ORIGINAL ARTICLES

Fall-related injury among people with arthritis, a concern among different age groups!

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ABSTRACT

Background and objectives: The association between arthritis and falls has been study mainly in older adults, and information about fall-related injuries and arthritis in younger population is scarce. In addition, there is a gap of knowledge about the activities and types of injury associated with falls among people with arthritis in different age groups. The aims of the study were: 1) to explore the association between arthritis and fall-related injury among different age groups, and 2) to compare the main activity associated with fall-related injury and the type of injury resulted from falls between age groups in people with arthritis.
Methods: This study used aggregated data from the Canadian Community Health Survey for the years 2001, 2003, 2005, 2009/2010 and 2013/2014.
Results: People with arthritis were significantly more likely to report fall-related injuries than people without arthritis across all age groups. Younger people (12-19 years) were over six times more likely to fall when practicing sports, whereas all adults were more likely to slip/trip/stumble while walking. As a result of the falls, older adults (65 and over) were more likely to have broken bones and other kind of injuries (i.e., bruises, cuts, etc.), while all younger age groups reported more strains/sprains.
Conclusion: Fall-related injury is a concern across all age groups in people with arthritis, and not only among older adults. In addition, the activities performed when the fall occurred and the type of injuries resulted from the falls were different between age groups. These findings contribute to reduce the gap of knowledge about fall-related injuries among people with arthritis in different age groups.

Key Words: Arthritis, Falls, Unintentional injuries, Canada

1. INTRODUCTION

Arthritis is one of the most common chronic conditions worldwide. It was estimated that this disease affected more than 4.2 million Canadians aged 15 years and older (16% of the population) in 2007-2008.[1] A greater prevalence was found in US, where approximately 52.5 million of adults (22.7%) had diagnosis of some form of arthritis or other kind of rheumatic disease in 2010-2012.[2] Although arthritis affects people of all ages, evidence has shown that its prevalence increases with age from approximately 1 in 250 among children under age 18 to 1 in 2 among persons ages 65 or older.[2,3]

People with arthritis can experience chronic pain, muscle weakness, balance and gait impairments, and fatigue, which all are known to be associated with falls.[4–6] Previous research has found an association between arthritis and falls.[7–10] The Centre for Disease Control reported an aged-adjusted median prevalence for fall-related injuries 2.5 times

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higher among older adults with self-reported arthritis than in those without arthritis in USA.[10] A previous study showed that 36.4% of adults with Rheumatoid Arthritis reported falling during a 1-year follow-up period, and more than half of those falls resulted in moderate injuries.[8] However, except for Stanmore et al.,[8] this association has been study mainly in older adults and information about fall-related injuries and arthritis in younger population with arthritis is scarce. In addition, there is a gap of knowledge about the activities and types of injury associated with falls among people with arthritis among different age groups. Therefore, the objectives of this study were: 1) to explore the association between arthritis and fall-related injuries among different age groups, and 2) to compare the main activity associated with fall-related injuries and the type of injury resulted from falls between age groups in people with arthritis.

2. METHODS

2.1 Data source

This study used public files with aggregated data from the Canadian Community Health Survey (CCHS) for the years 2001, 2003, 2005, 2009/2010 (combined) and 2013/2014 (combined). Data from the 2007/2008 and 2011/2012 surveys were not included in the analysis because information on injuries was not collected in all the provinces and territories in those years.

The CCHS is a cross-sectional survey, conducted by Statics Canada, which collects information on the health status, health care utilization and health care determinants of the Canadian population. It covers the population 12 years of age and over living in the ten provinces and the three territories. People living on reserves and other Aboriginal settlements, full-time members of the Canadian Forces, the institutionalized population and persons living in the Quebec health regions of Région du Nunavik and Région des Terres-Cries-de-la-Baie-James were excluded. These exclusions represent less than 3% of the Canadian population aged 12 and over.

The survey used three sampling frames to select the sample of households: 40.5% of the sample of households were selected from an area frame, 58.5% were selected from a list frame of telephone numbers and the remaining 1% were selected from a Random Digit Dialling (RDD) sampling frame. Interviews were conducted in person using computer assisted personal interviewing (CAPI) and over the phone using computer assisted telephone interviewing (CATI). The response rates for the 2001, 2003, 2005, 2009/2010 and 2013/2014 CCHS were 84.7%, 80.7%, 78.9%, 72.3% and 66.2%, respectively. CCHS user guides provide a detailed description of the survey, including background and methodology.[11–15]

2.2 Arthritis

The population with arthritis was identified using the question "Do you have arthritis, excluding fibromyalgia?" included in the CCHS. An additional question asking "What kind of arthritis do you have?" was also incorporated in the 2001, 2003 and 2005 CCHS (10-12), but not in the subsequent years of the survey.

2.3 Fall-related injury

Fall-related injuries were identified when people how reported "yes" to the question "in the past 12 months, were you injured?" also replied positively to the question was the injury the result of a fall? Additional questions used to further explore fall-related injuries included: "How did you fall?" and "What type of injury did you have? For example, a broken bone". Activities describing how the fall-related injury occurred were categorized as: practicing sports (i.e. skiing, skating, etc.), going up/down stairs/furniture, slip/trip/stumble while walking or other. Types of injuries resulted from the fall were grouped in three main groups as follow: broken bones, sprain/strains or others (i.e. multiple injuries, dislocations, cuts, bruises/blisters, concussions, etc.).

2.4 Demographic characteristics and others

Demographic characteristics used to describe the study population included: sex (female vs. male); age (years); marital status (married/common law, divorce/separated, single/never married); higher level of education attained (<secondary school, secondary school, some post-secondary school, post-secondary graduation). Additional descriptors of the population presented were: BMI (calculated using the self-reported height and weight) and self-reported physical activity level (active, moderate, inactive).

2.5 Statistical analysis

Descriptive statistics were used to explore the distribution of demographic characteristics by fall-related injury status among people with arthritis. Chi square and *t* tests were used to test differences in the distribution of characteristics between people with arthritis with and without fall-related injuries. After stratifying the population by age groups (12-19, 20-44, 45-64 and 65+ years),[16] crude and adjusted (i.e., sex and year of the survey) logistic regression analyses were used to assess the association between arthritis and fall-related injuries. In the group of people with arthritis who reported fall-related injuries, further logistic regression analyses were done to estimate if there were differences across age groups in a) the type of activity performed when they fell and b) the type of injury resulted from the fall. A subsequent subanalysis was completed (for the years 2001, 2003, and 2005)

to analyse the association between fall-related injuries and type of arthritis. Sampling weights were included in all the analysis in order to account for the complex sampling design of the CCHS.[11–15] Statistical significance was accepted at *p*-values < .05. All analyses were performed using SPSS software, version 20.0 (SPSS, Chicago, IL, USA).

3. Results

3.1 Descriptives

The final sample studied included 648,823 participants, 137,259 (21.2%) of them reported to have arthritis. A higher percentage of people with arthritis reported a fall-related injury in the past 12 months compared with people without arthritis (6.4% vs. 5.4%, $p < .001$). A higher percentage of fall-related injuries among people with arthritis were reported by females (71.8%). The distribution of age, marital status, level of education and physical activity level, but not BMI, were significantly different among people with arthritis who reported and did not reported fall-related injuries (see Table 1).

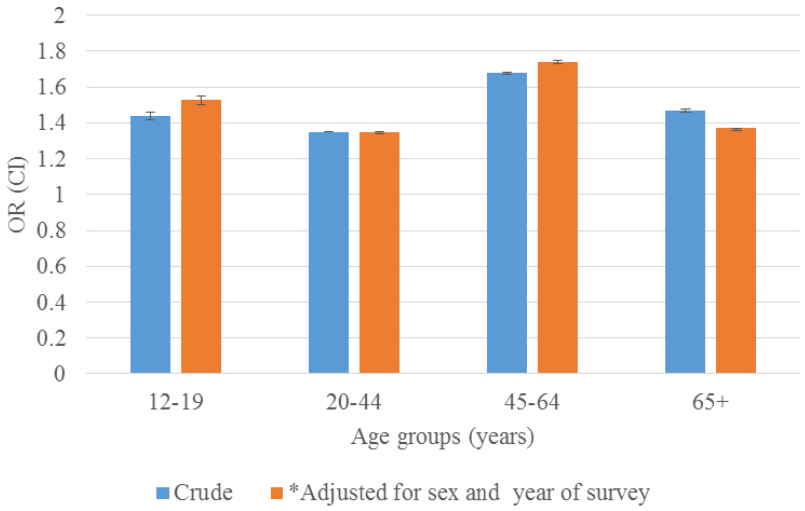
Table 1. Description of the population part of the CCHS 2001, 2003, 2005, 2009/2010 and 2013/2014

		n (%)						
		All* **648,823 (100)**	**Arthritis† 137 259 (21.2)**			**No Arthritis† 500 015 (77.1)**		
			Fall-related injury 8,716 (6.4)	**No Fall-related injury 127,673 (93.0)**	***p***	**Fall-related injury 26,837 (5.4)**	**No Fall-related injury 470,621 (94.1)**	***p***
Sex	Female	352,660 (54.4)	6,259 (71.8)	83,033 (65.0)	< .001	13,126 (48.9)	242,700 (51.6)	< .001
Age groups (years)	12-19	76,891 (11.9)	105 (1.2)	588 (0.4)	< .001	7,981 (29.8)	60,660 (12.9)	< .001
	20-29	73,507 (11.3)	227 (2.6)	2,256 (1.8)		4,108 (15.3)	70,473 (15.0)	
	30-39	94,452 (14.6)	429 (4.9)	5,665 (4.4)		3,671 (13.6)	84,532 (18.0)	
	40-49	96,329 (14.8)	777 (8.9)	12,228 (9.6)		3,214 (12.0)	78,238 (16.6)	
	50-59	97,856 (15.1)	1,634 (18.7)	26,147(20.5)		2,998 (11.2)	72,034 (15.3)	
	60-69	92,392 (14.2)	1,913 (21.9)	32,783 (25.6)		2,260 (8.4)	54,743 (11.6)	
	70-79	72,837 (11.2)	1,983 (22.9)	30,130 (23.6)		1,542 (5.7)	33,621 (7.1)	
	80+	44,559 (6.9)	1,648 (18.9)	17,876 (14.0)		1,063 (4.0)	16,320 (3.5)	
Marital status	married/ common law	329,776 (50.8)	3,915 (44.9)	68,591 (53.7)	< .001	9,680 (36.1)	245,343 (52.1)	< .001
	divorced/ separated	126,738 (19.6)	3,729 (42.8)	45,569 (35.7)		3,884 (14.5)	72,370 (15.4)	
	single/ never married	191,111 (29.5)	1,058 (12.1)	13,284 (10.4)		13,225 (49.2)	152,018 (32.3)	
	Not stated	1,198 (0.1)	14 (0.2)	229 (0.2)		48 (0.2)	890 (0.2)	
Education	< secondary school graduation	186,550 (28.8)	2823 (32.4)	44,660 (35.0)	< .001	9,405 (35.0)	118,953 (25.3)	
	Secondary/ some post-secondary	152,362 (23.4)	1,939 (22.2)	27,987 (22.0)		6,220 (23.2)	115,719 (24.6)	
	post-secondary graduation	297,427 (45.8)	3,803 (43.6)	52,621 (41.2)		10,910 (40.6)	229,149 (48.7)	
	Not stated	12,484 (2.0)	151 (1.8)	2,405 (1.8)		302 (1.1)	6,800 (1.4)	
BMI (kg/m^2)	mean(SD)	25.9 (5.1)	27.4 (6.0)	27.4 (5.4)	.62	25.5 (5.1)	25.7 (4.9)	< .001
Physical activity	Active	168,472 (26.0)	1,578 (18.1)	22,955 (18.0)	.03	10,335 (38.5)	127,418 (27.1)	< .001
	Moderate	155,205 (23.9)	1,787 (20.5)	27,956 (21.9)		6,197 (23.1)	116,181 (24.7)	
	Inactive	304,084 (46.9)	5,003 (57.4)	72,632 (56.9)		9,616 (35.8)	212,345 (45.1)	
	Not stated	21,062 (3.2)	348 (4.0)	4,130 (3.2)		689 (2.6)	14,677 (3.1)	
Fall-related injury	Yes	37,169 (5.7)	8,716 (6.4)	-	-	26,837 (5.4)	-	-
Type of arthritis ‡	OA	40,943 (6.3)	2,507 (60.5)	38,148 (58.9)	.04	-	-	-
	RA	19,099 (2.9)	1,094 (26.4)	17,902 (27.6)	.08	-	-	-
	Other	9,401 (1.4)	545 (13.1)	8,740 (13.5)	.53	-	-	-

Note. Unless otherwise specified, data is presented in number and percentage. "Not stated" includes the responses: not stated, don't know or refusal. *1.7% of the population did not provided information about diagnosis of arthritis. †Information of injury-related falls was missing in the 0.6% (870) people with arthritis and in the 0.5% (2 557) people without arthritis. ‡Information available only from 2001, 2003 and 2005 CCHS.

3.2 Arthritis and fall-related injuries

After adjusting the analyses for sex and year of data collection, people with arthritis were significantly more likely to report fall-related injuries than people without arthritis across all age groups. People with arthritis between 12 and 19 years, 20 and 44 years, 45 and 64 years and people 65 years and over were 53% (OR 1.53, 95% CI 1.50-1.55), 35% (OR 1.35, 95% CI 1.34-1.35), 74% (OR 1.74, 95% CI 1.73-1.75) and 37% more likely (OR 1.37, 95% CI 1.36-1.37) to report injury-related falls than their peers without arthritis (see Figure 1).



$p < .05$ in all age groups. Sampling weights were used in all the analyses.

Figure 1. Falls in people with Arthritis compared with people wihtout Arthritis, by age group

3.3 Type of arthritis and fall-related injuries

Among the people who reported arthritis in the 2001, 2003 and 2005 CCHS (n = 82,025) an additional question about the type of arthritis was also formulated, 85% (n = 694,430) of them provided this information. People in the youngest (12-19 years) and the oldest groups (65+ years) with other kind of arthritis were more likely to report fall-related injuries than their peers with osteoarthritis (see Table 2). However, adults (20-64) with osteoarthritis were more likely to report falls than people with rheumatoid arthritis or other kind of arthritis.

Table 2. Association between falls-related injury and type of arthritis* within each age groups

Type of arthritis	Crude											
	12-19 years			20-44 years			45-64 years			65+ years		
	OR	CI		OR	CI		OR	CI		OR	CI	
Osteoarthritis	1	-	-	1	-	-	1	-	-	1	-	-
Rheumatoid arthritis	0.80	0.76	0.85	0.79	0.79	0.80	0.87	0.86	0.89	0.88	0.88	0.89
Other	1.28	1.22	1.35	0.86	0.85	0.87	0.97	0.95	0.98	0.96	0.95	0.97
	Adjusted for sex and year of the survey											
Type of arthritis	OR	CI		OR	CI		OR	CI		OR	CI	
Osteoarthritis	1	-	-	1	-	-	1	-	-	1	-	-
Rheumatoid arthritis	0.80	0.75	0.84	0.81	0.81	0.82	0.87	0.86	0.88	0.95	0.94	0.96
Other	1.22	1.16	1.29	0.88	0.87	0.89	0.96	0.95	0.98	1.03	1.02	1.04

Note. Bold = Significantly different from the reference group. *Information available only from 2001, 2003 and 2005 CCHS. Sampling weights were used in all the analyses.

3.4 Type of activity performed by people with arthritis when they fell across age groups

Compared with older adults (65+ years), younger people (12-19 years) were over six times more likely to fall when practicing sports but 28% and 74% less likely to fall while going up/down stairs or due to slip, trip or stumble (see Table 3). Younger adults (20-44 years) and middle age adults (45-64 years) were more likely to fall while doing sport related activities or when going up/down stairs or furniture but less likely to fall due to slip, trip or stumble while ambulating compared with older adults (65+ years) (see Figure 2).

Table 3. Activities during which people with Arthritis fell by age groups

	Crude			Adjusted for sex, and year of the survey		
	OR	CI		OR	CI	
Age groups	**Sports**					
65+	1	-	-	1	-	-
45-64	**2.62**	2.58	2.66	**2.29**	2.26	2.32
20-44	**1.54**	1.53	1.56	**1.49**	1.47	1.51
12-19	**6.99**	6.78	7.21	**6.20**	6.01	6.40
Age groups	**Stairs (up/down)**					
65+	1	-	-	1	-	-
45-64	**1.10**	1.08	1.11	**1.05**	1.04	1.06
20-44	**1.16**	1.15	1.17	**1.14**	1.13	1.15
12-19	**0.72**	0.69	0.75	**0.69**	0.66	0.72
Age groups	**Slip/trip/Stumble**					
65+	1	-	-	1	-	-
45-64	**0.58**	0.57	0.59	**0.65**	0.64	0.66
20-44	**0.78**	0.77	0.78	**0.79**	0.78	0.80
12-19	**0.26**	0.25	0.27	**0.29**	0.28	0.30
Age groups	**Other activity**					
65+	1	-	-	1	-	-
45-64	**0.89**	0.87	0.91	**0.84**	0.83	0.86
20-44	**0.82**	0.81	0.83	**0.85**	0.83	0.86
12-19	**1.64**	1.56	1.72	**1.47**	1.40	1.54

Note. Bold = Significantly different from the reference group. Sampling weights were used in all the analyses.

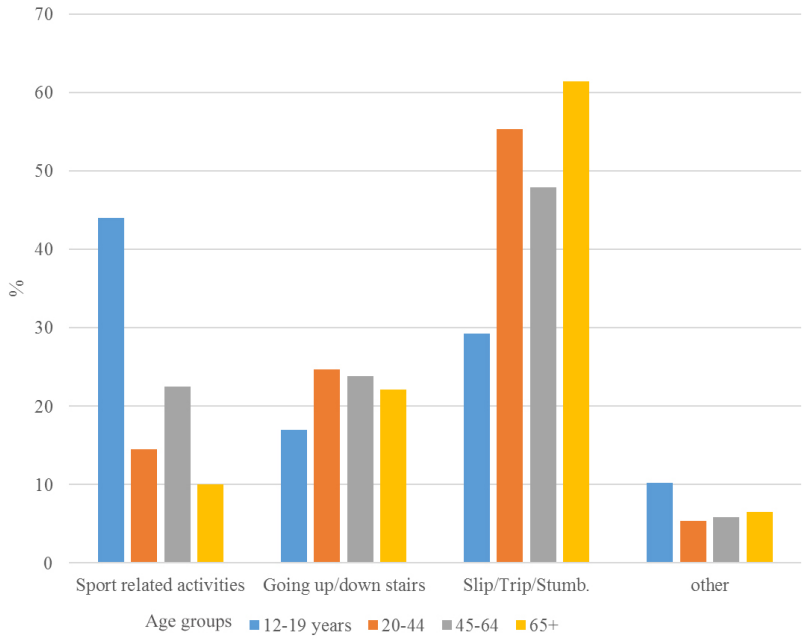


Figure 2. How people whith arthritis fell?

3.5 Type of injury resulting from falls across age groups

Older adults (65+ years) were more likely to have broken bones and other type of injuries such as cuts, bruises, etc. (see Table 4) than people in the three younger age groups. Younger people (12-19 years), young adults (20-44 years) and middle age adults (45-64 years) reported 55%, 93% and over twice more strains and/or sprains derivate from a fall than older adults (65+ years).

Table 4. Type of Injury resulting from falls in people with Arthritis by age groups

	Crude			Adjusted for sex and year of the survey		
	OR	**CI**		**OR**	**CI**	
Age groups	**Broken bones**					
65+	1	-	-	1	-	-
45-64	**0.39**	0.8	0.40	**0.39**	0..38	0.40
20-44	**0.52**	0.51	0.52	**0.52**	0.51	0.52
12-19	**0.65**	0.63	0.67	**0.64**	0.62	0.67
Age groups	**Strain/Sprains**					
65+	1	-	-	1	-	-
45-64	**2.55**	2.52	2.58	**2.55**	2.52	2.58
20-44	**1.93**	1.92	1.95	**1.93**	1.92	1.95
12-19	**1.55**	1.49	1.60	**1.56**	1.50	1.61
Age groups	**Other type of injury**					
65+	1	-	-	1	-	-
45-64	**0.75**	0.74	0.76	**0.72**	0.71	0.73
20-44	**0.79**	0.78	0.80	**0.78**	0.77	0.79
12-19	**0.71**	0.69	0.74	**0.69**	0.67	0.72

Note. Bold = Significantly different from the reference group. Sampling weights were used in all the analyses.

4. DISCUSSION

People with arthritis were significantly more likely to report fall-related injuries than people without arthritis across all age groups. In addition, the activities performed when the fall occurred and the type of injuries resulted from the falls were different between the four age groups studied. Therefore, special considerations should be take into account when targeting falls among specific age groups in people with arthritis.

Evidence has shown an increased risk of falls among older adults with arthritis which could be explained at least partially by changes in musculoskeletal structures, chronic pain, muscle weakness, balance and gait impairments, and fatigue.[7, 17, 18] Hence those factors can be present in people with arthritic conditions despite their age, it is very likely that they can contribute to increase the risk of falling in this population among all age groups. We also found that people with osteoarthritis were more likely to report a fall-related injury than people with other kind of arthritis among adults (20-64), but the opposite occurred in the youngest and oldest groups. Previous studies have mainly explored falls among people with rheumatoid arthritis[7, 8] and osteoarthritis[9] separately, and comparison of falls occurrence between different types of arthritis has not been reported. However, based on the findings from this study, it is possible that particular characteristics of each type of arthritis may influence the risk of falls in the individuals. Further research about this regard is advised in order to better elucidate the relationship between specific factors and falls risk among people with different types of arthritis across age groups.

The results shown that younger people (12-19 years) were over 6 times more likely to fall when practicing sports, while adults 20 years and older were more likely to slip/trip/stumble while walking. Those findings suggest that preventive programs directed to decrease fall-related injuries in younger people with arthritis should focus in the practice of sport related activities. This also implies that could be helpful to involve coaches and personal trainers in the designing of preventive and educational interventions for this specific age group. On the other hand, these findings also suggest that interventions directed to decrease fall-related injuries among adults 20 years and over should emphasized on precautions in the performance of everyday activities such as walking on different surfaces.

People in the three younger groups with arthritis reported

high occurrence of sprain and strains associated with falls compared to older adults (65 years and over). This could be associated to a modification of the viscoelastic properties of musculoskeletal tissues (i.e., ligaments and muscles) secondarily to the chronic inflammatory process present in this disease. Conversely, older adults with arthritis (65 years and over) reported a high occurrence of bone fractures compared to the three younger groups. It is possible that the high loss of bone density associated with osteoporosis commonly found among older adults, especially females, can contribute to the occurrence of more serious consequences associated with falls among this group of people.

Findings from this research can be potentially helpful in the design of educational and preventive strategies aimed to decrease fall-related injuries and their consequences in people with arthritis among different age groups. We hypothesized that in younger people with arthritis muscle strength training, flexibility exercises and/or use of supporting braces in the practice of sports might help to decrease strain/sprains, the most common fall-related injuries in this age group. In addition, preventive strategies to avoid falls among adults with arthritis should include environmental risk assessment and selection of appropriate foot wear along with muscle strength and balance training. Nevertheless, further studies are needed to explore the potential effects of those suggestions in decreasing falls and fall-related injuries among specific age groups of people with arthritis.

Limitations and strengths

Several limitations should be considered when interpreting the results of this study. First, information about the occurrence of injuries and falls was self-reported over the past year which could be influenced by recall bias and potentially contribute to subjects' misclassification. Although it is expected that the person will be likely to remember serious injuries, less serious injuries could be forgotten. Second, people were asked only about the most important injury in the last year. This question does not offer room for multiple occurrence of injuries that might had happened in the same person. Knowing the frequency of injuries occurred could provide more precision regarding the magnitude of the problem, however, the information collected produced findings to support further research and support the development of interventions. Third, low response rate during the last years of the survey might limit the generalization of the findings. However, Statistics Canada had adjusted the survey weights by redistributing the weights of non-responding house-holds or people to responding house-holds of people with similar characteristics. In addition, the authors believe that the main reason for the overtime decline in response rate is rather due a considerable decrease in the use of land telephone lines, which was used to select the population. Unfortunately, response rates for general households' surveys have been on the decline in recent decades[19] probably due an increase of telephone solicitation for fundraising, market research or sales. Fourth, since the current study was completed using the aggregated version of the survey, it was not possible to determined if an individual participated more than a year which could result in an overrepresentation of the sample. However, authors do not expect that the likelihood to be aleatorily selected to participate in the survey more than once will affect the results of the study due to the large number of total Canadian population from where the sample is selected every year and to the strong methodologic approach used to select the sample used by Statistics Canada. In addition, the analyses were controlled by the year of the survey and weighted by the population weights assigned for that particular year. Fifth, the analyses were not controlled for additional comorbidities which could also contribute to falls. Sixth, as information about the type of arthritis was not available in all the years of the survey and some people did not report this information. In addition, self-report type of arthritis might lead to a possible misclassification. Nevertheless, authors believe that this study provides a robust overview of the occurrence of falls among people with different types of arthritis.

To the best of our knowledge this is one of the first studies which explored the association between arthritis and fall-related injuries among different age groups, and compared the activities performed when the fall occurred and type of injuries resulted from the falls between age groups. The main strength of this study is the use of a well-validated population-based survey.[11–15]

5. Conclusion

Results from this study suggested that injury-related falls among people with arthritis is an important concern that should be considered in all age groups, and not only among older adults. In addition, the results shown that people between 12 and 19 years were more likely to fall when practicing sports, while adults 20 year and over were more likely to slip/trip/stumble while walking. Younger people (12-64 years) with arthritis reported high occurrence of sprain and strains, while older adults with (65 years and over) reported a high occurrence of bone fractures and other type of injuries. These findings contribute to reduce the gap of knowledge about fall-related injuries in people with arthritis among different age groups.

Conflicts of Interest Disclosure

The authors of this article declare that they have no conflict of interest.

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