2.02
41	1998	1.97	1.76	2.20
41	1999	1.99	1.77	2.22
41	2000	1.67	1.42	1.93
42	1991	1.32	1.12	1.53
42	1992	1.61	1.44	1.81
42	1993	1.71	1.50	1.93
42	1994	1.67	1.49	1.87
42	1995	1.61	1.44	1.79
42	1996	1.63	1.44	1.81
42	1997	1.85	1.64	2.06
42	1998	2.21	1.93	2.52
42	1999	2.34	2.05	2.67
42	2000	1.85	1.55	2.19
43	1991	1.44	1.19	1.77
43	1992	1.85	1.58	2.16
43	1993	1.99	1.66	2.36
43	1994	1.93	1.62	2.26
43	1995	1.79	1.53	2.07
43	1996	1.72	1.46	1.98
43	1997	1.81	1.51	2.13
43	1998	2.03	1.65	2.48
43	1999	2.15	1.76	2.59
43	2000	1.88	1.45	2.33

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
4	1991	1.24	1.28	1.33
4	1992	1.63	1.67	1.71
4	1993	1.80	1.85	1.89
4	1994	1.79	1.84	1.88
4	1995	1.71	1.75	1.79
4	1996	1.67	1.71	1.75
4	1997	1.79	1.83	1.87
4	1998	2.00	2.06	2.11
4	1999	2.06	2.12	2.18
4	2000	1.69	1.75	1.82

HA: 4 Vancouver Island HA

HSDA: 41 South Vancouver Island
42 Central Vancouver Island
43 North Vancouver Island

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
51	1991	1.32	1.08	1.56
51	1992	1.47	1.27	1.69
51	1993	1.53	1.28	1.80
51	1994	1.55	1.32	1.80
51	1995	1.60	1.39	1.82
51	1996	1.75	1.53	1.98
51	1997	2.10	1.83	2.40
51	1998	2.58	2.19	3.04
51	1999	2.65	2.25	3.09
51	2000	1.86	1.52	2.25
52	1991	1.24	1.02	1.48
52	1992	1.47	1.30	1.67
52	1993	1.55	1.34	1.78
52	1994	1.52	1.33	1.72
52	1995	1.45	1.28	1.62
52	1996	1.42	1.25	1.60
52	1997	1.51	1.31	1.71
52	1998	1.69	1.43	1.95
52	1999	1.83	1.57	2.10
52	2000	1.77	1.46	2.11
53	1991	1.53	1.23	1.95
53	1992	1.74	1.46	2.07
53	1993	1.75	1.44	2.10
53	1994	1.63	1.35	1.93
53	1995	1.48	1.22	1.74
53	1996	1.38	1.12	1.63
53	1997	1.38	1.12	1.67
53	1998	1.51	1.15	1.88
53	1999	1.71	1.33	2.13
53	2000	1.97	1.53	2.45

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
5	1991	1.26	1.32	1.38
5	1992	1.48	1.52	1.57
5	1993	1.53	1.59	1.64
5	1994	1.50	1.55	1.60
5	1995	1.46	1.50	1.55
5	1996	1.47	1.51	1.56
5	1997	1.62	1.67	1.72
5	1998	1.87	1.93	2.00
5	1999	1.99	2.06	2.13
5	2000	1.76	1.84	1.91

HA: 5 Northern HA

HSDA: 51 Northwest
52 Northern Interior
53 Northeast

Table G.27. Fitted Medical Adverse Event Rate. Females 0-19 Years.

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
11	1991	0.93	1.16	1.42
11	1992	1.36	1.62	1.92
11	1993	1.60	1.92	2.31
11	1994	1.69	2.02	2.39
11	1995	1.64	1.96	2.33
11	1996	1.53	1.86	2.24
11	1997	1.48	1.80	2.14
11	1998	1.46	1.78	2.09
11	1999	1.42	1.74	2.08
11	2000	1.29	1.62	2.01
12	1991	1.04	1.29	1.58
12	1992	1.27	1.54	1.84
12	1993	1.38	1.70	2.05
12	1994	1.46	1.77	2.12
12	1995	1.50	1.80	2.16
12	1996	1.51	1.84	2.23
12	1997	1.61	1.94	2.32
12	1998	1.72	2.05	2.46
12	1999	1.70	2.04	2.45
12	2000	1.40	1.77	2.20
13	1991	0.93	1.10	1.28
13	1992	1.19	1.35	1.53
13	1993	1.29	1.47	1.68
13	1994	1.31	1.48	1.67
13	1995	1.28	1.45	1.63
13	1996	1.25	1.44	1.64
13	1997	1.33	1.52	1.71
13	1998	1.47	1.66	1.88
13	1999	1.51	1.72	1.95
13	2000	1.29	1.54	1.80
14	1991	0.96	1.12	1.31
14	1992	1.28	1.46	1.65
14	1993	1.39	1.60	1.83
14	1994	1.39	1.58	1.78
14	1995	1.32	1.49	1.67
14	1996	1.25	1.42	1.62
14	1997	1.28	1.46	1.66
14	1998	1.39	1.59	1.80
14	1999	1.45	1.66	1.89
14	2000	1.28	1.53	1.80

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
1	1991	1.10	1.14	1.18
1	1992	1.41	1.45	1.49
1	1993	1.56	1.61	1.65
1	1994	1.58	1.62	1.67
1	1995	1.53	1.57	1.61
1	1996	1.49	1.54	1.58
1	1997	1.54	1.58	1.62
1	1998	1.65	1.69	1.74
1	1999	1.69	1.74	1.79
1	2000	1.51	1.57	1.63

HA: 1 Interior HA

HSDA: 11 East Kootenay
12 Kootenay/Boundary
13 Okanagan
14 Thompson Cariboo Shuswap

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
21	1991	1.44	1.69	1.99
21	1992	1.73	1.96	2.20
21	1993	1.74	1.98	2.23
21	1994	1.65	1.86	2.08
21	1995	1.53	1.73	1.94
21	1996	1.48	1.69	1.91
21	1997	1.62	1.83	2.05
21	1998	1.91	2.13	2.37
21	1999	2.11	2.36	2.63
21	2000	1.85	2.19	2.52
22	1991	0.96	1.11	1.26
22	1992	1.13	1.27	1.42
22	1993	1.14	1.29	1.46
22	1994	1.09	1.23	1.37
22	1995	1.03	1.16	1.29
22	1996	1.01	1.14	1.29
22	1997	1.11	1.24	1.39
22	1998	1.30	1.45	1.61
22	1999	1.43	1.61	1.79
22	2000	1.30	1.51	1.74
23	1991	0.89	1.03	1.17
23	1992	1.17	1.29	1.42
23	1993	1.30	1.44	1.58
23	1994	1.35	1.49	1.62
23	1995	1.35	1.48	1.62
23	1996	1.34	1.48	1.63
23	1997	1.40	1.54	1.69
23	1998	1.49	1.64	1.80
23	1999	1.50	1.65	1.84
23	2000	1.30	1.48	1.69

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
2	1991	1.15	1.19	1.23
2	1992	1.39	1.42	1.45
2	1993	1.47	1.50	1.54
2	1994	1.45	1.48	1.51
2	1995	1.39	1.42	1.45
2	1996	1.38	1.41	1.44
2	1997	1.47	1.50	1.53
2	1998	1.64	1.68	1.71
2	1999	1.75	1.80	1.84
2	2000	1.60	1.65	1.70

HA: 2 Fraser HA

HSDA: 21 Fraser Valley
22 Simon Fraser
23 South Fraser

Table G.27. (continued) Fitted Medical Adverse Event Rate. Females 0-19 Years.

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
31	1991	0.93	1.16	1.40
31	1992	1.27	1.53	1.82
31	1993	1.56	1.87	2.21
31	1994	1.80	2.10	2.45
31	1995	1.88	2.22	2.60
31	1996	1.85	2.23	2.66
31	1997	1.80	2.14	2.52
31	1998	1.68	1.99	2.31
31	1999	1.50	1.81	2.13
31	2000	1.30	1.62	1.99
32	1991	0.72	0.85	1.00
32	1992	0.74	0.86	0.99
32	1993	0.75	0.89	1.04
32	1994	0.81	0.94	1.08
32	1995	0.89	1.01	1.13
32	1996	0.96	1.09	1.24
32	1997	1.06	1.20	1.35
32	1998	1.14	1.29	1.44
32	1999	1.15	1.31	1.47
32	2000	1.01	1.19	1.38
33	1991	0.83	1.00	1.18
33	1992	1.04	1.20	1.39
33	1993	1.12	1.30	1.52
33	1994	1.15	1.32	1.51
33	1995	1.13	1.31	1.49
33	1996	1.12	1.30	1.51
33	1997	1.17	1.36	1.56
33	1998	1.27	1.47	1.68
33	1999	1.31	1.52	1.74
33	2000	1.18	1.41	1.68

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
3	1991	0.91	0.94	0.98
3	1992	1.04	1.07	1.11
3	1993	1.13	1.17	1.21
3	1994	1.20	1.24	1.27
3	1995	1.25	1.29	1.32
3	1996	1.29	1.33	1.37
3	1997	1.35	1.39	1.43
3	1998	1.41	1.45	1.49
3	1999	1.40	1.44	1.49
3	2000	1.27	1.32	1.37

HA: 3 Vancouver Coastal HA

HSDA: 31 Richmond
32 Vancouver
33 North Shore / Coast Garibaldi

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
41	1991	1.02	1.18	1.35
41	1992	1.49	1.66	1.84
41	1993	1.69	1.89	2.11
41	1994	1.70	1.88	2.07
41	1995	1.58	1.74	1.91
41	1996	1.45	1.62	1.80
41	1997	1.46	1.62	1.80
41	1998	1.55	1.73	1.91
41	1999	1.61	1.80	1.99
41	2000	1.44	1.66	1.91
42	1991	0.76	0.92	1.09
42	1992	1.01	1.16	1.32
42	1993	1.12	1.30	1.49
42	1994	1.17	1.34	1.52
42	1995	1.15	1.32	1.50
42	1996	1.11	1.29	1.48
42	1997	1.12	1.29	1.48
42	1998	1.14	1.33	1.52
42	1999	1.13	1.33	1.53
42	2000	1.03	1.24	1.48
43	1991	0.75	0.96	1.18
43	1992	1.04	1.28	1.55
43	1993	1.17	1.45	1.79
43	1994	1.18	1.45	1.77
43	1995	1.12	1.37	1.66
43	1996	1.04	1.30	1.60
43	1997	1.05	1.30	1.58
43	1998	1.09	1.36	1.64
43	1999	1.12	1.40	1.69
43	2000	1.01	1.31	1.64

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
4	1991	1.02	1.06	1.10
4	1992	1.39	1.43	1.47
4	1993	1.58	1.63	1.68
4	1994	1.59	1.63	1.68
4	1995	1.51	1.55	1.59
4	1996	1.42	1.46	1.51
4	1997	1.43	1.47	1.51
4	1998	1.50	1.54	1.59
4	1999	1.54	1.59	1.64
4	2000	1.42	1.48	1.53

HA: 4 Vancouver Island HA

HSDA: 41 South Vancouver Island
42 Central Vancouver Island
43 North Vancouver Island

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
51	1991	0.96	1.15	1.37
51	1992	1.19	1.39	1.60
51	1993	1.27	1.50	1.75
51	1994	1.29	1.50	1.75
51	1995	1.25	1.47	1.72
51	1996	1.24	1.47	1.74
51	1997	1.33	1.56	1.82
51	1998	1.47	1.71	1.98
51	1999	1.51	1.76	2.06
51	2000	1.27	1.56	1.88
52	1991	0.94	1.12	1.33
52	1992	1.02	1.19	1.37
52	1993	0.97	1.16	1.35
52	1994	0.92	1.08	1.25
52	1995	0.87	1.03	1.19
52	1996	0.86	1.03	1.21
52	1997	0.97	1.15	1.34
52	1998	1.18	1.38	1.58
52	1999	1.36	1.59	1.83
52	2000	1.31	1.58	1.90
53	1991	0.92	1.14	1.39
53	1992	1.07	1.30	1.55
53	1993	1.08	1.34	1.62
53	1994	1.06	1.31	1.57
53	1995	1.04	1.27	1.53
53	1996	1.03	1.28	1.55
53	1997	1.14	1.39	1.67
53	1998	1.33	1.59	1.88
53	1999	1.43	1.72	2.04
53	2000	1.27	1.59	1.97

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
5	1991	1.09	1.13	1.18
5	1992	1.23	1.28	1.32
5	1993	1.26	1.31	1.36
5	1994	1.22	1.26	1.31
5	1995	1.17	1.22	1.26
5	1996	1.18	1.22	1.27
5	1997	1.28	1.33	1.37
5	1998	1.48	1.53	1.58
5	1999	1.61	1.67	1.72
5	2000	1.51	1.58	1.64

HA: 5 Northern HA

HSDA: 51 Northwest
52 Northern Interior
53 Northeast

Table G.28. Fitted Medical Adverse Event Rate. Males 20-39 Years.

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
11	1991	2.14	2.62	3.14
11	1992	2.97	3.38	3.85
11	1993	3.15	3.66	4.21
11	1994	3.04	3.50	3.99
11	1995	2.79	3.15	3.53
11	1996	2.51	2.84	3.18
11	1997	2.33	2.72	3.12
11	1998	2.32	2.81	3.35
11	1999	2.53	3.04	3.59
11	2000	2.59	3.37	4.34
12	1991	2.17	2.66	3.19
12	1992	2.98	3.40	3.85
12	1993	3.19	3.69	4.21
12	1994	3.12	3.58	4.06
12	1995	2.93	3.29	3.69
12	1996	2.69	3.04	3.41
12	1997	2.56	2.97	3.40
12	1998	2.60	3.10	3.64
12	1999	2.79	3.31	3.86
12	2000	2.70	3.47	4.36
13	1991	2.68	3.10	3.57
13	1992	3.39	3.71	4.03
13	1993	3.53	3.89	4.26
13	1994	3.41	3.73	4.06
13	1995	3.17	3.42	3.68
13	1996	2.90	3.13	3.39
13	1997	2.73	3.00	3.29
13	1998	2.70	3.05	3.42
13	1999	2.89	3.25	3.61
13	2000	3.02	3.59	4.22
14	1991	3.39	3.91	4.46
14	1992	4.58	4.97	5.39
14	1993	4.83	5.26	5.73
14	1994	4.55	4.92	5.32
14	1995	3.99	4.33	4.64
14	1996	3.49	3.81	4.09
14	1997	3.23	3.55	3.87
14	1998	3.10	3.50	3.90
14	1999	3.02	3.41	3.80
14	2000	2.50	3.08	3.73

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
1	1991	3.27	3.17	3.37
1	1992	4.08	4.01	4.16
1	1993	4.33	4.24	4.41
1	1994	4.10	4.03	4.17
1	1995	3.69	3.63	3.75
1	1996	3.32	3.27	3.38
1	1997	3.18	3.11	3.24
1	1998	3.20	3.11	3.28
1	1999	3.29	3.21	3.37
1	2000	3.36	3.23	3.48

HA: 1 Interior HA

HSDA: 11 East Kootenay
12 Kootenay/Boundary
13 Okanagan
14 Thompson Cariboo Shuswap

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
21	1991	3.02	3.49	4.00
21	1992	4.20	4.56	4.95
21	1993	4.52	4.94	5.39
21	1994	4.32	4.70	5.09
21	1995	3.87	4.17	4.48
21	1996	3.40	3.67	3.96
21	1997	3.09	3.40	3.72
21	1998	2.97	3.34	3.73
21	1999	2.97	3.33	3.71
21	2000	2.66	3.22	3.81
22	1991	3.57	3.96	4.38
22	1992	4.30	4.58	4.86
22	1993	4.44	4.75	5.06
22	1994	4.32	4.59	4.87
22	1995	4.08	4.31	4.55
22	1996	3.86	4.08	4.33
22	1997	3.81	4.06	4.32
22	1998	3.93	4.26	4.60
22	1999	4.26	4.61	4.98
22	2000	4.46	5.01	5.61
23	1991	4.14	4.57	5.05
23	1992	4.93	5.23	5.53
23	1993	5.07	5.40	5.74
23	1994	4.92	5.21	5.51
23	1995	4.65	4.89	5.15
23	1996	4.39	4.64	4.91
23	1997	4.34	4.61	4.89
23	1998	4.41	4.75	5.10
23	1999	4.39	4.74	5.10
23	2000	3.81	4.31	4.82

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
2	1991	4.10	4.01	4.19
2	1992	4.82	4.76	4.89
2	1993	5.03	4.96	5.10
2	1994	4.86	4.80	4.92
2	1995	4.51	4.46	4.57
2	1996	4.23	4.17	4.29
2	1997	4.14	4.08	4.20
2	1998	4.25	4.18	4.33
2	1999	4.39	4.31	4.46
2	2000	4.33	4.21	4.44

HA: 2 Fraser HA

HSDA: 21 Fraser Valley
22 Simon Fraser
23 South Fraser

Table G28. (continued) Fitted Medical Adverse Event Rate. Males 20-39 Years.

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
31	1991	2.98	3.58	4.25
31	1992	3.65	4.13	4.64
31	1993	3.77	4.32	4.88
31	1994	3.75	4.25	4.77
31	1995	3.70	4.12	4.57
31	1996	3.70	4.09	4.54
31	1997	3.83	4.31	4.81
31	1998	4.06	4.70	5.39
31	1999	4.15	4.77	5.44
31	2000	3.28	4.09	5.04
32	1991	3.30	3.64	4.01
32	1992	4.01	4.25	4.52
32	1993	4.11	4.39	4.67
32	1994	3.96	4.20	4.45
32	1995	3.69	3.91	4.12
32	1996	3.48	3.72	3.93
32	1997	3.55	3.78	4.01
32	1998	3.80	4.09	4.40
32	1999	4.16	4.48	4.82
32	2000	4.22	4.71	5.25
33	1991	2.78	3.22	3.70
33	1992	3.74	4.07	4.43
33	1993	3.98	4.38	4.81
33	1994	3.89	4.25	4.62
33	1995	3.63	3.92	4.23
33	1996	3.38	3.66	3.96
33	1997	3.32	3.66	4.01
33	1998	3.42	3.85	4.31
33	1999	3.53	3.96	4.43
33	2000	3.07	3.68	4.35

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
3	1991	3.53	3.44	3.62
3	1992	4.19	4.12	4.26
3	1993	4.38	4.30	4.45
3	1994	4.22	4.15	4.28
3	1995	3.94	3.88	3.99
3	1996	3.75	3.69	3.81
3	1997	3.81	3.75	3.88
3	1998	4.11	4.03	4.20
3	1999	4.39	4.30	4.48
3	2000	4.37	4.23	4.49

HA: 3 Vancouver Coastal HA

HSDA: 31 Richmond
32 Vancouver
33 North Shore / Coast Garibaldi

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
41	1991	2.65	3.06	3.48
41	1992	4.28	4.58	4.88
41	1993	4.89	5.26	5.66
41	1994	4.75	5.08	5.43
41	1995	4.26	4.52	4.78
41	1996	3.80	4.05	4.31
41	1997	3.72	4.00	4.29
41	1998	3.91	4.29	4.69
41	1999	4.06	4.44	4.85
41	2000	3.42	3.93	4.48
42	1991	2.70	3.12	3.61
42	1992	3.33	3.65	4.00
42	1993	3.40	3.77	4.16
42	1994	3.25	3.58	3.92
42	1995	2.99	3.26	3.53
42	1996	2.72	2.97	3.23
42	1997	2.55	2.83	3.13
42	1998	2.53	2.90	3.29
42	1999	2.83	3.22	3.63
42	2000	3.30	3.96	4.70
43	1991	2.52	3.08	3.69
43	1992	3.34	3.82	4.33
43	1993	3.52	4.08	4.67
43	1994	3.44	3.94	4.48
43	1995	3.24	3.64	4.06
43	1996	3.00	3.38	3.78
43	1997	2.87	3.33	3.83
43	1998	2.91	3.51	4.16
43	1999	3.21	3.84	4.52
43	2000	3.28	4.23	5.46

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
4	1991	3.08	2.98	3.18
4	1992	4.18	4.11	4.25
4	1993	4.63	4.54	4.72
4	1994	4.45	4.37	4.53
4	1995	4.03	3.97	4.09
4	1996	3.62	3.56	3.68
4	1997	3.53	3.47	3.60
4	1998	3.73	3.64	3.82
4	1999	3.99	3.89	4.08
4	2000	3.97	3.83	4.11

HA: 4 Vancouver Island HA

HSDA: 41 South Vancouver Island
42 Central Vancouver Island
43 North Vancouver Island

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
51	1991	2.57	3.06	3.60
51	1992	2.97	3.34	3.72
51	1993	2.95	3.40	3.86
51	1994	2.93	3.33	3.75
51	1995	2.94	3.27	3.60
51	1996	3.00	3.32	3.65
51	1997	3.21	3.62	4.06
51	1998	3.52	4.08	4.70
51	1999	3.70	4.27	4.88
51	2000	2.96	3.72	4.58
52	1991	1.73	2.08	2.45
52	1992	2.34	2.63	2.91
52	1993	2.52	2.84	3.20
52	1994	2.48	2.78	3.11
52	1995	2.36	2.60	2.86
52	1996	2.22	2.45	2.69
52	1997	2.19	2.46	2.75
52	1998	2.25	2.59	2.98
52	1999	2.33	2.68	3.06
52	2000	2.00	2.52	3.09
53	1991	2.21	2.73	3.32
53	1992	2.90	3.36	3.83
53	1993	3.05	3.58	4.14
53	1994	3.00	3.48	4.00
53	1995	2.87	3.25	3.64
53	1996	2.73	3.08	3.46
53	1997	2.70	3.12	3.58
53	1998	2.84	3.40	4.01
53	1999	3.22	3.80	4.46
53	2000	3.24	4.23	5.42

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
5	1991	2.55	2.45	2.65
5	1992	3.01	2.93	3.08
5	1993	3.17	3.09	3.26
5	1994	3.10	3.02	3.18
5	1995	2.95	2.88	3.01
5	1996	2.86	2.79	2.92
5	1997	2.95	2.88	3.03
5	1998	3.19	3.09	3.30
5	1999	3.41	3.30	3.51
5	2000	3.25	3.10	3.39

HA: 5 Northern HA

HSDA: 51 Northwest
52 Northern Interior
53 Northeast

Table G.29. Fitted Medical Adverse Event Rate. Females 20-39 Years.

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
11	1991	2.14	2.62	3.14
11	1992	2.97	3.38	3.85
11	1993	3.15	3.66	4.21
11	1994	3.04	3.50	3.99
11	1995	2.79	3.15	3.53
11	1996	2.51	2.84	3.18
11	1997	2.33	2.72	3.12
11	1998	2.32	2.81	3.35
11	1999	2.53	3.04	3.59
11	2000	2.59	3.37	4.34
12	1991	2.17	2.66	3.19
12	1992	2.98	3.40	3.85
12	1993	3.19	3.69	4.21
12	1994	3.12	3.58	4.06
12	1995	2.93	3.29	3.69
12	1996	2.69	3.04	3.41
12	1997	2.56	2.97	3.40
12	1998	2.60	3.10	3.64
12	1999	2.79	3.31	3.86
12	2000	2.70	3.47	4.36
13	1991	2.68	3.10	3.57
13	1992	3.39	3.71	4.03
13	1993	3.53	3.89	4.26
13	1994	3.41	3.73	4.06
13	1995	3.17	3.42	3.68
13	1996	2.90	3.13	3.39
13	1997	2.73	3.00	3.29
13	1998	2.70	3.05	3.42
13	1999	2.89	3.25	3.61
13	2000	3.02	3.59	4.22
14	1991	3.39	3.91	4.46
14	1992	4.58	4.97	5.39
14	1993	4.83	5.26	5.73
14	1994	4.55	4.92	5.32
14	1995	3.99	4.33	4.64
14	1996	3.49	3.81	4.09
14	1997	3.23	3.55	3.87
14	1998	3.10	3.50	3.90
14	1999	3.02	3.41	3.80
14	2000	2.50	3.08	3.73

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
1	1991	3.27	3.17	3.37
1	1992	4.08	4.01	4.16
1	1993	4.33	4.24	4.41
1	1994	4.10	4.03	4.17
1	1995	3.69	3.63	3.75
1	1996	3.32	3.27	3.38
1	1997	3.18	3.11	3.24
1	1998	3.20	3.11	3.28
1	1999	3.29	3.21	3.37
1	2000	3.36	3.23	3.48

HA: 1 Interior HA

HSDA: 11 East Kootenay
12 Kootenay/Boundary
13 Okanagan
14 Thompson Cariboo Shuswap

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
21	1991	3.02	3.49	4.00
21	1992	4.20	4.56	4.95
21	1993	4.52	4.94	5.39
21	1994	4.32	4.70	5.09
21	1995	3.87	4.17	4.48
21	1996	3.40	3.67	3.96
21	1997	3.09	3.40	3.72
21	1998	2.97	3.34	3.73
21	1999	2.97	3.33	3.71
21	2000	2.66	3.22	3.81
22	1991	3.57	3.96	4.38
22	1992	4.30	4.58	4.86
22	1993	4.44	4.75	5.06
22	1994	4.32	4.59	4.87
22	1995	4.08	4.31	4.55
22	1996	3.86	4.08	4.33
22	1997	3.81	4.06	4.32
22	1998	3.93	4.26	4.60
22	1999	4.26	4.61	4.98
22	2000	4.46	5.01	5.61
23	1991	4.14	4.57	5.05
23	1992	4.93	5.23	5.53
23	1993	5.07	5.40	5.74
23	1994	4.92	5.21	5.51
23	1995	4.65	4.89	5.15
23	1996	4.39	4.64	4.91
23	1997	4.34	4.61	4.89
23	1998	4.41	4.75	5.10
23	1999	4.39	4.74	5.10
23	2000	3.81	4.31	4.82

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
2	1991	4.10	4.01	4.19
2	1992	4.82	4.76	4.89
2	1993	5.03	4.96	5.10
2	1994	4.86	4.80	4.92
2	1995	4.51	4.46	4.57
2	1996	4.23	4.17	4.29
2	1997	4.14	4.08	4.20
2	1998	4.25	4.18	4.33
2	1999	4.39	4.31	4.46
2	2000	4.33	4.21	4.44

HA: 2 Fraser HA

HSDA: 21 Fraser Valley
22 Simon Fraser
23 South Fraser

Table G.29. (continued) Fitted Medical Adverse Event Rate. Females 20-39 Years.

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
31	1991	2.98	3.58	4.25
31	1992	3.65	4.13	4.64
31	1993	3.77	4.32	4.88
31	1994	3.75	4.25	4.77
31	1995	3.70	4.12	4.57
31	1996	3.70	4.09	4.54
31	1997	3.83	4.31	4.81
31	1998	4.06	4.70	5.39
31	1999	4.15	4.77	5.44
31	2000	3.28	4.09	5.04
32	1991	3.30	3.64	4.01
32	1992	4.01	4.25	4.52
32	1993	4.11	4.39	4.67
32	1994	3.96	4.20	4.45
32	1995	3.69	3.91	4.12
32	1996	3.48	3.72	3.93
32	1997	3.55	3.78	4.01
32	1998	3.80	4.09	4.40
32	1999	4.16	4.48	4.82
32	2000	4.22	4.71	5.25
33	1991	2.78	3.22	3.70
33	1992	3.74	4.07	4.43
33	1993	3.98	4.38	4.81
33	1994	3.89	4.25	4.62
33	1995	3.63	3.92	4.23
33	1996	3.38	3.66	3.96
33	1997	3.32	3.66	4.01
33	1998	3.42	3.85	4.31
33	1999	3.53	3.96	4.43
33	2000	3.07	3.68	4.35

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
3	1991	3.53	3.44	3.62
3	1992	4.19	4.12	4.26
3	1993	4.38	4.30	4.45
3	1994	4.22	4.15	4.28
3	1995	3.94	3.88	3.99
3	1996	3.75	3.69	3.81
3	1997	3.81	3.75	3.88
3	1998	4.11	4.03	4.20
3	1999	4.39	4.30	4.48
3	2000	4.37	4.23	4.49

HA: 3 Vancouver Coastal HA

HSDA: 31 Richmond
32 Vancouver
33 North Shore / Coast Garibaldi

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
41	1991	2.65	3.06	3.48
41	1992	4.28	4.58	4.88
41	1993	4.89	5.26	5.66
41	1994	4.75	5.08	5.43
41	1995	4.26	4.52	4.78
41	1996	3.80	4.05	4.31
41	1997	3.72	4.00	4.29
41	1998	3.91	4.29	4.69
41	1999	4.06	4.44	4.85
41	2000	3.42	3.93	4.48
42	1991	2.70	3.12	3.61
42	1992	3.33	3.65	4.00
42	1993	3.40	3.77	4.16
42	1994	3.25	3.58	3.92
42	1995	2.99	3.26	3.53
42	1996	2.72	2.97	3.23
42	1997	2.55	2.83	3.13
42	1998	2.53	2.90	3.29
42	1999	2.83	3.22	3.63
42	2000	3.30	3.96	4.70
43	1991	2.52	3.08	3.69
43	1992	3.34	3.82	4.33
43	1993	3.52	4.08	4.67
43	1994	3.44	3.94	4.48
43	1995	3.24	3.64	4.06
43	1996	3.00	3.38	3.78
43	1997	2.87	3.33	3.83
43	1998	2.91	3.51	4.16
43	1999	3.21	3.84	4.52
43	2000	3.28	4.23	5.46

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
4	1991	3.08	2.98	3.18
4	1992	4.18	4.11	4.25
4	1993	4.63	4.54	4.72
4	1994	4.45	4.37	4.53
4	1995	4.03	3.97	4.09
4	1996	3.62	3.56	3.68
4	1997	3.53	3.47	3.60
4	1998	3.73	3.64	3.82
4	1999	3.99	3.89	4.08
4	2000	3.97	3.83	4.11

HA: 4 Vancouver Island HA

HSDA: 41 South Vancouver Island
42 Central Vancouver Island
43 North Vancouver Island

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
51	1991	2.57	3.06	3.60
51	1992	2.97	3.34	3.72
51	1993	2.95	3.40	3.86
51	1994	2.93	3.33	3.75
51	1995	2.94	3.27	3.60
51	1996	3.00	3.32	3.65
51	1997	3.21	3.62	4.06
51	1998	3.52	4.08	4.70
51	1999	3.70	4.27	4.88
51	2000	2.96	3.72	4.58
52	1991	1.73	2.08	2.45
52	1992	2.34	2.63	2.91
52	1993	2.52	2.84	3.20
52	1994	2.48	2.78	3.11
52	1995	2.36	2.60	2.86
52	1996	2.22	2.45	2.69
52	1997	2.19	2.46	2.75
52	1998	2.25	2.59	2.98
52	1999	2.33	2.68	3.06
52	2000	2.00	2.52	3.09
53	1991	2.21	2.73	3.32
53	1992	2.90	3.36	3.83
53	1993	3.05	3.58	4.14
53	1994	3.00	3.48	4.00
53	1995	2.87	3.25	3.64
53	1996	2.73	3.08	3.46
53	1997	2.70	3.12	3.58
53	1998	2.84	3.40	4.01
53	1999	3.22	3.80	4.46
53	2000	3.24	4.23	5.42

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
5	1991	2.55	2.45	2.65
5	1992	3.01	2.93	3.08
5	1993	3.17	3.09	3.26
5	1994	3.10	3.02	3.18
5	1995	2.95	2.88	3.01
5	1996	2.86	2.79	2.92
5	1997	2.95	2.88	3.03
5	1998	3.19	3.09	3.30
5	1999	3.41	3.30	3.51
5	2000	3.25	3.10	3.39

HA: 5 Northern HA

HSDA: 51 Northwest
52 Northern Interior
53 Northeast

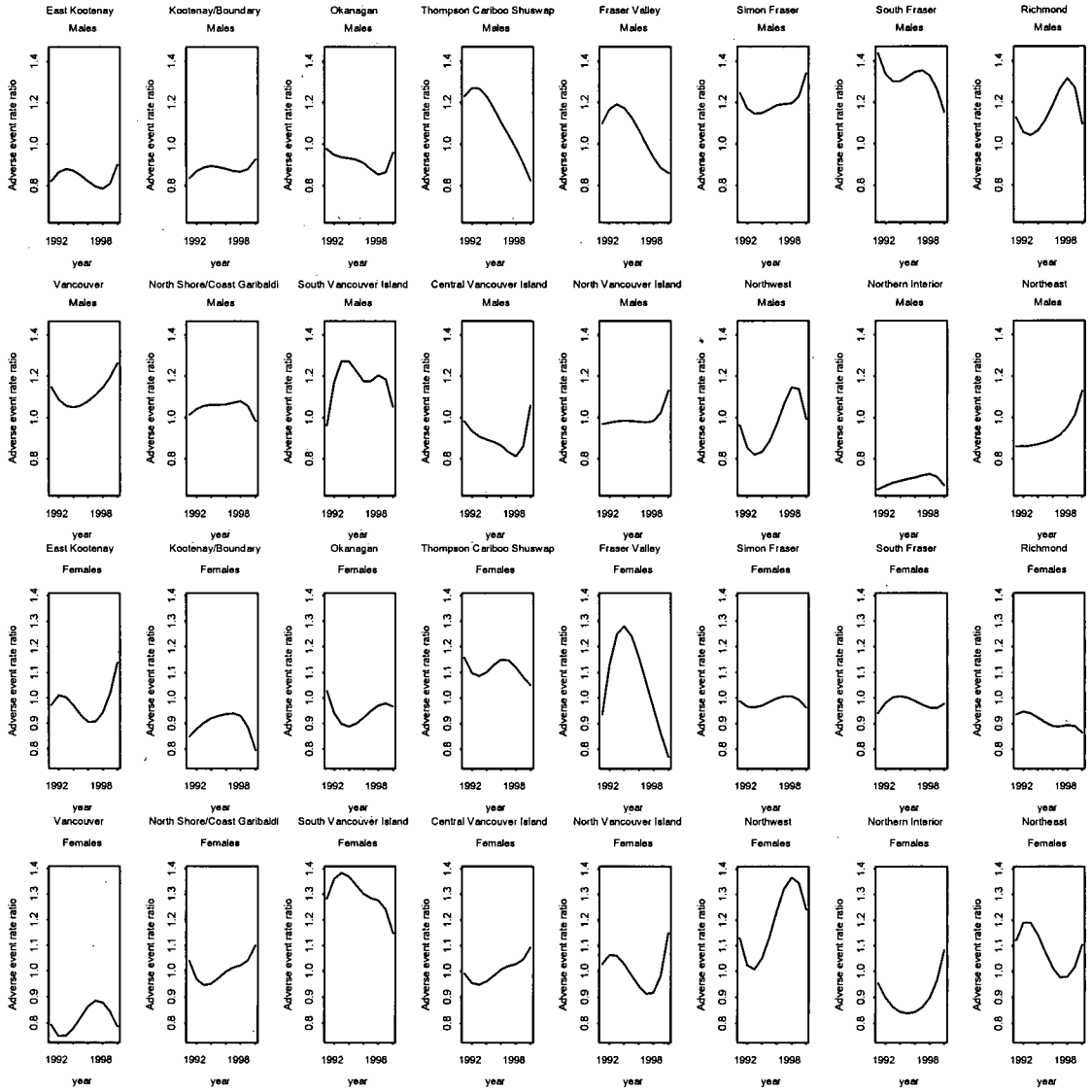

Figure G.1. Annual Ratio between the Medical Adverse Event Incidence Rate of Each Health Services Delivery Area and British Columbia for Males and Females Aged 20-39 Years, 1991-2000.

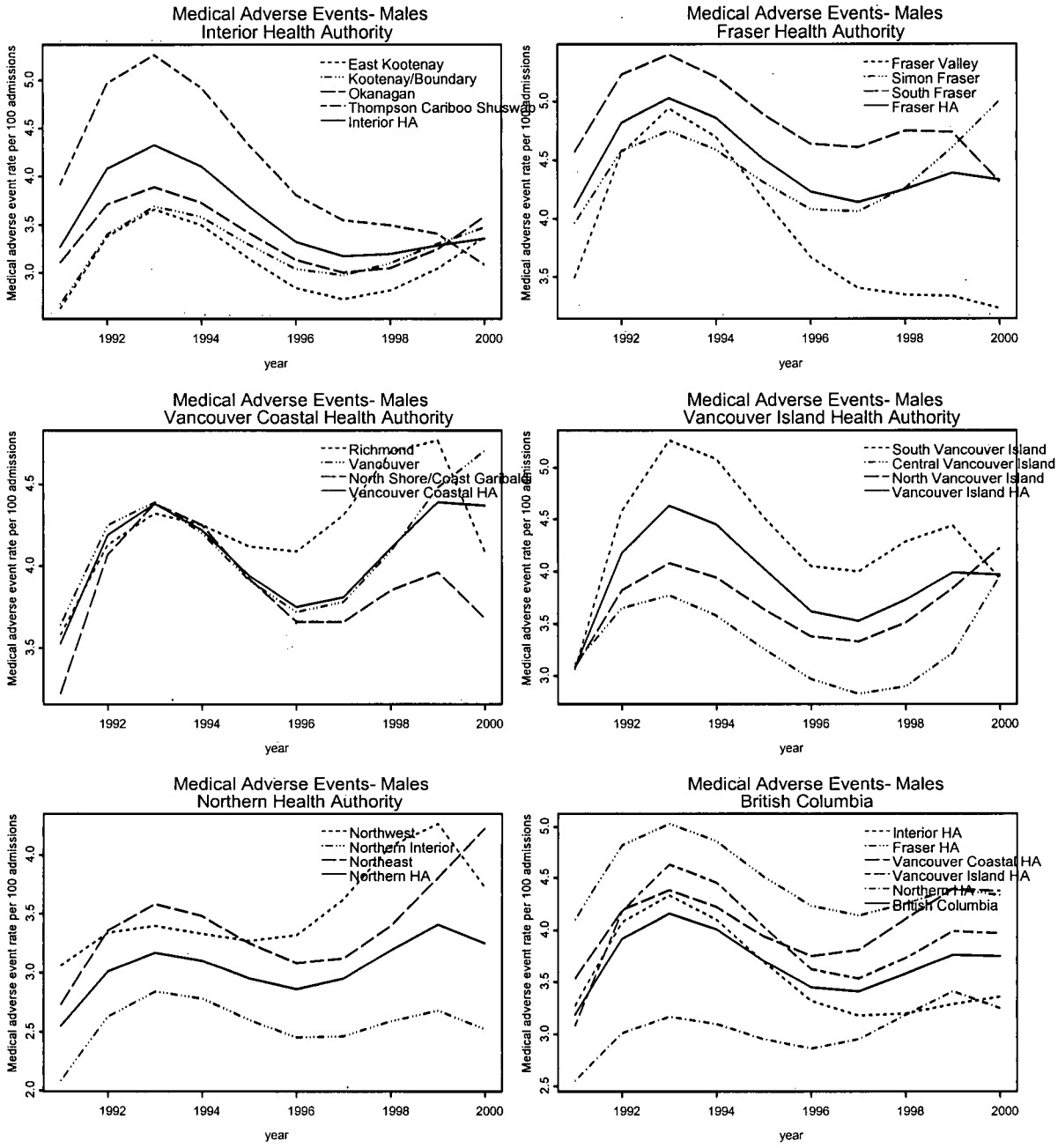

Figure G.2. Annual Medical Adverse Event Incidence Rates per 100 Admissions for Males Aged 20-39 Years at the Health Services Delivery Area, Health Authority and Provincial Levels, 1991-2000.

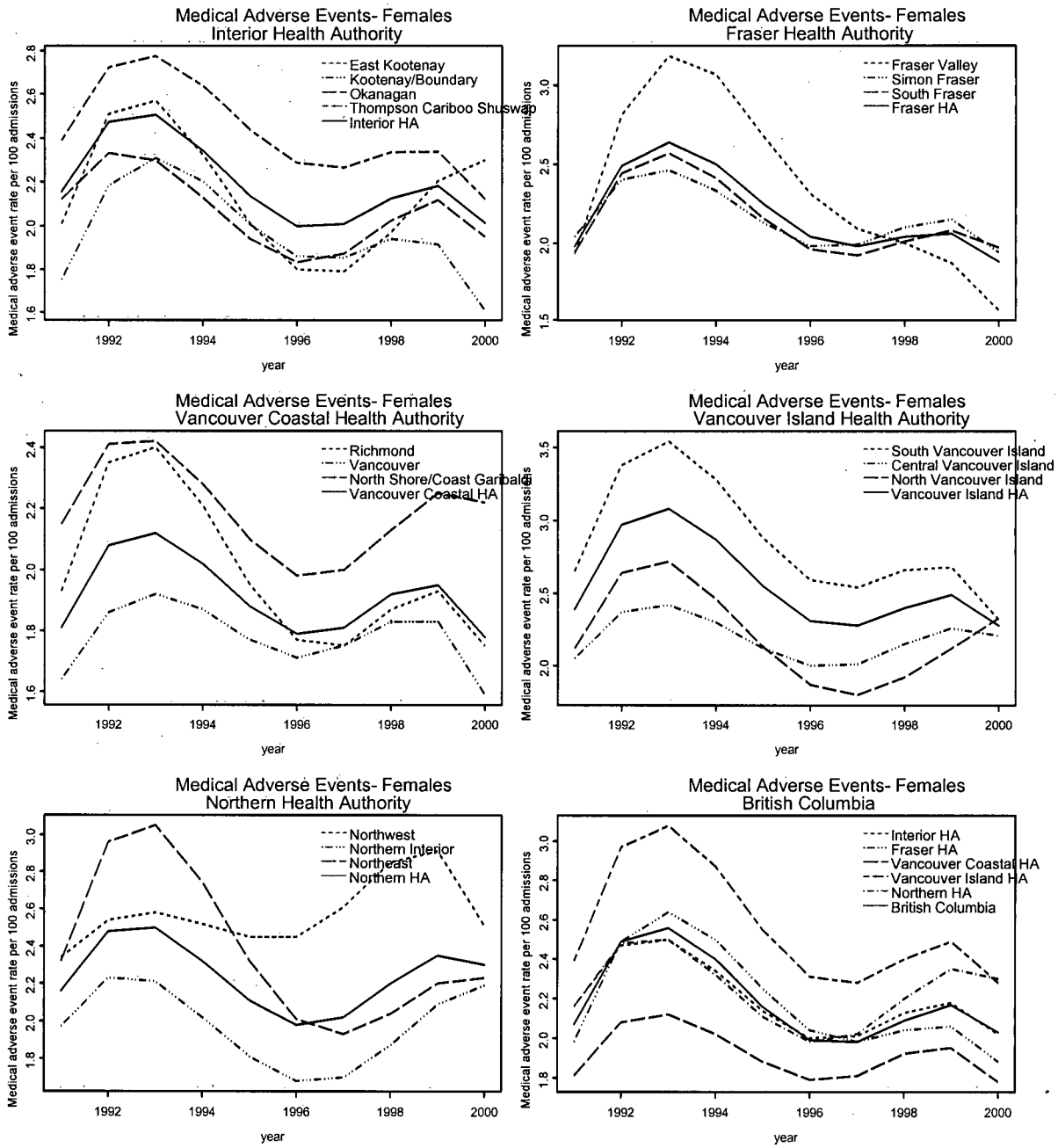

Figure G.3. Annual Medical Adverse Event Incidence Rates per 100 Admissions for Females Aged 20-39 Years at the Health Services Delivery Area, Health Authority and Provincial Levels, 1991-2000.

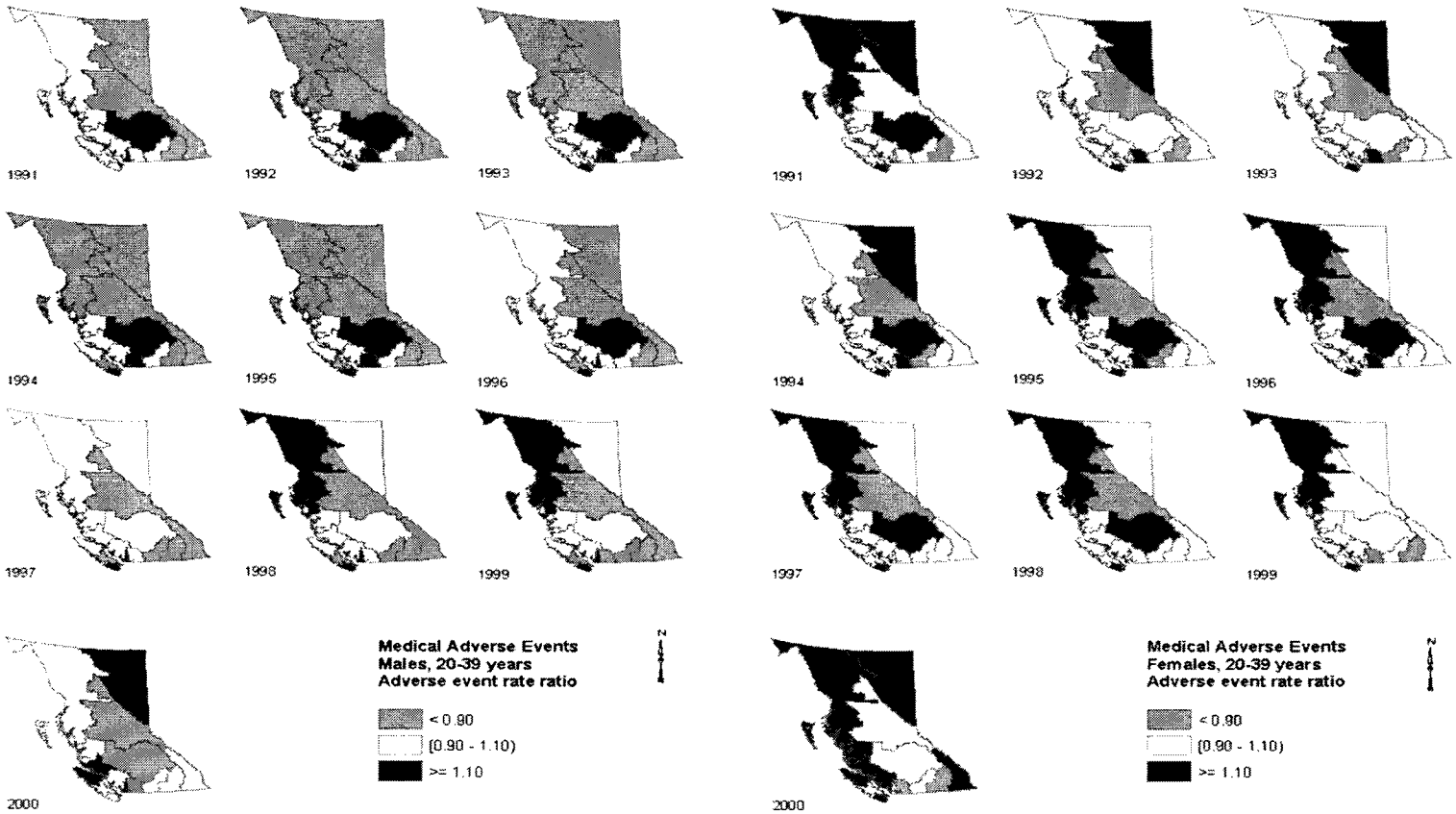

Figure G.4. Map of Annual Ratio between the Medical Adverse Event Incidence Rate of Each Health Services Delivery Area and British Columbia for Males and Females Aged 20-39 Years, 1991-2000.

Table G.30. Fitted Medical Adverse Event Rate. Males 40-64 Years.

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
11	1991	2.64	3.11	3.62
11	1992	3.42	3.82	4.27
11	1993	3.60	4.00	4.43
11	1994	3.41	3.77	4.14
11	1995	3.08	3.41	3.73
11	1996	2.82	3.13	3.44
11	1997	2.79	3.11	3.45
11	1998	3.02	3.45	3.91
11	1999	3.79	4.31	4.85
11	2000	5.19	6.10	7.07
12	1991	3.26	3.73	4.29
12	1992	4.10	4.51	4.93
12	1993	4.30	4.73	5.18
12	1994	4.15	4.54	4.92
12	1995	3.84	4.17	4.52
12	1996	3.56	3.88	4.20
12	1997	3.47	3.81	4.17
12	1998	3.53	3.96	4.43
12	1999	3.67	4.10	4.56
12	2000	3.40	4.02	4.70
13	1991	4.56	4.98	5.45
13	1992	5.57	5.89	6.21
13	1993	5.78	6.12	6.46
13	1994	5.56	5.86	6.16
13	1995	5.15	5.41	5.69
13	1996	4.80	5.06	5.33
13	1997	4.74	5.00	5.26
13	1998	4.81	5.14	5.47
13	1999	4.75	5.07	5.41
13	2000	4.01	4.44	4.90
14	1991	4.02	4.47	4.93
14	1992	5.64	5.98	6.33
14	1993	6.20	6.58	6.99
14	1994	5.99	6.32	6.68
14	1995	5.35	5.63	5.93
14	1996	4.69	4.96	5.26
14	1997	4.32	4.57	4.85
14	1998	4.14	4.45	4.77
14	1999	4.02	4.34	4.66
14	2000	3.61	4.03	4.48

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
1	1991	4.30	4.38	4.47
1	1992	5.39	5.45	5.52
1	1993	5.73	5.80	5.87
1	1994	5.50	5.56	5.63
1	1995	5.00	5.05	5.10
1	1996	4.55	4.60	4.65
1	1997	4.40	4.45	4.50
1	1998	4.44	4.51	4.57
1	1999	4.51	4.58	4.64
1	2000	4.34	4.43	4.52

HA: 1 Interior HA

HSDA: 11 East Kootenay
12 Kootenay/Boundary
13 Okanagan
14 Thompson Cariboo Shuswap

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
21	1991	5.63	6.19	6.80
21	1992	6.83	7.25	7.68
21	1993	6.95	7.38	7.82
21	1994	6.48	6.85	7.22
21	1995	5.75	6.08	6.41
21	1996	5.09	5.41	5.73
21	1997	4.77	5.07	5.38
21	1998	4.60	4.97	5.35
21	1999	4.48	4.83	5.20
21	2000	3.91	4.39	4.91
22	1991	5.27	5.66	6.06
22	1992	6.41	6.71	7.01
22	1993	6.53	6.84	7.14
22	1994	6.11	6.36	6.63
22	1995	5.51	5.75	6.00
22	1996	5.09	5.35	5.61
22	1997	5.20	5.44	5.68
22	1998	5.63	5.93	6.25
22	1999	6.02	6.35	6.69
22	2000	5.66	6.09	6.52
23	1991	5.14	5.52	5.91
23	1992	6.57	6.86	7.16
23	1993	7.07	7.36	7.67
23	1994	6.92	7.18	7.45
23	1995	6.46	6.70	6.96
23	1996	6.06	6.32	6.59
23	1997	6.09	6.32	6.57
23	1998	6.33	6.61	6.91
23	1999	6.35	6.66	6.96
23	2000	5.55	5.93	6.34

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
2	1991	5.62	5.70	5.79
2	1992	6.81	6.87	6.94
2	1993	7.09	7.16	7.22
2	1994	6.75	6.80	6.86
2	1995	6.16	6.21	6.26
2	1996	5.73	5.78	5.83
2	1997	5.69	5.74	5.79
2	1998	5.98	6.04	6.10
2	1999	6.10	6.17	6.24
2	2000	5.58	5.67	5.76

HA: 2 Fraser HA

HSDA: 21 Fraser Valley
22 Simon Fraser
23 South Fraser

Table G.30. (continued) Fitted Medical Adverse Event Rate. Males 40-64 Years.

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
31	1991	4.79	5.40	6.09
31	1992	5.91	6.41	6.94
31	1993	6.11	6.59	7.10
31	1994	5.80	6.23	6.69
31	1995	5.36	5.76	6.17
31	1996	5.12	5.53	5.94
31	1997	5.40	5.83	6.28
31	1998	5.89	6.46	7.06
31	1999	5.89	6.46	7.07
31	2000	4.28	5.02	5.82
32	1991	4.63	4.99	5.37
32	1992	5.59	5.86	6.14
32	1993	5.76	6.04	6.33
32	1994	5.53	5.77	6.01
32	1995	5.18	5.40	5.63
32	1996	5.01	5.25	5.49
32	1997	5.33	5.57	5.81
32	1998	5.92	6.22	6.54
32	1999	6.16	6.48	6.82
32	2000	5.13	5.55	5.98
33	1991	3.31	3.70	4.11
33	1992	4.46	4.77	5.09
33	1993	4.90	5.22	5.56
33	1994	4.88	5.16	5.47
33	1995	4.67	4.94	5.22
33	1996	4.60	4.87	5.18
33	1997	4.97	5.27	5.59
33	1998	5.64	6.04	6.46
33	1999	5.98	6.41	6.85
33	2000	4.97	5.51	6.10

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
3	1991	4.57	4.66	4.75
3	1992	5.56	5.62	5.69
3	1993	5.80	5.87	5.94
3	1994	5.60	5.66	5.72
3	1995	5.26	5.32	5.37
3	1996	5.12	5.18	5.24
3	1997	5.46	5.52	5.58
3	1998	6.12	6.21	6.29
3	1999	6.37	6.46	6.54
3	2000	5.35	5.46	5.56

HA: 3 Vancouver Coastal HA

HSDA: 31 Richmond
32 Vancouver
33 North Shore / Coast Garibaldi

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
41	1991	4.95	5.38	5.83
41	1992	6.74	7.07	7.40
41	1993	7.34	7.70	8.07
41	1994	7.08	7.39	7.70
41	1995	6.36	6.64	6.93
41	1996	5.67	5.95	6.26
41	1997	5.38	5.65	5.92
41	1998	5.32	5.64	5.97
41	1999	5.25	5.57	5.91
41	2000	4.65	5.08	5.51
42	1991	3.87	4.28	4.72
42	1992	5.08	5.40	5.74
42	1993	5.41	5.75	6.10
42	1994	5.16	5.47	5.78
42	1995	4.68	4.94	5.21
42	1996	4.26	4.51	4.77
42	1997	4.13	4.40	4.67
42	1998	4.16	4.49	4.83
42	1999	4.03	4.34	4.68
42	2000	3.19	3.60	4.03
43	1991	4.21	4.87	5.63
43	1992	5.28	5.84	6.43
43	1993	5.53	6.11	6.69
43	1994	5.34	5.86	6.38
43	1995	4.95	5.39	5.86
43	1996	4.57	5.00	5.46
43	1997	4.42	4.89	5.37
43	1998	4.40	4.98	5.59
43	1999	4.36	4.93	5.54
43	2000	3.64	4.42	5.31

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
4	1991	4.83	4.93	5.03
4	1992	6.26	6.33	6.41
4	1993	6.74	6.83	6.91
4	1994	6.47	6.54	6.61
4	1995	5.82	5.89	5.95
4	1996	5.24	5.31	5.38
4	1997	5.03	5.09	5.16
4	1998	5.06	5.14	5.21
4	1999	4.97	5.05	5.12
4	2000	4.36	4.46	4.56

HA: 4 Vancouver Island HA

HSDA: 41 South Vancouver Island
42 Central Vancouver Island
43 North Vancouver Island

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
51	1991	3.77	4.31	4.89
51	1992	4.94	5.38	5.85
51	1993	5.28	5.72	6.21
51	1994	5.14	5.54	5.97
51	1995	4.84	5.20	5.58
51	1996	4.67	5.04	5.42
51	1997	4.93	5.34	5.77
51	1998	5.42	5.98	6.58
51	1999	5.61	6.19	6.80
51	2000	4.40	5.15	5.96
52	1991	2.77	3.17	3.59
52	1992	3.71	4.04	4.38
52	1993	4.07	4.41	4.77
52	1994	4.04	4.36	4.69
52	1995	3.85	4.13	4.44
52	1996	3.71	3.99	4.29
52	1997	3.84	4.13	4.44
52	1998	4.13	4.50	4.91
52	1999	4.28	4.67	5.09
52	2000	3.62	4.18	4.75
53	1991	3.07	3.66	4.30
53	1992	4.06	4.60	5.17
53	1993	4.34	4.88	5.44
53	1994	4.14	4.62	5.13
53	1995	3.73	4.15	4.58
53	1996	3.34	3.72	4.13
53	1997	3.14	3.55	3.99
53	1998	3.23	3.77	4.34
53	1999	4.02	4.63	5.29
53	2000	5.73	6.88	8.20

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
5	1991	3.52	3.63	3.73
5	1992	4.51	4.59	4.68
5	1993	4.85	4.94	5.03
5	1994	4.72	4.80	4.88
5	1995	4.41	4.48	4.55
5	1996	4.21	4.28	4.35
5	1997	4.36	4.44	4.51
5	1998	4.77	4.87	4.97
5	1999	5.02	5.13	5.23
5	2000	4.80	4.96	5.10

HA: 5 Northern HA

HSDA: 51 Northwest
52 Northern Interior
53 Northeast

Table G.31. Fitted Medical Adverse Event Rate. Females 40-64 Years.

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
11	1991	3.02	3.57	4.18
11	1992	3.66	4.11	4.58
11	1993	3.78	4.21	4.65
11	1994	3.63	4.02	4.41
11	1995	3.38	3.74	4.11
11	1996	3.18	3.55	3.93
11	1997	3.24	3.59	3.98
11	1998	3.48	3.90	4.36
11	1999	3.91	4.39	4.89
11	2000	4.20	4.96	5.80
12	1991	2.83	3.30	3.79
12	1992	3.66	4.08	4.51
12	1993	3.93	4.34	4.76
12	1994	3.82	4.19	4.57
12	1995	3.53	3.88	4.26
12	1996	3.29	3.65	4.03
12	1997	3.34	3.68	4.04
12	1998	3.54	3.94	4.37
12	1999	3.70	4.13	4.57
12	2000	3.37	3.92	4.53
13	1991	3.69	4.07	4.46
13	1992	4.51	4.80	5.10
13	1993	4.76	5.06	5.36
13	1994	4.66	4.93	5.19
13	1995	4.37	4.62	4.88
13	1996	4.09	4.34	4.60
13	1997	3.99	4.22	4.47
13	1998	3.98	4.25	4.54
13	1999	3.91	4.20	4.49
13	2000	3.50	3.87	4.27
14	1991	4.21	4.64	5.08
14	1992	5.32	5.66	6.00
14	1993	5.57	5.91	6.26
14	1994	5.26	5.56	5.86
14	1995	4.67	4.95	5.24
14	1996	4.14	4.40	4.69
14	1997	3.87	4.11	4.36
14	1998	3.78	4.06	4.34
14	1999	3.83	4.12	4.41
14	2000	3.77	4.17	4.60

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
1	1991	4.02	4.10	4.18
1	1992	4.84	4.91	4.97
1	1993	5.07	5.14	5.20
1	1994	4.87	4.92	4.98
1	1995	4.46	4.51	4.57
1	1996	4.11	4.17	4.22
1	1997	3.99	4.03	4.08
1	1998	4.04	4.10	4.15
1	1999	4.12	4.18	4.24
1	2000	4.02	4.10	4.19

HA: 1 Interior HA

HSDA: 11 East Kootenay
12 Kootenay/Boundary
13 Okanagan
14 Thompson Cariboo Shuswap

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
21	1991	5.72	6.31	6.92
21	1992	7.08	7.53	8.01
21	1993	7.38	7.82	8.27
21	1994	7.00	7.37	7.76
21	1995	6.24	6.60	6.98
21	1996	5.52	5.87	6.25
21	1997	5.10	5.41	5.75
21	1998	4.81	5.16	5.53
21	1999	4.50	4.85	5.21
21	2000	3.82	4.29	4.77
22	1991	4.78	5.14	5.52
22	1992	5.80	6.06	6.35
22	1993	5.99	6.27	6.56
22	1994	5.72	5.95	6.20
22	1995	5.23	5.46	5.69
22	1996	4.82	5.07	5.31
22	1997	4.77	4.99	5.21
22	1998	4.94	5.20	5.46
22	1999	5.17	5.45	5.74
22	2000	5.07	5.45	5.85
23	1991	4.97	5.34	5.71
23	1992	6.35	6.63	6.92
23	1993	6.89	7.19	7.48
23	1994	6.83	7.09	7.35
23	1995	6.38	6.62	6.87
23	1996	5.84	6.10	6.36
23	1997	5.54	5.76	5.98
23	1998	5.36	5.61	5.87
23	1999	5.24	5.51	5.78
23	2000	4.96	5.31	5.66

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
2	1991	5.35	5.44	5.52
2	1992	6.50	6.57	6.63
2	1993	6.88	6.94	7.01
2	1994	6.64	6.70	6.75
2	1995	6.12	6.17	6.23
2	1996	5.61	5.67	5.73
2	1997	5.36	5.41	5.46
2	1998	5.32	5.37	5.43
2	1999	5.30	5.36	5.42
2	2000	5.07	5.15	5.23

HA: 2 Fraser HA

HSDA: 21 Fraser Valley
22 Simon Fraser
23 South Fraser

Table G.31. (continued) Fitted Medical Adverse Event Rate. Females 40-64 Years.

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
31	1991	5.61	6.30	7.06
31	1992	6.85	7.41	8.00
31	1993	6.70	7.21	7.76
31	1994	5.85	6.27	6.73
31	1995	4.88	5.29	5.73
31	1996	4.27	4.68	5.11
31	1997	4.31	4.68	5.06
31	1998	4.73	5.18	5.65
31	1999	5.16	5.66	6.17
31	2000	4.76	5.41	6.10
32	1991	3.93	4.26	4.63
32	1992	4.67	4.93	5.19
32	1993	4.84	5.11	5.38
32	1994	4.74	4.97	5.20
32	1995	4.55	4.76	4.98
32	1996	4.47	4.70	4.94
32	1997	4.77	4.98	5.21
32	1998	5.23	5.51	5.80
32	1999	5.41	5.72	6.04
32	2000	4.61	5.00	5.40
33	1991	3.49	3.87	4.29
33	1992	4.54	4.86	5.19
33	1993	5.05	5.37	5.71
33	1994	5.14	5.43	5.75
33	1995	4.92	5.23	5.53
33	1996	4.66	4.97	5.29
33	1997	4.58	4.86	5.15
33	1998	4.58	4.90	5.25
33	1999	4.61	4.95	5.31
33	2000	4.41	4.87	5.37

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
3	1991	4.37	4.46	4.54
3	1992	5.23	5.30	5.36
3	1993	5.46	5.53	5.59
3	1994	5.26	5.32	5.38
3	1995	4.93	4.98	5.04
3	1996	4.72	4.78	4.84
3	1997	4.84	4.90	4.95
3	1998	5.20	5.27	5.34
3	1999	5.40	5.47	5.55
3	2000	4.92	5.02	5.12

HA: 3 Vancouver Coastal HA

HSDA: 31 Richmond
32 Vancouver
33 North Shore / Coast Garibaldi

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
41	1991	4.18	4.57	4.97
41	1992	5.62	5.91	6.22
41	1993	6.08	6.40	6.73
41	1994	5.87	6.14	6.42
41	1995	5.31	5.56	5.83
41	1996	4.80	5.06	5.33
41	1997	4.66	4.89	5.13
41	1998	4.74	5.01	5.28
41	1999	4.81	5.11	5.41
41	2000	4.45	4.84	5.25
42	1991	3.91	4.33	4.80
42	1992	4.78	5.12	5.47
42	1993	5.02	5.36	5.73
42	1994	4.87	5.18	5.50
42	1995	4.52	4.81	5.10
42	1996	4.17	4.46	4.75
42	1997	4.03	4.29	4.56
42	1998	4.06	4.35	4.66
42	1999	4.26	4.58	4.92
42	2000	4.50	4.94	5.41
43	1991	3.46	4.09	4.82
43	1992	4.29	4.85	5.45
43	1993	4.45	4.96	5.50
43	1994	4.18	4.65	5.14
43	1995	3.77	4.21	4.69
43	1996	3.46	3.91	4.39
43	1997	3.49	3.93	4.38
43	1998	3.68	4.18	4.71
43	1999	3.76	4.26	4.82
43	2000	3.10	3.78	4.51

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
4	1991	4.35	4.45	4.54
4	1992	5.47	5.55	5.62
4	1993	5.81	5.89	5.96
4	1994	5.59	5.66	5.72
4	1995	5.10	5.16	5.23
4	1996	4.67	4.73	4.79
4	1997	4.53	4.59	4.64
4	1998	4.62	4.69	4.76
4	1999	4.76	4.83	4.90
4	2000	4.68	4.78	4.87

HA: 4 Vancouver Island HA

HSDA: 41 South Vancouver Island
42 Central Vancouver Island
43 North Vancouver Island

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
51	1991	3.81	4.46	5.17
51	1992	4.54	5.00	5.50
51	1993	4.93	5.47	6.00
51	1994	5.34	5.85	6.35
51	1995	5.66	6.16	6.69
51	1996	5.88	6.44	7.01
51	1997	6.17	6.70	7.26
51	1998	6.14	6.75	7.42
51	1999	5.59	6.18	6.80
51	2000	4.18	4.82	5.51
52	1991	2.43	2.83	3.23
52	1992	3.46	3.80	4.14
52	1993	3.95	4.30	4.68
52	1994	4.02	4.34	4.67
52	1995	3.79	4.10	4.41
52	1996	3.54	3.84	4.15
52	1997	3.46	3.74	4.04
52	1998	3.46	3.79	4.13
52	1999	3.46	3.78	4.14
52	2000	3.06	3.51	4.01
53	1991	3.79	4.51	5.29
53	1992	4.83	5.45	6.13
53	1993	5.12	5.73	6.37
53	1994	4.91	5.46	6.04
53	1995	4.41	4.94	5.51
53	1996	3.94	4.45	5.00
53	1997	3.68	4.17	4.68
53	1998	3.55	4.11	4.68
53	1999	3.57	4.13	4.70
53	2000	3.39	4.14	4.97

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
5	1991	3.52	3.63	3.74
5	1992	4.40	4.49	4.58
5	1993	4.84	4.93	5.02
5	1994	4.93	5.01	5.09
5	1995	4.82	4.91	4.99
5	1996	4.65	4.74	4.83
5	1997	4.66	4.75	4.82
5	1998	4.62	4.72	4.81
5	1999	4.46	4.56	4.65
5	2000	3.92	4.05	4.16

HA: 5 Northern HA

HSDA: 51 Northwest
52 Northern Interior
53 Northeast

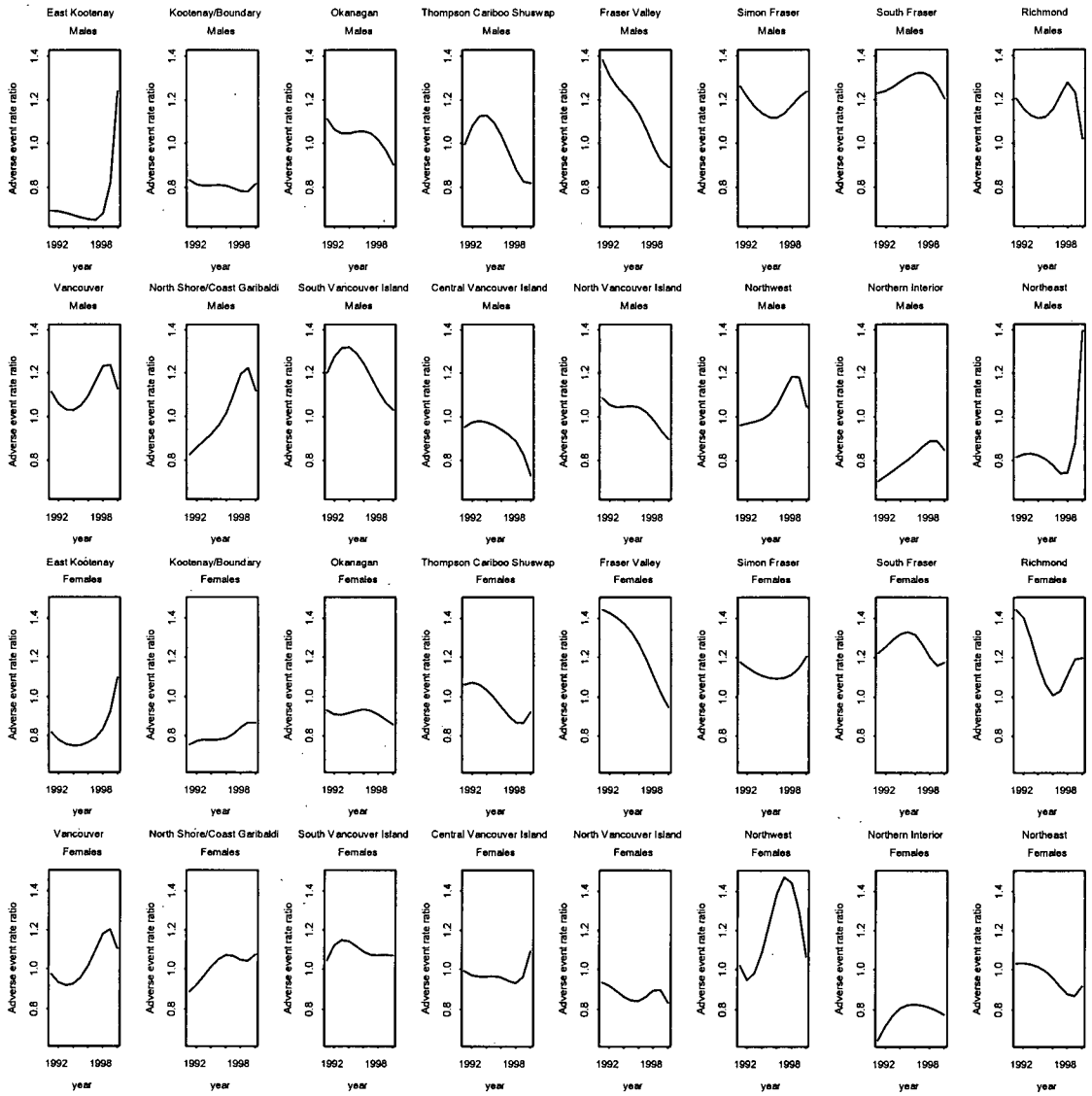

Figure G.5. Annual Ratio between the Medical Adverse Event Incidence Rate of Each Health Services Delivery Area and British Columbia for Males and Females Aged 40-64 Years, 1991-2000.

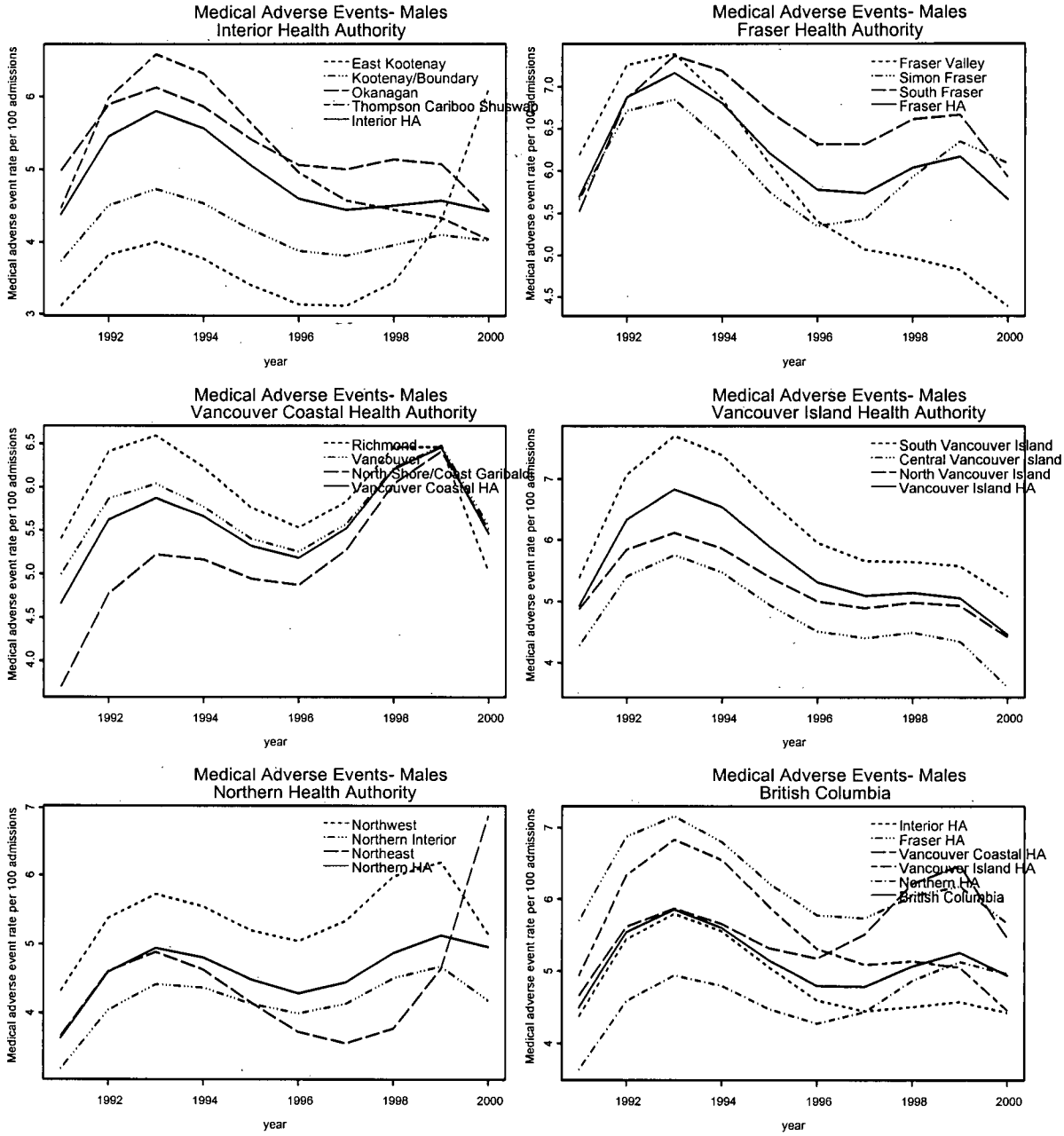

Figure G.6. Annual Medical Adverse Event Incidence Rates per 100 Admissions for Males Aged 40-64 Years at the Health Services Delivery Area, Health Authority and Provincial Levels, 1991-2000.

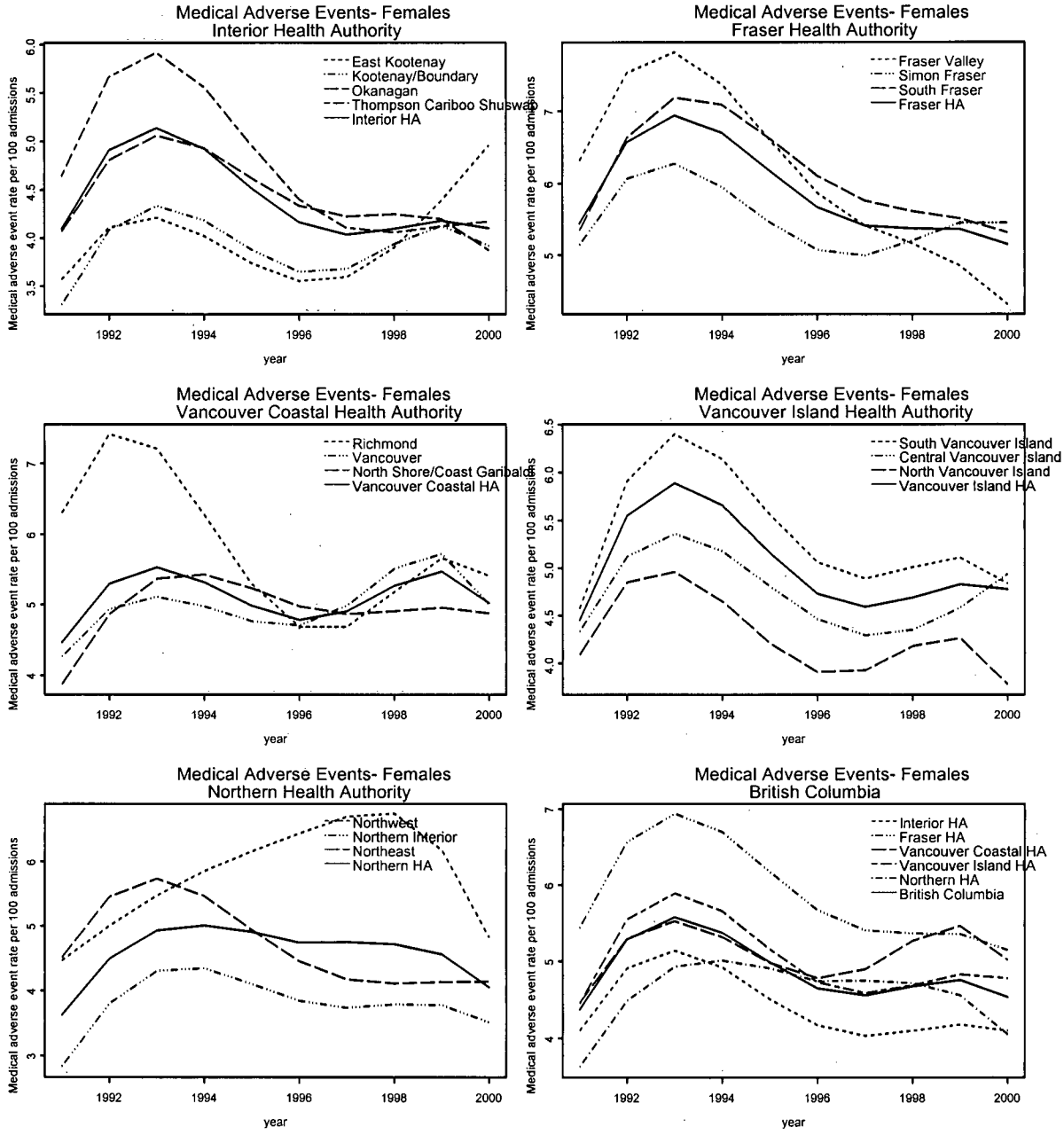

Figure G.7. Annual Medical Adverse Event Incidence Rates per 100 Admissions for Females Aged 40-64 Years at the Health Services Delivery Area, Health Authority and Provincial Levels, 1991-2000.

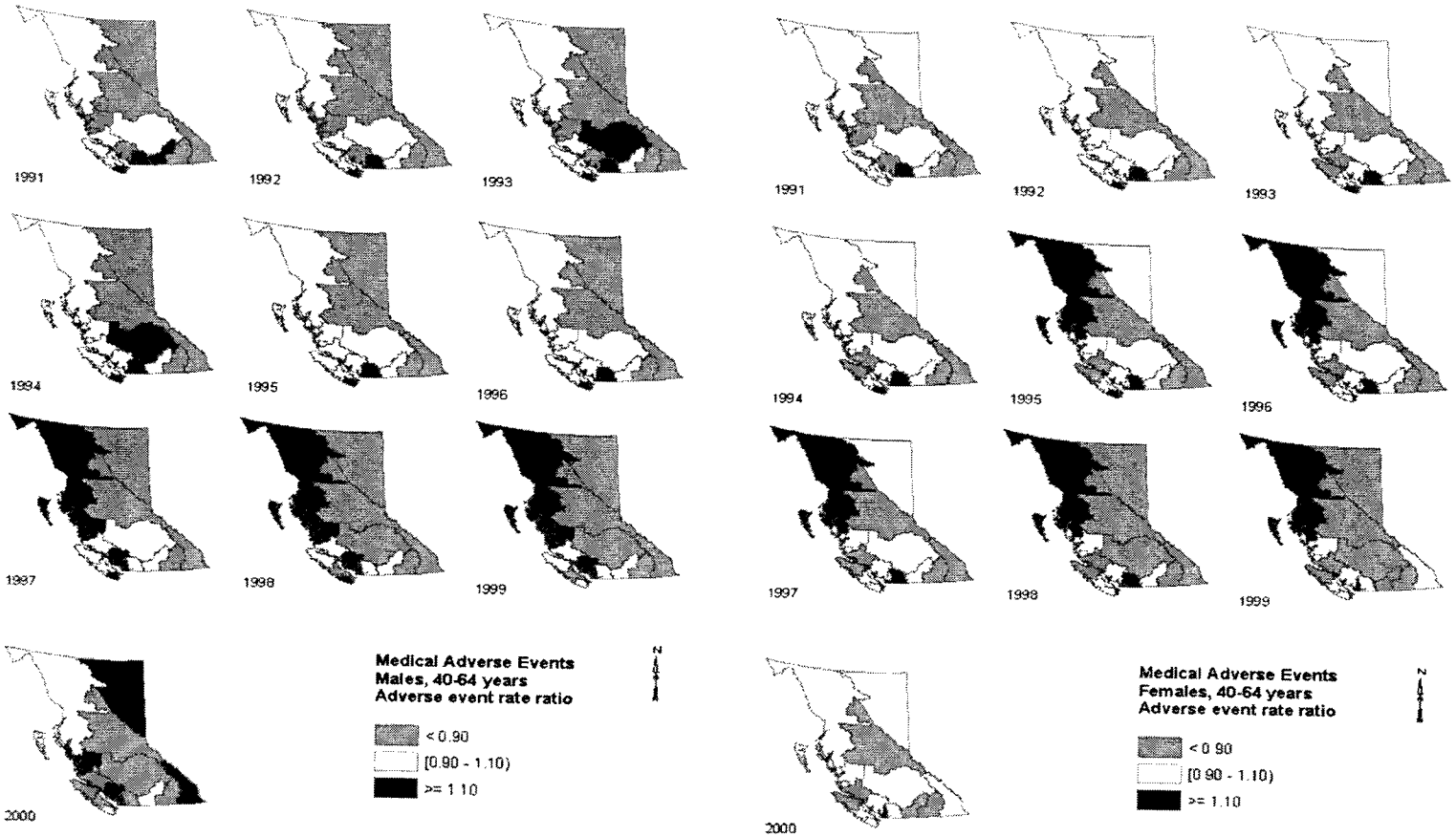

Figure G.8. Map of Annual Ratio between the Medical Adverse Event Incidence Rate of Each Health Services Delivery Area and British Columbia for Males and Females Aged 40-64 Years, 1991-2000.

Table G.32. Fitted Medical Adverse Event Rate. Males 65-79 Years.

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
11	1991	3.20	3.87	4.61
11	1992	4.05	4.58	5.16
11	1993	4.27	4.80	5.36
11	1994	4.20	4.67	5.16
11	1995	3.97	4.41	4.87
11	1996	3.78	4.25	4.72
11	1997	3.89	4.36	4.86
11	1998	4.26	4.84	5.47
11	1999	5.04	5.72	6.43
11	2000	6.06	7.09	8.22
12	1991	3.38	3.98	4.62
12	1992	4.46	4.95	5.46
12	1993	5.11	5.62	6.15
12	1994	5.48	5.96	6.47
12	1995	5.61	6.09	6.60
12	1996	5.65	6.16	6.72
12	1997	5.83	6.34	6.87
12	1998	6.01	6.62	7.29
12	1999	6.10	6.74	7.43
12	2000	5.57	6.46	7.37
13	1991	7.23	7.78	8.37
13	1992	7.70	8.06	8.43
13	1993	7.71	8.09	8.48
13	1994	7.58	7.91	8.25
13	1995	7.28	7.59	7.93
13	1996	6.87	7.21	7.56
13	1997	6.49	6.81	7.11
13	1998	6.10	6.45	6.80
13	1999	5.84	6.19	6.55
13	2000	5.60	6.07	6.57
14	1991	7.46	8.19	8.95
14	1992	8.77	9.30	9.85
14	1993	8.80	9.33	9.89
14	1994	8.16	8.60	9.05
14	1995	7.15	7.56	7.98
14	1996	6.19	6.60	7.01
14	1997	5.58	5.93	6.30
14	1998	5.18	5.59	6.04
14	1999	5.12	5.54	5.99
14	2000	5.18	5.77	6.40

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
1	1991	6.83	6.96	7.09
1	1992	7.53	7.61	7.70
1	1993	7.65	7.74	7.83
1	1994	7.38	7.46	7.53
1	1995	6.96	7.03	7.10
1	1996	6.53	6.61	6.69
1	1997	6.19	6.26	6.33
1	1998	5.99	6.07	6.15
1	1999	5.95	6.04	6.12
1	2000	6.02	6.14	6.25

HA: 1 Interior HA

HSDA: 11 East Kootenay
12 Kootenay/Boundary
13 Okanagan
14 Thompson Cariboo Shuswap

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
21	1991	8.53	9.29	10.10
21	1992	10.47	11.04	11.63
21	1993	10.58	11.15	11.74
21	1994	9.69	10.16	10.64
21	1995	8.45	8.88	9.31
21	1996	7.50	7.91	8.34
21	1997	7.24	7.61	8.00
21	1998	7.25	7.72	8.22
21	1999	6.94	7.43	7.93
21	2000	5.48	6.08	6.68
22	1991	7.57	8.14	8.71
22	1992	9.00	9.39	9.79
22	1993	9.39	9.79	10.21
22	1994	9.19	9.55	9.92
22	1995	8.68	9.03	9.39
22	1996	8.18	8.55	8.93
22	1997	8.04	8.38	8.72
22	1998	8.05	8.46	8.88
22	1999	8.02	8.45	8.90
22	2000	7.44	7.98	8.54
23	1991	7.69	8.24	8.80
23	1992	9.23	9.62	10.01
23	1993	9.87	10.27	10.69
23	1994	9.93	10.28	10.64
23	1995	9.57	9.90	10.24
23	1996	9.06	9.42	9.79
23	1997	8.74	9.07	9.40
23	1998	8.58	8.96	9.35
23	1999	8.65	9.06	9.47
23	2000	8.81	9.37	9.97

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
2	1991	8.31	8.44	8.57
2	1992	9.76	9.85	9.94
2	1993	10.20	10.29	10.38
2	1994	9.92	10.00	10.07
2	1995	9.29	9.37	9.44
2	1996	8.67	8.75	8.83
2	1997	8.40	8.47	8.54
2	1998	8.41	8.49	8.58
2	1999	8.38	8.47	8.56
2	2000	7.99	8.10	8.22

HA: 2 Fraser HA

HSDA: 21 Fraser Valley
22 Simon Fraser
23 South Fraser

Table G.32. (continued) Fitted Medical Adverse Event Rate. Males 65-79 Years.

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
31	1991	7.78	8.79	9.94
31	1992	8.71	9.43	10.21
31	1993	8.64	9.38	10.14
31	1994	8.33	8.96	9.62
31	1995	7.95	8.54	9.14
31	1996	7.79	8.41	9.06
31	1997	8.24	8.87	9.52
31	1998	8.85	9.62	10.46
31	1999	8.80	9.56	10.44
31	2000	6.74	7.75	8.82
32	1991	6.06	6.53	7.04
32	1992	6.82	7.14	7.48
32	1993	7.02	7.37	7.72
32	1994	7.04	7.35	7.66
32	1995	6.97	7.27	7.57
32	1996	6.98	7.31	7.65
32	1997	7.34	7.66	7.98
32	1998	7.82	8.20	8.60
32	1999	8.04	8.47	8.90
32	2000	7.37	7.93	8.50
33	1991	5.01	5.58	6.17
33	1992	6.33	6.76	7.21
33	1993	6.86	7.32	7.79
33	1994	6.95	7.35	7.77
33	1995	6.74	7.12	7.54
33	1996	6.52	6.92	7.35
33	1997	6.60	7.00	7.41
33	1998	6.84	7.32	7.83
33	1999	7.02	7.53	8.07
33	2000	6.55	7.24	7.96

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
3	1991	6.42	6.54	6.66
3	1992	7.24	7.32	7.41
3	1993	7.53	7.62	7.71
3	1994	7.51	7.59	7.67
3	1995	7.34	7.42	7.49
3	1996	7.27	7.35	7.44
3	1997	7.55	7.63	7.71
3	1998	8.03	8.13	8.23
3	1999	8.24	8.35	8.46
3	2000	7.54	7.68	7.82

HA: 3 Vancouver Coastal HA

HSDA: 31 Richmond
32 Vancouver
33 North Shore / Coast Garibaldi

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
41	1991	7.63	8.12	8.64
41	1992	9.82	10.20	10.59
41	1993	10.38	10.79	11.23
41	1994	9.79	10.14	10.51
41	1995	8.60	8.94	9.28
41	1996	7.49	7.82	8.17
41	1997	6.87	7.16	7.46
41	1998	6.65	6.99	7.34
41	1999	6.82	7.19	7.57
41	2000	7.17	7.69	8.25
42	1991	5.52	6.08	6.67
42	1992	6.96	7.38	7.80
42	1993	7.35	7.77	8.21
42	1994	7.06	7.44	7.82
42	1995	6.42	6.77	7.14
42	1996	5.80	6.15	6.51
42	1997	5.52	5.83	6.15
42	1998	5.46	5.83	6.22
42	1999	5.65	6.04	6.46
42	2000	5.79	6.34	6.93
43	1991	5.04	6.38	7.81
43	1992	7.40	8.42	9.53
43	1993	8.24	9.28	10.45
43	1994	8.02	8.97	10.02
43	1995	7.21	8.02	8.89
43	1996	6.25	7.00	7.83
43	1997	5.53	6.30	7.10
43	1998	5.06	5.94	6.90
43	1999	4.97	5.78	6.66
43	2000	4.53	5.71	7.03

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
4	1991	7.23	7.36	7.50
4	1992	9.06	9.15	9.25
4	1993	9.53	9.63	9.74
4	1994	9.02	9.11	9.20
4	1995	8.00	8.08	8.16
4	1996	7.06	7.15	7.23
4	1997	6.51	6.59	6.66
4	1998	6.39	6.47	6.56
4	1999	6.56	6.65	6.74
4	2000	6.91	7.04	7.17

HA: 4 Vancouver Island HA

HSDA: 41 South Vancouver Island
42 Central Vancouver Island
43 North Vancouver Island

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
51	1991	4.66	5.65	6.76
51	1992	5.62	6.37	7.17
51	1993	5.98	6.74	7.53
51	1994	6.17	6.88	7.61
51	1995	6.33	7.00	7.72
51	1996	6.62	7.31	8.06
51	1997	7.31	8.06	8.85
51	1998	8.03	9.00	10.04
51	1999	8.06	9.06	10.13
51	2000	6.13	7.33	8.65
52	1991	3.28	3.91	4.61
52	1992	4.31	4.81	5.37
52	1993	4.81	5.35	5.91
52	1994	5.02	5.51	6.05
52	1995	4.98	5.46	5.97
52	1996	4.86	5.35	5.89
52	1997	4.88	5.37	5.87
52	1998	4.97	5.54	6.14
52	1999	5.21	5.81	6.45
52	2000	5.22	6.11	7.08
53	1991	3.41	4.39	5.50
53	1992	4.40	5.21	6.10
53	1993	4.83	5.62	6.48
53	1994	4.98	5.71	6.50
53	1995	5.03	5.71	6.45
53	1996	5.13	5.84	6.60
53	1997	5.55	6.36	7.27
53	1998	6.04	7.09	8.28
53	1999	6.23	7.27	8.42
53	2000	4.83	6.15	7.61

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
5	1991	4.33	4.52	4.69
5	1992	5.23	5.36	5.50
5	1993	5.68	5.82	5.96
5	1994	5.84	5.97	6.10
5	1995	5.83	5.96	6.08
5	1996	5.91	6.04	6.17
5	1997	6.22	6.35	6.48
5	1998	6.68	6.85	7.02
5	1999	6.87	7.05	7.22
5	2000	6.25	6.49	6.72

HA: 5 Northern HA

HSDA: 51 Northwest
52 Northern Interior
53 Northeast

Table G.33. Fitted Medical Adverse Event Rate. Females 65-79 Years.

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
11	1991	3.64	4.42	5.25
11	1992	3.86	4.36	4.90
11	1993	3.65	4.19	4.77
11	1994	3.54	4.02	4.52
11	1995	3.51	3.92	4.34
11	1996	3.58	4.00	4.43
11	1997	3.89	4.37	4.86
11	1998	4.35	4.97	5.63
11	1999	4.86	5.51	6.23
11	2000	4.62	5.57	6.62
12	1991	4.79	5.50	6.31
12	1992	5.27	5.79	6.34
12	1993	5.11	5.68	6.27
12	1994	4.87	5.37	5.88
12	1995	4.61	5.04	5.46
12	1996	4.42	4.85	5.26
12	1997	4.51	4.95	5.41
12	1998	4.68	5.22	5.79
12	1999	4.76	5.31	5.89
12	2000	4.09	4.85	5.67
13	1991	5.37	5.87	6.38
13	1992	5.69	6.01	6.33
13	1993	5.57	5.91	6.26
13	1994	5.39	5.67	5.97
13	1995	5.16	5.41	5.68
13	1996	4.96	5.23	5.51
13	1997	4.93	5.20	5.48
13	1998	4.89	5.21	5.55
13	1999	4.66	4.98	5.31
13	2000	3.87	4.29	4.73
14	1991	5.72	6.40	7.14
14	1992	7.04	7.51	7.99
14	1993	7.21	7.71	8.23
14	1994	6.79	7.23	7.67
14	1995	6.08	6.45	6.82
14	1996	5.38	5.73	6.09
14	1997	4.92	5.26	5.62
14	1998	4.66	5.06	5.48
14	1999	4.61	5.00	5.42
14	2000	4.44	4.99	5.58

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
1	1991	5.67	5.79	5.91
1	1992	6.11	6.18	6.26
1	1993	6.07	6.16	6.24
1	1994	5.78	5.85	5.92
1	1995	5.42	5.48	5.54
1	1996	5.12	5.18	5.24
1	1997	5.02	5.09	5.15
1	1998	5.07	5.15	5.22
1	1999	5.00	5.08	5.16
1	2000	4.59	4.70	4.80

HA: 1 Interior HA

HSDA: 11 East Kootenay
12 Kootenay/Boundary
13 Okanagan
14 Thompson Cariboo Shuswap

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
21	1991	6.73	7.44	8.17
21	1992	9.52	10.03	10.58
21	1993	10.20	10.79	11.40
21	1994	9.46	9.96	10.46
21	1995	8.09	8.51	8.92
21	1996	6.86	7.25	7.65
21	1997	6.27	6.63	7.01
21	1998	6.00	6.42	6.86
21	1999	5.58	5.99	6.42
21	2000	4.33	4.87	5.44
22	1991	7.01	7.55	8.11
22	1992	7.79	8.15	8.52
22	1993	7.73	8.09	8.47
22	1994	7.35	7.66	7.98
22	1995	6.89	7.18	7.48
22	1996	6.59	6.90	7.21
22	1997	6.74	7.04	7.35
22	1998	7.09	7.46	7.85
22	1999	7.21	7.60	8.02
22	2000	6.34	6.87	7.41
23	1991	6.87	7.39	7.90
23	1992	8.70	9.09	9.50
23	1993	9.33	9.75	10.18
23	1994	9.17	9.53	9.89
23	1995	8.52	8.86	9.20
23	1996	7.84	8.19	8.56
23	1997	7.55	7.86	8.18
23	1998	7.46	7.83	8.21
23	1999	7.38	7.76	8.17
23	2000	6.84	7.34	7.86

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
2	1991	7.35	7.46	7.58
2	1992	8.84	8.92	9.00
2	1993	9.24	9.33	9.41
2	1994	8.83	8.91	8.98
2	1995	8.08	8.15	8.21
2	1996	7.43	7.50	7.57
2	1997	7.22	7.28	7.35
2	1998	7.30	7.38	7.46
2	1999	7.22	7.30	7.38
2	2000	6.52	6.63	6.74

HA: 2 Fraser HA

HSDA: 21 Fraser Valley
22 Simon Fraser
23 South Fraser

Table G.33. (continued) Fitted Medical Adverse Event Rate. Females 65-79 Years.

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
31	1991	6.68	7.61	8.62
31	1992	8.33	9.01	9.72
31	1993	8.43	9.15	9.90
31	1994	7.84	8.46	9.08
31	1995	6.99	7.53	8.06
31	1996	6.31	6.85	7.38
31	1997	6.21	6.73	7.27
31	1998	6.46	7.08	7.74
31	1999	6.73	7.40	8.12
31	2000	6.23	7.15	8.15
32	1991	5.09	5.49	5.91
32	1992	5.74	6.01	6.30
32	1993	5.77	6.07	6.38
32	1994	5.60	5.86	6.13
32	1995	5.39	5.63	5.88
32	1996	5.31	5.58	5.85
32	1997	5.64	5.91	6.19
32	1998	6.16	6.51	6.87
32	1999	6.40	6.77	7.14
32	2000	5.54	6.03	6.54
33	1991	5.10	5.67	6.27
33	1992	5.84	6.23	6.64
33	1993	5.92	6.34	6.78
33	1994	5.78	6.16	6.53
33	1995	5.58	5.91	6.25
33	1996	5.47	5.80	6.16
33	1997	5.65	5.99	6.36
33	1998	5.90	6.34	6.79
33	1999	5.82	6.27	6.72
33	2000	4.71	5.29	5.92

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
3	1991	5.71	5.82	5.94
3	1992	6.42	6.50	6.57
3	1993	6.50	6.59	6.67
3	1994	6.26	6.34	6.41
3	1995	5.93	6.00	6.06
3	1996	5.77	5.84	5.91
3	1997	5.99	6.06	6.13
3	1998	6.45	6.54	6.63
3	1999	6.62	6.71	6.80
3	2000	5.84	5.97	6.09

HA: 3 Vancouver Coastal HA

HSDA: 31 Richmond
32 Vancouver
33 North Shore / Coast Garibaldi

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
41	1991	5.85	6.29	6.75
41	1992	7.60	7.92	8.24
41	1993	8.09	8.44	8.80
41	1994	7.72	8.02	8.32
41	1995	6.90	7.17	7.45
41	1996	6.08	6.36	6.64
41	1997	5.63	5.88	6.15
41	1998	5.44	5.76	6.08
41	1999	5.48	5.81	6.15
41	2000	5.43	5.90	6.40
42	1991	4.57	5.10	5.66
42	1992	5.87	6.25	6.64
42	1993	6.17	6.59	7.04
42	1994	5.93	6.30	6.68
42	1995	5.42	5.74	6.06
42	1996	4.94	5.24	5.56
42	1997	4.73	5.03	5.34
42	1998	4.74	5.11	5.47
42	1999	4.89	5.26	5.65
42	2000	4.75	5.28	5.84
43	1991	4.66	5.69	6.79
43	1992	6.37	7.23	8.18
43	1993	6.73	7.75	8.88
43	1994	6.45	7.37	8.35
43	1995	5.87	6.58	7.35
43	1996	5.18	5.82	6.53
43	1997	4.68	5.38	6.14
43	1998	4.50	5.30	6.17
43	1999	4.68	5.47	6.30
43	2000	4.67	5.85	7.27

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
4	1991	5.78	5.90	6.01
4	1992	7.28	7.38	7.47
4	1993	7.72	7.82	7.92
4	1994	7.37	7.45	7.53
4	1995	6.58	6.65	6.72
4	1996	5.87	5.94	6.01
4	1997	5.48	5.55	5.62
4	1998	5.40	5.48	5.57
4	1999	5.50	5.59	5.67
4	2000	5.54	5.66	5.78

HA: 4 Vancouver Island HA

HSDA: 41 South Vancouver Island
42 Central Vancouver Island
43 North Vancouver Island

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
51	1991	4.46	5.45	6.55
51	1992	5.07	5.77	6.51
51	1993	5.03	5.81	6.65
51	1994	5.00	5.71	6.49
51	1995	5.09	5.68	6.31
51	1996	5.32	5.88	6.49
51	1997	5.84	6.52	7.27
51	1998	6.45	7.37	8.44
51	1999	6.52	7.43	8.44
51	2000	4.75	5.86	7.10
52	1991	3.38	4.07	4.81
52	1992	4.02	4.52	5.03
52	1993	4.06	4.62	5.21
52	1994	4.00	4.51	5.04
52	1995	3.93	4.35	4.79
52	1996	3.95	4.33	4.74
52	1997	4.16	4.60	5.06
52	1998	4.46	5.04	5.64
52	1999	4.57	5.15	5.75
52	2000	3.70	4.43	5.25
53	1991	4.60	5.71	6.92
53	1992	5.72	6.64	7.64
53	1993	5.73	6.76	7.89
53	1994	5.39	6.30	7.30
53	1995	4.90	5.63	6.39
53	1996	4.40	5.07	5.73
53	1997	4.12	4.82	5.55
53	1998	4.17	5.01	5.93
53	1999	4.95	5.86	6.83
53	2000	6.34	7.95	9.86

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
5	1991	4.58	4.78	4.98
5	1992	5.20	5.34	5.47
5	1993	5.25	5.40	5.55
5	1994	5.05	5.19	5.33
5	1995	4.88	5.00	5.11
5	1996	4.86	4.97	5.07
5	1997	5.11	5.23	5.35
5	1998	5.58	5.74	5.89
5	1999	5.78	5.93	6.08
5	2000	5.30	5.53	5.74

HA: 5 Northern HA

HSDA: 51 Northwest
52 Northern Interior
53 Northeast

Table G.34. Fitted Medical Adverse Event Rate. Males 80 or More Years.

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
11	1991	2.16	3.12	4.22
11	1992	2.60	3.30	4.06
11	1993	2.71	3.43	4.18
11	1994	2.87	3.54	4.27
11	1995	3.06	3.70	4.41
11	1996	3.34	3.99	4.74
11	1997	3.79	4.53	5.36
11	1998	4.23	5.20	6.33
11	1999	4.46	5.47	6.67
11	2000	3.54	4.81	6.29
12	1991	2.50	3.39	4.40
12	1992	3.49	4.18	4.93
12	1993	3.99	4.68	5.43
12	1994	4.24	4.90	5.60
12	1995	4.31	4.96	5.68
12	1996	4.36	5.03	5.79
12	1997	4.56	5.27	6.03
12	1998	4.70	5.54	6.51
12	1999	4.56	5.39	6.37
12	2000	3.44	4.46	5.64
13	1991	4.81	5.65	6.58
13	1992	4.64	5.11	5.61
13	1993	4.36	4.85	5.35
13	1994	4.34	4.75	5.18
13	1995	4.36	4.73	5.11
13	1996	4.31	4.72	5.15
13	1997	4.27	4.65	5.04
13	1998	4.05	4.50	4.96
13	1999	3.87	4.32	4.77
13	2000	3.57	4.14	4.76
14	1991	4.83	5.90	7.05
14	1992	6.02	6.79	7.61
14	1993	6.16	6.93	7.77
14	1994	5.89	6.55	7.27
14	1995	5.36	5.99	6.65
14	1996	4.90	5.53	6.18
14	1997	4.78	5.37	6.01
14	1998	4.80	5.50	6.25
14	1999	4.94	5.67	6.44
14	2000	4.65	5.65	6.72

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
1	1991	4.90	5.09	5.27
1	1992	5.00	5.12	5.23
1	1993	5.04	5.16	5.27
1	1994	4.95	5.05	5.15
1	1995	4.85	4.94	5.04
1	1996	4.76	4.86	4.96
1	1997	4.78	4.88	4.98
1	1998	4.83	4.94	5.05
1	1999	4.77	4.88	5.00
1	2000	4.41	4.57	4.72

HA: 1 Interior HA

HSDA: 11 East Kootenay
12 Kootenay/Boundary
13 Okanagan
14 Thompson Cariboo Shuswap

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
21	1991	6.63	7.78	9.00
21	1992	8.31	9.14	10.03
21	1993	8.42	9.25	10.16
21	1994	7.84	8.53	9.26
21	1995	6.94	7.58	8.26
21	1996	6.24	6.88	7.54
21	1997	6.11	6.70	7.31
21	1998	6.10	6.78	7.51
21	1999	5.64	6.32	7.04
21	2000	3.97	4.79	5.69
22	1991	6.79	7.68	8.62
22	1992	7.71	8.32	8.97
22	1993	7.64	8.24	8.88
22	1994	7.21	7.71	8.25
22	1995	6.60	7.10	7.59
22	1996	6.13	6.66	7.18
22	1997	6.11	6.59	7.09
22	1998	6.35	6.91	7.49
22	1999	6.81	7.42	8.06
22	2000	7.00	7.89	8.83
23	1991	6.19	7.04	7.95
23	1992	6.79	7.35	7.94
23	1993	7.05	7.65	8.27
23	1994	7.39	7.91	8.44
23	1995	7.60	8.11	8.64
23	1996	7.66	8.23	8.83
23	1997	7.74	8.26	8.81
23	1998	7.65	8.22	8.82
23	1999	7.53	8.14	8.76
23	2000	7.27	8.07	8.90

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
2	1991	7.26	7.46	7.65
2	1992	7.99	8.13	8.26
2	1993	8.11	8.24	8.38
2	1994	7.86	7.98	8.09
2	1995	7.50	7.61	7.72
2	1996	7.22	7.33	7.45
2	1997	7.19	7.30	7.41
2	1998	7.30	7.42	7.55
2	1999	7.34	7.47	7.60
2	2000	7.08	7.25	7.43

HA: 2 Fraser HA

HSDA: 21 Fraser Valley
22 Simon Fraser
23 South Fraser

Table G.34. (continued) Fitted Medical Adverse Event Rate. Males 80 or More Years.

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
31	1991	9.40	11.45	13.76
31	1992	9.87	11.26	12.84
31	1993	8.72	9.93	11.28
31	1994	7.41	8.36	9.39
31	1995	6.29	7.17	8.11
31	1996	5.77	6.68	7.65
31	1997	6.29	7.18	8.10
31	1998	7.41	8.50	9.60
31	1999	8.28	9.50	10.80
31	2000	7.02	8.58	10.30
32	1991	4.60	5.22	5.90
32	1992	5.89	6.36	6.85
32	1993	6.39	6.91	7.44
32	1994	6.46	6.92	7.40
32	1995	6.22	6.66	7.11
32	1996	5.91	6.37	6.86
32	1997	5.86	6.30	6.75
32	1998	6.00	6.51	7.06
32	1999	6.38	6.94	7.54
32	2000	6.67	7.52	8.39
33	1991	4.24	5.15	6.16
33	1992	4.76	5.40	6.07
33	1993	4.89	5.54	6.23
33	1994	4.99	5.57	6.20
33	1995	5.02	5.58	6.17
33	1996	5.02	5.62	6.28
33	1997	5.17	5.75	6.37
33	1998	5.23	5.91	6.61
33	1999	5.24	5.93	6.68
33	2000	4.75	5.67	6.67

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
3	1991	5.73	5.92	6.11
3	1992	6.54	6.67	6.80
3	1993	6.80	6.94	7.07
3	1994	6.65	6.77	6.89
3	1995	6.34	6.46	6.58
3	1996	6.09	6.21	6.33
3	1997	6.15	6.27	6.39
3	1998	6.51	6.64	6.77
3	1999	6.93	7.09	7.24
3	2000	6.93	7.14	7.35

HA: 3 Vancouver Coastal HA

HSDA: 31 Richmond
32 Vancouver
33 North Shore / Coast Garibaldi

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
41	1991	5.31	5.98	6.67
41	1992	7.02	7.54	8.09
41	1993	7.24	7.79	8.38
41	1994	6.64	7.09	7.55
41	1995	5.71	6.11	6.53
41	1996	4.98	5.38	5.81
41	1997	4.82	5.19	5.56
41	1998	5.05	5.48	5.93
41	1999	5.43	5.91	6.43
41	2000	5.38	6.06	6.77
42	1991	3.97	4.84	5.76
42	1992	5.21	5.86	6.54
42	1993	5.51	6.17	6.88
42	1994	5.34	5.92	6.55
42	1995	4.92	5.45	6.01
42	1996	4.52	5.06	5.63
42	1997	4.47	4.98	5.50
42	1998	4.58	5.14	5.73
42	1999	4.65	5.23	5.85
42	2000	4.15	4.92	5.78
43	1991	4.16	6.07	8.41
43	1992	5.32	6.88	8.71
43	1993	5.54	7.05	8.78
43	1994	5.42	6.76	8.27
43	1995	5.14	6.37	7.74
43	1996	4.93	6.15	7.52
43	1997	5.09	6.36	7.82
43	1998	5.35	6.83	8.56
43	1999	5.39	6.85	8.57
43	2000	3.97	5.83	8.01

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
4	1991	5.49	5.68	5.88
4	1992	6.88	7.03	7.17
4	1993	7.13	7.28	7.43
4	1994	6.61	6.73	6.86
4	1995	5.82	5.93	6.04
4	1996	5.21	5.32	5.43
4	1997	5.07	5.17	5.27
4	1998	5.30	5.42	5.54
4	1999	5.60	5.73	5.86
4	2000	5.48	5.66	5.84

HA: 4 Vancouver Island HA

HSDA: 41 South Vancouver Island
42 Central Vancouver Island
43 North Vancouver Island

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
51	1991	2.97	4.38	5.97
51	1992	3.87	5.06	6.39
51	1993	4.33	5.52	6.89
51	1994	4.64	5.77	7.06
51	1995	4.75	5.90	7.19
51	1996	4.86	6.02	7.38
51	1997	5.07	6.23	7.58
51	1998	5.26	6.55	8.14
51	1999	5.48	6.80	8.37
51	2000	5.00	6.85	9.16
52	1991	1.87	2.77	3.77
52	1992	2.85	3.61	4.48
52	1993	3.23	4.00	4.92
52	1994	3.23	3.96	4.82
52	1995	3.07	3.73	4.49
52	1996	2.88	3.54	4.26
52	1997	2.92	3.57	4.29
52	1998	3.11	3.88	4.77
52	1999	3.51	4.34	5.30
52	2000	3.50	4.85	6.43
53	1991	2.75	4.01	5.59
53	1992	3.60	4.72	6.02
53	1993	3.81	4.93	6.22
53	1994	3.68	4.71	5.91
53	1995	3.38	4.32	5.41
53	1996	3.06	3.96	4.98
53	1997	2.87	3.78	4.82
53	1998	2.83	3.87	5.00
53	1999	3.18	4.28	5.52
53	2000	3.45	5.23	7.51

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
5	1991	3.30	3.56	3.82
5	1992	4.07	4.29	4.51
5	1993	4.42	4.64	4.86
5	1994	4.39	4.60	4.80
5	1995	4.26	4.45	4.65
5	1996	4.07	4.26	4.44
5	1997	4.07	4.26	4.44
5	1998	4.42	4.65	4.87
5	1999	4.75	5.00	5.24
5	2000	5.19	5.59	5.96

HA: 5 Northern HA

HSDA: 51 Northwest
52 Northern Interior
53 Northeast

Table G.35. Fitted Medical Adverse Event Rate. Females 80 or More Years.

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
11	1991	2.69	3.75	4.93
11	1992	2.95	3.68	4.47
11	1993	2.97	3.75	4.57
11	1994	3.18	3.89	4.65
11	1995	3.45	4.10	4.79
11	1996	3.64	4.33	5.11
11	1997	3.86	4.57	5.35
11	1998	4.03	4.82	5.74
11	1999	4.36	5.19	6.18
11	2000	4.50	5.83	7.40
12	1991	3.03	3.85	4.78
12	1992	3.52	4.16	4.86
12	1993	3.66	4.35	5.12
12	1994	3.77	4.40	5.09
12	1995	3.76	4.34	4.98
12	1996	3.62	4.21	4.86
12	1997	3.47	4.03	4.61
12	1998	3.26	3.82	4.43
12	1999	3.05	3.59	4.19
12	2000	2.53	3.34	4.27
13	1991	3.95	4.60	5.32
13	1992	3.96	4.38	4.82
13	1993	3.84	4.26	4.70
13	1994	3.83	4.19	4.57
13	1995	3.80	4.14	4.50
13	1996	3.71	4.08	4.47
13	1997	3.63	3.97	4.32
13	1998	3.44	3.82	4.21
13	1999	3.27	3.65	4.03
13	2000	3.01	3.49	4.01
14	1991	5.25	6.28	7.43
14	1992	6.07	6.82	7.62
14	1993	6.02	6.76	7.60
14	1994	5.70	6.32	6.99
14	1995	5.20	5.78	6.38
14	1996	4.76	5.35	5.98
14	1997	4.62	5.17	5.76
14	1998	4.48	5.08	5.70
14	1999	4.07	4.63	5.23
14	2000	2.86	3.60	4.41

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
1	1991	4.61	4.77	4.93
1	1992	4.71	4.82	4.93
1	1993	4.69	4.81	4.92
1	1994	4.58	4.68	4.77
1	1995	4.47	4.56	4.65
1	1996	4.31	4.40	4.50
1	1997	4.22	4.31	4.40
1	1998	4.13	4.23	4.32
1	1999	3.94	4.03	4.13
1	2000	3.60	3.74	3.86

HA: 1 Interior HA

HSDA: 11 East Kootenay
12 Kootenay/Boundary
13 Okanagan
14 Thompson Cariboo Shuswap

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
21	1991	7.32	8.49	9.77
21	1992	10.12	11.01	11.97
21	1993	10.34	11.26	12.23
21	1994	9.10	9.83	10.62
21	1995	7.35	7.98	8.68
21	1996	5.95	6.55	7.19
21	1997	5.35	5.87	6.41
21	1998	5.05	5.66	6.30
21	1999	4.65	5.22	5.84
21	2000	3.43	4.12	4.88
22	1991	5.76	6.44	7.17
22	1992	6.78	7.27	7.76
22	1993	6.86	7.36	7.87
22	1994	6.54	6.96	7.38
22	1995	6.03	6.41	6.80
22	1996	5.59	6.00	6.42
22	1997	5.57	5.94	6.34
22	1998	5.71	6.15	6.61
22	1999	5.74	6.21	6.70
22	2000	5.08	5.71	6.35
23	1991	6.28	7.03	7.83
23	1992	7.45	7.99	8.55
23	1993	8.29	8.87	9.48
23	1994	8.99	9.52	10.05
23	1995	9.27	9.80	10.33
23	1996	9.04	9.61	10.21
23	1997	8.43	8.91	9.41
23	1998	7.58	8.08	8.60
23	1999	7.20	7.71	8.26
23	2000	7.63	8.37	9.14

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
2	1991	6.89	7.06	7.22
2	1992	8.13	8.25	8.37
2	1993	8.55	8.68	8.81
2	1994	8.38	8.49	8.59
2	1995	7.90	8.00	8.10
2	1996	7.39	7.50	7.60
2	1997	6.99	7.08	7.17
2	1998	6.71	6.82	6.92
2	1999	6.51	6.62	6.72
2	2000	6.36	6.50	6.65

HA: 2 Fraser HA

HSDA: 21 Fraser Valley
22 Simon Fraser
23 South Fraser

Table G.35. (continued) Fitted Medical Adverse Event Rate. Females 80 or More Years.

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
31	1991	6.04	7.43	8.98
31	1992	9.40	10.57	11.81
31	1993	9.81	11.03	12.31
31	1994	8.54	9.49	10.46
31	1995	6.81	7.59	8.40
31	1996	5.62	6.35	7.15
31	1997	5.54	6.23	6.97
31	1998	6.19	7.03	7.95
31	1999	6.84	7.79	8.87
31	2000	6.00	7.25	8.64
32	1991	4.86	5.38	5.92
32	1992	5.33	5.69	6.06
32	1993	5.27	5.64	6.02
32	1994	5.07	5.37	5.71
32	1995	4.76	5.06	5.37
32	1996	4.50	4.82	5.16
32	1997	4.48	4.78	5.09
32	1998	4.58	4.92	5.28
32	1999	4.72	5.11	5.51
32	2000	4.65	5.20	5.78
33	1991	4.81	5.64	6.54
33	1992	4.71	5.25	5.82
33	1993	4.42	4.96	5.53
33	1994	4.31	4.77	5.26
33	1995	4.27	4.70	5.15
33	1996	4.30	4.79	5.30
33	1997	4.57	5.05	5.54
33	1998	4.76	5.30	5.87
33	1999	4.54	5.08	5.64
33	2000	3.39	4.06	4.80

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
3	1991	5.51	5.67	5.82
3	1992	6.00	6.10	6.21
3	1993	6.02	6.12	6.23
3	1994	5.66	5.75	5.84
3	1995	5.21	5.30	5.38
3	1996	4.93	5.02	5.10
3	1997	4.96	5.05	5.13
3	1998	5.19	5.29	5.39
3	1999	5.35	5.47	5.57
3	2000	5.03	5.18	5.32

HA: 3 Vancouver Coastal HA

HSDA: 31 Richmond
32 Vancouver
33 North Shore / Coast Garibaldi

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
41	1991	5.03	5.57	6.13
41	1992	6.17	6.58	7.01
41	1993	6.07	6.50	6.93
41	1994	5.43	5.75	6.10
41	1995	4.61	4.91	5.23
41	1996	4.03	4.34	4.66
41	1997	3.98	4.26	4.53
41	1998	4.31	4.63	4.97
41	1999	4.85	5.22	5.62
41	2000	5.15	5.69	6.28
42	1991	3.92	4.75	5.69
42	1992	4.08	4.63	5.22
42	1993	4.11	4.69	5.30
42	1994	4.28	4.79	5.32
42	1995	4.36	4.84	5.36
42	1996	4.21	4.74	5.30
42	1997	3.95	4.41	4.88
42	1998	3.50	3.98	4.48
42	1999	3.26	3.73	4.22
42	2000	3.26	3.91	4.62
43	1991	4.10	5.72	7.64
43	1992	5.19	6.59	8.22
43	1993	5.36	6.89	8.70
43	1994	5.37	6.71	8.25
43	1995	5.11	6.32	7.64
43	1996	4.77	5.95	7.25
43	1997	4.64	5.77	7.04
43	1998	4.56	5.73	7.04
43	1999	4.37	5.52	6.81
43	2000	3.28	4.95	6.91

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
4	1991	5.23	5.38	5.54
4	1992	6.02	6.14	6.25
4	1993	5.98	6.10	6.22
4	1994	5.47	5.57	5.66
4	1995	4.86	4.95	5.03
4	1996	4.42	4.51	4.60
4	1997	4.27	4.35	4.43
4	1998	4.40	4.49	4.59
4	1999	4.69	4.79	4.90
4	2000	4.97	5.12	5.27

HA: 4 Vancouver Island HA

HSDA: 41 South Vancouver Island
42 Central Vancouver Island
43 North Vancouver Island

HSDA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
51	1991	2.37	3.49	4.76
51	1992	2.42	3.24	4.14
51	1993	2.46	3.32	4.29
51	1994	2.74	3.59	4.55
51	1995	3.13	3.96	4.94
51	1996	3.42	4.30	5.38
51	1997	3.55	4.44	5.50
51	1998	3.54	4.45	5.57
51	1999	3.75	4.73	5.94
51	2000	4.05	5.84	8.05
52	1991	1.93	2.78	3.77
52	1992	2.25	2.92	3.67
52	1993	2.30	3.01	3.84
52	1994	2.38	3.04	3.79
52	1995	2.45	3.04	3.72
52	1996	2.43	3.03	3.70
52	1997	2.44	3.03	3.71
52	1998	2.46	3.07	3.78
52	1999	2.52	3.13	3.84
52	2000	2.28	3.24	4.40
53	1991	3.79	5.35	7.39
53	1992	3.10	4.13	5.36
53	1993	2.55	3.61	4.79
53	1994	2.47	3.43	4.50
53	1995	2.62	3.50	4.49
53	1996	2.83	3.74	4.79
53	1997	3.09	4.08	5.25
53	1998	3.22	4.28	5.53
53	1999	2.93	3.97	5.15
53	2000	1.69	3.04	4.76

HA	Year	Quantile 0.025	Fitted rate	Quantile 0.975
5	1991	3.36	3.62	3.86
5	1992	3.14	3.32	3.50
5	1993	3.05	3.24	3.43
5	1994	3.12	3.30	3.47
5	1995	3.26	3.42	3.58
5	1996	3.40	3.58	3.74
5	1997	3.52	3.70	3.87
5	1998	3.56	3.74	3.91
5	1999	3.56	3.75	3.93
5	2000	3.66	3.97	4.25

HA: 5 Northern HA

HSDA: 51 Northwest
52 Northern Interior
53 Northeast

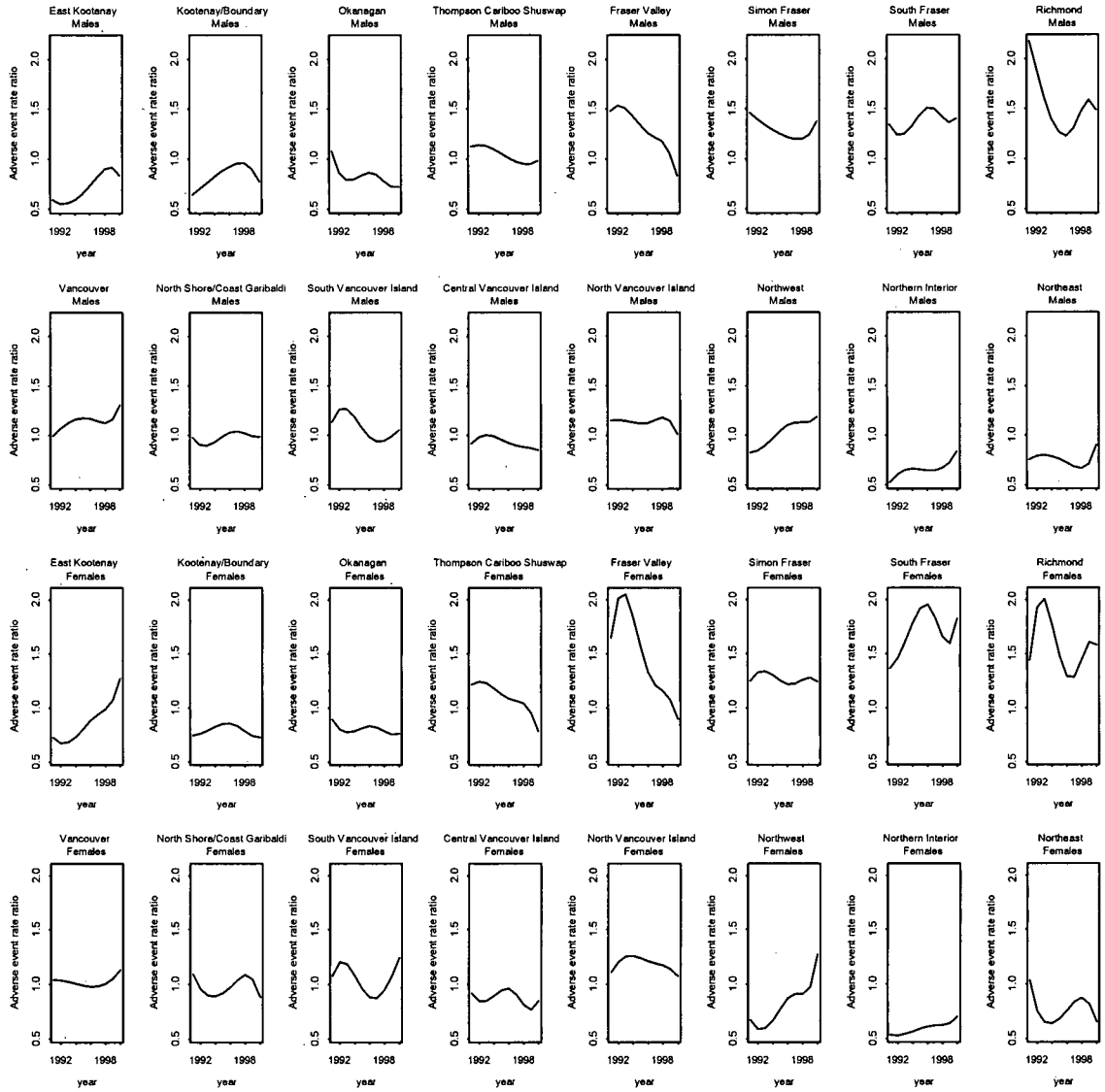

Figure G.9. Annual Ratio between the Medical Adverse Event Incidence Rate of Each Health Services Delivery Area and British Columbia for Males and Females Aged 80 or More Years, 1991-2000.

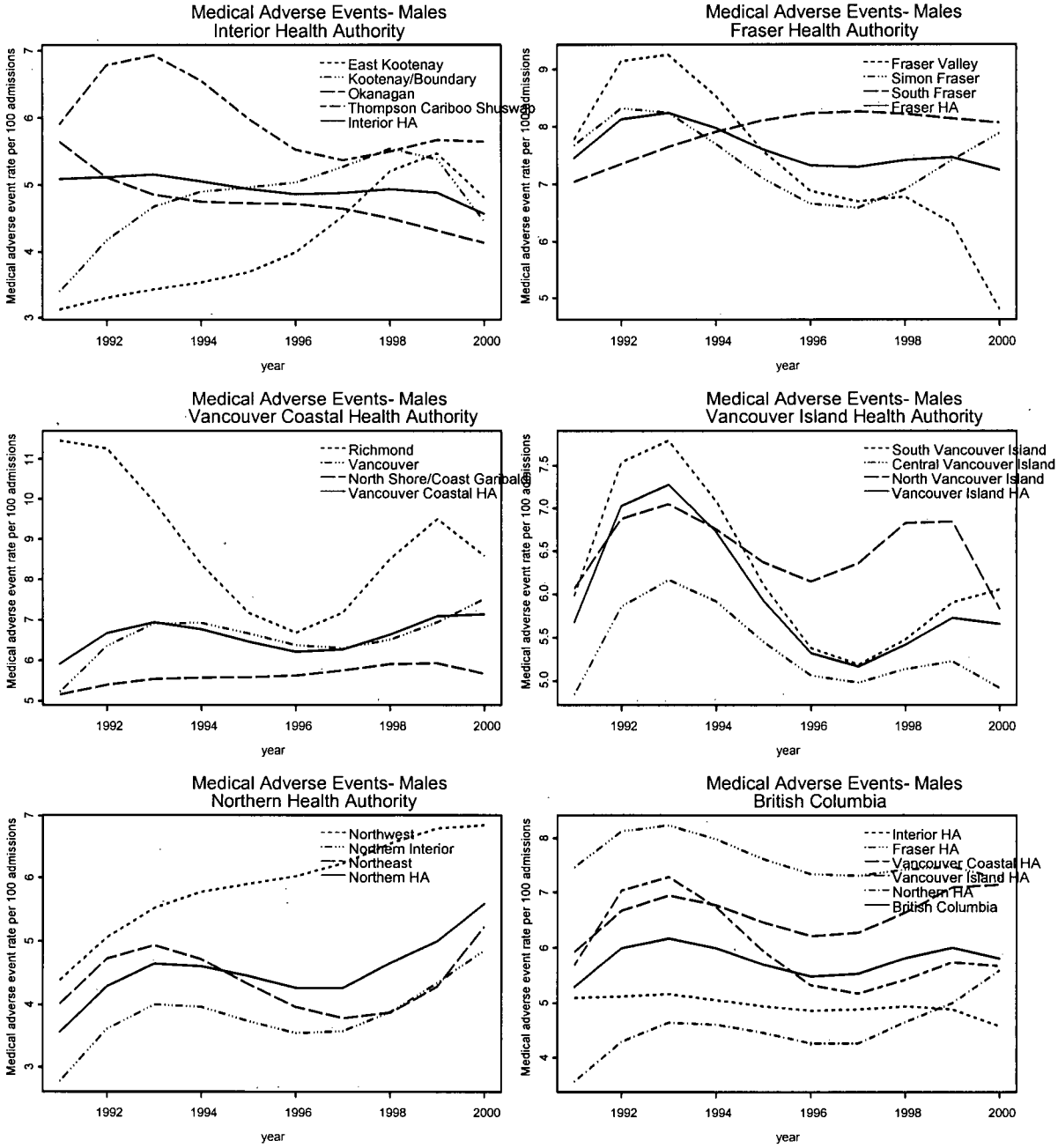

Figure G.10. Annual Medical Adverse Event Incidence Rates per 100 Admissions for Males Aged 80 or More Years at the Health Services Delivery Area, Health Authority and Provincial Levels, 1991-2000.

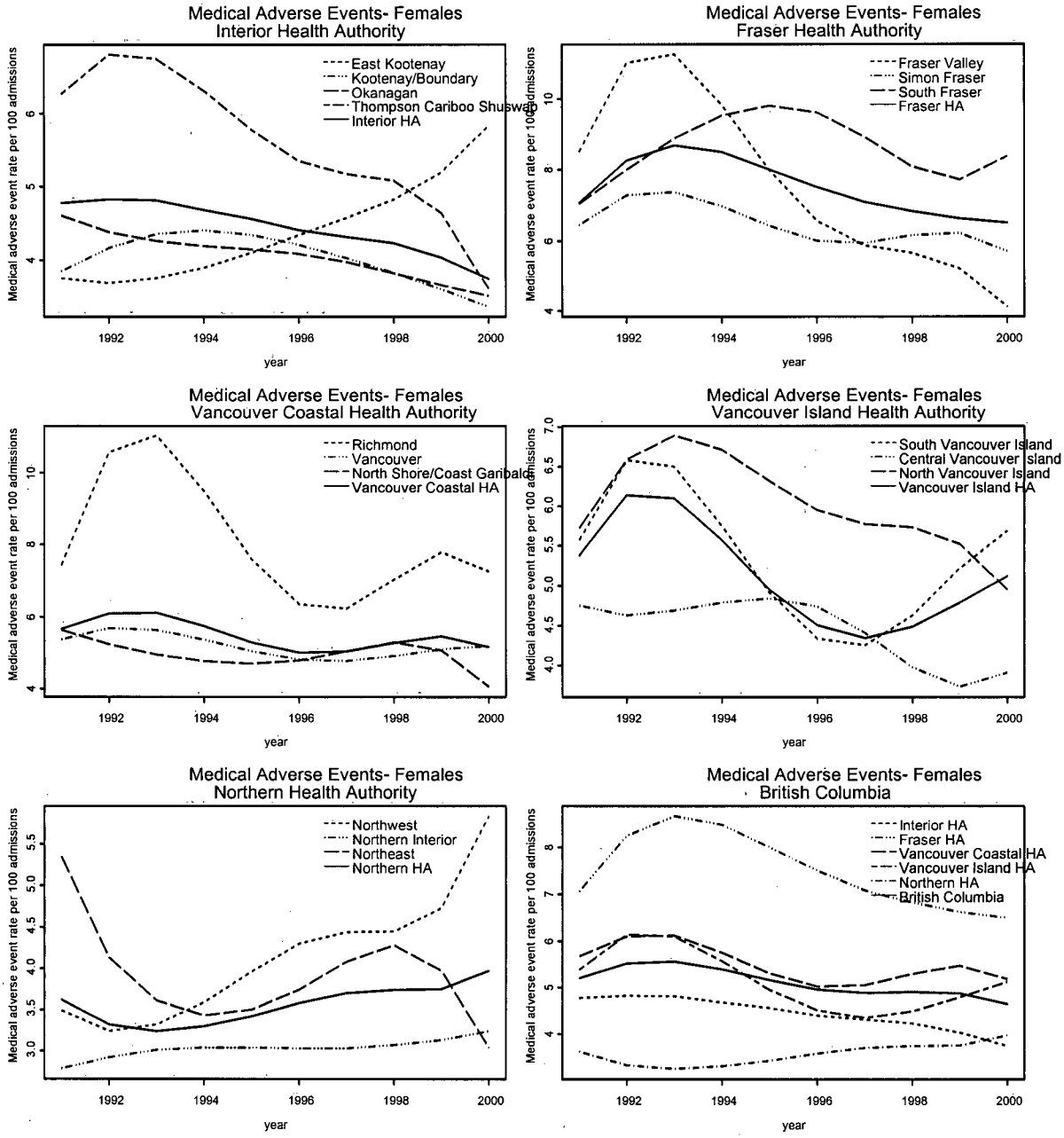

Figure G.11. Annual Medical Adverse Event Incidence Rates per 100 Admissions for Females Aged 80 or More Years at the Health Services Delivery Area, Health Authority and Provincial Levels, 1991-2000.

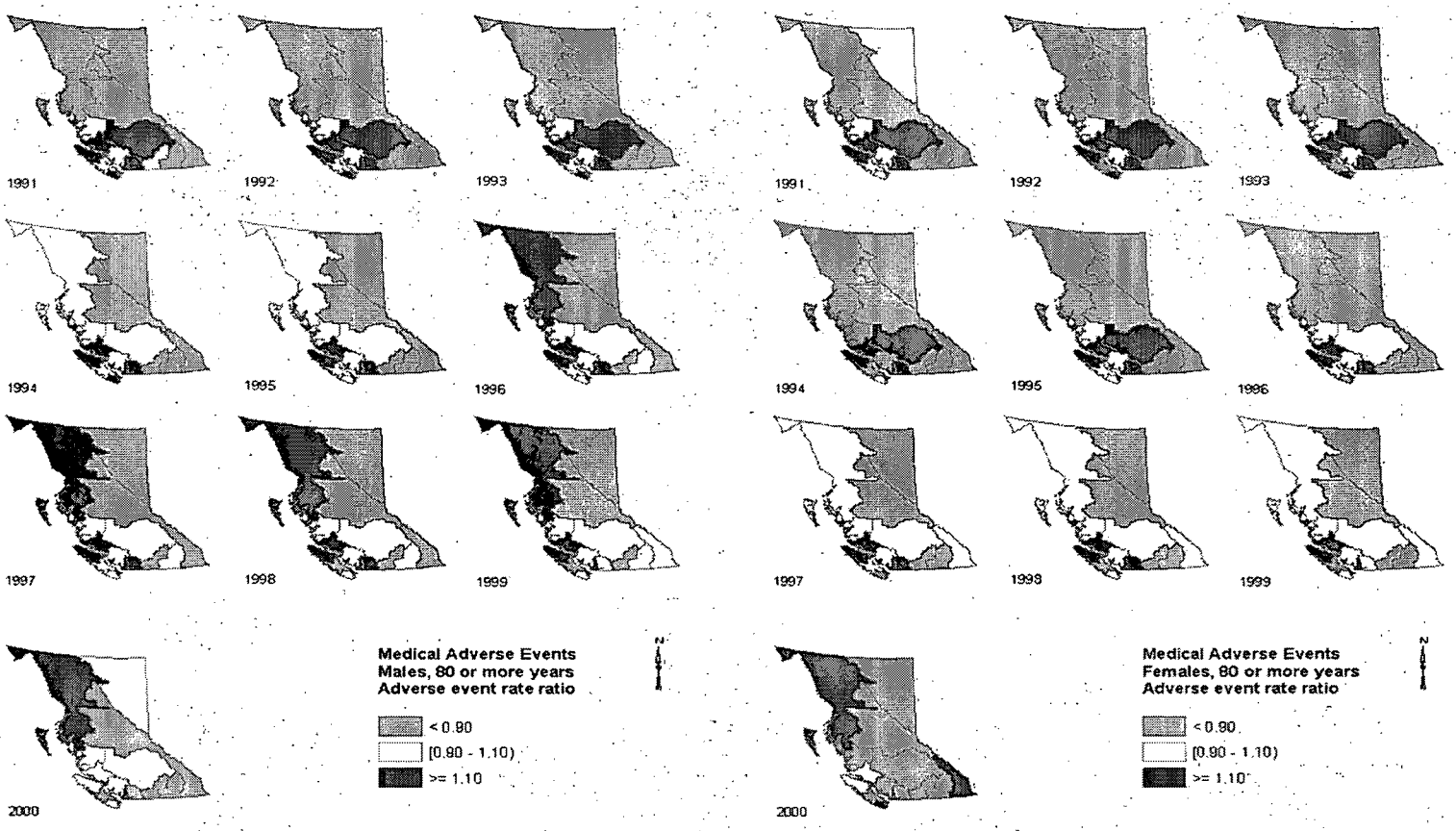

Figure G.12. Map of Annual Ratio between the Medical Adverse Event Incidence Rate of Each Health Services Delivery Area and British Columbia for Males and Females Aged 80 or More Years, 1991-2000.

Table G.36. Fitted Medical Adverse Event Rate at the BC Level. Males, All Ages.

	Year	Quantile 0.025	Fitted rate	Quantile 0.975
0-19 years	1991	1.28	1.40	1.53
	1992	1.59	1.73	1.87
	1993	1.67	1.85	2.03
	1994	1.64	1.81	1.99
	1995	1.57	1.73	1.89
	1996	1.55	1.70	1.85
	1997	1.65	1.82	1.99
	1998	1.84	2.05	2.28
	1999	1.97	2.18	2.40
	2000	1.75	1.93	2.12
	Year	**Quantile 0.025**	**Fitted rate**	**Quantile 0.975**
20-39 years	1991	2.85	3.19	3.54
	1992	3.55	3.92	4.31
	1993	3.76	4.16	4.60
	1994	3.63	4.01	4.43
	1995	3.36	3.70	4.07
	1996	3.14	3.45	3.78
	1997	3.08	3.41	3.77
	1998	3.18	3.58	3.98
	1999	3.36	3.76	4.17
	2000	3.28	3.75	4.27
	Year	**Quantile 0.025**	**Fitted rate**	**Quantile 0.975**
40-64 years	1991	4.04	4.50	4.98
	1992	5.05	5.55	6.09
	1993	5.33	5.86	6.42
	1994	5.12	5.61	6.13
	1995	4.70	5.15	5.62
	1996	4.39	4.80	5.24
	1997	4.34	4.79	5.26
	1998	4.54	5.07	5.62
	1999	4.72	5.26	5.82
	2000	4.26	4.94	5.69
	Year	**Quantile 0.025**	**Fitted rate**	**Quantile 0.975**
65-79 years	1991	5.55	6.28	7.07
	1992	6.62	7.38	8.20
	1993	7.00	7.78	8.61
	1994	6.90	7.63	8.42
	1995	6.55	7.24	7.95
	1996	6.23	6.89	7.58
	1997	6.13	6.82	7.56
	1998	6.23	7.00	7.83
	1999	6.37	7.12	7.93
	2000	5.93	6.87	7.88
	Year	**Quantile 0.025**	**Fitted rate**	**Quantile 0.975**
80+ years	1991	4.50	5.29	6.19
	1992	5.19	5.99	6.85
	1993	5.35	6.17	7.08
	1994	5.21	5.99	6.86
	1995	4.96	5.69	6.51
	1996	4.77	5.48	6.26
	1997	4.82	5.53	6.32
	1998	5.06	5.81	6.67
	1999	5.24	6.00	6.88
	2000	4.86	5.80	6.88

Table G.37. Fitted Medical Adverse Event Rate at the BC Level. Females, All Ages.

	Year	Quantile 0.025	Fitted rate	Quantile 0.975
0-19 years	1991	0.99	1.11	1.24
	1992	1.21	1.35	1.51
	1993	1.29	1.47	1.66
	1994	1.30	1.49	1.69
	1995	1.26	1.45	1.66
	1996	1.25	1.44	1.65
	1997	1.31	1.50	1.70
	1998	1.43	1.61	1.80
	1999	1.49	1.67	1.85
	2000	1.35	1.53	1.72
	Year	**Quantile 0.025**	**Fitted rate**	**Quantile 0.975**
20-39 years	1991	1.91	2.07	2.25
	1992	2.29	2.49	2.70
	1993	2.33	2.56	2.81
	1994	2.19	2.40	2.63
	1995	1.97	2.16	2.37
	1996	1.82	1.99	2.17
	1997	1.82	1.98	2.15
	1998	1.92	2.09	2.27
	1999	2.00	2.17	2.35
	2000	1.83	2.03	2.25
	Year	**Quantile 0.025**	**Fitted rate**	**Quantile 0.975**
40-64 years	1991	3.95	4.38	4.84
	1992	4.83	5.29	5.78
	1993	5.10	5.58	6.09
	1994	4.93	5.38	5.88
	1995	4.54	4.99	5.46
	1996	4.22	4.65	5.11
	1997	4.16	4.56	5.01
	1998	4.27	4.68	5.14
	1999	4.36	4.76	5.20
	2000	4.05	4.54	5.06
	Year	**Quantile 0.025**	**Fitted rate**	**Quantile 0.975**
65-79 years	1991	5.24	5.87	6.55
	1992	5.99	6.72	7.50
	1993	6.09	6.88	7.74
	1994	5.82	6.55	7.34
	1995	5.43	6.08	6.76
	1996	5.13	5.71	6.34
	1997	5.07	5.68	6.31
	1998	5.23	5.90	6.61
	1999	5.36	6.02	6.75
	2000	4.96	5.69	6.53
	Year	**Quantile 0.025**	**Fitted rate**	**Quantile 0.975**
80+ years	1991	4.37	5.20	6.18
	1992	4.57	5.52	6.63
	1993	4.49	5.56	6.78
	1994	4.35	5.39	6.58
	1995	4.22	5.16	6.21
	1996	4.13	4.96	5.93
	1997	4.08	4.89	5.81
	1998	4.13	4.91	5.81
	1999	4.11	4.88	5.76
	2000	3.64	4.65	5.86

Appendix H

Diagnostic Plots

As an illustration of the process used to assess convergence of parameters in model (3.1), in this appendix we present several diagnostic plots. In particular, we chose to show residual plots and several plots for the parameter σ_φ, which represents the overall dispersion between regions, for the model fitted for the number of deaths due to road traffic accidents, males with age between 20 and 39 years.

Figure H.1. Superimposed Posterior Marginal History Plot for Parameter σ_φ (or sigma.beta5) from Three Independent Runs after Convergence.

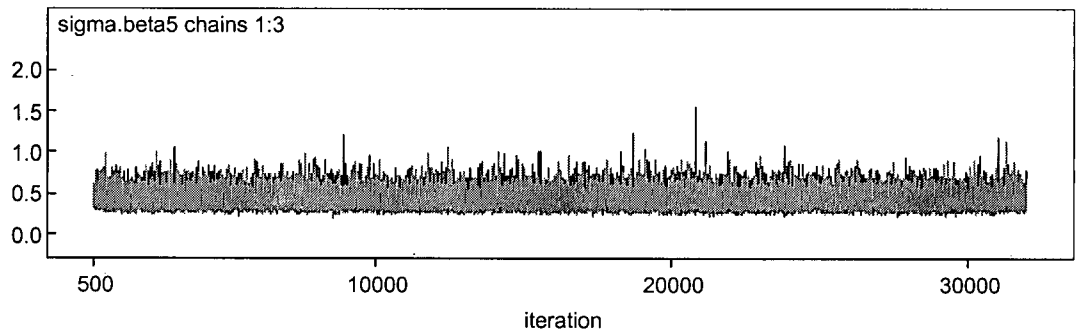

Figure H.2. Superimposed Posterior Marginal Density Plot for Parameter σ_φ (or sigma.beta5) from Three Independent Runs after Convergence.

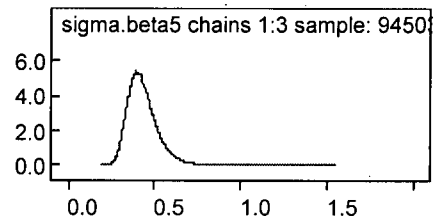

Figure H.3. Superimposed Posterior Marginal Autocorrelation Plot for Parameter σ_{φ} (or sigma.beta5) from Three Independent Runs after Convergence.

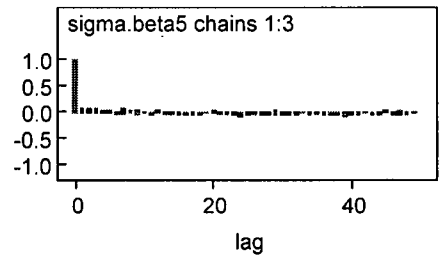

Figure H.4. Superimposed Posterior Marginal Gelman-Rubin Convergence Statistic Plot for Parameter σ_{φ} (or sigma.beta5) from Three Independent Runs after Convergence.

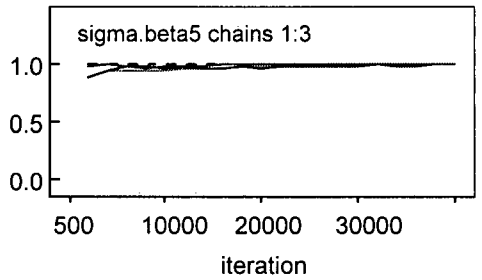

Figure H.5. QQ Plots of the Standardized Residuals for each year of study.

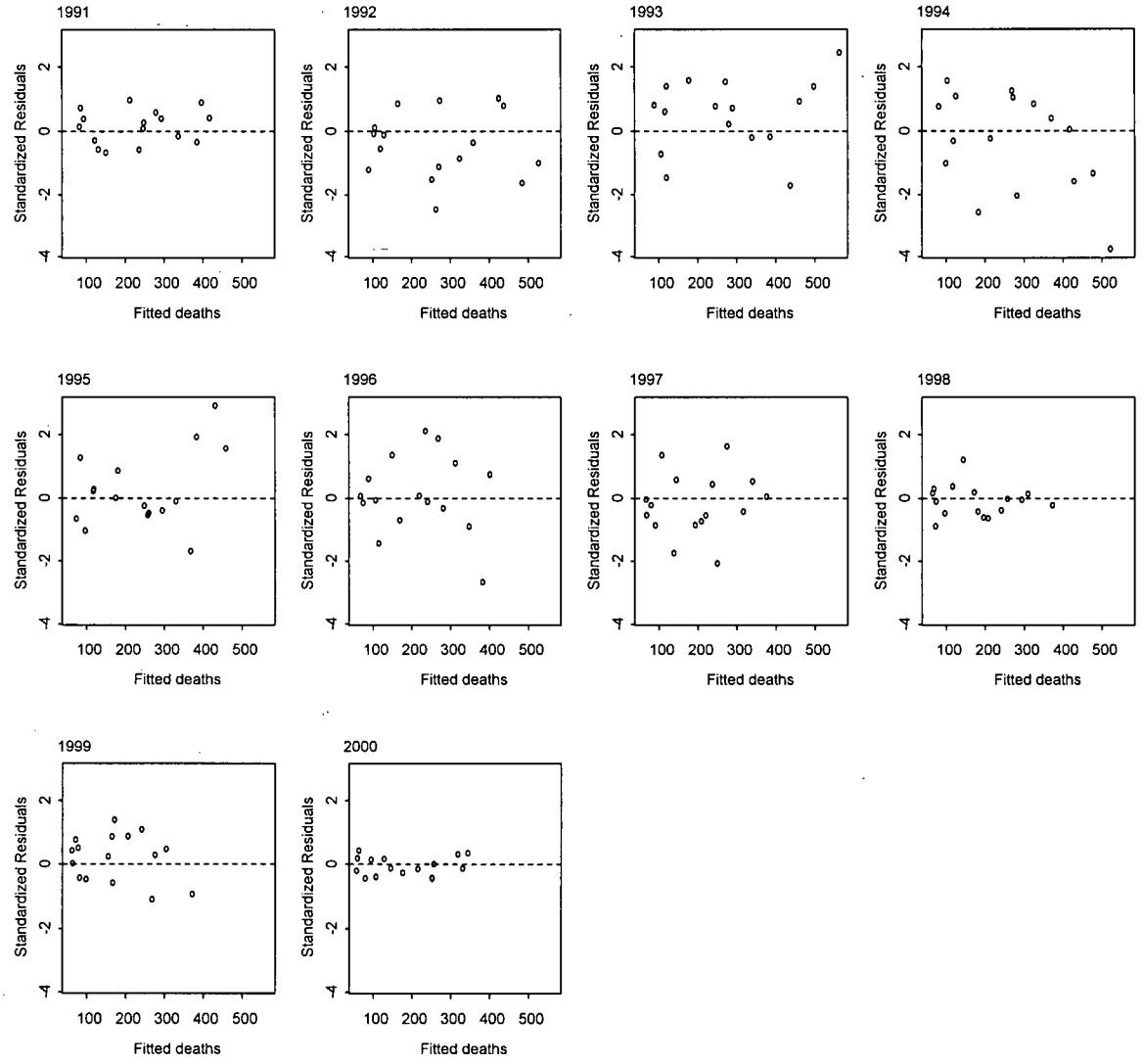
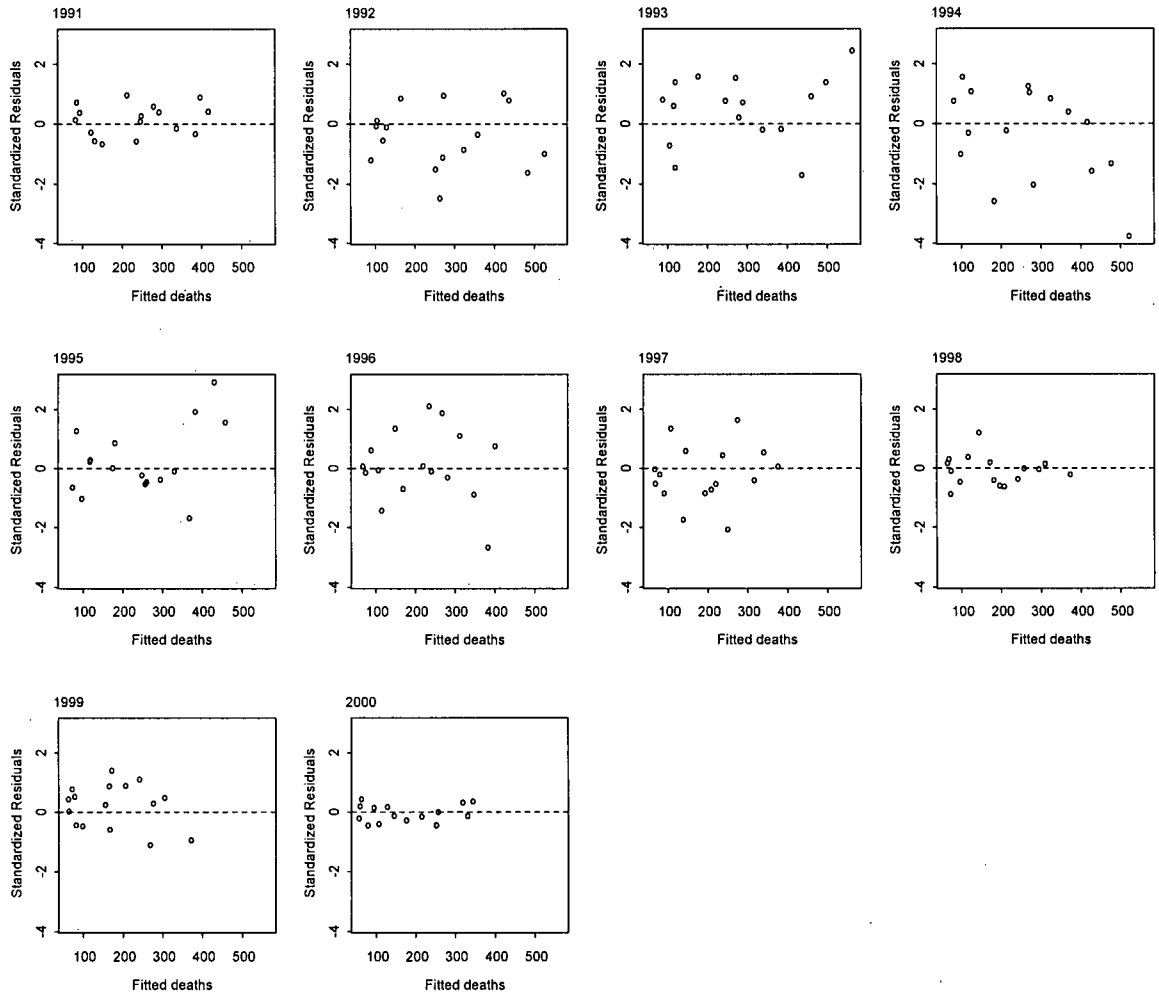
Figure H.6. Plot of the Observed Number of Deaths by the Standardized Residuals.