
**Central East
Health Information Partnership**

**Does the Rapid Risk Factor
Surveillance System
Measure Up?**

Seniors Who Fall

Yvonne Gray

May 2004



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*** The Ontario Public Health Units participating in the Rapid Risk Factor Surveillance System for 2003**

Brant County Health Unit (HU)	Durham Region Health Department
Elgin-St Thomas HU	Grey Bruce HU
Haliburton, Kawartha, Pine Ridge HU	Halton Region Health Department
City of Hamilton -Public Health and Community Services	Kingston, Frontenac and Lennox & Addington HU
Hastings & Prince Edward Counties HU	Huron County HU
County of Lambton Community Health Services Department	Leeds, Grenville and Lanark District
Middlesex-London HU	Regional Niagara Public Health Dept.
City of Ottawa PHU	Regional Municipality of Peel Health Dept.
Perth District HU	Simcoe County District HU
Sudbury & District HU	Toronto Public Health
Region of Waterloo Public Health	Windsor-Essex County HU
York Region Health Services Dept.	

Executive Summary

Falling is a serious public health problem for seniors. Up to 30% of seniors fall each year in the community and at least 20% of these require medical care. Prevention of falls has been identified as a priority for public health action by the Ontario Ministry of Health and Long-Term Care. Falls in seniors can be prevented by modification of such risk factors as use of sedative medications, balance and gait impairment, and environmental hazards. The Rapid Risk Factor Surveillance System (RRFSS) currently in use in a number of Public Health Units across Ontario includes questions on falls and can be used to monitor falls experience in seniors.

The purpose of this report is to use RRFSS data to describe the prevalence of seniors experiencing at least one fall in the community in the past year and their characteristics. This data is then compared with other sources of community-based falls data including the Canadian Community Health Survey, the National Population Health Survey and research studies.

RRFSS falls data show that almost 20% of seniors fall and that a third of these have serious falls. Characteristics associated with falling include female gender, living alone, a poor self-assessment of general health and chronic disease. RRFSS falls rates are consistent with reports from studies collecting data on a one-year falls recall basis from independently functioning seniors. RRFSS rates for serious falls are similar to Statistics Canada survey results. However, compared with these data sources and considering the epidemiology of falls, RRFSS may be underestimating falls in older seniors. Comparisons with characteristics of RRFSS seniors who fall and known risk factors for falling are consistent with published data.

RRFSS is a valuable source of falls information and pooling of data across PHUs allows analysis of risk factors for subgroups of the population such as seniors. Further development of the falls module to capture a greater proportion of falls in older seniors and additional, modifiable, risk factors would enhance the effectiveness of this surveillance system in supporting public health action to reduce falls in seniors.

Introduction

Preventing falls in seniors has been identified as a priority for public health action in Ontario. The goal of the Ministry of Health and Long-Term Care (MOHLTC) is to reduce the rate of serious fall-related injuries in seniors by 20% by the year 2010.¹ Effective programming to reduce falls requires information gathered through public health surveillance. Traditionally, falls surveillance has relied on administrative data sources, but the majority of falls occurring in the community do not require a health care visit and are not captured by these systems. The Rapid Risk Factor Surveillance System (RRFSS) is a community based, health-related, risk factor surveillance system currently being administered in a number of Public Health Units (PHUs) across Ontario. Questions about falls experience in the previous 12 months are included in the survey. The purpose of this report is to explore how data collected by RRFSS can be used to describe falls among seniors in Ontario.

Background

Impact of falls in seniors

Falls are the most frequent cause of injury-related disability and death in people age 65 and older living in the community.² Injury resulting from a fall is one of the leading causes of hospital admission for both men and women in this age group.³ It is estimated that up to a third of Canadian seniors fall each year in the community.⁴⁻⁶ The Ontario Trauma Registry reports that for seniors, 72 000 emergency room visits, 25 000 hospitalizations and over 800 deaths were falls related in Ontario during 2001.⁷ At least 1% of Canadian deaths are attributed directly to falls but it is estimated that falls are a contributing factor in twice that number.⁸ Even when no serious injury occurs following a fall, the experience of falling can create fear and anxiety among seniors.⁹ As a result, a fall in the community is often a precipitating factor in moving a senior from independent living to an institution.⁸ Because the risk of falling increases with age, it is probable that the frequency of falls will continue to escalate as Canada's population ages. In addition, there is an increase in the rate of hospital-based, age-adjusted falls, which can be linked

to greater mobility among seniors combined with an increased use of alcohol and certain medications.¹⁰

Risk Factors for falls in seniors

Prospective studies of falls in seniors in the community have identified a number of risk factors that are associated with an increased likelihood of falling.^{2 11} In many cases falls result from a combination of several factors and the risk of falling increases with the number of factors present.⁵ Falling is associated with both personal characteristics and environmental factors. Personal characteristics include increasing age, female sex, chronic diseases and disabilities which result in lower limb weakness and balance impairment, a history of previous falls and use of neurologically active medications. (*see Appendix A.*) Environmental hazards can be structural or related to weather conditions. Hospital surveillance data in Ontario has identified steps and stairs as the most common environmental hazard in fall-related injuries.¹² Active seniors with some health impairment appear to be at particular risk of serious falls due to greater exposure to environmental hazards combined with a diminished capacity to respond to balance upset.^{11 13}

Surveillance for falls

Public health surveillance is the ongoing, systematic collection, analysis and interpretation of data on public health-related events for use in public health action to reduce illness and death.¹⁴ Interventions which lead to improvements in public health, are usually available for conditions under surveillance. Public health surveillance has traditionally focused on prevention and control of infectious disease. However, public health surveillance also has an essential role in monitoring other causes of disability and premature death and in this context, falls in seniors is a major public health problem.¹⁵

Over many years of research, individual characteristics, which increase the likelihood of falling, and effective interventions, such as enhancing mobility that reduce the risk of falling have been identified for seniors. Good public health surveillance information is required to identify seniors at risk, and also to support and evaluate falls intervention programmes by monitoring changes in fall outcomes.

Sources of falls surveillance data used to monitor the more severe outcomes of falls include hospital administrative databases and vital statistics. Surveillance for less severe falls outcomes, the prevalence of risk factors and any use of preventive measures requires ongoing data collection at an individual level in the community.

Hospital based surveillance

Hospital based surveillance systems describe serious falls which require hospital care. In Ontario, information is available on demographic, diagnostic, treatment, short-term outcome data and the immediate circumstances of a fall.⁷ People using emergency rooms and inpatient services following an injury are recorded in this system. These data have a number of limitations when used to describe the burden of falls in seniors. Most falls in seniors occur in the community and are not recorded in this system; event rather than client-based data is reported; and a fall, while precipitating an emergency room visit, may not be the main reason for admission reported in the hospital discharge abstracts.¹⁶

Vital statistics

Vital statistics mortality records can be used as an ongoing surveillance system to quantify fall-related deaths. External cause of injury codes (E codes) describe the underlying circumstances of death such as a motor vehicle or fall-related accident.¹⁶

Community surveillance

Many seniors who are admitted to hospital for a fall-related injury have a history of previous falls in the community.^{10 17} Data collected and used for prevention at a community level can reduce the impact of serious falls on hospital resources.¹⁸ There is, however, no provincial or national community based surveillance system equivalent to hospital sources of falls data. The only systematic and ongoing, community based surveillance system collecting information on falls in Canada is RRFSS.

Other sources of community falls data

There are a number of other sources of information in Canada which report on falls in the community. These include survey data and studies on community samples. There are two

national surveys in Canada, administered by Statistics Canada, that are collecting falls related information. These are the Canadian Community Health Survey (CCHS), a biannual cross-sectional survey and the National Population Health Survey (NPHS) a longitudinal survey. The CCHS gathers information at a community and regional level of geography. Common content, asked of all respondents, includes an injury module with a question on serious falls experience (*see Appendix B for CCHS survey design*). The NPHS started as a cross-sectional and longitudinal survey in 1994. The longitudinal component is ongoing with the cross sectional component now separated as the CCHS (2001). The NPHS also collects information on falls-related serious injury. Community study samples include a Montreal study of falls and risk factors.⁴

RRFSS

RRFSS is an adult surveillance system initiated by public health units in Ontario. Data is collected by means of a population-based, computer-assisted, telephone survey administered monthly to 100 respondents in participating Public Health Units (PHU). RRFSS started as a pilot survey in Durham Regional Health Unit in 1999. In 2001 the surveillance system was adopted by 9 PHUs and expanded to 23 of Ontario's 37 PHUs by 2003. Based on 2001 population estimates, the 23 PHUs participating in RRFSS include 87% of the total adult population and 84% of the total senior population of Ontario.¹⁹ The purpose of RRFSS is to provide ongoing, timely, relevant information to assist with local programming initiatives. Questionnaires, data analysis and dissemination of information are developed in partnership between participating PHUs. Question modules are closely linked to health outcomes as identified by the Mandatory Health Programs and Services Guidelines.¹ RRFSS is designed to be both a flexible data collection system responsive to local information needs and emerging health issues, and to have consistency across health units and over time. This is achieved by using a mix of common core question modules and locally relevant, optional, additional modules. The survey is conducted by the Institute for Social Research at York University and data are available for analysis 6-8 weeks after survey administration. (*For RRFSS survey design and analysis see Appendix C*)

Research objectives

RRFSS has accumulated a large body of information that can be used to examine community-based events which are not otherwise recorded in the health care system. A falls module has been included in the RRFSS core survey for the past three years. The data collected from this module are the basis for describing falls and activity limiting falls in the RRFSS population.

The primary objective of this report is to describe, using RRFSS data:

- (i) the prevalence of seniors who fall and have serious falls in the community
- (ii) the characteristics of seniors who fall and those characteristics which increase the likelihood of a serious fall.

The secondary objective of this report is to compare RRFSS results with the results from other sources of falls information.

Methods

Sample for falls research analysis

The data used in this report come from the RRFSS database and were collected between January 2001 and November 2003. Data were released for use by 19 of 23 PHUs for the period of participation of each health unit in RRFSS. This included 6 PHUs in 2001 (n=9900), 16 PHUs in 2002 (n=17 299) and 19 PHUs for 2003 (n=20 755). The 19 PHUs represent 77% of the population of Ontario adults based on 2001 population estimates.¹⁹ Two additional PHUs permitted release of data but this data was not received in time to include in the analysis. A random sample of adults was selected each year for each PHU, however over the course of the three years it is conceivable that individuals were interviewed more than once.

A total of 7155 survey respondents aged 65 years and older were selected from the RRFSS data for the 19 public health units. Variables selected for analysis included falls, serious falls and personal characteristics some of which are reported in the literature as being associated with falls.

Definitions

The two survey questions on falls experience in the falls module were used to define the categories of *falls* used in this analysis:

1. “*Falling downstairs, off a ladder, or on an icy walkway or tripping and falling down over something left on the floor, happen to many people everyday. Have you had a fall in the past 12 months?*” A fall was a positive response to this question and was used to find the prevalence of seniors with at least one fall in the past 12 months.
2. “*Did your fall result in an injury that was serious enough to make it difficult to walk, get dressed, go to work, or do most of the things you normally do?*” A serious fall was a positive response to this activity-limiting question on falls and was used to find the prevalence of seniors who had at least one serious fall in the past 12 months

Other variables were selected to describe characteristics of seniors who reported a fall. These variables were related to risk factors for falls, reported in published data such as increasing age, gender, living circumstances, self health assessment and chronic disease. In addition socio-demographic variables for income and education were selected in order to control for the effect of these factors on the variables of interest. These variables were then collapsed for ease of analysis.

Seniors were categorised into two *age groups*, younger seniors (aged 65 to 74 years) and older seniors (aged 75+ years). For *household living circumstances*, households with one adult were compared with households with more than one adult in the household.

Household income levels were defined as lower or higher based on total household income and number of adults in the household.⁸ Households with an income of less than \$20 000 and 1-3 adults, or an income of less than \$30 000 and four or more adults are defined as lower income. Households with an income of more than \$20 000 and 1-3 adults, or more than \$30 000 and four or more adults are defined as higher income. At least one-third of the sample did not report an income value. So that other information on these people could be used in the regression analysis, a variable for unknown income was included in the analysis. *Education* was defined in three categories, high school not completed, some post-secondary education and post secondary graduate. Respondents

were asked if they had used any alcohol in the past 12 months. *Alcohol use* was categorised as yes or no depending on the answer to this question. A third of respondents did not report on alcohol use and a variable for unknown alcohol use was included in the analysis.

Questions regarding *chronic health conditions* were combined together into a binary variable for any chronic disease (Yes/No). Variables with scaled responses were analysed as binary variables. *General health assessment* was defined as poor (fair/poor) or good (good to excellent).

Population estimates for 2001 were used to make comparisons with RRFSS population proportions for age and sex.¹⁹

Analysis

The data used for falls analysis were collected over a three-year period and with an increasing number of PHUs in each year. Certain PHUs have therefore contributed a larger proportion of the sample size (*see Appendix D*). The data were initially examined for differences in the frequency of falls between health units and across time using chi-squared analysis and a significance value of 0.05. No significant differences for falls were noted in these analyses and the data was then pooled for the three years of data collection and for all PHUs.

Pooled unweighted data was initially used to examine for sparse data. The data was then analysed using sampling weights which reflected the probability of respondent selection in each household, i.e. the number of adults in the household, and corrected to the original sample size. RRFSS analysis guidelines (*see Appendix B*) regarding release of data, based on cell size and weighted data sampling variability were followed.

In order to describe rates of falls, descriptive analyses were conducted at the level of the combined PHUs using falls and serious falls variables. Bivariate analyses with socio-demographic and health related variables were used to describe characteristics of seniors

who fell and also those characteristics associated with more serious falls. Variables of interest from these bivariate analyses were used to examine independent associations for falls and serious falls.

Statistical tests of association were performed using Pearson chi-squared tests and considered significant at $p < 0.05$. The independent effect of variables on falls outcomes was assessed using multivariate logistic regression. An “unknown” category was included in the regression model for income and alcohol use. Variables were dropped from the regression model in a stepwise procedure when the log likelihood test of significance for including a variable in the model was $p \geq 0.10$. As all the variables were analysed as categorical data, global differences across health units and over time were examined with a chi-squared test statistic and a significance of $p < 0.05$. The coefficient of variation for a proportion estimate was < 16.5 unless noted. The analysis was conducted using SPSS Version 12.0 (Sept 2003).

Results

The characteristics of RRFSS seniors, based on the selected variables, are outlined in *Table 1*. Females predominate in this population, are more likely to live alone and to have a lower income.

Table 1. RRFSS senior population characteristics (n=7155)

Variables	All	Male (%)	Female (%)
Sex		36.3	63.7
Age			
65 to 74	62.1	64.5	60.4
75+	34.9	35.5	39.6
Adults in household			
One adult	29.8	17.5	38.5
Income			
lower	14.9	9.8	18.9
higher	48.7	60.9	40.2
Unknown	36.4	29.3	41.4
Education			
< high school	36.2	37.5	36.6
high school +	36.8	33.0	40.8
post graduate	24.9	29.5	22.6
General health			
Fair/poor	26.2	25.7	26.6
Chronic disease			
Yes	47.2	48.1	46.2
Alcohol use			
Yes	45.8	50.6	42.4
No	18.4	13.5	21.9
Missing	35.7	35.8	35.7

Both males and females gave similar general health assessments and have a similar prevalence of at least one chronic condition. There is a significantly greater prevalence of chronic disease in older seniors (50.4%) when compared with younger seniors (44.9%), ($P < 0.001$). Although about half of the senior population had taken alcohol in the past year, less than 10 % drank alcohol daily.

Comparison with the census population estimates for these 19 PHUs showed similar proportions for age and gender distribution.

Frequency of falls

In all, 18.2% [CI. 17.1,18.9] of the senior population reported falling in the previous 12 months (n=1289) and 6.0 % [CI 5.45,6.55] or one third of those who fell (n = 430), reported a serious fall. (*Figure 1*)

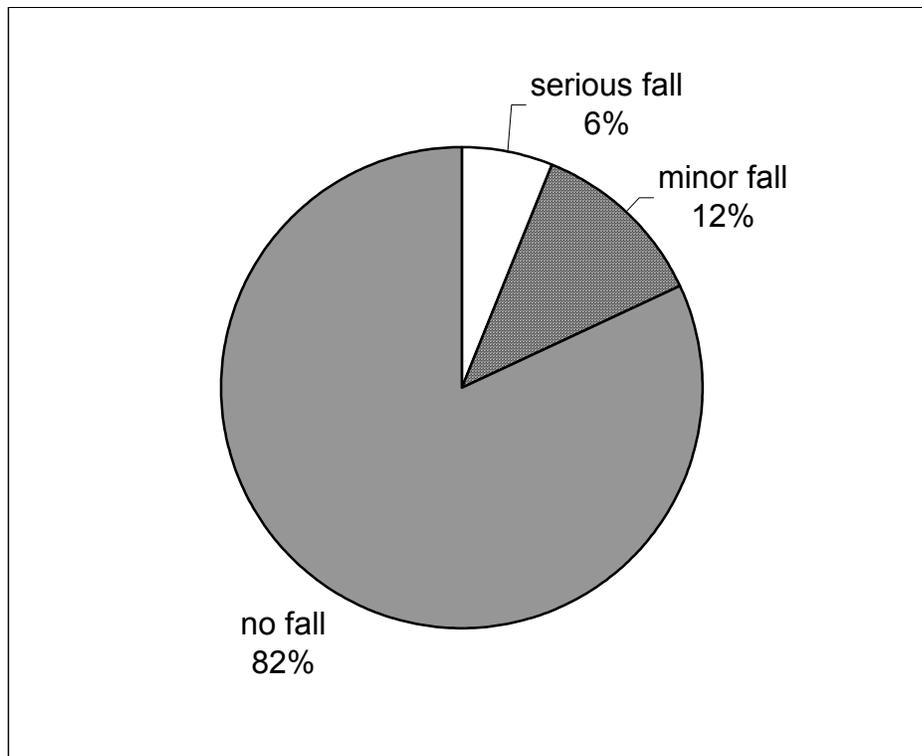


Figure 1. Frequency of falls in seniors: RRFSS, N = 7155

Among all seniors significantly more females (19.5%) than males (16.2%) reported falling ($p = 0.001$). The frequency of falling increased with age for males and females (*Figure 2*)

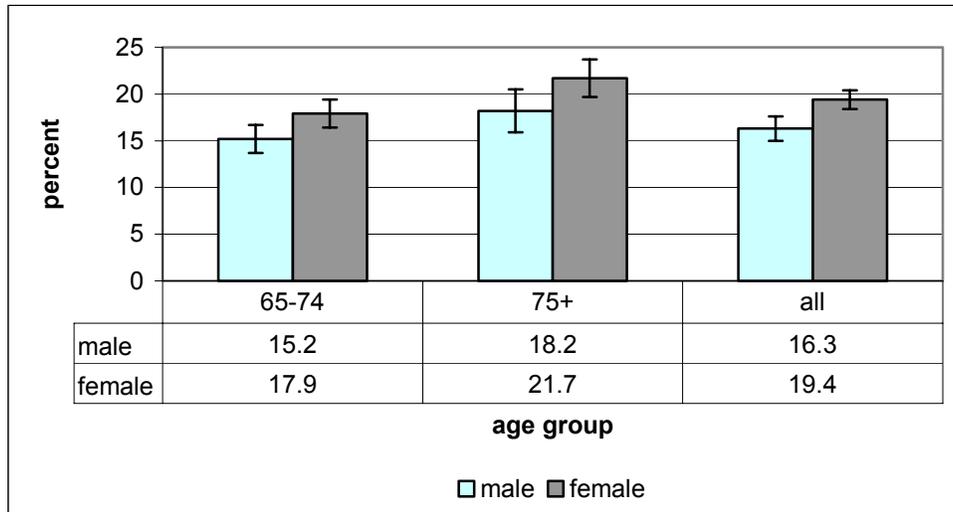


Figure 2. Falls in seniors for males and females by age category: RRFSS

The proportion of falls that resulted in activity limiting injury also increased with age (*Figure 3*) although the association with age was not significant. However when the age groups are combined females were more likely to report a serious fall than males ($p = 0.050$).

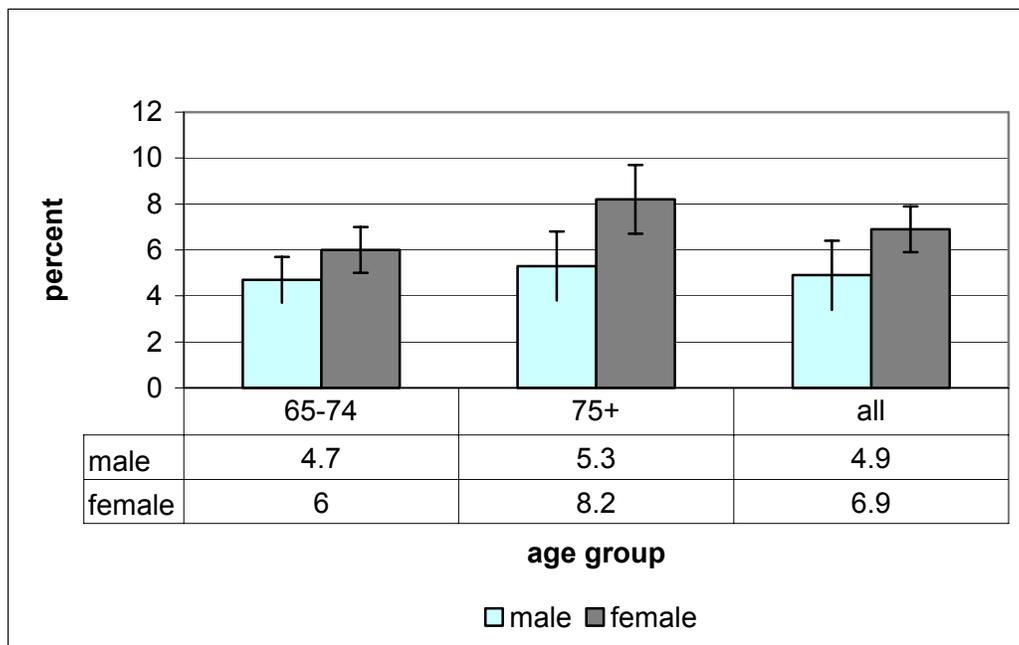


Figure 3. Serious falls in seniors for males and females by age category: RRFSS

Characteristics of seniors who fall and characteristics related to serious falls

Characteristics associated with falls

Bivariate analyses using Pearson chi-squared tests were conducted to test for associations between reported falls and variables describing characteristics of seniors (*Table 3*).

Table 2. Factors associated with seniors who reported a fall and with reporting a serious fall: RRFSS

Variable [¶]	% Seniors who fell	% Seniors with a Serious fall
Gender		
Female	19.4*	6.8*
Male	16.3	4.9
Age group		
65 to 74	16.8*	5.4
75 +	20.3	7.1
Education		
< high school	18.4	5.2
high school +	18.2	6.5
post grad	17.8	6.8
Income		
lower	20.4	7.8
higher	18.1	5.9
unknown	17.2	5.5
Adults in household		
One	20.9*	7.8*
More than one	16.9	5.3
Alcohol use		
Yes	17.7	5.4
No	19.9	6.6
Unknown	17.7	6.6
Health self-assessment		
Poor/fair	23.9*	8.7*
Good - excellent	15.8	4.8
Chronic disease		
Yes	20.3*	7.1
No	16.2	5.1

* P-value < 0.05 on Pearson chi-squared analysis.

Seniors who reported falling in the previous 12 months were more likely to be female, to live alone, to complain of poor general health, to be aged 75 years or over and have at least one chronic disease (*Table 2*). Lower household income was a contributory factor in females only ($p=0.048$). Education category did not appear to be associated with falling.

When a senior reported a fall, characteristics, which increased the likelihood of a serious fall, included female gender, living alone and a poor general health assessment (*Table 2*). Males with post secondary education had higher than expected serious falls rates but this did not reach significance ($p =0.07$)

Characteristics independently associated with falls

Logistic regression analysis was used to examine the independent effects of the variables from *Table 2* on the risk of falling for seniors. The measure of risk used was the odds ratio. Characteristics which were independently associated with the risk of a fall included female gender, poor health assessment, chronic disease, and living alone ($p=0.057$) (*Table 3*)

Table 3. Characteristics associated with seniors who report a fall (n = 6150)

Variables	Seniors who fall	
	Odds ratio	95% Confidence limits
Age group		
65-74 [¶]	1.00	
75 +	1.13	0.99 – 1.30
Gender		
Female	1.19	1.03 – 1.37
Male [¶]	1.00	
Adults in household		
One	1.21	1.00 – 1.30
More than one [¶]	1.00	
Health self-assessment		
Poor/fair	1.57	1.35 - 1.82
Good [¶]	1.00	
Chronic disease		
Yes	1.16	1.01 - 1.33
No [¶]	1.00	

[¶] Reference category for which the odds ratio is one

When a fall was reported, the risk of that fall being serious was positively associated with a poor general health assessment and a better education (*Table 4*). Increasing age or chronic diseases did not appear to be related to more serious falls.

Table 4. Among seniors who fall, characteristics associated with reporting a serious fall (n = 1202)

Seniors with a serious fall		
Variables	Odds ratio	95% Confidence limits
Gender		
Female	1.22	0.92 – 1.61
Male [¶]	1.00	
Adults in household		
One	1.26	0.95 – 1.68
More than one [¶]	1.00	
Health self-assessment		
Poor/fair	1.45	1.10- 1.90
Good [¶]	1.00	
Education		
Post Grad	1.81	1.25 – 2.30
High School +	1.69	1.25 – 2.55
< High School [¶]	1.00	

[¶] Reference category for which the odds ratio is one

Discussion

Review of findings

Falls occur in a substantial proportion of the RRFSS senior population. Almost 20% of seniors recall at least one fall in the past year and a third of these are falls which interfere with activities of daily living. Falling and injury due to falls increase with age and women are more likely to fall in all age groups. Other personal characteristics that increase the likelihood of a senior reporting a fall include poor general health, chronic disease and living circumstances (*Table 2*). When the individual effect of each characteristic is considered, health status, female sex and living without another adult in the household appear to be more important contributors to falling than increasing age (*Table 3*). The respondent's health status (as described by personal health assessment) is also related to the likelihood of reporting a serious fall. While level of education is a factor in serious falls, age and sex did not appear to influence the type of fall reported (*Table 4*).

Published reports of falls prevalence in senior populations generally predict that up to 30% of seniors will fall each year.⁴ Surveillance systems do not usually pick up all cases of common conditions, but for effective surveillance to occur those cases which are reported should be representative of the population at risk in terms of demographics and known risk factors for the condition under surveillance.²⁰ Comparison of seniors who fall in RRFSS with other sources of falls data can help determine the effectiveness of RRFSS in monitoring falls in the community.

Comparisons of fall rates

RRFSS falls rates and Canadian national survey data

The CCHS uses PHU geographic areas to describe the Health Regions (HR) for data collection in Ontario (*see Appendix B*). Only data from CCHS HRs corresponding to PHUs which contributed data to this report are used in making comparisons with RRFSS. Data from the NPHS is at a national level from published sources⁸

The measure used by RRFSS to describe the rate of falls is consistent with the way the Canadian national population surveys, the CCHS and the NPHS, measure fall rates. In all three surveys, the rate of falls refers to the prevalence of seniors with at least one relevant fall in the previous 12 months. However, in the national surveys, respondents are asked only about serious falls. In addition, information is first collected about the most serious injury which occurred in the previous 12 months and then if the injury was caused by a fall. Those people who have had an activity-limiting fall and a more serious injury such as “a burn, poisoning or a laceration” are not included in the fall count.

Table 5. Community based studies of falls in seniors

Study	Design	N	Age group	% Seniors who fall	% Seniors with a Serious fall
NPHS ⁸ 1996/97	Household survey	11 282	65 +	---	4
CCHS ²¹ 2001	Household survey	4151	65 +	---	5.3 [¶]
O Loughlin ⁴ 1993 Montreal	Prospective community based	409	65 +	29.1	17.9
Tinetti M. ⁵ 1988 US	Prospective community based	336	75 +	32	7.7
Bath P. ¹¹ 1999 UK	Historic community based	1042	65 +	26.4	---
RRFSS	Household survey	7155	65 +	18.2	6.0

[¶] CI. 4.41-6.25

In spite of these limitations, rates of serious falls in seniors appear to be similar between the three sources of survey data. However, it appears that the proportion of reported falls occurring in older seniors in RRFSS is lower than from the national surveys. The population proportions for seniors in each age group are similar for all three surveys. Yet, in the national surveys over 50% of the total serious falls occurred in people age 75 years and older^{8 21} and in the RRFSS population 44% of falls occur in the older age group. Fall

rates increase substantially in older seniors² and RRFSS may be underestimating the prevalence of falls in this group.

The errors due to under reporting of falls should be similar among surveys based on recall information and using the same data collection method.²² However the CCHS may be recording a higher proportion of falls in older seniors because both in-person interviews and telephone interviews are used for data collection. Almost 50% of seniors interviewed by the CCHS, in the RRFSS PHUs, were surveyed in person. Also those who had an in-person interview reported falling significantly more frequently than those with a telephone interview.²¹ Among CCHS seniors who were interviewed by telephone 4.6% [2.69-6.52; CV = 21.3] reported a serious fall.

It is also possible that the questions used to collect falls data in the national surveys may underestimate activity-limiting falls occurring in younger seniors. The proportion of ‘most serious injuries’ due to a fall in the CCHS increases by 50% in older seniors and it is possible that a greater proportion of falls are not recorded for younger seniors if these respondents also have other accidents in the same time period.²¹

RRFSS falls rates and community sample data

Many fall-related hospital admissions in seniors have a history of previous, less serious falls in the community.⁵ RRFSS is the only on-going community and population based survey collecting data on all falls. Other sources of population-based data for prevalence of all falls are mainly research samples and may not be directly comparable.

Research studies of falls in seniors are either retrospective, based on one-year recall of falls or prospective. Prospective study subjects use stickers to record all falls as they occur and researchers have regular contact with subjects during the study period. In addition, these studies have clear definitions of what constitutes a fall and an in person interview to ensure inclusion of all relevant events. Prospective studies can be considered a “gold standard” of community falls rates and generally report higher rates than those seen in the RRFSS population (*Table 6*).

Retrospective community studies of independently functioning seniors report falls rates in the range of 21% - 26%^{11 13} and these values appears to be more consistent with rates reported from RRFSS.

Characteristics of RRFSS seniors and risk factors for falls

Prospective studies of community-dwelling seniors have identified a number of personal factors that contribute to the risk of falls. These include female gender, poor general health assessment, chronic disease and disability, and sedative medication.²³ Some of these factors such as demographic characteristics and self-reports of health status can be compared with characteristics of seniors who fall in RRFSS. Other factors such as the effects of chronic disease are not as clear-cut.

Demographics and risk factors for falls in seniors

In the RRFSS population the association between falling and age or sex is not as strong when other risk factors are also considered (*Table 4*). This is consistent with the Tinetti study of risk factors for falls in seniors which found no independent association between falling and any demographic characteristics. They suggest that apparent associations with demographics and living situation are due to the effects of other risk factors.⁵

It is not clear why a better education predisposes to serious falls. Individuals with a better education tend to be younger, male, in the higher income group and report a good health self-assessment. Perhaps these people engage in more activities where they are more likely to fall as the risk of falling increases with the number of hours per week spent in walking outdoors for relaxation.¹¹

Health status and risk factors for falls in seniors

In studies which investigate chronic disease among seniors, the prevalence of reported chronic disease varies depending on the number of conditions considered. In a US study of almost 4000 women where 14 conditions were investigated, 95 % had at least one chronic disease. The CCHS 1.1 cycle, asked respondents about over 20 chronic conditions and 78% of seniors had at least one chronic disease.²¹ Many of these conditions are also risk factors for falls. In RRFSS, questions are asked individually about

6 major chronic conditions³ and respondents can then list other conditions (<http://www.cehip.org/rrfss/resources>). Almost half of RRFSS seniors report at least one chronic disease and while chronic disease is related to falling in this analysis (*table 3*) it does not increase the likelihood of a serious fall. In addition unlike other falls data, reporting more than one condition is not related to greater risk of falling.^{2 24} This lack of association may be due to the fact that conditions specific to falls are not volunteered by seniors. For example, when asked directly almost half of CCHS seniors reported having arthritis while less than 3% of RRFSS seniors volunteer this information.²¹

Risk of falling is associated with an accumulation of factors which signify functional decline in seniors rather than due to any single chronic disease.^{2 5} Falls and the likelihood of more serious falls are associated with a poor health assessment in the RRFSS population and it is likely that this indicator of general health is a better reflection of physical functioning in relation to falls risk than any specific chronic disease.

It is important to collect risk factor information because modifying even a few factors can reduce the risk of falling and injuries related to falls.¹⁸ Seniors in the community with no intrinsic risk factors have a low likelihood of falling but the presence of four or more risk factors can increase this probability up to 78%.⁵ Using the present RRFSS falls module it is not possible to examine many of the factors which contribute to the risk of falling. Additional information that would be useful to collect, includes use of centrally-acting medications,²⁵ mobility problems such as difficulties in getting up from a chair etc.,⁴ vision problems, number of falls in the previous 12 months and use of falls prevention strategies.

Limitations of using RRFSS data for falls

The PHUs which contributed data to this report represent 77% of the adult population of Ontario and except for Sudbury PHU, most of this population live in the southern part of the province. In addition, apart from Sudbury and Ottawa PHUs where French-speaking adults are surveyed, RRFSS is administered only to English speaking people. Results for this analysis may not, therefore, be generalisable to the whole population of Ontario. The analysis in this report is based on cross-sectional data and so cause cannot be attributed to

apparent associations. For example, falls are strongly related to a poor general health assessment, but it is not clear if poor health is as a result of a fall or a contributing factor to falling. The falls module is limited to questions related to prevalence of seniors experiencing a fall. Many risk factors for falls in seniors cannot be examined using this module. However, associations with falls and characteristics which can be explored in RRFSS are consistent with published risk factors. Finally many people are institutionalized following a fall or a fall may result in death and these falls are not recorded in RRFSS.

Advantages of using RRFSS data for falls

RRFSS has been collecting information on a substantial proportion of the population of Ontario for the past three years. It is a valuable resource with which to examine public health risk factors that are not otherwise recorded in health care administrative databases. Consistency of questions across PHUs facilitates pooling of data and provides an adequate sample size to analyse risk factors for subgroups of the population such as seniors. In addition, these factors can be monitored over time to help assess the effectiveness of new initiatives in falls risk reduction. RRFSS data is available for analysis shortly after collection and as new information becomes available falls question modules can be adapted to capture relevant outcomes.

Conclusions

Analysis of RRFSS data show that falls among seniors are a major problem for many public health regions of Ontario. Similarities in the prevalence of seniors who fall allow these regions to pool data to examine falls risk factor data. Knowledge about seniors at increased risk of falling can be used to develop effective falls preventive action. RRFSS is a valuable source of falls information. Further development of the falls module to capture a greater proportion of falls in older seniors and additional, modifiable, risk factors would enhance the effectiveness of this surveillance system in supporting public health action to reduce falls in seniors.

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Appendix A: Risk Factors for falls in seniors

Prospective studies of falls in seniors in the community have identified a number of risk factors that are associated with an increased likelihood of falling.^{8 16 22} While some falls can be traced to a single cause, in most cases falls result from a combination of several factors. These factors can include both personal characteristics and external or environmental causes.

Intrinsic

Increasing Age

Aging is a significant risk factor in contributing to falls in seniors. During aging reduced muscle mass, decreasing bone density and degenerative joint disease result in an increased likelihood of falls and bone fractures.²² It is estimated that 25% of seniors, over the age of 65 years, fall in the community and that this proportion increases to 50% by the age of 80 years.⁹

Sex

Females seniors of all ages are more likely to fall than male seniors and more likely to have a fall that results in serious injury.²

Past history of falls

People who fall once are more likely to fall again and those seniors who are admitted to hospital with serious falls often have a prior history of falls.¹⁷

Comorbidity

As people age the risk of developing one or more chronic conditions increases. Certain ailments predispose to falling.²⁴ These include conditions affecting:

- lower limb function: arthritis, strokes, foot problems and muscle weakness.
- vision: cataracts and glaucoma.
- balance and gait: stroke, Parkinson's disease.
- dizziness and drop attacks: cardiovascular disease

- bladder dysfunction: incontinence and frequency of urination particularly at night

However the relationship between falls and comorbidity is not a linear one. Increasing frailty can also limit activity to such an extent that the opportunities to fall and fall frequency are reduced.⁸

Medications

The use of certain medications can also exacerbate the problem of falling for seniors. Not only are seniors more likely to be on a range of medications, they are also more sensitive to adverse drug effects. Medications, which have been shown to be associated with falls in seniors, include long acting sedatives, narcotics, antipsychotics and antidepressants. The risk of falling increases with the number of concurrent medications used.^{22 25}

Extrinsic

Seniors are vulnerable to environmental hazards and risk of falling in seniors is increased both by exposure to environmental hazards, and by a diminished capacity to respond to balance upset.⁸ Environmental factors that contribute to falls include weather, steps, stairs, inadequate lighting, lack of handrails, loose floor rugs and clutter, and bathroom architecture.^{24 26}

There is some variation in the characteristics of seniors who fall outside and those who fall indoors. People who have fallen outside are more likely to be active seniors with some compromising health problem and seniors who fall inside tend to have more serious health problems and greater frailty. In a UK population based study of falls in seniors in the community, over 55% of falls were attributed to extrinsic factors such as tripping and < 15% to intrinsic factors such as dizziness or blackouts.⁸

Appendix B: Canadian Community Health Survey

The Canadian Community Health Survey (CCHS)²¹ is a cross-sectional survey collecting information on health status, health care utilisation and health determinants for the Canadian population. The CCHS operates on a two-year cycle and this report uses data from cycle 1.1 collected between September 2000 and November 2001. Cycle 1.1 is a large sample survey designed to provide data at the geographic level of health region (HR). In Ontario, CCHS HRs correspond to the 37 public health unit regions. Many questions used in the CCHS have been adapted for RRFSS. These factors allow direct comparisons with RRFSS and the CCHS.

CCHS sample design

The CCHS target population is persons age 12 years and older who live in private dwellings in the ten provinces and the three territories. Institutionalized people, residents of Indian Reserves and Crown lands, full-time members of the Canadian Armed Forces and some people in remote areas are not included. The CCHS cycle 1.1 covered 98% of the Canadian population.

There are a total of 136 HRs in Canada. Each province is divided into a number of HRs and each territory is considered a single HR. Allocation of sample size to each HR was a three-step process. In the first two steps sample was allocated among the provinces according the population size and number of health regions. Then each province's sample was allocated among its HRs in proportion to the square root of the estimated population of each HR.

Selection of households for interview was based on a multi-stage stratified cluster design previously used by Statistics Canada for the Canadian Labour Force Survey (LFS). Some areas also used random digit dialling frames and telephone lists to identify households. Strata were created in each province based on geography, population density and socio-economic parameters. In each stratum clusters of residential buildings were selected by random sampling and the final sample was obtained by systematic sampling of selected clusters. Selection of respondents in each household was designed to over sample seniors

and youths (12-19). Samples were distributed equally over 12 months of data collection to minimise seasonal effects.

Data collection

The CCHS cycle 1.1 was administered using a computer assisted interview either in person or by telephone depending on how the household was initially identified. Samples selected from the LFS area frame (83%) had a personal interview. Those selected using telephone lists (17%) had a telephone interview. However the proportion of households selected by each method varied between HRs across the country. In 6% of households proxy interviews were used if the selected respondent was unable to complete an interview. The overall response rate for CCHS cycle 1.1 was 84.7%.

Data analysis and release

In order to generalise results to the general population, survey weights are used in data analysis which reflect the probability of selection of each respondent. Sampling weights are included in the public use data files. Standard errors and sampling variability are calculated using the bootstrap technique for calculating the variance of a proportion. Release of estimates from the CCHS depend on adhering to a number of release guidelines. These include a minimum of 30 observations in the denominator and acceptable sampling variability for weighted data estimates. This is measured using the coefficient of variation (CV). Where the CV is between 0 and 16.5 data is released without qualification, where a CV is between 16.5 and 33.3 data is released with qualification, and data is not released if the CV is greater than 33.3

Appendix C: RRFSS sampling and analysis

RRFSS sampling design

RRFSS is a population-based, computer-assisted, telephone survey of adults in Ontario using a two-stage sampling design. First a sample is drawn for each participating PHU for the whole year using random digit dialling procedures to select households and then a survey respondent is selected. The person with the next birthday is chosen, given that they are 18 years or older. The RRFSS sample is designed to be representative of the adult population of the catchment area of each health unit who live in a private dwelling with a telephone. With the exception of Ottawa and Sudbury, where surveys include a French translation, all interviews are conducted in English. The response rate for the survey in 2002 was an average of 60% across PHUs (range 55%-68%).

RRFSS analysis guidelines

Reported RRFSS data are weighted to reflect the probability of respondent selection in each household, i.e. the number of adults in the household, and corrected to the original sample size. This allows generalisation of the sample to the participating PHU populations.

Guidelines for release of data are based on cell sample sizes and sampling variability. Release of data is allowed where the numerator cell size is greater than 5 and the denominator cell size is greater than 30. The sampling variability is measured by the coefficient of variation (CV). Where the CV is between 0 and 16.5 data is released without qualification, where a CV is between 16.5 and 33.3 data is released with qualification and data is not released if the CV is greater than 33.3

Calculation of standard error is based on the parametric method where SE of a proportion = $\text{SQRT} [p * (1-p) / n]$.

(Guidelines available from the RRFSS co-ordinator at the RRFSS website:

www.cehip.org/rrfss)

Appendix D. RRFSS Seniors population sample by PHU: (2001-2003)

Public Health Unit	Total *	% Men 65-74 yrs	% Men 75+ yrs	% Women 65-74 yrs	% Women 75+ yrs
Brant County	109	22.0	14.7	36.7	26.6
Durham	407	30.2	15.7	33.4	20.6
Elgin-St. Thos.	316	25.3	18.4	32.9	23.4
Grey Bruce	475 [†]	24.4	14.1	36	25.5
Haliburton / Kawartha, Pine Ridge	756 [†]	27.4	15.5	34.3	22.9
Halton Region	478	28.8	15.4	35.3	20.5
City of Hamilton	341	26.4	12.0	37.0	24.6
Kingston, Frontenac and Lennox & Addington	337	25.8	11.3	38.6	24.3
Lambton	339	26	14.5	38.1	21.5
Leeds, Grenville and Lanark District	178	34.8	15.7	24.2	25.3
Niagara	551	23.4	13.8	37.7	25.0
Ottawa	362	26.7	12.9	35.8	24.5
Peel	299	27.8	13.7	35.1	23.4
Perth District	353	28.3	15.9	33.1	22.7
Simcoe County	550	21.8	14.7	39.1	24.4
Sudbury and District	426	24.6	14.6	40.4	20.4
Toronto	333	27.9	18.3	27.3	26.4
Windsor-Essex county	250	29.2	14.0	34.4	22.4
York Region	442	30.4	14.7	34.8	20.2

* Total adult sample size selected for each PHU is the same for each month. Variation in sample size reflects the length of time each PHU has participated in RRFSS

[†] Over 21% of adult population sample in the senior age group



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