

Medication Prescribed Within One Year Preceding Fall-Related Injuries in Ontario Older Adults



Yu Ming, PhD¹, Aleksandra A. Zecevic, PhD¹, Richard G. Booth, RN, PhD², Susan W. Hunter, PhD³, Rommel G. Tirona, PhD⁴, Andrew M. Johnson, PhD¹

¹School of Health Studies, Western University, London; ²Arthur Labatt Family School of Nursing, Western University, London; ³School of Physical Therapy, Western University, London; ⁴School of Physiology and Pharmacology, Western University, London, ON

<https://doi.org/10.5770/cgj.25.569>

ABSTRACT

Background

Serious injuries secondary to falls are becoming more prevalent due to the worldwide ageing of societies. Several medication classes have been associated with falls and fall-related injuries. The purpose of this study was to describe medication classes and the number of medication classes prescribed to older adults prior to the fall-related injury.

Methods

This population-based descriptive study used secondary administrative health-care data in Ontario, Canada for 2010–2014. Descriptive statistics were reported for Anatomic Therapeutic Chemical 4th level medication classes. Frequency of medications prescribed to older adults was calculated on different sex, age groups, types of medications, and injuries.

Results

Over five years (2010–2014), 288,251 older adults (63.2% females) were admitted to an emergency department for a fall-related injury (40.0% fractures, 12.1% brain injury). In the year before the injury, 48.5% were prescribed statins, 27.2% antidepressants, 25.0% opioids, and 16.6% anxiolytics. Females were prescribed more diuretics, antidepressants, and anxiolytics than males; and people aged 85 years and older had a higher percentage of diuretics, antidepressants, and antipsychotics. There were 36.4% of older adults prescribed 5–9 different medication classes and 41.2% were prescribed 10 or more medication classes.

Discussion

Older adults experiencing fall-related injuries were prescribed more opioids, benzodiazepines, and antidepressants than previously reported for the general population of older adults in Ontario. Higher percentage of females and more 85+ older adults were prescribed with psychotropic drugs, and they were also found to be at higher risk of fall-related injuries. Further

associations between medications and fall-related injuries need to be explored in well-defined cohort studies.

Key words: medication prescription, fall-related injuries, fall-related fractures, older adults

INTRODUCTION

Falls are the leading cause of both fatal and non-fatal injury in older adults.⁽¹⁾ Nearly one-third of older adults fall every year.⁽²⁻³⁾ Minor injuries, such as bruises or lacerations, occur in 30–50% of falls, while 5–10% of falls lead to serious injuries such as hip fractures or traumatic brain injury.⁽⁴⁻⁹⁾ Fall-related injuries can also result in adverse consequences such as reduced quality of life,⁽¹⁰⁾ higher possibility of admission to long-term care facilities,⁽¹⁰⁾ and increased risk of death.⁽¹¹⁾

Numerous fall-related risk factors in older adults have been identified through past research. Specific use of certain medications and concurrent use of more than four medications have consistently been reported to be associated with both increased risk of falls and fall-related injury in this population.⁽¹²⁻¹⁷⁾ Widely acknowledged fall risk-increasing drugs (FRIDs) include antihypertensive agents, diuretics, antidepressants, analgesics, anti-epileptics, and sedative/hypnotics.⁽¹⁸⁻²²⁾

While previous research has commonly investigated the association between specific and known FRIDs and fall-related injuries (e.g., benzodiazepines,⁽²³⁻²⁴⁾ anti-hypertensive medications,⁽²⁵⁻²⁶⁾ and antidepressants⁽²⁷⁻²⁸⁾), limited evidence currently exists regarding medication classes of other than FRIDs that were prescribed to older adults prior to a fall-related injury. Providing a more comprehensive picture of medication classes prescribed to older adults before the occurrence of a fall-related injury is necessary to expand our knowledge on medications that may induce any fall-related injury. Therefore, the purpose of this study was: 1) to describe medication classes and numbers of medication classes prescribed to older adults within one year prior to the fall-related

injury; and 2) to describe medication classes prescribed to older adults within one year prior to fall-related fractures and fall-related brain injury, as these two types of injury are of high prevalence and can cause serious consequences.⁽²⁹⁻³¹⁾

METHODS

Study Design and Setting

We conducted a population-based, descriptive study of medication classes prescribed to older adults who experienced at least one fall-related injury from 1 January 2010 to 31 December 2014, using Ontario health-care administrative data held by the provincial data steward ICES. Ontario is the largest province in Canada, with a population of over 13 million and 2.2 million older adults over the age of 65,⁽³²⁾ all of whom have access to universal health-care services. ICES is an independent, non-profit research institute whose legal status under Ontario's health information privacy law allows it to collect and analyze health-care and demographic data, without consent, for health system evaluation and improvement. ICES is a prescribed entity under section 45 of Ontario's *Personal Health Information Protection Act*. Section 45 authorizes ICES to collect personal health information, without consent, for the purpose of analysis or compiling statistical information with respect to the management of, evaluation or monitoring of, the allocation of resources to or planning for all or part of the health system. Projects conducted under section 45, by definition, do not require review by a Research Ethics Board. This project was conducted under section 45, and was approved by ICES' Privacy and Legal Office.

Population

Older adults aged 66 years and older who experienced a fall-related injury over the study period and resided in Ontario were included in this study. We chose the study period to be between 2010 and 2014 because it aligns well with the first of 'baby boomers' reaching the age of 65. The result of this study can serve as a baseline characteristics description for comparison with our future fall-related injuries research results. A fall-related injury was defined by combining at least one ICD-10 code for falls (W00-W19) with at least one code for injury (S00-S99, T00-T14) (Appendix A). The Emergency Department visit date for a fall-related injury was defined as the index date. Fall-related injuries of interest in this study were: 1) any fall-related injury; 2) fall-related fracture; and 3) fall-related traumatic brain injury (TBI). Fall-related fracture was identified through presence of at least one specific fracture S code (S02, S12, S22, S32, S42, S52, S62, S72, S82, S92, T02, T08, T10, T12, T142) and one W code (W00-W19). Fall-related traumatic brain injury was identified by presence of at least one specific concussion and brain injury code (S06, S099) and one W code (W00-W19). If a patient had multiple falls during the time period, only the first fall was included.

Data Sources

We used records arising from several databases held by ICES, including: 1) the Ontario Drug Benefit (ODB) database,

which provides prescription drug coverage data for residents over the age of 65, including individuals in long-term care homes;⁽³³⁾ 2) the Discharge Abstract Database (DAD), which records information on all hospital admissions and discharge diagnosis; 3) the National Ambulatory Care Reporting System (NACRS), which captures information on visits to emergency departments and community-based ambulatory care facilities; and 4) the Ontario Registered Persons Database (RPDB), which contains demographic information for Ontario residents. ICES also applied validated case definition, including diabetes, chronic obstructive pulmonary diseases (COPD), asthma, hypertension, and dementia to each older adult and produced flags for these comorbidities. These datasets were linked using a unique encoded identifier, which ensured the confidentiality of personal and health information. In this study, socio-demographic data were extracted from the RPDB, primary diagnosis data arose from both NACRS and DAD, and medication prescriptions were drawn from ODB.

Medication Information

Medication information extracted from the ODB database used the Drug Identification Number (DIN) assigned by Health Canada.⁽³⁴⁾ Each DIN uniquely identifies the manufacturer, trade name, active ingredients, strength of active ingredients, pharmaceutical form, and route of administration.⁽³⁴⁾ For better understanding and comparability with the results of other studies, DIN codes were converted into Anatomical Therapeutic Chemical (ATC) level 5 codes, which represent the chemical substance.⁽³⁵⁾ Medication prescription information was reported on the 4th level of ATC codes in this study. ATC 4th level is the level used to count number of different medications as it is the level which aggregates medications just above their descriptive chemical substance.^(36,37)

Outcomes

The primary outcome of this study was medication classes prescribed to older adults within one year prior to any fall-related injury, fall-related fractures, and fall-related traumatic brain injuries. Canadian Institute of Health Information reported medication use in general older adult population during the whole year of 2016.⁽³⁷⁾ To allow contextualization and comparison of our results with their findings,⁽³⁷⁾ we chose one year look-back window for medication use in older adults who have experienced fall-related injuries. We also explored medication prescription patterns in both fall-related fractures and fall-related brain injuries and medications taken in the year prior to these specific injuries. Finally, the number of ATC 4th level medication classes prescribed to each older adult within a year was calculated and summarized into four categories: 0–4 medication classes, 5–9 medication classes, 10–14 medication classes, and 15 or more medication classes.⁽³⁷⁾

Statistical Analysis

Descriptive analysis summarized the cohort baseline characteristics such as age, sex, age group, and income quintile. Income quintile is a measure of socioeconomic status that

divides the population living in the same dissemination area into five income groups (1 represents the lowest income) with approximately 20% of the population in each group.⁽³⁸⁾ The dissemination area was determined from the older adults' residential postal code and statistics Canada Census data.⁽³⁹⁾ Prevalence of diabetes, COPD, asthma, hypertension, and dementia was also calculated using descriptive statistics. The fall-related injury (any injury type) was reported for each year and as a five-year total (2010–2014).

The percentage of people prescribed each ATC 4th level medication class was calculated by dividing the number of people who were prescribed a certain class within a year prior to a fall-related injury (numerator) by the total number of people who experienced a fall-related injury (denominator). The top 20 medication classes with the highest number of users were summarized as the percentage of female and male users, and percentage of different age-group users (i.e., 66–74, 75–84, 85+). The same analysis was repeated for subgroups of older adults who experienced fall-related fractures and fall-related TBIs. The difference between percentages of female and male older adults prescribed certain medication classes was determined by Wilcoxon rank-sum test and the comparison among different age groups was determined by Kruskal-Wallis test. All analyses were conducted with SAS 9.4 (SAS Institute Inc., Cary, NC).

RESULTS

A total of 288,251 older adults experienced any fall-related injury during the time frame of interest. Fall-related fractures

made up 40.0% of all fall-related injuries, superficial injuries were 23.2%, open wound were 16.3%, traumatic brain injury were 12.1%, sprains and strains were 5.0%, and other injuries were 3.5%. The mean age was 78.3 ± 7.8 years old and 63.2% of the older adults were female. Over three quarters (76.9%) were diagnosed with hypertension, 30.5% with diabetes, 26.9% with COPD, 15.8% with dementia, and 15.0% with asthma (Table 1). Of the study population, 3.5% were not prescribed any medication classes within one year before the injury, while 18.9% were prescribed 1–4 different medication classes, 36.4% were prescribed 5–9 different medication classes, 26.0% were prescribed 10–14 different medication classes, and 15.2% were prescribed more than 15 different medication classes. Complete medication classes prescribed are provided in Appendix B, Table B1.

HMG-CoA reductase inhibitors (C10AA), commonly known as statins and used to treat high cholesterol, were the most commonly prescribed medication class, used by nearly half (48.5%) of the study population (Table 2). They were also the most frequently prescribed medication class in analyses stratified by sex and age subgroups (Figure 1). More than half (54.8%) of males were using statins before they experienced any fall-related injury. In the 75–84 age group, 53.4% used statins and the percentage dropped to 42.8% in the group of 85 years and older adults. The most prescribed statin (Appendix B, Table B2) was atorvastatin (24.3% in all older adults who experienced fall-related injuries), followed by rosuvastatin (17.2%) and pravastatin (1.9%).

Proton pump inhibitors (PPIs, A02BC) were the second most prescribed drug class, with 34.3% of all older adults. For

TABLE 1.
Characteristics of older adults who experienced fall-related injuries in 2010-2014.

	2010	2011	2012	2013	2014	2010-2014
Age (Mean ± SD)	78.7 ± 7.6	78.5 ± 7.7	78.5 ± 7.8	78.1 ± 7.9	77.8 ± 8.0	78.3 ± 7.8
Age Median	79	79	79	78	78	78
Total Number	56,203	56,230	55,945	58,950	60,923	288,251
Age 66-74 (n, %)	18,673 (33.2)	19,296 (34.3)	19,842 (34.8)	22,160 (37.6)	23,813 (39.1)	103,424 (35.9)
Age 75-84 (n, %)	22,429 (39.9)	22,014 (39.2)	21,551 (38.5)	21,644 (36.7)	21,752 (35.7)	109,400 (38.0)
Age 85+ (n, %)	15,091 (26.9)	14,920 (26.5)	14,912 (26.7)	15,146 (25.7)	15,358 (25.2)	75,427 (26.2)
Sex Female (n, %)	36,562 (65.1)	35,976 (64.0)	35,315 (63.4)	36,492 (61.9)	37,656 (61.8)	182,136 (63.2)
Income Quintile						
1 (lowest)	11,687 (20.88%)	11,325 (20.22%)	11,169 (20.04%)	11,668 (19.87%)	13,868 (22.80%)	59,717 (20.79%)
2	11,525 (20.59%)	11,455 (20.46%)	11,521 (20.68%)	11,953 (20.35%)	13,486 (22.17%)	59,940 (20.87%)
3	11,134 (19.89%)	10,922 (19.50%)	10,921 (19.60%)	11,480 (19.55%)	11,816 (19.43%)	56,273 (19.59%)
4	10,887 (19.45%)	11,146 (19.90%)	11,208 (20.11%)	11,920 (20.30%)	10,581 (17.40%)	55,742 (19.41%)
5	10,737 (19.18%)	11,151 (19.91%)	10,902 (19.57%)	11,712 (19.94%)	11,069 (18.20%)	55,571 (19.35%)
Comorbidities						
Diabetes (n, %)	16,639 (29.6)	16,926 (30.1)	17,036 (30.5)	18,200 (30.9)	19,161 (31.5)	87,962 (30.5)
COPD (n, %)	15,388 (27.4)	15,207 (27.0)	15,223 (27.2)	15,781 (26.8)	15,963 (26.2)	77,572 (26.9)
Asthma (n, %)	8,379 (14.9)	8,374 (14.9)	8,283 (14.8)	8,951 (15.2)	9,192 (15.1)	43,179 (15.0)
Hypertension (n, %)	43,325 (77.1)	43,332 (77.1)	43,197 (77.2)	45,113 (76.5)	46,556 (76.4)	221,523 (76.9)
Dementia (n, %)	9,329 (16.6)	9,175 (16.3)	8,934 (16.0)	9,130 (15.5)	9,007 (14.8)	45,575 (15.8)

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age groups 75–84 and 85 years and older, a slightly greater percentage of PPI use was found (36.2% and 36.5%, respectively), while the age group 66–74 years old had somewhat lower prevalence (30.6%, Figure 1). Commonly prescribed medications included pantoprazole (14.2%), rabeprazole (13.2%), lansoprazole (5.1%), and omeprazole (4.7%).

Four drug classes for the management of hypertension were noted among the top 10 drug classes. Angiotensin-converting enzyme inhibitors (ACEIs, C09AA) were prescribed to 33.9% of male and 26.1% females. Most common ACEIs were ramipril (14.8%), perindopril (7.0%), enalapril (2.4%), and lisinopril (2.0%). A higher percentage of males (27.8%) were prescribed beta-blocking agents (BBs) than females (24.8%). BBs included metoprolol (11.5%), bisoprolol (7.6%), and atenolol (6.7%). Agents acting on the renin-angiotensin system (ARBs, C09CA) included candesartan, valsartan, irbesartan, losartan, and telmisartan. Thiazides (C03AA) included hydrochlorothiazide (15.2%) and indapamide (2.2%). ARBs and thiazides were prescribed in higher percentage to females than males. The prescription of agents for treatment of high blood pressure increased with age (Figure 1). The percentage of the 85 years and older age group prescribed ACEIs,

beta-blocking agents and dihydropyridine derivatives were the highest among the three age groups.

Biphosphates (M05BA) and thyroid hormones (H03AA) were prescribed to 28.3% and 23.1% of females, but only to 7.1% and 10.0% males, respectively. These two medication classes emerged as the most gender-specific among the older adults who experienced any fall-related injury. The percentage of older adults prescribed these two drug classes also increased with age (Figure 1), with the age group 85 years and older having the highest percentage.

Natural opium alkaloids (N02AA) were prescribed to a quarter of female and male older adults. For example, codeine and oxycodone were prescribed to 17.3% and 6.6%, respectively, of older adults who had fall-related injuries one year prior to the injury. The highest percentage of opioids prescription was noted for the age group 75–84 years. Older adults 85 years and older were prescribed fewer opioids than the other two age groups (Figure 1). Benzodiazepine derivatives were prescribed to 19.0% females and 12.4% males, with an increase with age to 18.5% in 85 years and older people. Lorazepam was prescribed to 12.2%, oxazepam to 2.7%, and clonazepam to 2.7% of older adults. For antidepressants, such

TABLE 2.
Top 20 medication classes prescribed to older adults prior to a fall-related injury, percentage of users, 2010-2014

ATC Code	Drug Class	Common Use	Percentage of Use			
			Total (%)	Female (%)	Male (%)	p value
C10AA	HMG CoA reductase inhibitors	High cholesterol	48.5	44.7	54.8	<0.01
A02BC	Proton pump inhibitors	Gastroesophageal reflux, peptic ulcer disease	34.3	35.8	31.7	<0.01
C09AA	ACE inhibitors, plain	High blood pressure	29.0	26.1	33.9	<0.01
C07AB	Beta blocking agents, selective	High blood pressure, heart failure	25.9	24.8	27.8	<0.01
N02AA	Natural opium alkaloids	Management of moderate to severe pain	25.0	25.0	25.0	0.72
C08CA	Dihydropyridine derivatives	High blood pressure, heart failure, angina	23.7	24.8	21.8	<0.01
M05BA	Biphosphates	Prevent bone density loss, treat osteoporosis	20.4	28.2	7.1	<0.01
H03AA	Thyroid hormones	Hypothyroidism	18.3	23.1	10.0	<0.01
H02AB	Glucocorticoids	Autoimmune and inflammatory disorders, cancer, asthma, COPD	17.0	16.6	17.7	<0.01
N05BA	Benzodiazepine derivatives	Agitation, anxiety, insomnia, seizures	16.6	19.0	12.4	<0.01
C03CA	Sulfonamides, plain	High blood pressure, heart failure	16.5	16.0	17.5	<0.01
C09CA	Agents acting on the renin-angiotensin system	High blood pressure, heart or kidney disease	16.3	17.7	13.8	<0.01
C03AA	Thiazides, plain	High blood pressure, heart or kidney disease	15.2	17.0	12.1	<0.01
J01MA	Fluoroquinolones	Respiratory and urinary tract infections	15.2	15.2	15.1	0.56
N06AB	Selective serotonin reuptake inhibitors	Depression	14.7	16.4	11.9	<0.01
A10BA	Biguanides	Type 2 diabetes	14.3	12.9	16.8	<0.01
J01CA	Penicillins with extended spectrum	Bacterial infection	13.6	13.6	13.7	0.58
R03CC	Selective beta-2-adrenoreceptor agonists	COPD, asthma	13.1	13.3	12.8	<0.01
A06AA	Softeners, emollients	constipation	12.9	12.8	13.1	0.04
N06AX	Other antidepressant (TCAs)	Depression	12.5	13.5	10.7	<0.01

as selective serotonin reuptake inhibitors (SSRIs, including citalopram, escitalopram, fluoxetine, etc.) and tricyclic antidepressants (TCAs, including amitriptyline, clomipramine, and doxepin), there was a higher percentage of female users than male users, namely 16.4% female, 11.9% male for SSRIs and 13.5% female, 10.7% male for TCAs.

Fall-related fractures were diagnosed in 115,230 older adults (40.0% of all older adults with any fall-related injury). More women (70.7%) than men (29.3%) experienced fall-related fractures. For 85 years and older age group, the number of females (22,231) was almost three times as many as males (7,742). Statins and PPIs were still the top two most commonly prescribed medication classes. A higher percentage of males were prescribed statins, ACEIs, and BBs than females, while a higher percentage of females were prescribed bisphosphonates, dihydropyridine derivatives, and thyroid hormones. As for age differences, adults 85 years and older had the highest percentage of prescribed ACEIs, BBs, bisphosphonates, dihydropyridine derivatives, thyroid hormones, benzodiazepine derivatives, agents acting on the renin-angiotensin system, SSRIs, fluoroquinolones, and emollients (Table 3).

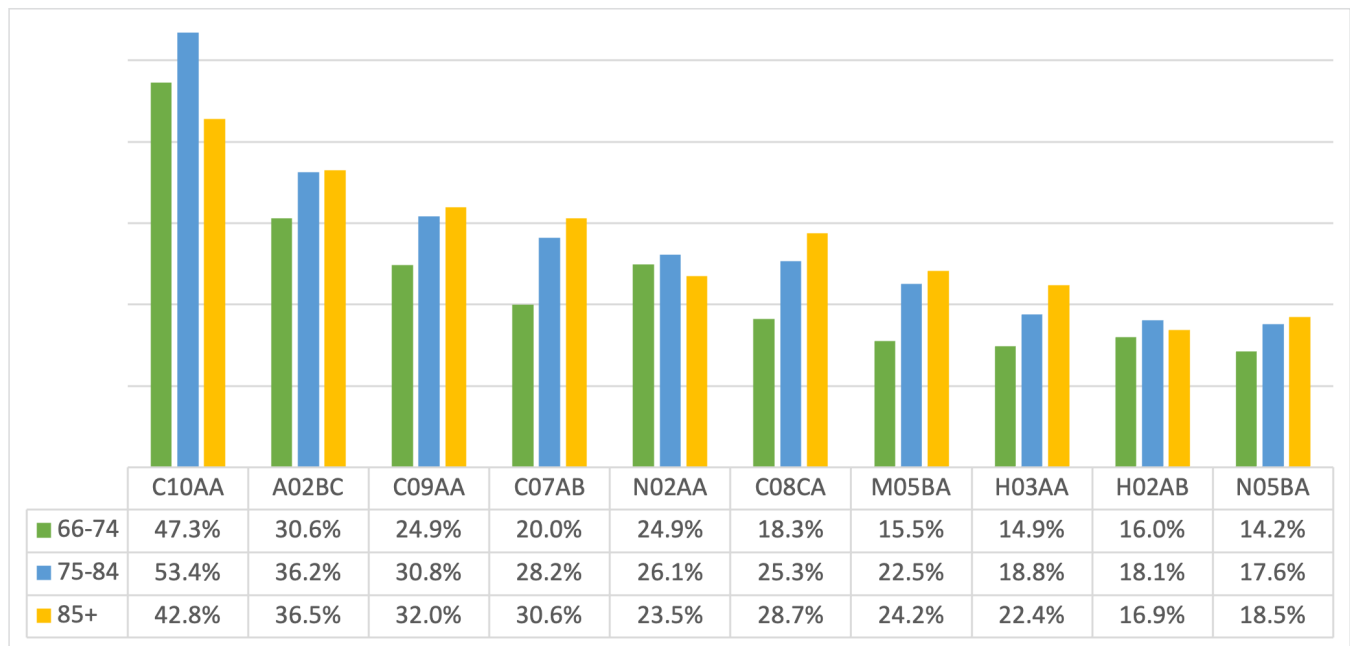
Fall-related TBIs was observed in 34,810 older adults (12.1% of all older adults with any fall-related injury), 20,246 occurred in females (58.7%) and 14,364 in males (41.3%). Nearly a third (31.7%) of older adults who experienced fall-related TBIs were in the 66–74 age group, with 39.9% in the 75–84 and 28.4% in the 85+ age groups, respectively. A higher percentage of males diagnosed with fall-related traumatic brain injury were prescribed statins, ACEIs, and BBs than

females, while higher percentage of females were prescribed opioids, benzodiazepine derivatives, bisphosphonates, and thyroid hormones. As for age groups, adults 85 years and older had the highest prescriptions of ACEIs, BBs, dihydropyridine derivatives, bisphosphonates, thyroid hormones, sulfonamides, benzodiazepine derivatives, SSRIs, fluoroquinolones, emollients, TCAs, and contact laxatives (Table 4).

DISCUSSION

Using health-care administrative data, this study has described the medication classes prescribed to older adults in one year prior to a fall-related injury and two specific fall-injury types (i.e., fracture and traumatic brain injury). The results showed that among older adults sustaining any fall-related injury, 48.5% were prescribed statins, 34.3% PPIs, 25.0% opioids, and 16.6% anxiolytics. Similar patterns of medication prescription were also found for fall-related fractures and traumatic brain injury. Notably, 36.4% of older adults were prescribed 5–9 different medication classes and 41.2% were prescribed 10 or more medication classes within one year prior to fall-related injuries.

The findings of this study also indicate that medications prescribed to older adults who had any fall-related injury were similar—but not the same—to medications prescribed to the general population of older adults in Ontario.⁽³⁷⁾ CIHI reported that, in the whole year of 2016, there were 51.7% and 17.3% of Ontario general population of older adults (OGP-OAs) who were prescribed statins and agents acting on RAS,⁽³⁷⁾ while in our study, 48.5% and 16.3% of older adults who



^aC10AA, HMG CoA reductase inhibitors; A02BC, proton pump inhibitors; C09AA, ACEIs; C07AB, beta blocking agents; N02AA, Natural opium alkaloids; C08CA, dihydropyridine derivatives; M05BA, bisphosphonates; H03AA, thyroid hormones; H02AB, glucocorticoids for systematic use; N05BA, benzodiazepine derivatives

FIGURE 1. Top 10 medications^a prescribed to older adults of different age group before they experienced a fall-related injury

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TABLE 3.

Top 20 medication classes prescribed to older adults with fall-related fracture, usage rate by sex and age group, 2010-2014

ATC Codes	Drug Class					Age Group			
		Total (%)	Female (%)	Male (%)	<i>p</i> value ^a	66-74 (%)	75-84 (%)	85+ (%)	<i>p</i> value ^b
C10AA	HMG CoA reductase inhibitors	45.4	42.5	52.4	<0.01	44.6	50.4	39.6	<0.01
A02BC	Proton pump inhibitors	33.1	33.9	31.0	<0.01	29.2	35.1	35.4	<0.01
C09AA	ACE inhibitors, plain	27.6	25.5	32.8	<0.01	23.1	29.5	31.0	<0.01
N02AA	Natural opium alkaloids	24.5	24.2	25.2	<0.01	23.7	26.0	23.5	<0.01
C07AB	Beta blocking agents, selective	24.5	23.7	26.2	<0.01	18.4	26.8	29.3	<0.01
M05BA	Biphosphates	23.6	30.0	8.1	<0.01	18.9	26.1	26.5	<0.01
C08CA	Dihydropyridine derivatives	23.6	24.3	21.8	<0.01	17.7	25.2	29.2	<0.01
H03AA	Thyroid hormones	18.6	22.3	9.7	<0.01	15.1	18.9	22.7	<0.01
N05BA	Benzodiazepine derivatives	16.6	18.5	12.1	<0.01	13.9	17.8	18.7	<0.01
H02AB	Glucocorticoids	16.1	15.5	17.4	<0.01	15.3	17.0	15.8	<0.01
C09CA	agents acting on the renin-angiotensin system	15.7	16.7	13.3	<0.01	14.1	17.0	16.0	<0.01
C03CA	Sulfonamides, plain	15.5	14.9	16.9	<0.01	8.3	15.3	25.2	<0.01
C03AA	Thiazides, plain	14.7	16.1	11.3	<0.01	12.8	15.7	15.7	<0.01
N06AB	Selective serotonin reuptake inhibitors	14.6	15.7	11.9	<0.01	13.0	14.9	16.4	<0.01
J01MA	Fluoroquinolones	14.3	14.2	14.6	0.14	11.6	14.8	17.3	<0.01
J01CA	Penicillins with extended spectrum	13.0	13.0	13.1	0.51	13.7	13.3	11.7	<0.01
A10BA	Biguanides	12.7	11.7	15.3	<0.01	14.1	14.0	9.2	<0.01
R03CC	Selective beta-2-adrenoreceptor agonists	12.4	12.3	12.4	0.62	12.6	12.9	11.4	<0.01
A06AA	Softeners, emollients	12.2	11.9	13.0	<0.01	7.8	13.3	16.5	<0.01
N06AX	Other antidepressants	12.1	12.8	10.3	<0.01	10.9	12.1	13.5	<0.01

^aWilcoxon rank-sum test.

^bKruskal-Wallis test.

had fall related injury (FRI-OAs) were prescribed statins and ARBs within the year before the injury. However, compared to prescription in OGP-OAs, higher percentage of FRI-OAs were prescribed with ACEIs, BBs, opioids, bisphosphonates, benzodiazepine derivatives, thiazides, and SSRI. For example, CIHI reported there were 15.4% of OGP-OAs prescribed opioids, while in our study, 25.0% of FRI-OAs were prescribed opioids the year before their fall-related injury. The percentage of being prescribed SSRI in FRI-OAs and OGP-OAs were 14.6% and 10.5% respectively, bisphosphonates were 20.4% and 9.4% respectively, and benzodiazepine derivatives were 15.2% and 10.8% respectively.

From the above comparison, a finding is that all medication classes (except for bisphosphonates) with a higher percentage of prescription in older adults who had any fall-related injury were recognized as FRIDs. These classes of medications have been repeatedly identified to be related to falls and fall-related injury.⁽⁴⁰⁻⁴³⁾ In this aspect, findings from our studies were supportive to previous studies on FRIDs and their association with falls and fall-related injury.

In this study, a number of medication classes were prescribed to a high percentage of older adults the year before they had fall-related injury, such as statins (48.5%), PPIs (34.3%), bisphosphonates (20.4%), thyroid hormones (18.3%), glucocorticoids (17.0%), and fluoroquinolones (15.2%). Unfortunately, research regarding the association between these medication classes and fall-related injuries has not been well-established.^(26,44) The role of these commonly prescribed medication classes on fall-related injury in older adults needs to be disclosed as well.

Medications can be seen as a surrogate for a person's health status and the number of medications was a valid proxy for multi-comorbidities.⁽⁴⁵⁾ Using multiple medications concurrently is common in older adults with multi-comorbidities and is associated with adverse outcomes such as mortality, falls, injuries, adverse drug reactions, and prolonged length of stay in hospital.⁽⁴⁶⁻⁴⁸⁾ The risk of having adverse consequences and experiencing harm increased with each additional medication because of complicated drug-drug and drug-disease interactions.⁽⁴⁹⁾ Our study showed that 77.9% of older adults

TABLE 4.
Top 20 medication classes prescribed to older adults with fall-related traumatic brain injury, by sex and age group

ATC Codes	Drug Class					Age Group			
		Total (%)	Female (%)	Male (%)	<i>p</i> value ^a	66-74 (%)	75-84 (%)	85+ (%)	<i>p</i> value ^b
C10AA	HMG CoA reductase inhibitors	52.0	48.2	57.4	<0.01	49.5	57.3	47.3	<0.01
A02BC	Proton pump inhibitors	35.5	37.5	32.5	<0.01	31.8	37.3	36.9	<0.01
C09AA	ACE inhibitors, plain	30.3	27.3	34.6	<0.01	26.1	31.9	32.7	<0.01
C07AB	Beta blocking agents, selective	28.7	27.7	30.2	<0.01	22.1	30.8	33.2	<0.01
C08CA	Dihydropyridine derivatives	25.1	26.5	23.1	<0.01	19.3	26.9	29.2	<0.01
N02AA	Natural opium alkaloids	24.9	25.4	24.1	<0.01	25.0	25.7	23.5	<0.01
M05BA	Biphosphates	19.4	28.1	7.0	<0.01	13.9	20.9	23.3	<0.01
H03AA	Thyroid hormones	19.1	24.8	11.0	<0.01	15.7	19.0	23.1	<0.01
C03CA	Sulfonamides, plain	18.1	17.5	19.0	<0.01	10.3	17.5	27.6	<0.01
C09CA	agents acting on the renin-angiotensin system	17.4	19.3	14.8	<0.01	15.8	19.0	17.0	<0.01
H02AB	Glucocorticoids	17.3	17.2	17.5	0.34	16.1	18.3	17.4	<0.01
N05BA	Benzodiazepine derivatives	17.2	20.0	13.2	<0.01	15.7	17.8	18.0	<0.01
A10BA	Biguanides	16.6	15.2	18.6	<0.01	18.2	18.1	12.6	<0.01
N06AB	Selective serotonin reuptake inhibitors	16.5	18.6	13.6	<0.01	15.2	16.9	17.4	<0.01
J01MA	Fluoroquinolones	16.1	16.2	16.0	0.64	13.0	16.5	18.9	<0.01
C03AA	Thiazides, plain	15.3	17.6	12.1	<0.01	13.4	16.7	15.5	<0.01
J01CA	Penicillins with extended spectrum	14.4	14.7	14.0	0.06	15.5	14.2	13.7	<0.01
A06AA	Softeners, emollients	14.4	14.2	14.6	0.30	10.1	15.2	18.1	<0.01
N06AX	Other antidepressants	13.4	14.8	11.5	<0.01	13.1	13.0	14.4	<0.01
R03CC	Selective beta-2-adrenoreceptor agonists	12.8	13.3	12.0	<0.01	13.0	12.9	12.2	0.14

^aWilcoxon rank-sum test.

^bKruskal-Wallis test.

who had any fall-related injury were prescribed five or more different classes of medication within one year before the injury and 41.2% were prescribed 10 or more different classes of medication. CIHI reported that 65.7% general population of older adults in Canada were prescribed five or more medication classes and 26.5% were prescribed 10 or more medication classes in the year of 2016.⁽³⁷⁾ Compared with the general population of older adults, a higher percentage of older adults who experienced fall-related injuries were prescribed multiple medication classes before the injury. Untangling multiple medications prescribed to older adults by enhancing communication between patients and health-care providers, and improving cooperation of pharmacists, family doctors, and specialists in prescribing practices will be important in future research.

Strengths and Limitations

The strengths of this study are the large number of observations and provincial representativeness. This study included

data for over a quarter million older adults and provided detailed information on demographics, comorbidities, and strictly defined fall-related injury using ICD-10-CA codes. All the data were obtained from ICES databases which were reported to have excellent data completeness⁽⁵⁰⁾ and high quality as per previous studies.⁽⁵¹⁻⁵³⁾

Several limitations are associated with this study. First is the inherent limitation of administrative data that may lead to underreporting of some diagnoses,⁽⁵⁴⁾ which might have been omitted during the coding process. Second, only dispensed drugs were recorded in the ODB database, and the information collected through the ODB database could be an underestimation of prescriptions. Additionally, prescription (and even dispensing) cannot be equated with actual use. If older adults forgot to take medications as they were instructed, the registry data could be an overestimation of drug use; while on the other hand, if older adults get medications with multiple pharmacies, the registry data could underestimate the actual medication use.

CONCLUSION

This study described the medications classes and numbers of medication classes prescribed to older adults prior to a fall-related injury. Gender difference in medication prescribed was noted, specifically more females were prescribed antidepressants (SSRIs and TCAs) and anxiolytics (short-acting benzodiazepines such as lorazepam and long-acting such as clonazepam). A higher percentage of people 85 years and older were prescribed antihypertensive agents (ACEIs, BBs and dihydropyridine derivatives) and anxiolytics (benzodiazepines). There were 77.6% older adults were prescribed five or more different medication classes prior to any fall-related injury. Well-designed cohort studies are needed to determine the association between medication classes and different types of fall-related injuries.

ACKNOWLEDGEMENTS

This study was supported by ICES, which is funded by an annual grant from the Ontario Ministry of Health and Long-Term Care (MOHLTC). The opinions, results, and conclusions reported in this paper are those of the authors and are independent from the funding sources. No endorsement by ICES or the Ontario MOHLTC is intended or should be inferred.

CONFLICT OF INTEREST DISCLOSURES

We have read and understood the *Canadian Geriatrics Journal's* policy on conflicts of interest disclosure and declare there are not conflicts of interest.

FUNDING

This research did not receive external funding.

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Correspondence to: Yu Ming, PhD, School of Health Studies, Western University, 1151 Richmond Street, London, ON, Canada N6A3K7

Email: yming5@uwo.ca

APPENDIX A. ICD-10 codes for injuries and falls

Falls

- W00 Fall on same level involving ice and snow
- W01 Fall on same level from slipping, tripping and stumbling
- W02 Fall involving skates, skis, sport boards and in-line skates
- W03 Other fall on same level due to collision with, or pushing by, another person
- W04 Fall while being carried or supported by other persons
- W05 Fall involving wheelchair
- W06 Fall involving bed
- W07 Fall involving chair
- W08 Fall involving other furniture
- W09 Fall involving swing
- W10 Fall on and from stairs and steps
- W11 Fall on and from ladder
- W12 Fall on and from scaffolding
- W13 Fall from, out of or through building or structure
- W14 Fall from tree
- W15 Fall from cliff
- W16 Diving or jumping into water causing injury other than drowning or submersion
- W17 Other fall from one level to another
- W18 Fall on same level in or from bathtub
- W19 Unspecified fall

Injury

- S00-S09 Injuries to the head
- S10-S19 Injuries to the neck
- S20-S29 Injuries to the thorax
- S30-S39 Injuries to the abdomen, lower back, lumbar spine and pelvis
- S40-S49 Injuries to the shoulder and upper arm
- S50-S59 Injuries to the elbow and forearm
- S60-S69 Injuries to the wrist and hand
- S70-S79 Injuries to the hip and thigh
- S80-S89 Injuries to the knee and lower leg
- S90-S99 Injuries to the ankle and foot
- T00-T07 Injuries involving multiple body regions
- T08-T14 Injuries to unspecified parts of trunk, limb or body region

TABLE B1. Continued

ATC Codes	Drug Class	Female				Male				Total			
		66-74	75-84	85+	Total	%	66-74	75-84	85+	Total	%		
A10BX	Other blood glucose lowering drugs, excl. insulins	43	79	37	159	0.1	28	51	16	95	0.1	254	0.1
A11CC	Vitamin D and analogues	499	837	629	1965	1.1	458	668	395	1521	1.4	3486	1.2
B01AA	Vitamin K antagonists	2280	5597	5833	13710	7.5	2643	5344	3576	11563	10.9	25273	8.8
B01AB	Heparin group	505	537	323	1365	0.7	371	476	206	1053	1.0	2418	0.8
B01AC	Platelet aggregation inhibitors excl. heparin	2830	5263	5008	13101	7.2	3413	4923	3042	11378	10.7	24479	8.5
B01AE	Direct thrombin inhibitors	317	884	809	2010	1.1	381	793	560	1734	1.6	3744	1.3
B01AF	Direct factor Xa inhibitors	758	1037	714	2509	1.4	526	785	486	1797	1.7	4306	1.5
B01AX	Other antithrombotic agents	20	26	16	62	0.0	18	23	13	54	0.1	116	0.0
B03AD	Iron in combination with folic acid	3393	5997	5509	14899	8.2	2075	3733	2846	8654	8.2	23553	8.2
B03BA	Vitamin B12 (cyanocobalamin and analogues)	2196	3648	3523	9367	5.1	1119	1986	1559	4664	4.4	14031	4.9
B03BB	Folic acid and derivatives	1303	1610	1091	4004	2.2	737	890	559	2186	2.1	6190	2.1
B03XA	Other antianemic preparations	75	141	83	299	0.2	43	106	63	212	0.2	511	0.2
B05AA	Blood substitutes and plasma protein fractions	177	348	296	821	0.5	69	128	107	304	0.3	1125	0.4
B05BB	Solutions affecting the electrolyte balance	426	484	245	1155	0.6	318	379	174	871	0.8	2026	0.7
B05XA	Electrolyte solutions	15	25	16	56	0.0	7	9	9	25	0.0	81	0.0
C01AA	Digitalis glycosides	779	2358	3301	6438	3.5	892	1812	1525	4229	4.0	10667	3.7
C01BC	Antiarrhythmics, class Ic	185	245	131	561	0.3	90	128	64	282	0.3	843	0.3
C01CA	Adrenergic and dopaminergic agents	36	83	32	151	0.1	50	108	51	209	0.2	360	0.1
C01DA	Organic nitrates	3102	5853	6997	15952	8.8	2937	4645	3545	11127	10.5	27079	9.4
C02AB	Methyl dopa	60	105	118	283	0.2	25	41	25	91	0.1	374	0.1
C02AC	Imidazoline receptor agonists	309	217	118	644	0.4	82	71	33	186	0.2	830	0.3
C02CA	Alpha-adrenoreceptor antagonists	221	333	282	836	0.5	451	761	429	1641	1.5	2477	0.9
C02DB	Hydrazinophthalazine derivatives	171	324	277	772	0.4	155	270	129	554	0.5	1326	0.5
C03AA	Thiazides, plain	9338	12533	9169	31040	17.0	4603	5321	2940	12864	12.1	43904	15.2
C03BA	Sulfonamides, plain	1769	2527	1806	6102	3.4	1148	1518	781	3447	3.2	9549	3.3
C03CA	Sulfonamides, plain	5460	10254	13402	29116	16.0	4101	7758	6709	18568	17.5	47684	16.5
C03DA	Aldosterone antagonists	1204	1821	1921	4946	2.7	1055	1478	957	3490	3.3	8436	2.9
C03DB	Other potassium-sparing agents	629	832	632	2093	1.1	219	251	191	661	0.6	2754	1.0

TABLE B1. Continued

ATC Codes	Drug Class	Female				Male				Total			
		66-74	75-84	85+	Total	%	66-74	75-84	85+	Total	%	%	
C03EA	Low-ceiling diuretics and potassium-sparing agents	1189	1600	1349	4138	2.3	342	468	331	1141	1.1	5279	1.8
C04AD	Purine derivatives	114	221	240	575	0.3	142	237	136	515	0.5	1090	0.4
C07AA	Beta blocking agents, non-selective	857	1126	884	2867	1.6	545	681	418	1644	1.5	4511	1.6
C07AB	Beta blocking agents, selective	11055	18228	15896	45179	24.8	9634	12649	7206	29489	27.8	74668	25.9
C07AG	Alpha and beta blocking agents	400	641	521	1562	0.9	541	821	444	1806	1.7	3368	1.2
C07BB	Beta blocking agents, selective, and thiazides	180	234	128	542	0.3	80	67	35	182	0.2	724	0.3
C07CA	Beta blocking agents, non-selective, and other diuretics	21	38	29	88	0.0	10	14	9	33	0.0	121	0.0
C08CA	Dihydropyridine derivatives	11153	17993	15951	45097	24.8	7725	9698	5722	23145	21.8	68242	23.7
C08DA	Phenylalkylamine derivatives	240	357	298	895	0.5	144	162	96	402	0.4	1297	0.4
C08DB	Benzothiazepine derivatives	2993	4920	4251	12164	6.7	1870	2522	1499	5891	5.6	18055	6.3
C09AA	ACE inhibitors, plain	13192	18661	15763	47616	26.1	12529	15070	8356	35955	33.9	83571	29.0
C09BA	ACE inhibitors and diuretics	1985	2166	1370	5521	3.0	1604	1344	581	3529	3.3	9050	3.1
C09CA	agents acting on the renin-angiotensin system	9578	13183	9416	32177	17.7	5568	6204	2923	14695	13.8	46872	16.3
C09DA	Angiotensin II receptor blockers (ARBs) and diuretics	3124	3452	2029	8605	4.7	1747	1451	508	3706	3.5	12311	4.3
C09DB	ARBs and calcium channel blockers	832	832	451	2115	1.2	471	391	144	1006	0.9	3121	1.1
C10AA	HMG CoA reductase inhibitors	27117	33976	20398	81491	44.7	21800	24490	11904	58194	54.8	139685	48.5
C10AB	Fibrates	972	1162	467	2601	1.4	852	703	236	1791	1.7	4392	1.5
C10AC	Bile acid sequestrants	437	532	460	1429	0.8	189	246	157	592	0.6	2021	0.7
C10AD	Nicotinic acid and derivatives	74	65	14	153	0.1	132	90	28	250	0.2	403	0.1
C10AX	Other lipid modifying agents	2878	3148	1170	7196	4.0	2601	2442	707	5750	5.4	12946	4.5
C10BX	HMG CoA reductase inhibitors, other combinations	481	681	442	1604	0.9	442	508	206	1156	1.1	2760	1.0
D01AA	Antibiotics	305	404	393	1102	0.6	150	180	117	447	0.4	1549	0.5
D01AC	Imidazole and triazole derivatives	3499	4741	4472	12712	7.0	1862	2453	1767	6082	5.7	18794	6.5
D01AE	Other antifungals for topical use	1257	1299	969	3525	1.9	1091	1116	676	2883	2.7	6408	2.2
D05AX	Other antipsoriatrics for topical use	509	391	198	1098	0.6	444	353	140	937	0.9	2035	0.7
D06AX	Other antibiotics for topical use	3713	5171	5205	14089	7.7	2433	3659	2758	8850	8.3	22939	8.0
D06BX	Other chemotherapeutics	645	620	341	1606	0.9	245	275	119	639	0.6	2245	0.8
D07AA	Corticosteroids, weak (group I)	3848	5128	4542	13518	7.4	2120	3029	2199	7348	6.9	20866	7.2

TABLE B1. Continued

ATC Codes	Drug Class	Female				Male				Total			
		66-74	75-84	85+	Total	%	66-74	75-84	85+	Total	%		
D07AB	Corticosteroids, moderately potent (group II)	971	1099	773	2843	1.6	474	616	378	1468	1.4	4311	1.5
D07AC	Corticosteroids, potent (group III)	2290	2734	2014	7038	3.9	1525	2063	1242	4830	4.6	11868	4.1
D07AD	Corticosteroids, very potent (group IV)	1366	1317	789	3472	1.9	612	754	393	1759	1.7	5231	1.8
D07XC	Corticosteroids, potent, other combinations	200	198	177	575	0.3	121	146	97	364	0.3	939	0.3
D10AF	Antinfectives for treatment of acne	58	31	8	97	0.1	43	48	14	105	0.1	202	0.1
D10AH		79	78	66	223	0.1	49	47	20	116	0.1	339	0.1
G01AG	Triazole derivatives	195	157	83	435	0.2	N/A	N/A	N/A	N/A	0.0	440	0.2
G03BA	3-oxoandrosten (4) derivatives	6	4	3	13	0.0	541	370	118	1029	1.0	1042	0.4
G03CA	Natural and semisynthetic estrogens, plain	2917	2596	1530	7043	3.9	N/A	N/A	N/A	7	0.0	7050	2.4
G03HA	Androgens, plain	2	1	0	3	0.0	31	96	82	209	0.2	212	0.1
G03XA	Antigonadotropins and similar agents	482	585	390	1457	0.8	12	10	6	28	0.0	1485	0.5
G04BD	Drugs for urinary frequency and incontinence	2922	4248	3447	10617	5.8	1134	1898	1187	4219	4.0	14836	5.1
G04CA	Alpha-adrenoreceptor antagonists	841	1051	767	2659	1.5	6362	9975	6452	22789	21.5	25448	8.8
G04CB	Testosterone-5-alpha reductase inhibitors	N/A	N/A	N/A	N/A	0.0	3031	4997	3357	11385	10.7	11389	4.0
H02AB	Glucocorticoids	10186	11888	8114	30188	16.6	6354	7872	4605	18831	17.7	49019	17.0
H03AA	Thyroid hormones	12594	16233	13300	42127	23.1	2769	4286	3574	10629	10.0	52756	18.3
H03BA	Thiouracils	60	72	58	190	0.1	14	26	8	48	0.0	238	0.1
H04AA	Glycogenolytic hormones	80	98	85	263	0.1	72	84	36	192	0.2	455	0.2
J01AA	Tetracyclines	309	288	190	787	0.4	226	240	104	570	0.5	1357	0.5
J01CA	Penicillins with extended spectrum	9185	9310	6284	24779	13.6	5536	5849	3128	14513	13.7	39292	13.6
J01CF	Beta-lactamase resistant penicillins	571	669	691	1931	1.1	439	583	379	1401	1.3	3332	1.2
J01CR	Combinations of penicillins, incl. beta-lactamase inhibitors	1500	1419	1137	4056	2.2	1024	1038	570	2632	2.5	6688	2.3
J01DB	First-generation cephalosporins	18	31	21	70	0.0	15	15	13	43	0.0	113	0.0
J01DC	2nd-generation cephalosporins	1764	2008	1704	5476	3.0	1037	1343	815	3195	3.0	8671	3.0
J01DD	3rd-generation cephalosporins	297	445	379	1121	0.6	207	253	197	657	0.6	1778	0.6
J01EA	Trimethoprim and derivatives	116	213	193	522	0.3	57	101	65	223	0.2	745	0.3
J01EE	Intermediate-acting sulfonamides	2985	4057	3695	10737	5.9	1350	1864	1217	4431	4.2	15168	5.3
J01FA	Macrolides	8142	7044	4229	19415	10.7	4178	4042	2096	10316	9.7	29731	10.3

TABLE B1. Continued

ATC Codes	Drug Class	Female				Male				Total			
		66-74	75-84	85+	Total	%	66-74	75-84	85+	Total	%	%	
													#
J01FF	Lincosamides	1726	1740	976	4442	2.4	973	970	497	2440	2.3	6882	2.4
J01GB	Other aminoglycosides	14	21	11	46	0.0	9	18	N/A	31	0.0	77	0.0
J01MA	Fluoroquinolones	7489	9948	8864	26301	14.4	4765	6388	4268	15421	14.5	41722	14.5
J01XA	Glycopeptide antibacterials	20	34	21	75	0.0	9	22	12	43	0.0	118	0.0
J01XD	Imidazole derivatives	15115	1550	866	3931	2.2	872	860	423	2155	2.0	6086	2.1
J01XE	Nitrofurans derivatives	5186	7225	5696	18107	9.9	751	1310	1047	3108	2.9	21215	7.4
J01XX	Other antibacterials	N/A	N/A	N/A	14	0.0	8	N/A	N/A	13	0.0	27	0.0
J02AB	Imidazole derivatives	25	23	16	64	0.0	42	39	26	107	0.1	171	0.1
J02AC	Triazole derivatives	159	144	78	381	0.2	81	99	41	221	0.2	602	0.2
J04AK	Other drugs for tuberculosis	16	17	12	45	0.0	6	12	N/A	22	0.0	67	0.0
J04AM	Combinations of drugs for treatment of tuberculosis	33	43	39	115	0.1	22	36	16	74	0.1	189	0.1
J05AB	Nucleosides and nucleotides	887	1001	714	2602	1.4	466	556	272	1294	1.2	3896	1.4
J05AF	Nucleoside and nucleotide reverse transcriptase inhibitors	36	12	N/A	52	0.0	64	18	N/A	87	0.1	139	0.0
J05AH	Neuraminidase inhibitors	262	1017	2450	3729	2.0	219	535	778	1532	1.4	5261	1.8
L01AA	Nitrogen mustard analogues	46	111	56	213	0.1	49	89	41	179	0.2	392	0.1
L01AB	Alkyl sulfonates	108	90	28	226	0.1	33	23	N/A	56	0.1	282	0.1
L01BA	Folic acid analogues	1047	1046	431	2524	1.4	366	339	149	854	0.8	3378	1.2
L01BC	Pyrimidine analogues	63	83	14	160	0.1	31	46	20	97	0.1	257	0.1
L01XE	Protein kinase inhibitors	43	48	12	103	0.1	37	39	14	90	0.1	193	0.1
L01XX	Other antineoplastic agents	75	156	147	378	0.2	52	91	64	207	0.2	585	0.2
L02AB	Progestogens	52	100	107	259	0.1	60	110	68	238	0.2	497	0.2
L02AE	Gonadotropin releasing hormone analogues	N/A	N/A	N/A	N/A	0.0	487	1269	1087	2843	2.7	2844	1.0
L02BA	Anti-estrogens	243	291	230	764	0.4	10	30	30	70	0.1	834	0.3
L02BB	Anti-androgens	N/A	N/A	N/A	N/A	0.0	225	684	675	1584	1.5	1586	0.6
L02BG	Aromatase inhibitors	978	971	514	2463	1.4	N/A	N/A	N/A	10	0.0	2473	0.9
L03AA	Colony stimulating factors	98	45	15	158	0.1	31	26	6	63	0.1	221	0.1
L04AA	Selective immunosuppressants	240	175	46	461	0.3	202	105	15	322	0.3	783	0.3
L04AB	Tumor necrosis factor alpha (TNF-α) inhibitors	108	90	28	226	0.1	33	23	N/A	56	0.1	282	0.1

TABLE B1. Continued

ATC Codes	Drug Class	Female				Male				Total			
		66-74	75-84	85+	Total	%	66-74	75-84	85+	Total	%		
L04AD	Calcineurin inhibitors	270	169	97	536	0.3	203	160	62	425	0.4	961	0.3
L04AX	Other immunosuppressants	189	139	62	390	0.2	101	91	24	216	0.2	606	0.2
M01AE	Propionic acid derivatives	4491	3622	1766	9879	5.4	2570	1973	748	5291	5.0	15170	5.3
M01AH	Coxibs	3717	3891	2288	9896	5.4	1698	1729	778	4205	4.0	14101	4.9
M03BX	Other centrally acting agents	1119	850	306	2275	1.2	566	412	135	1113	1.0	3388	1.2
M04AA	Preparations inhibiting uric acid production	1240	2250	1920	5410	3.0	2683	3815	2010	8508	8.0	13918	4.8
M05BA	Biphosphates	14187	21354	15912	51453	28.2	1867	3299	2316	7482	7.1	58935	20.4
M05BX	Other drugs affecting bone structure and mineralization	446	896	679	2021	1.1	14	35	28	77	0.1	2098	0.7
N02AA	Natural opium alkaloids	15408	17873	12311	45592	25.0	10350	10711	5437	26498	25.0	72090	25.0
N02AB	Phenylpiperidine derivatives	608	922	877	2407	1.3	334	407	237	978	0.9	3385	1.2
N02AJ	Opioids in combination with non-opioid analgesics	13685	15531	10035	39251	21.6	9283	9555	4712	23550	22.2	62801	21.8
N02BA	Salicylic acid and derivatives	1351	2294	1931	5576	3.1	1239	1785	1078	4102	3.9	9678	3.4
N03AA	Barbiturates and derivatives	164	172	89	425	0.2	134	133	58	325	0.3	750	0.3
N03AB	Hydantoin derivatives	716	710	437	1863	1.0	713	666	311	1690	1.6	3553	1.2
N03AE	Benzodiazepine derivatives	2372	1967	1049	5388	3.0	1060	916	369	2345	2.2	7733	2.7
N03AF	Carboxamide derivatives	538	491	284	1313	0.7	377	308	130	815	0.8	2128	0.7
N03AG	Fatty acid derivatives	603	340	153	1096	0.6	432	278	90	800	0.8	1896	0.7
N03AX	Other antiepileptics	3036	3026	1889	7951	4.4	1638	1656	757	4051	3.8	12002	4.2
N04AA	Tertiary amines	64	47	21	132	0.1	65	49	6	120	0.1	252	0.1
N04BA	Dopa and dopa derivatives	924	1653	1001	3578	2.0	1023	1971	860	3854	3.6	7432	2.6
N04BB	Adamantane derivatives	102	74	16	192	0.1	97	103	13	213	0.2	405	0.1
N04BC	Dopamine agonists	742	719	400	1861	1.0	455	514	189	1158	1.1	3019	1.0
N04BD	Monoamine oxidaseB inhibitors	24	29	14	67	0.0	38	37	11	86	0.1	153	0.1
N04BX	Other dopaminergic agents	91	119	39	249	0.1	117	176	48	341	0.3	590	0.2
N05AA	Phenothiazines-aliphatic sidechain	168	111	75	354	0.2	124	102	56	282	0.3	636	0.2
N05AB	Phenothiazines piperazine structure	899	855	373	2127	1.2	537	487	160	1184	1.1	3311	1.1
N05AC	Phenothiazines piperidine structure	79	98	52	229	0.1	24	15	7	46	0.0	275	0.1
N05AD	Butyrophenone derivatives	182	349	416	947	0.5	179	319	222	720	0.7	1667	0.6

TABLE B1. Continued

ATC Codes	Drug Class	Female				Male				Total			
		66-74	75-84	85+	Total	%	66-74	75-84	85+	Total	%	#	%
N05AH	Diazepines, oxazepines, thiazepines and oxepines	2178	3160	3404	8742	4.8	1431	1993	1413	4837	4.6	13579	4.7
N05AN	Lithium	295	194	78	567	0.3	187	97	18	302	0.3	869	0.3
N05AX	Other antipsychotics	778	1585	2049	4412	2.4	562	958	789	2309	2.2	6721	2.3
N05BA	Benzodiazepine derivatives	10302	13766	10602	34670	19.0	4420	5446	3334	13200	12.4	47870	16.6
N05CD	Benzodiazepine derivatives	1207	1537	1184	3928	2.2	656	808	515	1979	1.9	5907	2.0
N06AA	Non-selective monoamine reuptake inhibitors	4182	4347	2208	10737	5.9	1452	1437	695	3584	3.4	14321	5.0
N06AB	Selective serotonin reuptake inhibitors	9510	11206	9084	29800	16.4	4198	5191	3221	12610	11.9	42410	14.7
N06AG	Monoamine oxidase A inhibitors	50	41	12	103	0.1	28	24	7	59	0.1	162	0.1
N06AX	Other antidepressants	7940	8789	7339	24068	13.2	3806	4399	2873	11078	10.4	35146	12.2
N06BA	Centrally acting sympathomimetics	145	99	72	316	0.2	104	88	32	224	0.2	540	0.2
N06DA	Anticholinesterases	1295	6300	7831	15426	8.5	997	3746	3319	8062	7.6	23488	8.1
N07AA	Anticholinesterases	47	47	29	123	0.1	30	50	25	105	0.1	228	0.1
N07AB	Choline esters	48	57	46	151	0.1	28	53	44	125	0.1	276	0.1
N07BA	Drugs used in nicotine dependence	237	48	N/A	288	0.2	196	43	N/A	240	0.2	528	0.2
P03AC	Pyrethrines	90	141	217	448	0.2	63	82	77	222	0.2	670	0.2
R01AD	Corticosteroids (nasal preparations)	3002	2786	1547	7335	4.0	1577	1726	876	4179	3.9	11514	4.0
R02AX	Other nasal preparations	32	33	21	86	0.0	21	19	7	47	0.0	133	0.0
R03BA	Glucocorticoids (drugs for COPD)	4821	4940	3189	12950	7.1	2184	2743	1522	6449	6.1	19399	6.7
R03BB	Anticholinergics	4553	6158	4246	14957	8.2	3341	5164	3197	11702	11.0	26659	9.2
R03CB	Non-selective beta-adrenoreceptor agonists	77	84	79	240	0.1	44	40	34	118	0.1	358	0.1
R03CC	Selective beta-2-adrenoreceptor agonists	9090	9039	6065	24194	13.3	4754	5607	3227	13588	12.8	37782	13.1
S01AA	Antibiotics-ophthalmologicals	2063	2660	2028	6751	3.7	1127	1658	1080	3865	3.6	10616	3.7
S01AD	Antivirals-ophthalmologicals	68	61	45	174	0.1	45	53	36	134	0.1	308	0.1
S01AE	Fluoroquinolones	76	100	96	272	0.1	43	63	63	169	0.2	441	0.2
S01BA	Corticosteroids, plain	3520	4958	2405	10883	6.0	1919	2855	1334	6108	5.8	16991	5.9
S01BC	Antiinflammatory agents,	1240	1800	811	3851	2.1	694	1121	460	2275	2.1	6126	2.1
S01EA	Sympathomimetics in glaucoma	707	1336	1315	3358	1.8	496	945	669	2110	2.0	5468	1.9
S01EB	Parasympathomimetics	71	152	251	474	0.3	46	83	98	227	0.2	701	0.2

MING: MEDICATION PRESCRIPTION PRIOR TO FALL-RELATED INJURY

TABLE B2.
Numbers of older adults being prescribed with different generic names within one year prior to fall-related injury

Generic Medication Names	Female					Male					Total	
	66-74	75-84	85+	Total	%	66-74	75-84	85+	Total	%	#	%
Atorvastatin	12491	17122	11208	40821	14.2	10462	13107	6765	30334	10.5	71155	24.7
Amlodipine	8728	14064	12598	35390	12.3	6187	7730	4590	18507	6.4	53897	18.7
Codeine	10500	12465	8376	31341	10.9	6921	7715	3993	18629	6.5	49970	17.3
Levothyroxine	12594	16233	13300	42127	14.6	2769	4286	3574	10629	3.7	52756	18.3
Ramipril	6254	9119	7921	23294	8.1	6632	8165	4599	19396	6.7	42690	14.8
Hydrochlorothiazide	9338	12533	9169	31040	10.8	4603	5321	2940	12864	4.5	43904	15.2
Rosuvastatin	11920	11644	5293	28857	10.0	9431	8156	3024	20611	7.2	49468	17.2
Glucose	9727	11013	5692	26432	9.2	7991	8510	3329	19830	6.9	46262	16.0
Metformin	8771	9660	5014	23445	8.1	7615	7466	2771	17852	6.2	41297	14.3
Furosemide	5460	10254	13402	29116	10.1	4101	7758	6709	18568	6.4	47684	16.5
Amoxicillin	9135	9232	6211	24578	8.5	5506	5811	3110	14427	5.0	39005	13.5
Rabeprazole	7840	10255	7578	25673	8.9	4053	5249	3038	12340	4.3	38013	13.2
Lorazepam	7637	10196	7826	25659	8.9	3076	3948	2426	9450	3.3	35109	12.2
Pantoprazole	8507	10347	7956	26810	9.3	4914	6138	3819	14871	5.2	41681	14.5
Metoprolol	4392	7695	7342	19429	6.7	4426	5911	3520	13857	4.8	33286	11.5
Docusate	5198	9364	8785	23347	8.1	3480	5960	4444	13884	4.8	37231	12.9
Acetaminophen	4428	8708	9740	22876	7.9	2129	3943	3635	9707	3.4	32583	11.3
Nitroglycerin	3016	5646	6716	15378	5.3	2859	4488	3412	10759	3.7	26137	9.1
Salbutamol	8769	8690	5819	23278	8.1	4616	5417	3138	13171	4.6	36449	12.6
Risedronate	7908	11776	8987	28671	9.9	1044	1826	1302	4172	1.4	32843	11.4
Betamethasone	4120	5230	4157	13507	4.7	2922	3764	2551	9237	3.2	22744	7.9
Warfarin	2280	5597	5833	13710	4.8	2643	5344	3576	11563	4.0	25273	8.8
Atenolol	3441	5168	4030	12639	4.4	2254	2844	1497	6595	2.3	19234	6.7
Ciprofloxacin	4595	6190	5434	16219	5.6	2950	3798	2456	9204	3.2	25423	8.8
Hydrocortisone	3916	5183	4561	13660	4.7	2174	3103	2241	7518	2.6	21178	7.3
Cephalexin	4198	5317	4870	14385	5.0	3241	3968	2478	9687	3.4	24072	8.4
Alendronate	5743	8498	6053	20294	7.0	739	1300	921	2960	1.0	23254	8.1
Ferrous	3393	5997	5509	14899	5.2	2075	3733	2846	8654	3.0	23553	8.2
Sennosides	3206	6243	6004	15453	5.4	2133	3928	3249	9310	3.2	24763	8.6
Tiotropium	3850	5095	3371	12316	4.3	2904	4326	2531	9761	3.4	22077	7.7
Azithromycin	4835	4412	2762	12009	4.2	2483	2508	1334	6325	2.2	18334	6.4
Prednisolone	4465	5113	3166	12744	4.4	2667	3350	1830	7847	2.7	20591	7.1
Bisoprolol	3171	5245	4414	12830	4.5	2965	3870	2154	8989	3.1	21819	7.6
Oxycodone	4697	4549	2352	11598	4.0	3432	2819	1055	7306	2.5	18904	6.6
Perindopril	3538	4598	3559	11695	4.1	3239	3497	1812	8548	3.0	20243	7.0
Ranitidine	2961	3715	2821	9497	3.3	1634	2156	1284	5074	1.8	14571	5.1
Nitrofurantoin	5186	7225	5696	18107	6.3	751	1310	1047	3108	1.1	21215	7.4

MING: MEDICATION PRESCRIPTION PRIOR TO FALL-RELATED INJURY

TABLE B2. Continued

Generic Medication Names	Female					Male					Total	
	66-74	75-84	85+	Total	%	66-74	75-84	85+	Total	%	#	%
Lactulose	2277	4695	5696	12668	4.4	1784	3194	2776	7754	2.7	20422	7.1
Omeprazole	2887	3670	2638	9195	3.2	1380	1799	1074	4253	1.5	13448	4.7
Salmeterol	4105	4893	3105	12103	4.2	2332	3236	1891	7459	2.6	19562	6.8
Diltiazem	2993	4920	4251	12164	4.2	1870	2522	1499	5891	2.0	18055	6.3
Clopidogrel	2469	4495	4213	11177	3.9	3041	4206	2582	9829	3.4	21006	7.3
Clarithromycin	3654	2864	1584	8102	2.8	1849	1678	847	4374	1.5	12476	4.3
Meloxicam	3633	3970	2125	9728	3.4	1545	1531	786	3862	1.3	13590	4.7
Nifedipine	2234	3551	3060	8845	3.1	1397	1774	1016	4187	1.5	13032	4.5
Fluticasone	3186	3136	2075	8397	2.9	1422	1712	965	4099	1.4	12496	4.3
Allopurinol	1258	2278	1935	5471	1.9	2768	3887	2032	8687	3.0	14158	4.9
Tamsulosin	58	44	22	124	0.0	4451	7019	4622	16092	5.6	16216	5.6
Clotrimazole	2564	3723	3672	9959	3.5	1236	1741	1296	4273	1.5	14232	4.9
Sulfamethoxazole	2985	4057	3695	10737	3.7	1350	1864	1217	4431	1.5	15168	5.3
Lansoprazole	3180	3751	2770	9701	3.4	1758	2130	1228	5116	1.8	14817	5.1
Celecoxib	3717	3891	2288	9896	3.4	1698	1729	778	4205	1.5	14101	4.9
Citalopram	3529	4848	4348	12725	4.4	1589	2337	1554	5480	1.9	18205	6.3
Trazodone	3032	4269	4476	11777	4.1	1573	2340	1843	5756	2.0	17533	6.1
Ezetimibe	2878	3148	1170	7196	2.5	2601	2442	707	5750	2.0	12946	4.5
Cyanocobalamin	2196	3648	3523	9367	3.2	1119	1986	1559	4664	1.6	14031	4.9
Amitriptyline	3535	3525	1681	8741	3.0	1205	1143	530	2878	1.0	11619	4.0
Candesartan	2242	3071	2346	7659	2.7	1378	1499	741	3618	1.3	11277	3.9
Valsartan	2192	3205	2371	7768	2.7	1230	1457	707	3394	1.2	11162	3.9
Latanoprost	1455	2837	3232	7524	2.6	844	1665	1390	3899	1.4	11423	4.0
Gliclazide	2737	3091	1796	7624	2.6	2618	2552	1140	6310	2.2	13934	4.8
Naproxen	3124	2305	912	6341	2.2	1756	1274	426	3456	1.2	9797	3.4
Donepezil	809	4044	5057	9910	3.4	621	2337	2079	5037	1.7	14947	5.2
Levofloxacin	1645	2155	1864	5664	2.0	1013	1579	1117	3709	1.3	9373	3.3
Dexamethasone	2181	2411	1054	5646	2.0	1315	1658	621	3594	1.2	9240	3.2
Enalapril	1098	1683	1673	4454	1.5	811	1117	673	2601	0.9	7055	2.4
Irbesartan	1759	2362	1597	5718	2.0	1063	1148	508	2719	0.9	8437	2.9
Hydromorphone	2349	3167	2681	8197	2.8	1539	1658	935	4132	1.4	12329	4.3
Domperidone	2317	3003	2220	7540	2.6	986	1278	754	3018	1.0	10558	3.7
Budesonide	2456	2320	1348	6124	2.1	1362	1489	801	3652	1.3	9776	3.4
Oxazepam	1281	2099	2022	5402	1.9	623	947	678	2248	0.8	7650	2.7
Spirolactone	1204	1821	1921	4946	1.7	1055	1476	957	3488	1.2	8434	2.9
Losartan	1329	2061	1555	4945	1.7	669	874	448	1991	0.7	6936	2.4
Metronidazole	2124	2146	1195	5465	1.9	1110	1131	538	2779	1.0	8244	2.9
Telmisartan	1715	2170	1375	5260	1.8	999	1081	465	2545	0.9	7805	2.7

MING: MEDICATION PRESCRIPTION PRIOR TO FALL-RELATED INJURY

TABLE B2. Continued

<i>Generic Medication Names</i>	<i>Female</i>					<i>Male</i>					<i>Total</i>	
	<i>66-74</i>	<i>75-84</i>	<i>85+</i>	<i>Total</i>	<i>%</i>	<i>66-74</i>	<i>75-84</i>	<i>85+</i>	<i>Total</i>	<i>%</i>	<i>#</i>	<i>%</i>
Indapamide	1283	1850	1246	4379	1.5	684	901	428	2013	0.7	6392	2.2
Lisinopril	905	1441	1174	3520	1.2	762	1011	556	2329	0.8	5849	2.0
Beclomethasone	1399	1779	1165	4343	1.5	761	1099	621	2481	0.9	6824	2.4
Quetiapine	1546	2260	2544	6350	2.2	1003	1478	1118	3599	1.2	9949	3.5
Hydrocodone	1683	1562	700	3945	1.4	885	836	350	2071	0.7	6016	2.1
Digoxin	779	2358	3301	6438	2.2	892	1812	1525	4229	1.5	10667	3.7
Tolterodine	1694	2561	1998	6253	2.2	645	1173	735	2553	0.9	8806	3.1
Risperidone	702	1540	2039	4281	1.5	517	937	783	2237	0.8	6518	2.3
Pravastatin	889	1546	1137	3572	1.2	587	885	551	2023	0.7	5595	1.9
Terazosin	305	473	339	1117	0.4	1162	2042	1257	4461	1.5	5578	1.9
Clonazepam	2372	1967	1049	5388	1.9	1060	916	369	2345	0.8	7733	2.7
Dorzolamide	624	1324	1625	3573	1.2	406	922	747	2075	0.7	5648	2.0