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Study of Factors Associated with Fall-related Injuries
Among Frail Older Adults

by

Victoria Janice Scott
B.Sc.N. University of Victoria, 1994

A Dissertation Submitted in Partial Fulfillment of the
Requirements for the Degree of

DOCTOR OF PHILOSOPHY

in the Faculty of Human and Social Development

We accept this dissertation as conforming
to the required standard

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ABSTRACT

Falls are the most frequent cause of injury-related hospitalization and death for people 65 years and older in Canada (Canadian Institute of Health Information, 1998; Langlois et al., 1995; Raina & Torrance, 1996). Studies show the etiology of a falls to be a complex combination of factors that reflect physical, behavioral and social conditions operating alone, or in conjunction with environmental hazards (Speechley & Tinetti, 1991; O'Loughlin et al., 1993). However, the particular role of these factors in relation to falls that result in injury—the subject of this study—is less well understood. Fall-related injuries among frail, older, community-dwelling adults are the focus of this study due to the growing numbers of seniors living in the community who have multiple chronic conditions, the serious consequences of many of these events for this population, and the mounting costs related to treatment.

The purpose of this study was to understand the extent and nature of fall-related injuries among frail older adults and to examine the patterns and compounding effects of a wide range of variables representing biological, behavioural, environmental, social and economic risk factors. Differences were examined for risk factors among fallers, non-fallers, injured and non-injured persons.

The secondary data used for this study were provided through the University of Victoria Centre on Aging in British Columbia and are based on the Capital Regional District (CRD) Patterns of Care Survey 1995-96 (Centre on Aging, 1996). The data from the CRD Survey are based on interviews with frail community-dwelling seniors represented by two purposefully selected groups. One group consisted of over 3,000

seniors in the CRD receiving publicly-funded home support services in 1995, and the other, a matched sample of 810 seniors screened by age, gender and functional limitations, drawn from the 56,774 seniors in the CRD not receiving home support services. Five hundred and six participants were randomly selected from each group.

Of the 1012 respondents to the CRD Survey, 245 reported a fall with an injury, 91 reported falling without an injury and 675 were non-fallers (fall data were missing for one case). Findings showed that 72.9% of those who fell reported being injured as a result of one or more of their falls. This injury rate is considerably higher than that found in other studies that look at the general population of persons aged 65 and over. These differences are explained by the precondition of frailty that defines the population in the CRD Survey. Findings also differ from most other studies in the lack of association found between falls with injury and advanced age or female gender, indicating the strong influence of frailty, regardless of age or gender, for this sample.

The results indicate that considerable differences exist in the patterns and combined effect of multiple risk factors between older adults who fall and sustain an injury and those who do not. The findings both confirm and contradict the findings of earlier studies, as well as shedding light on factors not previously studied.

This study was conducted from a critical gerontological perspective. This perspective is particularly relevant to the study of seniors' issues that are influenced by a complex combination of factors—such as fall-related injuries—as it enables an examination of multiple perspectives of the issue within larger social, economic and political contexts. A critical gerontological framework was use in this study to guide the selection of variables, to explain the findings in light of previous knowledge, and to

critically examine social policies that influence the ability to implement strategies for prevention.

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TABLE OF CONTENTS

Tables and Figures

Tables

Figures

Acknowledgments

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This work is dedicated to my husband David, with my love and gratitude for his love, encouragement and editing throughout my lengthy academic pursuits. Finally, my appreciation to my family for their understanding and support through my attempts to juggle studying with wanting to there as a mother, step-mother, grandmother, sister and daughter.

CHAPTER 1

Introduction

Fall-related injuries are a serious problem among older people in Canada. Approximately 30% of community-dwelling Canadians aged 65 years and older experience at least one fall each year (O'Loughlin, Robitaille, Boivin, & Suissa, 1993). It is estimated that from 6 to 25 percent of falls among those 65 and over result in moderate to severe injuries (fracture, dislocation, or lacerations) and 55% in minor soft tissue injury (Alexander, Rivara, & Wolf, 1992; Nevitt, Cummings, & Hudes, 1991). Falls are the most frequent cause of injury-related hospitalization and, in 1995/96, accounted for 78% of injury-related deaths for people 65 years and older in Canada (Canadian Institute of Health Information, 1998; Langlois et al., 1995; Raina & Torrance, 1996).

Studies show the etiology of a fall-related injury to be a complex combination of factors that reflect physical, behavioral and social conditions operating alone, or in conjunction with environmental hazards (Speechley & Tinetti, 1991; O'Loughlin et al., 1993). However, the particular role of these factors in falls that result in injury—the subject of this study—is less well understood. Fall-related injuries are the focus of this study due to the serious consequences of many of these events, and the current lack of understanding of the magnitude of this problem and factors that are associated with those who sustain such injuries and those who do not.

The three objectives of this dissertation study are:

1. to understand the extent and nature of fall-related injuries among older Canadians,

2. to examine the patterns and compounding effects of a wide range of variables for differences between older persons who reported a fall-related injury and:
   (a) those who did not fall, and
   (b) those who fell without injury.
3. to examine the study findings in light of existing government policies related to older persons and the prevention of fall-related injuries.

Impact of the Problem

The consequences of fall-related injuries include considerable costs in terms of human suffering and health care expenses. The human costs for older persons who survive fall-related injuries are often severe, resulting in a loss of independence, financial hardship, pain, permanent disabilities, limitations in activity, and for some a profound fear of falling again (Grisso et al., 1990; Nevitt et al., 1991; Tinetti, Mendes de Leon, Doucette, & Aker, 1994b). Fear and anxiety resulting from injuries due to a fall can lead to diminished social and mental stimulation and the reduction of one's quality of life leading to low self-esteem and depression (Craven & Bruno, 1986). The impact on families is also often severe in terms of extra care needed for the elderly relative who falls, and stress resulting from anticipating future falls and their consequences (Orlando, 1988; Patla, Frank & Winter, 1990). Many families are unable to cope with the demands of such care and approximately 40% of nursing home admissions are directly attributable to an elderly person having had a fall (Adler-Trains, 1994, as cited in Rawsly, 1998).

Costs to Canadians for the treatment and care of those who sustain fall-related injuries is a growing problem with the projected increase in injuries paralleling the population increases in this age group. The proportion of persons aged 65 and over in

Canada is expected to rise from the current 13% to 22.7% by 2031 (Statistics Canada, 1993, as cited in Elliot, Hunt & Hutchinson, 1996). In 1995/96 there were 72,472 injury-related admissions to hospital in Canada for persons 65 years and older and fall-related injuries accounted for 84% (60,486) of these (Canadian Institute for Health Information, 1998). Compared to younger age groups, persons aged 65 and over admitted for fall-related injuries remain in hospital longer, with an average length of stay of 17 days (Scott & Gallagher, 1997). The length of stay due to fall-related injuries also increases with advanced age. For those aged 85 years and older, 20% of hospital days for all reasons for being hospitalized are attributed to fall-related injuries (Scott & Gallagher, 1997).

According to the U.S. National Academy of Science, injury is probably the most under-recognized major health problem facing the world today; the study of injury presents an unparalleled opportunity for reducing morbidity and mortality and realizing significant savings in both financial and human terms—all for a relatively modest investment (as cited in Raina & Torrance, 1996). This investment is well worth undertaking since injury-related expenditure from all causes was determined in 1993 to be the third largest contributor in Canada to the total burden of illness, accounting for 14.3 billion dollars, or 11.1% of the total burden of illness (Herbert, 1998). Only illness due to cardiovascular (19.7 billion dollars) and musculoskeletal (17.8 billion dollars) categories ranked higher (see Figure 1). Yet, injury-related research in 1993 ranked last in terms of the proportion of funds allocated by government (Herbert, 1998). These funds totaled 6.2 million dollars, representing only 1.2% of the total research expenditures for all causes of illness (see Figure 2). The proportion of research funds allocated to fall-related injuries is unknown but indications are that funding for research on injuries

among children and people in the workplace are given higher priority (Scott & Gallagher, 1997).

Figure 1

Distribution of Direct and Indirect Costs by Diagnostic Category, Canada 1993

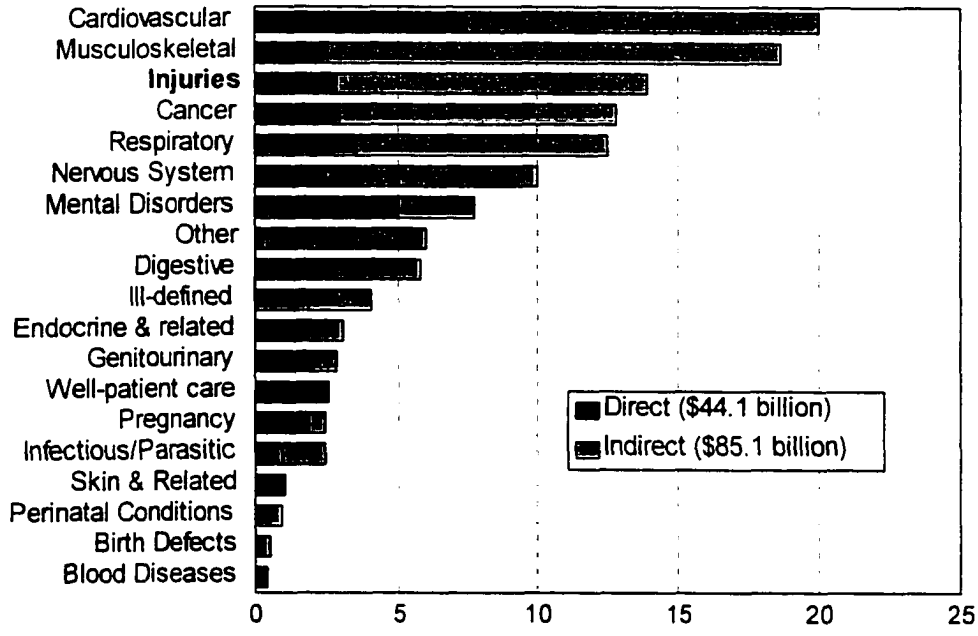
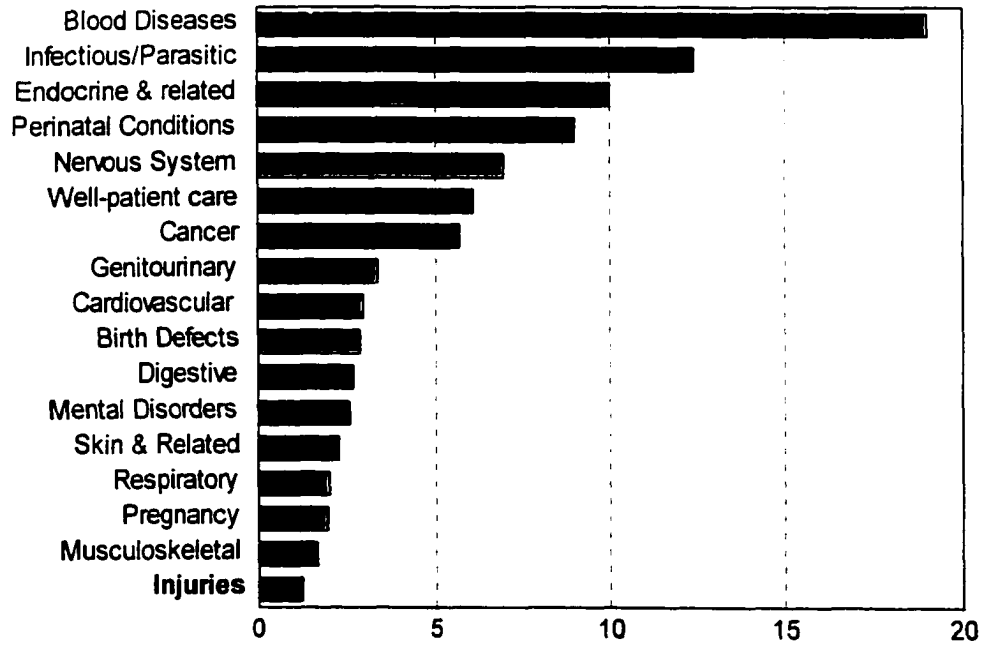


Figure 2

Research Share of Total Cost by Diagnostic Category, Canada 1993



Figures 1 & 2 adapted from Herbert, 1998

Despite the magnitude of this problem, relatively little is known about the risk factors associated with fall-related injuries among older people. Research in this country is limited to isolated studies, operating on short-term funding (Scott & Gallagher, 1997). The only national data collection systems on injury-producing falls in Canada are mortality and hospital separation records for each province. These records do not include sufficient detail to understand the nature or severity of the problem. The extent of the problem is also poorly understood as there are no systems for the collection of data on fall-related injuries for persons who are treated in emergency departments, physicians' offices, medical treatment centres, or for those who are injured but do not require medical attention (Scott & Gallagher).

Data Source

To gain a better understanding of the factors associated with all fall-related injuries among older Canadians this author conducted an investigation based on self-reported injury due to a fall by community-dwelling seniors. The secondary data used for this study were provided through in the University of Victoria Centre on Aging and is based on the Capital Regional District (CRD) Patterns of Care Survey 1995-96 (Centre on Aging, 1996). The data from the CRD Survey are based interviews with frail community-dwelling seniors represented by two purposefully selected groups. One group represented the over 3,000 seniors in the CRD receiving publicly-funded home support services in 1995, and the other, a matched sample of 810 seniors screened by age, gender and functional limitations, drawn from the 56,774 seniors in the CRD not receiving home support services. Five hundred and six participants were randomly selected from each group. The data therefore provide an opportunity to examine factors associated with fall-

related injuries among a high-risk group of seniors. There is a good fit between the research objectives put forward for this study and the data generated from the CRD Survey.

The data cover a wide range of health-related variables in addition to detailed information on the nature and types of fall-related injuries. While the data can only be generalized to the population of frail seniors, this group is of most interest, as they tend to be those most at risk of injury due to falls. Compared to other studies on falls that result in injury, these data are a good source of detailed information on all types of fall-related injuries, regardless of their severity (Centre on Aging, 1996). The survey also allows for an examination of those who were injured with regard to a broad set of health determinants including biological, behavioural, environmental, social and economic factors.

Key Definitions

Two terms key to this dissertation are "fall" and "injury". For the CRD Survey, the meaning of these terms are left to the respondent to interpret. Respondents were asked in they had experienced a fall in the past six months and if one or more of these falls had resulted in an injury. Responses were based on self-reports, which according to Polit and Hungler (1995) are a preferred method of obtaining information related to feelings, behaviours and information unavailable through any records. A disadvantage of self-reporting of a fall is that there is a tendency to underreport (Peel & McClure, 1998). However, there is evidence to support that reports of falls that result in injury are more reliable (Peel & McClure). Compared to other studies on falls among seniors, the reliability of the data for this study may also have been enhanced by the six-month recall

time period, as opposed to the twelve-month period typically used in other studies (Baldwin,Craven & Dimond, 1996; Tinetti et al., 1994b).

The self-reporting of a fall and fall-related injury may have been enhanced by the use of a predetermined definition for the terms "fall" and "injury". However, to date there is no agreed upon definition for either term among those who conduct research on this issue. This is demonstrated by the variety of definitions are given in the literature for both. For instance, Northridge, Nevitt, Kelsey, and Link (1995) for the purposes of their study on home hazards, defined a fall as: "falling all the way to the ground, or falling and hitting an object such as a chair or stair" (p. 510). They exclude falls due to loss of consciousness. Vellas, Garry, Wayne, Baumgartner and Albarede (1992) defined a fall as: "an event which results in a person coming to rest inadvertently on the ground or other lower level and other than as a consequence of the following: sustaining a violent blow; loss of consciousness; sudden onset of paralysis, as in a stroke and an epileptic seizure" (as cited in Vellas, Wayne, Romero, Baumgartner, & Garry, 1997, p. 190).

Luukinen, Koski, Honkanen, and Kivela (1995), in a study of fall-related injuries among elderly people in Northern Finland, defined a fall according to the International Classification of Diseases (ICD-9). This definition excludes falls from bicycles or those caused by motor vehicles, and defines a fall as: "an unexpected event wherein a person fell to the ground from an upper level or from the same level and included falls upstairs and onto a piece of furniture" (Luukinen et al., p. 872).

The Kellog International Work Group (1987) define a fall as "an event which results in a person's coming to rest inadvertently on the ground or other lower level and other than as a consequence of the following: sustaining a violent blow; loss of

consciousness; sudden onset of paralysis, as in a stroke; or an epileptic seizure" (as cited in Raina, Dukeshire, Chambers, Toivonen, & Lindsay, 1997, p. 3)

An anatomically explicit definition by Hornbrook et al. (1994) is: "losing your balance such that your hands, arms, knees, bottom, or body touch or hit the ground or floor" (p. 19). The same authors define a near-fall as: "losing your balance but managing to catch yourself before hitting the floor" (Hornbrook et al., p. 19).

A short and simple definition of a fall proposed by Japanese researchers is: "events that cause subjects to fall to the ground against their will" (Yasumura et al., 1994, p. 3324). A similarly simple definition used by Morris and Isaacs (1980) is: "an untoward event in which the individual comes to rest unintentionally on the ground" (p. 9). This differs only slightly from the following definition by Nyberg and Gustafson (1996): "incidents in which the subject unintentionally came to rest on a level below knee height" (p. 1821).

The definition of an "injury" due to a fall, the second term germane to this dissertation, is also rarely provided in the literature. Where discussed, terms denoting injury types and the degree of injury sustained differ widely from one study to another. Some studies only consider severe injuries such as fractures, while others discuss cuts, lacerations, soft-tissue injury, bruises, abrasions or scrapes. Other studies only focus on falls that result in hip fractures. Considering the diversity in definitions represented, there is clearly a need for some standardization to facilitate communication between those researching this phenomenon.

Definitions of other key terms used in this study include:

- Fallers: respondents who reported having one or more falls.

- Non-fallers: respondents who did not report having a fall.
- Biological factors: concerning physiological conditions.
- Behavioural factors: concerning actions or feelings.
- Environmental factors: concerning physical locations and surroundings.
- Social and economic factors: concerning social support, social status and financial resources.
- Frailty: is used here to describe seniors with functional limitations who were assessed by the local health authorities as requiring publicly funded home support services and others who were selected for inclusion in the CRD Survey for having similar limitations.

Dissertation Overview

This dissertation begins in Chapter 2 with a critical analysis of the larger social, economic, and political contexts within which the problem of fall-related injuries exist in Canada. This includes a discussion of existing policy making processes and structures and how they either enhance or restrain the conditions for reducing fall-related injuries among seniors in Canada. This analysis serves as a background to the discussion of the findings, allowing for a contextual examination of the complex nature of the problem and subsequent need for multisectoral and multidisciplinary approaches to injury reduction.

Chapter 3 provides a discussion of the need for a theoretical perspective and comprehensive conceptual framework to guide the study of fall-related injuries among seniors. Studies chosen for review include those that reflect the complex nature of both direct and indirect contributing factors for fall-related injuries among seniors. This chapter concludes with a critique of the literature, highlighting the gaps and limitations in

the studies reviewed. This is followed by a description of the purpose of the dissertation study and a rationale for the selection of specific variables.

Chapter 4 presents an overview of the methodology for the study, including the study design, the secondary data source, sample and data analysis conducted. Chapters 5 and 6 present the study findings, discussion, study limitations, recommendations for future studies, theoretical developments and conclusions drawn from the findings.

CHAPTER 2

Economic, Social and Political Context

Fall-related injuries represent considerable costs in terms of human suffering and health care expenses. A recent study estimates the annual cost of fall-related injuries for Canadians 65 years and older to be $2.8 billion in 1994 (Asche, Gallagher, & Coyte, 1997). Yet, to date there are no national injury-prevention programs for seniors, and systematic collection of data on fall injuries is limited to mortality rates and hospital separation records. This chapter will address this lack of attention by applying a critical gerontological lens to the economic, social and political constraints that are limiting or blocking the development of comprehensive prevention strategies.

While there is a growing awareness among officials at all levels of government that prevention of injury for *children* should be placed on their policy-making agendas, there is less awareness of the impact of injuries due to falls among *older* persons. Recognition of the magnitude and implications of this problem is spreading among seniors, persons with disabilities, health care providers, researchers and some government officials. The challenge is to move from simple awareness of the problem to policy changes that will support preventive strategies.

Fall-related injuries among seniors are complex, requiring multifaceted and interdisciplinary approaches to research and prevention. An exploration is needed of a multitude of potential factors, their compounding effects, and consideration of the economic, social and political contexts that influence them. A critical gerontological perspective is used to guide this exploration as it enables an examination of multiple perspectives of the issue based on a broad health-determinants model. Such a model

encompasses the notion of multidimensional influences and a social context for the resolution of health problems.

This chapter will discuss the influence of the Canadian policy context on the determinants and consequences of fall-related injuries among older community-dwelling Canadians. A model is presented to guide the critique of the policy-making processes and structures to determine how they either enhance or restrain conditions for the prevention of fall-related injuries among seniors. The discussion includes an examination of strategies for influencing policy-making in this area. This chapter includes both formative and existing trends in policy-making strategies with examples from Federal, Provincial and Municipal levels of government in Canada.

What is Public Policy and Who Makes It?

Public policy deals with social and economic issues at all levels of government. On a national and multi-national level, issues concern the basic structure of political and economic life and include the disposition of income, wealth and political power (Wharf & McKenzie, 1995). On a provincial and local government level, issues are related to the provision of health and social services, as well as city and neighborhood development (Wharf & McKenzie).

Policy makers are traditionally those with the resources and the power to influence others. Shiflett and McFarland (1978) define power as, "the degree of influence over others, to the extent that obedience or conformity are assumed to follow" (as cited in Rodger, 1993, p. 24). Whether the issues are ordinary or grand, national or local, policy analysts agree that most Canadian policies are made by white, middle class, men who are politicians, professionals or businessmen (Lindblom, 1979; Dyck, 1993). As Wharf and

McKenzie (1995) point out, "Relatively few women, poor people and members of ethnic minorities took part in decisions which affected them" (p.18).

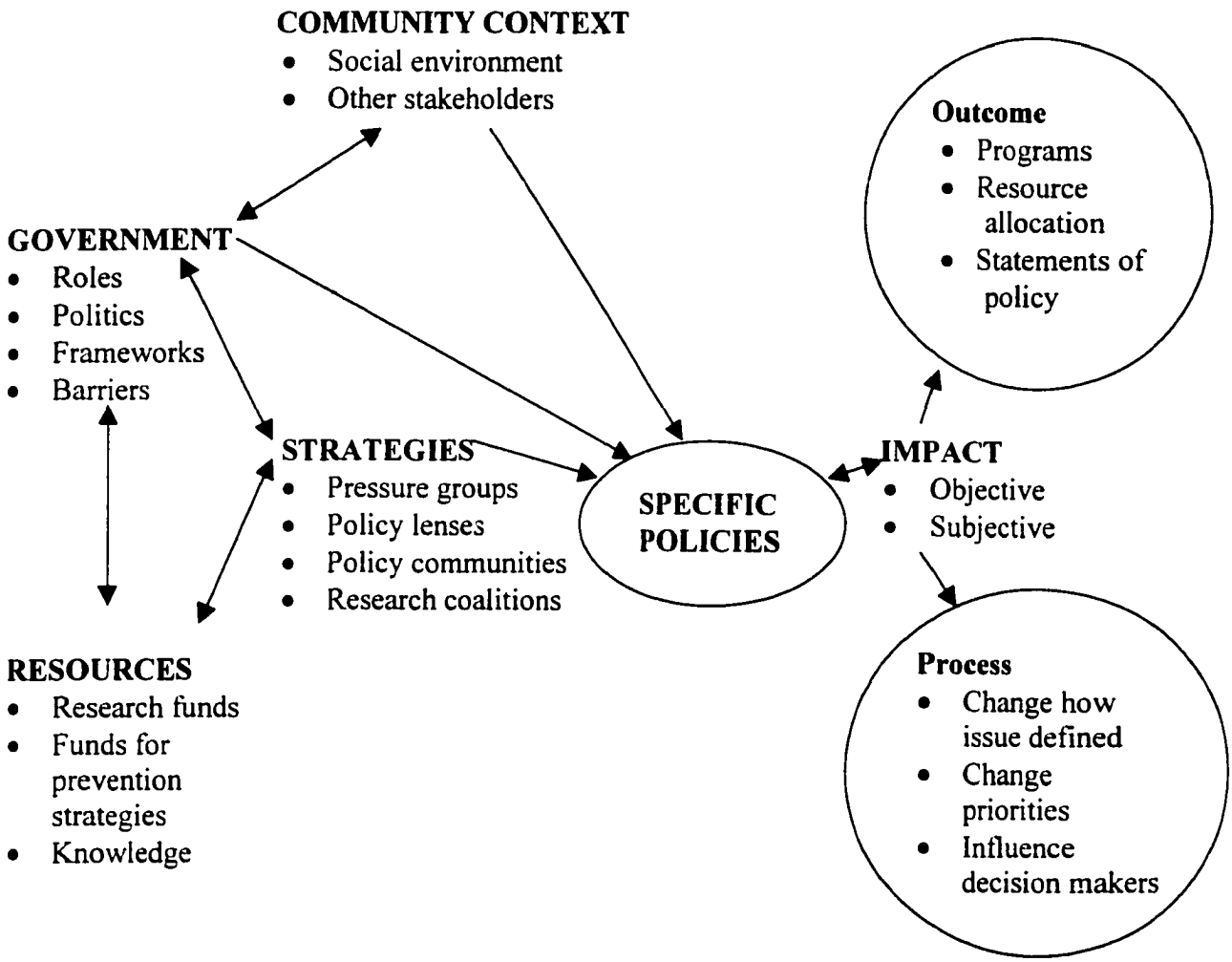
A Model to Demonstrate the Policy-making Process

The model chosen to demonstrate the policy-making process and structure concerning the prevention of fall-related injuries among older adults is adapted from Neysmith's 1987 model of community influence in policy making (see Figure 1). Neysmith developed this model—based on the earlier work of Butcher, Collis, Glen and Sillis (1980, as cited in Neysmith, 1987)—for her case study on the effectiveness of a senior's advisory group's efforts to influence policy making by the Mayor and Council of a Canadian municipality. This model will be used as a framework for the remainder of the chapter. Areas to be discussed include the community context, government roles and policy frameworks, pressure groups, strategies for influencing policy and required resources for effective influence. This section concludes with a discussion of how to determine the impact of policy through the use of subjective and objective measures.

Neysmith's original model did not include a *Community Context* component—this was added by the author to situate the issue in its larger social, economic and historical context. The guiding principle that frames this model is the need for meaningful participation in policy decisions by those directly effected by the outcomes of those decisions. This model speaks to the need to have structures and resources in place to facilitate such participation. Within such a framework seniors and older persons with disabilities would have open lines of communication with decision-makers in order to influence the process and outcome of policies that effect their lives. Each of the components is presented as they relate to the subject of this dissertation.

Figure 3

A Model to Demonstrate Components of Policy-making Process and Structure



(Adapted from Neysmith, 1987)

Community Context

Social environment.

A number of barriers exist within the social environment of Canada to influencing the development of healthy policy for older people. Many of these barriers are posed by negative attitudes toward older people, particularly those in ill health and those with disabilities. Butler (1978), describes this negative attitude as "ageism...a profound psychosocial disorder characterized by institutionalized and individual prejudice against the elderly, stereotyping, myth-making, distaste, and/or avoidance" (as cited in Fraboni, Saltstone & Hughes, 1990, p. 57). Shapiro (1996) proposes that the roots of ageism are found in intergenerational competition over resources. Shapiro (1996) sees the source of this competition in the carefully constructed distortion of facts spread by "heavily-financed special interest groups and some politicians" (p. 2). Motivated by self-interest and profit these groups have influenced the media and general public into falsely believing that social programs and health services to the elderly and disabled are the root cause of our debt and deficit (Shapiro, 1996).

Intergenerational competition is also spurred by what Robertson refers to as "apocalyptic demography" (as cited in Marshall, 1993, p. 156). The large and growing proportion of the Canadian population comprised of seniors—particularly those who are chronically ill or have disabilities—is seen by some as an opportunity to unfairly accuse them of being the cause of our larger social problems. In fact, they are the victims of many social inequities (Marshall, 1993). As members of the Federal Task Force on Disability Issues point out, this "blame the victim mentality" is a major barrier to full integration into society for older persons and those with disabilities (Federal Task Force

on Disability Issues, 1996, p. 8). Policy critic McQuaig (1988) makes it evident that while our growing debt and deficit is blamed on spending on social programs, the true sources of the deficit were high credit, unemployment and unequal tax structures favouring the wealthy, big business and foreign investors. Her arguments are compelling.

To overcome barriers posed by negative attitudes, policy makers need to be guided by sources other than heavily financed special interest groups. This will only happen if decision-makers invest the necessary time to seek out a wide range of opinions from all citizens, particularly those who are disadvantaged.

Other stakeholders.

There are a number of stakeholders other than those in the health and social service sectors who have a vested interest in fall-related injuries. For example, fall injuries do not only occur in the home, but also in public places. Prevention therefore requires a coordinated plan of action with the participation of a wide array of responsible parties from government and non-governmental organizations (NGO). Such stakeholders include public and private organizations or agencies whose mandate includes safety of vulnerable groups. Examples of these are government organizations such as transit authorities and agencies representing those at risk, such as the Canadian National Institute for the Blind (CNIB).

To effectively serve public safety, organizations such as these must communicate and coordinate their efforts. Part of this coordination is the responsibility of government as most organizations are directly or indirectly financed and regulated by government. Community members can also influence government's willingness to fund such organizations through the impact of pressure groups (Payne-O'Connor, 1986). The

effectiveness of pressure groups is dependent upon knowledge of the problem, connections to those with power to implement change, availability of large groups of articulate and forceful speakers and financing (Payne-O'Connor, 1986). This cycle of influence seldom includes the weak, poor or isolated.

An example of the need for cooperation and influence for falls prevention was demonstrated in a project where municipal governments were responding to pressure from elderly pedestrians to move a bus shelter that was obstructing the safe passage of pedestrians using wheelchairs (Gallagher & Scott, 1996). The jurisdiction for design and placement of the bus shelter came under the authority of the local Transit Company, while ownership of the land on which the shelter was placed was under municipal authority. Neither the municipal staff nor the Transit Company officials were aware of the problem. Neither had ever consulted elderly pedestrians as to placement of the shelters and there were no channels for making a complaint that would reach both organizations. Change was impossible without the cooperation of all parties and the human and financial resources of the pressure group in this case were insufficient to bring about the necessary coordination. This is not an isolated example, as most requests for hazard removal or design alterations to sidewalks involve a multitude of stakeholders. These include those responsible for sidewalk design and maintenance, as well as those responsible for the placement of obstacles such as telephone poles, water hydrants, private business signs, restaurant seating, mail boxes, bicycle racks, trash cans, service grates, planters, seats, construction barriers, and others.

Government

Government roles.

In addition to coordination between stakeholder groups, government roles in the prevention of fall-related injuries need to reflect the multifaceted nature of the problem. Falls among seniors occur due to a complex set of factors related to personal health, behaviors, abilities, the environment and the individuals' economic and social resources. For this reason, governments have a dual set of responsibilities. Firstly, they need to promote the physical, mental, economic and social well-being of those who are at risk. And secondly, they have a mandate to create and maintain environments that are safe and accessible to all (Office for Disability Issues, 1997; Province of British Columbia, 1991).

These responsibilities stem from the fact that being at risk for injuries due to falls is closely tied to health status, social status and the environmental surroundings of individuals. Effective policy platforms are those that promote risk reduction based on the broad determinants of health status including early childhood experiences, housing, income, social supports, and environmental hazards (Province of British Columbia, 1991, p. B-4). Policy makers cognizant of the impact of these determinants are better situated to enact policies that address the contributing factors rather than just treating the injuries. An example of the impact which income has on health is shown by the more than eleven years' difference in disability-free life expectancy that exists between the lowest and highest income levels in Canada (Province of British Columbia, 1991). Effective policies are also those that reflect the fact that health status is affected by the ability of individuals to control those events that influence their health and well-being (Evans, Barer & Marmor, 1994).

Traditionally, the ability to influence public policy-making has been limited to those with wealth and power. As McQuaig (1988) points out, in Canada "an estimated three hundred business, professional and trade association on the national scene spend more that $122 million a year on lobbying" (p. 1995). This is stiff competition for the attention of policy makers for seniors—particularly the chronically ill or disabled who are most at risk for fall-related injuries. As a group, those most at risk also tend to be more isolated, less well off, and physically less able to make their voices heard than the general population (Robertson, cited in Marshall, 1993). Without policy guidelines for inclusion of these groups in the policy-making process, the voices of such marginalized people are not heard.

Political context.

The political climate of the day influences the ability of government policy makers to implement change. This shifts with the party in power, the agenda of cabinets, and the interests and backgrounds of different ministers (Dyck, 1993). Unfortunately, policies and programs that are given priority by politicians and senior bureaucrats tend to be those that "enhance the image of the political party in power" (Wharf & McKenzie, 1998, p. 5) rather that those that serve the needs of the disadvantaged.

Frameworks put in place through collaboration of interested government and non-government groups exist to guide policy making. The major existing policy frameworks designed to facilitate policy-making that could support the prevention of falls and related injuries among seniors include:

(a) Ottawa Charter of 1986 (Hamilton & Bhatti, 1996).

(b) Milan Declaration on Healthy Cities of 1990 (World Health Organization, August, 9, 1990)

(c) National Framework on Aging of 1997 (Division of Aging and Seniors, 1997)

(d) Federal Task Force on Disability Issues of 1996 (Moore, Rosenberg, & McGuinness, 1997)

The following is a brief overview of these frameworks, how they apply to injury-prevention from falls for those at risk, and barriers to their implementation.

(a) The Ottawa Charter

The Ottawa Charter arose from the First International Conference on Health Promotion, hosted by Canada in 1986 (Hamilton & Bhatti, 1996). This document has been instrumental in focusing discussion on Canadian health care policies and programs (Hamilton & Bhatti, 1996). The Charter calls for a clear political commitment to promoting health and equity for all, counteracting unhealthy living conditions and unsafe environments, and to accepting the community as the essential voice in matters of its health, living conditions and well-being (World Health Organization, August 20, 1996). The five areas for action called for in the Ottawa Charter of 1986 are supportive of all aspects of policy development for prevention of falls among the elderly. These are:

- building policy that contributes to health-promoting conditions,
- ensuring positive impacts on health in the context of technological and environmental changes,
- strengthening the capacity of communities to set priorities and make decisions on issues that affect their health,

- developing personal skills and knowledge of individuals to meet life's challenges and to contribute to society, and
- reorienting health services to focus on the needs of the whole person and invite a true partnership among the providers and users of services (Hamilton & Bhatti, 1996, p.3)

However, translating rhetoric into action has been a challenge for Canadian politicians. If implemented as adopted over ten years ago, the principles of the Ottawa Charter would have made a considerable impact on the health and safety of seniors and older persons with disabilities. This has not happened and there is still much work to be done.

(b) The Milan Declaration on Healthy Cities

The Milan Declaration on Healthy Cities is another set of guiding principles which, if implemented, would promote the creation of safe public environments, free of hazards that contribute to falls and injuries (World Health Organization, August, 9, 1990). Drafted by mayors and senior political representatives from the World Health Organization (WHO) Healthy Cities network, in Milan in April 1990, this document declares a political commitment to take the following measures:

- establish effective intersectoral mechanisms for healthy public policies with community participation,
- implement comprehensive, citywide intersectoral strategies to address major health challenges,
- promote equity and reduce inequalities in health,

- reduce the adverse effects of traffic on health and support comprehensive urban transport planning,
- create mechanisms for public accountability on decisions effecting health, and
- make health and environmental impact assessment part of all urban planning decisions, policies and programs.

A number of Canadian politicians were vocal in support of this document during the early 1990's. This led to the instigation of the Canadian Healthy Communities Project—an initiative that spawned a number of local government committees around the country for the purpose of involving members of the public in local policy making (Municipality of Saanich, no date). One example was the Healthy Saanich 2000 Committee—of which this writer was a founding member. The Milan document proved to be a valuable guide for municipal politicians and bureaucrats in assisting them to facilitate public input from a wide range of interest groups. However, the momentum that followed the release of the Milan document has dwindled and some of these committees, including the Healthy Saanich 2000 Committee, have lost political support and have been disbanded (personal communication, Saanich Councilor C. Pickup, November, 1996). Others have changed their focus and are now working on more specific issues such as access for the disabled or transportation, rather than the general issue of Healthy Cities (personal communication, J. Hughes, Disabled Access Advisory group member, April, 1997).

(c) National Framework on Aging

The National Framework on Aging (NFA) is a document in progress, designed to guide future policy development that effects seniors (Division of Aging and Seniors, 1997). It represents the efforts of a partnership between diverse groups of seniors across the country who were members of the Federal/Provincial/Territorial Committee (F/P/T) and federal officials from the Interdepartmental Committee on Aging and Seniors Issues (Division of Aging and Seniors, 1997). Following a series of focus group meetings across the country the five core principles of "dignity, independence, participation, fairness and security" (Division of Aging and Seniors, 1997, p. 8) were chosen to direct the following policy goals:

- involve seniors in the formulation and implementation of policies that directly affect their well-being,
- eliminate age discrimination and encourage harmony across the generations,
- coordinate policy planning between departments, ministries and agencies,
- ensure that policies reflect the uniqueness of individuals, their needs, preferences, and right to self-determination,
- ensure that seniors are in control of their own lives,
- ensure that policies consider equally the needs of seniors, and the needs of other age groups,
- ensure that seniors have adequate income, and access to a safe and supportive, living environment that is adaptable to changing capacities (Division of Aging and Seniors, 1997).

Future work of the NFA will be to review of new and existing policies to determine their ability to reflect these goals (Division of Aging and Seniors, 1997).

Parallel to the National Framework on Aging, and in response to the identification of "safety" as one of the core principles, the Division of Aging and Seniors is in the process of developing another document titled: *Prevention of Injury Among Seniors: A Framework for Action* (Division of Aging and Seniors, 1998, January draft). This writer has been an advisor to this document, and acted as a co-facilitator of a pre-conference workshop for key informant input, at the Annual General Meeting of the Canadian Association of Gerontology (Hall & Scott, 1997). When completed, this document will be available to guide future policies directly related to seniors' safety with particular reference to the prevention of injury due to falls.

The goal of this document is to move injury prevention away from a purely medical focus, to a community model, where collaboration and consultation will be encouraged between a wide range of government and community stakeholders (Division of Aging and Seniors, draft). It is too early to determine how this document will be received by departments of government outside of the Division of Aging and Seniors, or if any of its suggestions will be implemented. However, based on the draft version, this is the framework with the closest fit to the recommendations being put forward in this paper for a community-based action plan for fall prevention among seniors.

(d) Federal Task Force on Disability Issues

The document titled the *Federal Task Force on Disability Issues* is designed to address the needs of all persons with disabilities through the enforcement of constitutional law and civil rights (Moore et al., 1997). These rights as laid down in the

Constitution Act of 1982 under section 15 of the *Charter*, "guarantees to persons with disabilities the right to equality before and under the law and to the equal protection and benefit of the law without discrimination in all jurisdictions" (as cited in Federal Task Force on Disability Issues, 1996, p. 9). Based on these rights, recommendations developed by the Task Force in consultation with persons with disabilities across the country include:

- involvement of people with disabilities in policy planning that affects their lives, acknowledging that they know their issues and how to resolve them,
- barriers-free access in all regions of the country,
- clear government statement on values, principles and objectives needed to guide policy for people with disabilities,
- information sharing between the provinces, within governments and agencies representing persons with disabilities, and
- development of programs and services that are flexible, transparent and coordinated (Federal Task Force on Disability Issues, 1996)

Persons with disabilities who participated in the Federal Task Force expressed concern this document not follow its numerous predecessors to be abandoned to gather dust on government shelves. For example, in the opinion of many Task Force members, the government response to the 1983 and 1987 *Obstacles* reports was "equivocal and in some cases, non-existent" (Department of the Secretary of State, 1983; Department of the Secretary of State, 1987; Federal Task Force on Disability Issues, 1996, p. 1). Through this latest document people with disabilities "seek guarantees that a 'new system' will not abandon them to a fragmented, patchwork array of regional activities that mitigates

equity and sentences them to return to a marginal existence" (Federal Task Force on Disability Issues, 1996, p. 14).

In summary, framework documents are only as good as the actions they create. If all the pledges and recommendations made in the four well-established frameworks presented above were being enacted as stated, this chapter would not need to be written. Unfortunately there is a gap between the rhetoric and the reality. According to policy critic Shapiro (1996), this gap is created and maintained by those in favour of privatization, decentralization and Americanization of our social institutions. These and other barriers form the following discussion.

Barriers to policy formation.

According to policy critiques Shapiro (1996) and McQuaig (1993), barriers to policy formation that promotes health and safety for marginalized groups are rooted in the profit motives of a small percentage of the population with the wealth and power to influence government policy. Shapiro (1996) refers to these small but powerful groups as "special and heavily-financed interest groups" (p. 2). McQuaig (1993), calls them as the 'boys in the back room', who are perpetuating a myth of economic demise due to escalating social services.

Hill (1996) sees the problem as separation of *social policy* from the larger context of *public policy*. Rather than providing universal services to all and then taxing the wealthy, the poor are isolated and named as social service recipients. In this way they become ghettoised, making them easy targets of blame (Hill, 1996). A particular irony is that this separation treats issues such as tax breaks for the wealthy as separate and distinct from welfare cuts to the poor.

Influences that drive governments' preoccupation with fiscal restraint are having their impact felt in all aspects of health and social security in Canada. Federally, these influences are seen in massive cuts in transfer payments to the provinces. Provincially, advocates of restraint are pushing for reductions in payments to the municipalities. The outcome is the dismantling of social services and financial support systems across all levels of government at a time when need is growing.

Advocates for restraint point to the decline in poverty rates among seniors. This is a fair statement for 1971 to 1986, where a sharp decline was seen in the proportion of seniors below Statistics Canada's "low-income cutoff" (Dyck, 1993, p. 123). This was due to the implementation the financial support programs such as the Old Age Pension Act, Old Age Security, Canada Pension Plan, the Guaranteed Income Supplement and the Spouse's Allowance—all put into effect between 1926 and 1975.

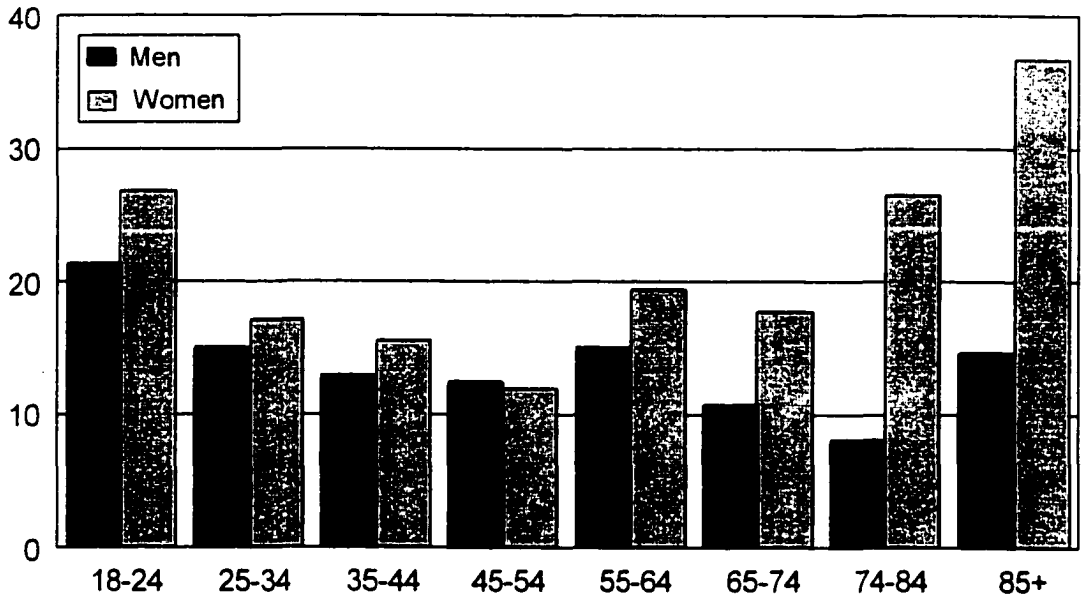
However, by 1995 the number of poor Canadians was higher than it was during the depths of the last two recessions (National Council of Welfare, 1997). Current poverty rates show some improvement and are now at 16.9% for those aged 65 and over. There is little security however, as seniors are having to battle to keep existing programs. An example was the swift and widespread national protest by seniors against de-indexation of their Old Age Pensions in 1985. Despite these efforts, four years later in the 1989 budget, the government successfully introduced taxing back of OAS payments for those with incomes over $50,000—known as the "clawback" (Dyck, 1993, p. 123). As Neysmith (1987) points out, numbers alone do not influence policy – rather, concerted and organized efforts by those affected.

Neysmith (1987) sees an increasing need for vigilance by seniors in the policy arena. Increased numbers mean increased demand for services. In Canada, the proportion of seniors will increase from 11.8 % to 24.5% over the 1991 to 2036 period, with nearly half a million people over the age of 90 by 2036 (Dyck, 1993). The problem is not only increased numbers of older people, but also decreases in the proportion of people who they depend on to contribute financial support for their social programs and services. The "dependency ratio" in 1991 was 57 per 100, i.e. for every 100 people between 18 and 65, there were 57 in the dependent age ranges (Dyck, p. 125). Twenty-five percent were aged 0-17 and 12 percent were aged 65 and over. This ratio is expected to increase to 75 dependent people for every 100 in the work force by 2036, with 18% aged 0-17 and 25 percent aged 65 and over. The financially dependent rely upon those in the workforce to finance pensions, social security, education and medical services. With fewer than half of those 65 and over currently carrying private pension plans, seniors' sources of income will be in jeopardy with fewer contributors to public pension plans.

Future problems will be most critical for the growing proportion of very old people—those over 85. For instance, women over 85 years of age in 1995 represented the age group with the largest percentage of people living below the poverty line at 36.7% (see Figure 4) (National Council of Welfare, 1997, p. 34). For women over the age of 85 who live alone, the rates are highest of all, with 53% living below Statistics Canada's low-income cut-off. Coincidentally, they are also the people shown to be most likely to fall and sustain an injury (Northridge et al., 1995; Scientific Advisory Board, 1996).

Figure 4

Percentage of Adult Canadians Living Below the Poverty Line



Source: Poverty Profile, National Council of Welfare, 1997

This over 85 cohort will be even more dependent, needing a wider range of services and increasingly expensive support programs. The greatest strains on resources are expected to be in the areas of housing and health care (Dyck, 1993). According to Ivan Fellegi (1988):

> It is estimated that, according to current patterns of hospitalization, the number of hospital beds needed for the elderly (involving mostly chronic diseases) would be close to the entire 1983 hospital capacity in twenty years; to meet the needs of the elderly alone, we would need to double the hospital system in 50 years (as cited in Dyck, 1993, p. 125-6).

To address these health care demands, governments are encouraging the elderly to remain in their own homes longer through the provision of home support programs (Dyck, 1993). This shift away from hospital and institutional care puts greater emphasis on the need for safe public and private environments. There is also a greater need for attention to injury prevention by those who supply home support services for the growing number of community-dwelling seniors with chronic health conditions and disabilities. With more frail elderly people living in the community than ever before, safe public and pedestrian facilities are going to be even more critical. There will also be increases in the number of independently mobile seniors with disabilities with the advent of newly designed mobility aids such as scooters, motorized wheelchairs and walkers (Gallagher & Scott, 1996).

The media constantly reminds us of the numerous recent attacks on social programs and services for seniors and persons with disabilities. Structures need to be in place to monitor and resist these attacks in order to promote policies that support healthy and safe living conditions for groups at risk of injury from falls. One way of countering government cutback is through organized pressure groups.

Strategies used to Influence Policy Development

Effective strategies for influencing and monitoring policy formation across ministries, departments and governments are the mobilization of pressure groups, the implementation of policy lenses and the formation of policy communities (see Figure 3).

Pressure groups.

A pressure group is an "organization whose members act together to influence public policy in order to promote their common interest" (Pross, 1986, as cited in Dyck, 1993). They normally have a narrow focus and are organized around a single, central interest. They often work closely with bureaucracy to "work out technical arrangements to their mutual satisfaction" and are increasingly involved in the administration of government programs relevant to their interests (Dyck, p. 301). Benefits to government in utilizing pressure groups in this way include being kept "abreast of current demands and societal changes", thereby promoting "general political stability" (Coleman, 1986, cited in Dyck, p. 301).

There are many pressure groups whose members are directly or indirectly influencing policy on issues related to injury-producing falls among older persons. Some are promoting improved health status for marginalized groups and others are lobbying for the creation of safer public environments through the elimination of hazards that lead to falls. Examples include municipal advisory groups on disability issues and seniors advisory groups to the provincial and federal Governments. However, few of these groups have the financial resources to maintain effect pressure of long periods of time. Government funding is required for groups attempting to address national issues to

overcome costly geographical barriers to effective communication. Unfortunately, the price of accepting government support is a loss of independence and free speech.

An example to be highlighted here is a government-supported group known as the Seniors Advisory Council (SAC). This group reports to the Ministry of Health and Ministry Responsible for Seniors in British Columbia. Established in 1989, and legislated by and Order in Council, this group is a link to government policy makers for all seniors in BC (Office for Seniors, 1995). Their official mandate is to advise the Minister Responsible for Seniors on issues of concern to seniors in British Columbia and to give seniors a voice in shaping government policy through:

- maintaining close links with major seniors' organizations and organizations involved in providing services to seniors; and
- working with the Office for Seniors to counteract discrimination based on age and raise public awareness about the diversity of seniors' lives (Office for Seniors, 1995).

This mandate is fulfilled through public forums held four times a year, establishment of task forces based on issues raised by seniors around the province, and the development of position papers to present recommendations to government based on task force findings.

While the mandate of "shaping government policy" sounds like an ideal opportunity to implement change on behalf of seniors, there are a number of restrictions and limitations to the effectiveness of such groups that differentiate them from true pressure groups. For instance, SAC members are restricted to forming broad consensus statements rather that tackling specific policies or issues (personal communication, G.

Hinton, Director, Office for Seniors, May 1997). Another limitation is the degree of acceptance of recommendations by governments of the day. While position papers and consultations with SAC are used by the Minister to inform the development and creation of policy, Ministers are not bound in any way to follow SAC's recommendations (personal communication, G. Hinton, Director, Office for Seniors, May 1997). Control over funding for the SAC also comes under the direction of the Minister. Even with a legislated mandate, the ability to operate is restricted by limited funding.

Despite the fact that numerous mandated and non-mandated groups like the SAC are operating in all provinces and territories in Canada, they are only able to communicate with a fraction of all the seniors in the country. Their numbers are small, their funding minimal, their abilities restricted, and their effectiveness conditional to the goals of their government funding bodies (Dyck, 1993). For instance, SAC members receive an honorarium of $175 per day and are expected to accomplish their tasks over a total of nine days per year (personal communication, G. Hinton, Director, Office for Seniors, May 1997).

However, within these limitations SAC has managed to put the prevention of falls among seniors on their agenda and indications are that this has government support. Falls prevention comes under SAC's larger mandate of promoting the safety and security of seniors. One of the actions taken to date is a nation-wide inventory of all projects related to injury prevention for seniors. This is part of a national initiative aimed at reducing duplication and promoting cooperation and coordination among the operators of injury prevention programs and research projects around the country (personal communication, T. Graham, Office for Seniors, May 20, 1997). Falls prevention is seen

as a priority of this initiative, and support is being given for the gathering and sharing of data on falls that occur in all locations, including public places. However, this initiative is still in the planning stages and its implementation dependent upon 'soft' funding commitments.

Policy lenses.

A policy lens is "intended to enable both government and non-government policy-makers and program planners to develop and revise legislation, policy, programs and services" with issues of the target population taken into consideration (Crocker, Martin & Tonn, 1997, p. 3). One of the first lenses to be introduced in Canada was the gender lens, developed by the *Status of Women* (Status of Women Canada, no date). The goal of this lens is to "reduce the risk of public policy being inadequate or inappropriate [as] such oversights can be costly, both in economic and social terms" (Status of Women Canada).

With the gender lens as a model, British Columbia's Office for Seniors is taking the lead on developing a national lens for the review and development of policy that affects the safety and security of seniors (Personal communication, G. Hinton, Director, Office for Seniors, May 1997). This work is being undertaken on behalf of the Federal/Provincial/Territorial Ministers Responsible for seniors in collaboration with Health Canada's Division of Aging and Seniors.

A lens for issues related to persons with disabilities is already well under way to being implemented in British Columbia. The need for such a lens was made clear by lobby groups of persons with disabilities from around the province in recognition of their exclusion from the development of policies and programs that affect them. As a result,

many well-meaning initiatives contain discriminatory barriers that jeopardize safety and independence (Office for Disability Issues, 1997).

The disability lens is to be used to assess the impacts of all initiatives (policies, programs or decisions) on persons with disabilities. It is also a resource for all ministries to assist in creating policies and programs reflective of the rights and needs of persons with disabilities (Office for Disability Issues, 1997). When implemented, these directives have the potential to address the issue such as unsafe environments and inadequate building standards that lead to falls among persons with disabilities.

Policy communities.

Another strategy used by a number of pressure groups in Canada is the formation of "policy communities" (Dyke, 1993, p. 308). These are "groupings of government agencies, pressure groups, corporations, institutions, media people, and individuals including academics who have an interest in a particular policy field and attempt to influence it" (Dyke, p. 308-309). The formation of such communities is particularly relevant to those who wish to influence policy on the prevention of falls due to the complex nature of the problem and number of stakeholders involved. Formation of policy communities was a goal of a recent falls-prevention project known as the *Studies of Environment which Promotion Safety* (STEPS) project (Gallagher & Scott, 1997).

In partnership with an advisory group of seniors and persons with disabilities, Gallagher and Scott (1997) designed and delivered a series of workshops in the province of British Columbia, on "new ways of conducting community planning" for the creation of safer environments (p. 3). To accomplish this, all relevant stakeholders were notified of the workshops through a media and mailing campaign targeted to all agencies and

organizations in the province representing seniors and persons with disabilities, and to all municipal government and non-government officials with jurisdiction over public safety. Support and assistance was sought and received from key community and government leaders who provided support staff, suitable venues and assistance in the identification of local issues. Workshop participants included politicians, engineers, city planners, civic employees, health professionals, builders, seniors and persons with disabilities (Gallagher & Scott).

Workshop outcomes included an increased awareness of the problem of unsafe environments, identification of possible solutions and recognition of the need to work together to implement changes (Gallagher & Scott, 1997). Participant feedback indicated a commitment to ongoing consultation on this issue among a wide range of stakeholders including those who are at risk and those with the authority to change policies. Such partnerships or policy communities are key to the formation of policies that meet the needs of the people they are designed for.

Research coalitions.

The formation of research coalitions is another strategies for effecting policy change. This strategy can bring researchers with common interests together from across the country or around the world. The benefits of such coalitions include the sharing of unpublished findings, the joint development of proposals, a reduction in duplication of research efforts and a means of developing a common language for the standardization of key terms. Through a shared understanding of the issues, members of research coalitions are also well place to influence evidence-based policy agendas. Coalitions comprised of those with experience of the issue and/or a history of research in the area, become

valuable resources to policy-makers seeking ready access to information on specific issues. For the issue of the prevention of injuries among older adults, research coalitions would benefit from the inclusion of community researchers, i.e. those in the community who live with being at risk of falling who wish to conduct, or participate in, studies to address the problem. Research coalitions may also operate in conjunction with policy communities to increase their potential to inform and direct policy.

Resources

Resource scarcity is a factor that influences all government policy-making. Cutbacks, downsizing, reduced transfer payments, privatization, and deficit reduction are all issues policy makers must struggle with when allocating resources. However, these often tend to be the only issues considered, while issues related to values, principles and equity are neglected (Peters, 1995). In her survey of Canadian values, Peters found that while fiscal responsibility was valued by Canadians, it was only one of seven themes, the others being self-reliance, compassion, investment in future generations, democracy, freedom, and equality (Peters, p. 5).

The promotion of such values and principles does not necessarily mean increased costs. In fact, a collective responsibility to promote the safety of vulnerable members of society through the reduction of injury-producing falls could potentially save considerable outlays of hospital funds and other medical costs (Scott & Gallagher, 1997). Resources are not limited to funds however—they also include access to information, experiential knowledge and volunteers. Some resources require no additional funds and some require only a shift in priority of existing resources. For the problem of falls among the elderly resources are needed for research, community-based programs, support of

volunteer groups, implementation of policy lenses, and for the identification and reduction of risk factors that contribute to injury-producing falls.

Federal and provincial funding for research on falls prevention is an important factor in policy formation. Knowledge is needed on the extent and nature of the problem in order to implement strategies for prevention. Most falls among older people are predictable, and many are thought to be preventable. Based on what we do know to date, multifaceted prevention strategies are required to address the complexity of factors that increase the risk of falling with an injury. There are few studies that demonstrate the effectiveness of individual prevention strategies, but it is thought that the elimination of each risk factor reduces the likelihood of sustaining an injury, and that the most effective strategies are those that are tailored to individuals' risk profiles. Unfortunately, at present in Canada, there are no permanently funded fall-prevention programs. Most programs and research on fall prevention operate on the basis of short-term funding and for the most part operate independently and often in isolation of each other (Scott & Gallagher).

Knowledge is a key resource in the prevention of fall injuries among seniors. At present the only data collection systems for recording injuries from falls in Canada are limited to hospital separation and mortality records (Scott & Gallagher, 1997). These data only cover those who are admitted to hospital for fall-related injuries or those who die as a result of a fall. There are no systems for recording fall-related injuries of those who visit the emergency departments, physician offices, community health clinics, therapists or those who do not seek medical attention. Mortality and morbidity do not include the necessary information for identifying contributory factors and are therefore inadequate for those working in the field of fall prevention. For instance, they do not contain

information on the person's health condition or disability status, medications or mobility aids used at the time, or information on environmental contributors such as cracked sidewalks or lack of handrails on stairs. There are also no systems for recording the anecdotal stories that seniors have to tell of their falls and injuries, and no means of capturing their experience-based ideas for injury reduction.

Information that is collected on fall-related injuries is not readily accessible to those who need it. For example, community groups wishing to launch fall prevention programs to not have access to records kept by municipal governments on the number and location of fall-related injuries that occurred in their jurisdictions. Legal systems ostensibly designed to promote safety often inadvertently promote the hoarding of information perceived by many municipal government officials as potential litigious (Gallagher & Scott, 1996).

Federal and provincial resources are needed not only to fund additional research but also to fund and coordinate existing injury-prevention projects. It is significant that at the time of this writing, the STEPS Project is being replicated in five Canadian cities. With a shift in the allocation of funding priorities and better coordination among stakeholders, every city in Canada could have a program to support the safety of seniors in public places.

Impact

In measuring the impact of policies designed to facilitate the prevention of fall injuries it is necessary to measure both outcome and process (see Figure 3). Neysmith (1987) cautions those who analyze policy impact not to use only 'inputs' as a measure of success, as these are only tools used to obtain results. For instance, it is misleading to say

that policy development for the prevention of fall injuries is well on its way because of the formation of advisory groups or the drafting of frameworks for injury prevention. These are necessary but insufficient structures—their existence may not result in action.

Traditional measures employed by most health economists to judge the cost effectiveness of injury prevention efforts are also limited in their ability to capture the substance of policy impacts. An example is the measurement of health benefits for injury reduction in terms of the wages lost to employers for injured employees (Johannesson, 1996). This measure applies a formula for implementing risk reduction programs based on the amount of money lost due to a person being off work. The implication is that if the injured person is not in the labor force, then risk reduction is not economically viable. Such measures exclude all retired persons and those unable to work due to a disability.

In order to look at the quality of life component of cost/benefit analysis of risk reduction we need to go beyond the limitations of a monetary framework. Unlike Johannesson (1996), who focuses only on the economics of health, Hamilton and Bhatti (1996) encompass a broader evidence-based framework for decision-making on health policy. Their impact measures include studies based on experiential knowledge, underlying social factors, and evaluation studies that are both summative and formative. The Canadian Council on Social Development holds similar views (Hamilton & Bhatti). The Council supports evidence for assessing social indicators that tell us as Canadians "where we stand and are going with respect to our values and goals" (Canadian Council on Social Development, 1996, p. 7). Application of such a model of measurement to fall injuries among the elderly would include consideration of improved quality of life,

enhanced independence, and an increased sense of control through involvement in the policy-making process by those affected by the policy outcomes.

Conclusions

Through a critical gerontological perspective, fall-related injury among seniors has been examined in this chapter from multiple perspectives within the larger social, economic and political contexts of Canadian society. This analysis shows the prevention of such injuries to be complex, requiring a variety of policy approaches. This critical analysis shows that for the most part, there is an absence of effective policies, and that existing polices may be disadvantageous to the development fall prevention strategies for seniors. Examples of disadvantageous policies include cut backs in spending on social programs and health care, polices that exclude seniors—particularly senior women—of low income or those in poor health in the policy-making process, and building codes and standards that do not reflect the safety needs of older adults and those with disabilities. While policy platforms such as the Ottawa Charter, the Milan Declaration on Healthy Cities, The National Framework on Aging and the Federal Task Force on Disability Issues exist, they are more rhetoric that reality. So long as political agendas are dominated by economic interests of the wealthy few, the safety of the frail and aging elderly will continue to be in jeopardy.

The urgency for implementation of policy in the area of seniors' safety is heightened by a Canadian population that is aging, with increasing numbers of older people with disabilities and chronic illnesses becoming independently mobile with the assistance of barrier-free environments and technological advances in mobility aids. A larger proportion of Canada's future population will be at risk of injury from a fall than

ever before. These changes emphasize the need for widespread and cost effective strategies that recognized the social, economic and health determinants that contribute to people being at risk and the broad range of stakeholders who need to be involved if environmental design changes are to be implemented that promote safety. In order to implement polices that promote such strategies those affected by policies must be part of the policy-making process.

Influencing policy-making is a multi-staged and complex process that includes consideration of the larger community context, identification of relevant stakeholders, understanding of the government roles, policy-making frameworks, and barriers to acceptance of issues. Pressure groups need to establish their priorities, set out their strategies and amass their resources—human, informational and financial. The job is not completed however, until the impact is measured both objectively and subjectively in terms of outcome and process.

Guiding principles, frameworks and structures are all in place for the development of policies and programs to prevent falls in public places—what is missing is **action**. Many dedicated, competent people have devoted considerable time and effort into the creation of the Ottawa Charter, the Milan Declaration and other frameworks for policy development. Policy lenses and advocacy groups are in place or being developed. Research has demonstrated the connection between injury prevention and a broad range of health determinants for seniors and older adults with disabilities. What is needed now is the political will to act. Barriers to action are rooted in social attitudes that spur competition over resources. Pressures from well-financed groups motivated by power and profit encourage this competition. Politicians need to be convinced that both economic

and social benefits will result from policies that reduce fall-related injuries among seniors and that without policy changes the problems and related costs of these injuries will escalate.

CHAPTER 3

Theoretical Framework and Literature Review

The purpose of this chapter is to outline the development of a theoretical perspective and conceptual framework used to form the basis for this dissertation study. This framework was used to guide the following review of the current literature on fall-related injuries among seniors. The literature review focuses on the nature and extent of the problem of fall-related injuries among seniors with a view to gaining a better understanding of the contributing factors. This section reflects a wide body of work, based on Canadian and international studies on falls, encompassing sources from North America, Europe, Asia, Australia, and New Zealand. This chapter concludes with a critique of the studies reviewed and an outline of the dissertation study.

Theoretical Development

Theoretical development in the study of falls and fall-related injuries among older adults has been limited to a two-tired conceptual framework based on studies of intrinsic (those internal to the individual) and extrinsic (those external to the individual) factors. Findings from these studies point to falls and fall-related injuries as resulting from a complex combination of factors reflecting physical and behavioral conditions operating alone, or in conjunction with, environmental hazards (O'Loughlin et al., 1993; Speechley & Tinetti, 1991). Study findings indicate that the more internal and/or external risk factors—the greater chances that a fall will occur (Speechley & Tinetti; Tinetti et al., 1994a). Risk factors are also shown to have an additive effect, where having two risk factors imparts more than twice the risk of having each factor alone (Gallagher, 1995; Nevitt, Cummings, Kidd, & Black, 1989; Tideiksaar, 1986).

A considerable amount of research has been conducted into a wide array of risk factors. One review of epidemiological studies of falls among the elderly identified over 400 variables that have been investigated (Effective Health Care, 1996). Despite this, opinions differ on the contribution of specific factors and few studies have been conducted to investigate the interactions between factors or their combined effects. The understanding of the problem of falls and fall-related injuries among seniors is further hampered by a lack of investigations of factors that may be indirectly linked to falls and fall-related injuries. In addition to these omissions there is also a notable absence of any mention of a theoretical perspective used to guide the study of this phenomenon.

This lack of mention of theory is not unique to this field of gerontological study. Bengtson, Burgess and Parrott (1997) found it to be a common occurrence in most studies on issues related to older people. In their survey of 645 articles in eight major gerontological journals covering a period between 1990 and 1994, 72% had no reference to any theory in the interpretation or explanation of the findings.

Despite the noted absence of the mention of theory, it can be argued that all researchers "filter their data through a lens that is tantamount to a theoretical model" (Bengtson et al., 1997, p. S72). However, unless a theory is explicitly stated, it is difficult to interpret the findings within the larger context of a given issue. Explicit mention of theory is more commonly found in interpretive studies, yet it is equally applicable to empirical findings (Bengtson et al.). This is particularly important in epidemiological studies—such as the study presented in this dissertation—as these deal with the study of disease phenomena in population groups (Ryan, 1982). Population groups exist within complex social, historical, political, economic, and gender contexts (Berman, Ford-

Gilboe & Campbell, 1998) and without a theoretical framework for interpreting the findings there is no basis for exploring links and interrelationships among related phenomena that exist within these larger contexts. This is particularly true for the study of fall-related injuries among seniors due to the multitude and diversity of factors implicated and the larger social context in which these factors exist.

Theoretical development in this field is further hampered by a lack of research collaboration and information sharing across disciplines. Marmot, Kogevenas and Eston (1991) point out that many researchers fail to take advantage of data that exists across disciplines to explore links between the interactions and compounding effects of health-related issues. For instance, few studies on fall-related injury among seniors effectively link the findings of biological factors with those of social factors. Marmot et al. found that epidemiological studies of factors affecting health and disease "tend to include the category of social class or socioeconomic status as regularly but with as little thought as the category sex" (p. 113). Without an analysis of the broad social forces that determine states of health and disease they claim that the category of social class is devoid of a theoretical context and misses the potential for altering social inequities.

Explicit theory provides a lens through which to view phenomena of interest, a framework with which to explain findings, and a basis from which to expand or develop new theories. Clearly stated theoretical perspectives are necessary to account for "what we have empirically observed in the context of previous knowledge in our field" (Bengtson et al., 1997, p. S72). Without a theoretical framework to build on, studies become isolated collections of facts without a means for cumulative understanding.

The development of an appropriate theory to guide the study of health issues pertaining to seniors, such as fall-related injuries, is part of a long history of theoretical development in the study of gerontology. Early theories such as the "disengagement theory of aging" of the 1960s were discounted as "life course" and "age stratification" theories became popular in the following decades (Bengtson et al., 1997, p. S77). What is now described as the "third generation of theories" (Bengtson et al., p. S77) includes those based on a multidisciplinary and macro-social approach to the study of age-related issues. These include feminist theories of aging, life course, age stratification, political economy of aging and critical gerontology.

The application of any of these theoretical perspectives would elucidate issues of interest in the study of fall-related injuries among the elderly. However, the one that is most relevant for challenging traditional models and examining social structures pertinent to fall-related injuries among the elderly is the theory of critical gerontology (Bengtson et al., 1997; Berman et al., 1998). Critical gerontology is defined as a perspective that critically examines patterns within the larger social structures that influence the experiences and behaviours of older people (Bengtson et al., 1997). This perspective is particularly relevant to the study presented here as it enables an examination of multiple perspectives of the issue of fall-related injuries within larger social, economic and political contexts (Bengtson, et al.). Data sources examined for this study were based on the epidemiology of population patterns of health determinants and fall-related injury among older adults (Mausner & Kramer, 1985). A critical gerontology perspective lends itself to an examination of these patterns within the larger social structures of aging and will be used to question the taken-for-granted assumptions of how this issue is

traditionally investigated and asks *who* benefits from existing conceptualizations (Berman, et al., 1998).

Critical theoretical approaches are also used to uncover oppression and expose social inequities (Creswell, 1997). A number of studies have begun to suggest that for the problem of fall-related injuries, those most affected may be the very old, the ill, the disabled, and women (Griffin, Ray, Fought & Melton, 1992; Luukinen, Koski, Honkanen & Kivela, 1995; Northridge, Nevitt, Kelsey & Link, 1995; Nyberg & Gustafson, 1996). These people are also the least able to advocate on their own behalf for changes to policies that affect their health and safety.

Based on the work of Habermas, critical theorist Moody (1988) emphasizes the importance of the emancipatory nature of critical gerontology in the following:

> ...any theory of aging that settles for less than a form of emancipatory knowledge runs the risk that knowledge gained, whether technical or hemeneutic [sic], will be used for purposes that lead not to freedom but to new domination, perhaps a domination exercised ever more skillfully by professionals, bureaucrats, or policymakers (as cited in Lynott & Lynott, 1996, p. 757).

A critical gerontology perspective is used in this study to develop a new conceptual framework for the study of fall-related injuries among seniors. This framework is reflected in the selection of studies reviewed in this chapter and in the variables chosen for examination in this dissertation study. In the final chapter, a critical gerontology perspective is used to direct the interpretation of the findings and in the exploration of links and interrelationships among related phenomena that exist within the larger social, economic and policy contexts.

Conceptual Framework

A conceptual framework that is consistent with a critical perspective is one that is based on a broad health-determinants model. The health-determinants model encompasses the notion of multidimensional influences and a social context for the resolution of health problems. Researchers in the study of fall-related injuries have been quick to provide facts but slow to integrate them within a larger explanatory framework and remiss in not connecting findings to established explanations of social phenomena (Bengtson et al., 1997). This is most likely due to the narrow confines of the existing conceptual framework traditionally used to guide most studies on factors associated to fall-related injuries. This framework consists of intrinsic (biological and behavioural) factors, and extrinsic (environmental) factors. Limiting studies to this two-tired model of the issue ignores the contribution of social and economic determinants of health and the links that exist between these determinants and the biological, behavioural and environmental determinants.

Evans, Barer and Marmor (1994) summarize the problems associated with narrow conceptual frameworks in the following:

> ...there is a considerable degree of confusion about the importance of different determinants of health, and the relationship among them. Much of the confusion arises from the peddling of simple conceptualizations of complex phenomena. Improved diet, more exercise, less stress, better medical care, genetic engineering—each offers a simple remedy with a catchy label that may be easily understood. The problem is that when offered as explanations of why some people are healthy and other not, they are simplistic and incomplete (p. xviii).

To reflect the complex nature of the problem of fall-related injuries among older adults the following review of the literature was guided by a broad health-determinants model where studies of factors associated fall-related injuries among older adults are

reviewed under the four domains are biological, behavioural, environmental, and socioeconomic factors. While these separations are arbitrary—as most fall-related injuries result from the overlapping and compounding effects of multiple factors—they are useful in assisting our understanding of the contribution of like clusters of factors and in identifying target areas for risk reduction.

The biological factors include those pertaining to the human body and are related to the natural aging process as well as the effects of chronic and acute health conditions. Behavioural factors include those concerning human actions, emotions or choices. Environmental factors concern physical structures or objects, and policies designed to regulate them. Socioeconomic factors are those concerned with the influence and interaction of social or economic factors. In the following table (Table I) these four domains are presented with a summary of the potential risk factors shown in the literature to be associated with fall-related injuries among older adults. Evidence is stronger for some of these factors than others and many are only found to be problematic when found in combinations. Some factors, such as those concerned with social and economic conditions are found in the literature to be only indirectly related to fall-related injuries.

Table I

Potential Risk Factors for Falls and Fall-Related Injuries Among Older Adults

Biological	Behavioural	Environmental	Social/Economic
Advanced age	Taking multiple medications or excessive alcohol	Poor building design and/or maintenance	Income
Female gender	Taking:	Unenforced codes or inadequate standards	Social status
Chronic illness:	Tranquilizers	Poor stair design	Education level
Stroke	Sleeping pills	Lack of:	Employment
Osteoporosis	Antidepressants	Handrails	Living conditions
Urinary or bowel incontinence/ frequency	Antihypertensives	Curb ramps	Dwelling ownership
Physical disability	Antidiabetic agents	Rest areas	Safe housing
Cognitive impairment	Risk-taking behaviours	Lighting	Early childhood experiences
Mobility changes	Lack of exercise	Grab bars	Social environment
Gait disorders	Previous fall/frequent falling	Poor lighting or sharp contrasts	Caring relationships
Poor balance	Fear of falling	Slippery or uneven surfaces	Support networks
Postural sway	Inappropriate footwear	Obstacles, including:	Social interaction
Diminished muscle strength	Mobility aids	Scatter rugs	Emotional support
Sensory changes	Not using mobility aids	Trashcans	Living arrangements
Poor vision		Poles	
Diminished proprioception		Sidewalk furniture	

In the remainder of this chapter an overview is presented of the findings of studies on factors associated with falls and fall-related injuries under these four domains. The chapter closes with a critique of studies reviewed and a rationale for the variables selected for the dissertation study.

Literature Review

Biological Risk Factors

Biological factors covered in the literature on falls and fall-related injuries among seniors include age, gender, chronic illnesses, cognitive impairments, and balance and gait. These factors combined have received more attention in the literature on falls among

the elderly than any other category of risk factors. This may be due to the availability of funding for research into the development of medical procedures or medications used to treat many of these conditions. Studies for this category show that it is not the age, illness or disability per se that increases the risk of falling but symptoms or limitations imposed by these conditions.

Age.

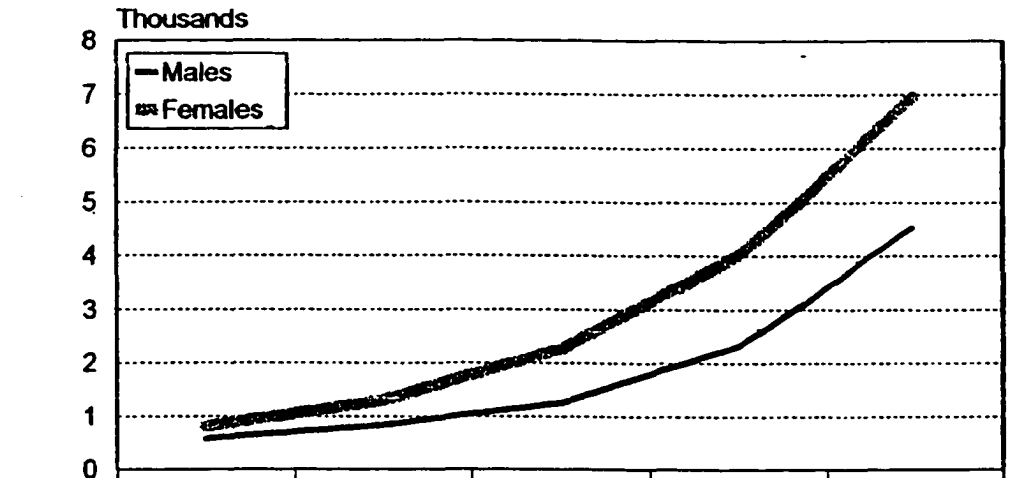
The number and severity of fall-related injuries increase with advancing age (Luukinen et al., 1995). For persons aged 75 years and older, falls are the leading cause of death from an unintentional injury and are the sixth most frequent cause of death from all causes (Baker & Harvey, 1985). In Canada for the year 1989, deaths attributed to fall-related injuries among men aged 85 years and over were 20 times higher than the rate for men between the ages of 65 to 74 (Riley, 1992, as cited in Raina & Torrance, 1996). Among women of the same ages, the rate was 44 times higher. The same pattern is seen for hospitalizations due to fall-related injuries. The highest hospitalization rates for all ages are for those aged 65 and older, and the rates increase with advancing age (Raina & Torrance).

Canadian data on this topic are provided in form of death rates and hospitalizations. A source of such data is a recent analysis conducted by this author of hospital and mortality data in British Columbia, and published in the *B.C. Health and Disease Surveillance* (Scott & Gallagher, 1997). A few exerts highlighting age and gender differences for fall-related injuries are provided below. Figure 5 shows the increasing rates for older ages for hospitalization due to a fall for both men and women

(Scott & Gallagher). However, while more women are hospitalized due to fall-related injuries, more men die from fall-related injuries (Figure 6).

Figure 5

Hospitalizations due to Falls Ages 65+ by Gender; BC Annual Average Rate per 100,000 Population 1991/92-1995/96

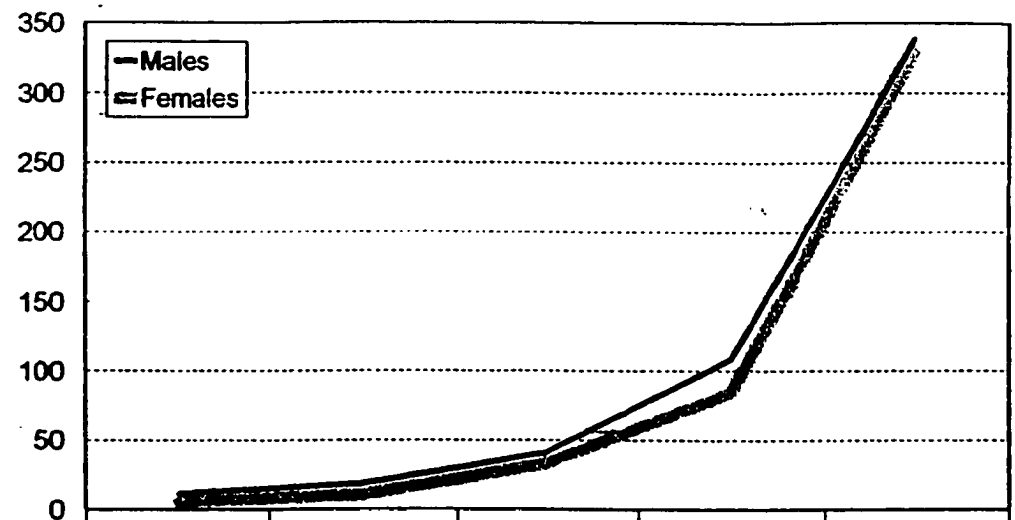


	65-69	70-74	75-79	80-84	85+
Males	0.576	0.828	1.254	2.333	4.524
Females	0.804	1.3	2.277	4.022	6.967

(Scott & Gallagher, 1997)

Figure 6

Deaths due to Falls Ages 65+ by Gender; B.C. Annual Average Rate per 100,000 Population 1991-1995



	65-69	70-74	75-79	80-84	85+
Males	10.9	18.5	40.9	108.4	338.9
Females	5.1	10.3	32.7	84.4	330.2

(Scott & Gallagher, 1997)

Gender.

Considerable differences exist between men and women in the incidence, causes, and consequences of falls. For instance, a prospective study of all community-dwelling elderly aged 70 years and older (n = 979) in five municipalities in Finland showed that women fell twice as often compared to men (Luukinen et al., 1995). Of those who fell, women sustained 71% of the reported minor injuries, 61% of the reported major injuries, and 73% of the reported fractures. Younger old men in the study had a relatively low incidence of falls but were found to sustain major injuries. The researchers concluded that this was probably related to the higher activity level for the men in this age group.

Hornbrook et al. (1994), also found gender differences in their study on the effects of a home-safety and exercise program on reducing falls. They found that men were less likely to suffer a fall requiring medical attention and had significantly fewer falls than women do. Being male was found to be significantly associated with having fewer fall-related fractures. The effect of home-safety and exercise interventions was found to be strongest for people 75 year and older and for males. especially for reducing fractures.

Other studies, looking at gender differences for falls in general rather than fall-related injuries specifically, show fall rates for women to be considerably higher than for men. For instance, a study by Northridge et al. (1995), found the incidence of falls among women to be as high as 78% in their study of 325 seniors over one year. Yasumura et al. (1994), in their door-to-door survey of a residential district of Tokyo, found that among 807 randomly selected community-dwelling elderly aged 65 and over, 21.5% of the women reported a fall in the preceding year compared to only 12.8% of the men. However, of the total number of falls reported (224), 44.7% of the men reported falling more than once, compared with only 32.7% of the women. Factors associated with increased risk of falling among the men included advancing age, history of a stroke, and visual deficits. For women, urinary or bowel incontinence was significantly associated with falling. The need to urinate at night was found to increase the risk for both sexes. This finding is confirmed in a study focusing on nocturia among seniors as a risk factor for falling (Stewart, Moore, Marks & Hale, 1992). Of the 1,508 subjects in this study of ambulatory persons aged 65 and over, 88.9% of the women and 91.7% of the men, reported nocturia. Falls were significantly associated with the frequency of having to get

up in the night to urinate. Of those who fell, 12.9% of the women and 7.3% of the men, reported having fractured a bone. However, the association between nocturia and fall-related fractures was not significant; soft tissue injuries were not reported.

Also of interest are the differences found by Arfken, Lach, Birge, & Miller (1994) between men and women in their reports of fear of falling. They study found that more than twice as many women than men reported a fear of falling (35% versus 15%, n = 890). For both genders, fear of falling was found to increase with age, with 21% of women aged 66-70 years reporting a fear of falling, compared to 45% for those aged 81 and over. For men, 14% of those aged 66-70 years reported a fear of falling, compared with 21% for those aged 81 and over. An increased rate of fear of falling is also associated with sustaining injuries from a fall (see section on Fear of Falling) (Arfken et al.).

Potential explanations for the increased reporting of fear of falling among women may be found in gender and age differences for known risk factors for falls such as medication use, physiological characteristics, and risk-taking behaviours. For instance, an American study using pharmacy claim records, shows benzodiazepine use to be greater among women (65.4%, n = 4,554) than men (Oster, Huse, Adams, Imbimbo, & Russell, 1990). Koski, Luukinen, Laippala, and Kivela (1996) in their population-based study in Finland, found that different factors were significantly associated with fall-related injuries among men and women. For men, these included older age, the absence of Achilles and quadriceps reflexes, muscle weakness in the lower limbs and the use of digitalis glycosides and calcium blockers (Koski et al.). For women, factors found to be significantly associated with fall-related injuries were reduced upper-leg muscle strength,

impaired orthostatic reaction, short step length, the use of more than four medications, the use of drugs for improving peripheral circulation and antidiabetic drugs (Koski et al.). In this study, the only biological and behavioural factors found to be significant for both men and women were impaired gait, and the use of long-acting benzodiazepines, calcium blockers, and anti-inflammatory drugs.

For older women, low bone density is considerably more prevalent than for men, and is also a known risk factor for fall-related injuries (see section on Osteoporosis). One study found that for women aged 80 years and older, 50% will have a bone mineral density that is 2.5 standard deviations below peak bone mass—thus meeting the World Health Organization criteria for having osteoporosis (Dian, 1996).

Risk taking behaviour may explain why some men sustain more severe injuries due to falls. For instance, Rush and Ouellet (1997) in their study of nurses' perceptions of elderly people's reluctance to use mobility aids, report that males appeared much less willing to use mobility aids that females (Rush & Ouellet).

In conclusion, women are found to be at greater risk of falling and sustaining an injury from a fall—particularly fractures. The factors associated with falls among women differ significantly from men with respect to the use of certain medications, areas of muscle weakness, increased fear of falling, lower bone density, incontinence, the need to urinate at night, hypotension, and short step length. The exception to this is among younger old men who sustain more serious injuries from falls, possibly due to higher activity levels or risk taking behaviours. Older age was found in two studies to be significantly associated with falls for men, but not for women. These and other factors are important findings for those who design and implement fall-prevention strategies.

Chronic conditions.

Common chronic conditions that put older people at high risk of having an injury-producing fall include the effects of cerebral vascular accidents, osteoporosis, anemia, arthritis and Parkinson's disease (Brainsky et al., 1997; Herndon et al., 1997; Nyberg & Gustafson, 1996; Scientific Advisory Board, 1996). Again, it is not the illness per se but the symptoms or underlying pathophysiology, which create the risk. Literature on the specific role of chronic illnesses as risk factors for fall-related injuries focus primarily on associations with osteoporosis and the effects of cerebral vascular accidents. Each of these issues will be reviewed separately.

(a) Osteoporosis

Osteoporosis is a condition of low bone mass and deterioration of bone tissue (Scientific Advisory Board, 1996). A person with osteoporosis who falls is at high risk of sustaining a fracture, particularly hip fractures. This is a major health problem considering that osteoporosis affects approximately 1.4 million Canadians, or approximately one in four women over the age of 50, and one in eight men over 50 (Scientific Advisory Board). In Canada in 1993, there were estimated to be over 21,000 osteoporosis-related hip fractures (Scientific Advisory Board). Approximately 20% of women and 34% of men who fracture a hip die in less than one year (Scientific Advisory Board). For persons living at home at the time of their hip fracture who survived the first year, "50% require assistance with walking or with activities of daily living and 14-25% become confined to nursing homes" (Green, Bassett, Foerster, & Kazanijian, 1997, p. 20).

The costs related to hip fractures are also considerable, both in terms of human suffering and costs to society. In a study of 759 community-dwelling seniors aged 65 and over, Brainsky et al. (1997) found the average increased costs of direct medical care, formal non-medical care and informal care after a hip fracture, to be approximately $17,500 US (in 1993 dollars) for the year following the fracture (Brainsky et al.).

The majority of studies on osteoporosis are written for physicians who provide treatment for osteoporosis-related fractures, and support a medical model of prevention—primarily through medication (Brainsky et al., 1997). This literature also draws attention to the considerable controversy over money spent on bone mineral density (BMD) screening as a measure for preventing fractures (Green et al., 1997).

Some studies point to a need for more research on risk factors for osteoporosis-related fractures other than enhancing bone density. For instance, Cummings and Nevitt (1989), hypothesize that four factors are predictive of sustaining a hip fracture from a fall: "(1) direction of the fall; (2) adequacy of protective reflexes; (3) adequacy of local 'shock absorbers'; and (4) bone strength at the hip" (as cited in Cumming & Klineberg, p. 774).

The studies indicate that the role of osteoporosis in fall-related injuries is complex and requires more investigation. At present, pharmaceutical remedies for osteoporosis dominate much of the medical literature on fall prevention for the elderly with little attention paid to contributing factors such as the environment or other debilitating physical conditions (Scientific Advisory Board, 1996).

(b) Cerebral vascular accidents

Cerebral vascular accidents, or strokes, result in symptoms that can put a person of any age at considerable risk of falling and sustaining an injury. Studies on falls among stroke victims are rare, and most are hospital-based (Nyberg & Gustafson, 1996; Tutuarima, van der Meulen, de Haan, van Straten, & Limburg, 1997). However, given that many symptoms persist after discharge, findings from hospital-based studies are also relevant for community-dwelling stroke victims. For instance, a Swedish study of rehabilitation patients recovering from a stroke found two factors to be significantly higher among those who fell based on a cumulative index of multiple risk factors (Nyberg & Gustafson). These are diminished visual perception of spatial relationships related to one-sided paralysis (visuospatial hemineglect) and a partial loss of the ability to perform coordinated movements (dyspraxia). Other risk factors such as having fallen previously or medication use showed little to no difference between the fall and non-fall groups, and in some cases the findings were opposite of the expected results. The researchers concluded that the changes brought on by the stroke outweighed the effects of other known risk factors (Nyberg & Gustafson).

A retrospective study of stroke patients in the Netherlands, using patient charts from 23 hospitals, found stroke patients to be more than twice as likely as general acute care patients to experience a fall (Tutuarima et al., 1997). Among the stroke patients (n = 720), 23% of the falls happened while the patient was in bed and 24% while sitting in a chair. Twenty-five percent of the falls resulted in mild to severe injuries. Factors found to be significantly associated with falling in a multivariate model with age and sex, include heart disease, mental decline, and urinary incontinence (Tutuarima et al.). Confusion was

found to be incrementally associated but was not significant in a multivariate model. Similar to the Nyberg and Gustafson's (1996) study, an unexpected finding was that the use of psychotropic drugs corresponded to a lowering of the fall risk. However, unlike Nyberg and Gustafson's findings, visual impairments and neurological deficits were not found to be significantly associated with falling.

The differences in findings between these studies, and the unexpected finding of a lowering of the risk for falls among those stroke victims using psychotropic drugs, point to the need for more research on factors related to falls among stroke victims. Also, future studies need to include community settings to reflect the interaction between risk factors associated with a stroke and environmental risk factors faced at home and in the community.

Cognitive impairments.

Cognitive impairments, or organic mental disorders, are classified by the DSM-III to include vascular conditions, intracranial infections, degenerative diseases, cerebral injury and lesions (Huelskoetter, 1987). These diseases effect approximately 7% of people aged 65 and over and 20% of those over 80 (Huelskoetter). Degenerative conditions are the most common of these disorders. Alzheimer's disease is the most common form of all degenerative mental impairments and the numbers are increasing. Older adults with cognitive impairments such as Alzheimer's disease are found to be at much higher risk than other's of the same age for experiencing an injury-producing fall (Asada et al., 1996; Oleske, Wilson, Bernard, Evans, & Terman, 1995). The exact causes of these falls are complex and pose considerable challenges for those who work to prevent fall-related injuries among people with dementia.

In a study looking at injuries among 281 community-dwelling persons with Alzheimer's disease, researchers found an annual injury rate of 42.7%, which is 1.6 times higher than injury rates among other community-dwelling seniors (Oleske et al., 1995). Of these, a fall was the single most common event, responsible for 43.8% of the injuries. Twenty-five percent of the falls resulted in fractures compared with only 3.1% among general community-dwelling seniors (Oleske et al.). The second most common source of injury was due to striking against objects such as furniture, walls or doorways, and accounted for 24.7% of the injuries.

The physical environment was reported to be a contributing factor in 74.9% of the injuries among persons with Alzheimer's disease, with only 4.1% of the injuries resulting from a free-falling motion (Oleske et al., 1995). "Surfaces (floors and stairs) were the most common source of injury, followed by furniture and building structures" (p. 744). Dementia severity was found to convey an independent risk of injury and increasing dementia severity was found to be associated with an increased risk of repeated injury (Oleske et al.).

A prospective cohort study in Japan studied 86 persons with dementia and 98 control subjects over a one year (Asada et al., 1996). Findings showed that 41% (n = 35) of those with dementia sustained fall-related injuries that required medical attention over the study period, and five of these were fractures. Of the 98 control subjects 27 fell once or more and 9 of these sustained injuries (11%), including two fractures. In a multivariate model using all subjects, and controlling for effects of other variables, the presence of dementia and a history of falls in the past year were found to be significant risk factors (Asada et al.).

Risk factors found to be independently and significantly predictive of fall-related injuries among those with dementia include difficult care status (resistance to help), a history of previous falls, and higher scores for physical ability to perform activities of daily living (ADLs) (Asada et al., 1996). The researchers conclude that the ability to perform ADLs (this measure indicates physical ability only and not effectiveness) is indicative of higher activity levels, which predispose the person to engage in potentially dangerous activities putting them at greater risk of injury from a fall. This pattern is also seen among older people without dementia, as Speechley and Tenetti (1991) show in their study, vigorous elderly people are more likely to sustain injuries from a fall compared to frail elderly, who fall more often but sustain fewer injuries .

Researchers noted that information on physiological risk factors for fall-related injuries were difficult to obtain from persons with dementia, such as accurate visual and hearing tests (Asada et al., 1996).

These studies provide compelling reasons for more research on falls among community-dwelling seniors with dementia. Surprisingly few studies were found on this topic given the high injury rates, high rates of institutionalization due to injuries, and the growing number of people with dementia.

Balance and gait.

Balance and gait abnormalities have been shown in numerous studies to be predictive of fall-related injuries among older people (Chen, Ashton-Miller, Alexander, & Schultz, 1994; Hausdorff, Edelberg, Mitchell, Goldberger, & Wei, 1997; King, Judge, & Wolfson, 1994; Maki, Holliday, & Topper, 1994; Topper, Maki, & Holliday, 1993). Many of the studies on gait and balance look at the role of body mechanics to explain

why older people fall. For example, studies show that different activities lead to different types of falls (Chen et al.; Topper et al.). Knowing which movements put some people at risk of an injury-producing fall and not others, and why, will assist in preventing them.

Fall-related injuries during walking are often triggered when a foot contacts an obstacle in its path (Chen et al., 1994). Yet little is known about how individuals of any age successfully negotiate obstacles, especially when hurrying (Chen et al.). A study on gait asked 24 young adults and 24 old adults to avoid stepping on a band of light, not knowing when or where it might appear as they proceeded down an eight-meter long walkway. Results showed that older adults are more likely to contact an obstacle and that this risk increases with time pressures (Chen et al.).

Age differences were also examined in a retrospective case controlled study comparing gait variability between elderly fallers, elderly non-fallers and young adults (Hausdorff et al., 1997). Findings revealed elderly fallers to have significantly more gait variability than either of the other groups, whereas non-fallers were not significantly different from the young adults. Gait variability measures included stride, stance and swing times. Those with a history of falling showed significantly greater variability in all three measures on a stride-to-stride bases. Fatigue was shown not to be a factor in the variability and the faller and non-faller groups were similar with respect to medication use, muscle strength, and disease categories that may confound the results. The faller group was slightly older, but after adjustment for age, fall status remained independently associates with gait variability. A limitation of this study was the omission of adjustment for sex despite the larger portion of women in the faller group (72%) compared the non-faller group (47%).

The importance of considering gender differences in studies of gait as a risk factor for falling is demonstrated by Fried, Cwikel, Ring and Galinsky (1990, as cited in Tideiksaar, 1997). This study of 36 community-dwelling older persons, showed impaired gait to be significantly predictive of falling, but only for women. Women who reported falling were found to walk more slowly, take smaller steps, and have impaired balance on turning.

Nevitt et al. (1991), found that fall-related injuries "most commonly occur during the performance of daily activities requiring leaning, stooping, and reaching" (as cited in Topper et al., 1993, p. M262). These findings lead to a study of gait and balance impairments by Topper et al.. They found that lateral postural sway (measured by degree of spontaneous sway while blindfolded) was the most predictive test for falling during everyday activities. Blindfolding eliminates visual cues and highlights limitations in proprioceptive, cutaneous, and vestibular inputs. These limitations could lead to greater risk of falling during normal activities when sudden shifts in balance require fast corrective action (Maki et al., 1994).

King et al. (1994), found postural sway to be less predictive of falling than a reduction in functional base of support (FBOS), particularly for persons over 80 years of age. FBOS (measured by the amount of pressure exerted by the foot when leaning) was most highly associated with falling while reaching, leaning, or bending while moving forward or backward.

These studies show subtle differences in the mechanics of gait and balance and demonstrate the complex nature of isolating specific risk factors. The findings are limited in their applicability to natural settings as most were conducted in laboratories using

simulated postural platforms, blindfolds and replicated home environments. Also, in order to isolate the variables related to only gait or balance, the researchers excluded subjects who were not active and independently mobile, thereby limiting the findings' generalizability. For those studies using a retrospective approach, it is impossible to say whether the balance and gait abnormalities existed prior to reported falls or were a result of them. It is also likely that balance and gait are interrelated with age-related changes and specific diseases such as osteoporosis and the effects of a stroke. The severity of the falls is not reported in any of the studies reviewed on gait and balance.

Behavioural Risk Factors for Fall-related Injuries

Behavioural risk factors covered in the literature on fall-related injuries among the elderly include the use of medications, alcohol, exercise, frequency of falling, fear of falling, footwear and use of mobility aids.

Medication use.

Medication use increases with advancing age due to the greater prevalence and severity of health problems among the elderly (Rosenberg & Moore, 1997). In addition to taking more drugs, older people also develop a heightened sensitivity to drug effects (Ray, Griffin, & Shorr, 1990). With advanced age there is an increase in both the half-life (the amount of time the drug remains in the body) and the active levels produced by a given dose (Ray et al., 1990). Also, age-related losses of gastrointestinal, hepatic or renal function, predispose older persons to adverse drug reactions (Ray et al.). Drug

interactions, side effects, and polypharmacy are all associated with increased risk of falling and injury among older persons (Ross, 1991). The class of drugs with the most well established link to fall-related injuries is benzodiazepines (Koski et al., 1996; Neutel, Hirdes, Maxwell, & Patten, 1996; Oster et al., 1990; Ray, Griffin, & Malcome, 1991; Ray et al., 1990).

Used for the treatment of anxiety or insomnia since 1962, benzodiazepines are among the most widely prescribed class of drugs for persons age 65 and over (Neutel et al., 1996; Oster et al., 1990). Yet, recent studies show that their use impairs both cognitive performance and psychomotor skills (Oster et al.). One study found that elderly persons taking psychotropic drugs have a 70-100% increase in the risk of hip fracture (Ray et al., 1987, as cited in Ray et al., 1990, p. 115). A large American study using pharmaceutical records, shows benzodiazepine users (n = 4,554) to be twice as likely as non-users (n = 13,662) to have at least one accident requiring emergency room care (Oster et al.). These findings show a clear association between benzodiazepine use and injuries but are nonspecific for age, sex and benzodiazepine type.

In Canada, it is estimated that approximately 10% of men, and 20% of women over 65 years of age use tranquilizers and /or sleeping pills (Quinn, Baker & Evans, 1993, as cited in Neutel et al., 1996). Benzodiazepines are the class of drug most often prescribed for both of these complaints.

In a controlled cohort study, falls injury was assessed by age group for all person age 20 years and older in the province of Saskatchewan after filling a prescription for either sedative or tranquilizer benzodiazepines (Neutel et al., 1996). This study used province-wide pharmaceutical and hospital records (fall injuries were classified using

ICD-9 codes E880-E888). A non-exposed control group was randomly selected with consideration for similar age and sex distribution. Benzodiazepine sedatives were found to be more predictive of fall injury than tranquilizers, and both were more predictive than the non-exposed control group (Neutel et al.). Those over 80 years of age showed the highest difference in admission rates for fall injuries after exposure to both benzodiazepines (see Table 2). Those under 60 showed the greatest relative difference.

Table 2

Rates of Hospitalization for Falls per 10,000

	Benzodiazepines sedatives	Benzodiazepines tranquilizers	Unexposed controls
Total	26.2	12.1	9.0
Men	22.8	11.9	5.7
Women	28.5	12.3	11.3
Age (years)			
20-59	8.6	5.7	0.8
60-79	25.5	16.9	10.7
80+	127.8	86.1	33.3

(Neutel et al., 1996, p. 275)

Neutel et al. (1996) also found that men aged 20 and over using benzodiazepine sedatives were 4 times more likely to be hospitalized for a fall-related injury than non-exposed men (see Table 2). For women the rate was 2.5 times that of non-exposed women. Benzodiazepine tranquilizer users also showed higher rates for both sexes than the control, but the differences were smaller. The rate of hospitalization was greatest for the first two weeks after the prescription was filled and then decreased for both sedatives and tranquilizers with increasing length of exposure (Neutel et al.). The authors

speculated that this could be due to an increased tolerance to the drug or that the person just stopped taking it.

A limitation of this study is the lack of information available through pharmacy records on concomitant conditions that predispose subjects to be a risk of falling. Also, conditions associated with taking benzodiazepines such as lack of sleep or depression may increase the risk of hospitalization due to falls.

Using the same data set as the Saskatchewan study (Neutel et al., 1996), but selecting a different sample, Ray et al. (1989) arrived at different conclusions. Findings from the latter study show current users of long half-life benzodiazepines to have a 70% greater risk of sustaining a hip fracture than those not using any psychotropic drugs. Although not statistically significant, the risk was higher for those taking more than the standard recommended dose. There was no increased risk of hip fractures among those using short half-life benzodiazepines.

The findings of these two studies are difficult to compare due to the different sub-samples and methods of categorizing benzodiazepines that are not mutually exclusive. Neutel et al. (1996) looked at all fall injuries based on benzodiazepines used most frequently, categorized as sedatives (flurazepam, triazolam) or tranquilizers (oxazepam, lorazepam and diazepam). Whereas, Ray, Griffin & Downey (1989) looked only at persons who had sustained a hip fracture, and contrasted the most frequently used long half-life drugs (chlordiazepoxide, diazepam and flurazepam), with short half-life benzodiazepines (lorazepam, oxazepam, triazolam). Note that triazolam is found under both the sedative and short half-life categories, and flurazepam, is under both tranquilizers and long half-life. Yet, findings show that sedatives and long half-life drugs

are highly associated with high injury risk, while tranquilizers and short half-life drugs are associated with less risk or no risk.

The exact mechanism of injury due to benzodiazepine use is less well documented than the consequences. Long half-life drugs are thought to impart the greatest risk due to their accumulation (they are designed to remain effective for at least 24 hours), thus increasing both the duration and intensity of exposure when taken daily (Ray et al., 1989). Koski et al. (1996) hypothesize that long half-life benzodiazepines reduce the peripheral nervous system's ability to respond to inputs, thereby contributing to fall risk.

Other medications associated with increased risk of falling and sustaining an injury are those known to cause orthostatic hypotension (loss of blood supply to the brain upon standing) (Aronow & Ahn, 1997). These include oral diuretics, antihistamines, trycyclic antidepressants, diazepam, anticholineric drugs, ganglion-blockers, methyldopa, and sympatholytic drugs (Caird, Andrews, & Kennedy, 1973, as cited in Ross, 1991).

Alcohol.

Alcohol, like medication, is known to attain higher levels in the blood stream of older people compared to younger people who have consumed equal amounts (Vestal, McGuire, Tobin, et al., 1977, as cited in Nelson, Sattin, Langlois, DeVito, & Stevens, 1992). Prolonged and heavy use is also linked to neurological impairments and is suspected of contributing to decreased bone density in older persons—both known risk factors for fall-related injuries. Despite these associations, the only study to focus exclusively on injury-producing fall risk and alcohol consumption in the elderly found no association between the two (Nelson et al., 1992). Other studies looking at multiple factors, including alcohol, confirm this lack of association (Nevitt et al. 1989; Prudham &

Evans, 1981; Tinetti, Speechley & Ginter, 1988). However, for people under the age of 60 years, alcohol is a known risk factor for falling (Hingson & Howland, 1987, as cited in Nelson et al., 1992).

Lack of exercise.

Understanding the role of lack of exercise as a risk factors for falls and fall-related injuries is made possible through studies that promote exercise as a fall-prevention strategy. Studying the role of exercise in falling is another way of measuring balance, gait and muscle strength. However, most studies examining the specific role of balance and gait (reviewed earlier in this chapter) are conducted in laboratory settings, where as exercise studies tend to be conducted in natural settings, thereby reflecting the potentially compounding effects of the environment.

Exercise programs are one of the few interventions for the reduction of falls that lend themselves to study through randomized controlled trials (RCT). When exercise is chosen as an intervention, the researcher can easily and ethically control the treatment, randomly assign subjects to exercise programs or control groups, and non-invasively take measures of muscle strength, gait, flexibility and balance. In addition, most programs show a change over relatively short periods of time. In theory, when the frequency and severity of falls are reduced among the treatment group, the evidence points to weak muscles, impaired gait, inflexible joints and poor balance as causal factors. However, as the review of the following studies shows, the evidence is seldom this clear.

Manchester, Woollacott, Zederbauer-Hylton and Marin (1989, as cited in Shumway-Cook, Gruber, Baldwin & Liao, 1997, p. 47) estimated that between 10% and 25% of all falls are associated with poor balance and gait abnormalities. The importance

of balance and gait as indicators of falls risk is often demonstrated through the effects of exercise programs on a reduction in fall risk.

In a study of community-dwelling older adults with a history of falls, Shumway-Cook et al. (1997) show that the adherence to a structured multifaceted exercise program improves balance and mobility, and reduces the risk for falls. Subjects with existing balance and mobility problems were referred for this study by their physicians (n=84). Three comparable groups were identified—those that were to fully adhere to the exercise program, those that were to partially adhere and a control group with no program. Exercise programs were tailored to individuals' impairments and functional disabilities as identified in baseline assessments. Exercises were conducted in physical therapy facilities and in subjects' homes over an 8 to 12 week period.

The results showed a significant positive improvement in both exercise groups for balance measures, and the fully adherent group was significantly improved over the partially adherent group for gait. For the fully adherent exercise group, fall risk (as measured by improvement in gait and balance) decreased by 33%, for the partially adherent group by 11%, and for the control group by 8%. Adherence to the exercise program was mixed, with the lowest participation among those who used mobility aids. It should be noted however, that researchers only looked at risk factors and did not measure reductions in the severity or frequency of falls (Shumway-Cook et al., 1997). A reduction in the number of risk factors for falls does not always translate into a reduction in the number of falls, as demonstrated by Wolfson et al. (1996). Their findings showed that while there was a significant reduction in risk factors for falls, the reduction in the number of fall-related injuries was not significant.

The largest and most comprehensive set of studies on the role of exercise in reducing falls comes from the Frailty and Injuries: Cooperative Studies Intervention Techniques (FICSIT) program in the United States (Province et al., 1995). Of the seven studies in the program, five were community-based and two were conducted in nursing homes. All included exercise programs of 10 to 36 weeks in length, with follow-up lasting two to four years. Participants in all sites were selected based on having previously fallen, being ambulatory and not having severe dementia. Sample sizes ranged from 100 to 1,323. Although all sites included an exercise program, and similar measures were recorded, three sites implemented additional interventions such as education on home safety and medication changes. The pooled results of all interventions from all sites showed a 10% lowering of risk factors for falls among those in the exercise programs. However, when the data from the three programs containing non-exercise components were removed, the exercise-only interventions were found not to be statistically significant, although a reduction still existed. Province et al. state that this may be due to the reduced sample size.

When individual sites that included balance training were analyzed, the reduction in the risk of falling was found to be 25%. And in one trial (Site 5), people who were offered the balancing exercise Tai Chi along with other interventions had a 37% lower risk of falling than the non-intervention group (Effective Health Care, 1996, p. 4). This finding is consistent with other studies that show improved postural balance for older persons who practice Tai Chi (Tse & Bailey, 1991; Wolfson et al., 1996). However, in the FISCIT trials, the effect of the balance enhancing interventions could not be separated

from other interventions. Therefore it can only be said that FICSIT interventions that included balance training or Tai Chi were significantly effective (Province et al., 1995).

None of the trial sites, individually or collectively, were found to have an effect on reducing fall-related injuries. In fact, "estimates indicated a slight non-significant increase in the risk" of injury (Province et al., 1995, p. 1364). Such increases in risk for injury with exercise have been reported elsewhere (Speechley & Tinetti, 1991, as cited in Province et al.), and indicate the need for caution in applying exercise interventions that are not tailored to individual abilities. Fall-related injuries were defined as involving one or more of the following characteristics: sustaining a fracture or soft-tissue injury, requiring medical care, or resulting in significant impairment for at least one week following the injury (Province et al., p. 1344).

As with the FICSIT trials, a number of other studies on the effects of exercise in reducing falls employ a number of strategies in addition to exercise, making it difficult to isolate the effects (Hornbrook et al., 1994; Reinsch, McRae, Lachenbruch, & Tobis, 1992). The Hawthorne effect (Polit & Hungler, 1995) must also be considered, where members of the control group may change their exercise patterns just because they are part of the study.

Tinetti et al. (1994a) demonstrated the effectiveness of multiple interventions, including exercise, in their large prospective random controlled trial with subjects recruited through their physicians. Multiple modifiable risk factors were targeted for the treatment group, including exercise, medication use, strength, gait and balance enhancement. Subjects were screened for being at risk of falling, age, community-dwelling, independent ambulation, no severe dementia, and no participation in vigorous

sports or walking for exercise at least one month prior to being in the study. The intervention lasted 3 months with a one-year follow-up for falls. Adherence to the exercise program was monitored in weekly home visits.

A significant reduction was found for the following risk factors among the treatment group: number of medications used, unsafe transfers to bath or toilet, and impaired balance or gait (Tinetti et al., 1994a). When the overall decline in risk factors was applied to a predictive model for falls based on assessments conducted prior to treatment, the risk of falling had declined by 11%. Those in the treatment group sustained fewer fall-related injuries and fewer falls that required medical attention, however, the number were small and findings not significant. The number of falls among the control group (n= 148) on the other hand, went from 65 falls in the previous year up to 68 in the follow-up year.

Tinetti et al. (1994a) concluded that their program was effective in reducing the overall number and severity of falls. However, the estimated costs of for each fall saved based on the overhead expenditures for the interventions applied was $1,948 US for falls not requiring medical attention and $12,392 US for falls that required medical care.

While all the studies reviewed point to exercise as a means of improving balance and muscle strength, the findings are mixed and often inconclusive with regard to the reduction of falls and related injuries. For future studies on the role of exercise in reducing falls, isolating the role of specific interventions may be indicated due to the lack of significant findings in multifactoral designs. For instance, the findings pointing to Tai Chi as a means of improving balance warrant further investigation to isolate the effect of this exercise. More long-term follow-up is also needed, as indications are that the effects

of exercise diminish rapidly when not maintained. While Tinetti et al. (1994a) show that exercise programs are effective, they may only be appropriate for a limited number of seniors. There is no mention, for instance, of the availability of exercise programs for seniors in the lower income brackets or exercise programs adapted to meet the needs of persons who use mobility aids such as wheelchairs or scooters.

Frequency of falling.

Frequency of falling has not been well examined in relation to its direct association with fall-related injury among community-dwelling elderly. It has been shown to be indirectly related to fall-related injuries in a study by Speechly and Tinetti (1991) who found that vigorous elderly people fell more frequently than frail elderly people, and that the vigorous elderly were more likely to sustain a serious injury. These findings would appear to contradict studies that show repetitive falling to be associated with a decrease in health status (Wolinsky, Johnson & Fitzgerald, 1992). It is also surprising to note that O'Loughlin et al. (1993) did not find frequency of falling to be associated with increased age or gender. As with other behavioural factors, frequency of falling and its relationship to resulting injuries is clearly a complex issues that requires further investigation.

Fear of falling.

Fear of falling has been found to be both a consequence and a predictor of falls, especially for the frail elderly (Vellas et al., 1997). According to Mahoney, Sager, Dunham, and Johnson (1994), half of all community-dwelling elderly who have fallen report being fearful of falling again, and 25% limit their activities to avoid a repeat fall. Such restriction of activity can lead to weakened muscles and decreased bone density,

thereby increasing, rather than diminishing, the risk of sustaining future fall-related injuries (Dian, 1996).

Tinetti et al. (1994b) defined fear as a fall-related consequence that limits function beyond what might be expected from the sustained injuries. Findings of a study by Arfken et al. (1994) confirm that fear of falling not only increases after a fall but also contributes to a subsequent increased rate of falls. Their sample consisted of 890 randomly selected older adults 65 years and older, stratified for age and gender. After gender and age adjustment, their results showed that those who reported being most afraid of falling were found to experience the most falls, to be more frail, and to report a poorer quality of life. Those who reported being fearful of falling did not leave their homes as often as those less fearful of falling. This association between fear of falling, a higher reported frailty, and reduced activities indicates that lack of exercise could contribute to falls. The implications of fear as a risk factor indicates that there is a need to concentrate on the emotional, as well as the physical impact of a fall (Tinetti et al., 1994).

Fear of falling does not appear to be as significant a risk factor for elderly people who are healthy and active. Reinsch et al. (1992), found no reports of fear of falling either before or after a fall for 222 active older people they monitored over two years (mean age 75.5). This lack of fear was not due to a lack of falls, as 39% fell at least once and 38% of these fell several times. The low level of injury for this group may explain this lack of reported fear. This assumption is confirmed by Arfken et al.'s (1994) findings that show an increased fear of falling was associated with severity of injury, with 9% of those who reported being very fearful having sustained a fracture, whereas only 0.5% of those expressing no fear had sustained a fracture.

Other variables they found to be significantly associated with a fear of falling are being female, gait abnormalities, low economic resources and cognitive impairments. Of these, gait abnormalities was the strongest predictor of a fear of falling (Vellas et al., 1997).

Footwear.

While many speculate about the role of improper footwear among older people as a contributing factor for higher risk of falling, there are few studies that actually examine this problem (Dunne, Bergman, Rogers, Inglin, & Rivara, 1993; Robbins, Gouw, & McClaran, 1992).

Robbins et al. (1992) tested the hypothesis that shoes with thick, soft midsoles, such as running shoes, provide less stability for balance in older men than those with thin, hard midsoles. They conclude that thin, hard soles are preferable for older men as sensitivity to foot position declines with age. They suggest that thicker, cushioned soles further dampen the sensitivity, reducing awareness of the foot position, thus increasing the risk of falling. However, this study was conducted in a laboratory setting and may not reflect the interaction of shoe type with other environmental risk factors for falling.

Dunne et al. (1993) conducted one of the few studies into the type of footwear worn by older people in the community through a random telephone survey of 652 retired persons 65 years and older. The majority of the respondents (75%) were women, and 87% were between 65 and 84 years. Participants were asked about the kind of footwear worn at the time of the telephone survey, if they had had a fall and what they were wearing at the time of the fall, and reasons for not wearing sturdy shoes. (Sturdy shoes were defined as having laces, a non-skid sole, and lateral support).

Results show that persons who had fallen in the previous year (28%) wore sturdy shoes at the same rate as those who had not fallen (Dunne et al., 1993). Those over 85 years were less likely to wear sturdy shoes, and men wore sturdy shoes considerably less often than women. The most frequent reason given for not wearing sturdy shoes was that people felt their regular shoes were adequate. Expense was not stated to be an issue. Twenty-five percent were wearing sturdy shoes at the time of the call, 20% were barefoot or in socks; house slippers accounted for 18%, laced canvas shoes 14.6%, loafers or slip-on shoes 10%, thongs 8% and dress shoes 3%. Calls were made between 9 a.m. and 9 p.m.—time of day made little difference. Sixty-nine percent reported wearing sturdy shoes some time during the week and 64 % reported wearing them daily.

These findings show that while most respondents were not wearing sturdy shoes when answering the telephone, the majority wore them daily. These results do not point to footwear as a major contributing factor for falls. Gallagher and Scott (1995) reached similar conclusions based on their findings that the majority of those who reported falling due to hazards in public places were wearing sturdy shoes such as walking shoes, runners or leather shoes (86%) at the time of their fall. And only 7% reported wearing either high-heel shoes or sandals at the time of their fall (Gallagher & Scott).

Use of mobility aids.

Mobility aids have been linked to fall-related injuries both through their use (Gaal, Rebholtz , Hotchkiss, & Pfaelzer, 1997; Gallagher & Scott, 1995) and lack of use (Parker, Twemlow & Pryor, 1996; Rush & Ouellet, 1997).

Rush and Ouellet's (1997) qualitative study contributes to an understanding of the reluctance of some older people to use mobility aids. Findings are based on nurses'

perceptions and observations of their (primarily community-dwelling) elderly clients' reluctance to use mobility aids. The nurses attributed this reluctance to negative societal attitudes towards physical imperfection, leading to stigmatization of those who use mobility aids. Nurses report that their clients view the use of aids as a sign of aging, dependence, and lack of autonomy. Aids become a visual reminder to the user and to all those observing them that they are getting old. "Utilizing an aid is a form of exposure; it is disclosing to the public a weakness, a change, a decline in one's mobility capacity" (Rush & Ouellet, 1997, p. 9). One elderly man said to his nurse: "I feel so stupid in a wheelchair and people look at me" (Rush & Ouellet, p. 9). Nurses reported that their client's negative responses to aids were so strong that many of them refused to use them and concealed them by "ensuring that they were out of sight and out of reach" (Rush & Ouellet, p. 10). Nurses found that their clients would stretch or push their bodies to their physical limits to avoid using their mobility aid.

Associated with the reluctance to use mobility aids, nurses also noticed a withdrawing from normal activities. As one nurse put it: "they don't want to be visually seen with a walker or what ever and so maybe there is a play that they would like to see or film or a speaker but they don't want to go..." (Rush & Ouellet, 1997, p. 10).

The importance of using mobility aids is demonstrated in a study on the causes of hip fractures. Among 787 elderly persons (78% were community-dwelling) who had sustained a hip fracture, 24% of those interviewed stated that they normally use a mobility aid but were not using it at the time of their fall (Parker et al., 1996).

People who use their mobility aids also report injuries, particularly those using scooters and wheelchairs (Gaal et al., 1997; Gallagher & Scott, 1995). In a retrospective

study of incidents among 109 wheelchair and scooter users over the previous five years, 106 had experienced a tip or fall, 84 a problem with the mobility aid and 63 experienced 'other' unspecified events (Gaal et al.). Of these 253 incidents, 68 (27%) required medical attention, including 13 hospitalizations. Tips and falls out of wheelchairs or scooters were reported to be associated with the design of the mobility aid and lack of stability on different surfaces (Gaal et al.).

Injuries among wheelchair users are not uncommon. A survey of community-dwelling long-term wheelchair users in Nova Scotia (n = 577) found that 47% had had injuries as a result of having fallen from their wheelchairs or because their wheelchair tipped over (Kirby, Coughlan & Christie, 1995). In the United States an estimated 36,000 wheelchair-related injuries requiring treatment are seen annually in emergency departments (Ummat & Kirby, 1994, as cited in Kirby et al.) and 51.3 wheelchair-related deaths are reported annually (Calder & Kirby, 1990, as cited in Kirby et al.). Unfortunately, these records do not include information on the causes of these injuries and it is not known how many are due to falls. Kirby et al. point to the need for improved safety precautions for wheelchair and scooter users. At present there is a lack of attention to safety in wheelchair or scooter design, inadequate or non-existent training for most new users, and often inappropriate, wheelchair and scooter selection for user needs. Injuries among scooter and wheelchair users were also reported due to environmental design flaws. For instance, scooter and wheelchair users reported tipping over due to steep curb ramps and high curb lips (Gallagher & Scott, 1995).

Environmental Factors for Fall-related Injuries

The study of environmental factors for fall-related injuries among community-dwelling seniors is an area of growing importance as more older people are living longer and remaining in their own homes rather than moving into institutional care (Wister & Gutman, 1997). While the emphasis in this section is on the role of the physical environment in fall-related injury, it must be remembered that most falls among the elderly result from the combined effects of multiple factors that contribute to the fall event. However, this complexity is seldom reflected in studies that purport to examine the role of the environment. Many studies present over simplistic views that are critical of the behaviour of the person who fell rather than the physical structures that may have contributed to the fall. Such studies often point to the older person's carelessness or lack of attention (Reinsch et al., p. 9). Others imply that seniors just need to pick of their feet or remove their clutter (Carter, Campbell, Sanson-Fisher, Redman, & Gillespie, 1997)

There is a lack of research on links between inadequate policies governing safety in the built environment and injuries due to falls. Few studies point to the responsibility of those who design and construct built environments for creating safe environments for seniors. Most studies in this area are not available for review as they are not published or are only available through gray literature sources such as conference proceedings or private reports. These include studies of seniors' safety under topics such as housing, building codes, and stair design (Aminzadeh, 1997; Pauls, 1996; Pauls, 1997; Rodriguez, 1994).

Environmental factors presented in this section are found in the literature under those that occur in public and outdoor locations and those that occur in the home.

Public places and outdoor locations.

Fall-related injuries due to hazards in outdoor and public places is under researched as traditional approaches to environmental risk factors focus instead, on indoor settings in private residences and institutions. The following overview looks at the few studies that exist on risk factors in public and outdoor locations. Attention is drawn to the magnitude of the problem and emphases the need to develop policies to reduce the number and severity of fall-related injuries that occur in these environments.

The first example of a study on outdoor locations is the Reinsch et al. (1992) study. On examination of falls among active healthy older adults they found that 51.2% (n = 242) of the falls occurred outside the home, with 18 one-time falls occurring on streets and sidewalks, and 7 one-time falls in public buildings. Repeat falls occurred 57 times on streets and sidewalks, and 31 times in public buildings. Transition areas such as garages, patios and entrances were also found to be problematic, with rapid changes in lighting also being implicated as a causal factor. Forty-two percent of the fallers stated they were "engaging in activities that were a part of independent living" at the time of their fall (Reinsch et al., p. 9). For repeat falls, 27.6% were associated with behaviours the authors termed, "inattentive activities", such as "walking on uneven ground, tripping over a sizable object, and looking somewhere else while walking" (Reinsch et al., p. 9). Speechley and Tinetti (1991) confirm the above finding that outdoor falls are common among active seniors in comparing fall incidence between frail and vigorous elderly. Their findings show that the vigorous group were significantly more likely to fall away from home due to environmental factors and were more likely to sustain a serious injury than the frail group (Speechley & Tinetti, 1991).

Gallagher and Brunt (1994) found that 65% of falls occurred outdoors among a sample of community-dwelling seniors. The majority—approximately 80%—of these occurred while walking on a familiar route. These findings lead to a subsequent study by Gallagher and Scott (1995) to identify the location and nature of hazards that cause falls in public places. For this study, a nine-month surveillance was conducted through a phone-in 'hotline' in the Capital Regional District of southern Vancouver Island. A total of 791 reports were received during the study. Three hundred and eighty-six people reported falling, 207 reported tripping, 114 reported slipping (these are not mutually exclusive categories), and 205 people reported potential hazards which they felt would likely cause someone to fall. Of those who slipped, tripped or fell, 74.6% (n = 543) reported an injury, with 220 people requiring medical attention and 117 sustaining a fracture. The most common location and condition reported was uneven, concrete sidewalks. Data analysis shows that the majority of fallers were elderly people walking from their residence to nearby shopping centers, bus stops, activity centers or medical offices. People of all ages were encouraged to participate—almost 40% of the participants were under the age of 65 and 22% of the participants reported using mobility aids. A major recommendation from the study encouraged city planners and civic engineers to consider these findings in the design and maintenance of pedestrian routes, especially routes frequently used by people at risk of falling (Gallagher & Scott).

Earlier studies of outdoor environmental contributors to falls are reported in Waller's (1985) review of the literature on injury prevention in the elderly. For instance, Sheldon (1960, as cite in Waller) found that stairs were most frequently found to be the cause of falls, and ice, snow and unexpected moving objects such as grandchildren and

pets were also problematic. The 1981 report of the Consumer Product Safety Commission (CPSC) stated that the elderly account for 85% of fatal injuries from stairway falls (1979, as cited in Waller). The CPSC concluded that stairs should have a non-sliding uniform surface, continuous handrails with cues at the end to indicate the top of the stairs, and the stair edges should be clearly differentiated. If outdoors, stairs should have a non-slip and well-drained surface.

Objects such as prosthetic devices, walkers, canes and wheelchairs are also found to contribute to falls, and poor lighting is implicated—particularly abrupt changes in luminance, bright contrasts, glare and low illumination (Waller, 1985). Waller concludes that some correctable flaw in the design or construction of buildings or walking routes often triggers accidents, and that only rarely are physical limitations of the elderly considered in the design of environments.

The scarcity and age of some of the studies on outdoor and public environments indicates a need for further research in this area. Existing findings show a need for coordinated policy making efforts between government officials, persons at risk of injury from falls and those responsible for the design and maintenance of public places. However, more evidence is needed to prioritize the elimination of hazards that pose the greatest risk of fall-related injuries for older people.

Home hazards.

According to Clemson, Cumming and Roland (1996) there is little evidence to support the contribution of home hazards to falls. In a study of 35 potential hazards, researchers found no difference in the number of home hazards among fallers and non-fallers. However, when looking at elderly people who had recently sustained a hip

fracture, more home hazards were found compared with homes of people who had recently fallen without sustaining a hip fracture. The hazards most significantly associated with the homes of persons with hip fractures were lack of railings for showers, toilets and stairs (Clemson et al.).

Northridge et al. (1995) confirm this lack of strong association between home hazards and falls. However, when home hazards were investigated based on whether the elderly person was considered vigorous or frail, these researchers found a greater risk for falls related to home hazards among vigorous older persons compared to frail older persons. The difference between frail and vigorous elderly with respect to environmental contributors to fall-related injuries was also the examined by Speechley and Tinetti (1991) in a prospective study of 336 community-dwelling elderly. They found that while frail elderly people fell more often than vigorous elderly people (52% versus 17%), they fell for different reasons. Compared to the frail elderly, the vigorous group were significantly more likely fall due to environmental hazards (53% versus 29%), were more likely to fall on stairs (27% versus 6%), and were more likely to sustain an injury from their fall (33% versus 6%) (Speechley & Tinetti).

In an Australian study inspections were conducted in 425 homes of people aged 70 and older using a predetermined hazard rating form (Carter, et al., 1997). This form included 99 potential hazards selected on the bases of risk factors identified in the literature and by experts (the authors do not provide the qualifications of these experts). Eighty percent of the homes were found to have at least one hazard (n = 342) and 39% (n = 164) had more than five. Study participants were interview on their perceptions of safety, and 30% of those who rated their homes as very safe had more than five hazards.

Those who were never visited by service providers were twice as likely to have five or more home hazards as those who were visited one or more times per week. This study did not look at a correlation between fall histories or injuries and the number of home hazards.

An English study points to a direct link between environmental hazards and hip fractures resulting from a fall (Parker et al., 1996). Of 787 persons interviewed after admission to hospital with a hip fracture, 93% (n = 729) were due to a fall, and of these, 564 were able to recall the nature of their fall. Fifty-four percent reported the involvement of an environmental hazard and over one third these occurred outside (n = 196). Of the outside locations, the most frequently reported hazards were pavement or kerb (n = 28) and falling off a bicycle (n = 24). Most commonly reported indoor hazards were chairs or beds (n = 39) and steps or stairs (n = 27).

Fifty percent of subjects in a Swedish study reported being injured due to a fall that involved environmental hazards (Sjorgen & Bjornstig, 1991). Snow or ice was cited as the main environmental contributor in 63 fall injuries, throw rugs were implicated in 28 cases, and stairs in 22 cases.

Although these last two studies identify the type of hazard involved in fall-related injuries, there are few clues as to the nature of the event. For instance, it is not clear if stair hazards were a problem because of poor lighting, step design or lack of handrails. Also, in order to identify the nature of contributing factors it is helpful know if the person who fell has a chronic health condition such as a recent stroke or if they were using a mobility aid at the time of the fall.

Overall, the studies on environmental hazards are mixed in their usefulness for identifying the specific nature of hazards associated with fall-related injuries. A link appears to exist between hip fractures and a hazard in the homes of elderly people, but the exact role of specific hazards in fall-related injuries is unclear. More research is needed to identify hazards associated with all types of injury due to falls. Study designs might also benefit from input from those at risk, as they are the experts on their own environments.

Social and Economic Factors[1]

Research is scarce on direct links between social and economic determinants of health and fall-related injuries among the elderly. However, there are many studies that provide evidence of indirect links.

This section begins with a review of one study that specifically examines links between falls and social and economic factors for seniors. In the absence of other studies that directly link social and economic factors with falls among the elderly, consideration is given in the remainder of this section to sources supporting indirect links. These include studies that link social and economic determinants of health with risk factors known to be associated to fall-related injuries among the elderly—such as poor health, chronic conditions, disability, risky health behaviours and physical surrounding (Griffin et al., 1992; Luukinen et al., 1995; Northridge et al., 1995; Nyberg & Gustafson, 1996). The consideration of links between such health-related conditions and social and economic factors is supported by the broad health determinants models as presented in

[1] The domain of social and economic factors is used here as a combined set of factors that may or may not be directly related to each other, and is distinct from the term socio-economic which is "concerned with the interaction of social and economic factors" (Hawkins & Allen, 1991, p. 1378).

the Health Canada guide for the Population Health Fund (1998) and the Regional Profile Summary of the Capital Health Region (1997).

These models draw attention to the role of a wide range of social and economic factors that influence the health and well being of our aging population. Specific social and economic determinants of health to be reviewed here include income, social status, education, employment, physical environment, early childhood experiences, health behaviours, social environment, living arrangements and the provision of care. It is important to note that these determinants do not act in isolation of each other. Rather, their complex interactions with each other—and with biological, behavioural and environmental factors—have an additive and compounding effect that is more powerfully predictive of health outcomes than any single determinant (Health Canada, 1998).

One of the few studies to specifically examine links between falls among the elderly and social and economic factors is by Gallagher, Hunter and Scott (in press). Based on a survey of 1,278 randomly selected seniors in the Capital Regional District of British Columbia, this study looks at associations between a wide array of variables and the number of falls reported over a six-month period. This study examines all falls, not only those that result in injury.

Social and economic variables examined by Gallagher et al. (in press) include socioeconomic status, housing satisfaction, friendship satisfaction and family satisfaction. On a bivariate level, satisfaction with family and with friends was correlated with falling. In a causal model testing antecedents and consequences of falling, lower socioeconomic status was found to be associated with a higher incidence of falling. However, this was not a direct link, as it occurred through the variable chronic illness. Lower socioeconomic

status was also linked to falling through female gender, but once again this was mediated through having more chronic illnesses. A composite variable called life satisfaction—included satisfaction with family, friends and housing—was found to be a consequence, rather than an antecedent of falling. This was an indirect link to falls through poorer mental health and increased dependency as a result of falling.

Income.

Higher levels of income and social status have been linked to improved health status "at each step up the income and social hierarchy" (Health Canada, 1998, p. 2). Numerous studies in countries around the world have demonstrated a correlation between "life expectancy and various measures of social status—income, education, occupation, residence" (Wilkinson, 1992, as cited in Evans et al., 1994, p. 3). Of all the social and economic determinants of health, poverty is widely accepted as the "greatest predictor of ill health" (Chappell, 1993).

Income for Canadians seniors is shown to differ by age, sex and living arrangement (Table 3). Rates of those living below the low-income cut-off are highest for women living alone and exceed rates for men living alone for all age categories. Rates among women living alone are on average four times higher than for women living with their spouse. Low income among men living alone is also a more common than for men living with their spouse.

Table 3

Percentage Below Statistics Canada's Low-income Cut-off, by Age, Sex and Living Arrangements, 1991

Females (%)				Males (%)			
Age group	Living alone	With spouse	With others	Age group	Living alone	With spouse	With others
55-59	39.0	10.3	22.3	55-59	32.0	8.6	20.2
60-64	40.7	11.7	20.6	60-64	37.3	12.2	21.1
65-69	39.4	8.5	19.0	65-69	31.8	9.6	18.0
70-74	39.3	8.1	17.5	70-74	28.5	7.9	18.9
75-79	42.9	10.1	17.3	75-79	30.5	9.7	12.2
80-84	47.5	11.7	18.5	80-84	36.3	12.3	18.5
85+	53.0	9.0	17.2	85+	39.5	13.2	18.7

Source: Census of Canada, Public Use Micro-data File, 1991 (as cited in Moore et al., 1997, p. 36).

Based on these findings, poverty is clearly a problem among those shown to be most at risk of fall-related injuries—the very old, particularly women (Luukinen et al., 1995; Scott & Gallagher, 1997). It is well known that poverty and social isolation are associated with fewer opportunities for maintaining good health (Barusch, 1994; Chappel, 1996). Links between poverty and poor health have been demonstrated in a number of ways. Elston, Koch, and Weissert, (1991) found poverty to be a significant predictors of functional dependency for both ADLs and IADLs. The Commonwealth Fund (1998) reported that elderly who are poor are twice as likely to report poor health and ADL restrictions as are those with moderate or high incomes (as cited in Barusch). Saunders (1998) showed that poverty was significantly related to stress-related poor health. And Lynch, Kaplan, and Shema (1997) demonstrated that sustained economic hardship leads to poorer physical, psychological, and cognitive functioning.

Raina, Dukeshire, Chambers, and Lindsay (1997), found income to be associated with having a sensory disability—approximately 25% of people aged 65 years and over in Canada have one or more sensory disabilities (National Health and Activity Limitations Survey, 1991, as cited in Raina, Dukeshire, Chambers & Lindsay). Low income among seniors is linked to both a contributor and a consequence of disability. For instance, cost was one of the most common reasons given by seniors with disabilities for not having a needed assistive device (Raina, Dukeshire, Chambers, & Lindsay). Raina, Dukeshire, and Lindsay report that based on longitudinal studies there is evidence of a causal relationship between lower income and poor health (as cited in Raina, Dukeshire, Chambers, & Lindsay). For instance, "low income of seniors, and particularly senior women, may be one contributing factor toward seniors developing sensory disabilities" (Raina, Dukeshire, Chambers, & Lindsay, p. 37).

Social status.

Many studies refer to social status or social class in terms of measures of income and wealth. Other studies describe social class in terms of occupational standing, level of education, housing tenure or early childhood experiences (Evans et al., 1994; Hirdes & Forbes, 1993; Lynch, Kaplan, & Salonen, 1997; Marmot et al., 1991). For all these measures strong evidence is presented in a number of studies showing social class differences for morbidity, mortality and health behaviour—with people at the lowest end of the social scale showing the most adverse health profiles (Evans et al.; Marmot et al.).

Education and employment.

Studies using education levels as a measure of social status point to higher self-rated health status for those with higher levels of education (BC Ministry of Health,

1994). A study of elderly Canadians' educational composition found that an individual's level of education is negatively correlated with hospitalization rates (Simmons-Tropea & Osborn, 1986, as cited in Desjardins, 1993). A longitudinal study in Ontario found higher levels of income and education to be consistently associated with a greater probability of maintaining good self-rated health (Hirdes & Forbes, 1993). However, the same study showed that the effect of education on health status tends to decline in higher income groups, with only minimal differences between middle and high-income groups. Higher levels of education are also associated with improved income opportunities, job security and long-term financial security, which are all in turn related to improved health outcomes (Evans et al., 1994; Health Canada, 1998).

Physical environment.

Links between type of dwelling and health are influenced by a number of factors including unsafe or stressful neighborhoods, cost of maintenance, locations that lead to social isolation, unclean surroundings, or in some cases homelessness (BC Ministry of Health, 1994). Hirdes and Forbes (1993) report that rural residence is associated with a greater probability of self-reported lower health status. A British study links health status to type of home ownership. Fox and Goldblatt (1985), found that people who own their own homes have lower mortality rates than renters (as cited in Marmot et al., 1991).

Early childhood experiences and health behaviours.

Early childhood experiences are also linked to poor health outcomes for lower classes. Lynch, Kaplan and Salonen (1997) found that adult behaviours detrimental to health (such as smoking and excessive alcohol consumption) are consistently related to poor childhood conditions, low levels of education, and parents who were poor. Lynch,

Kaplan, and Salonen, point out that understanding adult health behaviour is associated with socioeconomic conditions throughout the life course emphasizes the need for reforms to economic policy that are tied to public health policy.

Low social status is found to be a determinant of poor health despite access to free health care. Evans et al., (1994) point to British studies showing higher age standardized mortality rates in lower social classes persisting over time: even with the introduction of the National Health Services—despite the increased use of services once the services were free. As Evans points out, "While death is ultimately quite democratic, deferral appears to be a privilege correlated with rank" (as cited in Evans et al., p. 9).

Social environment.

Some theorists dismiss the role of social environment as a determinant of health in favour of the stronger influences of genetic endowment. This is refuted by Doll and Peto (1981, as cited in Evans et al., 1994) whose studies of migrant populations "demonstrate that as they take on the social patterns and customs of the host country, they take on its disease patterns as well" (p. 15). These changes were found to take place over time spans that are far too short for any changes in genetic endowment.

A large body of literature supports the contribution of supportive social environments in reducing stress-related illnesses (Evans et al., 1994). Some studies point to importance of the number of contact persons, regardless of the nature of the interaction (House, Landis, & Umberson, 1998, as cited in Evans et al., p. 22). While others emphasize the *quality* of the social interaction in promoting health (Evans et al.). However, most agree that the contribution of social supports by informal caregivers is the

mainstay of support for seniors—representing between 75% and 85% of all care received (Kane, 1990, as cited in Penning, Chappell, Stephenson, Rosenblood & Tuokko, 1998).

Opinions also vary on the measures to be used in the study of associations between social relationships and health status. Social relationship measures include marital status, living arrangements, number of close friends and relatives, church membership, and membership in formal or informal groups (Chappell & Badger, 1989; Hirdes & Forbes, 1993). Health status measures also vary widely and include mortality rates, chronic conditions, functional status, self-reported health status, and various measures of life satisfaction such as happiness and income adequacy (Chappell & Badger; Hirdes & Forbes).

Depending on the measures used, studies show different outcomes. Hirdes and Forbes (1992) point to the strong associations found between mortality and social isolation based on a social network index (as cited in Hirdes & Forbes, 1993). Whereas, Chappell and Badger (1989) found no associations between self-perceived health and ten indicators of social isolation—including living alone, no confidant, no companions, no children, unmarried, and three combinations of these. In addition to self-perceived health as an indicator of subjective well-being, Chappell and Badger also looked at perceived adequacy of income, happiness, and life satisfaction, for associations with social isolation. For these outcomes there were a number of significant associations. Most notably, living alone, unmarried, having no companions, and the combination of living alone and having no confidants were all related to less happiness and lower life satisfaction scores (Chappell & Badger). Of these, having no companions showed the strongest associations.

It is important to note that self-perceptions of health status and the presence of health problems are not synonymous. For example, the Canadian General Social Survey (Statistics Canada, 1985) found that while only 10% of community-dwelling seniors' perceived their health to be poor, 80% reported a health problem (as cited in Desjardins, 1993). The most common health problems reported were limb and joint problems, followed by hypertension, heart trouble and respiratory conditions. Chronic conditions and disabilities are particularly prevalent among the very old. The General Social Survey (1985) shows that approximately 25% of men and women age 80 and over have hearing impairments, 10% have visual impairments, and approximately 80% of women aged 80 and over have mobility impairments (as cited in Desjardins).

Pearlman and Crown (1992) in their longitudinal study of social support as a buffer to the effects of deteriorating health looked at the role of the spouse and paid helpers, the frequency and duration of support, and the function the support provides. Their study included older people with functional limitations who lived in the community at the start of the two-year study (N = 5,273). Effects of deteriorating health were measured by nursing home admissions—either temporary or permanent. Findings revealed that there were more admissions among elderly who lived alone, were unmarried, had caregiving relationships of less than three years' duration, received care for fewer that five days a week, and had a caregiver who was someone other than a spouse or an adult child. Specifically, having a caregiver who was a spouse or an adult child reduced the risk of nursing home admission by 32% and 29% respectively. Having a caregiving relationship of at least three years' duration reduced the risk by 32% (Pearlman & Crown).

Living arrangements and informal care.

Chappell and Prince (1994) found that seniors living alone were more likely to report having difficulty with activities of daily living and not having any informal support available to them. Living arrangement for seniors appear to be linked to health through the provision of physical and emotional support. A study by Chappell (1991) found that most elderly persons received help from only one individual. Those who lived with their spouse, received help from the spouse, those living with non-spousal others tended to received help from their children—primarily daughters. For those living alone, children or friends, were most often the ones to provide assistance and emotional support. Penning et al. (1998) found that seniors also rely heavily on self-care and that this is the single most prevalent form of care for seniors with disabilities. Reliance on self-care and informal care, rather than formal care, was found to be associated with lower income and education levels and living with others (Penning et al.).

The importance of self-care and informal care is increasing as more seniors are remaining in the community despite debilitating chronic conditions. Formal home support services and institutional care are being cut back in most provinces at a time when the number and proportion of the very old and frail is growing (Chappell, 1993; Desjardins, 1993). For instance, Canadian women aged 65 can expect to live an average of 19 years but can only expect 9 years to be disability-free (Desjardins).

The disadvantages of these cut backs to seniors' health are demonstrated by a study showing the effectiveness of personalized home support services in reducing health problems (Hall et al., 1992). This prospective randomized controlled trial involved two control groups (n = 81 each) and one treatment group (n = 86) of seniors who were

followed for three years. All participants received standard long-term care services to meet their basic assessed needs. In addition to these services, treatment group participants were visited by a home care nurse to assist them in designing a personalized health care plan. These plans included setting goals, developing personal health skills and referrals to appropriate community services to meet their needs related to health care, substance use, exercise, nutrition, stress management, emotional functioning, social support and participation, housing, finances and transportation. Findings showed the treatment group participants to be "more likely to be alive and living at home at every time point during the three years" (Hall et al., p. 73). And at the end of the three years the treatment group survival rate was 75.3% compared with only 59.3% and 58% for the two control groups.

Sources of informal support may also be dwindling at a time when demand is increasing. For instance, support for seniors from children will decrease due to smaller family sizes of the 'baby boomer' generation compared to seniors of today—in 1995, 42% of persons aged 65 and over who had children, had four or more (Statistics Canada, 1997). More senior women are also surviving their spouses for longer periods of time. At the time of the 1991 Canadian census, one in every ten men aged 65 and over was a widower, and one in every two women (Desjardins, 1993).

A Statistics Canada (1997) report shows that in 1991, 28% of persons age 65 and over lived alone, and for those aged 85 and over the percentage living alone was 53%. For women aged 65 and older, the proportion of those living alone more than doubled between 1961 and 1991 (from 16% to 34.2%) (Statistics Canada, 1991, as cited in Wister & Gutman, 1997). These percentages are expected to grow proportionally with the aging population—the proportion of people 65 and over is expected to almost double by 2041

(Statistics Canada, 1997). It is currently estimated that 270,000 community-dwelling Canadian seniors require substantial support to maintain independent living in the community (Penning & Chappell, 1996). According to the National Council on Aging (1993), this number is expect to triple in the next forty years (as cited in Penning & Chappell, 1996). Those who are most at risk of fall-related injuries can therefore expect to have less access to either formal or informal support. Less support is shown by this review to be associated with poor health, which in turn is shown to increase the risk of having fall-related injuries.

In conclusion, social and economic factors are intricately related to other factors shown to be associated with being at high risk for seniors having a fall-related injury. Poverty, low social status, fewer social contacts, and less formal and informal support are shown to be related to having more disabilities, having fewer assistive devises, less functional ability, more behaviours detrimental to health, less satisfaction with life and overall poorer health status. These relationships show clear links to biological, behavioural and environmental factors, which in turn have been shown to be associated with falls and fall-related injuries among seniors. The same populations who are shown to be most at risk of having fall-related injuries—elderly women, the fail, chronically ill, and disabled—are also shown to be most likely to be poor and have the fewest social supports. The inclusion of social and economic factors as a domain in the review of literature on studies of fall-related injuries among the elderly would therefore appear warranted. From a critical gerontology perspective, the inclusion of social and economic factors is also justified as these factors provide an opportunity to examine the interactions and compounding effects of the broader set of determinants that effect the health and

safety of older adults. In addition, the broader conceptual framework expands the opportunity for interpreting the findings within the larger social policy context of the issue.

A Critique of the Studies Reviewed

The studies reviewed show injury-producing falls to be a serious problem among older community-dwelling adults and one that will grow with the aging population. Numerous risk factors are shown to be directly associated with these injuries. These include: advanced age, female gender, osteoporosis, history of a stroke, dementia, use of certain benzodiazepines, polypharmacy, weakened leg muscles, poor reflexes, impaired gait or balance, a history of falling, fear of falling and not using appropriate mobility aids. A number of indirect associations are also demonstrated through the literature on the relationships between socioeconomic factors and various measures of poor health.

The associations between these factors are not equally strong for all populations. For instance, differences were found for specific risk factors among men and women, and between the frail and vigorous elderly. Risk factors found to be less strongly associated or not associated at all include alcohol, lack of exercise, type of footwear, and most environmental hazards. Lack of association may indicate a need for more, or better, studies—or it may indicate that these factors do not contribute to injury-producing falls. Different research methodologies may reveal new or different findings. The literature shows a propensity for retrospective studies conducted with small samples representing narrow population parameters. Studies with large, randomly selected samples are needed in order to generalize the findings to all older adults. Prospective studies are needed to examine the role of factors over time. More research is also needed to determine the

specific contributions made by each risk factor as well as their interactions and compounding effects.

No one study can be expected to address the multitude of factors associated with this complex phenomenon. However, a major failing found in the literature on fall-related injury among seniors is that most studies only examine isolated factors, or small clusters of factors, without consideration of the compounding effects of multiple factors that exist for most older adults. Another shortcoming is the lack of adequate consideration given to the role indirect factors such as income, social supports, and living arrangements. It is only through an examination of the links between fall-related injury and multiple heath determinants that responsibility for solutions can move away from the current narrow emphasis on behavioural changes and medical remedies to one that includes changes in health care and social policy.

A number of methodological issues also limit the understanding of the contribution of specific risk factors to fall injuries among the elderly. These include inconsistencies in the definition of terms and comparisons between different sample populations. Without standard definitions of terms such as 'fall' and 'injury', it is difficult to compare the contributions of specific risk factors. For example, a fall can mean landing on the ground, or on a seat, falling all the way to the ground or only onto the knees. Some studies exclude falls due to loss of consciousness or seizures, and others only exclude violent blows or falling off a bicycle. The degree of injury is also reported in different ways. For instance, some studies do not differentiate between minor or severe injuries, while others only discuss hip fractures, without consideration of other types of fractures, soft tissue injuries or lacerations. Studies of indirect factors are also difficult to

interpret due to the lack of clear definitions of terms for social support and for measure of health status.

Study samples also differ. Age ranges for older people usually start at age 65 years or older, but some studies start with ages as young as 50 or as old as age 70 without identifying differences in fall injury patterns between the upper and lower age ranges. Exclusion criteria also vary widely, for example most studies exclude those with dementia, while others exclude those who are not independently mobile or active. These criteria are often devised to facilitate ease of research. However, by excluding those most at risk of fall injury the findings have limited usefulness for prevention. Some studies are conducted in laboratory settings thereby limiting generalizability, as they do not reflect the multitude of contributory factors found in natural settings. This could explain why balance and gait training to reduce falls in controlled indoor settings is successful in reducing risk factors for falls (Maki et al., 1994; Shumway-Cook et al., 1997), while exercise regimes in natural settings outdoors do not show significant reductions (Province et al., 1995).

Another methodological issue is the lack of evidence of collaboration across disciplines. Researchers of the studies reviewed are primarily representatives of health care professions. The wide variety of potential risk factors points to a need for collaborative research across multiple disciplines. There is greater potential for understanding and resolving of this problem if studies involve those with expertise in areas as diverse as wheelchair or shoe design, optometry, building standards, sidewalk maintenance, health care policy, social assistance, and risk management. However, the most notable omission in the majority of the studies reviewed is the lack of involvement

of *those who are at risk* in any role other than as passive subjects of investigation. Studies conducted by practitioners without the input of other stakeholders—particularly the elderly who are at risk of falling—tend to promote medical treatments or solutions based on behavioural changes by those who fall.

Statement of Research Objectives

Despite considerable investigation into factors associated with fall-related injuries among the elderly, the etiology of this phenomenon remains unclear. This lack of understanding is influenced by a preponderance of research designs based on small samples, as well as an over emphasis on biological and behavioural risk factors for falls. There is little consideration of factors related to broader determinants of health, and few studies that examine factors associated specifically with fall-related injuries.

To address the limitations of previous studies this study investigated fall-related injuries among older Canadians with a view to understanding patterns and compounding effects of potential risk factors representing a broad range of health determinants represented by the four domains of biological, behavioural, environmental, and social and economic factors. To accomplish this, an exploratory investigation was conducted to examine differences between older people who have experienced a fall-related injury and those who have not. Information gained through differences that existed was applied to a discussion of the design of policies that affect the health and safety of seniors.

This study was based on the hypothesis that differences will exist for those older adults who sustained fall-related injuries, and a) those who did not fall, and b) those who fell without sustaining an injury, for a broad range of selected factors. It is also hypothesized that fall-related injuries are a major problem among those aged 65 years

and older and that differences will exist between men and women, and between younger and older age groups, for the nature and extent of the fall-related injuries. The hypotheses for this study were tested in the following research questions:

For frail community-dwelling seniors aged 65 years and over:

1. Are there differences in the extent and nature of the problem of fall-related injuries according to age and gender?
2. Are there differences in the patterns of variables representing the four domains of biological, behavioural, environmental, and social and economic risk factors among fallers, non-fallers, and injured and non-injured persons?
3. Are there differences in the compounding effects of combinations of variables representing the four domains of biological, behavioural, environmental, and social and economic risk factors among fallers, non-fallers, injured and non-injured persons?

To answer these questions an exploratory study was conducted using secondary data from the findings of the Capital Regional District Patterns of Care Survey 1995-96. The following chapter provides a description of the study methodology and secondary data source.

CHAPTER 4

Methodology

This chapter provides an overview of the methodology for the study of fall-related injuries among older adults including a description of the study objectives, the secondary data source, ethical considerations, the sample, reliability and validity of the data, measurements (with summary scores for key variables), analysis procedures and data assumptions.

Study Objectives

There are three major objectives of this study. The first is to gain a better understanding of the nature and extent of fall-related injuries among frail older adults. The second is to examine differences for a wide range of factors between those who have sustained a fall-related injury and those who have not. The third objective is to examine the findings in light of the Canadian social policy context pertaining to seniors. The following research questions are posed to address the first two objectives:

For frail community-dwelling seniors aged 65 years and over:

1. Are there differences in the extent and nature of the problem of fall-related injuries according to age and gender?
2. Are there differences in the patterns of variables representing the four domains of biological, behavioural, environmental, and social and economic risk factors among fallers, non-fallers, and injured and non-injured persons?
3. Are there differences in the compounding effects of combinations of variables representing the four domains of biological, behavioural, environmental, and

social and economic risk factors among fallers, non-fallers, injured and non-injured persons?

The final objective, of examining the findings in light of Canadian government policies related to older persons and injury, is presented in the final chapter of this dissertation under a discussion of the findings.

To meet these objectives a secondary data source was found that contained information on a wide range of social, economic, behavioural and physical health factors including detailed reports of fall-related injuries. This source was the 1995-96 Capital Regional District Patterns of Care Survey[1] (Centre on Aging, 1996) conducted by researchers at the University of Victoria in British Columbia.

The data from the CRD Survey are based interviews with frail community-dwelling seniors represented by two purposefully selected groups. One group represented the over 3,000 seniors in the CRD receiving publicly-funded home support services, and the other, a matched sample of 810 seniors screened by age, gender and functional limitations, drawn from the 56,774 seniors in the CRD not receiving home support services. Five hundred and six participants were randomly selected from each group. The data therefore provide an opportunity to examine factors associated with fall-related injuries among a high-risk group of seniors. There is a good fit between the research objectives put forward for this study and the data generated from the CRD Survey.

Study Design

This study uses secondary data analysis to address the research objectives. The design of the study of fall-related injuries among seniors reflects the cross-sectional and epidemiological design of the secondary data source. The purpose of the cross-sectional

design is to determine which subjects have, and have not, experienced a phenomenon over a single period of time (Polit & Hunger, 1995). The design of the CRD Survey is epidemiological in that researchers investigated the distribution of health problems in a population to study factors that influence this distribution (Ryan, 1982). Data found in the CRD Survey are based on self-reports of health phenomena in population groups in order to find patterns, commonalties of experience, similar characteristics, and the relationship of the characteristics to the health problem of interest (Ryan).

Ethical Considerations

Ethical approval was obtained for the CRD Survey at the original time of the study from the University of Victoria where the study was conducted (see Appendix A). Approval was given based on the ethical considerations including obtaining approval of all respondents prior to being interviewed, the assurance of privacy and the option to withdraw at any time. No subjects were contacted in conducting the secondary analysis of the data for this dissertation study. Personal information of respondents to the CRD Survey, such as names and addresses, were stripped from the data prior to this author obtaining the data. Codes were applied in place of personal information by the original researchers. Therefore, no application was needed to the Ethics Review Committee of the University of Victoria, for the purposes of this dissertation study.

Secondary Data Source

The data source used for this study was a the CRD Survey, conducted in the Capital Regional District (CRD)—one of 20 health regions in British Columbia—between 1995 and 1996. The purpose of this survey was to investigate how "self, informal and formal community-based care come together to support the independence

[1] Hereafter referred to as the CRD Survey

and autonomy of older persons attempting to cope with chronic illness and disabilities in the community setting" (Penning et al., 1998, p. ii). Interest in services for seniors is high in the CRD region due to the large proportion of seniors compared to proportion in other regions in Canada. The mild climate of the CRD makes it a popular retirement destination for seniors from across Canada. In 1996, persons age 65 years and over comprised 18.1% of the 317,990 persons in the CRD (Behie, 1998). This is considerably higher than the 12.8% of people aged 65 and over in all of British Columbia and higher than the rate of 12.2% for all seniors in Canada (Statistics Canada, 1996, as cited in Behie).

The study was carried out by researchers at the University of Victoria's Centre on Aging in conjunction with community partners representing seniors, informal caregivers, service providers, and regional and provincial health authorities (Penning et al., 1998). Data were gathered through face-to-face structured interviews that were conducted over 1995 and 1996 with 1012 seniors in the CRD (Penning et al.).

The 1995-96 CRD Survey sample was comprised of a combination of two matched groups. The sampling frame for the first group was comprised of the over 3,000 users of publicly-funded home support services[2] in the CRD long-term care program as of May, 1995 (Penning et al., 1998). From these, 962 were randomly selected to be in the CRD Survey. Of these, 333 (34.6%) were unable to participate due to illness or death, cognitive impairments, being moved to long-term care facilities, inability to be contacted, lack of spoken English, or no longer receiving home support services (Shaver, 1998). The refusal rate for this sample group was 19.6% (n = 123), leaving a total of 506 persons available to be interviewed (Shaver).

The sampling frame for the second group were all those seniors in the CRD who were not using publicly funded home support services[3]—as identified by a regional list of 56,774 seniors obtained from the BC Department of Vital Statistics. From this list, over 10,000 seniors were randomly selected and contacted in order to find a matched sample to the service user group for gender, age and functional ability (see Appendix B, "Telephone Screen for Matching").

Criteria for matching by age were based on 9 categories of 3-year intervals starting at age 65 years, and for functional ability, based on comparable ADL and IADL scores (see Appendix C, "Matching Criteria"). All potential participants had to have needed help in performing at least one ADL or IADL. This screening resulted in 810 potential non-users of services. Of these, 166 were unable to participate for reasons of having been moved to a long-term care facility prior to the interview, inability to be contacted, death, cognitive impairments, inability to speak English, inability to participate due to illness, or now receiving home-support services (Shaver, 1998). From those who were available and eligible, 506 non-users of service were randomly selected as a matched sample to the 506 service users, for a total sample of 1012 respondents.

For the study presented here the total sample of 1012 respondents is treated as one sample. The rationale for this is based on the matching of the sample for age, gender and functional limitations, and the results of chi square analyses, which showed a lack of any significant difference with regard to fall-related injury status between the service user group and non-users of service group (see Tables 26, 27 & 28, pp. 163, 164 & 165).

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[2] Hereafter, publicly funded service users are referred to as service users.
[3] Hereafter, those not using publicly funded services are referred to as non-users of services, or non-users.

Data collection methods and procedures.

Data for the CRD Survey were collected through interviews conducted over two successive six-month periods. For the service user group, interviews took place between July and December 1995, and for non-users, between February and July 1996 (personal communication, D. Allan, Centre on Aging, November 10, 1997). Both sets of interviews spanned winter and non-winter months, thereby lessening potential for climate differences that could effect outdoor falls among both groups.

Data collection procedures for the CRD Survey were developed by a multidisciplinary team of researchers in consultation with a community-based working committee. In designing the interview questions researchers drew on their expertise in their respective fields of sociology, anthropology, psychology and gerontology (Penning et al., 1998). An extensive review of the literature was conducted on related topics and scales used in previous studies were adapted for the operationalization of variables. A draft of the questionnaire was then sent to the community-based working committee for input on clarity and relevance to the study purpose. The questionnaire was pilot tested with a small group of seniors for feasibility, comprehension, and length of time to conduct the interview. Based on this pilot a number of questions were changed or removed.

Questionnaires from the following studies were adapted for the CRD Survey for questions related to health, functional ability, income, and social supports (personal communication, D. Allan, Centre on Aging, November 17, 1998):

1. Health Promotion Survey, (Statistics Canada, 1990).
2. The 1990 General Social Survey, (Statistics Canada, 1991).

3. Self-Care Assessment of Community-Based Elderly Project Questionnaire, (University of North Carolina Health Services Research Centre, 1990).
4. Health Activity Limitations Survey, (Statistics Canada, 1991).
5. Decision-Making Among the Elderly and the Use of Health and Social Services Questionnaire, (Chappell & Strain, 1985).
6. Health Care Beliefs and Practices Among Elderly Persons Using Medical and Social Services Questionnaire, (Segall & Chappell, no date).

Estimates of reliability and validity for established scales used in the CRD Survey from the above sources are reported in this dissertation under the section on "Measurement".

Most of the interviewers for the CRD Patterns of Care Survey had prior interviewing experience. Data collection errors and the influence of biases were minimized through extensive interviewer training, with specific attention to interviewing older adults. Staff and researchers and the Centre on Aging conducted quality assurance checks on the accuracy of the data collection procedures and provided ongoing support for the interviewers (personal communication, D. Allan, Centre on Aging, November 17, 1998).

All potential participants were sent a letter describing the study and advising them that they would be contacted with a request to participate. Verbal consent was requested when potential participants were contacted by telephone to set up a time for the interview. Participants were also evaluated at this time as to their ability to participate in the study. At the start of the interview participants were reminded of their right to terminate the interview at any time and their right to refuse to answer any questions

during the interview (Centre on Aging, 1996). There was no remuneration for participation in the Survey.

Interviews consisted of structured, closed-ended questions conducted in face-to-face interviews in the participants' homes. Advantages of face-to-face interviews over self-administered questionnaires are particularly relevant for elderly populations where attributes such as cognitive impairments, low vision or slow reading may impact on the accuracy of the self-administered responses (Polit & Hungler, 1995). Advantages to closed-ended questions include ease of analysis and reduced influence of interviewer biases. However, data quality depends on careful attention to content, wording and formatting (Polit & Hungler).

Face-to-face interviews are known to generate better quality data and higher response rates than those using telephone interviews (Polit & Hungler, 1995). However, while face-to-face interviews are preferable, issues of research control are potentially problematic for any study where data collection occurs in a natural setting (Polit & Hungler). Data collection took place in the homes of the respondents and is therefore open to the influence of numerous confounding factors. For instance, distractions in the home setting may interfere with concentration and the ability for accurate recall, or the personal nature of the questions could lead to withholding information that the respondent did not want to share with other family members who may be present. Responses may also be influenced by the excessive length of the survey, which contained 84 potential questions.

According to Polit and Hungler (1995), self-report is the preferred method of obtaining information related to feelings, behaviours and information unavailable through

any records. However, inaccuracies can result from surveys—such as the CRD Survey—that rely on self-reports without physical assessments, medical record checks or other means of validation. For instance, the ability of older adults to recall the number and specifics of falls is a known to be problematic— particularly among those who fall frequently (Peel & McClure, 1998). Recall for falls that result in injury has been shown to be more reliable but underreporting is still common. Peel and McClure found that 87% of falls resulting in injury were recalled correctly, compared to only 62% for falls not resulting in injury. For the CRD Survey, the meaning of the terms "fall" and "injury" are left to the respondent to interpret. Respondents were asked in they had experienced a fall in the past six months and if one or more of these falls had resulted in an injury.

Self-reports are also subject to the influence of social desirability responses—a "failure to endorse negative items, and the tendency to endorse positive ones...also known as faking good" (Kozma & Stones, 1988, p. 2). Cappeliez (1989) found socially desirable responding to be higher among older age groups than in younger age groups. However, using the Marlow-Crown Social Desirability Scale, Ray (1988) found that the association between social desirability responding and age was primarily an artifact of gender, where older women were significantly more likely than older men to fake an appearance of well-being. Conversely, Campbell et al. (1990) found that in relation to falls "men were more likely than women to deny having fallen and the history of the fall was often obtained from the man's wife, an observer or only after closer questioning" (p. 139). Such lack of reporting a fall may simply be a matter of forgetting. However, it has been speculated that the motivation for denying having fallen may be a desire to avoid

premature institutionalization or loss of independence (Campbell, Reinken, Allan, & Martinez, 1981; Cummings, Nevitt, & Kidd, 1988; Luukinen et al., 1995).

Despite the limitations mentioned above, benefits of using secondary data from large surveys include economy of financial and human resources. Typically, large budgets and many personnel are required to collect data on this scale. The success of the CRD Survey was no doubt further facilitated by the established reputation for sound research practices held by researchers and the investigative team of the University of Victoria Centre on Aging. This reputation is based on a history of close partnerships with many seniors' groups and health organization workers in the CRD region (Centre on Aging, 1996).

Measurement and Coding

A critical theoretical perspective was used to guide the selection of variables taken from the CRD Survey to be used for this study. This perspective challenges the assumptions of models typically used to guide the study of fall-related injuries among the elderly and supports a comprehensive interpretation of the problem (Bengtson et al., 1997). Instead of limiting the selection of variables to the traditional intrinsic and extrinsic factors—as described earlier in this dissertation—this study drew on variables representing:

(a) biological,

(b) behavioural,

(c) environmental, and

(d) social and economic domains.

The factors examined under each of these four domains represent those shown in the literature to be directly or indirectly associated with fall-related injuries among seniors. In addition, this study examined the interrelationships and compounding effects of these factors. Such an examination, based on multiple perspectives, enhances the ability to interpret the findings within larger policy contexts that influence the lives and security of older peoples (Bengtson et al., 1997).

Dependent variables examined in this study consist of three possible outcomes of a self-report of experiencing a fall or fall-related injury. These outcomes are derived from responses to the CRD Survey asking the seniors how many times they fell in the past six months. This variable was coded as continuous for the total number of falls. Respondents were also asked if any of these falls resulted in an injury. Injuries were categorized as fractures, cuts, bruises, or other injuries, where zero equaled "no" for each category and one equaled "yes". The variables for the four injury types, were recoded to represent all those respondents who fell and were injured one or more times.

A new category, "Fall Injury Status" was created, comprised of the following dummy variables and recoding as shown in Table 4:

Table 4

Dependent Variables Coding

Variable	Dummy Variables	Values/Categories
Fall-related injury status Based on combinations of those who did not fall, those who reported falling at least once, and those who reported an injury from their fall.	Non-fallers/fall with injury	0 = No fall and no injury 1 = Fall with injury
	Non-fallers/fall with or without injury	0 = No fall and no injury 1 = Fall with or without injury
	Fall with/without injury	0 = Fall without injury 1 = Fall with injury

Independent variables were selected based on their fit with the study objectives. See Table 5 for the means, standard deviations and coding for the independent variables used in this study.

Table 5

Independent Variables, Means, Standard Deviations, and Coding

Variable	Mean	SD	Coding
Indoor falls[1]	1.98	6.74	0 through highest number of indoor falls
Outdoor falls[1]	1.02	5.51	0 through highest number of outdoor falls
Indoor falls[1] (grouped)	.71	.45	1 = one 2 = two or more
Outdoor falls[1] (grouped)	.46	.50	1 = one 2 = two or more
Frequency of falling[1] Indoor or outdoor	1.70	.85	1 = once 2 = twice 3 = three or more
Injury type[2]			
Fracture	.14	.35	0 = no; 1 = yes
Cut	.23	.42	0 = no; 1 = yes
Bruise	.58	.49	0 = no; 1 = yes
Other injuries	.23	.42	0 = no; 1 = yes
Age	81.91	7.17	65+ years
Age group	.40	.49	0 = 65 to 84 years 1 = 85 years or more
Gender	.81	.39	0 = male 1 = female
Number of chronic conditions	1.98	1.01	Sum of conditions (range 0 to 7)
Chronic conditions (grouped)	2.20	1.34	0 = none 1 = one 2 = two 3 = three to seven
Health troubles How much do your health troubles stand in the way of your doing things you want to do?	1.50	.86	0 = not at all 1 = a little (some things) 2 = a great deal 3 = completely

[1] For those who reported a fall only (N = 336)
[2] For those who reported a fall with injury only (N = 245)

Table 5 continued

Variable	Mean	SD	Coding
IADL Scale (5 items) Can you do own laundry Can you go shopping Can you do heavy housework Can you do light housework Can you do yardwork 1=without any help 2=some help from device ONLY 3=some help from person ONLY 4=some help from person and device 5=unable to do it	14.88	5.71	Sum of score (range 5 to 25)
CES-D scale (20 items) Bothered by things that don't usually bother me. Didn't feel like eating; appetite poor. Couldn't shake blues even w/help from family/friends. I was just as good as other people. I had trouble keeping my mind on what I was doing. I felt depressed. I felt that everything I did was an effort. I felt hopeful about the future. I thought my life has been a failure. I felt fearful My sleep was restless. I was happy. I talked less than usual. I felt lonely. People were unfriendly. I enjoyed life. I had crying spells. I felt sad. I felt that people dislike me. I could not "get going". 0 = rarely or none of the time (<one day in past week) 1 = some or a little of the time (1-2 days) 2 = occasionally or moderate amount of the time (3-4 days) 3 = most or all of the time (5-7 days)	10.95	9.16	Sum of score for 20 items (range 0 to 60)

Table 5 continued

Variable	Mean	SD	Coding
CES-D Scale (grouped)	.24	.43	0 = not depressed (score 0 to 15) 1 = depressed (score 16+)
Wheelchair use	.11	.32	0 = no 1 = yes
Household monthly income 01 = No income, to 24 = $5500+	7.80	3.87	Categories 0 to 24
Household monthly income (grouped)	.61	.59	0 = $0 to $1,249 1 = $1,250 to $3,249 2 = $3,250+
How does household income and assets currently satisfy your needs?	1.06	.64	0 = very well 1 = adequately 2 = inadequately
Education Years of schooling	11.30	3.32	0 to 27 years
Education Years of schooling (grouped)	.50	.50	0 = 0 to 11 1 = 12 or more
Living arrangements	.65	.48	0 = living with others 1 = living alone
Receiving emotional support Do you have someone who you confide in, talk to about yourself, your concerns, etc.?	.19	.39	0 = yes 1 = no
Social network Number of close relatives, friends and neighbours.	2.41	1.33	0 = 0 to 5 1 = 6 to 10 2 = 11 to 15 3 = 16 to 20 4 = 21 or more
Use of publicly funded support services	1.5	.50	1 = Users 2 = Non-users

It should be noted that there is no way of knowing when the fall-related injury occurred in relation to the onset of health-related factors measured by the variables to be examined. For instance, respondents are asked about health problems they had over the past year. However, they were not asked about the date of onset of health problems, nor were they asked the date of occurrence of the fall or fall-related injury (Centre on Aging, 1996). Therefore, causation cannot be imputed in interpreting the results—only that a relationship exists or does not exist. The following is a description of the independent variables used in this study.

Biological Factors

Biological factors shown in the literature (see Chapter 3) to be associated with falls and fall-related injuries among seniors include advanced age, gender, chronic illness, disabilities, mobility limitations, poor mental and physical health, cognitive impairments and sensory changes. Variables in the CRD Survey that provide information related to these factors include age, gender, chronic conditions, self-reported health problems, and a depression scale. In addition, a proxy variable for functional health was also examined, as represented by scores for Instrumental Activities of Daily Living (IADL). Each of the following biological variables is described below.

1. Age
2. Gender
3. Chronic conditions
    - Number of chronic conditions
    - Selected chronic conditions
        - Stroke or effects of a stroke
        - Eye trouble not relieved by glasses
        - Loss of bladder control
        - Loss of bowel control
        - Trouble with feet or ankles
        - Osteoporosis
        - Memory loss including Alzheimer's

4. Functional limitations
    - Health troubles causing activity limitation
    - IADL
5. Depression (CES-D)

Age.

Older age is shown to be associated with higher rates of falling and fall-related injuries (Luukinen et al., 1995; Raina & Torrance, 1996). In the data source used here, age is measured continuously but has also been recoded categorically to compare differences between younger and older ages groups for fall-related injury status where zero equals ages "65 to 84 years" and one equals "85 years and older". In this sample, ages ranged from 65 to 101 years with a mean of 82 years and a standard deviation of 7.17. Sixty percent of the sample was aged 65 to 84 years of age and the other 40% between the ages of 85 and 101 years.

Gender.

Female gender is shown in previous studies to be related to sustaining more fall-related injuries compared to male gender, and women's fall-related injuries are also shown to occur for different reasons (Hornbrook et al., 1994; Luukinen et al., 1995). However, findings from hospitalization data show that compared to women, more men die as a result of their falls (Scott & Gallagher, 1997). Gender was measured in the CRD Survey as a dichotomous variable where zero equaled "male" and one equaled "female". In this sample 81% of the respondents were women and 19% were men.

Chronic conditions.

Chronic conditions are shown in a number of studies to be associated with falls among the elderly, and having multiple chronic conditions has been shown to impart exponential risk for falling (Cummins & Nevitt, 1989; Nyberg & Gustafson, 1996). A

limited number of studies have also shown a link between fall-related injuries and specific chronic conditions (Huelskoetter, 1987; Koski et al., 1996; Maki et al., 1994; Scientific Advisory Board, 1996; Stewart et al., 1992; Tutuarima et al., 1997). These conditions include the effects of a stroke, having osteoporosis, urinary or bowel incontinence or frequency, impaired gait, reduced vision, and cognitive impairments.

In the data source used here this variable was measured categorically, covering 27 chronic conditions known to occur among seniors. Respondents were asked if they had any of conditions in the past year. A sub-scale of this variable was created comprised of seven factors consistent with conditions shown in the literature to be related to falls and fall-related injuries among seniors. This new variable includes the conditions of a stroke (or effects of a stroke), eye trouble not relieved by glasses, loss of bladder control, loss of bowel control, trouble with feet or ankles, osteoporosis, and memory loss (including Alzheimer's). The new variable "Count of Selected Chronic Conditions" was examined through logistic regression.

The seven selected chronic conditions were also grouped and coded as zero equals "none", one equals "one", two equal "two", and three equals "three to seven" chronic conditions. This variable, "Selected Chronic Conditions", was analyzed using chi square analysis. In addition, chi square tests were also conducted for each of the seven conditions with dichotomous outcome where zero equals "no" and one equals "yes".

For the sample in this study, 102 (10.1%) reported having none of the selected chronic conditions, 223 (22%) reported having one, 285 (28.2%) reported two, and 402 (39.7%) reported having between three and seven chronic conditions. The mean number of conditions reported was 2.20, with a standard deviation of 1.34. Only one person

reported having all seven conditions. For this sample, correlations among the seven conditions ranged from .00 to .20 (see Table 6). Inter-item reliability (Cronbach's alpha) for this measure was .29.

Table 6

Selected Chronic Conditions Correlation Matrix

	Stroke	Eye trouble	Bladder control	Bowel control	Feet or ankles	Osteo-porosis	Memory loss
Stroke	1.000	-	-	-	-	-	-
Eye trouble	.034	1.000	-	-	-	-	-
Bladder control	.046	.057	1.000	-	-	-	-
Bowel control	.057	.063*	.203**	1.000	-	-	-
Feet or ankles	.029	.090**	.140**	.025	1.000	-	-
Osteoporosis	-.005	.000	.013	.015	.105**	1.000	-
Memory loss	.042	.076*	.120**	.046	-.012	-.012	1.000

*Correlation is significant at the .05 level (2-tailed).
**Correlation is significant at the .01 level (2-tailed).

Functional limitations.

Functional limitations that lead to difficulties in performing normal activities that are shown to be associated with higher rates of falling and fall-related injury for seniors include problems with balance and gait, slow reflexes, and muscle weakness or poor reflexes in the lower limbs (Chen et al., 1994; Koski et al., 1996; Nevitt et al., 1991). Two measures that provide data on functional limitations are 1) a self-report of health troubles that limit activities and 2) Instrumental Activities of Daily Living (IADL) for indoor and outdoor household chores.

Respondents in the CRD Survey were asked, "How much do your health troubles stand in the way of your doing the things you want to do?". Coding and response percentages for this variable where zero equaled "not at all" (14.5%), one equaled "a little (some things)" (30.6%), two equaled "a great deal" (44.5%) and three equaled "completely"(10.1%). The mean response was 1.5 and the standard deviation was .86. Chi square tests were performed on this measure.

Instrumental activities of daily living (IADL) that best represent functional limitations that place elderly people living in the community at risk of a fall-related injury are those that measure the ability to perform normal house hold chores both indoors and outdoors. In the CRD Survey, this dimension of IADL is measured by the following five questions: (a) "Can you do own laundry"?; (b) Can you go shopping for groceries or clothes (assuming you have transport)"?; (c) "Can you do heavy housework (e.g. scrub floors, vacuum, windows/walls)"?; (d) "Can you do light housework (e.g. dusting, dishes, making bed)"?; and (e) "Can you do yardwork and gardening"?. This variable was measured by a scale where one equaled "without any help", two equaled "some help from device ONLY", three equaled "some help from person ONLY", four equaled "some help from person and device", and five equaled "unable to do it". Inter-item reliability (Cronbach's alpha) for this measure was .80 and correlations among the five questions ranged from .34 to .56.

These IADL categories are based on an established five-part scale developed by Wolinsky, Coe, Miller and Pendergast (1984) measuring abilities with basic personal activities, household chores and advanced chores denoting cognitive abilities. Reliability and validity of these scales are addressed by Wolinsky and Johnson (1991, as cited in

Fitzgerald, Smith, Martin, Freedman, & Wolinsky, 1993), and validated by Fitzgerald et al.. According to Fitzgerald et al. (p. S30), the reliability estimates for the dimension measuring household IADL, including the need for help in "preparing meals, shopping, performing housework, and traveling to places out of walking distance" (minimum factor loading = .774; Cronbach's alpha = .784).

For the CRD Survey data for this measure, forty-five cases had one missing value, and four cases had two missing values. These were replaced with the mean value across the five possible responses for those cases. Only one case had more than two missing values and this case was deleted from calculations for this measure. This five-question scale was then recoded to a continuous variable, "IADL1" with a range of 5 for responses of "without any help" to all five questions, to 25 for responses of "unable to do it" for all five questions. The mean score was 14.90 with a standard deviation of 5.70. This measure was analyzed through logistic regression.

Depression.

Depression has been demonstrated to be associated with higher rates of falling (Schulman & Acquaviva, 1987; Tideiksaar, 1986) and a number of studies have looked at depression as an outcome of fall-related injuries among seniors (Bond et al., 1998; Vetter & Ford, 1989). No significant relationship has been found to link depression to increased risk of sustaining a fall-related injury. However, a number of studies have demonstrated an association between higher rates of falls and falls with injury among seniors who are taking antidepressant medication (Koski et al., 1996; Neutel, 1996; Ray et al., 1990; Ross, 1991).

Depression is measured in the CRD Survey by use of the Center for Epidemiologic Studies Depression Scale (CES-D) (Centre on Aging, 1996). This 20 item, self-report scale was developed to identify depression in the general population (McDowell & Newell, 1996). This scale has also been found to be reliable when used among frail elderly, despite the inclusion of questions that deal with somatic symptoms (Davidson, Feldman, & Crawford, 1994).

In keeping with the recommendations of McDowell and Newell (1996) for evaluating depression based on the CES-D scale, a dummy variable was created representing the sum of responses on a scale of zero to three for each of the 20 items listed below, with a range of scores from 0 to 60. This variable was examined through logistic regression. With the exception of the four positive items (items 4, 8, 12, and 16), which are reversed, the coding is as follows:

(a) zero equals rarely or none of the time (for less that 1 day in past week),

(b) one equals some or a little (1-2 days),

(c) two equals occasionally or moderate amount of time (3-4 days), and

(d) three equals most or all of the time.

CES-D items:

1. Bothered by things that don't usually bother me
2. Didn't feel like eating; appetite poor
3. Couldn't shake blues even w/help from family/friends
4. I was just as good as other people
5. I had trouble keeping my mind on what I was doing
6. I felt depressed
7. I felt that everything I did was an effort
8. I felt hopeful about the future
9. I thought my life has been a failure
10. I felt fearful
11. My sleep was restless
12. I was happy

13. I talked less than usual
14. I felt lonely
15. People were unfriendly
16. I enjoyed life
17. I had crying spells
18. I felt sad
19. I felt that people dislike me
20. I could not "get going"

(Centre on Aging, 1996, p. 7-8).

According to Schein and Koenig (1997), a score of 15 or more is considered to "denote the presence of significant depressive symptoms in the general population" (p. 438). To reflect this cut-off, a variable was created with zero equaled to a score of 0 to 15 and one equaled to 16 or more. This variable was examined using chi square analysis.

The reliability of the CES-D scale has been demonstrated by its high correlation (0.65) with the depression categorization in the DSM-III (9, Table 2, as cited in McDowell & Newell, 1996). Specificity in the CES-D scale was demonstrated in its ability to distinguish between alcoholics and schizophrenics who were depressed from others who were not depressed (McDowell & Newell). Factor analysis of the CES-D scaled showed four factor groups with high internal consistency among the components.

CES-D scale split-half reliability was found to range from 0.76 to 0.85 (McDowell & Newell, 1996). Schein and Koenig (1997) report a Chronbach's alpha for CES-D total scores among samples of elderly persons of between 0.86 and 0.89 (p. 438). The CES-D scale has demonstrated reliability and validity in use with community-dwelling older adults regardless of age, sex, or socio-economic status (Schein & Koenig, 1997).

In the sample for this study, correlations among the items of the CES-D scale range from 0.00 to 0.64. For the scale as a whole, inter-item reliability (Cronbach's

alpha) was 0.84. However, the emphasis of the CES-D scale is on short-term symptoms of one week, to a few days, duration. Therefore, findings of association with fall-related injury events that were reported over a six-month period must be interpreted with caution.

CES-D scores for this study ranged from 0 to 51, with a mean score of 10.95 and a standard deviation of 9.16. Twenty-four percent of the sample obtained a score of 16 or higher, thereby exceeding the standard cut-off indicating clinical depression.

Behavioural Factors

Variables representing behavioural risk factors associated with falling are not covered well in this data source. Missing factors that are implicated in the literature as being associated with fall-related injuries among seniors include those related to fear of falling, footwear worn at the time of a fall-related injury, risk taking behaviours, and medication use. Factors that are covered include those related to frequency of falling and using a wheelchair. Wheelchair use can be considered a behavioural factor when incorrect use, or inappropriate design in relation to need, contributes to a fall (Gaal et al., 1997). It can also be considered a biological factor when viewed as a proxy for a functional limitation. It is unknown from the data available how wheelchair use has contributed to a fall or fall-related injury.

Potential behavioural factors considered include:

1. Frequency of falling.
2. Using a wheelchair.

Frequency of falling.

Studies show that repetitive falling is associated with a decrease in health status (Wolinsky, Johnson, & Fitzgerald, 1992). A study by O'Loughlin et al. (1993) examined

frequency of falling in relation to gender and increased age and did not find any significant difference in frequency between men or women or for increased age. However, Speechley and Tinetti (1991) found that vigorous elderly people were more likely to fall frequently compared to frail elderly people, and that the vigorous elderly were more likely to sustain serious injuries as a result of their falls.

In the CRD Survey, frequency of falling is measured by two variables for the number of times the respondent had fallen down indoors or outdoors over the past six months. These variables were recoded for the total number of falls reported for either indoors or outdoors under the categories of zero equals "one fall", and one equals "two falls", and two equals "three or more falls". Of those who reported falling, 56% reported falling once, 18% reported falling twice, and 26% reported falling three or more times. The number of falls ranged from one to over 96 times in the six-month period. The average number of falls was 1.69 and the standard deviation was 0.85.

Wheelchair use.

Wheelchairs and other mobility aids have been linked to falls and falls with injury both through their use and lack of proper use (Gaal et al., 1997; Gallagher & Scott, 1995; Parker et al., 1996; Rush & Ouellet, 1997). The only variable that provides an indication of the use of a mobility aid in the CRD Survey is the question where respondents were asked, "Do you ever use a wheelchair?". This variable was coded as zero equaled to "no" and one equaled to "yes. Wheelchair use was reported by 11.6% of the respondents.

Environmental Factors

Location.

The only environment factor addressed in the CRD Survey is the location of the fall. Respondents were asked how many times they fell indoors or outdoors in the past six months, and if any of these resulted in an injury. For those who reported falls in either location, over 99% were for 12 or fewer falls. There were a few extreme cases (less than 1%) of reports of over 70 falls. To address this heavily skewed data, these variables were truncated at 13 or more falls. The new variables for "frequency of indoor falls" and "frequency of outdoor falls" are coded as a continuous measures from "one" to "13 or more" falls. For those who reported an indoor fall (N = 236), the average number of falls was 2.19 and the standard deviation was 2.19. For those who reported an outdoor fall (N = 153), the average number of falls was 1.65 and the standard deviation was 1.70. Frequency of falling by location was examined as a continuous variable through logistic regression.

Indoor and outdoor locations were also recoded into categorical variables, where one equaled "one fall", two equaled "two or more falls". The two new variables, "number of indoor falls" and "number of outdoor falls" were examined by the by chi square analysis by gender, age group and fall injury status.

Social and Economic Factors

Few studies have been conducted to examine relationships between economic and social factors, and falls, or fall-related injuries. A study by Gallagher, Hunter, and Scott (in press) found lower socio-economic status to be indirectly linked to a higher incidence of falling mediated through chronic illness and female gender. Other studies show direct

and indirect links between a lack of social supports and lower socio-economic status with many factors known to be associated with falling (Barusch, 1994; Chappel, 1996; Elston et al., 1991; Raina, Dukeshire, Chambers & Lindsay, 1997).

This study conducted an exploratory investigation through bivariate analysis of the CRD data for direct links between fall-related injuries among seniors and social and economic factors including income, income adequacy, education, living arrangements, emotional support, network size and publicly funded service use.

Using logistic regression analysis, the compounding effects of selected social and economic factors were also examined in conjunction with other factors known to be associated with fall-related injuries. The factors examined through bivariate and logistic regression included:

1. Income
2. Income adequacy
3. Education
4. Living arrangements
5. Emotional support
6. Social network size
7. Publicly funded support service use

The following is a description of the variables from the CRD Survey that cover this domain.

Income.

Higher income has been shown to be associated with longer life expectancy, having fewer disabilities and overall better health (Health Canada, 1998). The CRD

Survey provides data on respondents' reports of average monthly household income under 24 categories ranging from (1) "no income" to (24) "$5500 or more". The average income was between $1250 and $1499 (N = 836). There were 176 missing cases for income. For these cases, the mean income of the respondents was calculated and inserted to replace the missing value.

Income was also recoded for bivariate analysis using a sub-scale of low (None to $1249), middle ($1250 to $3249), and high-income groups ($3250 to $5500 or more). Divisions for these categories are based on Statistics Canada (1995) income distributions (as cited in National Council of Welfare, 1998). For example, the low income cutoff, which indicates that a person is spending a disproportionate amount of their income on food, clothing and shelter, is $14,335 per year for an individual living alone in a city the size of Victoria, British Columbia (National Council of Welfare, 1998). A weakness of the data provided by the CRD Survey is the lack of information on the household size in relation to the average monthly household income.

Income adequacy.

With regard to income adequacy, respondents were asked, "How do you think your household income and assets currently satisfy your needs?". This variable was coded as five equaled "very well", four equaled "adequately", three equaled "with some difficulty", two equaled "not very well", and one equaled "totally inadequate". Less than five percent (4.6%) of this sample reported income adequacy as "totally inadequate" or "not very well", the majority (57.9%) reported their income as "adequate". The mean value reported was 3.88, with a standard deviation of .78.

Due to too few cells per case for the outcome variables, this variable was collapsed to three categories, and recoded as zero equaled "very well", one equaled "adequately", and two equaled "inadequately". This variable was analyzed through chi square analysis.

Education.

Less education has been linked to lower self-rated health status and higher hospitalization rates (Hirdes & Forbes, 1992; Simmons-Tropea & Osborn, 1986). In the CRD Survey education is measured by the question, "How many years of schooling have you had?". The number of years of education ranged from 0 to 27 with a mean 11.29 years with a standard deviation of 3.35. There were 15 cases with missing values and these were replaced with the mean value. This continuous variable was examined by logistic regression for its role in fall injury status.

This variable was also recoded to distinguish between those who have 12 years or more of schooling (i.e. high school equivalent), and those who have less than 12 years of schooling. This new variable was coded as zero equals "high school or more" and one equals "less that high school". For this sample, just over half had obtained the equivalent of high school (50.3%). Chi square tests were applied to this variable to examined education levels by fall injury status.

Living arrangements.

Social support by informal caregivers is the mainstay of support for seniors—representing between 75% and 85% of all care received (Kane, 1990, as cited in Penning et al., 1998). Furthermore, a study by Chappell (1991) found that most elderly persons received help from only one individual. A study of social isolation and well-being among

seniors found that living alone, being unmarried, having no companions, and the combination of living alone and having no confidants were found to be significantly related to less happiness and lower life satisfaction scores (Chappell & Badger, 1989).

A measure of social isolation in the CRD Survey is provided by responses to the question: "How many people, if any, live here with you?". This variable was recoded to the variable "living arrangements". Coding consisted of zero equaled "living with others" and one equaled "living alone". This variable was examined through chi square tests and through logistic regression. There were two missing values for this measure. These were replaced with the median of other cases prior to logistic regression analysis.

Social network size.

The emphasis in the CRD Survey is on size, rather than the quality, of social supports. However, the validity of measuring the size of a social network as an indicator of social support is debated by social theorists (Evans et al., 1994). Some say that size is of importance, regardless of the nature of the interaction (House et al, as cited in Evans et al.). Others emphasize the quality of interactions as important to promoting health (Evans et al.).

Data from the CRD Survey representing the size of the social support network is comprised of responses to questions on the number of close family members, friends and neighbours. This variable was recoded from individual responses to specific numbers of family members, friends and neighbours to a continuous variable representing the total number of people forming a close social network. This variable was examined through chi square tests, after recoding and collapsing into three categories, with zero equaled "0 to 5", one equaled to "6 to 15" and two equaled to "16 or more". For this study sample,

the mean number of all people in the social network of the respondents was 18.90, with a standard deviation of 14.95. This measure in its continuous form was also examined using logistic regression.

Emotional support.

One variable that does provide some indication of the quality of social support received by the CRD Survey respondents is the question: "Do you receive emotional support from anyone? That is, do you have someone you confide in, talk to about yourself, your concerns, etc.?". Such self-reports of perception of social support are shown to be robust measures (Chappell, 1991; Evans et al., 1994).

The variable for "emotional support" was coded zero equaled "yes" and one equaled "no". This variable was examined through chi square tests and through logistic regression.

For this sample, the majority (81.5%) of respondents reported having someone from whom they received emotional support. The mean value reported was .19 and the standard deviation was .39. There was one missing value for this measure. This was replaced with the median of other cases prior to the logistic regression analysis.

Publicly funded support service use.

The final measure applied to this study is based on the CRD Survey sampling procedures. This sample was randomly selected from two purposefully selected sub-samples—those receiving publicly funded home support services and a matched sample of those not receiving services by age, gender and functional ability. To determine if any differences exist by fall injury status for this variable, these two groups were examined using chi square analysis for the three fall injury outcome categories. This variable was

coded as one equaled to "users" (publicly funded home support service users), and two equaled to "non-users". Fifty percent of the sample was in each group, with a mean score of 1.5 and a standard deviation of .5.

Data Analysis

The following is an overview of the methods used in the analysis of the data to answer each of the three research questions. Attention is also given to data assumptions for bivariate and multivariate analysis. Statistical analysis was conducted with the use of the computer software program known as Statistical Package for the Social Sciences (SPSS) (Norusis, 1992).

Research Question #1

Descriptive and bivariate analyses were used to answer the research question #1: Are there differences in the extent and nature of the problem of fall-related injuries according to age and gender?

Descriptive statistics were used to identify central tendencies of selected variables and to describe key characteristics of respondents to the CRD Survey aged 65 years and older who experienced a fall-related injury. Bivariate analysis, using chi square tests, were conducted to determine differences between age groups and gender for type of fall-related injury sustained. There are no assumptions related to the distribution of the variables in the population in non-parametric tests, such as chi square tests (Munro, 1997). See Table 7 for a list of variables examined for research question #1.

Table 7

Variables Examined for Research Question #1

CRD Patterns of Care Survey 1995/96
Fall resulting in injury, by age group and gender for: 1. Type of injury: fracture, cut, bruise, other 2. Location and frequency: indoor, outdoor

Research Question #2

Bivariate analyses were used to answer research question #2: Are there differences in the patterns of variables representing the four domains of biological, behavioural, environmental, and social and economic risk factors among fallers, non-fallers, and injured and non-injured persons?

Chi-square tests were applied to determine whether samples from the population who experienced a fall-related injury differ in important ways from those who did not experience a fall-related injury. These tests are based on the logic of testing the null hypothesis of no difference between these groups (Howell, 1995; Spatz & Johnston, 1989; Tabachnick & Fidell, 1996).

Research Question #3

Multivariate analyses were applied to answer research question #3: Are there differences in the compounding effects of combinations of variables representing the four domains of biological, behavioural, environmental, and social and economic risk factors among fallers, non-fallers, injured and non-injured persons?

Multivariate statistical techniques were employed to explore the complex interrelationships and compounding effects of variables thought to be directly, or

indirectly, related to fall-related injuries among persons 65 years of age and older. Logistic regression was chosen as the best statistical technique due to the mix of scales of measurement used in the variables examined in this study. These include continuous measures used for variables such as age, the number of chronic conditions, and categorical and dichotomous measures used such as income and gender. Unlike other multivariate techniques, logistic regression can be used with a mixture of dichotomous, categorical and continuous independent variables and a dichotomous dependent variable—such as fall-related injury or no fall-related injury (Tabachnick & Fidell, 1996, p. 578). In addition, logistic regression provides more flexibility than other techniques as variables do not have to be "normally distributed, linearly related, or of equal variance within each group" (Tabachnick & Fidell, p. 575).

The linear regression equation is "the (natural log of the) probability of being in one group divided by the probability of being in the other group" (Tabachnick & Fidell, 1996, p. 576). Logistic regression allows for an evaluation of the best combination of variables for predicting group membership while controlling for confounding variables (Kleinbaum, 1992). For this study, the two major groups are represented by those who have experienced a fall-related injury and those who have not. These two groups are further differentiated to determine if differences exist between fall-related injuries and falls that do not result in injury. Logistic regression was used to find the best fitting variables and combinations of variables that predict membership under the variations of these groups. Independent variables examined are combinations of biological, behavioural factors, and social and economic factors.

In a logistic regression model, the unique contribution of each variable is evaluated for its ability to predict group membership, thereby controlling for the effects of all the other variables in the model (Tabachnick & Fidell, 1996, p. 591). In this way variables can be added or removed from a model with the goal of finding the 'best fitting' model that predicts group membership. Models can also be evaluated for the overall contribution of all variables in predicting group membership by comparing the chi square values of one model with that of another. Variables used to answer research questions #2 and #3 are listed in Table 8.

Table 8

Variables Examined for Research Question #2 and #3

CRD Patterns of Care Survey 1995/96

Dependent variables:

1. "non-fallers" versus "fall with injury"
2. "non-fallers" versus "fall with or without injury",
3. "fall without injury" versus "fall with injury"

Independent variables:

1. Age and sex
2. Number of chronic conditions
3. Selected chronic conditions such as arthritis, incontinence, stroke, etc.
4. Health troubles causing activity limitations
5. Instrumental Activities of daily living (IADL)
6. Depression
7. Using a wheelchair
8. Frequency of falling
9. Location of falls
10. Income
11. Income adequacy
12. Education: years of schooling
13. Living arrangements: alone or with others
14. Social network size
15. Emotional support
16. Use of publicly funded support services

Data Assumptions

Data assumptions for chi square analysis are consistent with the data used for this study. These include that the:

(a) data is frequency data,

(b) data can be categorized,

(c) categories created are mutually exclusive,

(d) categories are theoretically based, and

(e) the sample size is adequate, i.e. no cells with fewer than 5 cases (Munro, 1997).

Data assumptions for logistic regression are not as stringent as other multivariate statistical procedures. However, attention to multivariate normality and linearity among the predictors is important to enhancing power, "since a linear combination of predictors is used to form the exponent" (Tabachnick & Fidell, 1996, p. 579). The following is an overview of four potential violations of assumptions and steps taken to address these. These are, (a) small case-to-variable ratio, (b) number of variables, (c) multicollinearity, and (d) outliers.

Small case-to-variable ratio.

A small case-to-variable ratio is a problem when there are too few cases relative to the number of predictive variables and can result in too many cells with no cases. This can lead to "large parameter estimates and standard errors, and, possibly, failure of convergence" (Tabachnick & Fidell, 1996, p. 579). For this study, this concern has been remedied by collapsing categories or removing such variables when they were not important to the analysis.

Number of variables.

Additional variables result in an increase in the degrees of freedom and a reduction in the power of the analysis. "If there are too many variables relative to the sample size, the solution provides a wonderful fit to the sample that may not generalize to the population, a condition known as overfitting" (Tabachnick & Fidell, 1996, p. 12). Variables for this study were limited to those with the greatest theoretical relevance to the study. Selection of variables was also based on their relationship to other predictors in the multivariate analysis (i.e., not highly correlated with other variables) and to those with known reliability and validity. However, as with other cross-sectional studies where multiple tests are conducted on a number of variables, it is possible to find spurious results.

Multicollinearity.

Multicollinearity in logistic regression, like other multiple regression analyses, is "sensitivity to extremely high correlations among predictor variables" (Tabachnick & Fidell, 1996, p. 580). As shown in Table 9, correlation tables were generated to find potential sources of multicollinearity for discrete predictors. Other than the correlation of .80 for Falls and Injury, which are not used in the same analysis, the highest correlation is .49 for IADL and Service use. This accounts for less that 25% of the variability and is well below the .70 cut off for posing a threat to increasing the margin of error in multivariate analysis (Tabachnick & Fidell, 1996, p. 86). Thus there is no evidence of multicollinearity and there was no need to delete redundant variables from the model.

Table 9

Correlation Matrix (N = 1011[1])

	Age	Gender	Chronic	IADL	Health	CES-D	W/chair	Income	Educat.	Living	Netwk	Support	Service	Injury	Fall
Age	1.000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gender	-.016	1.000	-	-	-	-	-	-	-	-	-	-	-	-	-
Chronic	.032	.098**	1.000	-	-	-	-	-	-	-	-	-	-	-	-
IADL	.103**	.039	.170**	1.000	-	-	-	-	-	-	-	-	-	-	-
Health	-.079**	-.021	.249**	.455**	1.000	-	-	-	-	-	-	-	-	-	-
CES-D	-.065*	.012	.190**	.198**	.316**	1.000	-	-	-	-	-	-	-	-	-
W/chair	-.094**	-.001	.070*	.342**	.235**	.019	1.000	-	-	-	-	-	-	-	-
Income	-.139**	-.246**	-.001	-.114**	-.049	-.084**	.020	1.000	-	-	-	-	-	-	-
Educat.	-.082**	.022	-.012	-.094**	-.064*	-.107**	-.021	.276**	1.000	-	-	-	-	-	-
Living	.158**	.225**	-.013	-.024	-.001	.080*	-.073*	-.311**	-.040	1.000	-	-	-	-	-
Netwk	-.100**	.014	.002	-.176**	-.149**	-.201**	-.068*	.148**	.152**	-.129**	1.000	-	-	-	-
Support	.023	-.042	-.024	-.089**	-.028	.025	.014	-.047	-.049	.068*	-.114**	1.000	-	-	-
Service	-.018	.000	-.029	-.490**	-.265**	-.112**	-.178**	.285**	.173**	-.132**	.195**	-.044	1.000	-	-
Injury[2]	-.006	-.032	.112**	.097**	.065*	.105**	.059	.040	.075*	.033	.002	-.055	-.031	1.000	-
Fall[3]	.011	-.071*	.125**	.066*	.070*	.115**	.038	.022	.049	.028	.010	-.039	-.009	.802**	1.000

*Correlation significant at the 0.05 level (2-tailed)
**Correlation significant at the 0.01 level (2-tailed)

[1] One case missing due to missing data
[2] Fall-related injury coded 1, all others coded 0
[3] Fall-related injury and fall coded 1, all others coded 0

Outliers.

For dichotomous variables in logistic regression outliers are indicated by extreme uneven splits between the two categories. According to Rummel (1970), it is recommended that dichotomous variables with splits that exceed a 90-10 split be eliminated (as cited in Tabachnick & Fidell, 1996). There were no such variables found in this study.

For continuous variables in "nonlinear analyses such as logistic regression ...there are no distributional assumptions" (Tabachnick & Fidell, 1996, p. 71). Instead, it is recommended that observed distributions be tested against hypothesized distributions. For this study, no distributions were found that violated hypothesized distributions.

Results of the analyses for research questions one to three are presented in the following chapter.

CHAPTER 5

Results

The purpose of this study was to explore differences between seniors who sustained a fall with an injury compared to both those who did not fall, and, those who fell without an injury. This study focused on the four domains of biological, behavioural, environmental, and social and economic factors, examining their individual and combined effects in contributing to falls that result in injury among seniors. The nature and extent of the injuries sustained are also examined for differences between genders and age groups. In addition, policy implications for the prevention of fall-related injuries among seniors are discussed based on the findings. This chapter consists of the study findings, reported according to the research questions:

For frail community-dwelling seniors aged 65 years and over:

1. Are there differences in the extent and nature of the problem of fall-related injuries according to age and gender?
2. Are there differences in the patterns of variables representing the four domains of biological, behavioural, environmental, and social and economic risk factors among fallers, non-fallers, and injured and non-injured persons?
3. Are there differences in the compounding effects of combinations of variables representing the four domains of biological, behavioural, environmental, and social and economic risk factors among fallers, non-fallers, and injured and non-injured persons?

Differences by Age and Gender

It was hypothesized that fall-related injuries are a major problem among those aged 65 years and older and that differences exist between men and women and between younger and older age groups for the extent and nature of the fall-related injuries. To test this hypothesis, descriptive and chi square analyses were used.

Extent and Nature of the Problem

One third (N = 336 or 33.2%) of the CRD Survey respondents (N = 1012) reported falling once or more over the six-month period of the survey. Of those who fell, the majority (N = 245 or 72.9%) reported one or more injuries as a result of their fall(s). This was 24.2% of the total sample—one case was missing for the measure on injuries, for a total N of 1011.

As shown in Table 10, of those who reported a fall with injury, the majority of injured fallers were women (N = 193 or 78.8%), and 21.2% were men (N = 52). However, when the proportion of men and women among the non-fallers are compared to those who fell with or without an injury, there are significantly more men among those who fell with or without an injury. As shown in Table 10, the proportion of men who fell with an injury (27.1%) and who fell without an injury (13%), is significantly higher (p = .035) than among the women who fell with or without an injury (23.6% and 8.1% respectively).

Table 10

Fall Injury Status by Gender for the 1995-96 CRD Survey

	Females		Males		Total	
	N = 819		N = 192		N=1011	
	(*n*)	(%)	(*n*)	(%)	(*n*)	(%)
Fall with injury	193	23.6	52	27.1	245	24.2
Fall without injury	66	8.1	25	13.0	91	9.0
Non-fallers	560	68.4	115	59.9	675	66.8

$\chi^2 = 6.73$; $df = 2$; $\rho = .035$

The ages of those who reported fall-related injuries ranged from 66 to 101 years, with an average age of 81.8 years and a standard deviation of 7.1 years. As shown in Table 13, when fall-related injuries are considered under age groups, most of those who were injured were aged 85 years or older (N = 96 or 39.2%), and the numbers are greater with increasing age for both genders. However, as shown in Table 11, there are no significant differences between age groups when non-fallers are compared to those who fell with or without an injury.

Table 11

Fall Injury Status by Age Group for the 1995-96 CRD Survey

	65-74		75-84		85+		Total	
	N=168		N=441		N=402		N=1011	
	(*n*)	(%)	(*n*)	(%)	(*n*)	(%)	(*n*)	(%)
Fall with injury	44	26.2	105	23.8	96	23.9	245	24.2
Fall without injury	13	7.7	40	9.1	38	9.5	91	9.0
Non-fallers	111	66.1	296	67.1	268	66.7	675	66.8

$\chi^2 = .731$; $df = 4$; $\rho = .947$

There were also no significant differences found when those who reported a fall with an injury were examined based on both gender and by age group (see Table 12).

Table 12

Fall With an Injury by Gender and Age Group for the 1995-96 CRD Survey

	Males		Females		Total	
	N = 52		N = 193		N = 245	
	(*n*)	(%)	(*n*)	(%)	(*n*)	(%)
65-74	10	19.2	34	17.6	44	18.0
75-84	22	42.3	83	43.0	105	42.9
85+	20	38.5	76	39.4	96	39.2

$\chi^2 = .073$; $df = 2$; $\rho = .964$

Type of Injury

Of the 245 respondents who reported an injury, 19.3% (n = 47) reported sustaining a fracture, 31.5% (n = 76) a cut, 78.9% (n = 191) a bruise and 31.4% (n = 75) other injuries (note: these categories are not mutually exclusive).

The frequency of falling, location of falls and type of injury sustained were also examined for differences by age and gender using chi square tests. Findings in Tables 13 and 14 show no significant difference by gender or age group for those who sustained a fracture, cut, bruise or other injury due to a fall. Fractures were found to be only slightly more frequent among females (20.3% compared to 15.4% for males), and for those aged 85 years and older (21.9% compared to 17.6% for those aged 65 to 84 years). Other injury types were remarkably similar between the genders and age groups.

Table 13

Type of Fall-related Injury by Age Group for the 1995-96 CRD Survey

Type of fall-related injury	65 to 84 years of age		85+ years of age		Total	
	N=149		N=96		N=245	
	(*n*)	(%)	(*n*)	(%)	(*n*)[1]	(%)
Fracture						
No	122	82.4	75	78.1	197	80.7
Yes	26	17.6	21	21.9	47	19.3
$\chi^2 = .69$; $df = 1$; $\rho = .405$						
Cut						
No	103	70.1	62	66.0	165	68.5
Yes	44	29.9	32	34.0	76	31.5
$\chi^2 = .45$; $df = 1$; $\rho = .503$						
Bruise						
No	27	18.2	24	25.5	51	21.1
Yes	121	81.8	70	74.5	191	78.9
$\chi^2 = 1.84$; $df = 1$; $\rho = .175$						
Other						
No	99	67.3	65	70.7	164	68.6
Yes	48	32.7	27	29.3	75	31.4
$\chi^2 = 29$; $df = 1$; $\rho = .592$						

[1] Some totals may not equal the total N (245) due to missing data.

Table 14

Type of Fall-related Injury by Gender for the 1995-96 CRD Survey

Type of fall-related injury	Male		Female		Total	
	N=52		N=193		N=245	
	(*n*)	(%)	(*n*)	(%)	(*n*)[1]	(%)
Fracture						
No	44	84.6	153	79.7	197	80.7
Yes	8	15.4	39	20.3	47	19.3
$\chi^2 = .64$; $df = 1$; $\rho = .424$						
Cut						
No	36	69.2	129	68.3	165	68.5
Yes	16	30.8	60	31.7	76	31.5
$\chi^2 = .02$; $df = 1$; $\rho = .893$						
Bruise						
No	11	21.2	40	21.1	51	21.1
Yes	41	78.8	150	78.9	191	78.9
$\chi^2 = .00$; $df = 1$; $\rho = .987$						
Other						
No	35	68.6	129	68.6	164	68.6
Yes	16	31.4	59	31.4	75	31.4
$\chi^2 = .00$; $df = 1$; $\rho = .999$						

[1] Some totals may not equal the total N (245) due to missing data.

Location and Frequency of Falling

For those respondents who reported a fall-related injury, chi square test results in Table 15 show little difference by location for younger (65-84 years) and older (85+ years) age groups. Differences by gender (Table 16) are significant for "falling at either location". With men who reported a "fall with injury" reported falling more frequently than women (28.8% of men fell twice versus 15.2% of women; and 32.7% of men fell three or more times versus 28.8% of women; p=.033).

Table 15

Location of Falls for Those Who Reported a Fall With Injury by Age Group for the 1995-96 CRD Survey

	65 to 84 years of age		85+ years of age		Total	
	N=149		N=96		N=245	
	(*n*)	(%)	(*n*)	(%)	(*n*)[1]	(%)
Frequency indoor or outdoor						
One	78	53.1	49	51.0	127	52.3
Two	26	17.7	18	18.8	44	18.1
Three or more	43	29.3	29	30.2	72	29.6
χ^2 = .10; *df*= 2; ρ= .951						
Frequency indoor*						
One	54	51.9	29	41.4	83	47.7
Two or more	50	48.1	41	58.6	91	52.3
χ^2 = 1.85; *df*= 1; ρ= .174						
Frequency outdoor*						
One	53	68.8	37	78.7	90	72.6
Two or more	24	31.2	10	21.3	34	27.4
χ^2 = 1.44; *df*= 1; ρ= .231						

[1] Some totals may not equal the total N (245) due to missing data.
*Indoor and outdoor locations are not mutually exclusive.

Table 16

Location of Falls for Those Who Reported a Fall With Injury by Gender for the 1995-96 CRD Survey

	Male		Female		Total	
	N=52		N=193		N=245	
	(*n*)	(%)	(*n*)	(%)	(*n*)[1]	(%)
Frequency indoor or outdoor						
One	20	38.5	107	56.0	127	52.3
Two	15	28.8	29	15.2	44	18.1
Three or more	17	32.7	55	28.8	72	29.6
$\chi^2 = 6.83$; $df = 2$; $\rho = .033$						
Frequency indoor*						
One	13	36.1	70	50.7	83	47.7
Two or more	23	63.9	68	49.3	91	52.3
$\chi^2 = 2.44$; $df = 1$; $\rho = .118$						
Frequency outdoor*						
One	17	60.7	73	76.0	90	72.6
Two or more	11	39.3	23	24.0	34	27.4
$\chi^2 = 2.56$; $df = 1$; $\rho = .110$						

[1] Some totals may not equal the total N (245) due to missing data.

*Indoor and outdoor locations are not mutually exclusive.

Differences in the Patterns of Risk Factors

It was hypothesized that differences exist for older adults who sustained fall-related injuries, compared to (a) those who did not fall, and (b) those who fell without sustaining an injury. To test this hypothesis, chi-square were conducted to examine differences in the patterns of variables representing the four domains of biological, behavioural, environmental, and social and economic risk factors.

Biological and Behavioural Factors

The biological factors examined through bivariate analysis in this study include age, gender, chronic conditions, self-reported health troubles, and depression. Wheelchair use, while behavioural, is considered with biological factors as it is a proxy measure for certain chronic health conditions which affect mobility. The literature on wheelchair use as a risk factor for fall-related injuries does point to both behavioural and biological components (Gaal et al., 1997, Gallagher & Scott, 1995, Parker et al., 1996, Rush & Ouellet, 1997). Frequency of falling is considered under behavioural factors. Data for this variable is limited to those who reported one or more falls (N = 336). The results of these analyses are presented for the three outcome categories in Tables 17, 18 and 19.

Table 17

Biological Factors by Non-fallers and Fall With Injury for the 1995-96 CRD Survey

	Non-fallers		Fall with injury		Total	
	N=675		N=245		N=920	
	(*n*)	(%)	(*n*)	(%)	(*n*)[1]	(%)
Age group						
65 to 84 years	407	60.3	149	60.8	556	60.4
85 years or older	268	39.7	96	39.2	364	39.6
$\chi^2 = .02$; $df = 1$; $\rho = .887$						
Gender						
Male	115	17.0	52	21.2	167	18.2
Female	560	83.0	193	78.8	753	81.8
$\chi^2 = 2.12$; $df = 1$; $\rho = .145$						
Number of chronic conditions						
None	78	11.6	19	7.8	97	10.5
One	161	23.9	40	16.3	201	21.8
Two	195	28.9	65	26.5	260	28.3
Three to seven	241	35.7	121	49.4	362	39.3
$\chi^2 = 10.03$; $df = 3$; $\rho = .001$						
Health troubles						
Not at all	99	14.8	36	14.7	135	14.7
A little	226	33.7	55	22.4	281	30.7
A great deal	284	42.3	124	50.6	408	44.5
Completely	62	9.2	30	12.2	92	10.0
$\chi^2 = 11.76$; $df = 3$; $\rho = .008$						
CES-D score						
0 to 15	533	79.1	166	67.8	699	76.1
16 to 60	141	20.9	79	32.2	220	23.9
$\chi^2 = 12.66$; $df = 1$; $\rho = .000$						
Wheelchair use						
No	604	89.5	209	85.3	813	88.4
Yes	71	10.5	36	14.7	107	11.6
$\chi^2 = 3.05$; $df = 1$; $\rho = .081$						

[1] Some totals may not equal the total N (920) due to missing data.

Table 18

Biological Factors by Non-fallers and Fall With and Without Injury for the 1995-96 CRD Survey

	Non-fallers		Fall with and without injury		Total	
	N=675		N=336		N=1011	
	(*n*)	(%)	(*n*)	(%)	(*n*)[1]	(%)
Age group						
65 to 84 years	407	60.3	202	60.1	609	60.2
85 years or older	268	39.7	134	39.9	402	39.8
$\chi^2 = .00$; $df = 1$; $\rho = .957$						
Gender						
Male	115	17.0	77	22.9	192	19.0
Female	560	83.0	259	77.1	819	81.0
$\chi^2 = 5.04$; $df = 1$; $\rho = .025$						
Number of selected chronic conditions						
None	78	11.6	24	7.1	102	10.1
One	161	23.9	61	18.2	222	22.0
Two	195	28.9	90	26.8	285	28.2
Three to seven	241	35.7	161	47.9	402	39.8
$\chi^2 = 16.41$; $df = 3$; $\rho = .001$						
Health troubles						
Not at all	99	14.8	47	14.0	146	14.5
A little	226	33.7	84	25.0	310	30.8
A great deal	284	42.3	165	49.1	449	44.6
Completely	62	9.2	40	11.9	102	10.1
$\chi^2 = 9.45$; $df = 3$; $\rho = .024$						
CES-Depression score						
0 to 15	533	79.1	234	69.6	767	75.9
16 to 60	141	20.9	102	30.4	243	24.1
$\chi^2 = 10.93$; $df = 1$; $\rho = .001$						
Wheelchair use						
No	604	89.5	292	86.9	896	88.6
Yes	71	10.5	44	13.1	115	11.4
$\chi^2 = 1.48$; $df = 1$; $\rho = .224$						

[1] Some totals may not equal the total N (1011) due to missing data.

Table 19

Biological Factors by Fall Without Injury and Fall With Injury for the 1995-96 CRD Survey

	Fall without injury		Fall with injury		Total	
	N=91		N=245		N=336	
	(*n*)	(%)	(*n*)	(%)	(*n*)[1]	(%)
Age group						
65 to 84 years	53	58.2	149	60.8	202	60.1
85 years or older	38	41.8	96	39.2	134	39.9
$\chi^2 = .18$; $df = 1$; $\rho = .668$						
Gender						
Male	25	27.5	52	21.2	77	22.9
Female	66	72.5	193	78.8	259	77.1
$\chi^2 = 1.47$; $df = 1$; $\rho = .226$						
Number of chronic conditions						
None	5	5.5	19	7.8	24	7.1
One	21	23.1	40	16.3	61	18.2
Two	25	27.5	65	26.5	90	26.8
Three to seven	40	44.0	121	49.4	161	47.9
$\chi^2 = 2.57$; $df = 3$; $\rho = .463$						
Health troubles						
Not at all	11	12.1	36	14.7	47	14.0
A little	29	31.9	55	22.4	84	25.0
A great deal	41	45.1	124	50.6	165	49.1
Completely	10	11.0	30	12.2	40	11.9
$\chi^2 = 3.18$; $df = 3$; $\rho = .364$						
CES-D score						
0 to 15	68	74.7	166	67.8	234	69.6
16 to 60	23	25.3	79	32.2	102	30.4
$\chi^2 = 1.53$; $df = 1$; $\rho = .217$						
Wheelchair use						
No	83	91.2	209	85.3	292	86.9
Yes	8	8.8	36	14.7	44	13.1
$\chi^2 = 2.03$; $df = 1$; $\rho = .154$						

[1] Some totals may not equal the total N (336) due to missing data.

Age.

Age was not found to be significantly associated with fall-related injury. As shown in Tables 17, 18 and 19, when those of younger ages, 65 to 84 years are compared to those of older ages, 85 years and over, there is no significant difference based on age between any of the three outcome categories of "non-fallers", "fall with injury" and "fall without injury".

Gender.

Gender is similarly non-significant when the "fall with injury" group is compared to the "non-fallers". The results are also not significant when the "fall without injury" group are compared to the "fall with injury" group. However, crosstabulations in Table 18 show that gender does play a significant ($p = .025$) role for the "fall with or without injury" group compared to "non-fallers". As shown, there are proportionally more men (22.9%) and fewer women (77.1%) in the "fall with or without injury" group compared to the "non-fallers" group (17% for men and 83% for women).

Number of chronic conditions.

Sixty-eight percent of the CRD Survey respondents reported having two or more of the seven chronic conditions examined in this study. As shown in Table 17, chi square tests show significantly different findings ($p = .001$) for the number of chronic conditions reported when the "fall with injury" group are compared to the "non-fallers". In the "fall with injury" group, almost half (49.4%) reported between three and seven chronic conditions compared with only 35.7%, among "non-fallers".

These findings are similar, and also significant ($p = .001$), when the "fall with or without injury" group are compared to the "non-fallers" (see Table 18). However, when

comparisons are drawn between the "fall with injury" group and the "fall without injury" group, the findings are not significant (see Table 19).

Selected chronic conditions.

To uncover the contribution of specific chronic conditions in fall-related injuries, chi square tests were conducted for each of the seven conditions of stroke, eye trouble, loss of bladder control, loss of bowel control, trouble with feet or ankles, osteoporosis and memory loss (see Tables 20, 21 and 22). Table 20 shows that compared to "non-fallers", proportionally more of those in the "fall with injury" group had each one of the seven chronic conditions. The significant findings included: the "fall with injury" group more likely (p = .000) to also have reported having a "stroke or effects of a stroke", at 23% compared to 12.1%; more likely (p = .028) to report "eye trouble not relieved by glasses", at 60.8% compared to 52.7%; more likely (p = .006) to report a "loss of bladder control", at 34.2% compared to 25%; more likely (p = .030) to report a "loss of bowel control", at 17.2% compared to 11.7%; and more likely (p =.001) to report "memory loss", at 37.3% compared to 25.7%.

When "non-fallers" are compared to the "fall with or without injury" group, the findings are similar to those above for "stroke and effects of a stroke", "loss of bladder control" and "memory loss" (see Table 21). However, unlike the findings above, "eye trouble not relieved by glasses" and "loss of bowel control", are no longer significantly different.

Table 20

Selected Chronic Conditions by Non-fallers and Fall With Injury for the 1995-96 CRD Survey

Chronic conditions	Non-fallers		Fall with injury		Total	
	N=675		N=245		N=920	
	(*n*)	(%)	(*n*)	(%)	(*n*)[1]	(%)
Stroke or effects of a stroke						
No	590	87.9	188	77.0	778	85.0
Yes	81	12.1	56	23.0	137	15.0
$\chi^2 = 16.64$; $df = 1$; $\rho = .000$						
Eye trouble not relieved by glasses						
No	318	47.3	96	39.2	414	45.1
Yes	354	52.7	149	60.8	503	54.9
$\chi^2 = 4.80$; $df = 1$; $\rho = .028$						
Loss of bladder control						
No	505	75.0	160	65.8	665	72.6
Yes	168	25.0	83	34.2	251	27.4
$\chi^2 = 7.59$; $df = 1$; $\rho = .006$						
Loss of bowel control						
No	594	88.3	202	82.8	796	86.8
Yes	79	11.7	42	17.2	121	13.2
$\chi^2 = 4.69$; $df = 1$; $\rho = .030$						
Trouble with feet or ankles						
No	330	49.0	110	44.9	440	47.9
Yes	343	51.0	135	55.1	478	52.1
$\chi^2 = 1.23$; $df = 1$; $\rho = .267$						
Osteoporosis						
No	482	72.4	173	70.6	655	71.9
Yes	184	27.6	72	29.4	256	28.1
$\chi^2 = .27$; $df = 1$; $\rho = .600$						
Memory loss						
No	500	74.3	153	62.7	653	71.2
Yes	173	25.7	91	37.3	264	28.8
$\chi^2 = 11.73$; $df = 1$; $\rho = .001$						

[1] Some totals do not equal the total N (920) due to missing data.

Table 21

Selected Chronic Conditions by Non-fallers and Fall With and Without Injury for the 1995-96 CRD Survey

Chronic conditions	Non-fallers		Fall with or without injury		Total	
	N=766		N=245		N=1011	
	(*n*)	(%)	(*n*)	(%)	(*n*)[1]	(%)
Stroke or effects of a stroke						
No	590	87.9	263	78.5	853	84.8
Yes	81	12.1	72	21.5	153	15.2
$\chi^2 = 15.38$; $df=1$; $\rho= .000$						
Eye trouble not relieved by glasses						
No	318	47.3	138	41.1	456	45.2
Yes	354	52.7	198	58.9	552	54.8
$\chi^2 = 3.53$; $df= 1$; $\rho= .060$						
Loss of bladder control						
No	505	75.0	222	66.5	727	72.2
Yes	168	25.0	112	33.5	280	27.8
$\chi^2 = 8.17$; $df= 1$; $\rho= .004$						
Loss of bowel control						
No	594	88.3	282	84.2	876	86.9
Yes	79	11.7	53	15.8	132	13.1
$\chi^2 = 3.27$; $df= 1$; $\rho= .070$						
Trouble with feet or ankles						
No	330	49.0	152	45.4	482	47.8
Yes	343	51.0	183	54.6	526	52.2
$\chi^2 = 1.20$; $df= 1$; $\rho= .273$						
Osteoporosis						
No	482	72.4	237	70.5	719	71.8
Yes	184	27.6	99	29.5	283	28.2
$\chi^2 = .37$; $df= 1$; $\rho= .542$						
Memory loss						
No	500	74.3	211	63.0	711	70.5
Yes	173	25.7	124	37.0	297	29.5
$\chi^2 = 13.76$; $df= 1$; $\rho= .000$						

[1] Some totals do not equal the total N (1011) due to missing data.

Table 22

Selected Chronic Conditions by Fall Without Injury and Fall With Injury for the 1995-96 CRD Survey

Chronic conditions	Fall without injury		Fall with injury		Total	
	N=91		N=245		N=336	
	(*n*)	(%)	(*n*)	(%)	(*n*)[1]	(%)
Stroke or effects of a stroke						
No	75	82.4	188	77.0	263	78.5
Yes	16	17.6	56	23.0	72	21.5
$\chi^2 = 1.13$; $df=1$; $\rho= .287$						
Eye trouble not relieved by glasses						
No	42	46.2	96	39.2	138	41.1
Yes	49	53.8	149	60.8	198	58.9
$\chi^2 = 1.33$; $df= 1$; $\rho= .248$						
Loss of bladder control						
No	62	68.1	160	65.8	222	66.5
Yes	29	31.9	83	34.2	112	33.5
$\chi^2 = .16$; $df= 1$; $\rho= .693$						
Loss of bowel control						
No	80	87.9	202	82.8	282	84.2
Yes	11	12.1	42	17.2	53	15.8
$\chi^2 = 1.31$; $df= 1$; $\rho= .253$						
Trouble with feet or ankles						
No	42	46.7	110	44.9	152	45.4
Yes	48	53.3	135	55.1	183	54.6
$\chi^2 = .08$; $df= 1$; $\rho= .773$						
Osteoporosis						
No	64	70.3	173	70.6	237	70.5
Yes	27	29.7	72	29.4	99	29.5
$\chi^2 = .00$; $df= 1$; $\rho= .960$						
Memory loss						
No	58	63.7	153	62.7	211	63.0
Yes	33	36.3	91	37.3	124	37.0
$\chi^2 = .03$; $df= 1$; $\rho= .862$						

[1] Some totals do not equal the total N (336) due to missing data.

As shown in Table 22, there are no significant differences found when the "fall without injury" group are compared to the "fall with injury" group. The chronic conditions of "osteoporosis" and "trouble with feet or ankles" were not shown to be significantly associated with fall-related injuries for any of the three outcome categories.

Health troubles.

"Health troubles" were measured by responses to the question "How much do your health troubles stand in the way of your doing the things you want to do?". The majority (54.7%) of the respondents to the CRD Survey reported that health troubles stood in the way of their activities "a great deal" or "completely". As shown in Tables 17 and 18, responses among "non-fallers" were significantly different ($p = .008$) from those in the "fall with injury" group. Among the "non-fallers", 42.3% reported health troubles stood in the way "a great deal" and 9.2% "completely" compared to the "fall with injury" group, with 59.6% for "a great deal" and 12.2% for "completely". When "non-fallers" were compared to the "fall with or without injury" group, the differences are similar but less significant ($p = .024$). Differences were not significant between the "fall without injury" group compared to the "fall with injury" group (see Table 19).

Depression.

Close to one-quarter (24.1%) of all CRD Survey respondents had CES-D scores of 16 or over, indicating the presence of depressive symptoms. Chi-square tests results show that compared to "non-fallers" (20.9%), a significantly higher proportion ($p = .000$) of persons had CES-D scores of 16 or over among the "fall with injury" group (32.2%) (see Table 17). As shown in Table 18, the strength of this relationship persists ($p = .001$) when the "fall with or without injury" are compared to the "non-fallers" (30.4% versus

20.9%). However, when the "fall without injury" group (25.3%) are compared to the "fall with injury" group (32.2%), the differences are not statistically significant (see Table 19).

Wheelchair use.

The use of a wheelchair was reported by only 11.4% of the sample in this study. Findings in Tables 17, 18 and 19 show that 14.7% of those who reported a fall with an injury were wheelchair users compared to 10.5% of those who did not fall and 8.8% of those who fell without an injury. However, these findings are not statistically significant.

Frequency of falling.

Of the 336 respondents who reported falling once or more, 25.7% reported falling three times or more over the six-month period. Frequency of falling was investigated for differences between those who reported a "fall with injury" compared to a "fall without injury". As shown in Table 23, almost twice as many respondents (29.6%) who had reported a "fall with injury" also reported falling three times or more compared to the "fall without injury" group (15.4%, $p = 0.02$).

Table 23

Frequency of Falling by Fall Without Injury and Fall With Injury for the 1995-97 CRD Survey

Frequency of falling	Fall without injury		Fall with injury		Total	
	N=91		N=245		N=336	
	(*n*)	(%)	(*n*)	(%)	(*n*)[1]	(%)
Once	61	67.0	127	52.3	188	56.3
Twice	16	17.6	44	18.1	60	18.0
Three or more	14	15.4	72	29.6	86	25.7

$\chi^2 = 7.79$; $df = 2$; $\rho = .020$

[1] Some totals do not equal the total N (336) due to missing data.

Environmental Factors

Location.

Two hundred and thirty-five respondents reported falling once or more in an indoor location, of these, 170 (72.3%) also reported being injured from one or more of their falls (see Table 24). One hundred and fifty-three respondents reported falling once or more in an outdoor location, of these, 120 (78.4%) reported being injured from one or more of their falls (see Table 25). Since the total number of respondents who reported one or more injuries in either location is 245 (the "fall with injury" group), this means that 45 injured respondents fell once or more in both indoor and outdoor locations (170 + 120 – 245 = 45).

Chi square tests were conducted to investigate the difference between the "falls without injury" group and the "fall with injury" group by the number of falls in indoor and outdoor locations. Crosstabulations in Tables 24 and 25 show that significantly more (p = .001) of those who fell with an injury (51.2%) reported "two or more falls" in indoor locations compared to those who fell without injury (27.7%). For outdoor locations there were no significant differences between the groups.

Table 24

Number of Indoor Falls by Fall Without Injury and Fall With Injury for the 1995-97 CRD Survey

Number of indoor falls	Fall without injury		Fall with injury		Total	
	N=65		N=170		N=235	
	(*n*)	(%)	(*n*)	(%)	(*n*)	(%)
One	47	72.3	83	48.8	130	55.3
Two or more	18	27.7	87	51.2	105	44.7

$\chi^2 = 10.49$; $df = 1$; $\rho = .001$

Table 25

Number of Outdoor Falls by Fall Without Injury and Fall With Injury for the 1995-97 CRD Survey

Number of indoor falls	Fall without injury		Fall with injury		Total	
	N=33		N=120		N=153	
	(*n*)	(%)	(*n*)	(%)	(*n*)	(%)
One	26	78.8	90	75.0	116	75.8
Two more	7	21.2	30	25.0	37	24.2

$\chi^2 = .20$; $df = 1$; $\rho = .653$

Economic and Social Factors

Income.

Over half (54.1%) of this sample reported average monthly household incomes of "none to $1249". Many (38.9%) reported monthly incomes of "$1250 to $3249", and only 6.9% had monthly incomes of "$3250 to $5500+". Chi square tests were used to investigate differences in income groups by fall injury status. Crosstabulations in Tables 26, 27 and 28, show no statistically significant differences among "non-fallers", and those in the "fall with injury" or the "fall with or without injury" groups for income.

Income adequacy.

Income adequacy was measured by responses to the question, "How do you think your household income and assets currently satisfy your needs?". The majority (58.3%) of the respondents reported that their income needs were "adequately" satisfied, 17.6% reported their needs were "very well" satisfied, and 24.1% stated that their needs were "inadequately" met. As shown in Tables 26, 27 and 28, chi square tests did not reveal any statistically significant differences for income adequacy based on fall injury status. However, as shown in Table 28 the greatest differences for income adequacy were between those who reported a "fall with injury" compared to those who reported a "fall without injury". Over one-quarter (25.8%) of those who reported a "fall with injury" reported having "inadequate" income, compare to only 18.7% of those in the "fall without injury" group.

Table 26

Economic and Social Factors by Non-fallers and Fall With Injury for the 1995-97 CRD Survey

	Non-fallers		Fall with injury		Total	
	N=675		N=245		N=920	
	(*n*)	(%)	(*n*)	(%)	(*n*)[1]	(%)
Income group						
None to $1249	310	55.5	99	50.0	409	54.0
$1250 to $3249	213	38.1	81	40.9	294	38.8
$3250 to $5500+	36	6.4	18	9.1	54	7.1
$\chi^2 = 2.54$; $df = 2$; $\rho = .281$						
Income adequacy						
Very well	117	17.5	41	16.8	158	17.3
Adequately	390	58.3	140	57.4	530	58.1
Inadequately	162	24.2	63	25.8	225	24.6
$\chi^2 = .26$; $df = 2$; $\rho = .878$						
Education						
0 to 11 years	348	52.2	105	44.1	453	50.1
12 years or more	319	47.8	133	55.9	452	49.9
$\chi^2 = 4.55$; $df = 1$; $\rho = .033$						
Living arrangements						
With others	240	35.6	78	32.0	318	34.6
Living alone	434	64.4	166	68.0	600	65.4
$\chi^2 = 1.05$; $df = 1$; $\rho = .306$						
Emotional support						
No	132	19.6	36	14.7	168	18.3
Yes	542	80.4	209	85.3	751	81.7
$\chi^2 = 2.88$; $df = 1$; $\rho = .090$						
Network size						
None to 5	52	7.7	17	6.9	69	7.5
6 to 15	308	45.6	113	46.1	421	45.8
16 or more	315	46.7	115	46.9	430	46.7
$\chi^2 = .15$; $df = 2$; $\rho = .927$						
Publicly funded service use						
Users	335	49.6	129	52.7	464	50.4
Non-users	340	50.4	116	47.3	456	49.6
$\chi^2 = .66$; $df = 1$; $\rho = .418$						

[1] Some totals do not equal the total N (920) due to missing data.

Table 27

Economic and Social Factors by Non-fallers and Fall With and Without Injury for the 1995-97 CRD Survey

	Non-fallers		Fall with and without injury		Total	
	N=675		N=336		N=1011	
	(*n*)	(%)	(*n*)	(%)	(*n*)[1]	(%)
Income group						
None to $1249	310	55.5	142	51.4	452	54.1
$1250 to $3249	213	38.1	112	40.6	325	38.9
$3250 to $5500+	36	6.4	22	8.0	58	6.9
$\chi^2 = 1.46$; $df = 2$; $\rho = .481$						
Income adequacy						
Very well	117	17.5	60	17.9	177	17.6
Adequately	390	58.3	195	58.2	585	58.3
Inadequately	162	24.2	80	23.9	242	24.1
$\chi^2 = .03$; $df = 2$; $\rho = .984$						
Education						
0 to 11 years	348	52.2	152	46.2	500	50.2
12 years or more	319	47.8	177	53.8	496	49.8
$\chi^2 = 3.15$; $df = 1$; $\rho = .076$						
Living arrangements						
With others	240	35.6	110	32.8	350	34.7
Living alone	434	64.4	225	67.2	659	65.3
$\chi^2 = .76$; $df = 1$; $\rho = .384$						
Emotional support						
No	132	19.6	55	16.4	187	18.5
Yes	542	80.4	281	83.6	823	81.5
$\chi^2 = 1.54$; $df = 1$; $\rho = .215$						
Network size						
None to 5	52	7.7	24	7.1	76	7.5
6 to 15	308	45.6	150	44.6	458	45.3
16 or more	315	46.7	162	48.2	477	47.2
$\chi^2 = .26$; $df = 2$; $\rho = .880$						
Publicly funded service use						
Users	335	49.6	170	50.6	505	50.0
Non-users	340	50.4	166	49.4	506	50.0
$\chi^2 = .08$; $df = 1$; $\rho = .772$						

[1] Some totals do not equal the total N (1011) due to missing data.

Table 28

Economic and Social Factors by Fall Without Injury and Fall With Injury for the 1995-97 CRD Survey

	Fall without injury		Fall with injury		Total	
	N=91		N=245		N=336	
	(*n*)	(%)	(*n*)	(%)	(*n*)[1]	(%)
Income group						
None to $1249	43	55.1	99	50.0	142	51.4
$1250 to $3249	31	39.7	81	40.9	112	40.6
$3250 to $5500+	*	*	18	9.1	22	8.0
$\chi^2 = 1.41$; $df = 2$; $\rho = .495$						
Income adequacy						
Very well	19	20.9	41	16.8	60	17.9
Adequately	55	60.4	140	57.4	195	58.2
Inadequately	17	18.7	63	25.8	80	23.9
$\chi^2 = 2.14$; $df = 2$; $\rho = .344$						
Education						
0 to 11 years	47	51.6	105	44.1	152	46.2
12 years or more	44	48.4	133	55.9	177	53.8
$\chi^2 = 1.50$; $df = 1$; $\rho = .220$						
Living arrangements						
With others	32	35.2	78	32.0	110	32.8
Living alone	59	64.8	166	68.0	225	67.2
$\chi^2 = .31$; $df = 1$; $\rho = .579$						
Emotional support						
No	19	20.9	36	14.7	55	16.4
Yes	72	79.1	209	85.3	281	83.6
$\chi^2 = 1.85$; $df = 1$; $\rho = .173$						
Network size						
None to 5	7	7.7	17	6.9	24	7.1
6 to 15	37	40.7	113	46.1	150	44.6
16 or more	47	51.6	115	46.9	162	48.2
$\chi^2 = .80$; $df = 2$; $\rho = .670$						
Publicly funded service use						
Users	41	45.1	129	52.7	170	50.6
Non-users	50	54.9	116	47.3	166	49.4
$\chi^2 = 1.53$; $df = 1$; $\rho = .216$						

[1] Some totals do not equal the total N (336) due to missing data.
*Unable to report as fewer than 5 cases.

Education.

As shown in Table 27, approximately equal numbers of respondents reported having "less than 12 years of education" (50.2%) and "12 or more years of education" (49.8%). When the "fall with injury" group is compared to the "non-fallers" as shown in Table 28, more years of education is significantly associated with the "fall with injury" group with 55.9% reporting "12 or more years of education", compared to 47.8% for "non-fallers" ($p = .033$). This association persisted when "non-fallers" were compared with the "fall with or without injury" group but the level of significance did not reach $p < .05$ (see Table 27). No significant difference was found for education between the "fall without injury" and the "fall with injury" groups (see Table 28).

Living arrangements.

Whether the respondents lived alone or with others was examined. Two thirds of the respondents (65.4%) reported that they lived alone but this factor was not found to be significantly associated with falls with or without injury (see Tables 26, 27 and 28).

Emotional support.

Respondents were asked: "Do you receive emotional support from anyone? That is, do you have someone who you confide in, talk to about yourself, your concerns, etc.?". Most (81.5%) of the respondents answered "yes" (see Table 27). As shown in Tables 26 and 27, slightly more respondents reported "yes" among the "fall with injury" and "fall with or without injury" group compared to "non-fallers" but these findings did not reach significance.

Network size.

The vast majority of the respondents (92.5%) reported network sizes of six or more close family members, friends and neighbours (see Table 27). There was no association between this factor and any of the outcome categories (see Tables 26, 27 and 28).

Publicly funded service use.

This sample for the CRD Survey was purposefully comprised of half who used publicly funded support services and a matched sample—for age, gender, and functional ability—of those who did not use these services. There was no association found for this factor for any of the outcome categories for this study (see Tables 26, 27 and 28).

Combined Effects of Multiple Risk Factors

It was hypothesized that differences exist based on the combined effects of multiple risk factors for older adults who sustained fall-related injuries, compared to (a) those who did not fall, and (b) those who fell without sustaining an injury. To test this hypothesis, while controlling for the compounding effects of combinations of variables, tests were performed on key variables using logistic regression. The independent/predictor variables in the logistic regression were: age, gender, number of chronic conditions, health troubles, IADL, depression, using a wheelchair, income, education, living arrangements and emotional support. After testing for data assumptions, missing values for independent variables were replaced with mean values. A direct logistic regression method was used, with all variables entered for analysis in one step.

The goal of logistic regression is to find the "model that does the best job of prediction with the fewest predictors" (Tabachnick & Fidell, 1996, p. 576). To this end,

the first series (Model 1) of analysis included all variables deemed theoretically relevant. To enhance the power of analysis by increasing the case to variable ratio, only those variables with a p greater than .25 were entered in the second series of analysis (Model 2). In this way, logistic regression was used to "fit and compare" combinations of variables to find the model that best predicts the outcome while controlling for confounding variables (Kleinbaum, 1992).

Results from logistic regression tests are presented in Tables 29, 30 and 31. Results in Table 29 show variables that predict membership in the "fall with injury" group (N = 245), coded "1", compared to the "non-fallers" (N = 675), coded "0". Table 30 results show variables that predict membership in the "fall with or without injury" group (N = 336), coded "1", compared to "non-fallers", coded "0". Table 31 results show variables that predict membership in the "fall with injury" group, coded "1", compared to the "fall without injury" group (N = 91), coded "0".

The findings for logistic regression shown in these tables include the *B*-weights (B), standard error (SE), adjusted odds ratios (OR) and level of statistical significance at $p < .05$. *B*-weights indicate the probability between 1 and 0 of one outcome or the other (Munro, 1997). A *B*-weight of less than 0.5 indicates a higher probability of being in the outcome category coded as "1". The sign in front of the *B*-weights indicates the direction of the relationship. The standard error is used in the calculation of the statistical significance. The adjusted odd ratio is the ratio of one probability to another. In this case, it is the probability for each variable of being in the outcome category coded "1", over the probability for being in the outcome coded "0", with all other variables being held constant (Munro, 1997). The chi-square value indicates the difference between adding the

predictor variables to the model compared to the model with a constant only. A significant chi-square value demonstrates that the predictor variables as a set make a significant unique contribution to predicting group membership (Munro, 1997).

Table 29

Predictors of Fall With Injury versus Non-fallers: Logistic Regression

Predictor variables	Model 1			Model 2		
	B	S.E.	O.R.	***B***	S.E.	O.R.
Age	-.00	.01	1.00			
Gender	-.43	.20	.65*	-.45	.20	.63*
Chronic conditions	.27	.06	1.31***	.26	.06	1.30***
Health troubles	-.07	.11	.93			
IADL	.03	.02	1.03	.03	.01	1.03
Depression	.02	.01	1.02*	.02	.01	1.02*
Wheelchair use	.27	.25	1.31			
Income	.02	.02	1.02			
Education	.06	.02	1.06*	.07	.02	1.07**
Living arrangement	.35	.18	1.41	.28	.17	1.32
Emotional support	-.34	.21	.71	-.33	.21	.72
	$\chi^2 = 54.50$*** ($df = 11$)			$\chi^2 = 52.04$*** ($df = 7$)		

*$p < .05$
**$p < .01$
***$p < .001$

Table 30

Predictors of Fall With or Without Injury versus Non-fallers: Logistic Regression

Predictor variables	Model 1			Model 2		
	B	S.E.	O.R.	*B*	S.E.	O.R.
Age	.00	.01	1.00			
Gender	-.55	.18	.57**	-.56	.18	.57**
Chronic conditions	.25	.05	1.28***	.25	.05	1.29***
Health troubles	-.03	.09	.97			
IADL	.01	.01	1.01			
Depression	.02	.01	1.02*	.02	.01	1.02**
Wheelchair use	.19	.23	1.20			
Income	.01	.02	1.01			
Education	.04	.02	1.04*	.04	.02	1.04*
Living arrangement	.25	.16	1.29	.23	.15	1.26
Emotional support	-.23	.18	.79	-.24	.18	.79
	$\chi^2 = 50.71$*** ($df = 11$)			$\chi^2 = 48.91$*** ($df = 6$)		

*$p < .05$
**$p < .01$
***$p < .001$

Table 31

Predictors of Fall With Injury versus Fall Without Injury: Logistic Regression

Predictor variables	Model 1			Model 2		
	B	S.E.	O.R.	*B*	S.E.	O.R.
Gender	.21	.30	1.23	.25	.29	1.28
Chronic conditions	.06	.09	1.07	.06	.09	1.07
IADL	.05	.02	1.05*	.05	.02	1.05*
Depression	.00	.01	1.00			
Education	.07	.04	1.07	.07	.04	1.07
Living arrangement	.14	.27	1.15			
Emotional support	-.33	.32	.72			
	$\chi^2 = 12.20$ ($df = 7$)			$\chi^2 = 11.90$* ($df = 4$)		

*$p < .05$
**$p < .01$
***$p < .001$

Findings shown in Table 29 indicate that four of the eleven predictor variables for this sample were found to have statistically significant probabilities (p <.05) for membership in the "fall with injury" group in the first and second series of analysis (Models 1 and 2). The variables, as a set, in Models 1 and 2 were both significantly predictive of membership in the "fall with injury" group, with Model 1 $\chi^2 = 54.50$, $df =$ 11, p <.000, and Model 2 $\chi^2 = 52.04$, $df = 7$, $p < .000$.

The results in Model 2 in Table 29 show the odds of being in the "fall with injury" group based on gender as .64. The coding for gender is "1" for female and "0" for male. The negative sign for the *B*-weight for "gender" indicates that being in the "fall with injury" group is therefore associated with male gender.

Having multiple chronic conditions is shown to be the strongest predictor (p <.001) of being in the "fall with injury" group with all other variables held constant (see Table 31). This variable is continuous with a range of 0 to 7 selected chronic conditions, and for each additional chronic condition the odds increase for being in the "fall with injury" group. However, interpreting the odds for continuous variables is less straightforward than for dichotomous variables. Cumulative point increases are calculated by raising the base of the natural logarithm (2.718 or e), to the power of the *B*-weight for the variable after multiplying it by the number of points of interest (Munro, p. 303). Therefore, for someone with all 7 chronic conditions the calculation of the odds is $(7 \times .26)^e = 6.17$. This means that the odds are over six times greater for someone with all 7 chronic conditions for being in the "fall with injury" group compared to the "non-fallers" group.

Depression is also significantly associated with being in the "fall with injury" group, with $p < .05$. The odds of being in the "fall with injury" group based on the CES-D scale increases by an odds ratio of 1.02 for a one point increase in the 0 to 60 CES-D scale. A more meaningful interpretation can be obtained through calculating the odds based on a CES-D score over 15—which indicates that a person is depressed (Schein & Koenig, 1997). For example, the calculation of the odds of being in the "fall with injury" group for a person with a score of 30 on the CES-D scale is $(30 \times .02)^e = 1.82$. This means that a person with a score of 30 on the CES-D scale is almost twice as likely to be in the "fall with injury" group compared to the "non-fallers" group.

As shown in Table 29, education is also a predictor of membership in the "fall with injury" group. Education is coded as a continuous variable based on 0 to 27 years of schooling. This is the only variable from the domain of social and economic factors shown to be a significant with $p < .01$. The odds ratio for education in Model 2 is 1.07, indicating a small increase in the odds of being in the "fall with injury" group for every additional year of education. The stronger unique contribution of education to Model 2 compared to Model 1 ($p < .05$ versus $p < .01$), implies a moderating influence from the variables that were eliminated from Model 2.

Table 30 shows that the findings for the outcome categories of "fall with or without injury" versus "non-fallers" are similar as the "fall with injury" group versus the "non-fallers" with the small exceptions. As a set, in Models 1 and 2 were both significantly predictive of membership in the "fall with or without injury" group, with Model 1 $\chi^2 = 50.71$, $df = 11$, $p < .000$, and Model 2 $\chi^2 = 48.91$, $df = 6$, $p < .000$. As with the findings shown in Table 29, the same four variables—gender, chronic conditions,

depression and education—were found to be predictors of being in the "fall with or without injury" group. The unique contribution for depression was stronger in Model 2 compared to Model 1 ($p < .01$ versus $p < .001$), indicating a moderating influence from the variables present in Model 1 that were not included in Model 2.

To examine potential predictors for group membership based on those who reported a "fall with injury" and those who reported a "fall without injury" variables with a $p < .25$ were entered in the logistic regression Model 1 shown in Table 31. The number of variables entered was limited due to the smaller sample size for this outcome category (N =336). Variables entered in Model 2 for this outcome category were once again restricted to those with a $p < .25$. As a set of predictors, Model 1 did not reliably predict being in the "fall with injury" group with a χ^2 value of 12.20, $df = 7$. Model 2, with fewer variables was only marginally predictive with a χ^2 value of 11.90, $df = 4$, $p = < .05$.

IADL was the only significant predictor variable found, with $p = .05$. This variable was coded as a continuous variable with a range of scores from 5 to 25, with 25 indicating increasing need in help in some, or all, five categories of instrumental activities of daily living. The five IADL categories are based on responses to the following CRD Survey questions: (a) "Can you do your own laundry"?; (b) Can you go shopping for groceries or clothes (assuming you have transport)"?; (c) "Can you do heavy housework (e.g. scrub floors, vacuum, windows/walls)"?; (d) "Can you do light housework (e.g. dusting, dishes, making bed)"?; and (e) "Can you do yardwork and gardening"? (Centre on Aging, 1996).

The odds ratio of 1.05 shown in Table 31 indicates that there would be an increase in the probability of being in the "fall with injury" group for every increase in the IADL score between 5 and 25.

In summary, the findings of multivariate analysis show an increased likelihood of falling with injury for males, individuals with more chronic conditions, those who are more depressed, and those with more years of education. These predictors are the same for falling with or without injury, with slight variations in the degree of significance. There are also significant differences between those who fall with injury compared to those who fall without injury based on IADL scores.

CHAPTER 6

Discussion

The purpose of this study was to examine the differences between older adults who fell and sustained an injury and those who did not, to gain a better understanding how such events could be prevented. The results both confirm and refute those of previous studies and also shed light on factors not previously reported. A number of significant differences were found in this study between those who experienced a fall-related injury and those who did not. While it is not known if these factors are causal, many suggest strong direct or indirect links with fall-related injuries among seniors and add to the growing body of knowledge being used in the planning of prevention strategies and for the consideration of designs for future research in this area.

The following discussion of the results covers the extent and nature of the problem, and the patterns and combined effects of multiple variables representing a wide variety of risk factors for fall-related injuries among older adults. A discussion of these findings is then presented in relation to the Canadian Government policy context. This chapter concludes with comments on the limitations of this study and directions for future research and theoretical developments.

Extent and Nature of the Problem

This study shows that falls and fall-related injuries are a considerable problem for frail seniors in the CRD region. One third (33.2%) of the participants in the 1995/96 CRD Survey experienced one or more falls over a six-month period. This is almost double the finding of a previous study of the general population of seniors in the same region, where Gallagher et al. (in press) in a 1995 base-line study of seniors in the CRD, found that only

16.5% reported falling once or more over six months. Furthermore, if the time frame for the study reported here had been a year the figure would likely have been greater than the 29-33% annual figure reported by other researchers, as many community-dwelling seniors only fall once within a given year (O'Loughlin et al., 1993; Speechley & Tinetti, 1991; Tinetti et al., 1988).

The proportion of those who sustained injuries due to their falls is also higher than the findings of most other studies. Close to three-quarters (72.9%) of those who reported falling in the CRD Survey sustained an injury. However, direct comparisons with other studies are hampered by the variety of definitions used for an injury, different time periods for monitoring the falls and the variability in characteristics of the populations being studied. Findings from other studies typically show a range in the percent injured from 6% to 55% of those who fell (Alexander et al., 1992; 1992; Herndon et al., 1997; Langlois et al., 1995; Luukinen et al., 1995; Nelson et al., 1991; Oleske et al., 1995). An exception is a one-year prospective study of 325 community-dwelling seniors aged 60 years and older who had fallen at least once in the previous year (Nevitt et al., 1991). This study found that 82% of those who fell sustained an injury from one or more of their falls (Nevitt et al.). These rates are considerably higher than those found in most other studies and even higher that the 72.9% found in the CRD Survey. However, the time for monitoring was one year, compared to only six months for the CRD Survey.

The large proportion of those who fell and sustained an injury in the CRD Survey and the study by Nevitt et al. (1991) appear to be tied to the "high risk" characteristics of the samples. In the case of the study by Nevitt et al., the "high risk" factor is defined as having had one or more falls in the previous year. For the CRD Survey the "high risk"

factor is the presence of functional limitations. As discussed earlier, the sample for this study was comprised of seniors who were receiving home support services and a matched sample for age, gender and functional limitations—based on ADL and IADL scores—from the general population aged 65 and older. Functional limitations, as measured by IADL scores, are known to be associated with impaired mobility, gait and balance (Raina, Dukeshire, Chambers, & Lindsay, 1997; Wilkins & Park, 1996). These, in turn, are associated with being at higher risk for sustaining fall-related injuries (King et al., 1994; Maki et al, 1994; Topper et al., 1993).

Another explanation of the high rates of injury in the CRD Survey compared to other studies may be due in part to the broad definition used for a fall-related injury. This definition includes minor injuries such as bruises, severe injuries such as fractures and cuts and a category for "other". The inclusion of a category for "other" injuries may encourage more injuries to be reported that may be missed in other studies that specify injury categories.

With regard to location, severity of injury, and frequency of falling, this study's findings are surprisingly different from other studies by their lack of association with advancing age. Previous studies show the number and severity of fall-related injuries to increase with advancing age (Luukinen et al., 1995; Raina & Torrance, 1996). However, in the CRD Survey, only 23.9% of those aged 85 years and older reported a fall-related injury compared to 30.1% of those aged 70 to 74 years, and there was no difference by severity of injury. Age was also unrelated to the location of falls for those who reported a fall injury. These finding imply that age may have lesser import on fall injuries than the multiple chronic conditions and functional limitations represented in this sample.

With the exception of studies of falls that result in fractures, few studies have been conducted on the differences between the genders with respect to the nature, location or frequency of fall-related injuries. The finding in this study, that 20.3% of the women sustained a fall-related fracture compared to only 15.4% of the men, is consistent with other studies (Stewart et al., 1992). However, these findings are not statistically significant. There were no significant differences between the genders with respect to the location of falls among those who were injured. Compared to women, more men who were injured also reported falling frequently. This finding may be explained in part by the geographic location of this study, which is conducive to year-round outdoor activities. It may be that a number of the men in this study represent the large population of migrants from other regions of Canada who have chosen the CRD as a retirement destination (Behie, 1998). Indications are that many of these men have lead sedentary working lives and are now going through life-style changes that include taking up activities that put them at risk of sustaining a fall and injury.

The overall explanation for differences in the CRD findings compared to other studies may be attributed to the higher degree of frailty, regardless of age or gender, of this sample compared to the general population aged 65 and older. In other words, frailty may be the great leveler that negates the effects of other factors such as age and gender. This conclusion is supported by the bivariate and multivariate analysis conducted for an examination of the patterns and combined effects of multiple risk factors.

Patterns and Combined Effects of Multiple Risk Factors

The overall results indicate that considerable differences exist in the patterns and combined effect of multiple risk factors between older adults who fall and sustain an injury and those who do not.

Biological factors were shown to be the strongest predictors for sustaining a fall-related injury among the community-dwelling elderly in this study. However, it must be remembered that it is not the biological condition per se but the symptoms that underlie the condition that contribute to the risk of a fall injury. Bivariate analysis showed that the greatest differences were for factors representing depression, health troubles that stand in the way of normal activities and multiple chronic conditions—particularly the effects of a stroke, loss of bladder control, loss of bowel control, memory loss, and eye trouble not relieved by glasses.

The above findings both confirm and contradict the findings of previous studies. With regard to chronic conditions, findings from this study confirm existing knowledge and provide information not previously reported. For example, the strong association between the effects of a stroke and sustaining a fall-related injury has been previously well documented (Nyberg & Gustafson, 1996; Tutuarima et al., 1997). The study by Tutuarima et al. also supports the findings that multiple conditions are cumulative. The combination of urinary incontinence and the effects of a stroke were found by Tutuarima et al. to have a significant compounding effect for sustaining a fall-related injury. Links shown to exist between fall-related injuries and memory loss and eye trouble not relieved by glasses are also consistent with other findings (Kenny, 1996; Oleske et al., 1995).

However, the association between fall-related injuries and loss of bowel control has not been reported elsewhere.

Two chronic conditions conspicuous by their lack of association in this study were trouble with feet and ankles and osteoporosis. Trouble with feet and ankles has implications for gait and balance problems, which are well known to be linked to fall-related injuries (Chen et al., 1994; Maki et al., 1994). The lack of association with osteoporosis is particularly surprising given its well documented association with fall-related fractures and the fact that osteoporosis is found in approximately one in four women and one in eight men over the age of 50 years (Scientific Advisory Board, 1996).

Depression has previously been found to be an indirect contributor to falls and fall-related injuries through increased risk due to agitated behaviour and impaired judgment (Kenny, 1995; Schulman & Acquaviva, 1987). Gallagher et al. (in press) theorized that mental health status and life satisfaction were more likely consequences rather than predictors of falls. However, this study only focused on falls and not on fall-related injuries. Supporting evidence for links with fall-related injuries is found in studies showing higher rates of fall-related injuries among seniors using antidepressant medication (Caird et al., 1973, as cited in Ross, 1991). Given the prevalence of depression among the participants of this study who reported a fall injury (32.2% compared to 20.9% of non-fallers[1]), and the temporal limitations of this study that preclude attributing depression as an antecedent or a consequence, more research is needed to determine the role of depression in falls resulting in injuries.

[1] These rates are considerably lower than those found by Davidson et al. (1994) who found almost 53 percent of frail seniors to have scores above the CES-D cutoff point for depression of 16.

Differences with regard to patterns of variables between the "fall with injury" group and the "fall with or without injury" group, compared to "non-fallers" were only apparent for biological factors. Both groups were similarly different from non-fallers with the exception of eye trouble not relieved by glasses, loss of bowel control and years of education, which were not significant factors for the "fall with or without injury" group.

There were relatively few behavioural and environmental factors represented by the CRD Survey data. However, findings with regard to the location of the fall-related injury suggest a need for attention to potential environmental hazards in both indoor and outdoor locations. Findings showed that a slightly larger proportion of all respondents, who reported an injury, reported falling outdoors. However, on closer inspection of frequent fallers (those who reported two or more falls), injured fallers were likely to report falling in indoor locations. The implications of these findings are limited by a lack of information on the amount of time spent in either location, the activity engaged in at the time of the fall and other contributing factors such as footwear, use of mobility aids, home or public environmental hazards, etc. However, the findings do point to a need to investigate fall injuries by location, particularly those that occur outdoors, as little research has been conducted in this area.

With regard to behavioural factors, it was not surprising that frequency of falling (three or more falls) was shown to be associated with sustaining an injury as respondents to the CRD Survey were asked if they had sustained any injuries from one or more of their falls. Therefore, the chances of reporting an injury would increase with the number of falls. The fact that this was particularly evident for males may be indicative of greater

risk taking behaviours among men as shown in previous studies (Luukinen et al., 1995; Yasumura et al., 1994).

Social and economic factors were well represented in the data. However, the findings did not support the hypothesis of differences for those who sustained fall-related injuries compared to non-fallers, with the exception of education.

It was surprising, and contrary to the literature, to find that more years of education were associated with higher risk of sustaining a fall-related injury (Evans et al., 1994; Hirdes & Forbes, 1993). This association was found in bivariate and multivariate analysis, while controlling for the effects of age, gender, chronic conditions, health troubles, IADL, depression, wheelchair use, income, living arrangements and emotional support. This finding is unexpected given the literature on health determinants which points to more education being associated with higher income, and both being associated with improved health outcomes (Evans et al.; Health Canada, 1998; Hirdes & Forbes). Explanations for the association between higher education and fall-related injuries for this sample can only be speculative and more studies, with larger samples, are needed to understand the role of this complex factor. For instance, Hirdes and Forbes showed that the effect of education on health status tends to decline in higher income groups, with only minimal differences between middle and high-income groups. Therefore, it would also be worthwhile to re-examine this variable among seniors in other regions of the country with wider discrepancies in socioeconomic status.

The need to conduct studies that allow a comparison of these findings with other regions of the province is supported by a report showing substantial health differences among British Columbians by health region (BC Ministry of Health and Ministry

Responsible for Seniors, 1996). For example, this report shows residents of the CRD in general to have higher education and social status compared to the rest of the province. Perhaps with greater education among CRD residents, combined with a mild climate, comes increased exposure to walking groups, social outings, and sports such as golfing and curling. For seniors, these activities may increase their exposure to risk of injury from falling.

The lack of association between fall-related injury and low income was also surprising in light of the finding that over half of the respondents to the CRD Survey reported household incomes of below $1250.00 per month. A possible explanation may be that the availability of support services and access to health care in this region offsets the effects of low income on poor health outcomes. This theory is supported by the prevalence of poor health outcomes, including higher rates of hospitalizations for fall-related injuries among seniors, in northern and interior regions of British Columbia where harsh climates and isolated communities make service delivery and access to health services difficult (BC Ministry of Health and Ministry Responsible for Seniors, 1996; Scott & Gallagher, 1997).

In multivariate analysis, multiple chronic conditions, depression, male gender and more education were shown to be predictive of sustaining a fall-related injury, while controlling for the effects of age, health troubles, IADL, wheelchair use, income, living arrangements and emotional support.

There are many studies that examine the combined effects of multiple factors on the risk of sustaining a fall, but few that examine multiple factors for being at risk of injury from a fall. Studies that do focus on fall injury outcomes are often linked to

specific populations such as seniors with dementia or other chronic conditions (Asada et al., 1996; Nyberg & Gustafson, 1996; Oleske et al., 1995). For example, Asada et al. in their study of community-dwelling elderly with dementia, found that cognitive functioning, and care status were predictive of fall-related injuries, while controlling for age, gender, urban living, blindness, deafness, behaviour problems, medication use, support networks and use of formal services. As with the findings of the study presented here, it is interesting to note that age was not a significant predictor. It is also interesting to note from Asada et al.'s findings that chronic conditions, such as blindness and deafness, were not contributors to fall-related injuries, particularly given that all persons in the sample also had dementia.

A multivariate study closely aligned to the one presented here is that by Gallagher et al. (in press). Although focused on the number of falls and not injury outcomes, the study used secondary data from interviews with seniors in the same geographic area and examined the combined and interactive effects of a number of similar risk factors. Their findings corroborate the role of chronic illness as predictive of falling. However, unlike the study presented here, it was found that advanced age, female gender, and lower socioeconomic status were either directly or indirectly related to falling. The differences between the studies cannot be explained by the fact that falls were the outcome of interest. When all those who reported a fall with or without injury in the CRD Survey sample were compared to non-fallers the combined effects of variables were almost identical to the findings when those with injuries were compared to non-fallers. A more plausible explanation of the differences in the findings is that the samples differed in significant ways. The seniors interviewed for the CRD Survey were purposefully selected

from those with existing functional limitations, whereas the sample for the study by Gallagher et al was drawn from the general population of seniors in the region.

To further examine the difference between those who sustained a fall-related injury and those that fell and did not sustain an injury, logistic regression was also applied to examine the combined effects of multiple variables between these two groups. Findings indicated that higher IADL scores were shown as predictive of falling with an injury, while controlling for the effects of gender, chronic conditions, depression, education, living arrangements and receiving emotional support. This finding suggest that having functional limitations, as measured by IADL scores, may be a strong indicator of being at risk for sustaining a fall-related injury among those who fall. As such, it demonstrates the need for attention by those who care for frail elderly persons to implement prevention strategies.

Policy Implications

In addition to the study objectives addressed through the research questions of this study, a third objective was to examine the findings in light of Canadian government policies related to older persons and injury. This is addressed through the application of a critical gerontological perspective as outlined in Chapter 2. Such a perspective places the problem in the context of policies and social structures in this country that influence the determinants and consequences of fall-related injuries among community-dwelling seniors. The findings are discussed under the framework of 1) the social context, 2) government responsibility, 3) barriers to effective policy for the prevention of fall-related injuries among seniors, 4) strategies for change.

Social Context

The magnitude of the social problem created by fall-related injuries among frail seniors living in the community is made evident by the proportion of seniors affected and the severe nature of the injuries sustained. Close to one in four (24.2%) of the seniors in this study sustained one or more injuries as a result of a fall. Almost one fifth of those who were injured sustained a fracture (19.5%) and one third sustained a cut (31.5%). The financial and human burden posed by these injuries impact not only the individual who sustained the injury, but also their families and society as a whole.

The cost to the individual is often manifested in terms of pain, fear of repeated incidents, loss of independence, disability, and for some, premature death. For family members the loss of independence for their relative leads to an increased need for caregiving—often accompanied by additional stress and financial hardship. As a result of the increasing proportion of the frail elderly in the Canadian population, the potential cost to society for the medical treatment of fall-related injuries is enormous.

Despite the magnitude of this problem, little is being done locally or nationally to prevent falls among the elderly (see Chapter 2). An example of the social inequity of this problem is demonstrated in British Columbia by the recent allocation of funds for services such as "fast ferries" at a time when home support services for seniors are being considerably reduced (Kimpson & Argyle, 1999, December 3).

Government Responsibility

Governments in Canada have a responsibility to enact policies that promote the health and safety of all citizens, particularly those who are unable to advocate on their own behalf. The findings of this study show that there are multiple and compounding

factors associated with being at risk of sustaining a fall-related injury among the frail elderly. Close to half (49.4%) of those who were injured due to a fall also have between three to seven chronic conditions known to be associated with being at risk of sustaining fall-related injuries. One third are suffering from depression and most have health problems that stand in the way of normal activities.

Governments have a further responsibility to taxpayers to reduce avoidable medical expenditures. Fall-related injuries among seniors in British Columbia are the leading cause of hospital admission due to unintentional injuries for all ages (Scott & Gallagher, 1997). A study by Parker et al. (1996) found falls to be the cause of 93% of hospital admissions for hip fractures. The average cost of medical and non-medical services directly related to a hip fracture is estimated at $16,322 to $ 18,727 (in 1993 dollars) for the year following the fracture (Brainsky et al, 1997). Despite such evidence of significant economic burden posed by fall-related injuries among seniors, there is little evidence of government funding being put into prevention.

Policy frameworks exist that are designed to guide health promotion strategies for seniors in Canada. Unfortunately, most are not enacted. An example is the Ottawa Charter. This document calls for a clear political commitment to promoting health and equity for all, counteracting unhealthy living conditions and unsafe environments, and accepting the community as the essential voice in matters of its health, living conditions and well-being (World Health Organization, August 20, 1996). If this rhetoric had been translated into action ten years ago, when declared, the necessary programs would be in place for enhancing safety and reducing injuries among seniors. At present in Canada, there are no permanently funded fall-prevention programs (Scott & Gallagher, 1997).

Barriers to Effective Policy

Barriers to effective policy-making for the prevention of fall-related injuries among seniors include reluctance on the part of those in positions of authority to assume the responsibility to implement preventive measures. Findings from this study point to a broad range of potential stakeholders in positions of authority with a responsibility to act. These include family physicians with a responsibility to provide thorough examinations for physical risk factors and home support workers with a responsibility to educate those in their care with regard to risk taking behaviours. The evidence from this study demonstrating the strong influence of multiple chronic conditions as a risk factor for fall-related injuries points to a need to pay more attention to the safety requirements of these individuals. Such attention could include improving the frequency and quality of home support services with a focus on the development of prevention strategies tailored to individual's risk and live style—for example, obtaining appropriate mobility aids such canes, walkers and wheelchairs. Other strategies could include closer attention to safety needs in their built environments—such as installing grab bars in bathrooms, handrails on stairs and good lighting in hallways. However, despite the fact that the lack of these items are associated with increased risk of fall-related injuries among seniors (Clemson et al., 1996; Waller, 1995), they are not viewed as fundable items by health services providers nor as policy priorities by build code designers (Aminzadeh, 1997; Pauls, 1997).

Seniors themselves also have a responsibility to seek out the existing information on risk factors and prevention strategies. For all service providers and seniors there is a need for better access to information on prevention strategies that are based on proven models of best practices.

Findings from this study also show that fall-related injuries occur in both indoor and outdoor locations, suggesting the need for the involvement of a broad range of stakeholders. Strong evidence exists pointing to the role of multiple factors acting in conjunction with a variety of environmental contributors. This demonstrates the need for a coordinated plan of action with the participation of a wide array of responsible parties (Gallagher & Scott, 1995; Northridge et al., 1995; Speechley & Tinetti, 1991). For indoor falls these include those responsible for design and enforcement of building codes and standards. For outdoor locations these include those with jurisdiction over safe outdoor environments such as city planners, road engineers, architects and builders. In public locations responsibility for safety lies mainly with municipal governments and owners of public buildings. Sidewalk cracks, poor lighting and slippery surfaces have all been shown to be contributors to injury-producing falls among seniors (Gallagher & Scott, 1995; Parker et al., 1996; Sjorgen & Bjornstig, 1991). Unfortunately, those with the ability to enact changes to the built environment are seldom aware of the pain and suffering that result from injuries occurring in their jurisdictions, nor to they see the rising hospital costs related to such injuries as impacting directly on their mandates.

As the Canadian population ages, more elderly people are choosing to remain in the community thereby increasing the need for safe walking routes, secure home environments and support services that promote safe independent living. Unfortunately, funding for support services and elderly-friendly environments is not seen as a policy priority. Provincial transfer payments to municipal governments are being reduced and home support services withdrawn. Politicians are running on platforms of tax reduction at a time when the need for seniors' social programs and services are growing (Shapiro,

1996). Policy critics point to big businesses, foreign investors and other profit-driven self-interest groups as the source of the general public's misconception that social programs and health services to the elderly and disabled are the root cause of our debt and deficit (McQuaig, 1988; Shapiro, 1996). This fueling of a pervasive attitude of ageism in Canada is one of the greatest barriers to allocating resources for the implementation of fall-prevention programs for seniors.

The application of this study's finding to the development of policy is hampered by the lack of variables representing environmental and behavioural factors. However, the findings do point to a need for attention to the safety needs of seniors with physical and mental health problems such as multiple chronic conditions or symptoms of depression. The lack of association found between fall-related injury and certain social and economic factors in this study may be a function of the demographics of the region and indicates a need to replicate this study in other regions across Canada.

Overall, the findings of this study point to some clear directions for policy changes, including the allocation of funds for further study to uncover regional differences for factors representing a broad range of biological, behavioural, environment, social and economic risk factors. However, turning research findings into evidence-based policy making is a challenging task requiring political insight, knowledge of the policy-making process and the ability to identify allies. As Evans et al., (1994) cynically point out:

> Fortunately most of us have the intestinal fortitude to bear with good grace the suffering of others. For others (on the left), health differentials are markers for social inequality and injustice more generally, and are further evidence of the need to redistribute wealth and power, and restructure or overturn the existing social order (p. 6).

Strategies for Change

A strategy with potential for addressing the multitude of factors related to the problem of fall-related injuries among the elderly is the development of research coalitions. Such coalitions, formed of those with expertise in a diverse range of seniors' health and injury-related issues, have the potential to take the leadership in transforming knowledge and policy development in this area. At present in Canada, there are no effective means of sharing information related to injuries among seniors on a national basis. For example, there are at present no means of sharing unpublished research findings, of setting research priorities or of collectively informing policy-makers of the evidenced-based directions required to reduce adult injuries.

There are a number of provincially-based examples of injury prevention coalitions. However, all but one, focus primarily, or exclusively, on injuries related to children or person in the workplace. The exception is the "Adult Injury Management Network" (AIMNet) in British Columbia, of which this author is a co-supervisor along with Dr. Elaine Gallagher. The goal of this network is to promote collaborative investigation, education and community development for the purpose of reducing injuries among older adults and persons with disabilities in the province. Through the efforts of a diverse group of members representing seniors, persons with disabilities, health authorities, service providers, policy makers and researchers, AIMNet has fostered communication, education and dissemination of research findings to enhance the reduction of injury among adults in the province. However, the funding for this project is time-limited and there is no indication of continued funding beyond the April 2000.

A recent development in Canada that may be a first step in the direction for a national initiative is the newly established Health Canada Secretariat for Injury Prevention and Control (E-mail communication, NIPC@lists.smatrisk.ca, January 26, 2000). This federally funded office, with a staff of three, is currently in the process of developing their mandate. Early indications are that children's injuries will be a high priority but e-mail communications with a senior staff member in this office indicate that there is an interest and willingness to work on issues related to all ages (personal communication, Morag MacKay, February, 2000).

In conclusion, the findings of this study support the need for the development and implementation of policies at all levels of government for the prevention of fall-related injuries among seniors. We all pay eventually for shortsighted policies that lead to inequality and poor health (1986, cited in Evans, Barer and Marmor, 1994). As Kingdon (1995) points out, it may be a matter of waiting until policy-makers see the prevention injuries among older adults as an idea whose time has come. Competing demands of many factors often make such "policy windows" unpredictable (Kingdon, p. 165). However, advocates for the safety needs of seniors who are part of well-established research and policy coalitions are ideally situated to influence the policy agenda.

Study Limitations

The primary limitation of the CRD Survey for the purposes of this study is that it was not designed with the specific goal of understanding fall-related injuries among older people. As Polit and Hungler (1995) point out, lack of specificity is typical of survey research, where the goal is usually "extensive rather than intensive analysis" (p. 188). The CRD Survey was designed to understand concepts of independence and autonomy—

fall-related injury was of secondary interest. While it may be impossible for one study to address all potential factors that cover this complex topic, a number of important components were missing. For example, the data that was available would have been complimented by information on behavioural factors such as medication use, and environmental factors, such as specific injury locations, e.g. on stairs or sidewalk (Chen et al., 1994; Gallagher & Scott, 1995; Neutel et al., 1996).

Another disadvantage of using secondary data is a lack of familiarity with the criteria for the selection of existing measures or development of new measures. This disadvantage is compounded by a lack of supporting documentation on the reliability and validity of some of the measures used. In addition, the CRD Survey consisted exclusively of closed-ended, single and multiple-choice, questions. This format relies on expert knowledge to determine that all possible responses are included. Benefits include avoiding irrelevant responses and easier coding. In addition, closed-ended questions are known to elicit better responses for sensitive issues such as those on income or health (Waltz, Strickland, & Lenz, 1991). However, limited choices may lead to information pertinent to the phenomenon being lost and an inaccurate response may be forced when the question is not fully understood.

The ability to generalize the findings of this study is limited by the exclusion criteria and high non-response for the CRD survey respondents. The non-response rates for the CRD Survey were 34.6% for the service users and 19.6% for the non-service users (Shaver, 1998). Exclusion criteria included those who were too ill, non-English speaking, cognitively impaired or living in institutions. Generalization is further hampered by the unintentional exclusion of people who are homeless (Penning et al., 1998). Although

small in number, homeless people are shown to have a greater-than-average proportion of people with low income, chronic illness and disability—which potentially places them at high-risk for experiencing a fall-related injury (Barusch, 1994; Lynch et al., 1997). This oversight limits the ability to extrapolate the results of the proposed study to all elderly who may be at high risk.

Generalization of findings from the sample in this study are also limited by the purposeful sampling design, where seniors were selected from those receiving publicly funded home support services and a matched sample based on age, gender and functional ability. As shown in Table 32, the survey sample differs in a number of ways from the general population in this region based on characteristics outlined in a report of all seniors in the CRD (Behie, 1998). Compared to the general population of seniors in the CRD, the participants in the survey sample tend to be female, older, in poorer health and have more chronic conditions—including osteoporosis. More of those in the survey sample also tend to live in rental accommodation, are widowed and live alone compared to the general CRD population of seniors.

Table 32

Characteristics of the General Population of Seniors[1] in the CRD Compared to Respondents to the 1995/96 CRD Survey

	General Population %	Survey Sample %
Gender		
Male	41	19
Female	59	81
Age		
65-69	27	5
70-74	33	11
75-79	19	19
80-84	14	25
85+	7	40
Chronic Conditions		
None	7	0
One	16	1
Two	19	2
Three	16	3
Four	15	6
Five	11	9
Six or more	16	79
Selected chronic conditions		
Osteoporosis	13	28
Perceived Health		
Excellent	21	12
Good	51	40
Fair	23	34
Bad/poor	5	14
Education		
<high school	43	50
≥high school	57	50
Home Ownership		
Own home	79	53
Rent/other	21	47
Living Arrangements		
Lives alone	33	65
Lives with others	67	35
Marital Status		
Married/common-law	61	27
Widowed	28	59
Separated/divorced	7	7
Never married	4	7

[1] Behie, G., 1998 (weighted sample based on a random sample of 2% population aged 65 and over from British Columbia Vital Statistics).

It should also be noted that seniors in the CRD differ from seniors in other health regions of the province with respect to fall-related injuries that require hospitalization (Scott & Gallagher, 1997). As shown in Table 33, of the 20 Health Regions, the CRD, (also known as the Capital Health Region), ranked 17th in order of the average annual number of cases per 1,000 of those aged 65 years and older who were admitted to hospital for fall-related injuries for 1991/92-1995/96 (Scott & Gallagher). The health regions with the highest rates tend to be those in the north of the province, such as the North West, Northern Interior, Coast Garibaldi and Cariboo health regions. It is interesting to note that for 1995, the northern regions, with the exception of Coast Garibaldi, also ranked as the worst in the province for age standardized mortality rates and socio-economic status—based on overall levels of income, education and employment (BC Ministry of Health and Ministry Responsible for Seniors, 1996). By contrast, compared to other health regions in the province, the CRD has the fifth lowest age standardized mortality rate and the fourth highest ranking of socio-economic status (BC Ministry of Health and Ministry Responsible for Seniors, 1996).

However, the findings of this study can be considered representative of frail, elderly, community-dwelling seniors in the CRD and have the potential to be extrapolated to frail seniors in similar Canadian communities.

Table 33

Hospitalizations due to Falls, Ages 65+, by Health Region.

Health region	Cases per 1,000 population[1]
North West	32.78
Coast Garibaldi	28.14
Northern Interior	27.36
Cariboo	26.04
West Kootenay	24.78
East Kootenay	24.59
Peace Liard	23.82
Thompson	22.78
Up.Isl/Central Coast	21.69
Simon Fraser	20.63
North Okanagan	20.15
Burnaby	18.68
S.Oknag/Similkameen	18.26
S. Fraser Valley	18.08
Central Vancouver Isl.	17.65
Fraser Valley	17.14
Capital	16.71
North Shore	15.91
Vancouver	15.68
Richmond	15.49

[1]BC Age-Specific Average Annual Cases per 1,000 Population, 1991/92-1995/96 (Scott & Gallagher, 1997).

The ability to compare the findings of this study to those of other studies is limited by the fact that respondents were not provided with a predetermined, standardized definition for the terms "fall" and "injury". The fact that respondents were asked for a self-report based on their own interpretation of these terms is not uncommon (Raina, Dukeshire, Chambes, Toivonen & Lindsay, 1997). However, this does hamper comparisons, particularly given the variety of definitions currently being used for either term (see Chapter 1 for a description of definitions used in other studies).

Limitations imposed by the cross-sectional design of the CRD Survey include temporal limitations. This is particularly problematic for understanding the role of certain factors in relation to the fall injury event. For instance, it cannot be discerned from the data whether the fall-related injury occurred before or after a reported health problem. This does not negate the use of these variables, only that caution must be applied in the interpretation of the findings. Caution must also be applied in the interpretation of the results due to the cross-sectional nature of this study. While a number of significant differences were found between those who sustained fall-related injuries and those who did not, cause and effect cannot be imputed for any of these factors without confirmation through longitudinal studies that include multiple factors and large samples.

Recommendations for Future Research

The limitations of this study point to the need for more research in this area. To enhance generalizability, studies are needed that represent larger and more diverse segments of the seniors' population. For instance, data from this study only represent one of the twenty health regions in the province. Scott and Gallagher (1997) show that fall injury rates for seniors differ considerably by region in British Columbia. Future studies

would benefit from comparisons with health regions with different climates, different social and economic profiles, and different population densities.

Longitudinal studies are needed to isolate whether a factor was an antecedent or consequence of the fall injury event. Future study designs would also benefit from the collaboration of interdisciplinary teams of researchers with sound content knowledge of the complex and multifaceted nature of the problem.

In order to apply the findings of future studies to reducing fall-related injuries, factors need to be considered in light of their complex social, historical, political, economic, and gender contexts. The examination of findings in light of these contexts is further enhanced by the application of a critical gerontological theoretical framework to examine patterns within the larger social structures that influence the experiences and behaviours of older people who sustain fall-related injuries. Without a theoretical framework for interpreting the findings there is no basis for exploring links and interrelationships among the related phenomena that exist within these larger contexts. Fall-related injuries among seniors occur due to a multitude of diverse factors, which are influenced by the larger social context in which they exist.

Theoretical Development

This study confirms the existing theory that fall-related injuries occur due to a complex set of interacting factors. In addition, this study went beyond the two-tiered approach of previous studies that limited their exploration to biological and behavioural factors, to include an examination of potential environmental and social and economic factors. Unlike previous studies, data from the CRD Survey revealed that outdoor locations for fall-related injury occurrences are equally as prevalent as indoor locations.

However, further speculation on the role of the environment contributors was limited by a lack of data on specific environmental hazards or conditions.

The ability to examine social and economic factors was facilitated by data from the CRD Survey on income, income adequacy, education, living arrangements, emotional support, network size and use of social services. However, results did not reveal any significant findings that support the role of social and economic factors as contributors with the sole exception of more years of education found to be associated with sustaining a fall-related injury. This finding was in contrast to the literature that shows poor health outcomes to be associated with lower socioeconomic status as defined by less education and lower income (Hirdes & Forbes, 1993). It can only be speculated that for the CRD health region, social and economic factors may have less influence for reasons not explained by the data. For instance, the availability of services and transportation, combined with the mild climate, may lessen the impact of low income. Furthermore, the mild climate may promote greater activity, despite the presence of limited functional ability or chronic conditions. Another speculation with regard to the association with higher education may be that the CRD, as a popular retirement destination, may attract more people who are better educated and who have the means to move to a warmer climate. The climate may also make it possible for these same people to be more active in ways that might put them at greater risk of falling and being injured. Examples might be retired men who have led sedentary working lives and who now have the time to start playing tennis or elderly women who have moved from colder climates and are now able to garden more months of the year.

In summary, a potential theory that may be implied by these findings is that each region or community has its own unique set, or combination, of factors that best direct the design of effective community-based prevention strategies. This will only be confirmed by repeated studies in diverse regions. Furthermore, the diversity of findings in this and previous studies suggests that seniors are not a homogenous group for whom one set of prevention strategies work for all. The most effective prevention strategies will most likely be those that are tailored to the health conditions and life styles of individual seniors.

Conclusion

The study presented here was designed to explore the multifaceted nature of the problem of fall-related injuries among older Canadians. Analysis was conducted to investigate relationships and compounding effects of a wide range of biological, behavioural, environmental, and social and economic factors shown in the literature to be directly or indirectly linked to fall-related injuries among older persons. The CRD Survey was used as a credible source of data representative of larger populations of frail seniors in similar communities. The study methodology was designed to adhere to the principles of a critical gerontology perspective through a focus on a potentially debilitating health problem that primarily affects those who are least able to advocate on their own behalf. Due to the broad array of variables investigated and the credibility of the data source used, findings of this study have the potential for influencing policies related to improving the health and safety of frail older Canadians across the country.

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Appendix A

OFFICE OF RESEARCH ADMINISTRATION

UNIVERSITY OF VICTORIA

Certificate of Approval

University of Victoria
Committee on Research and Other Activities
Involving Human Subjects

Principal Investigator	Department	Supervisor
Dr. Margaret Penning	**Sociology/Centre on Aging**	
Faculty		

Co-Investigators:

Dr. Neena Chappell, Director	Centre on Aging
Dr. Peter Stephenson, Faculty	Anthropology
Dr. Lome Rosenblood, Faculty	Psychology
Dr. Holly Tuokko, Faculty	Centre on Aging

Title: *Independence Among Frail Seniors*

Project No.	Start Date	End Date	Approval Date
75-95	2 Mar 95	1 Mar 96	2 Mar 95

Certification

This is to certify that the University of Victoria Ethics Review Committee on Research and Other Activities Involving Human Subjects has examined the research proposal and concludes that, in all respects, the proposed research meets appropriate standards of ethics as outlined by the University of Victoria Research Regulation Involving Human Subjects.

Michael Corcoran,
Associate Dean, Research

Alex McAuley,
Associate Vice-President, Research

This Certificate of Approval is valid for the above term provided there is no change in the procedures. One year extensions may be granted provided there are no changes in the procedures.

P.O. Box 1700, Victoria, B.C., Canada V8W 2Y2 Telephone (604) 721-7973, Fax (604) 721-8960

Appendix B

Telephone Screen for Matching

Identification No.: _____

Interviewer: _____

Date of Interview: (day/month/year): _____

Sex of Respondent:

0. Male
1. Female

Hello. May I speak to (name of respondent)? Hello (Mr./Mrs./Ms.) (Name of respondent). My name is (name of interviewer). I am calling from the Centre on Aging at the University of Victoria. We are conducting a study of health, independence and service use among people aged 65 and over in the Capital Regional District of Vancouver Island. We are interested in talking to people about their health, health concerns, and use of health services.

You have been randomly selected to participate in this study from a list of people living in the region. We would like to ask you a few questions. Participation in the study is voluntary. However, your involvement is very important to the success of this project. All information you provide is confidential and your name will not be released to anyone. Also, if there are any questions you would rather not answer, please do not feel you have to answer.

This interview will only take about 5 minutes. However, based on the information you provide, we may also wish to invite you to participate in a more extensive interview.

First of all, could you please tell me ...

1. In what year were you born? What month? What day?

   (RECORD DAY / MONTH / YEAR) ___/___/___
   DD MM YY

   (Code actual age)

2. Now, I want to ask you about how you manage things in your daily life. I will mention a number of common, daily activities. For each, I'd like you to say if you can manage it without any help, with some help from a person and/or from a device of some kind, or whether you cannot do it at all. That is, someone else has to do this for you (or it does not get done). I am interested in your ability to do these activities, and NOT whether or not you actually do these things.

   1 = without any help
   2 = with some help from a device only
   3 = with some help from a person only
   4 = with some help from a person and a device
   5 = unable to do it

   Are you able to ...

a)	eat on your own?	1	2	3	4	5
b)	dress and undress?	1	2	3	4	5
c)	walk?	1	2	3	4	5
d)	get in/out of bed?	1	2	3	4	5
e)	take a bath or shower?	1	2	3	4	5

(Total ADL Score) ___

f)	do your own laundry?	1	2	3	4	5
g)	shop for groceries or clothing?	1	2	3	4	5
h)	prepare your own meals?	1	2	3	4	5
i)	do light housework (eg. dusting)?	1	2	3	4	5
j)	do heavy housework (eg. scrub floors)?	1	2	3	4	5
k)	take your own medicine?	1	2	3	4	5

(Total IADL Score) ___

3. a) Finally, could you please tell me if you currently receive services from any of the following agencies? (Circle # of agencies mentioned.)

b) Also, do you or your family pay for all or some of the services provided by this agency? If you do not pay for all of the services provided, who does - long-term care; the CRD (Capital Regional District); or some other agency? (eg. Veteran's Affairs, ICBC, Worker's Compensation Board, etc.)

AGENCY Which agency(ies) do you receive help from?	PAYMENT 0 Don't Receive 1 pay for none 2 pay for some 3 pay for all	If 1 or 2, Who else pays? 0 Don'tReceive 1 CRD/longterm care 2 Other agency: specify	
01 Alpha Home Care Services			__ __
02 Fernwood Home Support Services			__ __
03 Helping Hands Services			__ __
04 Island Community Home Support Services			__ __
05 Drake Medox Health Services			__ __
06 Nisika Home Support Services			__ __
07 Olsten (Kimberly) Quality Care			__ __
08 Para-Med Health Services			__ __
09 Victoria Home Support Society Services			__ __
10 Fairfield Homecare Services Society			__ __
11 James Bay Community Project			__ __
12 Metchosin/Sooke Homemakers Service			__ __
13 Peninsula Community Association (Sidney)			__ __
14 Outer Gulf Islands Home Care (formerly Pender Island Homecare Services)			__ __
15 Salt Spring Island Home Support Services			__ __
16 Other? (Specify)_____			

That concludes the interview. Thank you very much for your assistance. We hope to speak with you again.

INTERVIEW EVALUATION

1. How clear were the answers?

   a) Clear and appropriate
   b) A bit vague
   c) Wandered, hard to extract an answer
   d) Not responsive ___

2. Could the respondent hear you?

   a) Could hear clearly
   b) Seemed to have some trouble
   c) I needed to raise my voice and repeat questions
   d) Great difficulty in communicating
   e) Could not hear me ___

3. Did the respondent have difficulty communicating due to a language problem?

   a) Completely fluent
   b) Some problems
   c) Great difficulty
   d) Could not understand ___

4. Separate from any language or hearing problem, could the respondent understand you?

   a) No problem
   b) Some problem
   c) Great difficulty
   d) Could not understand ___

5. What was your overall impression of the respondent?

_____

_____

_____

_____

_____

_____

_____

Appendix C

Matching of respondents was done to ensure as close a similarity between the CRD user and nonuser groups. Names of seniors residing in the CRD were randomly selected from a list provided by Vital Statistics (n=56 774). Just over 10000 telephone screens were conducted. Respondents were asked their date of birth, gender, whether or not they used CRD services, and a series of functional ability questions. The functional ability questions, based on traditional ADL's and IADL's were:

ADL's
a) Are you able to eat on your own...
b) Are you able to dress and undress...
c) Are you able to walk...
d) Can you take a bath or shower...

IADL's
a) Can you do your heavy housework (eg. scrub floors)...
b) Can you prepare your own meals...
c) Can you do your light housework (eg. dusting)...
d) Can you do your own laundry...
e) Can you take your own medicine...
f) Can you shop for groceries or clothing...

The following 5-point Likert scale was used for each question.

1 Without any help
2 Some help from device only
3 Some help from person only
4 Some help from person and device
5 Unable to do it

Matching was done on age, gender, and functional ability. Age was grouped into 9 categories based on intervals of 3 years beginning with 65. The highest category included all those over 88 years of age. For practical purposes, the ADL questions were summed and categorized into 2 groups: a) those who reported no functional impairment (score=4); and b) those who reported any degree of functional impairment (score=5+). For those who reported no functional impairment (score=4), it was necessary to match on IADL's. This series of questions was summed and categorized into 4 groups: a) those who reported no functional impairment (score=6); b) score=7-8; c) score=8-9; and d) score=11+. The majority of respondents were matched on ADL (n=438).