





Retrospective Analysis of Circumstances of Falls and Related Injuries across Levels of Care in Older Adult Retirement Home Facilities

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Article

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Résumé

En vue de développer des interventions plus efficaces pour les blessures liées aux chutes, cette étude a analysé une nouvelle base de données provenant de six maisons de retraite sur une période de quatre ans, comprenant 1 877 chuteurs et 12 445 chutes. Les chutes ont été caractérisées en fonction du lieu, de l'activité, du site et du type de blessure, et la base de données a été stratifiée sur quatre niveaux de soins : vie autonome, soins de retraite, soins assistés et soins de la mémoire. La plupart des chutes se sont produites dans la chambre à coucher (62,8 %), pendant une activité inconnue (38,1 %), en marchant (20,2 %) et en effectuant des transferts de poids (14,6 %). Environ une chute sur trois (37 %) a entraîné une blessure, le plus souvent au niveau des membres supérieurs (31,8 %), de la tête (26,3 %) et des membres inférieurs (22,2 %), entraînant des déchirures cutanées (35,3 %), des douleurs (29,1 %) ou des ecchymoses (28,0 %). Si le lieu de la chute, l'activité et le site de la blessure étaient différents selon le niveau de soins, ce n'était pas le cas du type de blessure. Les données de cette étude peuvent aider à cibler les stratégies de prévention des blessures liées aux chutes à tous les niveaux de soins dans les maisons de retraite.

Abstract

Towards developing more effective interventions for fall-related injuries, this study analysed a novel database from six retirement home facilities over a 4-year period comprising 1,877 fallers and 12,445 falls. Falls were characterized based on location, activity, injury site, and type, and the database was stratified across four levels of care: Independent Living, Retirement Care, Assisted Care, and Memory care. Falls most occurred within the bedroom (62.8%), and during unknown (38.1%), walking (20.2%), and transfer tasks (14.6%). Approximately one in three (37%) of all falls resulted in an injury, most commonly involving the upper limb (31.8%), head (26.3%), and lower limb (22.2%), resulting in skin tears (35.3%), aches/pains (29.1%), or bruises (28.0%). While fall location, activity, and injury site were different across levels of care, injury type was not. The data from this study can assist in targeting fall-related injury prevention strategies across levels of care within retirement facilities.

Introduction

Falls and their effects in older adults, including fractures, fear of falling, decreased quality of life, and other effects, are a major public health issue. Falls occur in one of three community-dwelling older adults each year and are the most common cause of injuries and hospitalizations (Accreditation Canada, 2014). The mortality rates and financial costs associated with falls, and related injuries, are increasing in Canada (Parachute, 2021; Public Health Agency of Canada, 2014). Falls are associated with the highest total cost of all unintentional injuries, accounting for \$10.3 billion in Canada in 2018 (Parachute, 2021). Falls are the leading cause of hospitalizations in older adults, and the average length of stay for falls (22 days) is 70 per cent (9 days) greater compared to any other cause (Public Health Agency of Canada, 2014). As the number of Canadian seniors is expected to double by the year 2035 (Statistics Canada, 2010), novel prevention approaches are required to reduce the social and economic costs of fall-related injuries.

The causes, incidence, and injury rates of falls differ as a function of where older adults live. While approximately 8 per cent of all adults over the age of 65 live in residential care facilities which can include long-term care (LTC) homes (i.e., nursing homes), hospitals, and retirement

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facilities (definitions for each of these may differ across jurisdictions), the proportion of fall hospitalizations suffered by older adults residing in these settings is much larger than those from community-based dwellers (Public Health Agency of Canada, 2014). The rate of falls for older adults living in LTC is approximately three times larger than those living in the community (Harris et al., 2010). In addition, fall-related hospitalizations related to hip fractures were much higher (59%) for residents of care homes compared to community-related dwellings (32%) (Public Health Agency of Canada, 2014). The health implications associated with falls are growing as evidenced by a 19 per cent increase in fall-related hospitalizations from 2006 to 2010 from care home residents (Accreditation Canada, 2014; Statistics Canada, 2016). These results are not surprising given the increased comorbidity rates within older adults residing in care facilities. Beyond incidence, there are differences in falls between older adults living in the community compared to LTC including associated injuries, fall characteristics, and hospitalizations. In addition, there are differences between studies examining falls within LTC. For example, while Becker and Rapp (2010) report that in LTC more falls occur during transfers (42%) than walking (35%), McArthur et al. (2016) report the opposite with 14 per cent of falls associated with transfers and 28 per cent occurring during walking. In community-based dwellings, 54 per cent of falls occur during walking with only 12 per cent occurring during transfers (Luukinen et al., 1994). These differences in falls details across community and LTC settings are not surprisingly given associated differences in factors including functional independence, mobility patterns, health status, and comorbidities. More fulsome fall characterization within residential care settings is imperative to support the development of fall and injury-prevention interventions targeting specific older adult populations.

While the majority of falls research in residential care settings has been focused on LTC, 'retirement homes' are an important and substantial transitional setting that are understudied. In Ontario, LTC homes provide 24-hour nursing and personal care, and support residents who require frequent assistance with activities of daily living and monitoring to ensure safety or well-being. They are subsidized by government funding and are associated with specific regulatory and legislative frameworks. In comparison, retirement homes are privately paid residences for seniors who can generally direct their own care but may need support with some activities of daily living. Retirement homes often comprise a continuum of care (i.e., level of care) ranging from independent and retirement style living to units supporting physical or mental deficits. In Canada, there are approximately as many collective dwelling-related older adults who live in retirement home settings (35.8%) as there are in LTC and hospital settings (37.3%) (Statistics Canada, 2016). Despite potential differences between these settings from both resident perspectives (e.g., age, financial status, mobility, and cognitive abilities) and facility perspectives (e.g., level of care provided, staffing levels, and government funding), fall characterization details are limited for retirement homes. This is likely (in part) due to lower staffing levels and fewer regulatory requirements for documenting falls in privately owned retirement home ecosystems compared to LTC facilities. As falls are a critical cause of loss of independence and transitions to LTC, with significant social, financial, and economic costs, there is a need to examine fall rates, and associated details on causes and resulting injuries, within retirement homes to support the most effective intervention approaches.

Accordingly, the primary purpose of this study was to provide a comprehensive characterization of the circumstances and outcomes

related to falls for residents residing in retirement home facilities. Based on reported differences in fall characteristics and outcomes between community and LTC settings, the study's secondary purpose was to compare fall characteristics across levels of care. We hypothesized that the proportion of falls across levels of care within a retirement home setting would be different for (1) fall location, (2) activity at time of fall, (3) injury site, and (4) injury type. Specifically, we hypothesized that individuals in more independent living settings would experience (1) a lower proportion of falls in the bedroom, (2) a higher proportion of falls during dynamics tasks such as walking, (3) a higher proportion of injuries to the upper limb (due to more intact protective responses), and (4) a lower proportion of fractures.

Methods

Study sites

Six retirement home facilities from Southern Ontario, Canada, contributed to the falls database used in this study. There were four distinct levels of care within these retirement homes including: (1) Independent (Care) living (IC); (2) full-service Retirement Care suites (RC); (3) Physical Care (PC); and (4) Memory Care (MC). Independent living was comprised of one- or two-bedroom apartments in which residents were generally independent, but with available services such as some meals and laundry. RC residents lived in studio or one-bedroom suites on the main floor supported by a range of services including all-inclusive meals, medication administration, access to recreational activities, and weekly housekeeping and linen laundry. PC units provided services beyond RC including support with activities of daily living by PC Aides, additional recreational programs appropriate for those with greater physical care needs, and more frequent housekeeping. Finally, MC provided additional supports (beyond RC) targeting cognitive challenges (e.g., need for redirection/reassurance), recreational programs specifically tailored for individuals with dementia (including one-on-one programs), and more frequent housekeeping.

Data source

The falls database employed in this study was comprised of data collected during 2013–2016 from Schlegel Villages Inc. (owner/operator of a range of older adult residential facilities in Ontario, Canada). Falls were monitored and tracked as part of a program to improve the quality of life of residents living in their facilities. A fall was defined as 'a sudden, uncontrolled, unintentional downward displacement of the body to the ground or other object'.

For all falls that were observed by or reported to staff, fall-related data were documented by a staff member (nurse, personal support worker, or kinesiologist) using a structured fall incident report. In general, the incident report included details including date and time, location, activity at time of fall, mobility status, fall and injury prevention strategies (hip protectors, transfer pole, high/low bed, etc.), psychological state, injury, cause or contribution to fall, and follow-up details. Of the reported falls, 52.7 per cent were reported at the time of the fall (within 1 hour), 1.5 per cent were reported within 1–2 hours, 0.2 per cent within 2–3 hours, 0.4 per cent outside of 3 hours, and 45.2 per cent were unknown. On-site Kinesiologists reviewed the fall incident reports to consolidate information and enquire about further details, if needed. Individual fall incident report data were input into a corporate database used for quality improvement purposes (using Microsoft Access and Excel).

Schlegel Villages staff (co-author J.K.) removed individual faller names, age, and gender for anonymity purposes, after which the de-identified database was shared with the research team for research purposes. Given this study relied exclusively on the secondary use of non-identifiable information, participant consent was not required (Section D, Articles 5.5B within Canada's Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans). This study was approved by the Office of Research Ethics at the University of Waterloo.

Data analysis and statistical approaches

Data analysis was performed in MATLAB (R2020b, MathWorks). For free-form text fields within the database, a keyword search was performed. Data were reviewed according to the following domains: fall location, activity preceding fall, body site of injury (if any), and injury type (if any). In general, categories were directly drawn from the residential care partner's fall incident report (rather than being re-categorized by the research team). Specifically, fall location was categorized as: Bedroom, Bathroom, Hall, Lounge, Dining Room, Activity Room, or Other. Fall Activity was categorized as: Transfer, Walking, Sitting, Lying, Reaching, Standing, Turning, Other, or Unknown. Similar to Komisar et al. (2022), the site of an injury was categorized into five body parts including: upper limb (wrist, finger, shoulder, etc.), lower limb excluding thigh (ankle, knee, toe, etc.), head (face, nose, forehead, etc.), hip including thigh (thigh, pelvis, hip, sacrum, etc.), and torso (rib, back, collar bone, etc.). In addition, the type of injury suffered was categorized by no injury, bruising/bumps, skin tear/cut, soft tissue injury (i.e., skin abrasion/burn), fracture/break, or complaints of aches and pains.

Similar to McArthur et al. (2016), mean and standard deviations were used to describe continuous data, and per cent or counts were used to describe categorical data. These descriptive statistics were used to characterize the cause and circumstances of falls recorded in the retirement home falls database. Towards testing our hypotheses related to level of care, data were analysed using cross-tabulation. Pearson's χ^2 tests were used to examine the differences in proportions between variables of interest (location, activity, injury site, and injury type) and level of care (independent, retirement, assisted care, and memory care). Comparison of rates across levels of care was not conducted as the total number of residents residing in each category over the study period was not available. Similarly, analysis of potential differences between fallers and non-fallers were not included in this study as there was no reliable source of data indicating the number of non-fallers in each level of care within the retirement home facilities.

Results

General characteristics

The number of falls for all years across levels of care is presented in Table 1. The database included details on 12,445 falls that occurred in 1,870 unique residents. Of these residents, 25.2 per cent lived in IC, 36.2 per cent in RC, 17.4 per cent in AC, and 21.2 per cent lived in MC. Five hundred and fourteen residents suffered one fall, 294 suffered two, 190 suffered three, 147 suffered four, and 725 suffered five or more falls over the 4-year period. Across the 4 years, 2,268 falls were documented in 2013, 3,238 in 2014, 3,477 in 2015, and 3,472 in 2016. The lowest number of falls was observed in IC, with 1,560 total falls, while 3,534, 3,770, and 3,581 falls were recorded in RC, PC, and MC, respectively.

Fall location

Across levels of care, the Bedroom was the most common location for a fall to occur (62.8% of all falls, 7,812 total), followed by Bathroom (13.5%, 1,678 falls), 'Other' rooms (8.2%, 1,020 falls), Hall or Walkway (6.3%, 784 falls), Lounge (5.8%, 724 falls), Dining room (3.0%, 379 falls), and Activity room (0.4%, 48 falls). There were differences in fall location proportions across levels of care ($\chi^2(18) = 1,610.07, p < 0.001$). While the bedroom was consistently reported as the most common location for a fall, the relative percentage of falls in the bedroom differed across levels of care (see Figure 1). IC had the smallest percentage of falls in the bedroom (49%) compared to other levels of care yet had the largest in Other (10.8%) and Bathroom (16.9%). In contrast, PC had the largest percentage of falls in the bedroom (74%) yet had the fewest in Other (3.9%) and the Dining Room (1.9%). Furthermore, MC had the highest number of falls in the Lounge (15.1%) and Hall (10.3%), which were the second and third most common rooms for falls in MC only.

Activity at time of fall

Across levels of care, the largest percentage of falls occurred during an unknown activity (38.1%), which was reported when the activity prior to the fall was unwitnessed, unverifiable, and/or unknown (Figure 2). When the activity during the fall was known, walking was the most common activity (20.2%), followed by transferring (14.6%, typically sit to stand or stand to sit), standing (7.2%), sitting (6.8%), and reaching (5.4%). Lying, turning, or other categories were all reported in less than 5 per cent of falls. In addition, between 4.5 per cent (PC) and 11.4 per cent (IC) of falls occur during quiet standing tasks.

There were differences in fall rates across Activity by level of care ($\chi^2(24) = 1,163.0, p < 0.001$). While the largest number of falls

Table 1. General characteristics of falls across the four levels of care and in total

Level of care	Total falls	Fallers			Falls with injury (%)	Total injuries*
		Total #	1 fall	>1 fall		
Independent (IC)	1,560	390	132	258	663 (43)	802
Retirement (RC)	3,534	543	184	359	1,479 (42)	1,883
Physical (PC)	3,770	529	115	414	1,194 (32)	1,391
Memory (MC)	3,581	408	83	325	1,220 (34)	1,400
TOTAL	12,445	1,870	514	1,356	4,556 (37)	5,476

*Total injuries' are larger than total number of 'falls with injury' as some falls resulted in multiple injury sites.

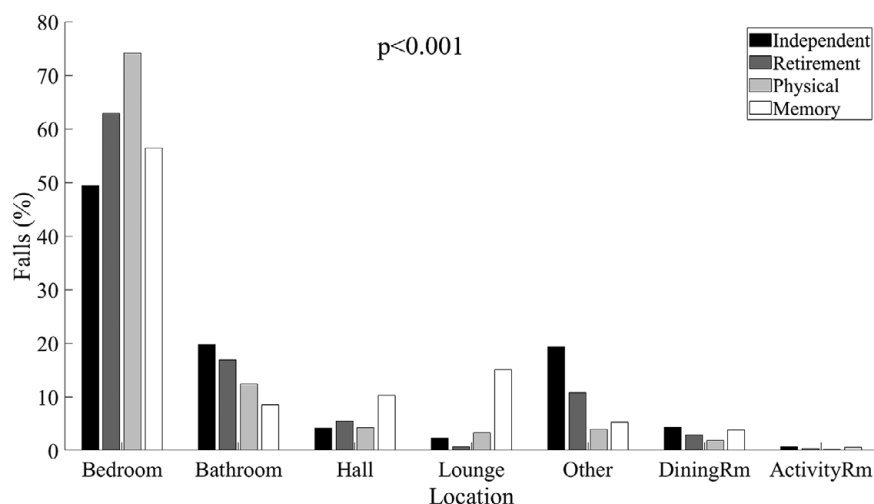


Figure 1. Relative (%) number of falls (within each level of care) across fall locations. Rm stands for Room.

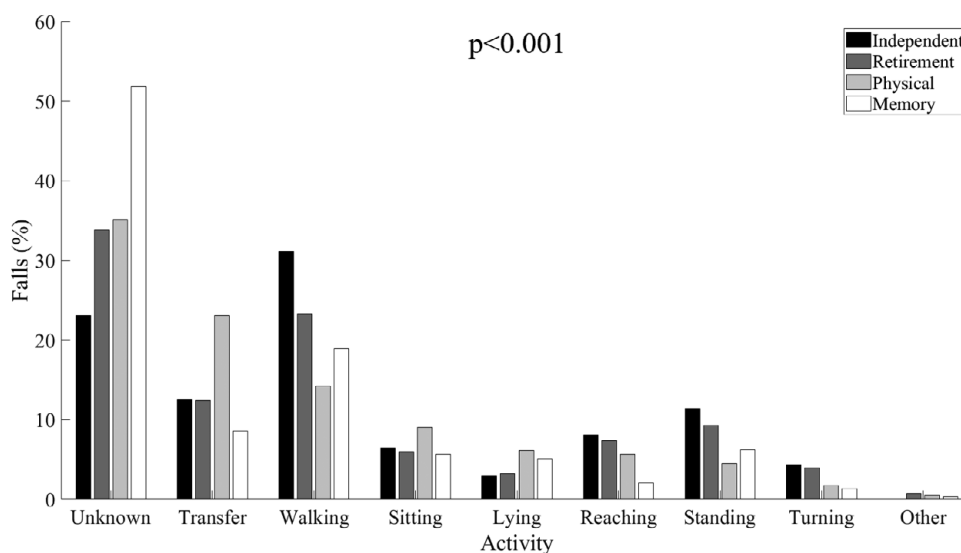


Figure 2. Relative (%) number of falls (within each level of care) across activity performed at the time of the fall.

occurred during Unknown activities, the most common known activity within IC was walking (31.2%, 486 falls). In PC, falls during transfer tasks (23.1%, 870 falls) were more prevalent than walking (14.2%, 535 falls). Finally, the largest number of falls occurred during unknown activities for Memory Care (51.9%, 1,857 falls), which was more than double the percentage of falls reported for IC residents (23.1%, 360 falls). Otherwise, the trends across levels of care and activities were similar for IC, RC, and PC residents.

Body site of injuries

Combined across levels of care, a total of 4,556 falls (37%) resulted in an injury, and more than one injury was reported in 10.1 per cent of falls. Overall, upper limb injuries were the most common site for an injury (31.8 of injury-related falls), followed by head (26.3), lower limb (22.2%), hip or pelvis (11.8%), and torso (7.9%). There were differences across Injury Site by the level of care ($\chi^2(12) = 44.8, p < 0.001$). Fall-related injuries were more prevalent in IC and RC (43% and 42%, respectively) compared to MC and PC (34% and 32%). Of the falls that resulted in an injury, arm injuries

were most prevalent in IC (33.7%), RC (31.7%), and PC (31.9%), whereas head injuries were most prevalent in MC (31.3%) (Figure 3). Hip and torso were consistently the fourth and fifth ranked sites for all levels of care, respectively.

Injury type

Collapsed across levels of care, the most common type of fall-related injury was a laceration (35.3% of falls that resulted in an injury), followed by complaints of aches and pains (29.1%), bruises (28.0%), soft tissue (4.1%), and fractures (3.4%). Fractures occurred in 1.7 per cent of all falls (208 fractures/12,445 falls with or without an injury). There were no differences across Injury Type by the level of care ($\chi^2(12) = 19.55, p = 0.076$) (Figure 4).

Discussion

The purpose of this study was to characterize the circumstances and injury outcomes related to falls for residents residing in retirement homes, and to investigate potential differences across levels of

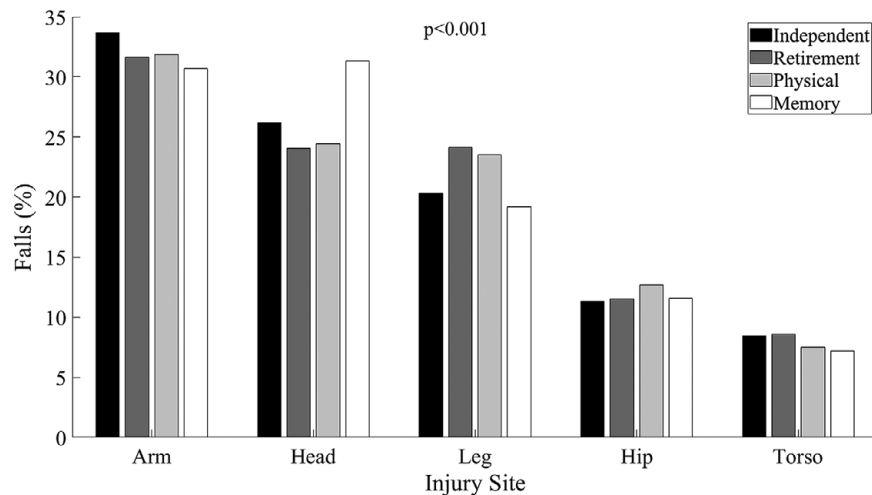


Figure 3. Relative (%) number of falls (within each level of care) across injury body site for falls that resulted in an injury.

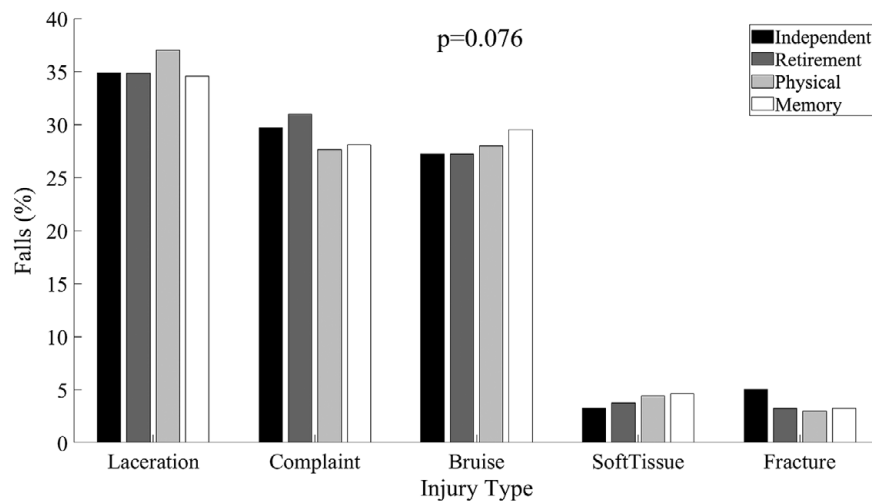


Figure 4. Relative (%) number of falls (within each level of care) across injury type for falls that resulted in an injury.

care (independent, retirement, physical, and memory care). Overall, the bedroom was the most common location for a fall (60.8%), followed by the bathroom (13.5%). While a large percentage of falls occurred during unknown activities (38.1%), walking (20.2%) and transferring (14.6%) tasks had the largest number of falls during *known* activities. More than one in three (37%) falls were reported to result in an injury, with the most common injury sites being the upper limb (31.8%), head (26.3%), and lower limb (22.2%). The most common injury types were a skin tear or laceration (35.3%), aches and pains (29.1%), and bruises (28.0%). Of the more severe injuries, 208 falls resulted in a fracture (4.6% of falls with an injury [4,556], 3.4% of all injuries [5,476], and 1.7 per cent of all falls [12,455]). In support of our first three hypotheses, the proportion of people who fell was different across levels of care for fall location, activity, and injury site, respectively. In contrast, the distribution of injury types did not differ across levels of care. This study provides novel insights regarding falls within retirement home facilities and suggest potential value in differential intervention approaches targeted to level of care within this residential setting.

While the current study supports literature indicating that bedrooms are a common fall location, the proportion of falls in

this location was higher than that reported in other settings. Falls for community dwelling older adults when at home most commonly occur within the bedroom (Stevens *et al.*, 2014 showed bedroom and living room as equal). In addition, 44 per cent of falls occurred within the bedroom for LTC settings (McArthur *et al.*, 2016). In retirement settings (current study), falls in the bedroom are even higher than LTC, ranging from 49 per cent in independent living to 74 per cent in physical care. Regardless of the level of care or living status, fall preventative strategies would likely perform well within the bedroom of older adults across levels of care. In addition, the second (and subsequent) most common location differed across levels of care. Those living in Memory Care neighbourhoods fell more in the hall and lounge compared to bathroom, likely a result of spending less time in their bedrooms. Accordingly, fall prevention interventions for Memory Care residents should consider focusing on public areas (such as the hall and lounge) in addition to the bedroom.

The activities at time of fall identified in this study aligns with previous research and indicate fall related activities tend to change with the level of care. The current study aligns with reports from LTC that unknown activities are often reported as the most prevalent

activity leading to a fall within LTC (McArthur et al., 2016). If a fall was not witnessed, the information reported would depend on the recollection of the resident themselves. Therefore, residents who have difficulty with memory are unlikely to report the necessary details of the fall. For falls that are known, independent and retirement care falls occurred the most during walking, matching community-based dwellers (the most independent group), and some reports on LTC (McArthur et al., 2016). Physical care had more transfer-related falls, similar to those reported in other LTC settings (Becker & Rapp, 2010). Independent residents have the ability to walk within, around, and outside the community. With a greater time spent during walking, it is not surprising these residents had a higher percentage of falls during walking. However, physical care residents, who are in need of physical assistance due to the movement-related deficits, are less likely to spend time walking. These residents have a higher percentage of falls during transfer tasks, likely due to the physical demands required to transfer from sit to stand, or from chair to bed, and so forth. Residents within memory care appear to match the more independent, physically able groups. Therefore, depending on how independent and physically able older adults are, fall preventative strategies may focus on gait-related training versus weight transfer training.

Our findings related to injury sites and types, differentiated by level of care, provide interesting data to support intervention efforts. Our injury sites data are difficult to compare to previous literature as injury location across injury type is not often reported (minor injuries reported in general but not location) (Milat et al., 2011; Nevitt et al., 1991; Stevens et al., 2014). It is unclear why IC, RC, and PC residents had more upper limb-related injuries while MC residents suffered more head-related injuries. These results may be due to a combination of factors related to the location and activity associated with falls. However, injury type was not influenced by level of care. The findings of lacerations as the most prevalent injury while soft tissue and fractures were the least reported injury type (>5%) across levels of care match previous reports in community and LTC settings (McArthur et al., 2016; Milat et al., 2011). With aging, the progressive loss of skin viscoelastic properties (Kaya & Saurat, 2010) likely leads to high prevalence of lacerations during falls. While a low percentage of the falls result in the more serious injury of a fracture, the circumstance of these falls still needs to be further examined to reduce the negative impact fall-related injuries. While there are several potential explanations for the finding that level of care did not influence injury type (including interacting factors of age, fall location, and other factors), further work is needed to understand the relationship between circumstances of falls (location, activity, cause, etc.) and the related injuries (type and site). For example, when we examined the specific types of fall-related injuries to the head, we observed the majority of head-related injuries resulted from bruises (48.3%) and lacerations (33.5%). Fractures to the head occurred in 0.4 per cent of head-related injuries.

A novel outcome from the current study are details regarding fall-related injury rates. Injury rates appear to differ across levels of care within retirement homes, and more broadly, for all types of living settings. Previous reports have identified injury-rates ranging from 1 per cent to 35 per cent across LTC facilities (Rubenstein et al., 1994; Svensson et al., 1991). However, in community-based dwellers, falls that resulted in an injury have been reported to range from 20 per cent to 66 per cent (Lord et al., 2001; Milat et al., 2011). In the current study, the proportion of falls that resulted in injuries ranged from 32 per cent to 43 per cent, depending on the level of care. Interestingly, the injury rates were higher for settings without added memory or assisted physical care. The higher injury rates for

more independent older adults may be due to an increase in dynamic activities/events (e.g., walking) that exposed them to greater fall risk and impact energy. Alternatively, they could result from under-reporting of less serious falls for residents in the more independent setting (IC and RC) as decreased staff to resident ratios in IC and RC may result in fewer falls witnessed by staff (and greater reliance on resident reporting). In addition, cognitive challenges may result in an inability to recall falls (or details associated with falls) for residents in MC. Further work is required to better understand that factors underlying differences in injury rates across levels of care. Regardless, the current study demonstrates that, regardless of where an individual lives within a retirement facility, falls are associated with a substantial risk of injury.

The current data have important implications for tailoring fall risk interventions across levels of care. For example, independent and retirement residents fall most commonly during walking. Therefore, gait-related interventions may serve the greatest benefit for preventing falls in this population. In contrast, for those with greater physical deficits/challenges (e.g., PC), fall prevention interventions targeting transfer tasks may provide greater benefits. In addition, as 75 per cent of falls for this group occurred in the bedroom, 'in-place' interventions such as safety flooring that target specific locations (e.g., bedroom and bathroom) may be appropriate (Lachance et al., 2017). Finally, for individuals in cognitive care units, head injuries and falls in common areas (e.g., halls and lounges) were prevalent. Accordingly, this population might preferentially benefit from head protective devices that are not fixed to specific room locations (Martel et al., 2020). In all cases, 'on-board' technologies (hip protectors and head protectors) have the potential to mitigate injury risk wherever a fall occurs. However, these benefits need to be weighed against issues of user acceptance and adherence (Korall et al., 2015; Van Schoor et al., 2003). Future work is needed to validate targeted fall and injury prevention strategies based on falls incident databases of this nature.

Limitations

There are well-known limitations associated with falls databases including missing data, limited information on non-fallers, and inaccuracies associated with self-reporting. As stated in the statistical analysis section, there was no reliable source of data indicating the number of non-fallers for the cohort examined. In some cases, falls were also recorded using second-party reports of fall-related events, which may reduce the accuracy of information recorded with each fall. As the falls incident report utilized in the study was developed by our corporate residential care facility partner, its psychometric properties were unknown. However, a sub-set of this falls database was reported on previously (McArthur et al., 2016). This study did not account for dependencies associated with repeat falls by the same faller, nor did it explicitly report on injury severity. While we acknowledge these limitations, the current study uses one of the largest falls databases reported in the literature and is the first, to the best of our knowledge, that focuses on retirement-home care facilities and characterizes falls across levels of care. Accordingly, the current study, therefore, has the potential to influence novel fall and injury prevention strategies through targeted approaches.

Conclusions

In this database of retirement home dwellers, a total of 1,870 fallers, accounting for 12,445 falls, were examined. The Bedroom was the

most common location for a fall (62.8%). Walking (20.2%) and transfer tasks (14.6%) were known tasks with the largest number of falls. Approximately 37 per cent of all falls resulted in an injury. Fall location, activity, and injury site were affected by level of care, for example, independent residents fell more while walking, while physical care residents fell more while transferring. The data from this study can assist in targeting fall and injury prevention strategies by focusing intervention strategies or technologies for varied levels of care.

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