Risk Factors for Falls in Home Care and Long-Term Care Settings: A Focus on Dementia and Parkinson's Disease

by

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis,

including any required final revisions, as accepted by my examiners. I understand that my thesis

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Abstract

It is well established that there are many intrinsic and extrinsic risk factors associated with falls in older adults. Less well-known is what risk factors predict falls in more vulnerable populations, such as those with neurological conditions living in long-term care homes or receiving home care services. Furthermore, evidence comparing those with neurological conditions to those without is lacking in the literature. The primary purpose of this thesis was to determine risk factors for falls in long-term care residents and home care clients with no recent history of falls to determine if risk factors differed between individuals with dementia or Parkinson's disease and those without any neurological conditions. Secondary data analysis was performed on a database of standardized health assessments completed for long-stay home care clients and long-term care residents in Ontario. Within each major diagnostic group, observations were stratified based on ambulatory status (ambulatory vs. non-ambulatory). Bivariate analyses followed by generalized estimating equations were used to determine statistically significant predictors of falls in each group within each care setting. The results of multivariable analyses showed that there is not a distinct set of risk factors associated with falls in home care clients and long-term care residents with dementia or Parkinson's disease that is systematically different from risk factors associated with falls in clients and residents not diagnosed with any of the neurological conditions in this study. These results suggest that a common set of risk factors may effectively predict falls in all clients and residents with no recent falls history, regardless of certain neurological diagnoses.

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List of Abbreviations

AD-Alzheimer's disease

ADL-Activities of daily living

AGS-American Geriatrics Society

BGS-British Geriatrics Society

CAP-Clinical assessment protocol

CCAC-Community care access centre

CHESS-Changes in Health, End-Stage Disease, Signs, and Symptoms

CIHI-Canadian Institute for Health Information

CPS-Cognitive Performance Scale

DRS-Depression Rating Scale

DSM-IV-Diagnostic and Statistical Manual of Mental Disorders, Version 4

GDS-Geriatric Depression Scale

GEE-Generalized estimating equations

HC-Home care

LHIN-Local Health Integration Network

LTC-Long-term care

OACCAC-Ontario Association of Community Care Access Centres

OR-Odds ratio

PD-Parkinson's disease

QICu-Quasi-Akaike Information Criterion unadjusted

RAI MDS/MDS 2.0-Resident Assessment Instrument Minimum Data Set, Version 2.0

RAI-HC-Resident Assessment Instrument for Home Care

RNAO-Registered Nurses' Association of Ontario

1 INTRODUCTION

1.1 Rationale

It is well established that falls among older adults are common, costly, and can cause injury. In Ontario, falls are the leading cause of injury and disability among older adults, accounting for 59% of all visits to emergency departments and 79% of hospitalizations in this group (1). Common consequences of falls in older adults include: fracture (2-4), head injury, spinal cord injury (5), soft tissue injury (3,4,6,7), self-limitation of activities caused by fear of falling (3,8), admission to a nursing home (9,10), chronic pain (11), reduced quality of life (11), and even death (6,12). In fact, falls, fall-related injuries, and their associated complications are the leading cause of injury-related death among older adults in Canada (1); between 1997 and 2002, over 7000 Canadians over the age of 65 died as a direct result of a fall (13). Falls also accounted for 95% of hip fractures in Canadian older adults in 2008-2009 (1). In 2004, Canadians over the age of 65 accounted for 84% of fall-related deaths, 53% of cases of permanent partial disability, and 54% of cases of permanent total disability, all due to falls (1). That same year, the cost of fall-related injuries among 4.1 million older adults was estimated to be greater than $2 billion (1). These costs associated with falls are both direct costs to the health care system for medications and medical services (14); as well as indirect costs associated with productivity losses by those who fall and their informal caregivers (1). The proportion of older adults in the Canadian population is expected to surpass the proportion of youth as early as 2015 (15), as such, falls will become an even greater economic, societal, and personal burden if measures are not taken to decrease the incidence of falls. Without intervention, the projected annual cost of falls in older adults will be $240 billion by the year 2040 (1).

The prevalence of fallers among healthy, community-dwelling older adults is approximately 30% per year (3,16). The prevalence of fallers in long-term care (LTC), or among home care (HC) clients is less well known, although it is likely that the prevalence is higher than 30% among those in LTC and HC. There are published statistics on the prevalence of fallers among samples of older adults living in both HC and LTC settings; however, some of them exclude participants based on characteristics associated with falls, such as ambulatory status (17) and severe cognitive impairment (18)--suggesting that they do not accurately capture all falls and all fallers. Regional differences related to study setting, temporal changes in terms of demographics, and varied exclusion criteria used across studies can all produce different prevalence estimates for fallers, and may not be representative of what is currently happening within Ontario. Furthermore, there are very few studies on falls among HC clients and it is likely that data from community-dwelling individuals are not representative of HC clients specifically. To advocate for and evaluate provincial falls risk assessment and prevention strategies, it is necessary to establish recent and accurate estimates of the prevalence of fallers in HC and LTC settings.

Identification of older adults who are at risk of falling is an important step in fall prevention and the process of determining resource allocation for falls prevention programs. The recognition of this important step has resulted in a vast amount of literature on multiple risk factors for falls in older adults that led to extensive lists of potential risk factors for care providers to assess. For example, the *Integrated Provincial Falls Prevention Framework and Toolkit*, developed for use with Ontario HC clients, by the Local Health Integration Network (LHIN) Collaborative, lists over 50 risk factors known to be associated with falls (19). In comparison, The Registered Nurses' Association of Ontario's (RNAO) *Prevention of Falls and Fall-injuries in the Older Adult* , developed for use with residents in LTC, lists only 13 risk factors, although "medical

conditions" are listed as a single risk factor (20). In Canada, falls risk assessment strives to comply with the American Geriatrics Society (AGS) and British Geriatrics Society (BGS) guidelines for Prevention of Falls in Older Persons, which recommends tailoring falls prevention strategies to individualized assessments for factors known to be associated with a high risk for falls (21). Given the multitude of risk factors for falls identified in the literature, individualized, comprehensive risk assessment for all HC clients and LTC residents may be unrealistic with the growing number of older adults in these care settings, unless risk assessment can be integrated into regular screening that is already in practice (22). The Minimum Data Set (MDS) assessments are used in HC and LTC to assess clients and residents at regular intervals and may serve as useful risk assessment tools, as they capture many risk factors and do not require completion of a separate assessment; saving time and resources (23).

The falls CAP was designed for use with the Minimum Data Set assessments that are used for all LTC residents and long-stay HC clients in Ontario. The falls CAP is also used in both care settings. Based on the number of previous falls an individual has suffered, they are placed into a distinct falls CAP risk category. However, not everyone who will fall has a history of prior falls; therefore, the use of a history of falls to predict future falls is not applicable to everyone. This limitation of the falls CAP corroborates the idea that identifying a few risk factors that are still relevant for everyone is ideal for detecting individuals who are at risk for falls in LTC and HC. Further, it is not clear how well the falls CAP works across all individuals in HC or LTC settings, or whether assessment of additional risk factors can greatly improve risk stratification. It is relevant to identify risk factors for falls separately in HC and LTC, since an individual's place of residence is highly correlated with their baseline falls risk, and will determine the settings in which falls prevention practices can reasonably be implemented (i.e., community

based programs vs. group interventions in a nursing home) (24). Ideally, if a simplified risk assessment that includes only a select few, strongly predictive risk factors that are captured by the MDS assessments could effectively identify individuals who are at risk for falls in both the LTC and HC populations, it would improve the continuity of care across different settings.

Another issue with the falls CAP is that it may underestimate the risk in individuals who are inherently at a high risk for falls, such as individuals with certain neurological diseases. A 2007 report, *The Burden of Neurological Diseases, Disorders, and Injuries in Canada,* cited neurological diseases as one of the leading causes of disability in Canada and suggested that because the incidence of these conditions tends to increase with age, the burden of these conditions is likely to increase as Canada's population ages (25). Individuals with these neurological diseases are also at a higher risk for falls than older adults without these diseases (26), suggesting that the falls CAP may underestimate the risk in people with neurological conditions and no history of falls. Despite the elevated risk in these neurological groups, population-based studies examining risk factors for falls in individuals with conditions such as Alzheimer's disease (AD), other dementias, and Parkinson's disease (PD) are less common compared to studies on falls risk factors among older adults without these conditions. Although dementia (27-29), AD (27,30) and PD (31-35) themselves have been identified as significant risk factors for falls, relatively few studies have examined what specific characteristics render these individuals more prone to falls than older adults without these conditions. Studies that sought to determine risk factors for falls in samples of people with PD (36) and AD (37) have generally found that some risk factors in these groups overlap with those of older adults without these conditions, while others are unique to each of these diagnostic subgroups. In addition, the effect of standard falls prevention strategies may be modified by the baseline level of functioning of

the population (38). Individuals with these neurological diseases often present with severe functional impairments and may need alternative prevention strategies that consider their particular functional limitations. Identifying risk factors for falls in people with AD and PD living in LTC or receiving HC services, who do not have a history of falls, will inform whether risk assessment should vary according to these diagnostic subgroups and may enhance the tailoring of fall prevention in these especially high risk subpopulations that are likely to become more prevalent in the near future.

1.2 Study Aims

The primary aim of this study was to identify risk factors that predict falls in LTC residents and long-stay HC clients in Ontario diagnosed with dementia and PD. These risk factors were compared to risk factors predictive of falls in LTC residents and HC clients without any of the selected neurological conditions (comparison group) in both healthcare settings. Secondary aims were:

- to report the prevalence of risk factors found to be predictive for falls in HC and LTC settings for those with PD, dementia, and the comparison group

- to report the prevalence of fallers at follow-up in each of three risk categories identified by the falls CAP for those with PD, dementia, other neurological conditions, and the comparison group, in both HC and LTC settings

2   BACKGROUND

A fall can be defined as 'an unintentional change in position that results in coming to the ground or another lower level' and can include falls that occur while being assisted by another person (39,40). Falls have also been described as a "geriatric syndrome;" a term used to describe clinical conditions of older adults that do not fit the technical classification of a disease (41). It is widely accepted that falls in older adults are not simply accidents but, like a geriatric syndrome, are "a multifactorial health condition that occurs when the accumulated effects of impairments in multiple systems render an older person vulnerable to situational challenges" (41). Accordingly, falls risk assessment and falls prevention programs are often multifactorial, and can vary depending on the setting and population in which they are implemented.

2.1   Falls Risk Assessment Practices in Ontario

The AGS/BGS Guidelines for the Prevention of Falls in Older Persons state that a substantial improvement in individual quality of life and public health can result from multifactorial risk assessment and a subsequent tailored intervention strategy for fall prevention (21). Although these general guidelines exist for use in Canada, current falls risk assessment and prevention practices for older adults in Ontario vary by an individual's place of residence. Older adults in Ontario live in a variety of different settings, including, but not limited to, homes in the community, retirement homes, assisted living facilities, and LTC homes. Older adults who live within homes in the community can be further subdivided into those who receive home care services and those who do not. This thesis focused on individuals living in LTC and individuals receiving HC services in their homes. In Ontario, there are different falls risk assessment and prevention strategies for these two healthcare settings.

2.1.1 Falls Risk Assessment in LTC

It is a requirement of the Ontario *Long-Term Care Homes Act, 2007,* that all LTC homes have a falls prevention and management program to reduce the incidence of falls (42). The Registered Nurses' Association of Ontario (RNAO) released their guidelines, *Prevention of Falls and Fall-injuries in the Older Adult,* in 2002 (revised in 2005 and 2011), for use with hospital patients and residents of LTC homes (20). There are many risk factors for falls listed throughout these guidelines; however, the quality of evidence used to inform certain prevention guidelines, such as medication reviews and assessing fall risk on admission, have been graded as only "fair," suggesting that it is still unclear which risk factors should be targeted for fall prevention (20). Moreover, despite the existence of policies and guidelines, the prevalence of fallers in LTC has not decreased substantially over the last few years. Health Quality Ontario reported that the prevalence of fallers in LTC in any given 30-day period actually increased; from 13.7% in 2010-2011 to 13.9% in 2011-2012 (43). Not only do these numbers indicate that the prevalence of fallers in Ontario LTC homes is not decreasing, they also suggest that current falls risk assessment and prevention strategies are not reducing falls, or are not being effectively implemented. This study provides new, quality evidence for assessing certain risk factors that are specific to residents of Ontario LTC facilities, which may help to simplify these guidelines while still being effective and applicable to this population.

2.1.2 Falls Risk Assessment in HC

The falls risk assessment and prevention guidelines for HC clients in Ontario are different from those used in LTC settings. HC services in Ontario are accessed through 14 different Community Care Access Centres (CCACs) that each report to a LHIN. In July, 2011, the LHIN Collaborative released their *Integrated Provincial Falls Prevention Framework and Toolkit* to

ensure a consistent approach to falls prevention across the province. Although these guidelines are not specific to HC clients, there is a section for case managers, who determine access to HC and complete health assessments for HC clients. The guidelines provide a detailed framework of a falls prevention strategy, as well as easy-to-use falls risk assessment tools. Within the list of falls risk factors for assessment are PD and cognitive impairment, indicating that these individuals are at a high risk for falls; however, it does not indicate whether these high risk groups should be assessed differently because of their underlying conditions. In addition, the list of falls risk factors in this *Toolkit* is extensive. While it aims to be comprehensive and target older adults at all risk levels, it is unrealistic to expect that a multitude of risk factors would be assessed on an individual basis for all HC clients. Instead, the guidelines suggest that each LHIN identify and focus on the most significant and remediable risk factors in its geographic area. It is up to the region to make decisions about which risk factors are important; however, this seems to defeat the purpose of having guidelines that aim to ensure a consistent approach across the province. The results of Health Quality Ontario's Public Reporting show that, as in LTC, the prevalence of fallers among HC Clients, in any given 90-day period, is increasing from 25% in 2009-2010 to 28% in 2010-2011. This increase suggests that the current falls prevention framework has not been effective in reducing falls. It may be more efficient to identify risk factors that are most predictive of falls in HC clients across Ontario, with and without certain neurological diseases, to maintain the province-wide applicability of the current guidelines. One way to maximize efficiency in falls screening is to use information from assessments that are already completed regularly within HC and LTC settings.

2.2   **Minimum Data Sets**

The Resident Assessment Instrument-Minimum Data Set (RAI-MDS 2.0, hereafter referred to as the MDS 2.0), is one of the most widely used assessment and data collection tools across multiple health care settings in Canada (11) and has been shown to be a valid health assessment measure. The MDS 2.0 provides a comprehensive assessment that allows for care planning, assessing quality of care (44), monitoring changes in health status and needs, determination of resource utilization, and development of case-mix indices to inform health policy decisions (45). Importantly, some of the health measures assessed by the MDS 2.0 and its HC version, the RAI-HC, have also been identified as risk factors for falls.

2.2.1   ***Validity and Reliability of the MDS Assessments***

Originally released in 1990 and subsequently modified (46), the MDS 2.0 has been shown, by multiple studies, to have good inter-rater reliability in the nursing home setting (44,46,47,48). Several items on the MDS 2.0 assessment have also been validated against standard measures, including the cognitive performance scale (CPS) (49), medical diagnoses (50), and nutritional status (51). The RAI-HC was released by the international RAI group (interRAI) in 1996 as an assessment tool specifically for individuals in community-based healthcare settings. The RAI-HC was found to have substantial inter-rater reliability, with an average weighted kappa value of 0.69 for main items found in many of the five interRAI assessment instruments tested in the same international study (52). Similarly, another international study reported that the RAI-HC had an average weighted kappa of 0.74 for common items and an average weighted kappa of 0.75 for common items on the MDS 2.0, which is used to assess nursing home residents (53). Overall, the MDS 2.0 and RAI-HC are valid, reliable measures for assessing falls risk factors and the prevalence of fallers in LTC and HC settings.

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2.2.2   Use of the MDS Assessments in Ontario LTC and HC Settings

The MDS 2.0 and RAI-HC are mandated for routine collection of health information on all LTC residents and long-stay HC clients. Ontario implemented the use of the MDS 2.0 in Ontario LTC facilities in June, 2005 to standardize the assessment of residents in LTC to improve quality of care and care planning. Under the requirements outlined by the Ministry of Health and Long Term Care, the MDS 2.0 is the standardized assessment instrument and must be used to assess each new resident within 14 days of admission to a LTC facility in the province. Additionally, each resident must be assessed with either an MDS 2.0 Quarterly or Full Assessment within 92 days of their previous assessment, and when any major changes to their health status arise (54). Similarly, the RAI-HC is used in all CCACs to assess long-stay HC clients (those who require > 60 days of uninterrupted service through a CCAC) at least once every six months, by a HC staff member. Long-stay clients represent approximately 46% of HC clients (55).

2.2.3   Assessing Risk Factors for Falls with The MDS Assessments

The MDS 2.0 and RAI-HC assess many different aspects of physical functioning, diagnosed health conditions, and behavioural symptoms; as such, they can be used to measure multiple risk factors for falls. Therefore, because these assessments must be completed on a regular basis in Ontario, they have the potential to act simultaneously as a health assessment and a falls risk assessment tool; thus overcoming the inefficiency created by completing separate, comprehensive falls risk assessments for every HC client and LTC resident. As well, studies have shown that the risk for falls increases substantially as the number of risk factors increases (18,56,57), therefore, the interRAI assessment forms provide a way to identify individuals at high risk of falling by evaluating a multitude of factors that are known to be associated with falls in a single form that is completed at regular intervals. However, the goal should still be to

develop a parsimonious risk assessment tool that evaluates individuals for a small number of risk factors that are able to predict most, if not all, falls since this will inform simplified, unanimous guidelines and policies regarding falls prevention practices. A shorter list of risk factors to assess for falls that is obtained from assessments that are already completed regularly increases the likelihood that HC and LTC staff will complete the risk assessment, which may in turn improve outcomes.

Other studies have successfully used the MDS 2.0 for nursing homes to examine risk factors for falls (27,28,58-62) and the RAI-HC to assess risk factors for falls in HC clients (34,63). Generally, these studies have large sample sizes due to the wide use of these assessments, and have identified risk factors for falls that are consistent with those reported in studies that did not use the MDS assessments, such as cognitive impairment (59), hypnotic use (60), and PD (34). The MDS assessments also capture risk factors that other studies have not, including resource utilization group activities of daily living score (60), changes in health, end-stage disease, signs and symptoms scale (CHESS) score (34), and residing in a dementia/AD special care unit (59). These assessments are able to capture a wide variety of potential risk factors for falls and the use of large datasets in this study allowed for easy stratification by diagnostic groups while still maintaining a large sample within each group.

2.3   The Falls CAP

A history of falls has been identified as a significant risk factor for future falls by many researchers in this area (29,58,64,65) and interRAI has developed clinical assessment protocols (CAPs) to be used in conjunction with the MDS assessments. Generally, the CAPs address items of the interRAI assessment instruments that are problem areas and identify individuals who may need assistance and care in these areas. The CAPs also include subsets of items for each problem

area, called "CAP triggers," that are used to identify people who are highly likely to experience declines in each problem area and people who are highly likely to improve when the problem is addressed. The falls CAP, specifically, aims to: "identify and modify underlying risk factors for falls, support safe activity in a safe environment, and recognize common pathways among falls, incontinence, and functional decline" (39). The falls CAP triggers are designed to stratify individuals into risk categories for falls based on previous fall history because those who developed the CAPs determined that a history of falls is the best predictor of future falls. Individuals triggering the "High Risk of Future Falls Group" have a history of multiple falls. As of 2008, 7% of LTC residents and 12% of HC clients fit into this category. It was estimated at that time that 40% of LTC residents in this group and 65% of HC clients in this group will fall in a 90-day period (39). Individuals triggering the "Medium Risk of Future Falls Group" have a history of a single fall. 15% of LTC residents and 15% of HC clients were in this category, according to the 2008 CAPs; in a 90-day period, approximately 25% of LTC residents and 40% of HC clients in this group will suffer a fall. The final falls CAP trigger group is the "Not Triggered," group, whose members have no known history of a fall; 78% of LTC residents and 78% of HC clients were in this group as of 2008 (39). There is no reported statistic in the CAPs guidelines regarding what percentage of people in the "Not Triggered" group go on to suffer a fall, which represents an important area for investigation, especially because they are the majority of individuals in both HC and LTC settings. These falls CAP trigger categories may be a more practical way to determine which individuals are at a high risk of falls than the tools recommended by the RNAO and Ontario Association of Community Care Access Centres (OACCAC), since they only require assessment of a single risk factor. Furthermore, the goal of the CAPs is to conveniently identify individuals at the highest risk and those most likely to

benefit from intervention. However, the falls CAP does not allow for the identification of individuals who may be at risk for their first fall, i.e., those who have no history of falls. As well, the literature to date recommends that multifactorial falls risk assessment and prevention strategies be used because they are the most effective for preventing falls (66,67), suggesting that a history of falls on its own may not be the best risk assessment strategy since it does not identify other modifiable risk factors that can be targeted for intervention. Therefore, it was necessary to examine the "Not Triggered" group to determine the prevalence of fallers and risk factors that predict falls in these individuals to adequately inform falls risk screening and prevention practices.

2.4   Prevalence of Fallers

The prevalence of falls, or fallers, reported across studies varies depending on sample characteristics, the definition used for a fall, and the time point selected for determining prevalence. Health Quality Ontario releases annual estimates of the percentage of older adults in Ontario living in LTC and HC settings, who experience a fall within a given time period from their last assessment with the MDS 2.0 or RAI-HC. While these reports are up-to-date and available by province or individual facility/LHIN, they do not provide information about how many times an individual fell in each care setting, they simply state the proportion of those who suffered a fall. Furthermore, they do not provide information on the prevalence of fallers in people with certain neurological diagnoses, such as dementia, who are at a higher risk due to their condition (26). The falls CAPs are currently used in both HC clients and LTC residents and can be used to distinguish the prevalence of fallers in each of the risk groups (Not Triggered, Medium Risk for Future Falls, and High Risk for Future Falls). The heterogeneity across studies and other reporting bodies such as the Canadian Institute for Health Information (CIHI), in terms

of sample characteristics etc., further supports the need for an estimate of falls prevalence that includes all fallers, especially among high-risk groups. The Home Care Reporting System and Continuing Care Reporting System report the annual percentage of individuals in HC and LTC who triggered the falls CAP; however, it is particularly important to discriminate between recurrent fallers and one-time fallers since the recurrent fallers are in the "high risk" group, according to the falls CAP, and therefore represent the largest burden in terms of time and resources spent caring for fallers. This study used data from the Home Care Reporting System and the Continuing Care Reporting System to provide an estimate of fallers in each falls CAP category within HC and LTC settings in Ontario to inform policy decisions on falls prevention guidelines.

2.5   Prevalence of Fallers in HC

Literature on the prevalence of fallers in the HC population is sparse; however, studies typically cite a community-based study published over 20 years ago that reported 1 in 3 older adults fall every year (3). In contrast, a study of HC clients in Ontario reported that 71% of the sample had fallen in the last 6 months; although, this study only included people that the researchers deemed to be at risk for falling (68). Therefore, the available prevalence estimates of falls in HC may overestimate, while the data from community-dwelling older adults may underestimate the prevalence of fallers, due to the relative health of community-dwelling older adults compared to HC clients. According to the falls CAP, 35% of all HC clients fall in a 6-month period (39). In 2010-2011, the Home Care Reporting System found that 32.3% of Ontario's long-stay HC clients suffered a fall within 90 days of their last RAI-HC assessment (69). These two estimates are similar but one time frame for capturing falls is double the length of the other time frame, suggesting that methods of obtaining the information are inconsistent and some falls may not be

captured. There is an important gap in knowledge regarding falls among HC clients in Ontario that is stratified based on the falls CAP risk groups--a gap that this study aimed to fill. Updated values on the prevalence of falls in Ontario LTC and HC settings, stratified according to falls CAP categories, will offer a useful indication of the problem of falls in these settings that also focuses on those who most require falls prevention interventions.

2.6 **Prevalence of Fallers in LTC**

The frequency of falls tends to be higher in those living in LTC compared to those living in the community (7,18,70). It is thought that this is because of an increased prevalence of frailty and chronic conditions among LTC residents, compared to those who are able to remain living in the community. It is also thought that there is better accuracy in the reporting of falls in LTC settings than in the community, where falls may be underreported (71). One single-center study of an Ontario long-term care facility found that 52.8% of residents fell at least once in a one year period (64). General estimates of fallers in nursing homes based on American studies are up to 50% of the population per year, and 40% fall two or more times each year (58,72,73). However, these estimates do not necessarily indicate the prevalence of fallers among LTC residents in Ontario. The falls CAP manual states that 40% of LTC residents fall in a 6 month period (39). According to the Continuing Care Reporting System 13.7% of older adults fell within 30 days of their last MDS 2.0 assessment from 2009-2010. This study attempted to define the prevalence of fallers across all LTC facilities in Ontario, within each falls CAP category, to provide an estimate that is representative of the Ontario population. These prevalence estimates may eventually help inform policy on falls prevention practices, in terms of where the greatest need for prevention is.

2.7   Prevalence of Fallers among People with Neurological Diseases

The prevalence of fallers among people with neurological diseases, such as AD and PD, is typically higher than among individuals without these diseases (74), although for many other neurological conditions, the prevalence of fallers in these groups is not known. Older adults with cognitive impairments and dementia have a higher annual prevalence of fallers at 60% (21) compared to 30% of community-dwelling, cognitively intact older adults (3). Up to 68% of people with PD suffer a fall in a 12-month period (36). By describing the prevalence of fallers among those with neurological conditions and those without, stratified by falls CAP risk category, the results of this study may help determine whether the underlying diagnosis, or the number of prior falls, is more important in predicting future falls. It also provides an indication of how well the falls CAP can predict future falls in those with and without neurological conditions.

3   RISK FACTORS FOR FALLS

Generally, falls are thought to be events resulting from the complex interplay of many risk factors rather than accidents (40). Therefore, although some odds ratios for individual risk factors reported in papers investigating risk factors for falls may only appear to slightly or moderately increase one's fall risk, older adults often have many of these risk factors and are therefore at a substantial risk for falls (3,18,29,32,56,57). Similarly, the presence of multiple chronic conditions or comorbidities is significantly associated with falls (32,56,75), as well as certain diagnoses, such as cardiovascular diseases and neurological diseases (76). Risk factors for falls can be classified as extrinsic factors, such as environmental hazards, and intrinsic factors, such as age and balance impairments. Risk factors for falls in LTC and community settings identified in the literature include: impaired balance (3,18), history of fracture (77), visual deficits (56,65,78), impaired gait (56,65,78), arthritis (31,57,79), age (27,32), gender (33), fall history (65), cognitive impairment (80), use of an assistive device (27,58,80), fear of falling (35), depression (33,57,79), urinary incontinence (81-84), impaired ADL function (27,58,65,85), postural hypotension (18), number of medications (18,57,86), and the use of psychotropic medications (87,88). Table 1 shows the most common risk factors for falls in 16 studies identified by the AGS. Subsequent systematic reviews have been conducted that divided the studies into those examining risk factors for falls in community-dwelling adults (32) and those examining risk factors among hospital inpatients and LTC residents (89). The systematic review of studies on risk factors for falls among community-dwelling older adults reported similar findings to those shown in Table 1 for history of falls (OR = 2.77; 95% CI 2.37-3.25), gait deficit (OR = 2.06; 95% CI 1.82-2.33), and use of an assistive device (OR = 2.18; 95% CI 1.79-2.65) (89). However, this subsequent review also reported that the presence of PD (OR = 2.71;

95% CI 1.08-6.84) and antiepileptic drug use (OR = 1.88; 95% CI 1.02-3.49) were among the

strongest risk factors for falls identified in pooled analyses. The review of LTC residents also

reported similar ORs for history of falls (OR = 3.06; 95% CI 2.12-4.41) and use of an assistive

device (OR = 2.08; 95% CI 1.88-2.31). The other important risk factor identified in LTC

residents in that review was the presence of moderate disability, compared to no disability (OR =

2.08; 95% CI 1.88-2.31). There are many risk factors for falls that inform multifactorial risk

assessment strategies; however, narrowing down this list to a few important risk factors will aid

in making individualized assessment efficient and will potentially help to inform universal fall

prevention strategies for HC and LTC, if the risk factors identified in both settings are similar.

Table 1[†]-Bivariate Analysis of Most Common Risk Factors for Falls in 16 Studies* That Examined Risk Factors

Risk Factor	Significant/Total[**]	Mean RR/OR[¶]	Range
Muscle Weakness	10/11	4.4	1.5-10.3
History of Falls	12/13	3.0	1.7-7.0
Gait Deficit	10/12	2.9	1.3-5.6
Balance Deficit	8/11	2.9	1.6-5.4
Use of Assistive Device	8/8	2.6	1.2-4.6
Visual Deficit	6/12	2.5	1.6-3.5
Arthritis	3/7	2.4	1.9-2.9
Impaired ADL Function	8/9	2.3	1.5-3.1
Depression	3/6	2.2	1.7-2.5
Cognitive Impairment	4/11	1.8	1.0-2.3
Age > 80 Years	5/8	1.7	1.1-2.5

† Adapted from (90)
*(2-4,17,18,29,31,56,58,77,80,91-94)
**Number of studies that found a significant odds ratio or relative risk ratio/total number of studies examining each risk factor
¶ Mean relative risk ratios (RR) calculated for prospective studies. Mean odds ratio (OR) calculated for retrospective studies.

As few studies exist on risk factors for falls in HC, the results of community-based studies were used in some cases throughout this background to infer potential risk factors for HC clients. HC clients represent a unique group in that they are not necessarily healthy, community-dwelling adults and they live in a less controlled environment than people in acute care or LTC settings. By extension, it is expected that their risk factors for falls will likely differ from those of community-dwelling and institutionalized individuals; however, very few studies have examined risk factors for falls among HC clients. The Aging at Home Strategy is working to provide more funding for HC services due to an increasing demand for them (95) and HC has been shown to be more cost effective than LTC (96). In lieu of these changes, there will likely be more HC clients in the near future who require falls risk assessment, necessitating identification of those risk factors now. An Ontario-based population study of HC clients found the following risk factors to be predictive of single-fallers: male gender, impaired gait, higher Changes in Health, End-Stage Disease and Signs and Symptoms (CHESS) score, and number of environmental hazards (34). In addition to the four risk factors identified for single-fallers, recurrent fallers were independently predicted by a diagnosis of PD, poor self-rated health, and higher scores on the Cognitive Performance Scale (CPS) (34). An American, retrospective, case-control study of home health care clients determined that neurological and cardiovascular diagnoses, as well as use of tricyclic antidepressants (TCAs), phenothiazine antipsychotics, and a higher number of previous falls were significantly associated with being a faller (76). HC clients residing in Italy from 1997-2001 were more likely to fall if they wandered (OR = 2.38; 95% CI 1.81-3.12), had issues with gait (OR = 2.13; 95% CI 1.81-2.51), had environmental hazards in their home (OR = 1.51; 95% CI 1.34-1.69) or suffered from depression (OR = 1.53; 95% CI 1.36-1.73) (63). Lastly, a study of Dutch HC clients > 65 years of age reported that malnutrition (OR = 1.98;

95% CI 1.34–2.92), high care dependency (OR = 1.68; 95% CI 1.12–2.53), and immobility (OR = 2.52; 95% CI 1.14–5.53) were significant predictors of falls (97). Although there is some literature on falls risk factors in HC clients, and one study identified PD as a risk factor, there is no evidence informing whether risk assessment should be different for those with PD or dementia, who are likely to be at a higher risk for falls. Providing additional evidence for risk factors significantly associated with falls among HC clients, and stratifying by neurological diagnostic groups, will help to inform risk assessment strategies for these individuals. Many intrinsic and extrinsic risk factors for falls in older adults are captured by the RAI-MDS 2.0 and RAI-HC assessment instruments and therefore can be assessed in LTC residents and HC clients (15). To inform falls risk assessment paradigms, it was necessary to examine both modifiable and non-modifiable risk factors for falls, although falls prevention strategies will focus on the modifiable risk factors.

3.1   Risk Factors for Falls-Extrinsic

3.1.1   Use of an Assistive Device

Assistive devices or mobility aids, such as walkers and canes, can be used to prevent falls, improve balance, and allow mobility in older adults (98). People with arthritis may use canes or walkers to reduce weight bearing on their lower limbs that might otherwise cause pain and discomfort (99). However, the use of a cane or walker can also have destabilizing biomechanical consequences and some people may abandon use of their device or use it improperly (99). Incidentally, several studies have noted that use of an assistive device is significantly associated with falls in institutionalized older adults. Specifically, nursing home residents that use a cane (27,58), walker (27,58), crutches (27), or any assistive device (18), are at a significantly increased risk of falls compared to those who do not use an assistive device. A large U.S. study

analyzed data from a telephone survey, for adults aged 85 or older, and reported that the presence of health conditions requiring use of an assistive device was significantly associated with a greater falls risk (OR = 2.18; 95% CI 1.82-2.62) (100). Interestingly, it has been demonstrated that use of a wheelchair significantly predicts falls in nursing home residents (OR = 1.19; 95% CI 1.09-1.31) (27). Use of an assistive device also independently predicts falls in community-dwelling older adults after hospital discharge (80). Finally, a systematic review of prospective studies of adults aged 65 or older determined that the pooled OR for use of a walking device across 11 studies that measured all falls as an outcome was 2.18, 95% CI 1.79-2.65, and for six studies that measured recurrent falls the pooled OR = 3.09, 95% CI 2.10-4.53. However, there was significant heterogeneity across studies as to what defined use of a walking device, so these results must be interpreted carefully (32). Use of an assistive device as a risk factor for falls does not imply that we should eliminate assistive devices; rather, it supports the need to ensure safe use of these devices, or the need for newly designed mobility aids that are better at preventing falls.

3.1.2   Environmental Factors

Generally, environmental risk factors for falls are more important in community-dwelling individuals than in institutionalized older adults (71); however, conditions related to the environment are the most commonly cited cause of falls in older adults, regardless of where they live (101). LTC facilities in Ontario have design standards outlined by the Ministry of Health and Long Term Care mandating features that prevent falls, such as grab bars next to toilets in all bathrooms—features that may not be present within the homes of HC clients (102). Incidentally, the RAI-HC assessment allows for the determination of environmental risk factors for falls but the MDS 2.0 used in Ontario LTC facilities does not. Presence of environmental hazards in a

home (34,63), as well as the presence of stairs in a home that must be used to access a bathroom for bathing, toileting, etc., (75) are independent predictors of falls in HC clients. It is important to note that for older adults, it is often the interaction between environmental factors, such as tripping hazards, and intrinsic functional deficits, such as impaired vision, that ultimately lead to falls (101). Therefore, it was crucial to examine both extrinsic and intrinsic risk factors for falls, as they are not always mutually exclusive in contributing to a fall event.

3.2   Risk Factors for Falls-Intrinsic

3.2.1   Non-modifiable Intrinsic Risk Factors

3.2.1.1   Prior Falls

The falls CAP is based on the premise that a history of falls is by far the best predictor of future falls (39). Certain consequences of falls, such as hip fracture and fear of falling can increase the risk for future falls (35), creating a vicious cycle. Fall history independently predicts falls in institutionalized older adults and is the strongest predictor; residents with a fall history are 3.4 times as likely to fall as residents with no fall history (58). Falls may result in fracture, or lead to recurrent falls; one study of nursing home residents reported that falls in the previous year and fracture in the previous five years predicted recurrent falls (65). Furthermore, results from a single-center trial indicated that a history of falls had an adjusted OR = 5.0 (29) and another single-center study of an Ontario LTC home found that a fall in the last 3 months independently predicted future falls (OR = 7.56; 95% CI 3.40-16.81) (64). Although a history of falls is an easy risk factor to assess, once a person has fallen, the presence of a fall history is not modifiable. In addition, not everyone who falls has a history of falling; therefore, it was necessary to find risk factors other than fall history that predict future falls in both LTC and HC settings.

3.2.1.2   Age and Gender

Demographic factors have also been reported as risk factors for falls in the literature. At any given time, almost 1 million Canadians are receiving HC services and 82% of these people are older adults. In Ontario, 83% of HC clients are over the age of 65 (15). Similarly, 93.5% of residents in LTC are older adults. Increasing age is significantly associated with falling in the community, institutionalized settings, and HC settings (27,29,32,33,68,77,91,103). Gender is another non-modifiable risk factor for falls and studies vary somewhat as to which gender is at a higher risk. There is evidence that both females (28,32,33) and males (34,100) are at a higher risk for falls. These gender differences across studies may be explained by a variety of different factors; for example, one study that determined females to be at higher risk specifically stated that females were also significantly more likely to be eligible for the study than those who were ineligible (28). Another plausible mechanism relates to the relative functional status of men versus women; older men may be more physically active (104) and may have greater lower body strength than women (105), both of which may prevent them from falling. Additionally, certain risk factors for falls, such as psychotropic medication use (106), are more associated with women than with men and failure to include these as confounders in multivariable models may explain the association between being female and falling. Conversely, men may be more likely than women to take risks in general, thus increasing their risk for falls (34). Despite some discrepancies with respect to gender, the evidence indicates that both age and gender were important risk factors to consider when predicting falls in older adults in LTC and HC, especially since the majority of individuals within these populations are women over the age of 65 (15).

3.2.2 *Modifiable Intrinsic Risk Factors*

3.2.2.1 *Impaired Gait, Balance, and Muscle Weakness*

Impairments in gait and balance are among the most frequently reported risk factors for falls among older adults. Arthritis and orthostatic hypotension are common causes of balance and gait impairments among older adults (98) and are significant risk factors for falls themselves (18,31). One study of 212 healthy females aged 21-82 years demonstrated that gait speed, measures of balance, and lower extremity muscle strength significantly decreased with age, non-linearly (107). Muscle weakness in LTC residents may be caused by physical inactivity, periods of prolonged bed rest, and the presence of chronic, debilitating conditions, such as stroke and pulmonary disease (71). Incidentally, impaired balance and gait, as well as reduced muscle strength, can all contribute to an increased falls risk (2,32,56,58,63,92). Unsteady gait can more than double a nursing home resident's risk of falling (27) and a low balance score on modified Tinetti scales, as well as hip weakness, independently predicts falls in both institutionalized and non-institutionalized older adults (18). There are different ways of measuring gait and balance impairments. The MDS 2.0 and RAI-HC each have an item that allows for easy determination of unsteady gait, which served as a composite measure of gait, balance, and lower limb muscle weakness in this study to avoid the presence of collinearity that may have been introduced by including all three factors in multivariable analyses.

3.2.2.2 *Visual Impairment*

Aging can be accompanied by impairments in vision, including, but not limited to, impaired spatial contrast sensitivity, decreased light sensitivity in the dark, slower visual processing speed (108), and reduced visual acuity (109). Vision is important for maintaining balance and postural control (109,110). Vision is also one of the mechanisms that senses changes in balance,

therefore, it is not only important for maintaining standing balance, but also for regaining one's balance once it has been perturbed. Poor vision reduces postural stability and doubles the risk of falls in older adults (111), as does poor visual acuity (109). Reduced depth perception predicts increased sway in older adults (112), which also significantly increases the risk of future falls (78). Older adults with impaired spatial contrast sensitivity are not able to detect edges under low-light conditions, which may result in them tripping over objects (111). Age-associated changes in vision are captured by the MDS assessments in terms of the degree of impairment, as well as peripheral vision losses and other visual disturbances, such as halos around objects or flashes of light. Numerous studies identifying risk factors for falls in older adults have observed a significant association between falls and impaired vision (56,65,68,78,103,113), as such, the degree of visual impairment was examined as a potential risk factor for falls in this study.

3.2.2.3 Impaired Cognitive Function

In addition to gait, balance, and visual deficits, it is widely accepted that aging can be associated with a decline in cognitive function that varies in severity among individuals. It is imperative to understand that this normal, age-related decline in cognitive function is non-pathological and distinct from dementia and other specific conditions that are characterized by cognitive decline; although, it is not yet entirely clear how to distinguish those with normal age-related cognitive decline from those with pathological declines in cognitive function. Nonetheless, age-related cognitive decline typically affects aspects of memory, processing speed, and reasoning – all of which are necessary to carry out everyday tasks (114). Several studies have reported that cognitive impairment independently predicts falls (18,80,115) and recurrent falls (34,116) in older adults. The increased risk for falls associated with cognitive impairment may be due to physical impairment in those with poor cognitive function. A study of cognitively impaired and

intact older adults revealed that those with cognitive impairments had performed significantly worse on tests of balance, gait, mobility, and strength. In this same study, cognitively impaired individuals were also significantly more likely to have suffered a fall and multiple falls during the 12-month follow-up period, compared to cognitively intact older adults (117). Executive function has also received attention as a key factor that increases falls risk in those with cognitive impairment (118) through affecting the ability to dual-task during walking and impairing attention (119,120). Although this age-related decline in cognitive function may not seem remediable, studies have indicated that cognitive plasticity persists into older ages (121,122) and that aspects of cognitive function can improve in older adults following intervention (123-125), suggesting that it could be targeted for fall prevention.

There are many different ways to measure cognitive function in older adults. The CPS was developed for use with the MDS assessment instruments; it uses 7 items from the cognitive patterns section of the assessments to calculate a score between 0 and 6, with higher scores indicating worse cognitive status (126). In nursing home residents, the CPS showed moderate (127) to good agreement with the Mini Mental State Exam (MMSE), a standard test for cognitive impairment, with a Cohen's k = 0.82 (95% CI 0.68-0.96) after adjusting for level of education and $r = -0.863$ ($P < 0.001$) (49). In a sample of older HC clients, the CPS was found to correlate significantly with the MMSE with an R^2 value of 0.81 ($p < 0.001$) (128). In 2009-2010, it was estimated that 14% of HC clients and 60% of LTC residents in Canada had moderate to severe cognitive impairment, according to the CPS (15). The relatively high prevalence of moderate to severe cognitive impairments suggested that this was a relevant risk factor for falls to include, as it could potentially predict falls in a large proportion of HC clients and LTC residents.

3.2.2.4   Impaired ADL Function

According to a 2011 report on older adults in Canada, 18% of HC clients and 74% of LTC

residents are completely dependent on others or require extensive assistance with activities of

daily living (ADLs) (15). A decrease in physical function, as measured by ADL performance,

also substantially increases an elderly individual's risk of placement in a LTC facility (129).

Some studies have observed an association between increasing age, particularly after age 80, and

an increase in ADL and Instrumental Activities of Daily Living (IADL) dependence (130-132),

even in cognitively intact older adults. However, it must be acknowledged that not all older

adults experience a decline in ADL function with age and that declines in function can be related

to underlying cognitive diseases, such as dementia or AD (133). Several studies have noted that

a decline in ADL function, measured in various ways, is significantly associated with falls in

nursing home residents. A large study that used the MDS 2.0 stated that nursing home residents

in the limited assistance, extensive-1, and extensive-2 categories of ADL function, according to

the ADL Self-Performance Hierarchy Scale, had significantly increased odds of falling (OR

(95%CI) = 1.35 (1.18-1.55), 1.34 (1.18-1.52) and 1.57 (1.31-1.88), respectively) (27).

Furthermore, ADL deterioration in the previous 90 days is independently associated with falls in

senior nursing home residents (OR = 1.19; 95% CI 1.09-1.29) (58). Lastly, a case-control study

of community-dwelling older adults who fell while in their homes demonstrated that being

dependent in 1 or more of 5 basic ADLs in the age 65-79 group was associated with an increased

risk of fall-related injuries (OR = 3.7; 95% CI 1.5-9.1) (85). Evidence indicates that functional

decline, as measured by impaired ADL performance, significantly increases the risk of falls in

older adults and as such was selected for inclusion in this study.

It is clear from the studies cited above that ADL performance can be measured with various indices. The ADL items in the MDS assessments are reliable, with weighted kappas ranging from 0.87-0.94. Similarly, the ADL Self-Performance Hierarchy Scale is able to explain 20.9% of the variation in nursing staff time spent with residents in nursing homes (134). Although the ADL Hierarchy Scale has not been validated for HC clients, the Home Care Reporting System uses this scale to report on the ADL status of HC clients annually (69) and the ADL summary scale has been validated with the RAI-HC in community-dwelling older adults (128). The ADL Self-Performance Hierarchy Scale is a convenient method of grouping HC clients and LTC residents according to their functional status; it allows easy determination of their functional status for assessing falls risk and ascertainment of improvements or declines in function following falls prevention practices. Furthermore, the ADL Hierarchy is superior to simply stating the number of ADLs that each resident is completely dependent in because it includes other degrees of impairment in function rather than just dependence. Older adults in LTC and HC are heterogeneous populations, suggesting that this study benefitted from the use of a scale that captured a spectrum of functional impairment.

3.2.2.5 *Frailty and the Changes in Health, End-Stage Disease, and Signs and Symptoms (CHESS) Scale*

Frailty has been reported in a number of studies to be a significant risk factor for falls (135,137); however, it remains a condition that defies a universal definition. The CHESS scale was developed as a scale embedded within the RAI-MDS assessments, including the MDS 2.0 and the RAI-HC, as a measure of health instability that may capture some of the consequences of frailty. It measures various aspects of health that are in the MDS assessments, including ADL status changes, cognitive changes in terms of decision making, weight changes, specific health

conditions (e.g. dyspnea), and nutrition/hydration status. From these items, the CHESS scale

assigns a score from 0-5, with higher scores indicating higher levels of health instability. The

CHESS captures some aspects of Bortz's Conceptual Framework of Frailty (138) by evaluating

weight loss, malnutrition, and end-stage diseases that may have a genetic origin and has been

used as a measure of frailty among HC clients (139). The CHESS scale does not correlate well

with the ADL Hierarchy Scale, the CPS, or the Depression Rating Scale (DRS); indicating that it

measures distinctly different aspects of health status than these other scales (140). The CHESS

has been shown to predict mortality in complex continuing care hospital patients in Ontario

(average age 76 ± 13.1 years), independent of age, sex, ADL status, CPS score, and do-not-

resuscitate orders. In addition, CHESS score is significantly associated with other important

health measures, such as daily pain, abnormal laboratory values, and physician visits (140). A

study of community-dwelling adults using HC services in Ontario reported that a single-point

increment on the CHESS scale significantly predicted falls and multiple falls (OR = 1.20 and

1.29, respectively). In summary, the CHESS scale was a useful way to measure changes in

health status, which may be a marker of frailty and an important risk factor for falls.

3.2.2.6   Number of Medications

Polypharmacy, the use of multiple medications, is common among older adults and has been

reported by several studies to be significantly associated with falls. In 2009, 63% of older adults

on public drug programs in Canada claimed five or more different classes of drugs and 23%

claimed 10 or more different drug classes (15). The polypharmacy phenomenon is partly due to

the fact that treatment regimens involving the use of two or more medications to manage a single

condition are becoming increasingly recommended for conditions that are especially prevalent in

older adults (141), such as hypertension (142) and diabetes (143). Further compounding the

association between aging and polypharmacy is the fact that some older adults have multiple chronic conditions that can all be managed with medication. According to the 2008 Canadian Survey of Experiences with Primary Health Care, 24% of older adults reported being diagnosed with 3 or more of 11 listed chronic conditions (144). Though these complex prescription regimens may be beneficial for treating their comorbid conditions, prescription and use of multiple medications by older adults is associated with adverse drug events (145) and falls. The mechanism linking falls and polypharmacy is not well understood. One theory is that taking more medications increases the probability of taking a type of medication that increases the risk for falls, such as a psychotropic drug (146). An alternate hypothesis is that polypharmacy is associated with having many comorbid conditions that increase the risk for falls (147). The exact number of medications associated with an increased falls risk varies slightly across studies; one study of nursing home residents reported that taking 5-9 medications increased the risk of falling 4-fold and taking ≥ 10 medications had an OR = 5.5; 95% CI 1.9-15.9 (86). Similarly, Robbins and colleagues found that taking > 4 medications independently predicted falls in institutionalized older adults (18). A systematic review determined that adults aged 60 or older showed no difference in mean number of medications taken between fallers and non-fallers but those taking greater than three or four medications were at an increased risk of recurrent falls compared to individuals taking fewer than three or four medications (148). Nursing home residents taking three or more medications are at a twofold increased risk of falls compared to residents taking less than three medications (57). Overall, the evidence suggests that older adults taking four or more medications are at an increased risk of falls compared to older adults taking fewer than 4 medications; however, the use of 10 or more medications would provide an even higher threshold that may distinguish those at highest risk for falls, as the evidence-to-date

suggests. The MDS 2.0 and RAI-HC only allow coding for 9 or more medications. The clinical

complexity of older HC clients and LTC residents and the fact that 23% of Canadian older adults

claimed 10 or more different drug classes in 2009, suggested the use of ≥ 9 medications as a cut-

off was justified.

3.2.2.7 Psychotropic Medication Use

Psychotropic medications are associated with an increased risk of falling. Broad classes of

psychotropic drugs include: anxiolytics, antipsychotics (or neuroleptics), antidepressants, and

sedative-hypnotics (149). Examples of antidepressants include: citalopram, fluoxetine, and

bupropion. Lorazepam and oxazepam are benzodiazepines commonly used to treat anxiety.

Olanzapine and clozapine are both atypical antipsychotics used among HC clients and LTC

residents. Psychotropic medications are often used in LTC settings to manage problematic

behavioural symptoms in residents who may or may not have cognitive impairments (149).

Many LTC residents also present with depression (150,151) and are prescribed antidepressants

(152). Unfortunately, psychotropic medications have several side effects that can increase one's

risk of falling, including autonomic effects, like orthostatic hypotension, and psychomotor

effects such as tardive dyskinesia, pseudoparkinsonism, akathisia (149), and even visual

disturbances (153). Furthermore, alcohol consumption can increase the half-life of these drugs

and enhance the central nervous system effects of them (154), implying that older adults taking

these medications and consuming alcohol are at an even greater risk for falls. A recent meta-

analysis revealed that the use of psychotropic medications in adults aged 60 and older is

associated with an increased risk of falls; although, the use of neuroleptics and antipsychotics

was not significantly associated with falling after adjusting for confounders (155). Another

systematic review (88) found that benzodiazepines (58,79,86,156-163), antidepressants

(33,65,79,115,156,160,162,164), and antipsychotics (58,86,115,161,165) are all associated with an increased falls risk in both community-dwelling and institutionalized older adults (163). An older systematic review and meta-analysis (87) calculated significant pooled ORs for the association between one or more falls in adults $\geq$ 60 years of age and the use of any psychotropics (OR = 1.73; 95% CI 1.52-1.97); neuroleptics (OR = 1.50; 95% CI 1.25-1.79); antidepressants (OR = 1.66, 95% CI 1.41-1.95); sedative hypnotics (OR = 1.54; 95% CI 1.30-1.70); and benzodiazepines (OR = 1.48; 95% CI 1.23-1.77). Leipzig and colleagues also observed a small association between falls and the use of diuretics, type IA antiarrythmic drugs, or digoxin in a subsequent systematic review and meta-analysis; however, none of the studies reviewed were randomized controlled trials, suggesting that the quality of evidence was lacking (148). Similarly, Woolcott and colleagues noted in their meta-analysis that the use of diuretics was not statistically associated with falls after adjusting for covariates (155). It is important to consider that no randomized controlled trials have been conducted to-date on the effect of polypharmacy on falls and only one has been conducted on the effect of an antipsychotic on falls (165). Thus, mainly observational evidence is available to support the claim that medication use is a significant risk factor for falls. These observational studies do not always account for duration of medication use or dosage, which could potentially have an effect on the association between number of medications and falls (88). Nonetheless, the use of psychotropic drugs in older adults is common and was therefore worth examining as a potential risk factor for falls in the HC and LTC populations in Ontario.

3.2.2.8 *Depression*

Evidence indicates that there is a significant association between depression and falls. In 2009-2010, 31% of Canadians living in LTC facilities and 14% of long-stay HC clients showed

possible signs of depression (15). The relationship between depression and falls is mediated by different factors, including fear of falling (166), chronic pain (167), and impairments in gait and balance (98,166). Specifically, it is thought that the association between depression and impairments in gait and balance is via sensory, cognitive, and motor pathways in the brain (166). Managing depression in older adults can be complicated by several factors: antidepressants contribute to an increased falls risk (79,87,115), depression is often underdiagnosed in older adults, and depression may be caused by underlying AD or dementia (168-170). Many studies have observed a significant association between depression and falls in various settings. Fallers in residential care are more likely to be depressed than non-fallers (65) and individuals diagnosed with depression in the same study were more likely to be recurrent fallers than single fallers or non-fallers. Depression also increases the risk of injurious falls in community-dwelling older adults (OR = 1.36; 95% CI 1.14-1.61) (33) and is significantly associated with falls in elderly, community-dwelling women (79). In a single-center, case-control study of nursing home residents, fallers were significantly more likely than non-fallers to suffer from depression (P=0.003) (57). In relation to HC clients, a case-control study of people receiving home health care in New York reported that depressive symptoms were associated with an almost two-fold increase in falls risk, even after controlling for other risk factors (OR = 1.90; 95% CI 1.01-3.59) (75). Cesari et al. observed a significant association between depression and falls in HC clients as well (OR = 1.53; 95% CI 1.36-1.73) (63). There is clearly an association between depression and falls; however, a clinical diagnosis of depression (57) and the presence of depressive symptoms (75) have both been associated with falls. Therefore, it was somewhat unclear which measure should be used in this study to predict falls.

In the nursing home setting, nurses tend to observe depressive symptoms in more residents than just those who are diagnosed with depression and there is a discrepancy between what nurses observe and what patients report in direct interviews, in terms of their depressive symptoms (171). The MDS DRS was developed and validated in a small sample of nursing home residents against the Hamilton Depression Rating Scale and Cornell Scale, with Pearson correlation values of 0.71 and 0.70, respectively. The MDS DRS showed 91% sensitivity and 69% specificity in diagnosing depression compared to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) classification when a cut-off score ≥ 3 was used to indicate depression in the same sample of residents. In addition, the DRS achieved acceptable internal consistency reliability with a Crohnbach's alpha value of 0.71 in nursing home residents (172). However, in a subsequent, larger study of nursing home residents, the MDS DRS did not correlate well with the Geriatric Depression Scale (GDS), a widely used measure of depression in research. The correlation coefficients for the 15-item and 5-item versions of the GDS with the DRS were only 0.073 and 0.065, respectively. Furthermore, the Crohnbach's alpha of the DRS in the same study only reached 0.542 (173). These results imply that the GDS and DRS measure different constructs and that the DRS may not be a reliable measure of depression. However, the MDS DRS may be better than the GDS at detecting depression in cognitively impaired individuals, as indicated by a significant association in cognitively impaired residents between their DRS score and clinical indicators of depression--namely depression diagnoses and the use of antidepressants (173). This association with clinical indicators was not detected with the GDS for both cognitively intact and cognitively impaired groups. A study of nursing home residents in the Netherlands revealed that a diagnosis of depression did not correlate as well with the DRS when cognitively impaired individuals were included in the analysis compared to only including

cognitively intact residents ($r = 0.303$ vs. $r = 0.196$). It was thought by the researchers that this discrepancy was likely due to the underdiagnosis of depression in cognitively impaired residents. The same study also reported that the prevalence of depression detected by the DRS was 42.5%, but only 14.4% had a clinical diagnosis of depression (174). Therefore, despite some of the limitations with respect to reliability and validity, the DRS seemed a more appropriate measure of depression than a clinical diagnosis for this study, given that the focus is on LTC residents and HC clients with neurological diseases who may have cognitive impairments. Furthermore, the use of a clinical diagnosis of depression would likely not have been adequate to detect all residents and clients with depression and could have potentially underestimated the effect of depression as a predictor of falls.

3.2.2.9 Dizziness, Vertigo, and Postural Hypotension

Dizziness and vertigo may result from a myriad of other underlying factors, including medications, cardiovascular conditions, anxiety, depression (101), or age-related deterioration of the vestibular system (175). Orthostatic, or postural, hypotension is usually defined as a drop in systolic blood pressure ≥ 20 mmHg upon standing from lying down (101). Approximately 10-30% of healthy, community-dwelling, elderly people have postural hypotension (101). Orthostatic hypotension may be a side effect of some medications and can also be caused by prolonged periods of lying down. Although postural hypotension can lead to dizziness and falls, the literature on postural hypotension as a predictor of falls in older adults is conflicting. In one study of ambulatory, non-institutionalized older adults postural hypotension independently predicted falls (18), while studies of community-dwelling older adults have reported that orthostatic hypotension did not predict falls (176,177). In contrast, a systematic review of community-dwelling older adults determined that vertigo is significantly associated with falls

(OR = 1.8 for single fallers; 2.3 for recurrent fallers) (32). Dizziness, lightheadedness, and vertigo are easily measured by both the MDS 2.0 and RAI-HC assessments whereas postural hypotension is not as straightforward to measure; thus, the items for dizziness, vertigo, and lightheadedness were chosen as potential risk factors for falls in this study.

3.2.2.10 Diabetes

Diabetes has been identified as a significant risk factor for falls in older adults in the community and in LTC (178,179) and there are a number of different mechanisms through which diabetes can increase the risk for falls. According to the 2005 Canadian Community Health Survey, approximately 1.3 million Canadians over the age of 12 have type 2 diabetes mellitus. Diabetes is primarily a disease of older adults, affecting 13.5% of individuals 60 and older compared to 5.8% of those 45-59 years of age (180). Diabetes can cause other major health concerns that increase the risk of falls, such as retinopathy that causes impaired vision (181), vestibular dysfunction that impairs balance (182), and peripheral neuropathy (136), especially in the lower limbs, that can impair proprioception (183). Another complication of treatment for diabetes is that drug regimens involving multiple medications are often used (143). Incidentally, a study of individuals 18 and older with diabetes stated that, compared to those taking 0-1 medications, individuals taking more than 7 medications had a 59% higher risk of falls (HR = 1.59; 95% CI 1.34-1.89) (184). Lastly, the use of insulin is a significant risk factor for falls in individuals with diabetes (185), which may be due to insulin-induced hypoglycemia that, if severe, can cause dizziness, blurred vision, and loss of consciousness (186). Not only are there many different diabetes-related complications that can increase the risk of falls, these complications are not mutually exclusive of one another and older adults with diabetes may also suffer from age-associated changes in vision, balance, and gait, further increasing their risk for falls. Therefore,

older adults with diabetes were hypothesized to be at a significantly high risk for falls due to age-associated changes as well as diabetes-related morbidities.

3.2.2.11 Incontinence

The CAP for urinary incontinence reports that over 50% of people living in LTC experience at least occasional episodes of urinary incontinence, with some individuals experiencing it regularly. There are a few studies of community-dwelling older adults that observed a significant association between falls and urinary incontinence (81-83,113). Urinary incontinence is also associated with falls among nursing home residents (84,187). Remarkably, one study of urinary incontinence among individuals with dementia reported that it was the only risk factor that independently predicted falls in that sample (OR = 4.9 ± 2.2; 95% CI 2.0-12.0) (188). The association between falls and incontinence may be caused by those experiencing urinary urge incontinence rushing to the bathroom to avoid incontinent episodes, especially during the night (83). Although it appears that there is little evidence to support the association between falls and urinary incontinence, many studies simply do not evaluate it as an independent risk factor and, given the embarrassing nature of the condition, it may be underreported. Similarly, bowel incontinence independently predicted falls in a sample of home health care clients in New York state (75). To potentially corroborate the evidence presented, examining incontinence as a potential risk factor for falls was warranted. Given that LTC and HC staff complete the MDS assessments, it is less likely that urinary and bowel incontinence were underreported in these groups compared to studies of healthy, community-dwelling older adults that rely on self-report.

3.2.2.12 Pain

Although chronic pain is common among older adults and is associated with many other conditions, it has seldom been measured in studies as a potential risk factor for falls and the

association between chronic pain and falls is not well understood. Constant musculoskeletal pain affects over half of the older adult population, has many potential etiological factors, and can contribute substantially to disability (189). Pain can be associated with other falls risk factors, such as depression (167), and arthritis. A population-based study of community dwelling adults 70 and older reported that, after adjusting for other falls risk factors, pain at ≥ 2 sites, being in the highest pain severity tertile, and having the highest level of "pain that interferes with ADL performance", were all significantly associated with falls (rate ratio = 1.53 for each measure) (190). Potential mechanisms by which pain contributes to falls proposed in the study by Leveille et al. include neuromuscular responses, such as lower limb weakness and slowed reaction time; joint pathologies that may impair gait, such as arthritis; and the interference of pain with cognitive functions necessary to prevent falls, which may be particularly relevant in older adults with impaired cognitive function (190). Likewise, after adjusting for other relevant falls risk factors, having pain with slight, or moderate to severe interference with normal work in the previous four weeks is significantly associated with any falls in the past 12 months (prevalence ratio = 1.27 and 1.47, respectively), compared to individuals who experience no pain in the previous four weeks (191). Furthermore, having pain that resulted in moderate to severe interference with work in the previous four weeks is significantly associated with two or more falls in the last 12 months, after adjusting for other falls risk factors (191). There is evidence indicating that chronic pain is significantly associated with falls and plausible mechanisms have been identified. Pain is a common, manageable symptom among older adults and was therefore investigated as a potential predictor of falls in LTC residents and HC clients.

One issue with using pain as a risk factor is that pain is extremely subjective in nature and there are many different scales that have been developed to measure it, including the MDS Pain Scale

(192). The MDS Pain Scale was originally developed for nursing home residents and validated against a sensitive and convenient measure of pain--the Visual Analogue Scale. The MDS Pain Scale was able to explain 56% of the variance in Visual Analogue Scale scores of nursing home residents and the agreement between the two measures was good (kappa = 0.707), indicating acceptable validity of the MDS Pain Scale (192). The MDS Pain Scale has also been used to assess pain in community-dwelling older adults using the RAI-HC (193); it was an efficient way to assess pain as a risk factor for falls without having to stratify based on every level of intensity and frequency of pain.

3.2.3 Risk Factors for Falls in People with AD or PD

The prevalence of fallers in older adults with certain neurological conditions tends to be even higher than in neurologically healthy older adults (26), suggesting that they are at an even greater risk for falls than older adults without these conditions. These particularly vulnerable diagnostic groups present with many of the same impairments or risk factors for falls as individuals without neurological disorders. However, these individuals may experience a greater degree of impairment, or may experience a more rapid decline in body functions or systems that increases their risk for falls even more than older adults without AD or PD and explains why these conditions are often cited as risk factors for falls themselves. AD and PD are the most common neurodegenerative disorders affecting older adults in Canada (194,195). Therefore, given that the majority of the HC and LTC populations in Ontario are aged 65 and older, it is reasonable to infer that these conditions are the most prevalent neurodegenerative disorders within these populations. The progression of PD (196) and AD may also interact with typical aging processes to further impair functional ability and increase the risk of falls in these subgroups of older adults. In Canada, AD and PD account for the greatest number of years of

life lost due to premature mortality, compared to other neurological diseases, with the exception

of stroke (25). A history of stroke has been identified as a significant risk factor for falls among

older adults (91,100); however, the consequences of suffering a stroke vary tremendously across

individuals so it did not seem appropriate to examine those with a history of stroke together as a

single group in this study. Furthermore, many studies have been conducted on risk factors for

falls in people who have suffered a stroke (197-200) and this study aimed to look at conditions

that have not been widely studied. Additionally, although tension headaches are the most

common neurological condition among the general Canadian population (25), they are not

adequately captured by the MDS assessment. Therefore, the focus in this study was on risk

factors for falls in people with PD and AD and related dementias, in HC and LTC. Although

these disorders affect different aspects of neurological functioning, there are some similarities in

risk factors for falls among them, including gait abnormalities and postural instability (26).

Cognitive impairment and the presence of Lewy bodies are also common features among PD and

certain subtypes of dementia (201). There are risk factors described in the literature that are

unique to each neurological disease, suggesting that older adults with neurological diseases may

benefit from different falls risk assessment algorithms, or that the relative importance of certain

shared risk factors may be different in older adults with PD or AD, compared to older adults

without these conditions. However, there is some overlap of risk factors for falls among

individuals with neurological conditions and older adults without these conditions; thus, it may

be that a certain set of risk factors is most important when predicting falls, rather than the

presence or absence of a diagnosis of AD or PD and the associated clinical features of these

conditions that lead to falls. The results of this study provide a better understanding of the

relative importance of neurological diagnoses versus the presence of a group of risk factors in

predicting falls in HC and LTC settings. The literature suggests that everyone with AD or PD is at a high risk for falls, as such, the "Not Triggered" groups within these conditions were the focus of this study, since the falls CAP actually classifies them as low risk for falls. By focusing on the "Not Triggered" individuals with neurological diseases, this study provides an indication of how well the falls CAP predicts future falls in these diagnostic groups.

3.2.3.1   Alzheimer's Disease and Related Dementias

AD is prevalent among older adults and among those with AD and other dementias, falls are especially common (202). In 2008, the Alzheimer Society of Canada estimated that 500,000 Canadians have AD or a related dementia and identified it as the most significant cause of disability among Canadian older adults (194). Both community-dwelling and institutionalized older adults with dementia have a two- to three-fold higher falls risk compared to cognitively intact older adults (3,28,33,86,203). A potential mechanism linking falls to AD is slower processing speed, a measure of cognitive functional decline that is significantly associated with falls in older adults (203). Cognitive processing is important for postural control (204) and individuals with AD may lack adequate cognitive processing to maintain their normal gait speed while performing a second task, such as talking (205). Muir et al. demonstrated that individuals with mild cognitive impairment or AD did not differ significantly from healthy controls under single-task conditions. However, their gait velocity decreased, stride variability increased, and stride time increased, compared to controls, under dual-task conditions in which they were asked to walk and simultaneously perform a verbal task, such as naming animals (120). Falls in older adults tend to happen when they are performing usual daily activities (70), many of which require multi-task skills (120); therefore, individuals with AD may be at higher risk for falls because they have insufficient cognitive resources to perform ADLs or to walk and talk

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simultaneously. Similarly, a study comparing cognitively impaired individuals to cognitively healthy individuals reported that cognitively impaired participants fell more during the follow-up period and performed worse on tests of physical function, such as grip strength, timed up and go, and controlled leaning balance (117,206). Some of these tests are associated with a cognitive load because they involve integration of multiple cognitive processes that cognitively impaired people may not be able to handle, thus causing them to perform worse on these tests and increasing their risk for falls (117,206).

Individuals with AD present with many of the same risk factors for falls as cognitively healthy older adults, including age (37), psychotropic medication use (207,208), fall history (37), impaired gait (30,208), impaired balance (207), and arthritis (30). The association between certain risk factors and falls may be amplified in people with dementia; nursing home residents who start taking SSRIs and TCAs for the management of dementia-related behaviours have significantly higher fall rates than residents who initiate use of those drugs for the treatment of depression and depressive symptoms (164), suggesting that those drugs more strongly affect psychomotor and autonomic functioning in individuals with dementia. Additionally, people with AD and related dementias who present with the same falls risk factors as cognitively intact individuals may be at an even higher baseline risk of falls simply as a result of their underlying condition (26), thus, the falls CAP may not necessarily apply to these individuals because it may underestimate the risk for falls in those without a history of falls. The evidence indicates that individuals in LTC and HC with AD and related dementias are at higher risk for falls and the relative importance of certain risk factors may be different in those with dementia compared to those without dementia.

PD is the second most common age-related neurodegenerative condition after AD; it is estimated

that almost 100, 000 Canadians have PD and 85% of these people are over the age of 65 (195).

The main symptoms of PD are tremors, rigidity, and other involuntary movements (209);

consequently, falls are common among people with PD. A systematic review of risk factors for

falls among community-dwelling older adults reported that the presence of PD almost tripled the

risk for falls in this population (OR = 2.71; 95% CI 1.08-6.84) (32). Not unlike people with AD

and related dementias, individuals with PD present with some of the same risk factors as people

without PD. Impaired balance and postural instability are significant predictors of falls in this

population (210,211), as are previous falls (212-214), increasing age (214,215), mild cognitive

impairment (212), fear of falling (211), and the presence of dementia (36,215). ADL

impairment, as measured by certain items on a PD-specific scale that tracks the progression of

the illness (216), and higher scores on a PD-specific quality of life scale (214) also predict falls

in this population. There are other disease-specific characteristics of people with PD that are

associated with falls, including disease severity (36,211), freezing of gait (211-213), self-

selected gait speed < 1.1 m/s (213), and moderately to severely stooped posture (212). Freezing

of gait occurs when people with PD are suddenly unable to walk or unable to continue walking,

which can cause instability and falls if they are not able to adjust to the sudden gait disturbance

(217). Forward stooping posture tends to bring the center of gravity forward (218), which can

contribute to postural instability and forward falls. Specific measures of gait are also affected in

those with PD; they tend to have gait asymmetry, shorter strides, and increased stride time

duration that progress as the disease symptoms worsen (219). In early stages of the disease, it is

hypothesized that people with PD compensate for these gait alterations by conscious control of

stride length and timing (26). Activities that distract people with early-stage PD from concentrating on compensating for these gait abnormalities, such as talking while walking, may place them at risk for falls (220). Finally, some individuals with PD experience autonomic dysfunction, as such, some of these individuals present with orthostatic hypotension that can be caused or exacerbated by taking high doses of certain Parkinson's drugs, physiological deconditioning, or reduced blood volume caused by physical disability or inactivity (74,221). Unfortunately, many of the more unique risk factors for falls in people with PD are not captured by the MDS assessments; therefore, this study only tested the association between risk factors captured by the MDS and falls. However, individuals with PD represent another prevalent subgroup of older adults living in both LTC and HC settings who may differ from healthy older adults in terms of their risk factors that predict falls.

3.2.4   *Modifiability of Falls in People with Neurological Diseases*

Generally, effective falls prevention interventions among community-dwelling older adults include multi-component exercise programs or multifactorial interventions that rely on an interdisciplinary approach by the healthcare team (66-68). In contrast, a systematic review of falls prevention interventions among LTC residents reported that only vitamin D supplementation reached statistical significance for reducing the rate of falls (rate ratio = 0.63; 95% CI 0.46-0.86) (222). However, it is not known whether these interventions can effectively prevent falls in those with dementia or PD. Despite the severity of functional impairment that usually accompanies AD, related dementias, and PD, which seems to imply that falls are an inevitable consequence of these conditions, fall prevention interventions have been tested in samples of these groups and showed potential. In community-dwelling adults with PD, both a home based exercise program (223) and gait and step training (224) have reduced falls in these

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groups, although not significantly. A systematic review of fall prevention strategies in people with AD and other dementias concluded that occupational therapy-based interventions that included physical training to improve gait, balance, strength, and flexibility reduced falls in primarily institutionalized individuals (225). These interventions focused on risk factors that are similar between those with neurological conditions and those without; providing additional evidence that certain risk factors for falls, regardless of an underlying diagnosis of a neurological illness, are likely most important in assessing risk and preventing falls. Individuals with neurological conditions may only require a more rigorous prevention program to address their rapidly declining functional status. Additional studies are needed that focus on these diagnostic subgroups, to confirm that falls can in fact be prevented in these individuals.

4   SUMMARY OF BACKGROUND

Falls are common among older adults in HC and LTC settings, especially among individuals with dementia or PD, which are prevalent neurodegenerative diseases among older adults. The falls CAP may be a useful tool for predicting future falls in HC and LTC settings; however, it may underestimate the risk in people with dementia and PD who typically have a higher risk for falls than individuals without these conditions, due to their motor and cognitive impairments. Therefore, it is important to stratify HC clients and LTC residents based on a diagnosis of dementia or PD to determine if the falls CAP still applies to these groups. Additionally, the falls CAP does not predict future falls in those without a history of prior falls. Many other risk factors, besides a history of falls, have been identified in the literature and may help to identify individuals at a high risk for future falls among those without a recent history of falls. The MDS assessments are an efficient way to identify risk factors for falls, as they capture many different diagnoses and aspects of functioning that have previously been identified as risk factors for falls and are completed at regular intervals in both HC and LTC settings. Given that individuals with dementia and PD present with some unique risk factors, such as wandering and disease severity, it is relevant to identify risk factors within each subgroup to determine whether risk assessment should vary according to these diagnoses. Identification of multiple risk factors, rather than a history of falls alone (which is not modifiable), will help inform multifactorial falls prevention programs for individuals with dementia or PD.

5   RESEARCH METHODS

5.1   Primary Research Questions

1. What risk factors are predictive of falls in HC among clients diagnosed with PD or dementia who fell in the last 90 days but did not fall during the 90 days prior to their baseline assessment? Do these differ from risk factors predictive of falls in HC clients not diagnosed with the selected neurological conditions that also fell 90 days prior to follow-up but did not fall during the 90 days prior to their baseline assessment?

2. What risk factors are predictive of falls in LTC among residents diagnosed with PD or dementia who fell in the last 30 days but did not fall during the 30 days or 31-180 days prior to their baseline assessment? Do these differ from risk factors predictive of falls in residents not diagnosed with the selected neurological conditions that also fell 30 days prior to follow-up but did not fall 30 days or 31-180 days prior to their baseline assessment?

5.2   Secondary Research Questions

1. Among HC clients who are not diagnosed with any of the selected neurological conditions, what is the prevalence of fallers at follow-up in each of the falls CAP categories identified according to baseline assessments?

2. Among HC clients who are diagnosed with PD, dementia, or the selected neurological conditions what is the prevalence of fallers at follow-up in each of the falls CAP categories identified according to baseline assessments?

3. Among LTC residents who are not diagnosed with any of the selected neurological conditions, what is the prevalence of fallers at follow-up in each of the falls CAP categories identified according to baseline assessments?

4. Among LTC residents who are diagnosed with PD, dementia, or the selected neurological conditions what is the prevalence of fallers at follow-up in each of the falls CAP categories identified according to baseline assessments?

5. What is the prevalence of the predictive falls risk factors among HC clients without any of the selected neurological diseases who fell during the 90 days prior to follow-up but did not fall during the 90 days prior to their baseline assessment?

6. What is the prevalence of predictive falls risk factors among HC clients diagnosed with dementia or PD that fell during the 90 days prior to follow-up but did not fall during the 90 days prior to their baseline assessment?

7. What is the prevalence of predictive falls risk factors among LTC residents without any of the selected neurological diseases who fell during the 30 days prior to follow-up but did not fall during the 30 days or 31-180 days prior to their baseline assessment?

8. What is the prevalence of predictive falls risk factors among LTC residents diagnosed with PD or dementia that fell during the 30 days prior to follow-up but did not fall during the 30 days or 31-180 days prior to their baseline assessment?

5.3   Primary Hypotheses

Gait impairments have been identified as an important risk factor for falls in older adults with and without dementia or PD; therefore, this was likely to be a significant predictor of falls in all groups that were examined in this study, in both HC and LTC. It was hypothesized that the presence of dementia, or mild to severe cognitive impairment was likely to be a risk factor for falls in those with PD. Based on a previous study, the presence of at least two environmental hazards was hypothesized to be a significant predictor of falls in all HC clients, regardless of

diagnosis (34). The use of at least nine medications and use of psychotropic medications was hypothesized to predict falls in LTC residents with AD since medication is often used to control problematic behavioural symptoms; however, it was difficult to extend this hypothesis to HC clients since there is little evidence that suggests these medications are a significant risk factor in this group. In studies of individuals with PD, the severity of the condition, measured by Hoehn and Yahr staging is a significant risk factor for falls in this group. Although this specific scale is not on the MDS assessments, higher scores on the ADL Hierarchy Scale may have been reasonable indicators of disease severity and, by extension, were hypothesized to be significant predictors of falls within the PD group since this condition is characterized by progressive functional decline and impaired ADL function is a significant risk factor for falls (27,58,65). Conversely, risk factors that predict falls in the comparison groups in both care settings were hypothesized to be arthritis and moderate to severe visual impairment (90), as these are likely primary conditions in the healthy group and secondary conditions in the groups with neurological conditions, whose underlying neurological disease likely played a more prominent role in increasing their risk for falls.

5.4   Design

5.4.1   Origin of HC Data

The Ontario Association of Community Care Access Centres (OACCAC) has created and maintained a database of MDS assessments for HC clients who are expected to receive services for at least 60 consecutive days. All 14 CCACs in Ontario provide data to the OACCAC. Researchers affiliated with interRAI at the University of Waterloo receive updated data from the OACCAC twice per year as part of an existing license agreement between OACCAC, CIHI, and

interRAI. The existing dataset includes full assessments for HC clients receiving services in Ontario from January 1, 2002 to December 31, 2010. These assessments include individuals who are assessed both in the community and in hospitals; for the purposes of this study, only those who were assessed in the community were selected.

5.4.2 Sampling Frame for HC

In order to capture consecutive assessments with no discharge in between, we selected the most recent episode for each client/resident. 'Episode' in this study referred to a single admission period since clients/residents may be discharged and then return, in which case it would not have been relevant to use two consecutive assessments that were each from a different episode, given that the time between these assessments was likely too long to allow for proper interpretation of the results. We included all RAI-HC assessments completed for long-stay HC clients in Ontario from January, 2002-December, 2010 that have had ≥ 2 assessments within a single episode. The length of time between the two assessments (assessment interval) for HC clients had a positively skewed distribution with a mean of 248.2 ($\pm$191.2) days for all HC clients and 252.9 ($\pm$189.3) days for "Not Triggered" clients. The median (25th-75th %ile) assessment interval was 203 (161-285) days for all HC clients and 206 (167-288) days for "Not Triggered" clients. All individuals whose assessment interval was greater than 365 days were excluded from the sample since it would have been difficult to attribute fall(s) to risk factors obtained more than a year prior to the fall(s). After this exclusion, the median (25th-75th %ile) length of time between assessments for all HC clients was 190 (148-238) days and for the "Not Triggered" clients was 194 (156-240) days. The mean assessment interval after deleting assessments > 365 days apart was 191.0 ($\pm$ 77.2) days for all HC clients and 194.9 ($\pm$ 75.4) days for "Not Triggered" HC clients, suggesting that the data was more normally distributed after the exclusion. The two most recent assessments

in each client's most recent episode were used since the disease diagnoses were based on each person's most recent assessment in the database. Figure 2 shows how the observations used in the HC analyses were selected.
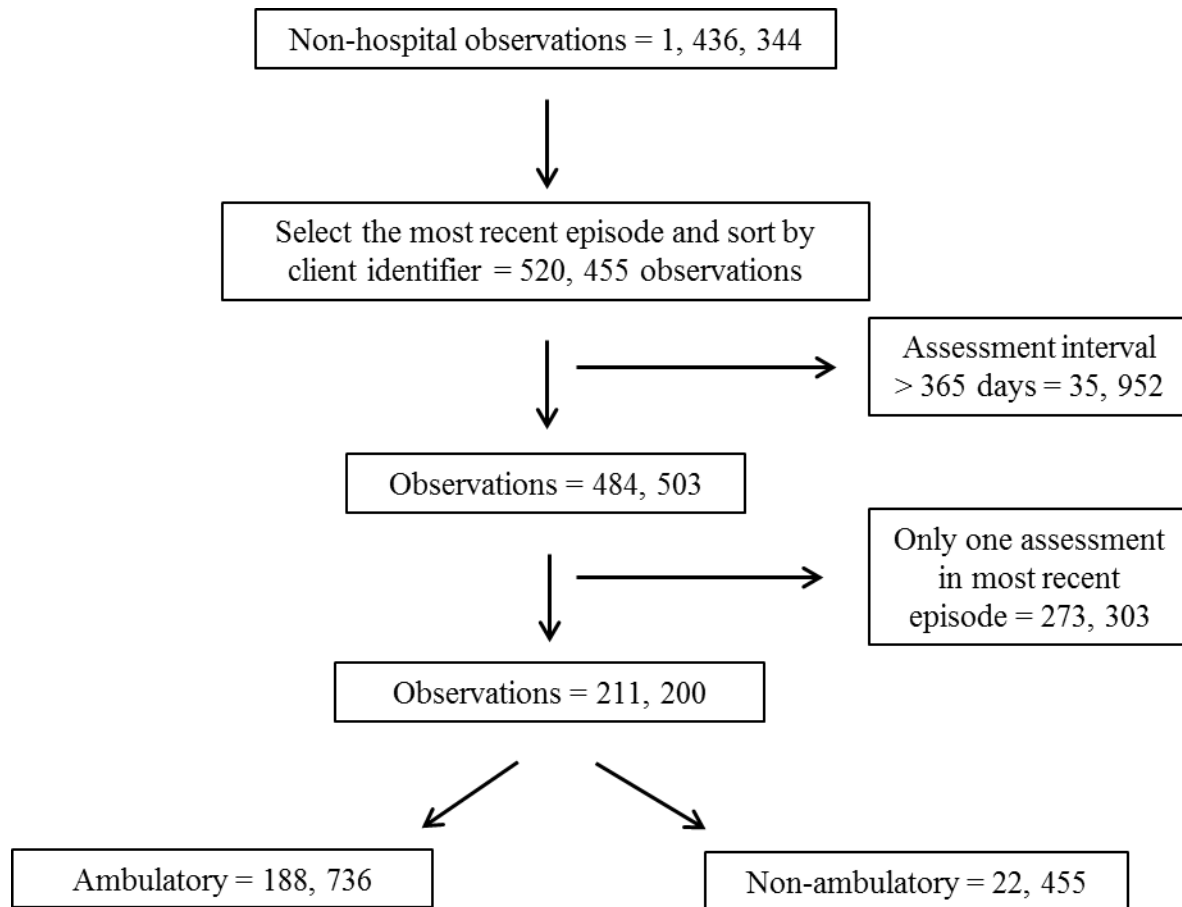
Figure 1-Flow Diagram Depicting Selection of Clients Used in HC Analyses

5.4.3 Origin of LTC Data

Researchers at the University of Waterloo who are affiliated with interRAI receive annual data from the Continuing Care Reporting System as part of an existing license agreement between CIHI and interRAI. The Continuing Care Reporting System is a database of MDS 2.0 full and quarterly assessment data completed for persons receiving continuing care in either a hospital or LTC setting. The LTC data for Ontario, specifically, consists of MDS 2.0 quarterly and full assessments of residents living in 635 facilities across the province from June 27th, 2003 to March 31st, 2011.

5.4.4 Sampling Frame for LTC

We included MDS 2.0 assessments completed for LTC residents in Ontario from June, 2003-March, 2011 that have had ≥ 2 assessments within their most recent episode. For LTC residents, both full and quarterly assessments were used because the two most recent assessments from the most recent episode were selected and they could have been either type of assessment. For variables that are on the full assessments but not on the quarterly assessments, values of these variables were carried forward from previous full assessments (the most recent one prior to the quarterly assessment) to represent these variables on the quarterly assessments. Residents who were discharged within 14 days of admission (unassessed episodes) and did not receive an initial assessment were excluded. LTC residents coded as comatose according to their baseline assessment were also excluded since they are unlikely to fall and were missing data for a variety of the selected risk factors as a result of being comatose. The mean (SD) assessment interval for all LTC residents was 80.5 (± 25.7) days and for "Not Triggered" residents was 80.8 (± 25.2) days.
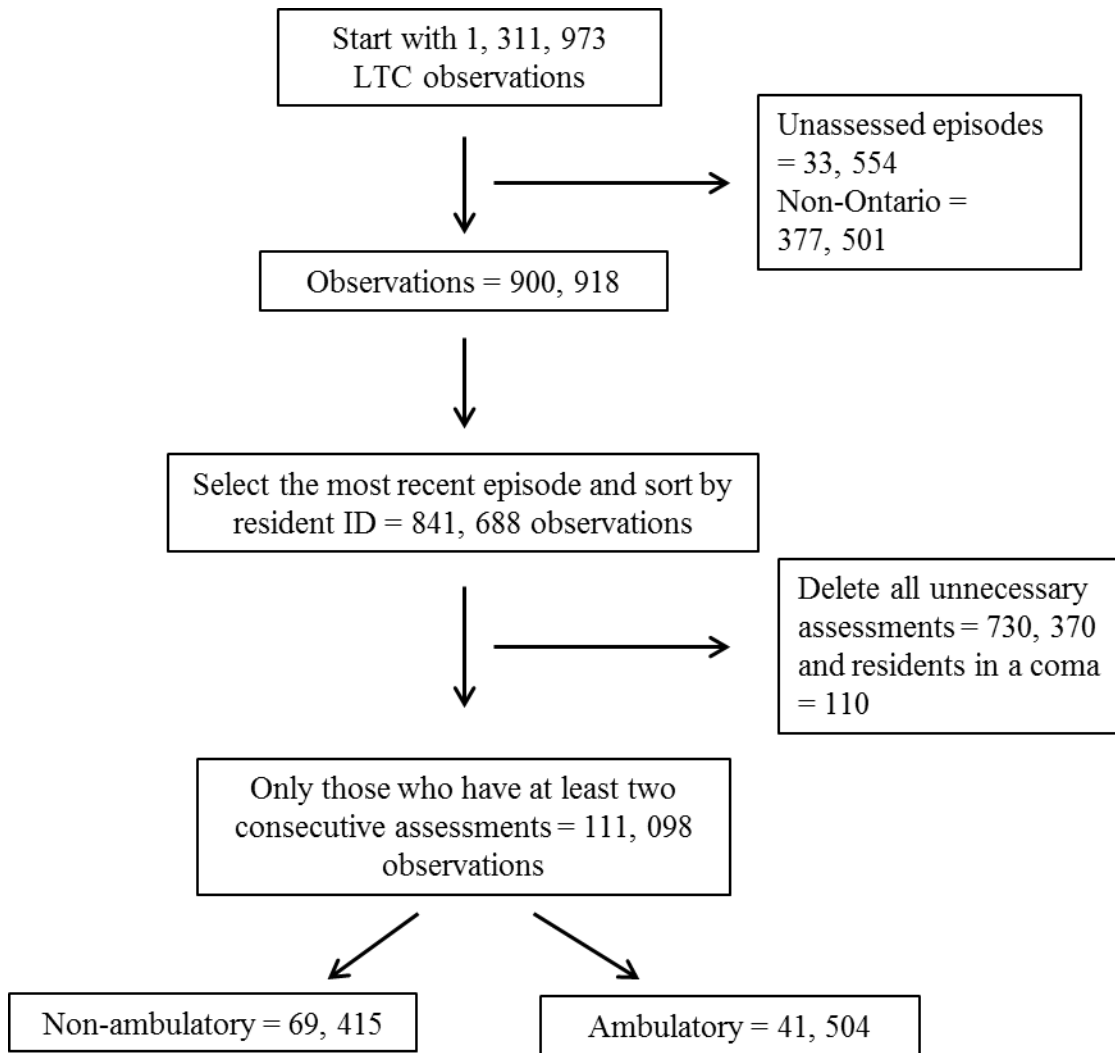
Figure 2-Flow Diagram Depicting Selection of Residents Used in LTC Analyses

5.4.5 Defining Six Groups of Residents/Clients

There were six groups analyzed in each care setting in this study. There were three main diagnostic groups in both care settings: AD and related dementias (dementia), PD, and comparison (having none of the following: dementia, PD, stroke, traumatic brain injury, epilepsy/seizure disorder, amyotrophic lateral sclerosis, muscular dystrophy, multiple sclerosis, Huntington's disease, cerebral palsy, and spinal cord injury). Within each of these diagnostic groups, the residents/clients were stratified based on ambulatory status at baseline and were classified as "ambulatory" or "non-ambulatory" (see Figures 1 and 2). Preliminary analyses of HC clients, regardless of falls CAP category, showed that wheelchair use significantly decreased the odds of being a faller in the AD and PD groups. The protective effect of wheelchair use suggested that ambulatory status was an effect modifier. Among studies that have chosen to address ambulatory status as an effect modifier, the approach has often been to exclude individuals who are non-ambulatory (2,7,17,93,165) or adjust for ambulatory status in multivariable models (226). One study chose to stratify based on ambulatory status to address its potential effect on falls (227). Stratification was chosen over exclusion and adjustment because the primary focus of this study is on individuals with neurological conditions, many of whom use wheelchairs due to their physical impairments; therefore, excluding these individuals would have significantly reduced the sample size and limited the external validity of this study. In addition, the ambulatory status of an individual may affect the types of fall prevention programs that can reasonably be used for that individual, lending further support for stratification by ambulatory status.

In HC, a client was classified as being "ambulatory" if their primary mode of locomotion indoors, at baseline, was no assistive device, cane, or walker/crutch. A client was classified as

"non-ambulatory" if their primary mode of locomotion indoors, at baseline, was a scooter, wheelchair, or in the "activity did not occur" category. In LTC, the modes of locomotion item is a "check all that apply" variable with 4 options: a) Cane, walker or crutch; b) Wheeled self; c) Other person wheeled; and d) Wheelchair primary mode of locomotion. In order to collapse the item to two levels with each person only counted once, the item was recoded as a variable with 16 levels, one for each possible combination of the 4 options, and then collapsed to two levels. If the "wheelchair as primary mode" item was checked off, the individual was classified as non-ambulatory, regardless of what other combination of items may have been checked off in addition to that. However, certain levels of the created locomotion item did not provide a clear indication as to whether a person was ambulatory or non-ambulatory (e.g. if only "wheeled self" or only "other person wheeled" were checked off). In order to deal with these ambiguous groups, the 16 level locomotion variable was cross referenced with the "walking in room" and "walking in corridor" items. If the majority of individuals within these ambiguous levels were able to walk independently in their room and corridor, the level was classified as ambulatory and if the majority of individuals within these levels were totally dependent, or the activity did not occur, the level was classified as non-ambulatory.

5.4.6 Dementia and PD Diagnoses

Table 2 shows the definitions of AD, dementia other than Alzheimer's, and PD according to the 2010-2011 versions of the MDS 2.0 and RAI-HC User's Manuals. The "Dementia other than Alzheimer's" group was combined with the AD group for the purposes of this study since the MDS manual lacks specific diagnostic criteria for either of these conditions, suggesting that individuals within the "Dementia other than Alzheimer's" group may actually have had AD and vice versa. The combined group is simply referred to as the "dementia" group throughout.

Studies on the validity of the diagnoses on the MDS assessments in LTC have reported varying

positive predictive values for dementia and PD. A study that compared ICD-9 diagnoses on

hospital Medicare claims to diagnoses on MDS assessments for all residents entering LTC

homes from hospitals in the U.S. from 1999 to 2007 reported a positive predictive value of 0.66

for AD, and 0.60 for PD (228). A study of residents from 945 skilled nursing facilities in Ohio,

who were newly admitted to hospital from their nursing homes, combined the AD and related

dementia diagnoses, as this study did. The study of skilled nursing facilities in Ohio reported a

positive predictive value of only 0.11 for a primary ICD-9 diagnosis of dementia on the

corresponding Medicare claim, and 0.41 for any dementia diagnosis on the corresponding

Medicare claim (229). Lastly, a study of nursing home residents from multiple states that also

compared MDS diagnoses to ICD-9 diagnoses on Medicare claims for hospital discharge

reported a positive predictive value of 0.86 for PD and 0.68 for AD (50). The variation in the

values reported across these studies may be due to the varied accuracy of the MDS assessments

and Medicare claims in different states, despite the existence of standard guidelines for

completing them. However, the relatively low values reported in some studies raises concerns

about the validity of the diagnostic groups defined in this study; suggesting that the results may

only apply to individuals diagnosed according to the MDS and not necessarily to those

diagnosed with standard diagnostic criteria, such as the ICD. It also is important to note for these

groups, and the independent variables outlined above that are obtained from the "disease

diagnoses" section of both the MDS 2.0 and RAI-HC, that the purpose of the disease diagnoses

items are to document conditions that are currently affecting the resident's/client's functional

status, treatment plan, and risk of death. Conditions that have been resolved and no longer affect

these domains are not documented. Therefore, the conclusions that can be drawn from the use of

these diagnoses as predictor variables is that if they were present and currently affecting the resident's/client's functional status etc., they were potential risk factors for falls.

The diagnoses used to define the major diagnostic groups were based on items from each resident/client's last (most recent) assessment because some of the other neurological conditions used for the descriptive portion of this study were only identified according to the "other current diagnoses" section on the client's last assessment, therefore, the last assessment was chosen to maintain consistency throughout the sample. The dementia and PD groups were not mutually exclusive since neither the MDS 2.0 nor the RAI-HC lists any conditions as the "primary" or "most important" diagnosis; therefore, if residents/clients had more than one of these diagnoses, they were included in all applicable groups. For HC clients, the item for PD is technically listed as "Parkinsonism," implying that this item also captures those with secondary Parkinsonism and not just those with diagnosed PD. The diagnoses were used, for both settings, if they were coded as "present," regardless of whether they were being actively monitored or treated by a health care professional.

Table 2-Definitions of 3 Major Neurological Conditions

	MDS 2.0 User's Manual Definition	**MDS-HC User's Manual Definition**
Alzheimer's Disease	"A degenerative and progressive dementia that is diagnosed by ruling out other dementias and physiological reasons for dementia"	"A degenerative and progressive dementia that is diagnosed by ruling out other dementias and physiological reasons for dementia"
Dementia Other Than Alzheimer's	"Includes diagnoses of organic brain syndrome (ODS) or chronic brain syndrome (CBS), senility, senile dementia, multi-infarct dementia, and dementia related to neurologic diseases other than Alzheimer's" (e.g. Huntington's disease)	"Includes diagnoses of organic brain syndrome (ODS) or chronic brain syndrome (CBS), senility, senile dementia, multi-infarct dementia, and dementia related to neurologic diseases other than Alzheimer's" (e.g. Huntington's disease)
Parkinson's Disease	No definition provided	No definition provided

5.4.7   Independent Variables for HC and LTC

Presence and severity of independent variables were determined based on each resident or client in the "Not Triggered" group's second last (second most recent) MDS 2.0 or RAI-HC assessment; these assessments are hereafter referred to as "baseline assessments". Tables 3 and 4 show the selected risk factors for both HC and LTC. Wandering was not examined as a potential risk factor for falls among non-ambulatory individuals in both care settings because it was noted that a very small proportion of non-ambulatory residents and clients wandered according to their baseline assessments. Number of medications was dichotomized to < 9 and ≥ 9 categories for both HC and LTC. A single variable was created for cardiovascular conditions in LTC residents and HC clients that included any of: hypertension, congestive heart failure, and peripheral vascular disease from the disease diagnoses section of the MDS assessments. Congestive heart failure and hypertension were chosen because they are commonly associated with orthostatic hypotension, a known risk factor for falls (230). Although dizziness, which may be an indicator of orthostatic hypotension, was also included as a risk factor, dizziness is only assessed for the 7 days prior to assessment. Diagnosed cardiovascular conditions may better represent ongoing causes of orthostatic hypotension. Peripheral vascular disease was included based on the results of Lewis et al. (76). The "disease diagnoses" section was also used, in both settings, to determine the presence of arthritis and diabetes. It was not possible to examine all major neurological conditions as their own separate diagnostic groups for the analytical part of this study due to time and sample size constraints and little information could be gained by combining the remaining conditions into a single group. Thus, the presence of other neurological conditions was included as a risk factor for falls in those with AD and/or PD because it was hypothesized that comorbid diagnosis of another neurological condition(s) could further increase the risk of

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falls in these groups. The list of other neurological conditions consisted of: Huntington's disease, muscular dystrophy, epilepsy, cerebral palsy, traumatic brain injury, spinal cord injury, stroke, multiple sclerosis, and amyotrophic lateral sclerosis. These conditions were selected based on neurological conditions being examined in a larger project at the University of Waterloo titled "Innovations in Data, Evidence, and Applications for Persons with Neurological Conditions." Table 5 shows how the vision and incontinence variables were collapsed for each care setting. Scores for each resident/client on the embedded scales were pre-calculated in the database. The 7 items used to calculate the DRS for both HC clients and LTC residents were obtained from the section on "indicators of depression, anxiety, sad mood." A DRS cut-off score of 3 was used to determine the presence of depression (172). The DRS showed 91% sensitivity and 69% specificity in diagnosing depression compared to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) classification when a cut-off score ≥ 3 was used to indicate depression (172). The DRS has also been validated against the Hamilton Depression Rating Scale and Cornell Scale, with Pearson correlation values of 0.71 and 0.70, respectively. In addition, the DRS achieved acceptable internal consistency reliability with a Crohnbach's alpha value of 0.71 in nursing home residents (172). The CPS score for each LTC resident and HC client was calculated using items from the "cognitive patterns" section of both the MDS 2.0 and RAI-HC as well as the "eating" item from the ADL self-performance section. The CPS has demonstrated moderate (127) to good agreement with the Mini Mental State Exam (MMSE), a standard test for cognitive impairment, in nursing home residents with a Cohen's $k = 0.82$ (95% CI 0.68-0.96) after adjusting for level of education and $r = -0.863$ ($P < 0.001$) (49). The CPS was found to correlate significantly with the MMSE in HC clients as well, with an R^2 value of 0.81 ($p < 0.001$) (128). CPS scores range from 0 to 6 with zero representing no cognitive impairment,

and higher scores indicating progressively higher levels of cognitive impairment. The CHESS score was calculated by adding signs and symptoms variables, such as dyspnea, vomiting, and dehydration, to a maximum of 2 and then adding 3 other variables: change in decision making, change in ADL status, and change in end-stage disease (140). CHESS scores range from 0 to 5, with zero indicating no health instability higher scores indicating progressively higher levels of health instability. The 4 items "toilet use," "personal hygiene," "locomotion on unit," and "eating," were used to calculate each resident's ADL Self-Performance Hierarchy Scale score. ADL Hierarchy Scale scores range from 0 to 6, with zero indicating the ability to perform ADLs independently, and higher scores indicating progressively higher dependence on others to perform ADLs. The ADL items in the MDS assessments are reliable, with weighted kappas ranging from 0.87-0.94 (134). Lastly, the Pain Scale score was calculated based on the frequency and intensity of pain, with scores ranging from 0-3. A score of zero indicates no pain, a score of one indicates less than daily pain, a score of two indicates mild to moderate daily pain, and a score of 3 indicates severe daily pain. The pain scale showed good agreement with the Visual Analogue Scale for pain (kappa = 0.707) (192). The interRAI scales used in this study were collapsed in both care settings in accordance with how Hirdes et al. collapsed the scales in their study aimed at describing individuals in complex continuing care facilities across Canada (231). Age was converted to a categorical variable for bivariate and multivariable analyses. The planned categories were: 0-44; 45-64; 65-74; 75-84; 85-94; and 95+, for both care settings. The 65-74 category was used as the reference group to determine if being younger than 65 may be a risk factor in people with neurological conditions, especially because early onset Parkinson's disease is typically diagnosed between the ages of 21-40 (232,233). However, within the "Not Triggered" individuals with dementia and PD, in both HC and LTC, the 0-44 group accounted

for < 0.5% of the samples. The small size of this category did not allow for sufficient analysis of age as a risk factor, especially at the multivariable level, where some cells in the matrix were empty and the model did not iterate. Therefore, the 0-44 category was collapsed with the 45-64 category for all groups, in both care settings, to be consistent in the approach. This categorization still allowed for the determination of age less than 65 as a risk factor for falls in these groups and still captured those with early onset dementia, which is typically defined as experiencing the onset of symptoms before age 65 (234,235). Ages that were coded in the dataset as less than zero or ≥ 115 were recoded as missing values.

5.4.8 Independent Variables for HC

Environmental hazards were categorized according to number of hazards: 0-1 and 2 or more (34). Absence of informal support was examined as a potential risk factor for falls among HC clients because it was hypothesized that individuals who were left alone for long periods of time may have been more likely to be a faller because they were not supervised or assisted while doing activities that may lead to a fall, depending on their functional status. The wandering item in the RAI-HC was collapsed such that the "occurred, easily altered" and "occurred, not easily altered" was collapsed to a binary variable "any wandering in the last 3 days" versus "no wandering in the last 3 days." Stair climbing was not examined as a potential risk factor among non-ambulatory HC clients because the baseline characteristics showed that most of these individuals did not wander or climb stairs. For HC clients, their ability to climb stairs was determined from the "stair climbing" item since being unable to use stairs without assistance has been shown to be a significant risk factor for falls (65). The item was collapsed to two levels: "without help" and "with help/did not occur". Broad classes of psychotropic medications taken in the last 7 days were examined as potential risk factors for falls, including: antipsychotics,

anxiolytics, antidepressants, and hypnotics or analgesics. The "disease diagnoses" section was used to classify someone as suffering a hip fracture in the previous 90 days, whether it was currently being monitored or not. The dizziness or lightheadedness item from the "problem conditions" section was used to capture dizziness that may or may not be related to orthostatic hypotension.

5.4.9   Independent Variables in LTC

The wandering item on the MDS 2.0 was dichotomized such that all three levels of wandering in the assessment were collapsed into "any wandering in the previous 7 days" and the behaviour not exhibited category represented "no wandering in the previous 7 days." Presence of hip fracture was obtained from the "disease diagnoses" section of the MDS 2.0 assessments. The use of psychotropic medications in the last 7 days was recoded such that any number of days from 1-7 was classified as "received psychotropic medication" and 0 was "did not receive psychotropic medication." The following classes of medication were used as potential predictors of being a faller: antipsychotics, antianxiety medication, antidepressants, hypnotics, and diuretics. The dizziness/vertigo item from the "problem conditions" section was used to capture dizziness that may or may not be related to orthostatic hypotension. 87 LTC residents were assigned a score of 8 on the vision item; these observations were recoded as "missing."

Literature regarding physical restraint use as a risk factor for falls in institutionalized older adults is inconsistent. There is evidence suggesting that they have no effect (236), that they increase the risk for falls (237,238), and that they reduce the risk for falls (237,239). The use of a trunk restraint or a chair that prevents rising were both included as risk factors in this study because they may have modified the risk for falls in LTC residents, especially among those who were non-ambulatory and spent much of their time in a wheelchair. These two variables were each

collapsed such that the "used daily" and "used less than daily" categories were combined. Use of

limb restraints was not included as a risk factor because they were only used on a very small

proportion of residents.

Table 3-Selected Risk Factors for HC

Risk Factor	Corresponding RAI-HC Item
Gender	BB1-Sex
Age	Approximate Age Calculated in Dataset
Impaired Vision	D1- Vision
Wandering	E3a-Wandering in Last 3 Days
Diabetes	J1y-Diabetes
Arthritis	J1m-Arthritis
Hip Fracture	J1n-Hip Fracture
Cardiovascular Disease	J1b, J1d, J1f-Congestive Heart Failure, Hypertension, Peripheral Vascular Disease
Impaired Gait	K6a-Unsteady Gait
Number of Medications	Q1- < 9 or ≥ 9 Medications Taken in the Last 7 Days or Since Last Assessment
Use of Psychotropic Medications	Q2a-Q2d-Psychotropic Medications Taken in the Last 7 Days or Since Last Assessment
Incontinence	I1a,I1b,I2-Bladder Continence in Last 7 Days, Bowel Continence in Last 7 Days
Impaired ADL Function	ADL Hierarchy Items H2c, H2g, H2h, H2i-Locomotion in Home, Eating, Toilet use, and Personal hygiene; H3 ADL Decline
Depression	E1a-E1g-Indicators of Depression for DRS Score
Cognitive Impairment	Section B1, B2, and B3 for CPS Score; B2b Worsening Decision Making
Pain	K14a, K14b-Frequency and Intensity of Pain for Pain Scale
CHESS Score	Various Items
Dizziness/Vertigo	K3-Dizziness or Lightheadedness in Last 3 Days
Alzheimer's Disease and/or Other Dementia	J1g, J1h-Alzheimer's, Dementia other than Alzheimer's
Parkinson's Disease	J1l-Parkinsonism
Other Neurological Conditions	Disease Diagnoses Section
Poor Self-Rated Health (34)	K8a-Client feels he/she has poor health (when asked)
Fear of Falling	K6b-Client limits going outdoors due to fear of falling
Stairs	H5-Stair Climbing
Environmental Hazards	O1a-O1i-Home Environment
Isolation (34)	F3a, G1ea- Length of Time Client is Alone During the Day, Presence of Informal Support
Absence of Informal Support	G1eA-Informal Support Lives with Client

Table 4-Selected Risk Factors for LTC

Risk Factor	Corresponding MDS 2.0 Items
Gender	AA2-Sex
Age	Age at Assessment Calculated in Dataset
Impaired Vision	D1-Vision
Wandering	E4Aa-Wandering Frequency in the Last 7 Days
Diabetes	I1a-Diabetes Mellitus
Arthritis	I1l-Arthritis
Hip Fracture	I1m-Hip Fracture
Cardiovascular Conditions	I1f, I1h, I1j-Congestive Heart Failure, Hypertension, Peripheral Vascular Disease
Impaired Gait	J1n-Unsteady Gait in Last 7 Days
Number of Medications	O1-Number of Different Medications used in the Last 7 Days
Psychotropic Medication Use	O4a-O4f-Number of Days During Last 7 Days Resident Received Any of: Antipsychotic, Antianxiety, Antidepressant, Hypnotic, Diuretic
Incontinence	H1a,H1b-Bowel Incontinence, Bladder Continence in Last 14 Days
Impaired ADL Function	ADL Hierarchy Items G1e, G1h-G1j-Locomotion on unit, Eating, Toilet use, and Personal hygiene
Depression	E1a, E1d, E1f, E1h, E1i, E1l, E1m-Indicators of Depression for DRS Score
Cognitive Impairment	B1-B4 for CPS Score
Pain	J2a, J2b-Pain Frequency and Intensity for Pain Scale
CHESS Score	Various Items
Dizziness/Vertigo	J1f-Dizziness/Vertigo in Last 7 Days
Alzheimer's Disease and/or Dementia	I1r, I1v-Alzheimer's Disease, Dementia other than Alzheimer's Disease
Parkinson's Disease	I1aa-Parkinson's Disease
Other Neurological Conditions	Disease Diagnoses Section
Restraint Use	P4c, P4e-Trunk Restraint, Chair Prevents Rising

Table 5-Collapsing of Variables in HC and LTC for Analyses

	Home Care	Long-Term Care
Bowel Continence	0-1 2-3 4-5, 8	0 1-3 4
Bladder Continence	0-1 2-3 4-5, 8	0 1-2 3 4
Vision	0 1-2 3-4	0 1-2 3-4

5.4.10 Dependent variable

For the analytical portion, the "Not Triggered" groups from both HC and LTC, according to baseline assessments, were analyzed and any falls in the last 90 or 30 days on their last assessments (hereafter referred to as "follow-up assessments"), respectively, was the outcome for the bivariate analyses and multivariable models. The RAI-HC defines a fall as "an unintentional change in position where the client ends up on the floor, ground, or other lower level; includes falls that occur while being assisted by others." The MDS 2.0 uses the same definition except it does not explicitly state that falls that occur while being assisted by another person should be included; it does however state that an "intercepted fall," when a person is caught before hitting the lower surface is not considered a fall. The slight difference in definitions between the two healthcare settings further supported the analysis of these datasets separately.

For the descriptive portion, the falls CAP categories for LTC were determined from baseline assessments. Individuals who fell in the last 30 days and in the last 31-180 days according to their baseline assessment were considered "High Risk," individuals who fell in the last 30 days but not in the last 31-180 days according to their baseline assessment were considered "Medium

Risk," and individuals who did not fall in either of these time periods, or who fell in the last 31-180 days but not the last 30 days, were coded as the "NotTriggered" group. The inclusion of individuals who fell in the last 31-180 days implies that some of the "Not Triggered" residents did have a history of falls but it was not recent. For HC, the falls CAP categories were based on the number of falls in the last 90 days, according to each client's baseline assessment; clients with zero falls at baseline were coded as "Not Triggered", clients with one fall at baseline were coded as "Medium Risk", and clients with ≥ 2 falls were coded as "High Risk". Then the follow-up assessment was used to determine the proportion of individuals in each falls CAP category that fell prior to follow-up in both settings. For LTC, only the last 30 days prior to the follow-up assessment was used, not the last 31-180 days, since this time period would overlap with the time period for each resident's baseline assessment. For HC, the outcome was fall/no fall in the last 90 days, regardless of how many falls.

5.5   Statistical Analysis

All statistics were performed using SAS version 9.2 for Windows. Within each of the 12 subgroups in both settings, those risk factors that differed significantly between fallers who were in the "Not Triggered" falls CAP category at baseline and non-fallers in the "Not Triggered" group, as determined by significant odds ratios, were used in a generalized estimating equation (GEE) model, with an exchangeable correlation matrix, to determine factors that predicted fallers among those in the "Not Triggered" category. A GEE was used rather than logistic regression because it accounts for clustering of data within LHINs. Data may have been clustered within LHINs because the policies regarding falls risk assessment and prevention in HC clients and LTC residents may be applied to all individuals receiving care within the same LHIN and may differ from one LHIN to another. The analysis was unable to be clustered by

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facility in LTC because the PD subgroups were relatively small and some LTC homes only had a single resident with PD, which did not allow the GEE model to correctly iterate. Therefore, to keep a consistent approach across all diagnostic subgroups, the LHIN was used as the unit of clustering in LTC and HC. A p value < 0.01 was set for statistical significance at the bivariate and multivariable levels to take a more parsimonious approach. For each model, the most significant variables, according to p values at the bivariate level were entered first, followed by variables that had progressively higher p values. If multiple variables had the same p value, the strongest predictors (those with the highest odds ratios) were entered first. The QICu statistic and the significance of predictors as they entered the GEE model were used to select appropriate predictors for the final multivariable model. The lower the QICu value, the better the fit of the model. Appendix B shows the model building and selection methods for each of the 12 subgroups. Each final model was also run as a logistic regression with the same set of predictor variables in order to report the c-statistic for each model.

Descriptive statistics were used to report the baseline characteristics, which also served to report the prevalence of predictive risk factors for falls. Descriptive statistics were also used to report the percentage of individuals within each falls CAP category for each diagnostic group that went on to suffer a fall prior to their follow-up assessment. Chi-square analyses were used to determine significant differences in baseline characteristics between ambulatory and non-ambulatory individuals within each subgroup.

5.5.1 *Multicollinearity*

When a GEE is used, the model will not iterate if any of the variables included are highly collinear; however, a measure known as the condition index can be calculated to determine if there is a high degree of collinearity among multiple predictors in a GEE model. In this study,

each final model was tested for multicollinearity using the condition index. The intercept-adjusted condition index is generally used to detect the presence of multicollinearity because the intercept typically does not have an interpretation in multivariable models that use continuous variables. This was not the case in this study because most of the independent variables in the models created were categorical and the intercept represents the outcome of not falling (outcome = 0) when all of the independent variables have a value of zero (i.e. are in the lowest category of the categorical variables). The exception to this is the assessment interval, which was left continuous and no one had an assessment interval of zero. Therefore, in order to report the unadjusted condition index where the intercept can be interpreted, if assessment interval was in the model, it was centered. Centering variables subtracts the mean from every individual's value for that variable. By doing this, the intercept for these variables was assigned the mean value rather than zero and all other values of the variable were relative to the mean of that variable. A condition index ≥ 30 was used to indicate the presence of multicollinearity that required removing one of predictor variables causing the issue from the model (240).

5.5.2   Confounders

Although variables, such as age and gender, were examined at the bivariate level, they may be confounding variables. Age and gender were only included in the multivariable models if they improved the fit statistics of the model and were significant correlates of being a faller. For example, if age was not significant at the bivariate level but improved the model at the multivariable level then age was kept in the final model. The length of time between assessments (assessment interval) of HC clients was also included as a covariate in the GEE models as long as it improved the fit statistic of the model and was significant. Since the assessment interval is not consistent among clients, it may have affected the falls outcome because a longer time period

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of observation would likely result in a client being positive for the falls outcome, while a shorter

period of observation may not.

6   RESULTS

6.1   Descriptive Results

Figures 3 through 6 and Tables 6 through 9 show the percentage of residents in each subgroup for both care settings that fell in the 90-day period or 30-day period prior to their follow-up assessment, in HC and LTC respectively, stratified by falls CAP category. The same trend is seen for all subgroups, regardless of ambulatory status or major diagnostic group. In both care settings, a lower proportion of non-ambulatory clients in each falls CAP category fell compared to ambulatory clients in the same falls CAP category. Within each falls CAP category in both settings, individuals with PD typically had the highest proportion of fallers.
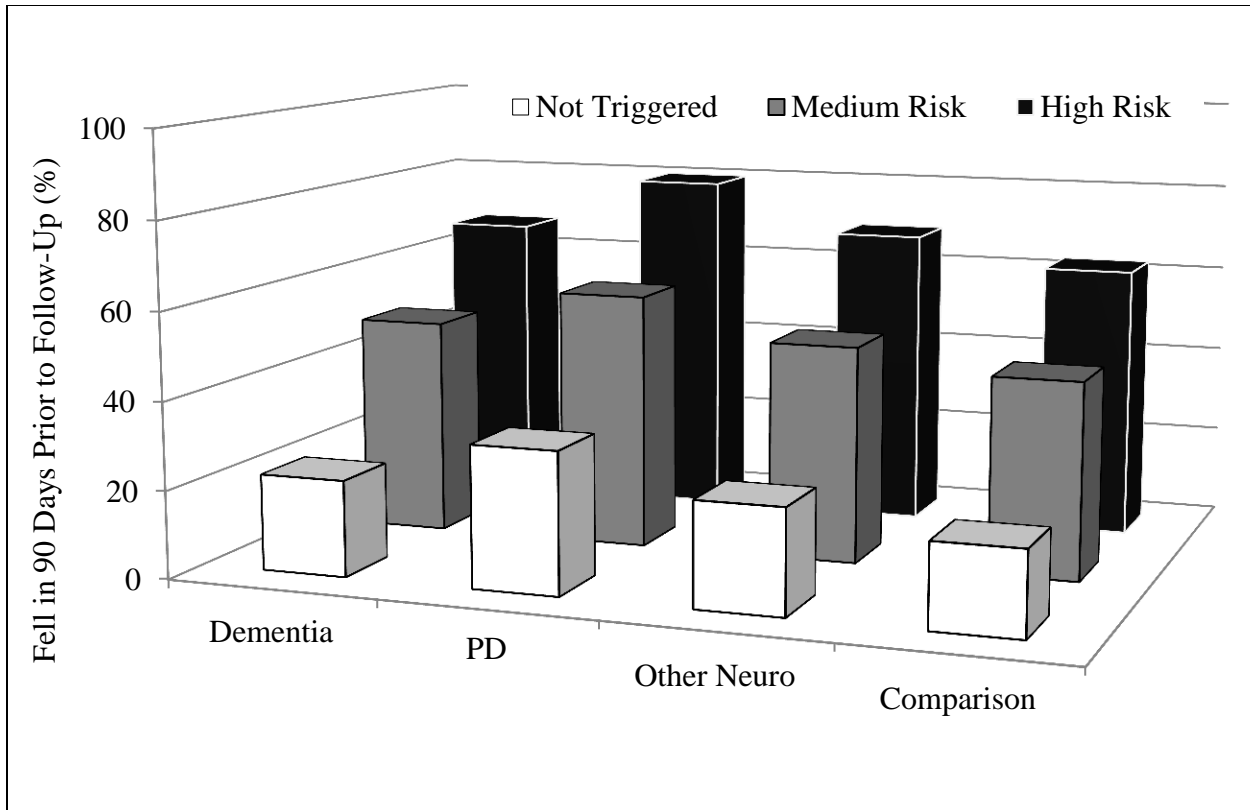
Figure 3-Ambulatory HC Clients That Fell Prior to Follow-Up by Falls CAP Category and Diagnostic Group

Table 6-Proportion of Ambulatory HC Clients That Fell Prior to Follow-Up by Falls CAP Category and Diagnostic Group

	Dementia (%)	PD (%)	Other Neurological Conditions (%)	Comparison (%)
Not Triggered	21.9	32.2	23.8	19.1
Medium Risk	49.6	58.5	49.6	44.9
High Risk	67.2	79.8	68.7	62.5

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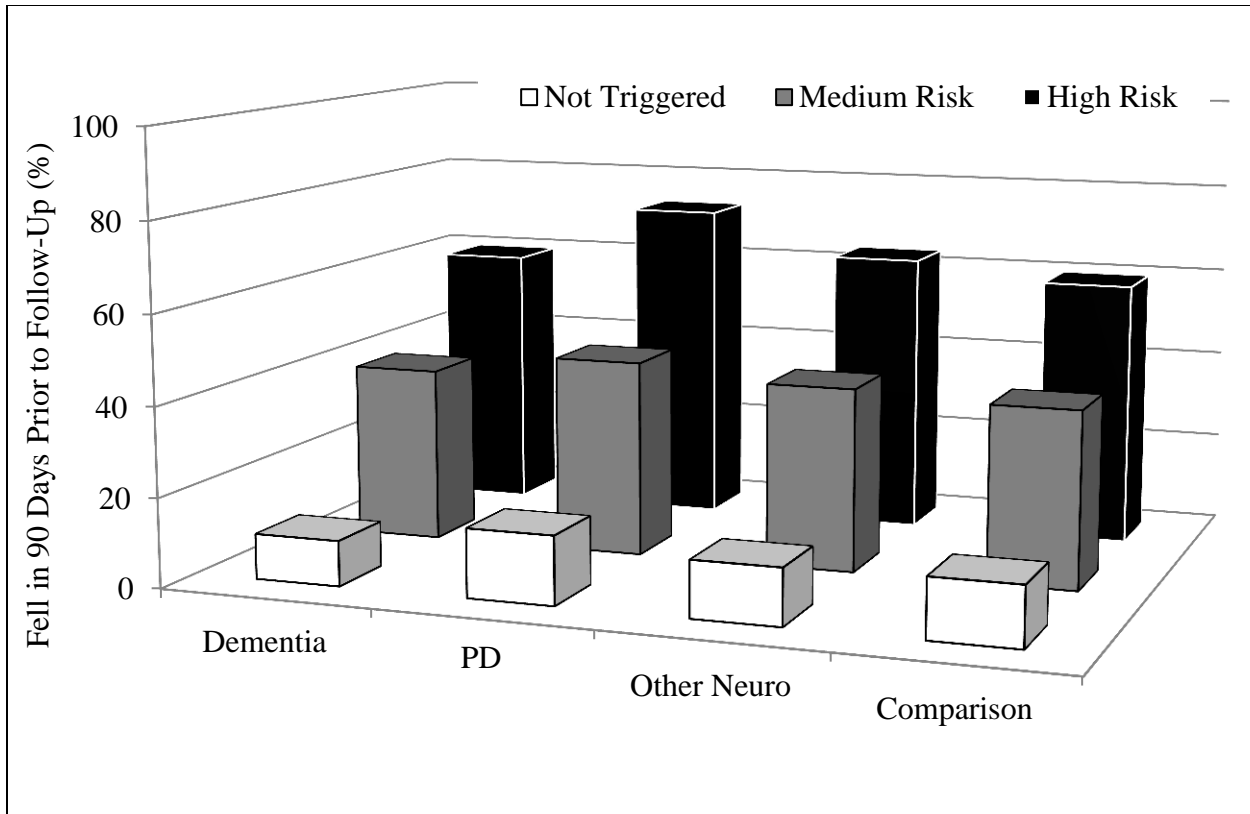
Figure 4-Non-Ambulatory HC Clients That Fell Prior to Follow-Up by Falls CAP Category and Diagnostic Group

Table 7-Proportion of Non-Ambulatory HC Clients That Fell Prior to Follow-Up by Falls CAP Category and Diagnostic Group

	Dementia (%)	PD (%)	Other Neurological Conditions (%)	Comparison (%)
Not Triggered	10.1	15.3	12.6	13.3
Medium Risk	39.3	44.1	41.2	39.7
High Risk	59.7	72.8	63.4	59.6
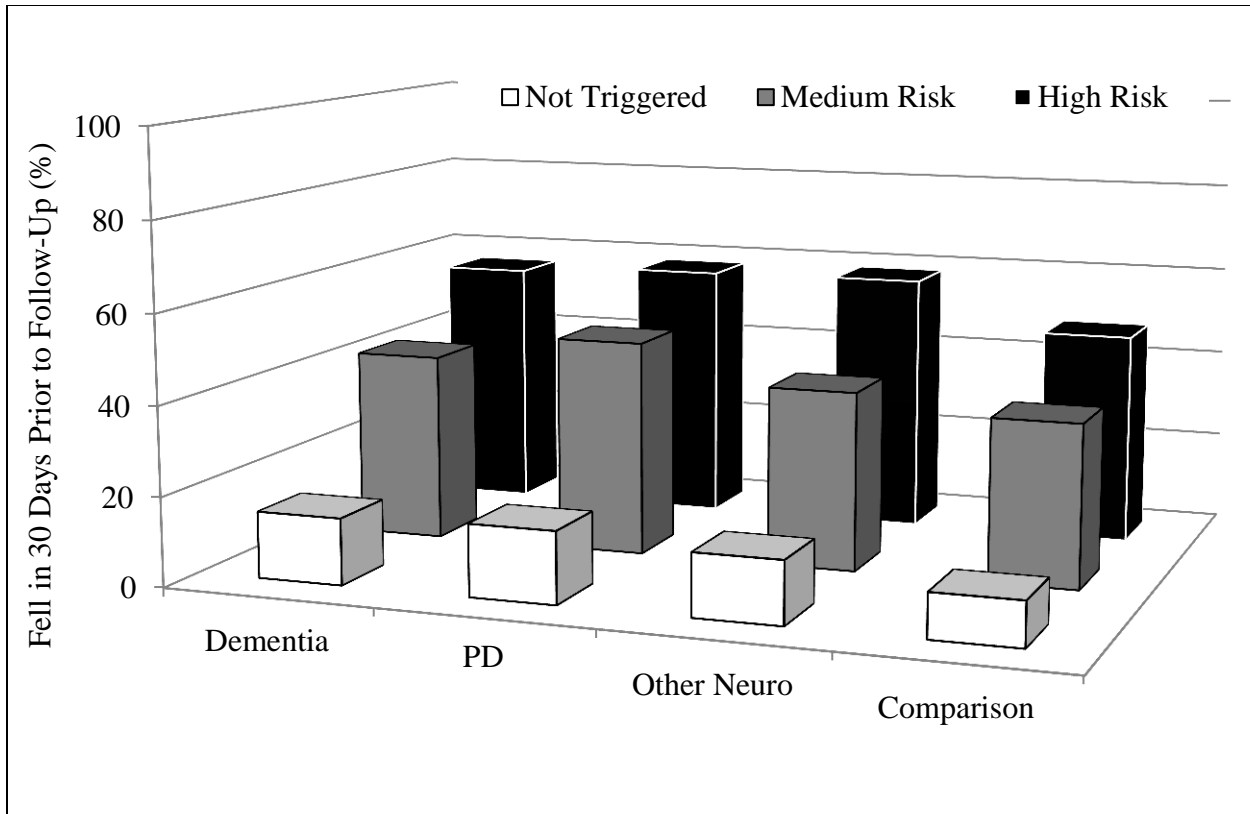
Figure 5-Ambulatory LTC Residents That Fell Prior to Follow-Up by Falls CAP Category and Diagnostic Group

Table 8-Proportion of LTC Residents That Fell Prior to Follow-Up by Falls CAP Category and Diagnostic Group

	Dementia (%)	PD (%)	Other Neurological Conditions (%)	Comparison (%)
Not Triggered	14.9	16.1	14.0	9.9
Medium Risk	42.3	48.4	40.2	36.6
High Risk	56.3	58.0	58.4	47.7
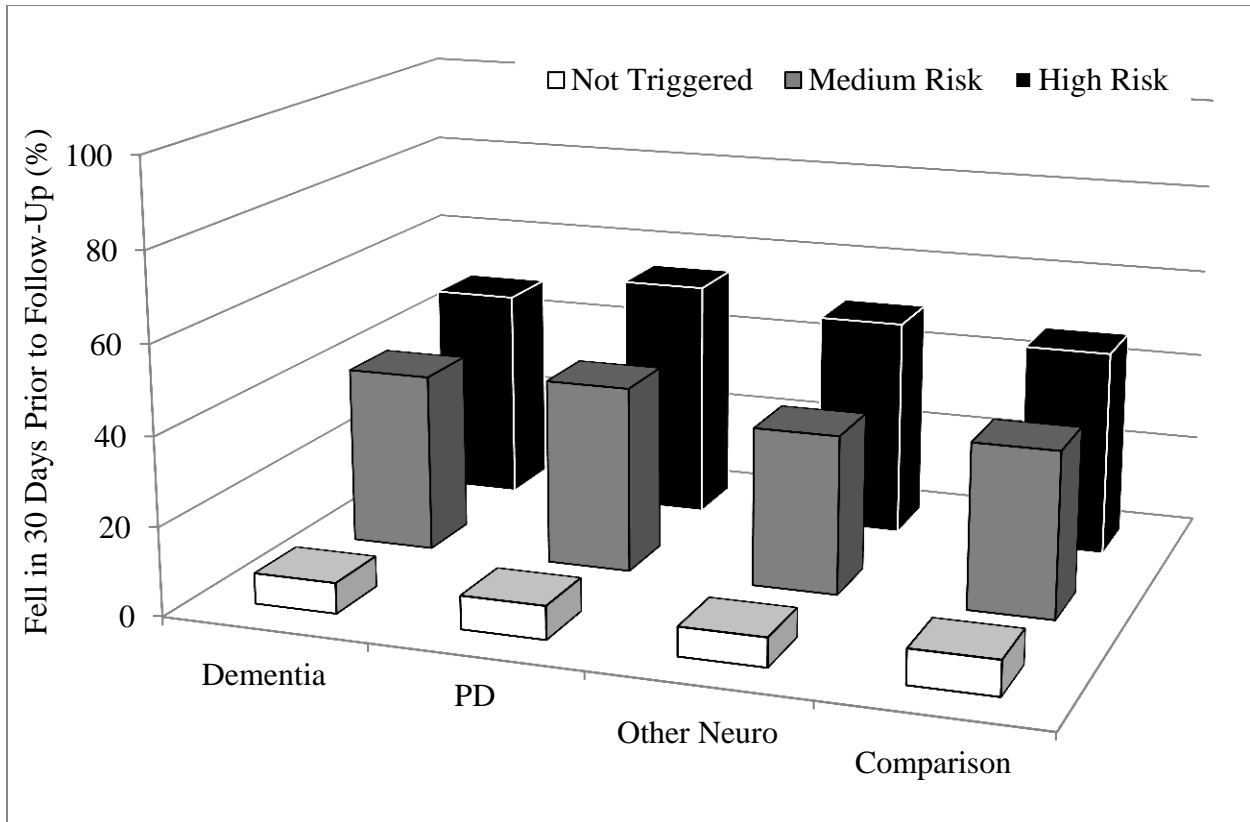
Figure 6-Non-Ambulatory LTC Residents That Fell Prior to Follow-Up by Falls CAP Category and Diagnostic Group

Table 9-Proportion of LTC Residents That Fell Prior to Follow-Up by Falls CAP Category and Diagnostic Group

	Dementia (%)	PD (%)	Other Neurological Conditions (%)	Comparison (%)
Not Triggered	6.9	7.5	6.5	7.8
Medium Risk	40.5	42.2	36.0	37.5
High Risk	48.5	54.6	49.8	47.0

6.2   Baseline Characteristics of Not Triggered HC Clients

Tables 10 through 12 show the baseline characteristics of HC clients by diagnostic group and ambulatory status. Generally, across all major diagnostic groups in HC, a significantly greater proportion of individuals in the non-ambulatory subgroup had impairments that have been documented in the literature as important risk factors for falls, compared to ambulatory individuals. These impairments included, but were not limited to, higher scores on the ADL Hierarchy Scale and CPS, poor vision, and frequent to complete bladder and bowel incontinence. Unsteady gait and fear of falling were more prevalent in non-ambulatory clients across all three major groups, with the exception of unsteady gait in PD, which was more prevalent in ambulatory clients. Less than 10% of HC clients in any of the subgroups had at least two environmental hazards in their home; however, across all three major diagnostic groups a significantly higher proportion of non-ambulatory clients had at least two environmental hazards in their homes. Within the dementia and PD groups, a significantly higher proportion of non-ambulatory HC clients had a comorbid diagnosis of another neurological condition. Conversely, as expected, a higher proportion of ambulatory individuals could independently climb stairs, were left alone all the time, and exhibited wandering behaviour in the three days prior to assessment, compared to non-ambulatory individuals.

Table 10-Baseline Characteristics of Not Triggered HC Clients with Dementia[*]

Independent Variables % (n)	Ambulatory[**]	Non-Ambulatory[†]	P Value
N	30597	2545	
Age in Years			< 0.0001
0 to < 65	2.8 (842)	3.3 (83)	
≥ 65 to < 75	10.4 (3191)	9.9 (252)	
≥ 75 to < 85	46.2 (14141)	36.1 (919)	
≥ 85 to < 95	37.8 (11559)	43.1 (1097)	
≥ 95 to < 115	2.8 (858)	7.6 (194)	
Male	34.9 (10678)	31.2 (794)	0.0002
Vision			< 0.0001
Adequate	73.4 (22449)	47.3 (1203)	
Impaired/Moderately Impaired	23.0 (7037)	35.8 (911)	
Highly/Severely Impaired	3.6 (1110)	16.9 (431)	
Wandering in Last 3 Days	9.9 (3030)	0.9 (24)	< 0.0001
Diabetes	18.9 (5775)	22.4 (571)	< 0.0001
Arthritis	42.7 (13072)	44.4 (1131)	0.09
Hip Fracture	2.7 (813)	8.9 (227)	< 0.0001
Diagnosed Cardiovascular Condition(s)	64.4 (19700)	61.8 (1573)	0.009
Unsteady Gait	44.8 (13693)	66.9 (1702)	< 0.0001
≥ 9 Medications	37.5 (11487)	43.6 (1109)	< 0.0001
Medication Use in Last 7 Days			
Antipsychotic/Neuroleptic	21.5 (6582)	22.3 (567)	0.64
Anxiolytic	12.8 (3920)	17.2 (437)	< 0.0001
Antidepressant	27.0 (8251)	27.7 (704)	0.45
Hypnotic or Analgesic	10.1 (3083)	12.6 (320)	< 0.0001
Bladder Continence in Last 7 Days			< 0.0001
Continent/Continent with Catheter	51.3 (15692)	14.8 (376)	
Usually Continent/ Occasionally Incontinent	25.5 (7811)	9.8 (249)	
Frequently Incontinent/ Completely Incontinent/Did Not Occur	23.2 (7094)	75.4 (1920)	
Worsening of Bladder	14.1 (4307)	19.2 (488)	< 0.0001

Continence			
Bowel Continence in Last 7 Days			< 0.0001
Continent/Continent with Ostomy	77.8 (23807)	24.6 (625)	
Usually Continent/ Occasionally Incontinent	14.6 (4457)	16.4 (418)	
Frequently Incontinent/ Completely Incontinent/Did Not Occur	7.6 (2330)	59.0 (1502)	
ADL Hierarchy Scale Score			< 0.0001
Independent	47.3 (14478)	3.6 (91)	
Supervision to Limited Assistance	39.6 (12108)	8.9 (227)	
Extensive to Maximal Assistance	12.4 (3780)	29.6 (752)	
Dependent to Total Dependence	0.8 (229)	58.0 (1475)	
ADL Decline	37.0 (11309)	43.2 (1099)	< 0.0001
DRS Score			< 0.0001
0	59.0 (18038)	65.1 (1657)	
1-2	25.8 (7886)	21.9 (558)	
3+	15.3 (4668)	13.0 (330)	
CPS Score			< 0.0001
Intact	1.5 (467)	1.0 (25)	
Borderline Intact to Mild Impairment	58.2 (17812)	23.4 (595)	
Moderate to Moderate Severe Impairment	26.5 (8118)	22.2 (565)	
Severe to Very Severe Impairment	13.7 (4199)	53.4 (1360)	
Worsening Decision Making	38.0 (11619)	26.3 (670)	< 0.0001
Pain Scale Score			< 0.0001
0	58.8 (17983)	55.1 (1401)	
1-2	38.0 (11639)	39.6 (1008)	
3	3.2 (972)	5.3 (136)	
CHESS Score			< 0.0001
No Health Instability	35.3 (10787)	39.5 (1004)	
Minimal to Low Health	56.0 (17125)	50.2 (1277)	

Instability			
Moderate to Very High Health Instability	8.8 (2682)	10.3 (263)	
Dizziness or Lightheadedness	8.9 (2714)	4.3 (109)	< 0.0001
Parkinson's Disease	4.0 (1214)	11.2 (284)	< 0.0001
Other Neurological Condition(s)	18.1 (5532)	36.9 (940)	< 0.0001
Poor Self-Rated Health	6.6 (2029)	10.0 (255)	< 0.0001
Fear of Falling	30.5 (9344)	52.9 (1346)	< 0.0001
Stair Climbing in Last 3 Days			< 0.0001
Without Help	47.4 (14485)	1.1 (28)	
With Help/Did Not Occur	52.7 (16109)	98.9 (2517)	
Presence of ≥ 2 Environmental Hazards	2.0 (597)	9.2 (235)	< 0.0001
Length of Time Client is Alone During the Day			< 0.0001
Never or Hardly Ever	50.8 (15535)	79.9 (2032)	
About One Hour	16.2 (4956)	9.6 (243)	
Long Periods of Time	25.5 (7808)	9.7 (246)	
All of the Time	7.5 (2298)	0.9 (23)	
Absence of Informal Support	0.8 (254)	1.4 (35)	0.005

*Dementia = Presence of AD or dementia other than AD

** Ambulatory = primary mode of locomotion is no assistive device used, cane used, walker used, or crutch used

† Non-Ambulatory = primary mode of locomotion is wheelchair, scooter or activity did not occur

Table 11-Baseline Characteristics of Not Triggered HC Clients with PD[*]

Independent Variables % (n)	Ambulatory[**]	Non-Ambulatory[†]	*P* Value
N	4477	833	
Age in Years			0.007
0 to < 65	4.6 (207)	6.1 (51)	
≥ 65 to < 75	17.9 (799)	18.5 (154)	
≥ 75 to < 85	50.3 (2253)	44.5 (371)	
≥ 85 to < 95	25.8 (1156)	28.6 (238)	
≥ 95 to < 115	1.4 (61)	2.3 (19)	
Male	48.5 (2173)	44.9 (374)	0.05
Vision			< 0.0001
Adequate	67.8 (3036)	53.1 (442)	
Impaired/Moderately Impaired	28.6 (1279)	37.2 (310)	
Highly/Severely Impaired	3.6 (162)	9.7 (81)	
Wandering in Last 3 Days	2.7 (119)	0.0 (0)	< 0.0001
Diabetes	21.0 (941)	20.9 (174)	0.93
Arthritis	49.7 (2227)	47.5 (396)	0.24
Hip Fracture	4.1 (182)	9.6 (80)	< 0.0001
Diagnosed Cardiovascular Condition(s)	62.3 (2790)	54.0 (450)	< 0.0001
Unsteady Gait	77.2 (3454)	71.9 (599)	0.001
≥ 9 Medications	53.5 (2393)	51.4 (428)	0.27
Medication Use in Last 7 Days			
Antipsychotic/ Neuroleptic	15.4 (691)	17.7 (147)	0.11
Anxiolytic	18.5 (830)	19.7 (164)	0.44
Antidepressant	29.6 (1325)	26.5 (221)	0.07
Hypnotic or Analgesic	13.8 (619)	15.1 (126)	0.32
Bladder Continence in Last 7 Days			< 0.0001
Continent/Continent with Catheter	47.0 (2102)	25.7 (214)	
Usually Continent/ Occasionally Incontinent	29.7 (1329)	16.5 (137)	
Frequently Incontinent/ Completely Incontinent/Did Not Occur	23.4 (1046)	57.9 (482)	
Worsening of Bladder	13.3 (595)	18.5 (154)	< 0.0001

Continence			
Bowel Continence in Last 7 Days			< 0.0001
Continent/Continent with Ostomy	85.4 (3822)	45.6 (380)	
Usually Continent/ Occasionally Incontinent	10.1 (454)	18.4 (153)	
Frequently Incontinent/ Completely Incontinent/Did Not Occur	4.5 (201)	36.0 (300)	
ADL Hierarchy Scale Score			< 0.0001
Independent	49.0 (2194)	6.2 (52)	
Supervision to Limited Assistance	35.9 (1608)	12.6 (105)	
Extensive to Maximal Assistance	13.8 (619)	34.1 (284)	
Dependent to Total Dependence	1.3 (56)	47.1 (392)	
ADL Decline	38.9 (1740)	47.5 (396)	< 0.0001
DRS Score			0.15
0	60.4 (2705)	64.0 (533)	
1-2	24.3 (1086)	21.7 (181)	
3+	15.3 (686)	14.3 (119)	
CPS Score			< 0.0001
Intact	31.0 (1388)	17.2 (143)	
Borderline Intact to Mild Impairment	54.4 (2437)	39.6 (330)	
Moderate to Moderate Severe Impairment	9.8 (438)	15.7 (131)	
Severe to Very Severe Impairment	4.8 (214)	27.5 (229)	
Worsening Decision Making	15.6 (698)	18.3 (152)	0.05
Pain Scale Score			0.05
0	39.5 (1768)	43.9 (366)	
1-2	51.2 (2290)	47.1 (392)	
3	9.4 (419)	9.0 (75)	
CHESS Score			0.10
No Health Instability	36.8 (1647)	33.3 (277)	
Minimal to Low Health	56.0 (2508)	58.2 (484)	

Instability			
Moderate to Very High Health Instability	7.2 (322)	8.5 (71)	
Dizziness or Lightheadedness	17.4 (779)	8.8 (73)	< 0.0001
Dementia	27.1 (1214)	34.1 (284)	< 0.0001
Other Neurological Condition(s)	17.3 (776)	27.3 (227)	< 0.0001
Poor Self-Rated Health	22.6 (1010)	22.8 (190)	0.88
Fear of Falling	55.0 (2464)	60.5 (504)	0.004
Stair Climbing in Last 3 Days			< 0.0001
Without Help	29.7 (1331)	1.7 (14)	
With Help/Did Not Occur	70.3 (3146)	98.3 (819)	
Presence of ≥ 2 Environmental Hazards	3.5 (157)	9.5 (79)	< 0.0001
Length of Time Client is Alone During the Day			< 0.0001
Never or Hardly Ever	47.4 (2123)	74.9 (624)	
About One Hour	17.1 (764)	11.8 (98)	
Long Periods of Time	24.9 (1116)	11.5 (96)	
All of the Time	10.6 (474)	1.8 (15)	
Absence of Informal Support	1.4 (64)	1.0 (8)	0.28

*PD = Presence of Parkinsonism

** Ambulatory = primary mode of locomotion is no assistive device used, cane used, walker used, or crutch used

† Non-Ambulatory = primary mode of locomotion is wheelchair, scooter or activity did not occur

Table 12-Baseline Characteristics of Not Triggered HC Clients in the Comparison Group[*]

Independent Variables % (n)	Ambulatory[**]	Non-Ambulatory[†]	P Value
N	80652	6844	
Age in Years			< 0.0001
0 to < 65	15.6 (12539)	33.8 (2311)	
≥ 65 to < 75	13.9 (11240)	16.8 (1149)	
≥ 75 to < 85	33.4 (26947)	25.0 (1709)	
≥ 85 to < 95	32.9 (26558)	20.1 (1375)	
≥ 95 to < 115	4.2 (3353)	4.4 (299)	
Male	29.5 (23751)	41.5 (2837)	< 0.0001
Vision			< 0.0001
Adequate	73.9 (59589)	71.5 (4893)	
Impaired/Moderately Impaired	22.0 (17737)	23.2 (1589)	
Highly/Severely Impaired	4.1 (3324)	5.3 (362)	
Wandering in Last 3 Days	0.3 (27)	0.2 (10)	0.008
Diabetes	25.1 (20202)	29.5 (2017)	< 0.0001
Arthritis	57.1 (46058)	49.3 (3373)	< 0.0001
Hip Fracture	3.8 (3054)	5.0 (339)	< 0.0001
Diagnosed Cardiovascular Condition(s)	71.1 (57315)	62.1 (4247)	< 0.0001
Unsteady Gait	51.4 (41414)	58.8 (4025)	< 0.0001
≥ 9 Medications	48.2 (38844)	53.3 (3645)	< 0.0001
Medication Use in Last 7 Days			
Antipsychotic/Neuroleptic	5.4 (4337)	5.3 (359)	0.64
Anxiolytic	18.0 (14506)	19.9 (1364)	< 0.0001
Antidepressant	19.0 (15333)	25.0 (1708)	< 0.0001
Hypnotic or Analgesic	13.8 (11102)	16.0 (1095)	< 0.0001
Bladder Continence in Last 7 Days			< 0.0001
Continent/Continent with Catheter	67.2 (54230)	56.6 (3874)	
Usually Continent/ Occasionally Incontinent	21.3 (17212)	17.4 (1188)	
Frequently Incontinent/ Completely Incontinent/Did Not Occur	11.4 (9211)	26.0 (1782)	
Worsening of Bladder	6.4 (5144)	9.4 (643)	< 0.0001

Continence			
Bowel Continence in Last 7 Days			< 0.0001
Continent/Continent with Ostomy	92.2 (74345)	73.2 (5008)	
Usually Continent/ Occasionally Incontinent	5.7 (4579)	11.9 (812)	
Frequently Incontinent/ Completely Incontinent/Did Not Occur	2.1 (1727)	15.0 (1024)	
ADL Hierarchy Scale Score			< 0.0001
Independent	80.5 (64880)	34.1 (2336)	
Supervision to Limited Assistance	15.9 (12830)	18.9 (1291)	
Extensive to Maximal Assistance	3.4 (2750)	28.5 (1953)	
Dependent to Total Dependence	0.2 (188)	18.5 (1264)	
ADL Decline	28.0 (22543)	32.0 (2192)	< 0.0001
DRS Score			0.89
0	67.5 (54449)	67.3 (4605)	
1-2	20.5 (16532)	20.6 (1408)	
3+	12.0 (9650)	12.1 (831)	
CPS Score			< 0.0001
Intact	63.8 (51488)	61.7 (4219)	
Borderline Intact to Mild Impairment	33.7 (27167)	30.4 (2081)	
Moderate to Moderate Severe Impairment	1.8 (1422)	3.6 (247)	
Severe to Very Severe Impairment	0.7 (574)	4.3 (297)	
Worsening Decision Making	5.7 (4571)	5.5 (379)	0.66
Pain Scale Score			< 0.0001
0	30.3 (24458)	27.3 (1870)	
1-2	56.1 (45206)	54.3 (3715)	
3	13.6 (10978)	18.4 (1258)	
CHESS Score			0.68
No Health Instability	39.1 (31515)	39.6 (2708)	
Minimal to Low Health	52.7 (42486)	52.4 (3585)	

Instability			
Moderate to Very High Health Instability	8.2 (6648)	8.1 (551)	
Dizziness or Lightheadedness	14.7 (11812)	8.6 (590)	< 0.0001
Poor Self-Rated Health	20.5 (16514)	23.6 (1616)	< 0.0001
Fear of Falling	37.7 (30400)	44.1 (3016)	< 0.0001
Stair Climbing in Last 3 Days			< 0.0001
Without Help	43.9 (35385)	3.7 (252)	
With Help/Did Not Occur	56.1 (45261)	96.3 (6592)	
Presence of ≥ 2 Environmental Hazards	2.8 (2252)	7.1 (487)	< 0.0001
Length of Time Client is Alone During the Day			< 0.0001
Never or Hardly Ever	31.7 (25536)	43.7 (2991)	
About One Hour	10.9 (8795)	14.9 (1021)	
Long Periods of Time	35.1 (28330)	30.5 (2089)	
All of the Time	22.3 (17990)	10.9 (743)	
Absence of Informal Support	2.9 (2366)	3.5 (238)	0.01

*Comparison = absence of: dementia, PD, epilepsy/seizure disorder, stroke, traumatic brain injury, amyotrophic lateral sclerosis, muscular dystrophy, Huntington's disease, spinal cord injury, cerebral palsy, and multiple sclerosis.
** Ambulatory = primary mode of locomotion is no assistive device used, cane used, walker used, or crutch used
† Non-Ambulatory = primary mode of locomotion is wheelchair, scooter or activity did not occur

6.3   Factors Associated with Being a Faller Among Not Triggered HC Clients

The results of the bivariate analyses are shown in Appendix A. Tables 9 through 14 show the final GEE models for each of the six Not Triggered subgroups in HC; the risk factors are shown in the order in which they entered the model. Three models were adjusted for the assessment interval and only one model was adjusted for age and gender. In three models, bowel continence was removed because the collinearity tests showed that it was a linear combination of other predictors (see Appendix B). Generally, there was an overlap of risk factors between those with AD or PD and those in the comparison group (Figure 7), although CHESS Score was only

associated with falls in clients in the comparison group. With the exception of non-ambulatory clients with dementia, unsteady gait significantly increased the odds of being a faller in all of the subgroups. ADL Hierarchy Scale score was also a significant risk factor in all subgroups except ambulatory clients with PD; however, higher scores significantly reduced the odds of being a faller rather than significantly increasing the odds, compared to being completely independent in ADL function, regardless of ambulatory status. In subgroups where CPS score was associated with falls, only borderline intact/mild cognitive impairment, or moderate/moderate severe impairment, significantly increased the odds of being a faller, compared to clients who were cognitively intact. Antidepressants were the only class of psychotropic medications that significantly increased the odds of being a faller in multivariable analyses and were associated with being a faller among ambulatory clients with dementia (OR = 1.11; 95% CI 1.04-1.19), ambulatory clients in the comparison group (OR = 1.33; 95% CI 1.27-1.39), and non-ambulatory clients in the comparison group (OR = 1.53; 95% CI 1.28-1.84). With the exception of non-ambulatory clients with PD, being in higher age categories than the 65-74 group increased the odds of being a faller in models that included age as a risk factor, as did being male in ambulatory clients with dementia (OR = 1.20; 95% CI 1.15-1.25), non-ambulatory clients with PD (OR = 1.64; 95% CI 1.18-2.28), and ambulatory clients in the comparison group (OR = 1.12; 95% CI 1.07-1.18).

Only some of the risk factors that were examined in HC, but not LTC, remained significant in certain subgroups at the multivariable level. Absence of an informal caregiver significantly reduced the odds of being a faller in ambulatory clients with dementia (OR = 0.59; 95% CI 0.40-0.87) and in the comparison subgroups. Inability to independently climb stairs (OR = 1.14; 95% CI 1.07-1.22) and worsening bladder continence (OR = 1.16; 95% CI 1.10-1.23) increased the

odds of falling in ambulatory clients with dementia. Being alone during the day for long periods of time and about one hour increased the odds of being a faller in ambulatory clients in the comparison group (OR = 1.13; 95% CI 1.08-1.18) and non-ambulatory clients with dementia (OR = 1.70; 95% CI 1.30-2.23), respectively. The presence of at least two environmental hazards was not a significant risk factor for falls in any of the subgroups of HC clients.

Figure 7-Factors That Significantly Increased the Odds of Being a Faller in HC Clients

The figure contains the following labels within the overlapping regions:

- Wandering
- Vision
- Diabetes
- CHESS score
- CPS score
- Pain Scale score
- Length of time alone
- Unsteady gait
- Antidepressant
- Dizziness
- ≥ 9 medications
- Male
- Bladder continence
- Age
- PD
- Worsening bladder continence
- Stair climbing
- Arthritis

Legend:

- Ambulatory Clients in the Comparison Group
- Non-Ambulatory Clients with PD
- Non-Ambulatory Clients with Dementia
- Non-Ambulatory Clients in the Comparison Group
- Ambulatory Clients with PD
- Ambulatory Clients with Dementia

Table 13-Final Adjusted Model for Ambulatory HC Clients with Dementia*

Risk Factor	Odds Ratio (95% CI)	*P* Value
Parkinson's Disease	1.63 (1.45-1.84)	< 0.0001
Unsteady Gait	1.43 (1.35-1.50)	< 0.0001
Bladder Continence		
Continent/Continent with Catheter	1.00 (reference)	
Usually Continent/Occasionally Incontinent	1.17 (1.10-1.25)	< 0.0001
Frequently Incontinent/Completely Incontinent/Did Not Occur	1.19 (1.14-1.26)	< 0.0001
Age		
0 to < 65	1.07 (0.85-1.34)	0.58
≥ 65 to < 75	1.00 (reference)	
≥ 75 to < 85	1.26 (1.16-1.37)	< 0.0001
≥ 85 to < 95	1.35 (1.24-1.46)	< 0.0001
≥ 95 to < 115	1.31 (1.06-1.63)	0.01
Male	1.20 (1.15-1.25)	< 0.0001
Dizziness or Lightheadedness	1.23 (1.09-1.38)	0.0007
Stair Climbing	1.14 (1.07-1.22)	0.0002
Worsening Bladder Continence	1.16 (1.10-1.23)	< 0.0001
ADL Hierarchy Scale Score		
Independent	1.00 (reference)	
Supervision to Limited Assistance	1.01 (0.95-1.08)	0.75
Extensive to Maximal Assistance	0.99 (0.89-1.10)	0.88
Dependent to Total Dependence	0.58 (0.41-0.82)	0.002
≥ 9 Medications	1.11 (1.07-1.14)	< 0.0001
Antidepressant	1.11 (1.04-1.19)	0.003
Absence of Informal Support	0.59 (0.40-0.87)	0.007
Arthritis	1.09 (1.05-1.13)	< 0.0001

*Adjusted for assessment interval
C-statistic = 0.60   Unadjusted Condition Index = 23.59

Table 14-Final Adjusted Model for Non-Ambulatory HC Clients with Dementia

Risk Factor	Odds Ratio (95% CI)	*P* Value
ADL Hierarchy Scale Score		
Independent	1.00 (reference)	
Supervision to Limited Assistance	1.20 (0.76-1.91)	0.43
Extensive to Maximal Assistance	0.51 (0.39-0.66)	< 0.0001
Dependent to Total Dependence	0.20 (0.15-0.27)	< 0.0001
Length of Time Client is Alone During the Day		
Never or Hardly Ever	1.00 (reference)	
About One Hour	1.70 (1.30-2.23)	0.0001
Long Periods of Time	1.65 (0.92-2.96)	0.09
All of the Time	2.78 (1.15-6.74)	0.02
Pain Scale Score		
0	1.00 (reference)	
1-2	1.09 (0.87-1.37)	0.45
3	1.43 (1.18-1.73)	0.0003

C-statistic = 0.72   Unadjusted Condition Index = 13.16

Table 15-Final Adjusted Model for Ambulatory HC Clients with PD

Risk Factor	Odds Ratio (95% CI)	*P* Value
Unsteady Gait	1.46 (1.26-1.68)	< 0.0001
CPS Score		
Intact	1.00 (reference)	
Borderline Intact to Mild Impairment	1.27 (1.09-1.48)	0.002
Moderate to Moderate Severe Impairment	0.97 (0.75-1.26)	0.82
Severe to Very Severe Impairment	1.08 (0.80-1.46)	0.59
Wandering in Last 3 Days	1.94 (1.21-3.10)	0.006

C-statistic = 0.55   Unadjusted Condition Index = 5.12

Table 16-Final Adjusted Model for Non-Ambulatory HC Clients with PD*

Risk Factor	Odds Ratio (95% CI)	*P* Value
Unsteady Gait	2.11 (1.26-3.54)	0.005
ADL Hierarchy Scale Score		
Independent	1.00 (reference)	
Supervision to Limited Assistance	0.92 (0.42-2.01)	0.83
Extensive to Maximal Assistance	0.41 (0.22-0.77)	0.006
Dependent to Total Dependence	0.13 (0.06-0.27)	< 0.0001
CPS Score		
Intact	1.00 (reference)	
Borderline Intact to Mild Impairment	1.73 (1.18-2.52)	0.005
Moderate to Moderate Severe Impairment	1.30 (0.68-2.48)	0.43
Severe to Very Severe Impairment	0.40 (0.14-1.11)	0.08
Male	1.64 (1.18-2.28)	0.003
Age		
0 to < 65	1.08 (0.51-2.31)	0.84
≥ 65 to < 75	1.00 (reference)	
≥ 75 to < 85	0.59 (0.39-0.87)	0.008
≥ 85 to < 95	0.55 (0.31-0.97)	0.04
≥ 95 to < 115	0.18 (0.01-2.38)	0.19

*Adjusted for age and gender
C-statistic = 0.77   Unadjusted Condition Index = 17.86

Table 17-Final Adjusted Model for Ambulatory HC Clients in the Comparison Group*

Risk Factor	Odds Ratio (95% CI)	*P* Value
Age		
0 to < 65	0.87 (0.79-0.95)	0.002
≥ 65 to < 75	1.00 (reference)	
≥ 75 to < 85	1.18 (1.13-1.24)	< 0.0001
≥ 85 to < 95	1.42 (1.37-1.47)	< 0.0001
≥ 95 to < 115	1.69 (1.56-1.83)	< 0.0001
Unsteady Gait	1.31 (1.27-1.35)	< 0.0001
CHESS Score		

No Health Instability	1.00 (reference)	
Minimal to Low Health Instability	1.07 (1.04-1.11)	< 0.0001
Moderate to Very High Health Instability	1.17 (1.09-1.25)	< 0.0001
Bladder Continence		
Continent/Continent with Catheter	1.00 (reference)	
Usually Continent/Occasionally Incontinent	1.17 (1.11-1.23)	< 0.0001
Frequently Incontinent/Completely Incontinent/Did Not Occur	1.28 (1.23-1.34)	< 0.0001
CPS Score		
Intact	1.00 (reference)	
Borderline Intact to Mild Impairment	1.15 (1.11-1.19)	< 0.0001
Moderate to Moderate Severe Impairment	1.15 (1.05-1.25)	0.002
Severe to Very Severe Impairment	1.05 (0.78-1.41)	0.73
Antidepressant	1.33 (1.27-1.39)	< 0.0001
Absence of Informal Support	0.81 (0.74-0.89)	< 0.0001
≥ 9 Medications	1.11 (1.08-1.15)	< 0.0001
Pain Scale Score		
0	1.00 (reference)	
1-2	1.05 (1.02-1.09)	0.006
3	1.16 (1.10-1.23)	< 0.0001
Vision		
Adequate	1.00 (reference)	
Impaired/Moderately Impaired	1.06 (1.03-1.10)	0.0001
Highly/Severely Impaired	1.09 (1.01-1.18)	0.03
ADL Hierarchy Scale Score		
Independent	1.00 (reference)	
Supervision to Limited Assistance	1.01 (0.98-1.05)	0.40
Extensive to Maximal Assistance	0.86 (0.77-0.97)	0.02
Dependent to Total Dependence	0.55 (0.37-0.83)	0.004
Dizziness or Lightheadedness	1.10 (1.06-1.14)	< 0.0001
Length of Time Client is Alone During the Day		
Never or Hardly Ever	1.00 (reference)	
About One Hour	1.05 (1.00-1.09)	0.05

Long Periods of Time	1.13 (1.08-1.18)	< 0.0001
All of the Time	1.07 (1.02-1.12)	0.002
Diabetes	1.12 (1.08-1.16)	< 0.0001
Male	1.12 (1.07-1.18)	< 0.0001

*Adjusted for assessment interval and gender
C-statistic = 0.61   Unadjusted Condition Index = 16.99

Table 18-Final Adjusted Model for Non-Ambulatory HC Clients in the Comparison Group*

Risk Factor	Odds Ratio (95% CI)	*P* Value
ADL Hierarchy Scale Score		
Independent	1.00 (reference)	
Supervision to Limited Assistance	0.94 (0.84-1.06)	0.32
Extensive to Maximal Assistance	0.52 (0.48-0.58)	< 0.0001
Dependent to Total Dependence	0.29 (0.24-0.36)	< 0.0001
Unsteady Gait	1.36 (1.12-1.65)	0.002
CHESS Score		
No Health Instability	1.00 (reference)	
Minimal to Low Health Instability	1.32 (1.14-1.53)	0.0003
Moderate to Very High Health Instability	1.40 (1.00-1.97)	0.05
Antidepressant	1.53 (1.28-1.84)	< 0.0001
CPS Score		
Intact	1.00 (reference)	
Borderline Intact to Mild Impairment	1.43 (1.28-1.60)	< 0.0001
Moderate to Moderate Severe Impairment	1.20 (0.76-1.90)	0.44
Severe to Very Severe Impairment	1.01 (0.69-1.49)	0.95
Dizziness or Lightheadedness	1.29 (1.07-1.55)	0.007

**Adjusted for assessment interval
C-statistic = 0.66   Unadjusted Condition Index = 5.66

6.4　Baseline Characteristics of Not Triggered LTC Residents

Tables 19 through 21 show the baseline characteristics of LTC residents by major diagnostic group and ambulatory status. As in HC, a significantly higher proportion of non-ambulatory LTC residents had poor vision; higher scores on the CHESS, CPS, and ADL Hierarchy scales, and experienced complete bowel and bladder incontinence in the 14 days prior to assessment. The proportion of residents with unsteady gait at baseline differed significantly between ambulatory and non-ambulatory residents across all three major diagnostic groups. In contrast to the baseline characteristics of HC clients, a higher proportion of ambulatory LTC residents had unsteady gait, compared to non-ambulatory residents. It was also noted that a significantly higher proportion of ambulatory residents exhibited wandering behaviour and experienced dizziness/vertigo prior to their baseline assessment.

Table 19-Baseline Characteristics of Not Triggered LTC Residents with Dementia[*]

Independent Variables % (n)[*]	Ambulatory[**]	Non-Ambulatory[†]	P Value
N	20719	35471	
Age in Years			< 0.0001
0 to < 65	3.1 (643)	1.8 (631)	
≥ 65 to < 75	8.1 (1672)	5.9 (2107)	
≥ 75 to < 85	35.6 (7380)	30.3 (10745)	
≥ 85 to < 95	46.5 (9628)	50.1 (17779)	
≥ 95 to < 115	6.7 (1388)	11.9 (4203)	
Gender			< 0.0001
Female	69.7 (14432)	73.4 (26031)	
Male	30.3 (6267)	26.5 (9410)	
Other Sex	0.1 (20)	0.1 (30)	
Vision			< 0.0001
Adequate	61.6 (12720)	41.0 (14518)	
Impaired/ Moderately Impaired	33.6 (6937)	43.2 (15305)	
Highly/Severely Impaired	4.9 (1010)	15.9 (5626)	
Wandering in Last 7 Days	36.0 (7454)	11.4 (4052)	< 0.0001
Diabetes Mellitus	22.1 (4574)	22.9 (8115)	0.03
Arthritis	35.8 (7425)	39.3 (13941)	< 0.0001
Hip Fracture	3.4 (708)	10.0 (3558)	< 0.0001
Diagnosed Cardiovascular Condition(s)	60.0 (12440)	58.2 (20660)	< 0.0001
Unsteady Gait	46.6 (9661)	24.6 (8723)	< 0.0001
≥ 9 Medications	56.6 (11719)	57.3 (20333)	0.08
Medication Use in Last 7 Days			
Antipsychotic	44.1 (9134)	39.2 (13905)	< 0.0001
Antianxiety	14.5 (2997)	14.8 (5233)	0.35
Antidepressant	50.5 (10453)	50.3 (17836)	0.70
Hypnotic	5.5 (1138)	5.1 (1812)	0.05
Diuretic	32.2 (6674)	32.5 (11516)	0.53
Bladder Continence in Last 14 Days			< 0.0001
Continent	31.0 (6412)	5.7 (2011)	

Usually Continent/ Occasionally Incontinent	22.2 (4598)	5.4 (1917)	
Frequently Incontinent	22.4 (4637)	17.1 (6063)	
Incontinent	24.5 (5072)	71.8 (25480)	
Bowel Continence in Last 14 Days			< 0.0001
Continent	53.3 (11034)	13.0 (4623)	
Usually Continent to Frequently Incontinent	31.2 (6460)	29.9 (10594)	
Completely Incontinent	15.6 (3225)	57.1 (20254)	
ADL Hierarchy Scale Score			< 0.0001
Independent	9.5 (1967)	0.5 (190)	
Supervision to Limited Assistance	33.3 (6898)	2.9 (1018)	
Extensive to Maximal Assistance	48.4 (10028)	29.0 (10291)	
Dependent to Total Dependence	8.8 (1826)	67.6 (23972)	
DRS Score			< 0.0001
0	33.9 (7032)	29.8 (10552)	
1-2	33.2 (6873)	38.1 (13512)	
3+	32.9 (6814)	32.2 (11407)	
CPS Score			< 0.0001
Intact	4.7 (971)	1.7 (615)	
Borderline Intact to Mild Impairment	28.3 (5871)	12.2 (4328)	
Moderate to Moderate Severe Impairment	48.8 (10118)	36.2 (12840)	
Severe to Very Severe Impairment	18.1 (3759)	49.9 (17688)	
Pain Scale Score			< 0.0001
0	67.6 (14004)	65.8 (23352)	
1-2	31.2 (6457)	32.5 (11530)	
3	1.3 (258)	1.7 (589)	
CHESS Score			< 0.0001
No Health Instability	52.9 (10960)	42.0 (14891)	
Minimal to Low Health Instability	42.1 (8731)	51.2 (18168)	

Moderate to Very High Health Instability	5.0 (1028)	6.8 (2412)	
Dizziness/Vertigo in Last 7 Days	2.8 (576)	1.4 (488)	< 0.0001
Parkinson's Disease	4.2 (868)	8.3 (2947)	< 0.0001
Other Neurological Condition(s)	15.5 (3204)	24.5 (8675)	< 0.0001
Use of Trunk Restraint	1.5 (311)	26.1 (9249)	< 0.0001
Use of Chair That Prevents Rising	1.3 (263)	22.2 (7881)	< 0.0001

*Dementia = Presence of AD or dementia other than AD

** Ambulatory = Primary mode of locomotion is no assistive device used, or primary mode of locomotion is not a wheelchair but cane, walker, or crutch used is selected on its own or in addition to "wheeled self" and/or "other person wheeled"

†Non-Ambulatory = Primary mode of locomotion is a wheelchair, or only "wheeled self" is selected, or only "other person wheeled" is selected, or "wheeled self" and "other person wheeled" are selected

Table 20-Baseline Characteristics of Not Triggered LTC Residents with PD[*]

Independent Variables % (n)[*]	Ambulatory[**]	Non-Ambulatory[†]	*P* Value
N	1609	4861	
Age in Years			< 0.0001
0 to < 65	3.4 (54)	2.1 (103)	
≥ 65 to < 75	13.4 (215)	11.0 (533)	
≥ 75 to < 85	43.5 (700)	41.4 (2012)	
≥ 85 to < 95	37.1 (597)	41.3 (2006)	
≥ 95 to < 115	2.6 (42)	4.3 (207)	
Gender			0.04
Female	54.2 (872)	57.8 (2808)	
Male	45.7 (736)	42.2 (2050)	
Other Sex	0.1 (1)	0.1 (3)	
Vision			< 0.0001
Adequate	62.2 (994)	45.5 (2213)	
Impaired/ Moderately Impaired	33.2 (531)	43.2 (2100)	
Highly/Severely Impaired	4.6 (74)	11.2 (546)	

Wandering in Last 7 Days	18.5 (297)	6.0 (290)	< 0.0001
Diabetes Mellitus	22.0 (354)	21.9 (1066)	0.95
Arthritis	36.0 (579)	37.1 (1805)	0.41
Hip Fracture	4.1 (66)	8.6 (418)	< 0.0001
Diagnosed Cardiovascular Condition(s)	55.2 (888)	53.1 (2582)	0.15
Unsteady Gait	54.8 (882)	28.3 (1376)	< 0.0001
≥ 9 Medications	72.4 (1165)	70.6 (3434)	0.18
Medication Use in Last 7 Days			
Antipsychotic	37.5 (603)	32.5 (1578)	0.0002
Antianxiety	19.0 (305)	16.2 (786)	0.01
Antidepressant	53.3 (857)	51.0 (2481)	0.12
Hypnotic	8.9 (143)	6.3 (304)	0.0003
Diuretic	30.0 (482)	30.6 (1486)	0.64
Bladder Continence in Last 14 Days			< 0.0001
Continent	30.1 (485)	7.9 (386)	
Usually Continent/ Occasionally Incontinent	22.8 (367)	6.7 (326)	
Frequently Incontinent	22.9 (368)	20.1 (976)	
Incontinent	24.2 (389)	65.3 (3173)	
Bowel Continence in Last 14 Days			< 0.0001
Continent	58.9 (948)	20.6 (1003)	
Usually Continent to Frequently Incontinent	27.4 (440)	33.2 (1612)	
Completely Incontinent	13.7 (227)	46.2 (2246)	
ADL Hierarchy Scale Score			< 0.0001
Independent	11.0 (177)	0.7 (36)	
Supervision to Limited Assistance	31.0 (499)	2.7 (130)	
Extensive to Maximal Assistance	45.7 (736)	27.9 (1357)	
Dependent to Total Dependence	12.2 (197)	68.7 (3338)	
DRS Score			< 0.0001
0	38.4 (617)	31.1 (1511)	
1-2	32.6 (525)	39.5 (1922)	
3+	29.0 (467)	29.4 (1428)	

CPS Score			< 0.0001
Intact	19.6 (316)	8.5 (412)	
Borderline Intact to Mild Impairment	36.0 (579)	21.8 (1060)	
Moderate to Moderate Severe Impairment	33.9 (545)	34.6 (1681)	
Severe to Very Severe Impairment	10.5 (169)	35.1 (1708)	
Pain Scale Score			0.43
0	62.1 (999)	60.5 (2942)	
1-2	36.1 (581)	37.9 (1840)	
3	1.8 (29)	1.6 (79)	
CHESS Score			< 0.0001
No Health Instability	53.5 (860)	43.9 (2134)	
Minimal to Low Health Instability	41.0 (660)	49.6 (2412)	
Moderate to Very High Health Instability	5.5 (89)	6.5 (315)	
Dizziness/Vertigo in Last 7 Days	3.9 (63)	2.1 (103)	< 0.0001
Dementia	54.0 (868)	60.6 (2947)	< 0.0001
Other Neurological Condition(s)	15.5 (250)	21.4 (1041)	< 0.0001
Use of Trunk Restraint	2.4 (39)	22.2 (1077)	< 0.0001
Use of Chair That Prevents Rising	2.0 (32)	21.3 (1036)	< 0.0001

*PD = Presence of Parkinson's disease

** Ambulatory = Primary mode of locomotion is no assistive device used, or primary mode of locomotion is not a wheelchair but cane, walker, or crutch used is selected on its own or in addition to "wheeled self" and/or "other person wheeled"

†Non-Ambulatory = Primary mode of locomotion is a wheelchair, or only "wheeled self" is selected, or only "other person wheeled" is selected, or "wheeled self" and "other person wheeled" are selected

Table 21-Baseline Characteristics of Not Triggered LTC Residents in the Comparison Group[*]

Independent Variables % (n)[*]	Ambulatory[**]	Non-Ambulatory[†]	P Value
N	10517	12755	
Age in Years			< 0.0001
0 to < 65	8.6 (907)	5.3 (670)	
≥ 65 to < 75	10.1 (1066)	8.4 (1071)	
≥ 75 to < 85	27.1 (2850)	25.3 (3225)	
≥ 85 to < 95	44.2 (4650)	46.1 (5877)	
≥ 95 to < 115	9.9 (1044)	15.0 (1909)	
Gender			< 0.0001
Female	68.7 (7225)	74.0 (9435)	
Male	31.2 (3283)	26.0 (3313)	
Other Sex	0.1 (9)	0.1 (7)	
Vision			< 0.0001
Adequate	66.2 (6956)	56.2 (7164)	
Impaired/ Moderately Impaired	28.5 (2998)	35.4 (4513)	
Highly/Severely Impaired	5.3 (553)	8.4 (1066)	
Wandering in Last 7 Days	6.7 (700)	3.9 (500)	< 0.0001
Diabetes Mellitus	27.4 (2884)	30.1 (3837)	< 0.0001
Arthritis	41.1 (4327)	46.8 (5966)	< 0.0001
Hip Fracture	4.0 (415)	9.6 (1224)	< 0.0001
Diagnosed Cardiovascular Condition(s)	65.1 (6848)	67.8 (8646)	< 0.0001
Unsteady Gait	42.8 (4498)	31.1 (3966)	< 0.0001
≥ 9 Medications	68.4 (7191)	74.8 (9544)	< 0.0001
Medication Use in Last 7 Days			
Antipsychotic	23.8 (2498)	19.8 (2525)	< 0.0001
Antianxiety	22.0 (2312)	20.8 (2654)	0.03
Antidepressant	42.4 (4457)	48.0 (6128)	< 0.0001
Hypnotic	9.4 (988)	9.0 (1145)	0.27
Diuretic	45.1 (4743)	50.1 (6392)	< 0.0001
Bladder Continence in Last 14 Days			< 0.0001
Continent	50.8 (5337)	21.3 (2719)	
Usually Continent/	23.8 (2501)	15.0 (1909)	

Occasionally Incontinent			
Frequently Incontinent	14.9 (1566)	22.6 (2879)	
Incontinent	10.6 (1113)	41.1 (5248)	
Bowel Continence in Last 14 Days			< 0.0001
Continent	76.7 (8069)	42.4 (5404)	
Usually Continent to Frequently Incontinent	17.6 (1847)	31.4 (4003)	
Completely Incontinent	5.7 (602)	26.3 (3348)	
ADL Hierarchy Scale Score			< 0.0001
Independent	26.8 (2822)	4.5 (579)	
Supervision to Limited Assistance	41.0 (4309)	11.0 (1398)	
Extensive to Maximal Assistance	25.7 (2703)	45.6 (5815)	
Dependent to Total Dependence	6.5 (683)	38.9 (4963)	
DRS Score			< 0.0001
0	46.5 (4887)	35.5 (4524)	
1-2	28.5 (2992)	30.2 (3851)	
3+	25.1 (2638)	34.3 (4380)	
CPS Score			< 0.0001
Intact	41.7 (4389)	30.4 (3874)	
Borderline Intact to Mild Impairment	39.4 (4140)	35.7 (4551)	
Moderate to Moderate Severe Impairment	15.8 (1661)	23.6 (3008)	
Severe to Very Severe Impairment	3.1 (327)	10.4 (1322)	
Pain Scale Score			< 0.0001
0	54.0 (5683)	46.1 (5877)	
1-2	43.0 (4515)	49.2 (6276)	
3	3.0 (319)	4.7 (602)	
CHESS Score			< 0.0001
No Health Instability	56.9 (5987)	40.4 (5152)	
Minimal to Low Health Instability	39.0 (4102)	51.7 (6593)	
Moderate to Very High Health Instability	4.1 (428)	7.9 (1010)	

Dizziness/Vertigo in Last 7 Days	4.2 (442)	2.7 (338)	< 0.0001
Use of Trunk Restraint	0.4 (39)	7.6 (966)	< 0.0001
Use of Chair That Prevents Rising	0.30 (32)	6.7 (853)	< 0.0001

*Comparison = absence of: dementia, PD, epilepsy/seizure disorder, stroke, traumatic brain injury, amyotrophic lateral sclerosis, muscular dystrophy, Huntington's disease, spinal cord injury, cerebral palsy, and multiple sclerosis.

** Ambulatory = Primary mode of locomotion is no assistive device used, or primary mode of locomotion is not a wheelchair but cane, walker, or crutch used is selected on its own or in addition to "wheeled self" and/or "other person wheeled"

†Non-Ambulatory = Primary mode of locomotion is a wheelchair, or only "wheeled self" is selected, or only "other person wheeled" is selected, or "wheeled self" and "other person wheeled" are selected

6.5   Factors Associated with Being a Faller Among Not Triggered LTC Residents

Tables 22 through 27 show the final GEE models for all six "Not Triggered" subgroups in LTC. Two final models are shown for each subgroup, with the exception of non-ambulatory LTC residents with dementia and non-ambulatory residents in the comparison group, because each original final model was adjusted for a variable that was not significant, but improved the fit statistic of the model and was deemed clinically important (see Appendix B).

As was reported in HC clients, there was some overlap in risk factors between subgroups of residents with neurological conditions and the subgroups without (Figure 8). Unsteady gait significantly increased the odds of being a faller in most subgroups in LTC; however, it was not significant among ambulatory residents with PD. Being in higher age categories than the 65-74 category and being male also increased the odds of being a faller in certain subgroups in LTC. Another similarity observed was that in subgroups with neurological conditions where CPS score met the cut-off for inclusion in the final GEE model, those with the highest levels of cognitive impairment were not at a significantly elevated odds of being a faller.

There were also several differences in LTC residents compared to HC Clients in terms of their risk factors for falls. ADL Hierarchy Scale score was only a significant risk factor in three subgroups; in ambulatory residents with dementia, those in the 3-4 score category were at highest risk for falls (OR = 1.52; 95% CI 1.28-1.80), compared to residents who were independent in ADL function. In contrast, non-ambulatory residents with dementia and non-ambulatory residents in the comparison group were significantly less likely to be a faller if they were in the highest ADL Hierarchy Scale categories. Bladder and bowel continence were more common risk factors among subgroups in LTC than they were in HC, as was medication use. In general, ambulatory residents experiencing increasing levels of bladder incontinence were at increased odds of falling, compared to those who were continent or continent with a catheter, while the opposite was true in non-ambulatory residents. Wandering in the 7 days prior to baseline assessment increased the odds of being a faller in all three ambulatory subgroups of residents and was typically one of the strongest predictors. In contrast, the use of restraints, both trunk restraint and chair that prevents rising, reduced the odds of being a faller in the non-ambulatory subgroups; although, use of a chair that prevents rising no longer remained significant in non-ambulatory residents with PD after adjusting for CPS score.
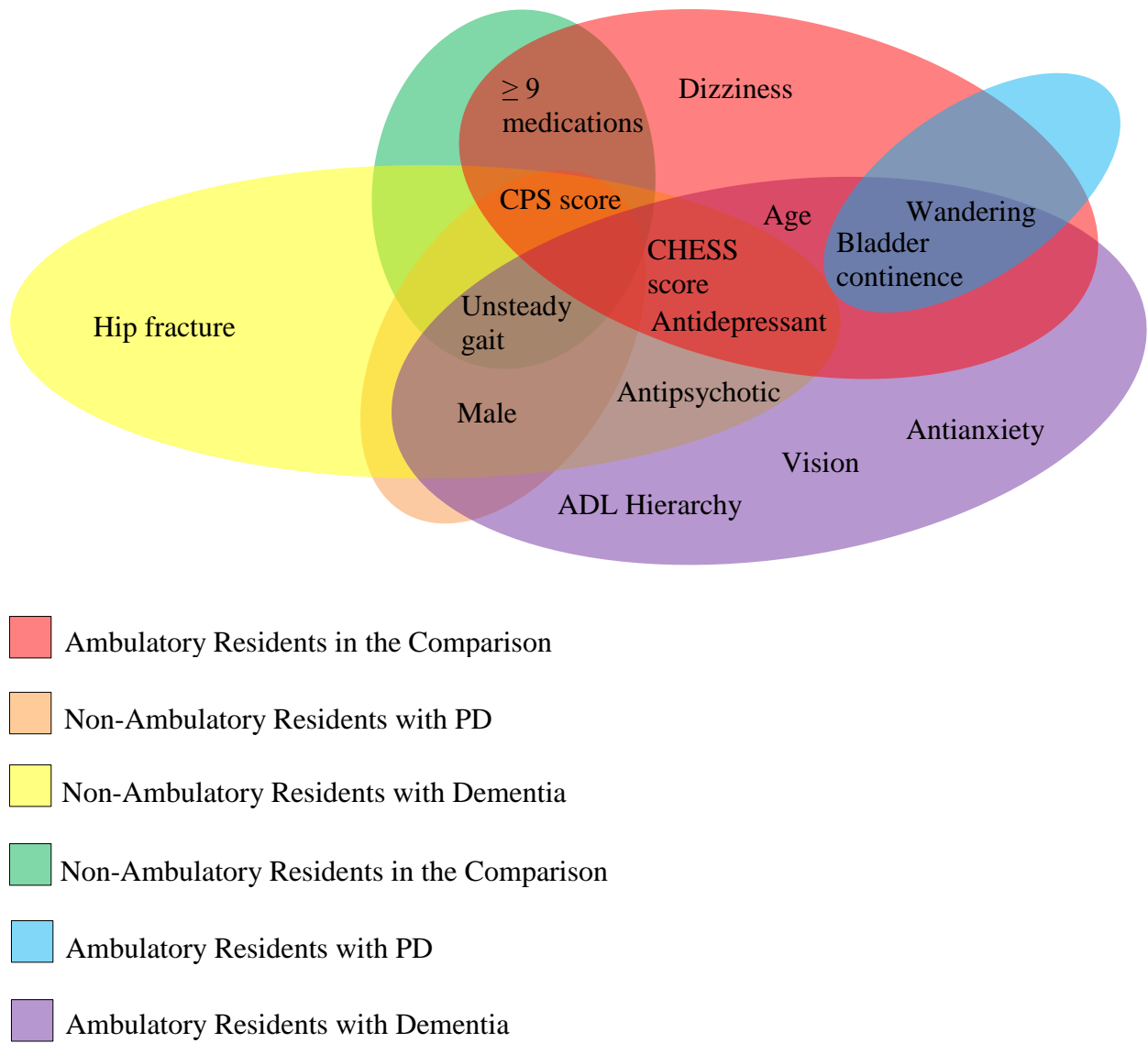
Figure 8-Factors That Significantly Increased the Odds of Being a Faller in LTC Residents

Table 22-Final Adjusted Model Estimates for Ambulatory LTC Residents with Dementia

Risk Factor	Model 1		Model 2*	
	Odds Ratio (95% CI)	*P* Value	Odds Ratio (95% CI)	*P* Value
ADL Hierarchy Scale Score				
Independent	1.00 (reference)		1.00 (reference)	
Supervision to Limited Assistance	1.22 (1.05-1.41)	0.008	1.22 (1.05-1.41)	0.008
Extensive to Maximal Assistance	1.52 (1.28-1.80)	< 0.0001	1.52 (1.28-1.80)	< 0.0001
Dependent to Total Dependence	0.81 (0.63-1.06)	0.12	0.85 (0.66-1.10)	0.22
Bladder Continence				
Continent	1.00 (reference)		1.00 (reference)	
Usually Continent/ Occasionally Incontinent	1.24 (1.12-1.38)	< 0.0001	1.24 (1.12-1.38)	< 0.0001
Frequently Incontinent	1.29 (1.10-1.50)	0.002	1.29 (1.11-1.51)	0.001
Incontinent	1.25 (1.12-1.39)	< 0.0001	1.26 (1.13-1.41)	< 0.0001
Wandering in Last 7 Days	1.45 (1.33-1.58)	< 0.0001	1.45 (1.33-1.57)	< 0.0001
Unsteady Gait	1.31 (1.21-1.42)	< 0.0001	1.31 (1.21-1.42)	< 0.0001
Age				
0 to < 65	0.98 (0.72-1.32)	0.88	0.97 (0.72-1.31)	0.86
≥ 65 to < 75	1.00 (reference)		1.00 (reference)	
≥ 75 to < 85	1.28 (1.11-1.46)	0.0005	1.28 (1.11-1.47)	0.0007
≥ 85 to < 95	1.46 (1.24-1.71)	< 0.0001	1.46 (1.24-1.71)	< 0.0001
≥ 95 to < 115	1.58 (1.24-2.00)	0.0002	1.58 (1.24-2.02)	0.0002
CHESS Score				
No Health Instability	1.00 (reference)		1.00 (reference)	
Minimal to Low Health Instability	1.20 (1.09-1.32)	0.0001	1.20 (1.09-1.32)	0.0001
Moderate to Very High Health Instability	1.19 (0.96-1.48)	0.10	1.19 (0.96-1.48)	0.11
Vision				
Adequate	1.00 (reference)		1.00 (reference)	
Impaired/Moderately Impaired	1.15 (1.07-1.22)	< 0.0001	1.15 (1.08-1.22)	< 0.0001
Highly/Severely Impaired	1.05 (0.80-1.37)	0.72	1.05 (0.81-1.38)	0.71
Antianxiety Medication	1.22 (1.06-1.40)	0.005	1.22 (1.06-1.41)	0.005
Antipsychotic	1.09 (1.03-1.16)	0.004	1.10 (1.04-1.16)	0.002

Antidepressant	1.16 (1.07-1.25)	0.0002	1.16 (1.07-1.25)	0.0002
Gender				
Female	1.00 (reference)		1.00 (reference)	
Male	1.25 (1.15-1.36)	< 0.0001	1.25 (1.15-1.37)	< 0.0001
Other	1.15 (0.20-6.70)	0.88	1.15 (0.20-6.71)	0.88
Use of Trunk Restraint			0.51 (0.30-0.88)	0.02

*Adjusted for use of trunk restraint

Model 1 C-statistic = 0.63   Unadjusted Condition Index = 18.54

Model 2 C-statistic = 0.63   Unadjusted Condition Index = 18.57

Table 23-Final Adjusted Model Estimates for Non-Ambulatory LTC Residents with Dementia

Risk Factor	Odds Ratio (95% CI)	*P* Value
Unsteady Gait	1.63 (1.42-1.87)	< 0.0001
ADL Hierarchy Scale Score		
Independent	1.00 (reference)	
Supervision to Limited Assistance	0.80 (0.58-1.12)	0.19
Extensive to Maximal Assistance	0.61 (0.44-0.85)	0.003
Dependent to Total Dependence	0.29 (0.20-0.41)	< 0.0001
Bowel Continence		
Continent	1.00 (reference)	
Usually Continent to Frequently Incontinent	0.84 (0.77-0.90)	< 0.0001
Completely Incontinent	0.61 (0.54-0.69)	< 0.0001
Use of a Chair That Prevents Rising	0.73 (0.60-0.88)	0.0008
Bladder Continence		
Continent	1.00 (reference)	
Usually Continent/ Occasionally Incontinent	1.02 (0.81-1.29)	0.84
Frequently Incontinent	0.83 (0.69-0.99)	0.04
Incontinent	0.73 (0.63-0.85)	< 0.0001
Gender		
Female	1.00 (reference)	
Male	1.44 (1.32-1.57)	< 0.0001
Other	1.64 (0.37-7.33)	0.52
Use of Trunk Restraint	0.78 (0.71-0.85)	< 0.0001
CPS Score		

Intact	1.00 (reference)	
Borderline Intact to Mild Impairment	1.34 (0.99-1.82)	0.05
Moderate to Moderate Severe Impairment	1.85 (1.46-2.39)	< 0.0001
Severe to Very Severe Impairment	1.32 (1.05-1.68)	0.02
Antidepressant	1.22 (1.11-1.34)	< 0.0001
Hip Fracture	1.25 (1.10-1.42)	0.0004
Antipsychotic	1.18 (1.08-1.30)	0.0004
CHESS Score		
No Health Instability	1.00 (reference)	
Minimal to Low Health Instability	1.04 (0.98-1.11)	0.20
Moderate to Very High Health Instability	1.30 (1.13-1.50)	0.0003
Diuretic	0.91 (0.86-0.97)	0.003

C-statistic = 0.74   Unadjusted Condition Index = 56.32

Table 24-Final Adjusted Model Estimates for Ambulatory LTC Residents with PD

	Model 1		Model 2*	
Risk Factor	**Odds Ratio (95% CI)**	***P* Value**	**Odds Ratio (95% CI)**	***P* Value**
Bladder Continence				
Continent	1.00 (reference)		1.00 (reference)	
Usually Continent/ Occasionally Incontinent	2.00 (1.37-2.91)	0.0003	1.86 (1.24-2.79)	0.003
Frequently Incontinent	2.71 (1.93-3.80)	< 0.0001	2.27 (1.49-3.44)	0.0001
Incontinent	1.51 (1.13-2.02)	0.006	1.43 (1.01-2.00)	0.04
Wandering in Last 7 Days	1.70 (1.32-2.19)	< 0.0001	1.47 (1.10-1.96)	0.009
ADL Hierarchy Scale Score				
Independent			1.00 (reference)	
Supervision to Limited Assistance			0.88 (0.48-1.61)	0.67
Extensive to Maximal Assistance			1.49 (0.75-2.89)	0.26

			0.61 (0.28-1.41)	0.22
Dependent to Total Dependence				

*Adjusted for ADL Hierarchy Scale Score
Model 1 C-statistic = 0.62   Unadjusted Condition Index = 3.62
Model 2 C-statistic = 0.65   Unadjusted Condition Index = 7.38

Table 25-Final Adjusted Model Estimates for Non-Ambulatory LTC Residents with PD

Risk Factor	Model 1		Model 2**	
	Odds Ratio (95% CI)	*P* Value	Odds Ratio (95% CI)	*P* Value
Unsteady Gait	2.02 (1.51-2.71)	< 0.0001	1.93 (1.43-2.59)	< 0.0001
Bowel Continence				
Continent	1.00 (reference)		1.00 (reference)	
Usually Continent to Frequently Incontinent	0.82 (0.61-1.11)	0.20	0.82 (0.61-1.09)	0.17
Completely Incontinent	0.34 (0.26-0.46)	< 0.0001	0.39 (0.27-0.56)	< 0.0001
Male*	1.66 (1.39-1.98)	< 0.0001	1.66 (1.40-1.97)	< 0.0001
Use of Chair That Prevents Rising	0.64 (0.46-0.89)	0.008	0.67 (0.48-0.94)	0.02
CPS Score				
Intact			1.00 (reference)	
Borderline Intact to Mild Impairment			1.34 (0.98-1.84)	0.07
Moderate to Moderate Severe Impairment			1.54 (1.00-2.38)	0.05
Severe to Very Severe Impairment			0.84 (0.48-1.46)	0.53

*Individuals in the "other" gender category were deleted to allow model to iterate
**Adjusted for CPS Score
Model 1 C-statistic = 0.70   Unadjusted Condition Index = 5.70
Model 2 C-statistic = 0.71   Unadjusted Condition Index = 2.63

Table 26-Final Adjusted Model Estimates for Ambulatory LTC Residents in the Comparison Group

Risk Factor	Model 1		Model 2	
	Odds Ratio (95% CI)	*P* Value	Odds Ratio (95% CI)	*P* Value
Bladder Continence				
Continent	1.00 (reference)		1.00 (reference)	
Usually Continent/ Occasionally Incontinent	1.16 (1.01-1.36)	0.03	1.14 (1.00-1.29)	0.05
Frequently Incontinent	1.51 (1.33-1.71)	< 0.0001	1.46 (1.25-1.70)	< 0.0001
Incontinent	1.36 (1.08-1.72)	0.009	1.35 (1.07-1.72)	0.01
CPS Score				
Intact	1.00 (reference)		1.00 (reference)	
Borderline Intact to Mild Impairment	1.24 (1.08-1.44)	0.003	1.23 (1.07-1.42)	0.004
Moderate to Moderate Severe Impairment	1.63 (1.21-2.19)	0.001	1.59 (1.18-2.15)	0.002
Severe to Very Severe Impairment	1.14 (0.67-1.95)	0.62	1.17 (0.71-1.94)	0.54
Wandering in Last 7 Days	1.62 (1.37-1.91)	< 0.0001	1.55 (1.30-1.84)	< 0.0001
Bowel Continence				
Continent	1.00 (reference)		1.00 (reference)	
Usually Continent to Frequently Incontinent	1.13 (0.96-1.33)	0.13	1.13 (0.95-1.35)	0.18
Completely Incontinent	0.47 (0.32-0.71)	0.0003	0.54 (0.36-0.81)	0.003
Antidepressant	1.39 (1.23-1.57)	< 0.0001	1.38 (1.22-1.55)	< 0.0001
CHESS Score				
No Health Instability	1.00 (reference)		1.00 (reference)	
Minimal to Low Health Instability	1.25 (1.08-1.44)	0.003	1.25 (1.08-1.44)	0.002
Moderate to Very High Health Instability	1.15 (0.72-1.84)	0.56	1.27 (0.75-2.16)	0.37
≥ 9 Medications	1.30 (1.10-1.53)	0.002	1.30 (1.10-1.54)	0.002
Age				
0 to < 65	0.67 (0.46-0.97)	0.03	0.67 (0.46-0.98)	0.04
≥ 65 to < 75	1.00 (reference)		1.00 (reference)	
≥ 75 to < 85	0.91 (0.93-1.31)	0.27	1.11 (0.93-1.32)	0.23
≥ 85 to < 95	1.21 (0.97-1.52)	0.10	1.23 (0.98-1.54)	0.08

≥ 95 to < 115	1.70 (1.31-2.21)	< 0.0001	1.71 (1.32-2.23)	< 0.0001
Dizziness/Vertigo in Last 7 Days	1.46 (1.21-1.76)	< 0.0001	1.46 (1.22-1.75)	< 0.0001
ADL Hierarchy Scale Score				
Independent			1.00 (reference)	
Supervision to Limited Assistance			0.99 (0.83-1.18)	0.90
Extensive to Maximal Assistance			1.16 (0.94-1.42)	0.17
Dependent to Total Dependence			0.65 (0.46-0.93)	0.02

*Adjusted for ADL Hierarchy Scale Score

Model 1 C-statistic = 0.64   Unadjusted Condition Index = 11.84

Model 2 C-statistic = 0.65   Unadjusted Condition Index = 12.99

Table 27-Final Adjusted Model Estimates for Non-Ambulatory LTC Residents in the Comparison Group

Risk Factor	Odds Ratio (95% CI)	*P* Value
Unsteady Gait	1.59 (1.41-1.79)	< 0.0001
ADL Hierarchy		
Independent	1.00 (reference)	
Supervision to Limited Assistance	0.94 (0.68-1.29)	0.69
Extensive to Maximal Assistance	0.78 (0.55-1.09)	0.14
Dependent to Total Dependence	0.43 (0.31-0.58)	< 0.0001
Bowel Continence		
Continent	1.00 (reference)	
Usually Continent to Frequently Incontinent	0.79 (0.69-0.89)	0.0002
Completely Incontinent	0.62 (0.48-0.80)	0.0002
Use of Trunk Restraint	0.75 (0.65-0.87)	0.0002
Bladder Continence		
Continent	1.00 (reference)	
Usually Continent/ Occasionally Incontinent	1.00 (0.82-1.22)	0.99
Frequently Incontinent	0.90 (0.74-1.10)	0.32
Incontinent	0.73 (0.64-0.83)	< 0.0001
CPS Score		
Intact	1.00 (reference)	
Borderline Intact to Mild Impairment	1.50 (1.27-1.79)	< 0.0001
Moderate to Moderate Severe Impairment	1.89 (1.62-2.20)	< 0.0001
Severe to Very Severe Impairment	1.65 (1.14-2.39)	0.009
≥ 9 Medications	1.23 (1.07-1.41)	0.003

C-statistic = 0.67   Unadjusted Condition Index = 15.95

7   DISCUSSION

The results of this study suggest that risk factors that increase the odds of being a faller in "Not Triggered" individuals with dementia and PD do not systematically differ from risk factors that increase the odds of being a faller in "Not Triggered" people without these conditions. There were several risk factors common to those with and without dementia and PD, in both HC and LTC. However, no two subgroups had the exact same profile of risk factors, which implies that there may still be some minor variation in factors that increase the odds of being a faller among different diagnostic groups. If the goal is to provide universal guidelines for risk assessment, the focus should be on risk factors that are similar across groups, unless a very strong predictor in a particular subgroup is identified (e.g. comorbid PD in ambulatory HC clients with dementia). Unsteady gait was a common and strong predictor of falls across many subgroups in both HC and LTC, and wandering behaviour (for ambulatory subgroups) was also a strong predictor of being a faller in several ambulatory subgroups in both care settings. Age greater than 65-74 years and male gender were also prevalent, strong predictors of being a faller in many subgroups in HC and LTC; however, these are not modifiable risk factors and thus can be used to assess risk but cannot be targeted for intervention. Mild to moderate cognitive impairment, as defined by scores of 1-4 on the CPS, was a common predictor of falls across several subgroups in both care settings, although it did not always reach statistical significance. In LTC, it may be beneficial to assess use of psychotropic medications, ≥ 9 medications, and bladder incontinence, depending on ambulatory status, in addition to the risk factors for HC to determine fall risk since these were also common predictors in this population. The magnitude and direction of the effect on the odds of being a faller associated with ADL Hierarchy Scale score, CPS score, and bladder and bowel continence indicate that having higher levels of impairment in these domains does not

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necessarily increase the odds of being a faller, and in some cases it significantly reduces the odds. Therefore, those with the most severe levels of impairment in cognition, ability to perform ADLs, or continence are not necessarily those that need to be targeted most for fall prevention, as they were not at the highest odds of being a faller among "Not Triggered" individuals. The descriptive analyses suggest that the falls CAP is useful for predicting future falls in HC and LTC settings; however, this must be confirmed with a formal statistical analysis. The results of this study indicate that a common set of a few key risk factors may be sufficient to predict falls in "Not Triggered" HC clients and LTC residents, regardless of a diagnosis of PD or dementia.

7.1   Risk Factors for Falls in Not Triggered HC Clients with Dementia

In HC, several risk factors that significantly increased the odds of being a faller were common among clients with dementia and clients in the comparison group, such as unsteady gait, male gender, bladder continence, use of ≥ 9 medications, dizziness, and antidepressant use. Previous studies of community-dwelling older adults that included individuals with and without dementia reported some of the same risk factors for falls, such as antidepressant use (33), male gender (34), and abnormal gait (120); therefore, it is not surprising that these risk factors for falls emerged even when HC clients were stratified by diagnosis. One explanation for the observed overlap in factors associated with being a faller is that HC clients without the neurological conditions of interest in this study are still not necessarily healthy older adults, as they require some level of care. For example, the prevalence of unsteady gait, a common risk factor between the dementia and comparison groups, is actually slightly higher among ambulatory clients in the comparison group than ambulatory clients with dementia, although the OR associated with unsteady gait was higher in the dementia subgroup. These observations suggest that individuals with and without dementia do not necessarily differ substantially in terms of the presence of

important risk factors for falls, which likely explains the observed overlap in risk factors across these groups. However, these findings also suggest that the unsteady gait may be more severe in those with dementia since it was more strongly associated with being a faller in this group versus the comparison group.

The positive association between male gender and falls is unclear, although, a study of HC clients in Ontario reported that being male significantly increased the risk for falls (34). Fletcher and Hirdes suggested that because a higher proportion of female HC clients reported a fear of falling, they may be more likely to limit their activity and as a result experience fewer falls (34). Males may also be more likely than women to engage in risky behaviour that can lead to falls (34). Although it may be difficult to determine the mechanism by which male gender increases the risk for falls, the strong associations observed in this study suggest that it should be used to identify clients at risk for future falls, regardless of a diagnosis of dementia.

Length of time alone was significantly associated with being a faller in ambulatory clients in the comparison group and in non-ambulatory clients with dementia. The risk factors length of time alone and highest Pain Scale score in non-ambulatory HC clients with dementia were likely associated with being a faller because of the constant care required by those with dementia who are unable to walk around their homes, combined with the fact that severe pain can further impair one's ability to perform daily activities and affect cognitive processes as well (190). Although this study did not look at the level of care received by clients in terms of formal support services, clients with dementia may not able to afford the level of care and supervision that they require, since not all services are fully covered by the government in Ontario. Absence of a primary informal caregiver was associated with a reduced odds of being a faller in

ambulatory clients with dementia and in the comparison group, perhaps because those who were able to function without formal support were likely those that were not at a high risk for falls.

Conversely, certain risk factors were associated with falls in the comparison group but not the dementia group, and vice versa. CHESS score only increased the odds of being a faller in the comparison subgroups, although it is unclear why this was the case since the proportion of clients within each CHESS score category at baseline did not vary dramatically between those with and without neurological conditions. PD was only examined as a risk factor in the dementia subgroups, as the comparison group consisted of individuals with none of the selected neurological conditions. Although PD was not prevalent among ambulatory HC clients with dementia, it was a strong predictor of being a faller and likely explains some of the gait and stair climbing issues in this subgroup. Since the MDS assessments used in this study did not specify a primary diagnosis, these individuals could also be classified as HC clients with PD that also have dementia. The presence of dementia in those with PD can cause a more rapid decline in motor function, which may explain the particularly high risk for falls associated with PD (241).

Though there were some risk factors for falls that were unique to HC clients with dementia or clients in the comparison group, there were also risk factors, such as unsteady gait, bladder continence, and antidepressant use, that were not only common among both groups, but were also some of the risk factors most highly associated with being a faller in these groups. Based on the results of this study, there does not appear to be strong evidence to justify the stratification of falls risk assessment by clients with dementia versus clients without any of the selected neurological conditions.

7.2 Risk Factors for Falls in Not Triggered HC Clients with PD

Mild cognitive impairment and unsteady gait increased the odds of being a faller in clients with PD and clients in the comparison group, which is consistent with previous literature (32,80,212,220); however, it is notable that the magnitude of risk associated with unsteady gait in clients with PD was higher compared to clients in the comparison group, which may reflect the more severe gait disturbances in clients with PD. It is interesting to note that mild cognitive impairment, but not dementia, significantly increased the odds of being a faller among clients with PD. The observation that those with mild to moderate cognitive impairment were at significant risk for being a faller, while those with severe cognitive impairment were not, has been previously reported in a study of nursing home residents (59). This phenomenon, which was observed in several subgroups, may be explained by the concept that those with severe cognitive impairment are also likely to have severe functional impairments and thus do not stand or walk often. A study of community-dwelling older adults reported that fall rates were lowest in those that could neither sit nor stand and highest in those with fair to poor mobility (242). Similarly, in non-ambulatory LTC residents, the risk of injurious falls increases with increasing mobility (227). Mobility does not capture all aspects of ADL function but may reflect ADL status; for example, if a person is completely dependent on others to perform ADLs, they are likely not very mobile. This theory regarding the inverse relationship between cognitive functioning and mobility in relation to falls is in line with the observation that being in the highest ADL Hierarchy Scale score categories significantly reduced the risk of being a faller in many subgroups of clients in this study, though this is contrary to what was originally hypothesized and to what several previous studies have found (58,65,85,216). However, a study of older adults in Taiwan also reported that severely impaired ADL function was negatively

associated with falls (243), which supports the results of this study. The relationship between cognitive function, ADL function, and falls appears complex and somewhat contradictory; however, it does have a logical internal consistency and provides evidence that those with the most severe levels of cognitive and ADL impairment are not necessarily at the highest risk for falls.

It is important to note that in all of the analyses conducted in this study, the risk factors that were included in the models likely interact and affect one another, though interactions were not tested in order to maintain a simplified approach to inform efficient risk assessment practices. Therefore, the potentially complex interplay of many of the risk factors in this study indicates that whether ADL function increased or decreased the risk of falls in any particular multivariable model may depend on what other variables were also present in that model. The performance of ADLs typically requires input from multiple domains, including mobility, gait, cognition, and motor skills (which may or may not be affected by the use of psychotropic medications). When multiple risk factors that potentially interact with one another are entered into a model, it is difficult to determine how they may interact with one another to affect the outcome without testing these interactions. However, it can be stated that each of the risk factors associated with falls remained independently significant, even after including the other variables in each model.

7.3 Risk Factors for Falls in Not Triggered LTC Residents with Dementia

Diagnoses may be less important than measures of functional status when one is considering falls in LTC residents since they must all meet the same criteria for admission in terms of care needs and supervision required. Furthermore, measures of impairment in domains such as ADL function and cognition were consistently associated with being a faller across many diagnostic groups in LTC and HC, while comorbid diagnoses were not as consistent. Incidentally, a

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comorbid diagnosis of another neurological condition in residents with PD or dementia did not meet the cut-off for inclusion in any of the final models, lending support to the idea that the changes in health status associated with age and the presence of these conditions is more important than an official diagnosis when it comes to predicting falls. Furthermore, CHESS score, a measure of health instability, was associated with falls in both dementia and comparison subgroups. Functional decline, especially in terms of malnutrition and weight loss, is common among all LTC residents, regardless of dementia diagnoses (244). Some of the measures captured by the CHESS, mainly weight loss, are also aspects of Fried's definition of frailty which is a known predictor of falls (135,137). Additionally, incontinence increased the odds of being a faller, regardless of diagnostic group. Previous literature has reported that all LTC residents are at a relatively high risk for falls due to functional impairments (23,71), which, in conjunction with the findings of this study, suggests that assessing those with dementia for falls using a separate set of risk factors would not greatly improve the identification of those at high risk for future falls.

Bladder and bowel continence were associated with being a faller among LTC residents with and without dementia. Furthermore, bladder and bowel continence were also more common risk factors among LTC residents than in HC clients, which may reflect the relative difference in functional status of people living in these care settings. Bladder continence has previously been identified as a significant risk factor falls in LTC residents with and without dementia (84,188). The protective effect of high levels of incontinence in non-ambulatory subgroups may be similar to the protective effect of high ADL Hierarchy Scale scores. Residents who are non-ambulatory and have severe incontinence issues are likely not mobile and thus are not at a high risk for falls. The prominent theory relating falls to incontinence is that older adults fall while rushing to the

bathroom to avoid premature voiding (83,245) and non-ambulatory residents with severe urinary or bowel incontinence are likely to be wearing briefs or similar protective padding so that they do not have to rush to the bathroom to avoid episodes of incontinence. Preliminary evidence from middle aged women suggests that there may also be a relationship between urinary incontinence and altered gait. Compared to the post voiding condition, women in the severe desire to void condition have significantly increased stride time variability and decreased stride length (246), which may explain the observed increase in risk for falls related to incontinence among ambulatory residents. It is relevant to note that certain classes of psychotropic medications, such as sedatives and antipsychotics, can exacerbate incontinence by reducing one's awareness of the urge to void. Antipsychotics can also impair bladder contractility and lead to overflow incontinence (247). The mechanisms linking falls to incontinence do not appear to be disease specific, which may explain why it increases the risk for falls in ambulatory residents with and without dementia. Although the falls CAP aims to recognize common pathways among falls, incontinence, and functional decline; it is not clear how assessment of bladder incontinence is incorporated into the falls CAP, since it is based solely on a history of falls. The results of this study suggest that assessing bladder incontinence among ambulatory LTC residents with no recent history of falls may help to identify those at high risk for future falls.

Antidepressants were the only class of psychotropic medications that increased the odds of being a faller in both residents with dementia and residents in the comparison group; however, the use of ≥ 9 medications was only significant among those in the comparison group but the dementia subgroups. The difference may reflect the relative importance of polypharmacy in the comparison group compared to the importance of specific classes of psychotropic medications in

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those with dementia. Antidepressants have been linked to falls in older adults through many different mechanisms; most of the literature relates to selective serotonin reuptake inhibitors and tricyclic antidepressants. Antidepressant use can impair postural reflexes, increase reaction time, contribute to orthostatic hypotension, and cause insomnia that leads to daytime drowsiness (248). All of these side effects can increase the risk of falling. It has been reported that antidepressants, antipsychotics, and benzodiazepines can enhance symptoms of dementia, such as hallucinations, and have been associated with rapid cognitive and functional decline in those with AD (249). Many antianxiety medications used are benzodiazepine receptor agonists and have side effects such as impaired coordination and balance, ataxia, delusions, hallucinations, and impaired short-term memory—all of which are thought to be associated with falls (250). Psychotropic medications may be used to control behavioural symptoms in nursing home residents, especially those with dementia (149), and they can also be administered as a sleep aid (251). A study of Dutch nursing home staff revealed that agitation and aggressive behaviour, (which are typically exhibited by residents with dementia), on the part of the resident were the main reasons to initiate treatment with psychotropic medication and that the staff and family of the residents felt that the benefits outweighed the risks; however, it was reported that in some cases physicians felt pressured by nurses to prescribe these drugs (252). The use of antipsychotics and antianxiety medications to manage behaviours in residents with dementia and their enhancement of hallucinations and delusions in those with dementia likely explains their association with being a faller in this group and not in the comparison group.

Hip fracture is typically a consequence of falls rather than a risk factor for falls; therefore, it is interesting that hip fracture was a significant risk factor for falls in non-ambulatory residents with dementia and no recent falls history at baseline. Among all of the subgroups in LTC, non-

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ambulatory residents in the dementia or comparison groups had the highest proportion of individuals with hip fracture. A hip fracture may be the reason that these residents are non-ambulatory (253,254) and could contribute to unsteady gait--another strong predictor of falls in this group. Overall, it is still not clear why previous hip fracture may increase the odds of being a faller in those without a history of falls.

Use of restraints significantly reduced the odds of being a faller in residents with and without dementia, which confirms the results reported in some other studies (237,239). Restraint use likely reduced the risk for falls because they can limit mobility and forward falling out of chairs. This explanation is in line with the results related to CPS score and ADL Hierarchy Scale score in that limited mobility and function significantly reduce the odds of being a faller.

Falls among LTC residents with dementia were associated with some of the same risk factors as residents in the comparison group, including bladder and bowel continence, antidepressant use, increasing age, and wandering (in ambulatory subgroups). The observation that a common set of risk factors can potentially predict falls in residents with dementia and residents in the comparison group may be related to residents in the comparison group not being very different from residents with dementia in terms of function and cognition since they are still LTC residents that require some level of care and supervision. Though the reason for the commonality among risk factors between these two groups is not entirely clear, the results suggest that a common set of risk factors could be used to predict falls in residents with dementia and residents without neurological conditions.

7.4   Risk Factors for Falls in Not Triggered LTC Residents with PD

Bladder and bowel continence, and wandering (in ambulatory residents) were common risk factors among residents with PD and residents in the comparison group. Importantly, unsteady

gait was not significant in ambulatory residents with PD or in the comparison group. This contradictory finding may be the result of miscoding individuals in these subgroups as ambulatory when in fact the majority of them were non-ambulatory; or it may be that risk factors, such as bladder continence and wandering, increase the odds of being a faller in these subgroups more than unsteady gait. A study of ambulatory outpatients with PD that tested the association between several risk factors and falls reported that the presence of urinary incontinence had an adjusted OR = 5.9; 95 % CI: 1.40,–24.0, whereas Timed Up and Go (the measure of gait function used) only had an adjusted OR = 1.18; 95% CI 1.03-1.63 (255). The association between urinary incontinence and falls in patients with PD may be explained by dysautonomia in those with PD, which is associated with orthostatic hypotension (255). Rushing to the bathroom to avoid incontinent episodes may also explain the link between falls and incontinence in those with PD (83) since this behaviour is not necessarily specific to individuals without neurological conditions.

To the author's knowledge, this is the first study to report wandering as a risk factor for falls in people with PD and people without dementia; however, wandering behaviour is likely due to cognitive impairment. Sleep disorders, such as rapid eye movement sleep behaviour disorder (REMSBD), are common among people with PD (256,257) and may predispose them to nocturnal wandering (256) and falls. Sleep disorders can even precede the diagnosis of PD due to pathological changes, such as the presence of Lewy bodies in the brainstem nuclei—a common feature of PD and REMSBD (256). Incidentally, nocturia is another common problem in people with PD (257); it would be interesting to examine whether most falls in ambulatory LTC residents with PD occur at nighttime as this may explain why bladder continence and wandering are strongly associated with falls in this subgroup.

7.5   The Falls CAP

The results of the descriptive analyses showed that, when stratified by falls CAP category, the proportion of HC clients and LTC residents with neurological conditions that fell in the 90 days and 30 days, respectively, prior to their follow-up assessments, did not differ greatly from the proportion of clients and residents in the comparison group that fell in the same time period, although the proportion of fallers in the PD subgroups was typically higher than the other diagnostic subgroups. The observation that those with PD had the highest proportion of fallers across all of the diagnostic groups and falls CAP categories, regardless of ambulatory status, suggests that PD may be an important risk factor for falls. In addition, PD was an independent and strong predictor of falls in ambulatory HC clients with dementia. "Not Triggered" individuals did not appear to be at a high risk for falls based on the proportion of fallers in these subgroups; however, the results do suggest that once an individual falls, this greatly increases the likelihood that they will continue to be a faller. The uniformity observed across different diagnostic groups, with the exception of PD, conflicts with existing evidence that a higher proportion of people with neurological conditions fall compared to older adults without diagnosed neurological conditions (3,21,36).

There are a few mechanisms to explain why falls may have been censored more in the dementia subgroups than the comparison subgroups, thereby explaining why there were no differences observed in the prevalence of fallers across these groups. Though fall-related injuries were not a focus of the present study, one explanation for the discrepancy between the proportion of fallers reported in this study and previous reports is that individuals with dementia may be more likely to experience an injury due to a fall and as a result they may be transferred to a different care facility, such as a hospital or LTC home. If the person with dementia was transferred and did not

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return by the time of their next MDS assessment in HC or LTC then that person would not have been captured by the descriptive analyses conducted in this study, resulting in what appears to be no difference in the proportion of fallers between neurological and non-neurological subgroups. There is evidence that people with AD are at a higher risk for fractures, especially hip fractures, compared to people without AD (258-261), although there is little evidence to explain why this is the case. One explanation offered by Weller et al. suggests that the association between AD and hip fracture could be explained by low BMI, weight loss, and nutrient deficiencies, as these have been shown to be associated with both hip fracture and AD (262-265). However, it is worth noting that these are also characteristics of non-demented frail older adults (266) and therefore they cannot fully explain the observed association between AD and fractures. Community-dwelling individuals with dementia who fall are also significantly more likely to be transferred to a long-term care facility than those with dementia who do not fall (261), which may explain why HC clients with dementia do not appear to be at a higher risk for falls than clients in the comparison group. Evidence supports that idea that those with dementia may have been more likely to suffer an injury due to a fall, resulting in almost no observable difference in the prevalence of fallers between those with and without neurological conditions in the present study. Similarly, people with dementia are at a higher risk of death than people without it (267). Therefore, if individuals with dementia fell and died prior to their next assessment, their fall(s) would not be captured by the descriptive analyses performed in this study, which could also explain why they do not appear to be at a higher risk for falls than individuals in the comparison subgroups.

An alternate explanation for the lack of elevated risk of falls in those with dementia observed in this study is that those with dementia, even if they do not suffer a fracture or other injury due to

their fall, may be more likely than older adults without dementia to be transferred to a different care facility, such as a nursing home (for HC clients). A fall may indicate to care providers that those with dementia are unable to remain in their current care setting, such as their home. This may be especially true for individuals with dementia because they are typically more functionally impaired than non-demented older adults and therefore may be more likely to be transferred to a different healthcare setting where they can receive a higher level of care and supervision. The present study did not examine individuals that were discharged to a different facility and thus, it cannot be confirmed that those with dementia were more likely to be transferred; however, there is evidence to support this claim. A study of community-dwelling older adults that linked multiple datasets reported that individuals with dementia had significantly more transitions in care per person-year of follow-up, and more mean total transitions, compared to individuals who were never diagnosed with dementia (268). Tracking individuals who were discharged to other care settings will be important in future studies to obtain more accurate statistics regarding the prevalence of fallers in HC and LTC settings.

Fewer non-ambulatory individuals in HC and LTC were fallers compared to their ambulatory counterparts, which is consistent with another study reporting that the rate of injurious falls in non-ambulatory residents is less than half the rate of ambulatory residents; however, the rate of all falls is not reported in that study (227). This result is expected given that, in LTC, a significantly higher proportion of non-ambulatory residents in each diagnostic group were restrained at baseline, compared to their ambulatory counterparts and restraint use significantly reduced the risk of falls. A study that observed falls in LTC homes via video cameras reported that walking forward was the most common activity at the time of a fall and that sitting or wheeling in a wheelchair was associated with the fewest falls (269). However, 21% of all falls in

the same study occurred while the resident was using a mobility aid and these were divided evenly among residents using wheelchairs and residents using walkers (269); suggesting that being in a wheelchair does not mean that the resident will not fall.

7.6   Strengths

There are numerous strengths and novelties of the present study that are worth noting. This study used a secondary data analysis approach to determine risk factors for falls, and to report the prevalence of fallers and risk factors. One advantage of secondary data analysis, aside from being relatively easy and inexpensive, is that it minimizes many selection and measurement biases, since the data was collected for purposes other than what it is being analyzed for. The sample sizes in each diagnostic group were large compared to previous studies on risk factors for falls that did not use the MDS assessments (89) because the databases used contained assessments spanning across many years. The large sample sizes suggest this study had higher statistical power than previous studies; however, it must be acknowledged that a formal power calculation was not performed for this study.

By focusing on the "Not Triggered" individuals, this study addressed risk factors for falls in those without a recent history of falls, in contrast to previous studies that tend to analyze individuals with and without prior falls together (90). The lack of stratification by other studies likely explains the higher ORs reported, compared to those seen in this study, since they did not all adjust for a history of falls (see Table 1). Some previous studies have excluded individuals based on severe cognitive impairment (18) or ambulatory status (17). In contrast, this study addressed these effect modifying factors by stratification, which improves the generalizability of the results and provides an indication as to whether these factors can alter the risk for falls or the risk factor profiles that are observed. For example, it was noted that in LTC, the presence of

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bladder incontinence in ambulatory residents increased the odds of being a faller while it decreased the odds of being a faller in non-ambulatory residents—a finding that has not been previously reported. Including multiple diagnostic groups within the same study also allowed for important comparisons and the identification of common risk factors that is not evident in previous work.

This study is the first to report on the prevalence of fallers stratified by falls CAP category, diagnosis, and ambulatory status, which provides a meaningful description of the problem of falls in HC and LTC, and may help to inform priorities in terms of resource allocation for falls prevention programs. Another advantage of this study, compared to others that used the MDS assessments, is that some of those previous studies do not report whether risk factors were obtained from the same assessments as the falls outcome or from a previous assessment (27,28,34,63). This study established temporal order and thus, the conclusions are based on the fact that the exposure (in this case the risk factors) preceded the outcome (falls).

7.7   Limitations

There are several limitations of this study that must be acknowledged. Though these Resident Assessment Instrument tools are standardized, there may have been cases where items were miscoded or not coded at all. For example, if a resident is found on the floor, staff may have assumed that they suffered a fall when they did not, which would result in miscoding that person as a faller. The user's manual for these assessments is also updated periodically and the definitions of certain items that were used as risk factors in this study may have changed over time. For example, level of visual impairment that was assessed for someone in 2002 may not be the same as that for a person assessed in 2010 if the number of categories of visual impairment or the definitions for the existing categories changed, however, they may be coded as being the

same in the database. A study of LTC residents also reported that MDS assessments completed

for residents with cognitive impairment were significantly less reliable than assessments

completed for cognitively intact residents, suggesting that the results of the dementia group may

be less reliable than those of the comparison group (270). Some ambulatory LTC residents in the

dementia group may have been misdiagnosed since almost 5% of them had a CPS score of zero.

It is likely that part of the ambiguity regarding diagnosis of these conditions is that there is still

no definitive, consistent method to diagnose AD and other dementias; however, there are

published consensus guidelines for diagnosing AD (271). It is important to consider that

cognitive function is a continuum and that cognition is made up of many different components.

Recent studies have grouped individuals with mild to moderate cognitive impairment with

individuals with dementia, arguing that the heterogeneity reflects what is actually seen in the

external population (117,272). Similarly, the RAI-HC item for PD refers to "Parkinsonism"

which is a broader term that encompasses Parkinson's disease and other secondary forms of

Parkinsonism that manifest as the classic symptoms: tremors, rigidity, bradykinesia, and gait

disturbances (273). This definition suggests that not all HC clients in this study classified as

having PD necessarily had diagnosed Parkinson's disease, which likely explains the large

sample size. The use of a broader term also implies that the results of this study are not

necessarily specific to HC clients with PD but rather to HC clients presenting with

Parkinsonism, some of whom have diagnosed PD. Primary causes of Parkinsonism that is not

PD include: dementia, cerebrovascular disease, and use of neuroleptic or antidopaminergic drugs

(274).

Another limitation of both the MDS 2.0 and RAI-HC is the timing between assessments. As

stated, the average length of time between assessments for HC clients was 190 days and since

the falls item only asks about falls in the previous 90 days, some falls may not have been accounted for. In addition, the use of only the last two assessments implies that the individuals classified as "Not Triggered" in this study had no recent history of falls but may have had a history of falls prior to the baseline assessment that was chosen, especially in LTC where some "Not Triggered" residents had fallen in the last 31-180 days, meaning that these results are only generalizable to those with no recent falls history. A related issue is that falls may have been underreported in HC clients, especially those with cognitive impairment, because older adults may forget that they have fallen (275), and HC clients may not receive care and supervision 24 hours a day as LTC residents do. It is estimated that 13-32% of falls are not reported among healthy older adults (275). Falls are also likely underreported in HC because some older adults fear institutionalization and loss of independence if they report falls. Many items on both assessments only capture the status of individuals in the 3-7 days prior to the assessment. This gap may not adequately capture their functional status for the entire period of time between assessments. Similarly, the MDS assessments do not capture the dose or duration of psychotropic medications and this may have important implications for risk assessment. There is evidence that the risk of falls is highest when use of benzodiazepines are initiated and that this risk lowers as time goes on (158); suggesting that psychotropic medication use may not substantially increase the odds of being a faller in individuals who have been taking them for a long time. There is also evidence that those taking higher doses of these medications are at a higher risk for falls than individuals taking lower doses (158), which implies that dose may be another important consideration when assessing risk. Carrying items from full assessments forward onto quarterly assessments in the LTC sample may also not have accurately captured the functional status of residents at the time of their fall.

One of the MDS 2.0 items for falls overlaps with the assessment interval of the previous assessment because it asks about falls in the last 30 days and falls in the last 31-180 days. Therefore, it was decided that falls in the last 30 days would be the outcome for the bivariate and multivariable analyses; however, this presents the same problem as the RAI-HC assessments in that there is a period of time that is not captured since the average assessment interval was 80 days. Furthermore, the MDS 2.0 does not code for the number of falls, meaning that a correct falls CAP score could not be calculated for each resident and instead a similar method based on when the resident fell, as described in the Methods section, was used to determine their falls CAP status. Lastly, this study did not capture those individuals who fell but then were transferred to a different healthcare sector or died which may also contribute to an underestimation of falls.

There are also limitations in the study design that negatively affect the validity of this study. Individuals who only had a single assessment in their most recent episode were excluded, which improved the internal validity of this study but limited the external validity. The major diagnoses used were based on each person's most recent assessment. The most recent assessment was used in order to maintain consistency across all of the analyses since some conditions, such as amyotrophic lateral sclerosis and muscular dystrophy, are not specifically listed in the disease diagnoses section and thus had to be ascertained based on free-text writing and ICD codes in the "other current or more detailed diagnoses" section, which was only completed for the most recent assessment in the database. However, these assessments span across several years in both care settings and when the most recent assessment was completed, individuals were at different lengths of stay within the system. Therefore, it is not known exactly who these results can be applied to in terms of informing clinical practice and given that some individuals may have been

in HC or LTC for a long time, they may have already received some fall prevention

interventions, which could have modified their risk of falls compared to others in the sample.

Certain risk factors were excluded from the analysis in this study, such as obesity and foot

problems, based on inadequate evidence from the literature to justify their inclusion but it may

be important to include these risk factors in future analyses as some studies have observed an

association between these factors and falls (27,276). Similarly, among subgroups with PD in

both care settings, very few risk factors were significantly associated with falls at the bivariate

level and this may be due to the fact that previous studies examining risk factors for falls have

used several PD-specific risk factors that the MDS assessments do not capture. Some examples

of PD-specific risk factors include disease severity as measured by Hoehn and Yahr staging (36),

scores on the Unified Parkinson's Disease Rating Scale (UPDRS) (216), and the Parkinson's

Disease Questionnaire (PDQ-39) (214). Another important consideration with respect to falls in

people with PD is that many of those on long-term levo-dopa therapy have "on" and "off"

periods where the "on" periods are characterized by mobility accompanied by dyskinesia, and

"off" periods are characterized by disability accompanied by akinesia (277). Some studies

account for this fluctuation in status by including the dose of levo-dopa in multivariable analyses

(212), or by only collecting data on risk factors during the "off" periods (210). This study did not

attempt to use levo-dopa dosage as a risk factor and was unable to capture whether individuals

with PD were in an "on" or "off" period at the time of their assessment; however, these may be

important measures to consider since being in a certain phase may be an important determinant

of a fall event.

Stratification by ambulatory status had its limitations as well since use of an assistive device

could not be used as a risk factor for falls and the ambulatory status that was assigned, though

based on logic and a consistent method, may not have reflected an individual's true ambulatory status at the time that they fell. In addition, stratification of the sample by diagnostic group and then further stratification by ambulatory status can facilitate decision-making around whether separate risk assessments need to be done for different diagnostic groups, but more work is needed to directly inform more general guidelines regarding risk factors for falls in the HC and LTC populations. Over-stratification also limited the GEE analysis in LTC, which was originally planned to be clustered by facility for LTC residents but was altered to clustering by LHIN because some clusters only contained a single observation, which did not allow the model to correctly iterate. While choosing LHINs as a cluster may have accounted for some of the correlation among the observations because they determine health service priorities for LTC homes in Ontario, clustering at the facility level would better account for these correlations when predicting falls, especially since LTC homes in Ontario are provided with a general framework for developing fall prevention strategies but are encouraged to tailor it to their individual homes (20). Facility level would likely provide a better basis for clustering of observations because residents in the same facility receive the same level of care, from the same staff, and live in the same physical environment. Conversely, in an attempt to simplify the translation of these findings into clinical practice, interaction terms were not tested in the multivariable analysis. Not testing interactions may be a limitation as well since interactions among certain risk factors may be important for predicting falls in these populations. Though it does not account for clustering of observations as a GEE does, the use of a logistic regression tree analysis, such as the one used by Yamashita et al., may be useful in future studies because the software used automatically determines interactions among predictor variables and attempts to identify clusters of characteristics that predict falls (278).

The use of bivariate analysis prior to the GEE analysis was informed by what was previously done according to the literature. However, the internal validity of this study may have been compromised by the use of this approach because the bivariate analyses assumed the observations were independent but the GEE analysis assumed that the observations were correlated to a certain degree. Finally, missing data was not accounted for by some form of imputation in this study because the number of missing observations in each case was less than 1% of the sample but it must be acknowledged that this missing data may have biased the results. For example, 273 observations for the Parkinson's variable were missing in LTC and 155 observations were missing for the primary mode of locomotion variable in LTC.

7.8 Implications and Future Directions

The first major implication of this study is that a universal approach to risk assessment for HC and LTC populations with no recent falls history may effectively identify those at high risk for future falls because, for the most part, the risk factors for falls in did not differ substantially between those with and without neurological conditions. However, given the limitations of this study, it is necessary to conduct a prospective study that captures all fallers to see if the major risk factors identified in this study are able to predict falls in all "Not Triggered" individuals in HC and LTC in Ontario to adequately inform risk assessment practices for these settings. Selecting a cohort that is newly admitted to each care setting may help to reduce the potential effects of falls prevention interventions and confirm that individuals do not have a history of falls. It may be relevant to define those with neurological conditions based on published diagnostic criteria to compare this study to others in this area of research. However, if the goal is to use the MDS assessments to identify those at high risk for falls in people receiving HC services and living in LTC, it may not be necessary to define these conditions based on accepted

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criteria because the external population is defined using the MDS criteria in the manuals as well. Similarly, the gaps in time between assessments are an inherent feature of the MDS assessments and an attempt to capture all falls that occur during the time that is not captured by the assessments is only relevant if the results are being compared to other studies that did so. It would also be relevant to use the LTC home as the cluster if a GEE analysis was used in a future study since this may better account for clustering of observations.

The second major finding of the current work is that a history of falls remains a strong indicator of future falls in older adults and therefore individuals with a history of falls require intervention to prevent future falls. The results of this study suggest that those in the "Not Triggered" group have the lowest prevalence of fallers at follow-up. However, it is clear, based on the results of the multivariable analyses in the "Not Triggered" groups, that there are other important factors to consider besides a history of falls and that the approach to risk assessment may need to be modified accordingly. Preventing the first fall by identifying those at high risk and initiating intervention seems necessary to prevent the vicious cycle of falls leading to more falls. Given the possible consequences of falls for the individual, it is clear that preventing even a single fall could prevent declines in quality of life that can be associated with falls for these individuals; however, it is not known whether falls prevention interventions are more cost effective in those with no falls history versus those with a falls history. A study of the long-term effectiveness of preventing falls in those in the "Not Triggered" group vs. the "High Risk" group, in terms of cost and efficacy of the intervention, may help to inform future priorities with respect to preventing falls at the population level.

In theory, if the risk factors identified in this study do prospectively predict falls in "Not Triggered" individuals in HC and LTC then the prevalence of these risk factors, as reported in

the baseline characteristics in this study, could be used to inform falls prevention practices.

Highly prevalent risk factors, such as unsteady gait, incontinence, and medication use that

predict falls may be most worth targeting because they will affect the greatest number of people.

In reality, there are already many studies that have identified effective interventions to prevent

falls in both community-dwelling and institutionalized older adults (66,279-285). Common

themes identified across these interventions are that they are multifactorial (or multicomponent,

in the case of exercise programs); they include balance exercises, strength training exercises

(particularly lower limb strengthening), and an interdisciplinary approach that incorporates

multiple health care providers. The issue is that these interventions may be more challenging to

implement and it is not known whether they are as effective in those with dementia or PD. So

even though diagnosis of a neurological condition, such as dementia or PD, does not appear to

affect the types of risk factors that predict falls in these groups, it is still important to consider

the functional limitations of people in these diagnostic groups, and the fact that their underlying

disease pathologies cannot be reversed, when trying to prevent them from falling. The evidence

regarding fall prevention programs in both community-dwelling and institutionalized people

with dementia is inconclusive (286,287). People with dementia may require more

encouragement and individual supervision to adhere to an exercise program for fall prevention

(288,289), which ultimately may lead to an increased burden on informal caregivers and

increased costs associated with preventing falls in this population. Very few studies have been

conducted on falls prevention interventions for people with PD and among those that have, none

have shown statistically significant reductions in falls following the intervention

(223,224,290,291). However, there is moderate evidence that physical activity and exercise can

improve postural instability and balance task performance in those with mild to moderate PD

(292); suggesting that if these are risk factors for falls then falls could theoretically be prevented by improvements in these domains. Further investigation is needed to determine what interventions can effectively prevent falls in people with dementia and/or PD.

There may also be other important barriers to effective falls prevention practices at the level of care providers. A 2008 survey by Accreditation Canada of 238 organizations found that only 42% of them were complying with falls prevention required organization practices, suggesting that lack of compliance by care providers is a barrier to implementing effective falls prevention programs (11). Related barriers to knowledge translation, on the part of care providers, cited in the literature include: a lack of time, lack of knowledge, and inadequate resources (293). Though the translation of evidence into clinical practice goes beyond the scope of the present study, it should be noted that the ability of evidence to positively affect falls prevention is highly dependent on its use in clinical practice. Therefore, it may be important to identify and resolve barriers to knowledge translation in order to reduce falls in HC and LTC settings.

8   CONCLUSION

The results of this study suggest that a common set of risk factors that includes unsteady gait, wandering (for ambulatory individuals), mild cognitive impairment, older age, and male gender, can be used to identify those with no recent falls history who are at high risk for falls in HC, regardless of a diagnosis of dementia and/or PD. The addition of bladder incontinence (for ambulatory residents), ≥ 9 medications, and psychotropic medication use, mainly antipsychotics and antidepressants, to this list may further help to predict falls in LTC. In addition, a history of falls that is stratified by falls CAP status appears to be a strong indicator of future falls. A future study that captures all fallers and selects a cohort of individuals that is newly admitted to each care setting is needed to confirm these findings.

REFERENCES

(1) SmartRisk. The Economic Burden of Injury in Canada. 2009.

(2) Luukinen H, Koski K, Laippala P, Kivela S-. Risk factors for recurrent falls in the elderly in long-term institutional care. Public Health 1995;109(1):57-65.

(3) Tinetti ME, Speechley M, Ginter SF. Risk factors for falls among elderly persons living in the community. N Engl J Med 1988;319(26):1701-1707.

(4) Berg WP, Alessio HM, Mills EM, Tong C. Circumstances and consequences of falls in independent community-dwelling older adults. Age Ageing 1997;26(4):261-268.

(5) Grimm D, Mion LC. Falls resulting in traumatic injury among older adults: Nursing care issues. AACN Advanced Critical Care 2011;22(2):161-168.

(6) Sattin RW, Lambert Huber DA, DeVito CA, Rodriguez JG, Ros A, Bacchelli S, et al. The incidence of fall injury events among the elderly in a defined population. Am J Epidemiol 1990;131(6):1028-1037.

(7) Luukinen H, Koski K, Honkanen R, Kivela S-. Incidence of injury-causing falls among older adults by place of residence: A population-based study. J Am Geriatr Soc 1995;43(8):871-876.

(8) Arfken CL, Lach HW, Birge SJ, Miller JP. The prevalence and correlates of fear of falling in elderly persons living in the community. Am J Public Health 1994;84(4):565-570.

(9) Tinetti ME, Williams CS. Falls, injuries due to falls, and the risk of admission to a nursing home. N Engl J Med 1997;337(18):1279-1284.

(10) Spoelstra SL, Given B, You M, Given CW. The contribution falls have to increasing risk of nursing home placement in community-dwelling older adults. Clin Nurs Res 2012;21(1):24-42.

(11) Scott V, Wagar B, Sum A, Metcalfe S, Wagar L. A public health approach to fall prevention among older persons in Canada. Clin Geriatr Med 2010;26(4):705-718.

(12) Riley R. Accidental falls and injuries among seniors. Health reports / Statistics Canada, Canadian Centre for Health Information 1992;4(4):341-354.

(13) Scott V, Pearce M, Pengelly C. Technical Report: Deaths due to falls among Canadians age 65 and over. 2005.

(14) Stevens JA, Corso PS, Finkelstein EA, Miller TR. The costs of fatal and non-fatal falls among older adults. Injury Prevention 2006;12(5):290-295.

(15) Canadian Institute for Health Information. Health Care in Canada, 2011: A Focus on Seniors and Aging. 2011.

(16) Campbell AJ, Borrie MJ, Spears GF, Jackson SL, Brown JS, Fitzgerald JL. Circumstances and consequences of falls experienced by a community population 70 years and over during a prospective study. Age Ageing 1990;19(2):136-141.

(17) Thapa PB, Gideon P, Fought RL, Ray WA. Psychotropic drugs and risk of recurrent falls in ambulatory nursing home residents. Am J Epidemiol 1995;142(2):202-211.

(18) Robbins AS, Rubenstein LZ, Josephson KR, Schulman BL, Osterweil D, Fine G. Predictors of falls among elderly people. Results of two population-based studies. Arch Intern Med 1989;149(7):1628-1633.

(19) LHIN Collaborative. Integrated Falls Prevention Framework & Toolkit 2011.

(20) Virani T, Schouten J, McConnell H, Lappan-Gracan S, Santos J, Russell B, et al. Prevention of Falls and Fall Injuries in the Older Adult. 2002.

(21) Kenny RAM, Rubenstein LZ, Tinetti ME, Brewer K, Cameron KA, Capezuti EA, et al. AGS/BGS Clinical Practice Guideline: Prevention of Falls in Older Persons. 2010.

(22) Fleming KC, Evans JM, Weber DC, Chutka DS. Practical Functional Assessment of Elderly Persons: A Primary-Care Approach. Mayo Clin Proc 1995 9;70(9):890-910.

(23) Perell KL, Nelson A, Goldman RL, Luter SL, Prieto-Lewis N, Rubenstein LZ. Fall risk assessment measures: An analytic review. J Gerontol - A Biol 2001;56(12):M761-M766.

(24) Speechley M. Knowledge translation for falls prevention: The view from Canada. J Saf Res 2011;42(6):453-459.

(25) Canadian Institute for Health Information. The Burden of Neurological Diseases, Disorders, and Injuries in Canada. 2007.

(26) Gordon A, Morris R. Falls and neurological disorders. CME Journal Geriatric Medicine 2008;10(3):107-113.

(27) French DD, Werner DC, Campbell RR, Powell-Cope GM, Nelson AL, Rubenstein LZ, et al. A Multivariate Fall Risk Assessment Model for VHA Nursing Homes Using the Minimum Data Set. J Am Med Dir Assoc 2007;8(2):115-122.

(28) Van Doorn C, Gruber-Baldini AL, Zimmerman S, Hebel JR, Port CL, Baumgarten M, et al. Dementia as a risk factor for falls and fall injuries among nursing home residents. J Am Geriatr Soc 2003;51(9):1213-1218.

(29) Myers AH, Baker SP, Van Natta ML, Abbey H, Robinson EG. Risk factors associated with falls and injuries among elderly institutionalized persons. Am J Epidemiol 1991;133(11):1179-1190.

(30) Buchner DM, Larson EB. Falls and fractures in patients with Alzheimer-type dementia. J Am Med Assoc 1987;257(11):1492-1495.

(31) Nevitt MC, Cummings SR, Kidd S, Black D. Risk factors for recurrent nonsyncopal falls. A prospective study. J Am Med Assoc 1989;261(18):2663-2668.

(32) Deandrea S, Lucenteforte E, Bravi F, Foschi R, La Vecchia C, Negri E. Risk factors for falls in community-dwelling older people: A systematic review and meta-analysis. Epidemiology 2010;21(5):658-668.

(33) Kelly KD, Pickett W, Yiannakoulas N, Rowe BH, Schopflocher DP, Svenson L, et al. Medication use and falls in community-dwelling older persons. Age Ageing 2003;32(5):503-509.

(34) Fletcher PC, Hirdes JP. Risk factors for falling among community-based seniors using home care services. J Gerontol - A Biol 2002;57(8):M504-M510.

(35) Friedman SM, Munoz B, West SK, Rubin GS, Fried LP. Falls and fear of falling: Which comes first? A longitudinal prediction model suggests strategies for primary and secondary prevention. J Am Geriatr Soc 2002;50(8):1329-1335.

(36) Wood BH, Bilclough JA, Bowron A, Walker RW. Incidence and prediction of falls in Parkinson's disease: A prospective multidisciplinary study. Journal of Neurology Neurosurgery and Psychiatry 2002;72(6):721-725.

(37) Ballard CG, Shaw F, Lowery K, McKeith I, Kenny R. The prevalence, assessment and associations of falls in dementia with Lewy bodies and Alzheimer's disease. Dement Geriatr Cogn Disord 1999;10(2):97-103.

(38) Fried LP. Epidemiology of aging. Epidemiol Rev 2000;22(1):95-106.

(39) Berg K, Lipsitz LA, Jonsson PV, Kelley-Gagnon MM, Goldman BD, Murphy K, et al. Falls Clinical Assessment Protocol. interRAI Clinical Assessment Protocols (CAPs) Ottawa: Canadian Institute for Health Information; 2008. p. 93.

(40) The prevention of falls in later life. A report of the Kellogg International Work Group on the Prevention of Falls by the Elderly. Dan Med Bull 1987;34 Suppl 4:1-24.

(41) Inouye SK, Studenski S, Tinetti ME, Kuchel GA. Geriatric syndromes: Clinical, research, and policy implications of a core geriatric concept. J Am Geriatr Soc 2007;55(5):780-791.

(42) Ontario Regulation. Long-Term Care Homes Act, 2007. The Ontario Gazette 2007:49-49.

(43) Health Quality Ontario. Long-Term Care Public Reporting. 2011; Available at: http://www.hqontario.ca/en/reporting/ltc/. Accessed June 29, 2012.

(44) Hawes C, Morris JN, Phillips CD, Mor V, Fries BE, Nonemaker S. Reliability estimates for the minimum data set for nursing home resident assessment and care screening (MDS). Gerontologist 1995;35(2):172-178.

(45) Fries BE, Schneider DP, Foley WJ, Gavazzi M, Burke R, Cornelius E. Refining a case-mix measure for nursing homes: Resource Utilization Groups (RUG-III). Med Care 1994;32(7):668-685.

(46) Morris JN, Nonemaker S, Murphy K, Hawes C, Fries BE, Mor V, et al. A commitment to change: Revision of HCFA's RAI. J Am Geriatr Soc 1997;45(8):1011-1016.

(47) Sgadari A, Morris JN, Fries BE, Ljunggren G, Jónsson PV, Dupaquier J-, et al. Efforts to establish the reliability of the Resident Assessment Instrument. Age Ageing 1997;26(Suppl. 2):27-30.

(48) Resnick NM, Brandeis GH, Baumann MM, Morris JN. Evaluating a national assessment strategy for urinary incontinence in nursing home residents: Reliability of the minimum data set and validity of the resident assessment protocol. Neurourol Urodyn 1996;15(6):583-598.

(49) Hartmaier SL, Sloane PD, Guess HA, Koch GG, Mitchell CM, Phillips CD. Validation of the minimum data set cognitive performance scale: Agreement with the mini-mental state examination. J Gerontol - A Biol 1995;50(2):M128-M133.

(50) Gambassi G, Landi F, Peng L, Brostrup-Jensen C, Calore K, Hiris J, et al. Validity of Diagnostic and Drug Data in Standardized Nursing Home Resident Assessments: Potential for Geriatric Pharmacoepidemiology. Med Care 1998;36(2):167-179.

(51) Blaum CS, O'Neill EF, Clements KM, Fries BE, Fiatarone MA. Validity of the Minimum Data Set for assessing nutritional status in nursing home residents. Am J Clin Nutr 1997;66(4):787-794.

(52) Hirdes JP, Ljunggren G, Morris JN, Frijters DH, Finne Soveri H, Gray L, et al. Reliability of the interRAI suite of assessment instruments: A 12-country study of an integrated health information system. BMC Health Services Research 2008;8.

(53) Morris JN, Fries BE, Steel K, Ikegami N, Bernabei R, Carpenter GI, et al. Comprehensive clinical assessment in community setting: Applicability of the MDS-HC. J Am Geriatr Soc 1997;45(8):1017-1024.

(54) Ontario Ministry of Health and Long-Term Care. RAI MDS 2.0 LTC Homes-Practice Requirements. Available at: http://www.health.gov.on.ca/en/public/programs/ltc/docs/rai_mds_practice_requirements.pdf. Accessed 06/20, 2012.

(55) Health Quality Ontario. Guide to Home Care Public Reporting. 2011; Available at: http://www.hqontario.ca/en/reporting/hc/GuideHC.html. Accessed 06/13, 2012.

(56) Tinetti ME, Franklin Williams T, Mayewski R. Fall risk index for elderly patients based on number of chronic disabilities. Am J Med 1986;80(3):429-434.

(57) Granek E, Baker SP, Abbey H. Medications and diagnoses in relation to falls in a long-term care facility. J Am Geriatr Soc 1987;35(6):503-511.

(58) Kiely DK, Kiel DP, Burrows AB, Lipsitz LA. Identifying nursing home residents at risk for falling. J Am Geriatr Soc 1998;46(5):551-555.

(59) Nazir A, Mueller C, Perkins A, Arling G. Falls and Nursing Home Residents With Cognitive Impairment: New Insights into Quality Measures and Interventions. J Am Med Dir Assoc 2012;13(9):819.e1-819.e6.

(60) Chen Y-, Hwang S-, Chen L-, Chen D-, Lan C-. Risk factors for falls among elderly men in a veterans home. Journal of the Chinese Medical Association 2008;71(4):180-185.

(61) Leland NE, Gozalo P, Teno J, Mor V. Falls in newly admitted nursing home residents: A national study. J Am Geriatr Soc 2012;60(5):939-945.

(62) Avidan AY, Fries BE, James ML, Szafara KL, Wright GT, Chervin RD. Insomnia and hypnotic use, recorded in the minimum data set, as predictors of falls and hip fractures in Michigan nursing homes. J Am Geriatr Soc 2005;53(6):955-962.

(63) Cesari M, Landi F, Torre S, Onder G, Lattanzio F, Bernabei R. Prevalence and risk factors for falls in an older community-dwelling population. J Gerontol - A Biol 2002;57(11):M722-M726.

(64) Krueger PD, Brazil K, Lohfeld LH. Risk factors for falls and injuries in a long-term care facility in Ontario. Canadian Journal of Public Health 2001;92(2):117-120.

(65) Kallin K, Lundin-Olsson L, Jensen J, Nyberg L, Gustafson Y. Predisposing and precipitating factors for falls among older people in residential care. Public Health 2002;116(5):263-271.

(66) Sherrington C, Tiedemann A, Fairhall N, Close JC, Lord SR. Exercise to prevent falls in older adults: an updated meta-analysis and best practice recommendations. New South Wales public health bulletin 2011;22(3-4):78-83.

(67) Chang JT, Morton SC, Rubenstein LZ, Mojica WA, Maglione M, Suttorp MJ, et al. Interventions for the prevention of falls in older adults: Systematic review and meta-analysis of randomised clinical trials. Br Med J 2004;328(7441):680-683.

(68) Markle-Reid M, Browne G, Gafni A, Roberts J, Weir R, Thabane L, et al. A cross-sectional study of the prevalence, correlates, and costs of falls in older home care clients 'at risk' for falling. Canadian Journal on Aging 2010;29(1):119-137.

(69) Canadian Institute for Health Information. HCRS 2010-2011 Quick Stats. 2011; Available at: http://www.cihi.ca/CIHI-ext-portal/internet/EN/TabbedContent/types+of+care/community+care/home+care/cihi021338. Accessed May 14, 2012.

(70) Lord SR, Sherrington C, Menz HB. Falls in Older People: Risk Factors and Strategies for Prevention. 1st ed. Cambridge, United Kingdom: Cambridge University Press; 2000.

(71) Rubenstein LZ, Josephson KR, Robbins AS. Falls in the nursing home. Ann Intern Med 1994;121(6):442-451.

(72) Ray WA, Taylor JA, Meador KG, Thapa PB, Brown AK, Kajihara HK, et al. A randomized trial of a consultation service to reduce falls in nursing homes. J Am Med Assoc 1997;278(7):557-562.

(73) Aronow WS, Ahn C. Association of postprandial hypotension with incidence of falls, syncope, coronary events, stroke, and total mortality at 29-month follow-up in 499 older nursing home residents. J Am Geriatr Soc 1997;45(9):1051-1053.

(74) Martin FC. Neurological aspects of falls in older adults. Clinical Medicine, Journal of the Royal College of Physicians of London 2011;11(2):160-161.

(75) Byers AL, Sheeran T, Mlodzianowski AE, Meyers BS, Nassisi P, Bruce ML. Depression and risk for adverse falls in older home health care patients. Research in gerontological nursing 2008;1(4):245-251.

(76) Lewis CL, Moutoux M, Slaughter M, Bailey SP. Characteristics of Individuals Who Fell while Receiving Home Health Services. Phys Ther 2004;84(1):23-32.

(77) Vellas BJ, Wayne SJ, Garry PJ, Baumgartner RN. A two-year longitudinal study of falls in 482 community-dwelling elderly adults. J Gerontol - A Biol 1998;53(4):M264-M274.

(78) Lord SR, Ward JA, Williams P, Anstey KJ. Physiological factors associated with falls in older community-dwelling women. J Am Geriatr Soc 1994;42(10):1110-1117.

(79) Lawlor DA, Patel R, Ebrahim S. Association between falls in elderly women and chronic diseases and drug use: Cross sectional study. Br Med J 2003;327(7417):712-715.

(80) Mahoney J, Sager M, Dunham NC, Johnson J. Risk of falls after hospital discharge. J Am Geriatr Soc 1994;42(3):269-274.

(81) Foley AL, Loharuka S, Barrett JA, Mathews R, Williams K, Mcgrother CW, et al. Association between the geriatric giants of urinary incontinence and falls in older people using data from the leicestershire mrc incontinence study. Age Ageing 2012;41(1):35-40.

(82) Chiarelli PE, Mackenzie LA, Osmotherly PG. Urinary incontinence is associated with an increase in falls: a systematic review. Australian Journal of Physiotherapy 2009;55(2):89-95.

(83) Brown JS, Vittinghoff E, Wyman JF, Stone KL, Nevitt MC, Ensrud KE, et al. Urinary incontinence: Does it increase risk for falls and fractures? J Am Geriatr Soc 2000;48(7):721-725.

(84) Hasegawa J, Kuzuya M, Iguchi A. Urinary incontinence and behavioral symptoms are independent risk factors for recurrent and injurious falls, respectively, among residents in long-term care facilities. Arch Gerontol Geriatr 2010;50(1):77-81.

(85) Langlois JA, Smith GS, Nelson DE, Sattin RW, Stevens JA, DeVito CA. Dependence in activities of daily living as a risk factor for fall injury events among older people living in the community. J Am Geriatr Soc 1995;43(3):275-278.

(86) Neutel CI, Perry S, Maxwell C. Medication use and risk of falls. Pharmacoepidemiol Drug Saf 2002;11(2):97-104.

(87) Leipzig RM, Cumming RG, Tinetti ME. Drugs and falls in older people: A systematic review and meta-analysis: I. Psychotropic drugs. J Am Geriatr Soc 1999;47(1):30-39.

(88) Hartikainen S, Lönnroos E, Louhivuori K. Medication as a risk factor for falls: Critical systematic review. J Gerontol - A Biol 2007;62(10):1172-1181.

(89) Deandrea S, Bravi F, Turati F, Lucenteforte E, La Vecchia C, Negri E. Risk factors for falls in older people in nursing homes and hospitals. A systematic review and meta-analysis. Arch Gerontol Geriatr 2013;56(3):407-415.

(90) Lundebjerg N. Guideline for the prevention of falls in older persons. J Am Geriatr Soc 2001;49(5):664-672.

(91) Campbell AJ, Borrie MJ, Spears GF. Risk factors for falls in a community-based prospective study of people of 70 years and older. J Gerontol 1989;44(4):M112-M117.

(92) Davis JW, Ross PD, Nevitt MC, Wasnich RD. Risk factors for falls and for serious injuries on falling among older Japanese women in Hawaii. J Am Geriatr Soc 1999;47(7):792-798.

(93) Lipsitz LA, Johnsson PV, Kelley MM, Koestner JS. Causes and correlates of recurrent falls in ambulatory frail elderly. J Gerontol 1991;46(4):M114-M122.

(94) Oliver D, Britton M, Seed P, Martin FC, Hopper AH. Development and evaluation of evidence based risk assessment tool (STRATIFY) to predict which elderly inpatients will fall: Case-control and cohort studies. Br Med J 1997;315(7115):1049-1053.

(95) Ontario Local Health Integration Network. Aging at Home Strategy. 2012; Available at: http://www.lhins.on.ca/page.aspx?id=880. Accessed 04/27, 2012.

(96) Hollander M, Chappell N. Synthesis Report: Final Evaluation on the National Evaluation of the Cost-Effectiveness of Home Care. 2002.

(97) Meijers JMM, Halfens RJG, Neyensj.C.L., Luiking YC, Verlaan G, Schols JMGA. Predicting falls in elderly receiving home care: The role of malnutrition and impaired mobility. Journal of Nutrition, Health and Aging 2012;16(7):654-658.

(98) Salzman B. Gait and balance disorders in older adults. Am Fam Physician 2010;82(1):61-68.

(99) Bateni H, Maki BE. Assistive devices for balance and mobility: Benefits, demands, and adverse consequences. Arch Phys Med Rehabil 2005;86(1):134-145.

(100) Grundstrom AC, Guse CE, Layde PM. Risk factors for falls and fall-related injuries in adults 85 years of age and older. Arch Gerontol Geriatr 2012;54(3):421-428.

(101) Rubenstein LZ. Falls in older people: Epidemiology, risk factors and strategies for prevention. Age Ageing 2006;35(Suppl.2):ii37-ii41.

(102) Ontario Ministry of Health and Long-Term Care. Long-Term Care Home Design Manual. 2009.

(103) Olsson Möller U, Midlöv P, Kristensson J, Ekdahl C, Berglund J, Jakobsson U. Prevalence and predictors of falls and dizziness in people younger and older than 80 years of age-A longitudinal cohort study. Arch Gerontol Geriatr 2013;56(1):160-168.

(104) Davis MA, Neuhaus JM, Moritz DJ, Lein D, Barclay JD, Murphy SP. Health behaviors and survival among middle-aged and older men and women in the NHANES I epidemiologic Follow-up Study. Prev Med 1994;23(3):369-376.

(105) Oman D, Reed D, Ferrara A. Do elderly women have more physical disability than men do? Am J Epidemiol 1999;150(8):834-842.

(106) Campbell AJ, Spears GF, Borrie MJ. Examination by logistic regression modelling of the variables which increase the relative risk of elderly women falling compared to elderly men. J Clin Epidemiol 1990;43(12):1415-1420.

(107) El Haber N, Erbas B, Hill KD, Wark JD. Relationship between age and measures of balance, strength and gait: Linear and non-linear analyses. Clin Sci 2008;114(11-12):719-727.

(108) Owsley C. Aging and vision. Vision Res 2011;51(13):1610-1622.

(109) Harwood RH. Visual problems and falls. Age Ageing 2001;30(Suppl. 4):13-18.

(110) Melton F, Horvat M, Ray C. Intrinsic and functional components of falls risk in older adults with visual impairments. Insight: Research and Practice in Visual Impairment and Blindness 2011;4(2):66-73.

(111) Lord SR. Visual risk factors for falls in older people. Age Ageing 2006;35(Suppl.2):ii42-ii45.

(112) Lord SR, Menz HB. Visual contributions to postural stability in older adults. Gerontology 2000;46(6):306-310.

(113) Tromp AM, Pluijm SMF, Smit JH, Deeg DJH, Bouter LM, Lips P. Fall-risk screening test: A prospective study on predictors for falls in community-dwelling elderly. J Clin Epidemiol 2001;54(8):837-844.

(114) Deary IJ, Corley J, Gow AJ, Harris SE, Houlihan LM, Marioni RE, et al. Age-associated cognitive decline. Br Med Bull 2009;92(1):135-152.

(115) Kallin K, Gustafson Y, Sandman P-, Karlsson S. Drugs and falls in older people in geriatric care settings. Aging Clin Exp Res 2004;16(4):270-276.

(116) Delbaere K, Kochan NA, Close JCT, Menant JC, Sturnieks DL, Brodaty H, et al. Mild cognitive impairment as a predictor of falls in community-dwelling older people. American Journal of Geriatric Psychiatry 2012;20(10):845-853.

(117) Taylor ME, Delbaere K, Lord SR, Mikolaizak AS, Close JCT. Physical impairments in cognitively impaired older people: Implications for risk of falls. Int Psychogeriatr 2013;25(1):148-156.

(118) Muir SW, Gopaul K, Montero Odasso MM. The role of cognitive impairment in fall risk among older adults: A systematic review and meta-analysis. Age Ageing 2012;41(3):299-308.

(119) Mirelman A, Herman T, Brozgol M, Dorfman M, Sprecher E, Schweiger A, et al. Executive function and falls in older adults: New findings from a five-year prospective study link fall risk to cognition. PLoS ONE 2012;7(6).

(120) Muir SW, Speechley M, Wells J, Borrie M, Gopaul K, Montero-Odasso M. Gait assessment in mild cognitive impairment and Alzheimer's disease: The effect of dual-task challenges across the cognitive spectrum. Gait and Posture 2012;35(1):96-100.

(121) Bherer L, Kramer AF, Peterson MS, Colcombe S, Erickson K, Becic E. Testing the limits of cognitive plasticity in older adults: Application to attentional control. Acta Psychol 2006;123(3):261-278.

(122) Yang L, Krampe RT. Long-term maintenance of retest learning in young Old and Oldest Old adults. J Gerontol - B Psychol 2009;64(5):608-611.

(123) Smith GE, Housen P, Yaffe K, Ruff R, Kennison RF, Mahncke HW, et al. A cognitive training program based on principles of brain plasticity: Results from the improvement in memory with plasticity-based adaptive cognitive training (IMPACT) study. J Am Geriatr Soc 2009;57(4):594-603.

(124) Li S-, Schmiedek F, Huxhold O, Röcke C, Smith J, Lindenberger U. Working Memory Plasticity in Old Age: Practice Gain, Transfer, and Maintenance. Psychol Aging 2008;23(4):731-742.

(125) Park DC, Gutchess AH, Meade ML, Stine-Morrow EA. Improving cognitive function in older adults: nontraditional approaches. J Gerontol - B Psychol 2007;62 Spec No 1:45-52.

(126) Morris JN, Fries BE, Mehr DR, Hawes C, Phillips C, Mor V, et al. MDS cognitive performance scale. J Gerontol 1994;49(4):M174-M182.

(127) Gruber-Baldini AL, Zimmerman SI, Mortimore E, Magaziner J. The Validity of the Minimum Data Set in Measuring the Cognitive Impairment of Persons Admitted to Nursing Homes. J Am Geriatr Soc 2000;48(12):1601-1606.

(128) Landi F, Tua E, Onder G, Carrara B, Sgadari A, Rinaldi C, et al. Minimum data set for home care: A valid instrument to assess frail older people living in the community. Med Care 2000;38(12):1184-1190.

(129) Luppa M, Luck T, Weyerer S, König H-, Brähler E, Riedel-Heller SG. Prediction of institutionalization in the elderly. A systematic review. Age Ageing 2010;39(1):31-38.

(130) Matsubayashi K, Okumiya K, Kawamoto A, Kimura S, Wada T, Fujisawa M, et al. Longitudinal changes in independence in the elderly - Kahoku longitudinal aging study (KLAS). Japanese Journal of Geriatrics 1994;31(10):752-758.

(131) Zuccolo PF, Ávila R, Nakano EY, Litvoc J, Lopes MA, Bottino CMC. Instrumental activities of daily living performance in healthy and cognitively intact seniors from a Brazilian sample and its relation to age and other socio-demographic variables. Int Psychogeriatr 2012;24(5):784-793.

(132) Covinsky KE, Hilton J, Lindquist K, Dudley RA. Development and validation of an index to predict activity of daily living dependence in community-dwelling elders. Med Care 2006;44(2):149-157.

(133) Ricci M, Guidoni SV, Sepe-Monti M, Bomboi G, Antonini G, Blundo C, et al. Clinical findings, functional abilities and caregiver distress in the early stage of dementia with Lewy bodies (DLB) and Alzheimer's disease (AD). Arch Gerontol Geriatr 2009;49(2):e101-e104.

(134) Morris JN, Fries BE, Morris SA. Scaling ADLs within the MDS. J Gerontol - A Biol 1999;54(11):M546-M553.

(135) Ensrud KE, Ewing SK, Taylor BC, Fink HA, Stone KL, Cauley JA, et al. Frailty and risk of falls, fracture, and mortality in older women: The study of osteoporotic fractures. J Gerontol - A Biol 2007;62(7):744-751.

(136) Nelson JM, Dufraux K, Cook PF. The relationship between glycemic control and falls in older adults. J Am Geriatr Soc 2007;55(12):2041-2044.

(137) Speciale S, Turco R, Magnifico F, Bellelli G, Trabucchi M. Frailty is the main predictor of falls in elderly patients undergoing rehabilitation training [5]. Age Ageing 2004;33(1):84-85.

(138) Bortz II WM. A conceptual framework of frailty: A review. J Gerontol - A Biol 2002;57(5):M283-M288.

(139) Armstrong JJ, Stolee P, Hirdes JP, Poss JW. Examining three frailty conceptualizations in their ability to predict negative outcomes for home-care clients. Age Ageing 2010;39(6):755-758.

(140) Hirdes JP, Frijters DH, Teare GF. The MDS-CHESS scale: A new measure to predict mortality in institutionalized older people. J Am Geriatr Soc 2003;51(1):96-100.

(141) Gurwitz JH. Polypharmacy: A new paradigm for quality drug therapy in the elderly? Arch Intern Med 2004;164(18):1957-1959.

(142) Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo Jr. JL, et al. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: The JNC 7 Report. J Am Med Assoc 2003;289(19):2560-2572.

(143) Garber AJ. Benefits of combination therapy of insulin and oral hypoglycemic agents. Arch Intern Med 2003;163(15):1781-1782+1785.

(144) Statistics Canada. 2008 Canadian Survey of Experiences with Primary Health Care 2009.

(145) Field TS, Gurwitz JH, Avorn J, McCormick D, Jain S, Eckler M, et al. Risk factors for adverse drug events among nursing home residents. Arch Intern Med 2001;161(13):1629-1634.

(146) Ziere G, Dieleman JP, Hofman A, Pols HAP, Van Der Cammen TJM, Stricker BHC. Polypharmacy and falls in the middle age and elderly population. Br J Clin Pharmacol 2006;61(2):218-223.

(147) Husson N, Watfa G, Laurain M-, Perret-Guillaume C, Niemier J-, Miget P, et al. Characteristics of polymedicated (= 4) elderly: A survey in a community-dwelling population aged 60 years and over. Journal of Nutrition, Health and Aging 2013:1-5.

(148) Leipzig RM, Cumming RG, Tinetti ME. Drugs and falls in older people: A systematic review and meta-analysis: II. Cardiac and analgesic drugs. J Am Geriatr Soc 1999;47(1):40-50.

(149) Gurvich T, Cunningham JA. Appropriate use of psychotropic drugs in nursing homes. Am Fam Physician 2000;61(5):1437-1446.

(150) Parmelee PA, Katz IR, Lawton MP. Depression among institutionalized aged: Assessment and prevalence estimation. J Gerontol 1989;44(1):M22-M29.

(151) Hyer L, Blazere DG. Depressive symptoms. Impact and problems in long term care facilities. Int J Behav Geriatr 1982;7:137-146.

(152) Buchanan D, Tourigny-Rivard M-, Cappeliez P, Frank C, Janikowski P, Spanjevic L, et al. National guidelines for seniors' mental health: The assessment and treatment of depression. Canadian Journal of Geriatrics 2006;9(Suppl. 2):S52-S58.

(153) Reed-Jones RJ, Solis GR, Lawson KA, Loya AM, Cude-Islas D, Berger CS. Vision and falls: A multidisciplinary review of the contributions of visual impairment to falls among older adults. Maturitas 2013.

(154) Meier P, Seitz HK. Age, alcohol metabolism and liver disease. Curr Opin Clin Nutr Metab Care 2008;11(1):21-26.

(155) Woolcott JC, Richardson KJ, Wiens MO, Patel B, Marin J, Khan KM, et al. Meta-analysis of the impact of 9 medication classes on falls in elderly persons. Arch Intern Med 2009;169(21):1952-1960.

(156) Ensrud KE, Blackwell TL, Mangione CM, Bowman PJ, Whooley MA, Bauer DC, et al. Central nervous system-active medications and risk for falls in older women. J Am Geriatr Soc 2002;50(10):1629-1637.

(157) Rozenfeld S, Bastos Camacho LA, Peixoto Veras R. Medication as a risk factor for falls in older women in Brazil. Pan Am J Public Health 2003;13(6):369-375.

(158) Ray WA, Thapa PB, Gideon P. Benzodiazepines and the risk of falls in nursing residents home. J Am Geriatr Soc 2000;48(6):682-685.

(159) Schwab M, Roder F, Aleker T, Ammon S, Thon K-, Eichelbaum M, et al. Psychotropic drug use, falls and hip fracture in the elderly. Aging Clin Exp Res 2000;12(3):234-239.

(160) Chaimowicz F, De Jesus Xavier Martins Ferreira,T., Miguel DFA. Use of psychoactive drugs and related falls among older people living in a community in Brazil. Rev Saude Publica 2000;34(6):631-635.

(161) Mustard CA, Mayer T. Case-control study of exposure to medication and the risk of injurious falls requiring hospitalization among nursing home residents. Am J Epidemiol 1997;145(8):738-745.

(162) Ebly EM, Hogan DB, Fung TS. Potential adverse outcomes of psychotropic and narcotic drug use in Canadian seniors. J Clin Epidemiol 1997;50(7):857-863.

(163) Neutel CI, Hirdes JP, Maxwell CJ, Patten SB. New evidence on benzodiazepine use and falls: The time factor. Age Ageing 1996;25(4):273-278.

(164) Thapa PB, Gideon P, Cost TW, Milam AB, Ray WA. Antidepressants and the risk of falls among nursing home residents. N Engl J Med 1998;339(13):875-882.

(165) Katz IR, Rupnow M, Kozma C, Schneider L. Risperidone and falls in ambulatory nursing home residents with dementia and psychosis or agitation: Secondary analysis of a double-blind, placebo-controlled trial. American Journal of Geriatric Psychiatry 2004;12(5):499-508.

(166) Iaboni A, Flint AJ. The complex interplay of depression and falls in older adults: A clinical review. American Journal of Geriatric Psychiatry 2012.

(167) Eggermont LHP, Penninx BWJH, Jones RN, Leveille SG. Depressive symptoms, chronic pain, and falls in older community-dwelling adults: The mobilize Boston study. J Am Geriatr Soc 2012;60(2):230-237.

(168) Bottino CMC, Barcelos-Ferreira R, Ribeiz SRI. Treatment of Depression in Older Adults. Curr Psychiatry Rep 2012:1-9.

(169) Mathews M, Mathews M, Mathews J. Recognition and Treatment of Depression in the Elderly. Primary Psychiatry 2004;11(2):33-37.

(170) Fernandez F, Levy JK, Lachar BL, Small GW. The management of depression and anxiety in the elderly. J Clin Psychiatry 1995;56(Suppl. 2):20-29.

(171) Burrows AB, Satlin A, Salzman C, Nobel K, Lipsitz LA. Depression in a long-term care facility: Clinical features and discordance between nursing assessment and patient interviews. J Am Geriatr Soc 1995;43(10):1118-1122.

(172) Burrows AB, Morris JN, Simon SE, Hirdes JP, Phillips C. Development of a Minimum Data Set-based depression rating scale for use in nursing homes. Age Ageing 2000;29(2):165-172.

(173) Koehler M, Rabinowitz T, Hirdes J, Stones M, Carpenter GI, Fries BE, et al. Measuring depression in nursing home residents with the MDS and GDS: An observational psychometric study. BMC Geriatrics 2005;5.

(174) Volicer L, Frijters DHM, Van Der Steen JT. Underdiagnosis and undertreatment of depression in nursing home residents. European Geriatric Medicine 2011;2(6):332-337.

(175) Matheson AJ, Darlington CL, Smith PF. Dizziness in the Elderly and Age-related Degeneration of the Vestibular System. New Zealand Journal of Psychology 1999;28(1):10-16.

(176) Gangavati A, Hajjar I, Quach L, Jones RN, Kiely DK, Gagnon P, et al. Hypertension, orthostatic hypotension, and the risk of falls in a community-dwelling elderly population: The maintenance of balance, independent living, intellect, and zest in the elderly of Boston study. J Am Geriatr Soc 2011;59(3):383-389.

(177) Liu BA, Topper AK, Reeves RA, Gryfe C, Maki BE. Falls among older people: Relationship to medication use and orthostatic hypotension. J Am Geriatr Soc 1995;43(10):1141-1145.

(178) Schwartz AV, Hillier TA, Sellmeyer DE, Resnick HE, Gregg E, Ensrud KE, et al. Older women with diabetes have a higher risk of falls: A prospective study. Diabetes Care 2002;25(10):1749-1754.

(179) Maurer MS, Burcham J, Cheng H. Diabetes mellitus is associated with an increased risk of falls in elderly residents of a long-term care facility. J Gerontol - A Biol 2005;60(9):1157-1162.

(180) Dinca-Panaitescu S, Dinca-Panaitescu M, Bryant T, Daiski I, Pilkington B, Raphael D. Diabetes prevalence and income: Results of the Canadian Community Health Survey. Health Policy 2011;99(2):116-123.

(181) Dhital A, Pey T, Stanford MR. Visual loss and falls: A review. Eye 2010;24(9):1437-1446.

(182) Agrawal Y, Carey JP, Della Santina CC, Schubert MC, Minor LB. Diabetes, vestibular dysfunction, and falls: Analyses from the national health and nutrition examination survey. Otology and Neurotology 2010;31(9):1445-1450.

(183) MacGilchrist C, Paul L, Ellis BM, Howe TE, Kennon B, Godwin J. Lower-limb risk factors for falls in people with diabetes mellitus. Diabetic Med 2010;27(2):162-168.

(184) Huang ES, Karter AJ, Danielson KK, Warton EM, Ahmed AT. The association between the number of prescription medications and incident falls in a multi-ethnic population of adult type-2 diabetes patients: The diabetes and aging study. Journal of General Internal Medicine 2010;25(2):141-146.

(185) Berlie HD, Garwood CL. Diabetes medications related to an increased risk of falls and fall-related morbidity in the elderly. Ann Pharmacother 2010;44(4):712-717.

(186) Schwartz AV, Vittinghoff E, Sellmeyer DE, Feingold KR, De Rekeneire N, Strotmeyer ES, et al. Diabetes-related complications, glycemic control, and falls in older adults. Diabetes Care 2008;31(3):391-396.

(187) Damián J, Pastor-Barriuso R, Valderrama-Gama E, de Pedro-Cuesta J. Factors associated with falls among older adults living in institutions. BMC Geriatrics 2013:6.

(188) Lee C-, Chen L-, Lo Y-, Liang C-, Chou M-, Lo C-, et al. Urinary incontinence: An under-recognized risk factor for falls among elderly dementia patients. Neurourol Urodyn 2011;30(7):1286-1290.

(189) Leveille SG. Musculoskeletal pain and risk for falls in older adults? Journal of Pain Management 2009;1(4):329-338.

(190) Leveille SG, Jones RN, Kiely DK, Hausdorff JM, Shmerling RH, Guralnik JM, et al. Chronic musculoskeletal pain and the occurrence of falls in an older population. JAMA - Journal of the American Medical Association 2009;302(20):2214-2221.

(191) Blyth FM, Cumming R, Mitchell P, Wang JJ. Pain and falls in older people. European Journal of Pain 2007;11(5):564-571.

(192) Fries BE, Simon SE, Morris JN, Flodstrom C, Bookstein FL. Pain in U.S. nursing homes: Validating a pain scale for the Minimum Data Set. Gerontologist 2001;41(2):173-179.

(193) Yoo I-. Analysis of multi-variate recurrent fall risk factors in elderly people using residential assessment instrument-home care - comparisons between single and recurrent fallers - . Journal of Korean Academy of Nursing 2011;41(1):119-128.

(194) Alzheimer Society of Canada. Rising Tide: The Impact of Dementia on Canadian Society. 2010.

(195) Parkinson Society Canada. Parkinson's Disease: Social and Economic Impact. 2003.

(196) Hughes LE, Barker RA, Owen AM, Rowe JB. Parkinson's disease and healthy aging: Independent and interacting effects on action selection. Hum Brain Mapp 2010;31(12):1886-1899.

(197) Batchelor FA, Mackintosh SF, Said CM, Hill KD. Falls after stroke. International Journal of Stroke 2012;7(6):482-490.

(198) Lim JY, Jung SH, Kim W-, Paik N-. Incidence and Risk Factors of Poststroke Falls After Discharge From Inpatient Rehabilitation. PM and R 2012;4(12):945-953.

(199) Nyström A, Hellström K. Fall risk six weeks from onset of stroke and the ability of the Prediction of Falls in Rehabilitation Settings Tool and motor function to predict falls. Clin Rehabil 2013;27(5):473-479.

(200) Sinanovic O, Raicevic B, Brkic M, Hajdarbegovic E, Zukic S, Kojic B, et al. Falls in hospitalized acute stroke patients. Med Arh 2012;66(1):33-34.

(201) Korczyn AD. Mild cognitive impairment in Parkinson's disease. J Neural Transm 2013;120(4):517-521.

(202) Härlein J, Dassen T, Halfens RJG, Heinze C. Fall risk factors in older people with dementia or cognitive impairment: A systematic review. J Adv Nurs 2009;65(5):922-933.

(203) Anstey KJ, Von Sanden C, Luszcz MA. An 8-year prospective study of the relationship between cognitive performance and falling in very old adults. J Am Geriatr Soc 2006;54(8):1169-1176.

(204) Teasdale N, Simoneau M. Attentional demands for postural control: The effects of aging and sensory reintegration. Gait and Posture 2001;14(3):203-210.

(205) Camicioli R, Howieson D, Lehman S, Kaye J. Talking while walking: The effect of a dual task in aging and Alzheimer's disease. Neurology 1997;48(4):955-958.

(206) Taylor ME, Delbaere K, Lord SR, Mikolaizak AS, Close JCT. Physical impairments in cognitively impaired older people: Implications for risk of falls. International Psychogeriatrics 2013;25(1):148-156.

(207) Horikawa E, Matsui T, Arai H, Seki T, Iwasaki K, Sasaki H. Risk of falls in Alzheimer's disease: A prospective study. Internal Medicine 2005;44(7):717-721.

(208) Kröpelin TF, Neyens JCL, Halfens RJG, Kempen GIJM, Hamers JPH. Fall determinants in older long-term care residents with dementia: A systematic review. International Psychogeriatrics 2013;25(4):549-563.

(209) Dauer W, Przedborski S. Parkinson's disease: Mechanisms and models. Neuron 2003;39(6):889-909.

(210) Contreras A, Grandas F. Risk of falls in Parkinson's disease: A cross-sectional study of 160 patients. Parkinson's Disease 2012.

(211) Robinson K, Dennison A, Roalf D, Noorigian J, Cianci H, Bunting-Perry L, et al. Falling risk factors in Parkinson's disease. NeuroRehabilitation 2005;20(3):169-182.

(212) Latt MD, Lord SR, Morris JGL, Fung VSC. Clinical and physiological assessments for elucidating falls risk in Parkinson's disease. Movement Disord 2009;24(9):1280-1289.

(213) Paul SS, Canning CG, Sherrington C, Lord SR, Close JCT, Fung VSC. Three simple clinical tests to accurately predict falls in people with Parkinson's disease. Movement Disord 2013.

(214) Voss TS, Elm JJ, Wielinski CL, Aminoff MJ, Bandyopadhyay D, Chou KL, et al. Fall frequency and risk assessment in early Parkinson's disease. Parkinsonism and Related Disorders 2012;18(7):837-841.

(215) Wielinski CL, Erickson-Davis C, Wichmann R, Walde-Douglas M, Parashos SA. Falls and injuries resulting from falls among patients with Parkinson's disease and other Parkinsonian syndromes. Movement Disord 2005;20(4):410-415.

(216) Hiorth YH, Lode K, Larsen JP. Frequencies of falls and associated features at different stages of Parkinson's disease. European Journal of Neurology 2013;20(1):160-166.

(217) Bloem BR, Hausdorff JM, Visser JE, Giladi N. Falls and freezing of Gait in Parkinson's disease: A review of two interconnected, episodic phenomena. Movement Disord 2004;19(8):871-884.

(218) Bloem BR, Beckley DJ, Van Dijk JG. Are automatic postural responses in patients with Parkinson's disease abnormal due to their stooped posture? Experimental Brain Research 1999;124(4):481-488.

(219) Baltadjieva R, Giladi N, Gruendlinger L, Peretz C, Hausdorff JM. Marked alterations in the gait timing and rhythmicity of patients with de novo Parkinson's disease. Eur J Neurosci 2006;24(6):1815-1820.

(220) Albanese A. Can falls be prevented in Parkinson's disease? Journal of Neurology, Neurosurgery and Psychiatry 2007;78(7):661.

(221) Senard JM, Raï S, Lapeyre-Mestre M, Brefel C, Rascol O, Rascol A, et al. Prevalence of orthostatic hypotension in Parkinson's disease. Journal of Neurology Neurosurgery and Psychiatry 1997;63(5):584-589.

(222) Cameron ID, Gillespie LD, Robertson MC, Murray GR, Hill KD, Cumming RG, et al. Interventions for preventing falls in older people in care facilities and hospitals. Cochrane database of systematic reviews (Online) 2012;12.

(223) Ashburn A, Fazakarley L, Ballinger C, Pickering R, McLellan LD, Fitton C. A randomised controlled trial of a home based exercise programme to reduce the risk of falling among people with Parkinson's disease. Journal of Neurology, Neurosurgery and Psychiatry 2007;78(7):678-684.

(224) Protas EJ, Mitchell K, Williams A, Qureshy H, Caroline K, Lai EC. Gait and step training to reduce falls in Parkinson's disease. NeuroRehabilitation 2005;20(3):183-190.

(225) Jensen LE, Padilla R. Effectiveness of interventions to prevent falls in people with alzheimer's disease and related dementias. American Journal of Occupational Therapy 2011;65(5):532-540.

(226) Yip YB, Cumming RG. The association between medications and falls in Australian nursing-home residents. Med J Aust 1994;160(1):14-18.

(227) Thapa PB, Brockman KG, Gideon P, Fought RL, Ray WA. Injurious falls in nonambulatory nursing home residents: A comparative study of circumstances, incidence, and risk factors. J Am Geriatr Soc 1996;44(3):273-278.

(228) Mor V, Intrator O, Unruh MA, Cai S. Temporal and geographic variation in the validity and internal consistency of the nursing home resident assessment Minimum Data Set 2.0. BMC Health Services Research 2011;11:78.

(229) Del Rio RA, Goldman M, Kapella BK, Sulit L, Murray PK. The Accuracy of Minimum Data Set Diagnoses in Describing Recent Hospitalization at Acute Care Facilities. J Am Med Dir Assoc 2006;7(4):212-218.

(230) Feldstein C, Weder AB. Orthostatic hypotension: A common, serious and underrecognized problem in hospitalized patients. Journal of the American Society of Hypertension 2012;6(1):27-39.

(231) Hirdes JP, Mitchell L, Maxwell CJ, White N. Beyond the 'iron lungs of gerontology': Using evidence to shape the future of nursing homes in Canada. Canadian Journal on Aging 2011;30(3):371-390.

(232) Kostic V, Przedborski S, Flaster E, Sternic N. Early development of levodopa-induced dyskinesias and response fluctuations in young-onset Parkinson's disease. Neurology 1991;41(2 I):202-205.

(233) Giovannini P, Piccolo I, Genitrini S, Soliveri P, Girotti F, Geminiani G, et al. Early-onset Parkinson's disease. Movement Disord 1991;6(1):36-42.

(234) Picard C, Pasquier F, Martinaud O, Hannequin D, Godefroy O. Early onset dementia: Characteristics in a large cohort from academic memory clinics. Alzheimer Dis Assoc Disord 2011;25(3):203-205.

(235) Fadil H, Borazanci A, Ait Ben Haddou E, Yahyaoui M, Korniychuk E, Jaffe SL, et al. Chapter 13 Early Onset Dementia. International Review of Neurobiology: Academic Press. p. 245-262.

(236) Dunn KS. The effect of physical restraints on fall rates in older adults who are institutionalized. J Gerontol Nurs 2001;27(10):40-48.

(237) Luo H, Lin M, Castle N. Physical restraint use and falls in nursing homes: A comparison between residents with and without dementia. Am J Alzheimers Dis Other Demen 2011;26(1):44-50.

(238) Basante J, Bentz E, Heck-Hackley J, Kenion B, Young D, Holm MB. Falls risk among older adults in long-term care facilities: A focused literature review. Physical and Occupational Therapy in Geriatrics 2001;19(2):63-85.

(239) Healey F, Oliver D, Milne A, Connelly JB. The effect of bedrails on falls and injury: A systematic review of clinical studies. Age Ageing 2008;37(4):368-378.

(240) Kleinbaum DG, Kupper LL, Muller KE, Nizam A. Regression Diagnostics. Applied Regression Analysis and Other Multivariable Methods Belmont, CA: Thomson Brooks/Cole; 2008. p. 287.

(241) Aarsland D, Kurz MW. The epidemiology of dementia associated with parkinson's disease. Brain Pathology 2010;20(3):633-639.

(242) Studenski S, Duncan PW, Chandler J, Samsa G, Prescott B, Hogue C, et al. Predicting falls: The role of mobility and nonphysical factors. J Am Geriatr Soc 1994;42(3):297-302.

(243) Cheng H-, Tsai AC. Predicting the risk of falling based on ADLs and IADLs in older Taiwanese. Taiwan Journal of Public Health 2012;31(1):21-30.

(244) Anderson K, Baraldi C, Supiano M. Identifying Failure to Thrive in the Long Term Care Setting. J Am Med Dir Assoc 2012;13(7):665.e15-665.e19.

(245) Moon S-, Kim YT, Lee TY, Moon H, Kim MJ, Kim SA, et al. The influence of an overactive bladder on falling: A study of females aged 40 and older in the community. International Neurourology Journal 2011;15(1):41-47.

(246) Booth J, Paul L, Rafferty D, MacInnes C. The relationship between urinary bladder control and gait in women. Neurourol Urodyn 2013;32(1):43-47.

(247) Truter I. Urinary incontinence. SA Pharmaceutical Journal 2009;76(9):12-19.

(248) Darowski A, Chambers S-CF, Chambers DJ. Antidepressants and falls in the elderly. Drugs and Aging 2009;26(5):381-394.

(249) Rosenberg PB, Mielke MM, Han D, Leoutsakos JS, Lyketsos CG, Rabins PV, et al. The association of psychotropic medication use with the cognitive, functional, and neuropsychiatric trajectory of Alzheimer's disease. Int J Geriatr Psychiatry 2012;27(12):1248-1257.

(250) Tanaka M, Suemaru K, Ikegawa Y, Tabuchi N, Araki H. Relationship between the risk of falling and drugs in an academic hospital. Yakugaku Zasshi 2008;128(9):1355-1361.

(251) Conn DK, Madan R. Use of sleep-promoting medications in nursing home residents: Risks versus benefits. Drugs and Aging 2006;23(4):271-287.

(252) Cornegé-Blokland E, Kleijer BC, Hertogh CMPM, Van Marum RJ. Reasons to prescribe antipsychotics for the behavioral symptoms of dementia: A Survey in dutch nursing homes among physicians, nurses, and family caregivers. J Am Med Dir Assoc 2012;13(1):80.e1-80.e6.

(253) Osnes EK, Lofthus CM, Meyer HE, Falch JA, Nordsletten L, Cappelen I, et al. Consequences of hip fracture on activities of daily life and residential needs. Osteoporosis Int 2004;15(7):567-574.

(254) Koot VCM, Peeters PHM, De Jong JR, Clevers GJ, Van Der Werken C. Functional results after treatment of hip fracture: A multicentre, prospective study in 215 patients. European Journal of Surgery 2000;166(6):480-485.

(255) Balash Y, Peretz C, Leibovich G, Herman T, Hausdorff JM, Giladi N. Falls in outpatients with Parkinson's disease: Frequency, impact and identifying factors. J Neurol 2005;252(11):1310-1315.

(256) Thorpy MJ. Sleep disorders in Parkinson's disease. Clin Cornerstone 2004;6(Suppl. 1):S7-S15.

(257) Roychowdhury S, Forsyth DR. Sleep disturbance in Parkinson disease. Journal of Clinical Gerontology and Geriatrics 2012 6;3(2):53-61.

(258) Malone DC, McLaughlin TP, Wahl PM, Leibman C, Arrighi HM, Cziraky MJ, et al. Burden of Alzheimer's disease and association with negative health outcomes. Am J Manag Care 2009;15(8):481-488.

(259) Weller I, Schatzker J. Hip fractures and Alzheimer's disease in elderly institutionalized Canadians. Ann Epidemiol 2004;14(5):319-324.

(260) Melton III LJ, Beard CM, Kokmen E, Atkinson EJ, O'Fallon WM. Fracture risk in patients with Alzheimer's disease. J Am Geriatr Soc 1994;42(6):614-619.

(261) Morris JC, Rubin EH, Morris EJ, Mandel SA. Senile dementia of the Alzheimer's type: An important risk factor for serious falls. J Gerontol 1987;42(4):412-417.

(262) Johansson C, Skoog I. A population-based study on the association between dementia and hip fractures in 85-year olds. Aging Clin Exp Res 1996;8(3):189-196.

(263) Sato Y, Asoh T, Oizumi K. High prevalence of vitamin D deficiency and reduced bone mass in elderly women with Alzheimer's disease. Bone 1998;23(6):555-557.

(264) Langlois JA, Visser M, Davidovic LS, Maggi S, Li G, Harris TB. Hip fracture risk in older white men is associated with change in body weight from age 50 years to old age. Arch Intern Med 1998;158(9):990-996.

(265) Singh S, Mulley GP, Losowsky MS. Why are Alzheimer patients thin? Age Ageing 1988 Jan;17(1):21-28.

(266) Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, et al. Frailty in older adults: Evidence for a phenotype. J Gerontol - A Biol 2001;56(3):M146-M156.

(267) Louis ED, Marder K, Cote L, Tang M, Mayeux R. Mortality from Parkinson disease. Arch Neurol 1997 Mar;54(3):260-264.

(268) Callahan CM, Arling G, Tu W, Rosenman MB, Counsell SR, Stump TE, et al. Transitions in care for older adults with and without dementia. J Am Geriatr Soc 2012;60(5):813-820.

(269) Robinovitch SN, Feldman F, Yang Y, Schonnop R, Leung PM, Sarraf T, et al. Video capture of the circumstances of falls in elderly people residing in long-term care: an observational study. The Lancet 2013 1/5–11;381(9860):47-54.

(270) Phillips CD, Chu CW, Morris JN, Hawes C. Effects of cognitive impairment on the reliability of geriatric assessments in nursing homes. J Am Geriatr Soc 1993;41(2):136-142.

(271) McKhann GM, Knopman DS, Chertkow H, Hyman BT, Jack Jr. CR, Kawas CH, et al. The diagnosis of dementia due to Alzheimer's disease: Recommendations from the National Institute on Aging-Alzheimer's Association workgroups on diagnostic guidelines for Alzheimer's disease. Alzheimer's and Dementia 2011;7(3):263-269.

(272) Taylor ME, Lord SR, Delbaere K, Mikolaizak AS, Close JCT. Physiological fall risk factors in cognitively impaired older people: A one-year prospective study. Dement Geriatr Cogn Disord 2012;34(3-4):181-189.

(273) Mitchell SL, Rockwood K. Defining Parkinsonism in the Canadian Study of Health and Aging. Int Psychogeriatr 2001;13(Suppl. 1):107-113.

(274) De Lau LML, Giesbergen PCLM, De Rijk MC, Hofman A, Koudstaal PJ, Breteler MMB. Incidence of parkinsonism and Parkinson disease in a general population: The Rotterdam Study. Neurology 2004;63(7):1240-1244.

(275) Cummings SR, Nevitt MC, Kidd S. Forgetting falls. The limited accuracy of recall of falls in the elderly. J Am Geriatr Soc 1988;36(7):613-616.

(276) Liao K-, Pu S-, Lin C-, Chang H-, Chen Y-, Liu M-. Association between the metabolic syndrome and its components with falls in community-dwelling older adults. Metabolic Syndrome and Related Disorders 2012;10(6):447-451.

(277) Marsden CD, Parkes JD. 'On off' effects in patients with Parkinson's disease on chronic levodopa therapy. Lancet 1976;1(7954):292-296.

(278) Yamashita T, Noe DA, Bailer AJ. Risk factors of falls in community-dwelling older adults: Logistic regression tree analysis. Gerontologist 2012;52(6):822-832.

(279) Becker C, Kron M, Lindemann U, Sturm E, Eichner B, Walter-Jung B, et al. Effectiveness of a multifaceted intervention on falls in nursing home residents. J Am Geriatr Soc 2003;51(3):306-313.

(280) Choi M, Hector M. Effectiveness of intervention programs in preventing falls: A systematic review of recent 10 years and meta-analysis. J Am Med Dir Assoc 2012;13(2):188.e13-188.e21.

(281) Gillespie LD, Robertson MC, Gillespie WJ, Lamb SE, Gates S, Cumming RG, et al. Interventions for preventing falls in older people living in the community. Cochrane Database of Systematic Reviews 2009(2).

(282) Markle-Reid M, Browne G, Gafni A, Roberts J, Weir R, Thabane L, et al. The effects and costs of a multifactorial and interdisciplinary team approach to falls prevention for older home care clients 'at risk' for falling: A randomized controlled trial. Canadian Journal on Aging 2010;29(1):139-161.

(283) Palvanen M, Kannus P, Piirtola M, Niemi S, Parkkari J, Järvinen M. Effectiveness of the Chaos Falls Clinic in preventing falls and injuries of home-dwelling older adults: A randomised controlled trial. Injury 2013.

(284) Schoenfelder DP. A fall prevention program for elderly individuals. Exercise in long-term care settings. J Gerontol Nurs 2000;26(3):43-51.

(285) Thomas S, Mackintosh S, Halbert J. Does the 'Otago exercise programme' reduce mortality and falls in older adults?: A systematic review and meta-analysis. Age Ageing 2010;39(6):681-687.

(286) Oliver D, Connelly JB, Victor CR, Shaw FE, Whitehead A, Genc Y, et al. Strategies to prevent falls and fractures in hospitals and care homes and effect of cognitive impairment: Systematic review and meta-analyses. Br Med J 2007;334(7584):82-85.

(287) Winter H, Watt K, Peel NM. Falls prevention interventions for community-dwelling older persons with cognitive impairment: A systematic review. Int Psychogeriatr 2013;25(2):215-227.

(288) Suttanon P, Hill KD, Said CM, Byrne KN, Dodd KJ. Factors influencing commencement and adherence to a home-based balance exercise program for reducing risk of falls: Perceptions of people with Alzheimer's disease and their caregivers. International Psychogeriatrics 2012;24(7):1172-1182.

(289) Mirolsky-Scala G, Kraemer T. Fall management in Alzheimer-related dementia: A case study. Journal of Geriatric Physical Therapy 2009;32(4):181-189.

(290) Allen NE, Canning CG, Sherrington C, Lord SR, Latt MD, Close JCT, et al. The effects of an exercise program on fall risk factors in people with Parkinson's disease: A randomized controlled trial. Movement Disorders 2010;25(9):1217-1225.

(291) Goodwin VA, Richards SH, Henley W, Ewings P, Taylor AH, Campbell JL. An exercise intervention to prevent falls in people with Parkinson's disease: A pragmatic randomised controlled trial. Journal of Neurology, Neurosurgery and Psychiatry 2011;82(11):1232-1238.

(292) Dibble LE, Addison O, Papa E. The effects of exercise on balance in persons with parkinson's disease: A systematic review across the disability spectrum. Journal of Neurologic Physical Therapy 2009;33(1):14-26.

(293) Grimshaw JM, Eccles MP, Walker AE, Thomas RE. Changing physicians' behavior: what works and thoughts on getting more things to work. J Contin Educ Health Prof 2002;22(4):237-243.

APPENDIX A

Results of Bivariate Analyses in HC

The % (n) column states the percentage of individuals within each level of the independent variables who fell within 90 days prior to their follow-up assessment. E.g. of all ambulatory HC clients with dementia who are female, 21% of them fell in the 90 days prior to their follow-up assessment.

Ambulatory HC Clients with Dementia

Risk Factor	Odds Ratio (95% CI)	*P* Value	% (n) That Fell
Age in Years			
0 to < 65	1.01 (0.83-1.24)	0.90	17.6 (148)
≥ 65 to < 75	1.00 (reference)		17.4 (555)
≥ 75 to < 85	1.31 (1.19-1.45)	< 0.0001	21.7 (3064)
≥ 85 to < 95	1.46 (1.32-1.62)	< 0.0001	23.6 (2723)
≥ 95 to < 115	1.46 (1.22-1.76)	< 0.0001	23.5 (202)
Male	1.15 (1.09-1.22)	< 0.0001	23.5 (2508)
Vision			
Adequate	1.00 (reference)		20.9 (4681)
Impaired/Moderately Impaired	1.24 (1.17-1.32)	< 0.0001	24.6 (1734)
Highly/Severely Impaired	1.29 (1.13-1.49)	0.0003	25.4 (282)
Wandering in Last 3 Days	1.04 (0.95-1.14)	0.36	22.5 (683)
Diabetes	1.04 (0.97-1.12)	0.24	22.5 (1297)
Arthritis	1.21 (1.15-1.28)	< 0.0001	23.8 (3109)
Hip Fracture	1.08 (0.92-1.28)	0.34	23.3 (189)
Diagnosed Cardiovascular Condition(s)	1.09 (1.03-1.15)	0.002	22.6 (3882)
Unsteady Gait	1.70 (1.61-1.79)	< 0.0001	26.9 (3684)
≥ 9 Medications	1.27 (1.20-1.34)	< 0.0001	24.5 (2810)
Medication Use in Last 7 Days			
Antipsychotic/Neuroleptic	1.02 (0.95-1.09)	0.61	22.1 (1456)
Anxiolytic	1.07 (0.99-1.16)	0.09	22.9 (899)

Antidepressant	1.16 (1.09-1.23)	< 0.0001	23.7 (1957)
Hypnotic or Analgesic	1.13 (1.03-1.23)	0.007	23.8 (734)
Bladder Continence in Last 7 Days			
Continent/Continent with Catheter	1.00 (reference)		19.1 (3004)
Usually Continent/ Occasionally Incontinent	1.34 (1.25-1.43)	< 0.0001	24.1 (1879)
Frequently Incontinent/ Completely Incontinent/Did Not Occur	1.45 (1.36-1.55)	< 0.0001	25.6 (1814)
Worsening of Bladder Continence	1.38 (1.28-1.48)	< 0.0001	26.9 (1158)
Bowel Continence in Last 7 Days			
Continent/Continent with Ostomy	1.00 (reference)		21.2 (5036)
Usually Continent/ Occasionally Incontinent	1.22 (1.14-1.32)	< 0.0001	24.7 (1101)
Frequently Incontinent/ Completely Incontinent/Did Not Occur	1.17 (1.06-1.30)	0.002	24.0 (558)
ADL Hierarchy Scale Score			
Independent	1.00 (reference)		20.4 (2957)
Supervision to Limited Assistance	1.15 (1.09-1.22)	< 0.0001	22.8 (2763)
Extensive to Maximal Assistance	1.29 (1.18-1.40)	< 0.0001	24.8 (938)
Dependent to Total Dependence	0.80 (0.57-1.13)	0.21	17.0 (39)
ADL Decline	1.12 (1.06-1.19)	< 0.0001	23.2 (2619)
DRS Score			
0	1.00 (reference)		21.6 (3894)
1-2	1.04 (0.97-1.11)	0.27	22.2 (1751)
3+	1.06 (0.98-1.14)	0.17	22.5 (1051)
CPS Score			
Intact	1.00 (reference)		23.3 (109)
Borderline Intact to Mild Impairment	0.93 (0.75-1.16)	0.51	22.1 (3931)
Moderate to Moderate	0.89 (0.74-1.17)	0.30	21.3 (1729)

Severe Impairment			
Severe to Very Severe Impairment	0.93 (0.74-1.17)	0.54	22.1 (928)
Worsening Decision Making	0.96 (0.91-1.01)	0.12	21.4 (2489)
Pain Scale Score			
0	1.00 (reference)		20.4 (3672)
1-2	1.21 (1.15-1.28)	< 0.0001	23.7 (2760)
3	1.45 (1.26-1.68)	< 0.0001	27.2 (264)
CHESS Score			
No Health Instability	1.00 (reference)		20.9 (2252)
Minimal to Low Health Instability	1.08 (1.02-1.14)	0.01	22.1 (3787)
Moderate to Very High Health Instability	1.23 (1.11-1.36)	< 0.0001	24.5 (657)
Dizziness or Lightheadedness	1.40 (1.28-1.53)	< 0.0001	27.6 (748)
Parkinson's Disease	1.94 (1.72-2.19)	< 0.0001	34.5 (419)
Other Neurological Condition(s)	1.20 (1.12-1.28)	< 0.0001	24.5 (1356)
Poor Self-Rated Health	1.33 (1.20-1.47)	< 0.0001	26.7 (542)
Fear of Falling	1.45 (1.37-1.54)	< 0.0001	26.5 (2474)
Stair Climbing in Last 3 Days			
Without Help	1.00 (reference)		18.8 (2723)
With Help/Did Not Occur	1.42 (1.34-1.49)	< 0.0001	24.7 (3974)
Presence of ≥ 2 Environmental Hazards	1.29 (1.07-1.55)	0.006	26.5 (158)
Length of Time Client is Alone During the Day			
Never or Hardly Ever	1.00 (reference)		21.9 (3408)
About One Hour	1.06 (0.98-1.14)	0.14	22.9 (1137)
Long Periods of Time	0.99 (0.93-1.06)	0.81	21.8 (1702)
All of the Time	0.87 (0.78-0.97)	0.01	19.6 (450)
Absence of Informal Support	0.53 (0.37-0.77)	0.0007	13.0 (33)

Non-Ambulatory HC Clients with Dementia

Risk Factor	Odds Ratio (95% CI)	*P* Value	% (n) That Fell
Age in Years			
0 to < 65	0.56 (0.22-1.38)	0.21	7.2 (6)
≥ 65 to < 75	1.00 (reference)		12.3 (31)
≥ 75 to < 85	0.78 (0.51-1.21)	0.27	9.9 (91)
≥ 85 to < 95	0.82 (0.54-1.25)	0.35	10.3 (113)
≥ 95 to < 115	0.60 (0.31-1.14)	0.12	7.7 (15)
Male	1.39 (1.07-1.82)	0.02	12.2 (97)
Vision			
Adequate	1.00 (reference)		12.7 (153)
Impaired/Moderately Impaired	0.65 (0.49-0.87)	0.003	8.7 (79)
Highly/Severely Impaired	0.41 (0.26-0.63)	< 0.0001	5.6 (24)
Diabetes	1.20 (0.89-1.62)	0.23	11.4 (65)
Arthritis	1.22 (0.94-1.58)	0.14	11.1 (125)
Hip Fracture	0.85 (0.53-1.38)	0.52	8.8 (20)
Diagnosed Cardiovascular Condition(s)	1.55 (1.18-2.03)	0.001	11.8 (165)
Unsteady Gait	2.18 (1.58-3.00)	< 0.0001	12.1 (206)
≥ 9 Medications	1.53 (1.18-1.99)	0.001	12.3 (136)
Medication Use in Last 7 Days			
Antipsychotic/Neuroleptic	0.78(0.55-1.07)	0.11	8.3 (47)
Anxiolytic	1.16 (0.83-1.61)	0.38	11.2 (49)
Antidepressant	1.54 (1.17-2.02)	0.002	13.1 (92)
Hypnotic or Analgesic	1.28 (0.89-1.85)	0.18	12.2 (39)
Bladder Continence in Last 7 Days			
Continent/Continent with Catheter	1.00 (reference)		12.8 (48)
Usually Continent/ Occasionally Incontinent	1.76 (1.14-2.71)	0.01	20.5 (51)
Frequently Incontinent/ Completely Incontinent/Did Not Occur	0.61 (0.43-0.86)	0.005	8.2 (157)
Worsening of Bladder Continence	1.14 (0.83-1.57)	0.41	11.1 (54)

Bowel Continence in Last 7 Days			
Continent/Continent with Ostomy	1.00 (reference)		17.8 (111)
Usually Continent/ Occasionally Incontinent	0.69 (0.48-0.98)	0.04	12.9 (54)
Frequently Incontinent/ Completely Incontinent/Did Not Occur	0.30 (0.22-0.40)	< 0.0001	6.1 (91)
ADL Hierarchy Scale Score			
Independent	1.00 (reference)		26.4 (24)
Supervision to Limited Assistance	1.05 (0.61-1.81)	0.986	27.3 (62)
Extensive to Maximal Assistance	0.40 (0.24-0.68)	0.0005	12.6 (95)
Dependent to Total Dependence	0.15 (0.09-0.25)	< 0.0001	5.1 (75)
ADL Decline	1.10 (0.85-1.42)	0.47	10.6 (116)
DRS Score			
0	1.00 (reference)		8.5 (141)
1-2	1.57 (1.16-2.12)	0.004	12.7 (71)
3+	1.65 (1.15-2.37)	0.006	13.3 (44)
CPS Score			
Intact	1.00 (reference)		20.0 (5)
Borderline Intact to Mild Impairment	0.80 (0.29-2.18)	0.66	16.6 (99)
Moderate to Moderate Severe Impairment	0.59 (0.22-1.63)	0.31	12.9 (73)
Severe to Very Severe Impairment	0.25 (0.09-0.67)	0.006	5.8 (79)
Worsening Decision Making	1.21 (0.91-1.61)	0.19	11.3 (76)
Pain Scale Score			
0	1.00 (reference)		8.4 (118)
1-2	1.40 (1.07-1.84)	0.02	11.4 (115)
3	2.21 (1.36-3.60)	0.001	16.9 (23)
CHESS Score			
No Health Instability	1.00 (reference)		8.4 (84)
Minimal to Low Health Instability	1.35 (1.02-1.79)	0.04	11.0 (140)

Moderate to Very High Health Instability	1.46 (0.95-2.26)	0.09	11.8 (31)
Dizziness or Lightheadedness	1.45 (0.83-2.55)	0.19	13.8 (15)
Parkinson's Disease	1.11 (0.75-1.65)	0.61	10.9 (31)
Other Neurological Condition(s)	0.88 (0.67-1.16)	0.37	9.4 (88)
Poor Self-Rated Health	1.38 (0.93-2.04)	0.11	12.69 (33)
Fear of Falling	1.42 (1.09-1.84)	0.01	11.5 (155)
Presence of ≥ 2 Environmental Hazards	0.97 (0.62-1.52)	0.89	9.8 (23)
Length of Time Client is Alone During the Day			
Never or Hardly Ever	1.00 (reference)		8.0 (163)
About One Hour	2.26 (1.55-3.29)	< 0.0001	16.5 (40)
Long Periods of Time	2.64 (1.84-3.77)	< 0.0001	18.7 (46)
All of the Time	5.02 (2.04-12.37)	0.0005	30.4 (7)
Absence of Informal Support	1.87 (0.77-4.55)	0.17	17.1 (6)

Ambulatory HC Clients with PD

Risk Factor	Odds Ratio (95% CI)	*P* Value	% (n) That Fell
Age in Years			
0 to < 65	1.05 (0.76-1.45)	0.78	33.3 (69)
≥ 65 to < 75	1.00 (reference)		32.3 (258)
≥ 75 to < 85	0.96 (0.81-1.14)	0.62	31.3 (706)
≥ 85 to < 95	1.09 (0.90-1.32)	0.37	34.3 (396)
≥ 95 to < 115	0.63 (0.34-1.16)	0.13	23.0 (14)
Male	1.14 (1.00-1.29)	0.04	33.7 (732)
Vision			
Adequate	1.00 (reference)		32.4 (983)
Impaired/Moderately Impaired	0.99 (0.86-1.13)	0.84	32.1 (410)
Highly/Severely Impaired	0.93 (0.66-1.31)	0.69	30.9 (50)
Wandering in Last 3 Days	1.78 (1.23-2.56)	0.002	45.4 (54)
Diabetes	1.11 (0.95-1.29)	0.19	34.0 (320)

Arthritis	0.96 (0.85-1.09)	0.53	31.8 (708)
Hip Fracture	0.86 (0.62-1.19)	0.36	29.1 (53)
Diagnosed Cardiovascular Condition(s)	0.96 (0.85-1.09)	0.52	31.8 (758)
Unsteady Gait	1.45 (1.24-1.70)	< 0.0001	34.0 (1175)
≥ 9 Medications	1.11 (0.98-1.26)	0.11	33.3 (796)
Medication Use in Last 7 Days			
Antipsychotic/ Neuroleptic	1.00 (0.84-1.19)	0.98	32.3 (223)
Anxiolytic	0.99 (0.84-1.16)	0.90	32.1 (266)
Antidepressant	1.14 (1.00-1.31)	0.06	34.3 (454)
Hypnotic or Analgesic	0.98 (0.82-1.17)	0.82	31.8 (197)
Bladder Continence in Last 7 Days			
Continent/Continent with Catheter	1.00 (reference)		31.1 (654)
Usually Continent/ Occasionally Incontinent	1.07 (0.92-1.24)	0.37	32.6 (433)
Frequently Incontinent/ Completely Incontinent/Did Not Occur	1.14 (0.97-1.34)	0.10	34.0 (356)
Worsening of Bladder Continence	1.32 (1.10-1.58)	0.003	37.7 (224)
Bowel Continence in Last 7 Days			
Continent/Continent with Ostomy	1.00 (reference)		32.5 (1243)
Usually Continent/ Occasionally Incontinent	0.98 (0.80-1.21)	0.88	32.2 (146)
Frequently Incontinent/ Completely Incontinent/Did Not Occur	0.76 (0.55-1.05)	0.10	26.9 (54)
ADL Hierarchy Scale Score			
Independent	1.00 (reference)		30.6 (671)
Supervision to Limited Assistance	1.18 (1.03-1.35)	0.02	34.2 (550)
Extensive to Maximal Assistance	1.12 (0.92-1.35)	0.26	33.0 (204)
Dependent to Total Dependence	1.08 (0.61-1.90)	0.80	32.1 (18)

ADL Decline	1.05 (0.92-1.19)	0.46	34.4 (648)
DRS Score			
0	1.00 (reference)		32.9 (891)
1-2	0.91 (0.78-1.06)	0.23	30.9 (336)
3+	0.94 (0.78-1.12)	0.47	31.5 (216)
CPS Score			
Intact	1.00 (reference)		28.8 (400)
Borderline Intact to Mild Impairment	1.30 (1.13-1.50)	0.0003	34.5 (841)
Moderate to Moderate Severe Impairment	1.07 (0.84-1.35)	0.60	30.1 (132)
Severe to Very Severe Impairment	1.20 (0.88-1.63)	0.24	32.7 (70)
Worsening Decision Making	1.08 (0.91-1.28)	0.38	33.7 (235)
Pain Scale Score			
0	1.00 (reference)		33.5 (593)
1-2	0.91 (0.80-1.04)	0.18	31.5 (722)
3	0.87 (0.69-1.10)	0.24	30.6 (128)
CHESS Score			
No Health Instability	1.00 (reference)		31.3 (516)
Minimal to Low Health Instability	1.05 (0.92-1.20)	0.45	32.5 (814)
Moderate to Very High Health Instability	1.19 (0.92-1.52)	0.19	35.1 (113)
Dizziness or Lightheadedness	1.13 (0.96-1.33)	0.16	34.4 (268)
Dementia	1.15 (1.00-1.33)	0.05	34.5 (419)
Other Neurological Condition(s)	0.93 (0.79-1.10)	0.39	30.9 (240)
Poor Self-Rated Health	0.88 (0.76-1.02)	0.10	30.1 (304)
Fear of Falling	1.16 (1.02-1.31)	0.03	33.6 (829)
Stair Climbing in Last 3 Days			
Without Help	1.00 (reference)		31.4 (418)
With Help/Did Not Occur	1.06 (0.92-1.21)	0.13	32.6 (1025)
Presence of ≥ 2 Environmental Hazards	0.92 (0.65-1.30)	0.65	32.9 (572)
Length of Time Client is			

Alone During the Day			
Never or Hardly Ever	1.00 (reference)		31.4 (667)
About One Hour	1.09 (0.91-1.30)	0.35	33.3 (254)
Long Periods of Time	1.09 (0.94-1.27)	0.27	33.3 (372)
All of the Time	1.01 (0.82-1.25)	0.92	31.7 (150)
Absence of Informal Support	0.70 (0.40-1.23)	0.22	25.0 (16)

Non-Ambulatory HC Clients with PD

Risk Factor	Odds Ratio (95% CI)	*P* Value	% (n) That Fell
Age in Years			
0 to < 65	0.89 (0.41-1.97)	0.78	19.6 (10)
≥ 65 to < 75	1.00 (reference)		21.4 (33)
≥ 75 to < 85	0.63 (0.39-1.01)	0.06	14.6 (54)
≥ 85 to < 95	0.51 (0.29-0.88)	0.02	12.2 (29)
≥ 95 to < 115	0.20 (0.03-1.58)	0.13	5.3 (1)
Male	1.45 (0.99-2.12)	0.05	17.9 (67)
Vision			
Adequate	1.00 (reference)		15.8 (70)
Impaired/Moderately Impaired	1.00 (0.67-1.49)	0.99	15.8 (49)
Highly/Severely Impaired	0.58 (0.27-1.26)	0.17	9.9 (8)
Diabetes	1.09 (0.69-1.71)	0.73	16.1 (28)
Arthritis	1.14 (0.78-1.67)	0.48	16.6 (64)
Hip Fracture	0.98 (0.51-1.87)	0.95	15.0 (12)
Diagnosed Cardiovascular Condition(s)	1.55 (1.06-2.27)	0.02	18.3 (70)
Unsteady Gait	3.10 (1.79-5.36)	< 0.0001	18.5 (111)
≥ 9 Medications	1.44 (0.98-2.12)	0.06	17.5 (75)
Medication Use in Last 7 Days			
Antipsychotic/Neuroleptic	0.85 (0.51-1.43)	0.54	13.6 (20)
Anxiolytic	0.63 (0.37-1.08)	0.09	11.0 (18)
Antidepressant	1.52 (1.01-2.28)	0.04	19.5 (43)
Hypnotic or Analgesic	1.21 (0.73-2.01)	0.45	17.5 (22)
Bladder Continence in Last			

7 Days			
Continent/Continent with Catheter	1.00 (reference)		17.3 (37)
Usually Continent/ Occasionally Incontinent	1.84 (1.10-3.07)	0.02	27.7 (38)
Frequently Incontinent/ Completely Incontinent/Did Not Occur	0.58 (0.37-0.91)	0.02	10.8 (52)
Worsening of Bladder Continence	1.10 (0.68-1.77)	0.71	16.2 (25)
Bowel Continence in Last 7 Days			
Continent/Continent with Ostomy	1.00 (reference)		23.2 (88)
Usually Continent/ Occasionally Incontinent	0.56 (0.33-0.93)	0.03	14.4 (22)
Frequently Incontinent/ Completely Incontinent/Did Not Occur	0.20 (0.12-0.34)	< 0.0001	5.7 (17)
ADL Hierarchy Scale Score			
Independent	1.00 (reference)		30.8 (16)
Supervision to Limited Assistance	1.22 (0.60-2.50)	0.58	35.2 (37)
Extensive to Maximal Assistance	0.52 (0.27-1.00)	0.05	18.7 (53)
Dependent to Total Dependence	0.13 (0.06-0.27)	< 0.0001	5.4 (21)
ADL Decline	1.10 (0.76-1.61)	0.61	15.9 (63)
DRS Score			
0	1.00 (reference)		13.5 (72)
1-2	1.38 (0.87-2.17)	0.17	17.7 (32)
3+	1.53 (0.91-2.58)	0.11	19.3 (23)
CPS Score			
Intact	1.00 (reference)		18.9 (27)
Borderline Intact to Mild Impairment	1.24 (0.67-1.63)	0.39	22.4 (74)
Moderate to Moderate Severe Impairment	0.68 (0.36-1.31)	0.25	13.7 (18)
Severe to Very Severe Impairment	0.16 (0.07-0.35)	< 0.0001	3.5 (8)

Worsening Decision Making	0.82 (0.49-1.37)	0.45	13.2 (20)
Pain Scale Score			
0	1.00 (reference)		11.5 (42)
1-2	1.62 (1.07-2.45)	0.02	17.4 (68)
3	2.26 (1.21-4.24)	0.01	22.7 (17)
CHESS Score			
No Health Instability	1.00 (reference)		15.2 (42)
Minimal to Low Health Instability	1.01 (0.67-1.52)	0.96	15.3 (74)
Moderate to Very High Health Instability	0.92 (0.44-1.93)	0.82	14.1 (10)
Dizziness or Lightheadedness	1.96 (1.11-3.46)	0.02	24.7 (18)
Dementia	0.58 (0.38-0.89)	0.01	10.9 (31)
Other Neurological Condition(s)	0.88 (0.57-1.36)	0.57	14.1 (32)
Poor Self-Rated Health	1.42 (0.93-2.17)	0.11	19.0 (36)
Fear of Falling	1.96 (1.29-2.99)	0.002	18.5 (93)
Presence of ≥ 2 Environmental Hazards	0.89 (0.46-1.73)	0.73	13.9 (11)
Length of Time Client is Alone During the Day			
Never or Hardly Ever	1.00 (reference)		12.2 (76)
About One Hour	1.85 (1.07-3.19)	0.03	20.4 (20)
Long Periods of Time	2.54 (1.52-4.25)	0.0004	26.0 (25)
All of the Time	4.81 (1.67-13.88)	0.004	40.0 (6)
Absence of Informal Support	1.87 (0.37-9.35)	0.45	25.0 (2)

Ambulatory HC Clients in the Comparison Group

Risk Factor	Odds Ratio (95% CI)	*P* Value	% (n) That Fell
Age in Years			
0 to < 65	0.81 (0.75-0.87)	< 0.0001	13.6 (1700)
≥ 65 to < 75	1.00 (reference)		16.3 (1827)
≥ 75 to < 85	1.21 (1.14-1.28)	< 0.0001	19.0 (5129)
≥ 85 to < 95	1.47 (1.39-1.56)	< 0.0001	22.2 (5890)

≥ 95 to < 115	1.75 (1.60-1.92)	< 0.0001	25.4 (851)
Male	0.97 (0.93-1.01)	0.10	18.7 (4451)
Vision			
Adequate	1.00 (reference)		18.2 (10832)
Impaired/Moderately Impaired	1.24 (1.19-1.30)	< 0.0001	21.6 (3839)
Highly/Severely Impaired	1.26 (1.16-1.37)	< 0.0001	21.9 (728)
Wandering in Last 3 Days	1.16 (0.87-1.55)	0.32	21.5 (58)
Diabetes	1.12 (1.08-1.16)	< 0.0001	20.4 (4124)
Arthritis	1.24 (1.19-1.28)	< 0.0001	20.5 (9437)
Hip Fracture	1.09 (1.00-1.20)	0.05	20.5 (625)
Diagnosed Cardiovascular Condition(s)	1.18 (1.14-1.23)	< 0.0001	20.0 (10255)
Unsteady Gait	1.56 (1.51-1.62)	< 0.0001	22.4 (9275)
≥ 9 Medications	1.29 (1.25-1.34)	< 0.0001	21.4 (8212)
Medication Use in Last 7 Days			
Antipsychotic/Neuroleptic	1.01 (0.93-1.09)	0.81	19.2 (834)
Anxiolytic	1.14 (1.09-1.19)	< 0.0001	20.8 (3010)
Antidepressant	1.34 (1.28-1.39)	< 0.0001	22.9 (3512)
Hypnotic or Analgesic	1.14 (1.08-1.19)	< 0.0001	20.8 (2313)
Bladder Continence in Last 7 Days			
Continent/Continent with Catheter	1.00 (reference)		17.3 (9354)
Usually Continent/ Occasionally Incontinent	1.37 (1.31-1.43)	< 0.0001	22.2 (3821)
Frequently Incontinent/ Completely Incontinent/Did Not Occur	1.53 (1.45-1.61)	< 0.0001	24.2 (2225)
Worsening of Bladder Continence	1.40 (1.31-1.50)	< 0.0001	24.4 (1255)
Bowel Continence in Last 7 Days			
Continent/Continent with Ostomy	1.00 (reference)		18.8 (13939)
Usually Continent/ Occasionally Incontinent	1.36 (1.26-1.46)	< 0.0001	23.8 (1091)
Frequently Incontinent/ Completely Incontinent/Did	1.18 (1.05-1.33)	0.005	21.4 (370)

Not Occur			
ADL Hierarchy Scale Score			
Independent	1.00 (reference)		18.6 (12067)
Supervision to Limited Assistance	1.21 (1.16-1.27)	< 0.0001	21.7 (2778)
Extensive to Maximal Assistance	1.05 (0.95-1.15)	0.35	19.3 (531)
Dependent to Total Dependence	0.58 (0.37-0.91)	0.02	11.7 (22)
ADL Decline	1.22 (1.16-1.28)	< 0.0001	20.9 (4718)
DRS Score			
0	1.00 (reference)		18.5 (10047)
1-2	1.10 (1.05-1.15)	< 0.0001	19.9 (3291)
3+	1.20 (1.13-1.26)	< 0.0001	21.3 (2056)
CPS Score			
Intact	1.00 (reference)		17.4 (8962)
Borderline Intact to Mild Impairment	1.36 (1.31-1.41)	< 0.0001	22.3 (6057)
Moderate to Moderate Severe Impairment	1.22 (1.07-1.39)	0.004	20.4 (290)
Severe to Very Severe Impairment	0.89 (0.71-1.12)	0.33	15.9 (91)
Worsening Decision Making	1.40 (1.30-1.50)	< 0.0001	24.4 (1116)
Pain Scale Score			
0	1.00 (reference)		17.5 (4280)
1-2	1.14 (1.09-1.18)	< 0.0001	19.4 (8784)
3	1.27 (1.20-1.35)	< 0.0001	21.3 (2335)
CHESS Score			
No Health Instability	1.00 (reference)		17.1 (5384)
Minimal to Low Health Instability	1.21 (1.17-1.26)	< 0.0001	20.0 (8487)
Moderate to Very High Health Instability	1.45 (1.36-1.55)	< 0.0001	23.0 (1529)
Dizziness or Lightheadedness	1.18 (1.13-1.22)	< 0.0001	21.8 (2574)
Poor Self-Rated Health	1.13 (1.09-1.18)	< 0.0001	20.7 (3414)
Fear of Falling	1.34 (1.29-1.39)	< 0.0001	22.0 (6678)
Stair Climbing in Last 3			

Days			
Without Help	1.00 (reference)		16.7 (5912)
With Help/Did Not Occur	1.32 (1.28-1.37)	< 0.0001	21.0 (9486)
Presence of ≥ 2 Environmental Hazards	1.14 (1.03-1.26)	0.01	21.1 (475)
Length of Time Client is Alone During the Day			
Never or Hardly Ever	1.00 (reference)		17.9 (4581)
About One Hour	1.11 (1.05-1.18)	0.0007	19.6 (1720)
Long Periods of Time	1.15 (1.10-1.20)	< 0.0001	20.1 (5688)
All of the Time	1.07 (1.02-1.12)	0.007	19.0 (3410)
Absence of Informal Support	0.69 (0.62-0.78)	< 0.0001	14.2 (335)

Non-Ambulatory HC Clients in the Comparison Group

Risk Factor	Odds Ratio (95% CI)	*P* Value	% (n) That Fell
Age in Years			
0 to < 65	0.78 (0.63-0.96)	0.02	11.1 (256)
≥ 65 to < 75	1.00 (reference)		13.8 (159)
≥ 75 to < 85	1.09 (0.88-1.35)	0.42	14.9 (255)
≥ 85 to < 95	1.04 (0.83-1.30)	0.76	14.3 (196)
≥ 95 to < 115	1.05 (0.73-1.51)	0.81	14.4 (43)
Male	0.95 (0.82-1.10)	0.48	12.9 (367)
Vision			
Adequate	1.00 (reference)		12.7 (621)
Impaired/Moderately Impaired	1.21 (1.03-1.42)	0.02	15.0 (238)
Highly/Severely Impaired	1.10 (0.81-1.50)	0.54	13.8 (50)
Diabetes	1.28 (1.11-1.49)	0.001	15.4 (310)
Arthritis	1.29 (1.12-1.48)	0.0004	14.8 (498)
Hip Fracture	1.14 (0.84-1.55)	0.41	14.8 (50)
Diagnosed Cardiovascular Condition(s)	1.37 (1.19-1.58)	< 0.0001	14.8 (571)
Unsteady Gait	1.64 (1.41-1.91)	< 0.0001	15.5 (625)
≥ 9 Medications	1.29 (1.22-1.49)	0.0004	14.7 (534)
Medication Use in Last 7			

Days			
Antipsychotic/Neuroleptic	1.17 (0.87-1.57)	0.31	15.0 (54)
Anxiolytic	1.20 (1.01-1.42)	0.03	15.0 (205)
Antidepressant	1.58 (1.35-1.83)	< 0.0001	17.5 (299)
Hypnotic or Analgesic	1.27 (1.06-1.52)	0.01	15.7 (172)
Bladder Continence in Last 7 Days			
Continent/Continent with Catheter	1.00 (reference)		12.4 (479)
Usually Continent/ Occasionally Incontinent	1.43 (1.19-1.71)	0.0001	16.8 (199)
Frequently Incontinent/ Completely Incontinent/Did Not Occur	1.06 (0.89-1.25)	0.53	13.0 (231)
Worsening of Bladder Continence	1.20 (0.95-1.50)	0.12	15.2 (98)
Bowel Continence in Last 7 Days			
Continent/Continent with Ostomy	1.00 (reference)		14.5 (727)
Usually Continent/ Occasionally Incontinent	0.92 (0.74-1.15)	0.47	13.6 (110)
Frequently Incontinent/ Completely Incontinent/Did Not Occur	0.45 (0.35-0.57)	< 0.0001	7.0 (72)
ADL Hierarchy Scale Score			
Independent	1.00 (reference)		16.7 (391)
Supervision to Limited Assistance	1.09 (0.91-1.30)	0.35	18.0 (232)
Extensive to Maximal Assistance	0.59 (0.50-0.71)	< 0.0001	10.7 (208)
Dependent to Total Dependence	0.33 (0.25-0.42)	< 0.0001	6.2 (78)
ADL Decline	1.49 (1.19-1.86)	0.0005	15.2 (333)
DRS Score			
0	1.00 (reference)		12.5 (577)
1-2	1.14 (0.96-1.36)	0.13	14.1 (198)
3+	1.34 (1.09-1.65)	0.005	16.1 (134)
CPS Score			
Intact	1.00 (reference)		12.6 (530)

Borderline Intact to Mild Impairment	1.35 (1.16-1.56)	< 0.0001	16.2 (337)
Moderate to Moderate Severe Impairment	0.78 (0.51-1.20)	0.26	10.1 (25)
Severe to Very Severe Impairment	0.42 (0.26-0.70)	0.0007	5.7 (17)
Worsening Decision Making	0.87 (0.64-1.20)	0.41	11.9 (45)
Pain Scale Score			
0	1.00 (reference)		11.2 (209)
1-2	1.27 (1.07-1.51)	0.006	13.8 (512)
3	1.40 (1.13-1.73)	0.002	15.0 (188)
CHESS Score			
No Health Instability	1.00 (reference)		10.7 (290)
Minimal to Low Health Instability	1.45 (1.24-1.69)	< 0.0001	14.8 (531)
Moderate to Very High Health Instability	1.59 (1.22-2.05)	0.0005	16.0 (88)
Dizziness or Lightheadedness	1.27 (1.10-1.47)	0.001	18.0 (106)
Poor Self-Rated Health	1.24 (1.06-1.45)	0.009	15.2 (246)
Presence of ≥ 2 Environmental Hazards	0.88 (0.66-1.16)	0.36	11.9 (58)
Fear of Falling	1.27 (1.11-1.47)	0.0007	14.9 (448)
Length of Time Client is Alone During the Day			
Never or Hardly Ever	1.00 (reference)		11.3 (337)
About One Hour	1.14 (0.92-1.41)	0.24	12.6 (129)
Long Periods of Time	1.39 (1.18-1.64)	0.0001	15.0 (313)
All of the Time	1.67 (1.34-2.08)	< 0.0001	17.5 (130)
Absence of Informal Support	0.94 (0.64-1.39)	0.75	12.6 (30)

Results of Bivariate Analyses in LTC

The % (n) column states the percentage of individuals within each level of the independent

variables who fell within 30 days prior to their follow-up assessment. E.g. of all ambulatory LTC

residents with dementia who are female, 14.3% of them fell in the 30 days prior to their follow-up assessment.

Ambulatory LTC Residents with Dementia

Risk Factor	Odds Ratio (95% CI)	*P* Value	% (n) That Fell
Age in Years			
0 to < 65	0.91 (0.69-1.22)	0.54	11.0 (71)
≥ 65 to < 75	1.00 (reference)		12.0 (200)
≥ 75 to < 85	1.26 (1.07-1.47)	0.006	14.6 (1075)
≥ 85 to < 95	1.37 (1.17-1.61)	< 0.0001	15.7 (1513)
≥ 95 to < 115	1.46 (1.19-1.79)	0.0003	16.6 (230)
Gender			
Female	1.00 (reference)		14.3 (2064)
Male	1.17 (1.08-1.27)	0.0002	16.3 (1024)
Other Sex	1.06 (0.31-3.61)	0.93	15.0 (3)
Vision			
Adequate	1.00 (reference)		13.8 (1758)
Impaired/ Moderately Impaired	1.28 (1.18-1.38)	< 0.0001	17.0 (1178)
Highly/Severely Impaired	1.08 (0.90-1.29)	0.41	14.8 (149)
Wandering in Last 7 Days	1.68 (1.56-1.82)	< 0.0001	19.3 (1440)
Diabetes Mellitus	1.00 (0.91-1.10)	0.99	14.9 (682)
Arthritis	1.05 (0.97-1.13)	0.25	15.3 (1136)
Hip Fracture	1.20 (0.98-1.46)	0.08	17.2 (122)
Diagnosed Cardiovascular Condition(s)	1.07 (0.99-1.16)	0.08	15.3 (1900)
Unsteady Gait	1.52 (1.40-1.64)	< 0.0001	17.7 (1714)
≥ 9 Medications	1.13 (1.05-1.22)	0.002	15.6 (1827)
Medication Use in Last 7 Days			
Antipsychotic	1.22 (1.13-1.32)	< 0.0001	16.3 (1492)
Antianxiety	1.23 (1.11-1.37)	< 0.0001	17.3 (519)
Antidepressant	1.19 (1.11-1.29)	< 0.0001	16.0 (1675)
Hypnotic	1.15 (0.97-1.35)	0.10	16.6 (189)
Diuretic	0.99 (0.91-1.08)	0.81	14.8 (990)
Bladder Continence in Last			

14 Days			
Continent	1.00 (reference)		11.2 (721)
Usually Continent/ Occasionally Incontinent	1.46 (1.31-1.63)	< 0.0001	15.6 (718)
Frequently Incontinent	1.71 (1.54-1.91)	< 0.0001	17.8 (827)
Incontinent	1.53 (1.38-1.71)	< 0.0001	16.3 (825)
Bowel Continence in Last 14 Days			
Continent	1.00 (reference)		13.3 (1468)
Usually Continent to Frequently Incontinent	1.44 (1.32-1.56)	< 0.0001	18.1 (1167)
Completely Incontinent	1.07 (0.96-1.)	0.22	14.1 (456)
ADL Hierarchy Scale Score			
Independent	1.00 (reference)		9.0 (176)
Supervision to Limited Assistance	1.49 (1.26-1.77)	< 0.0001	12.8 (883)
Extensive to Maximal Assistance	2.32 (1.97-2.73)	< 0.0001	18.6 (1860)
Dependent to Total Dependence	1.05 (0.85-1.32)	0.62	9.4 (172)
DRS Score			
0	1.00 (reference)		12.4 (873)
1-2	1.22 (1.11-1.34)	< 0.0001	14.7 (1013)
3+	1.52 (1.38-1.67)	< 0.0001	17.7 (1205)
CPS Score			
Intact	1.00 (reference)		9.8 (95)
Borderline Intact to Mild Impairment	1.26 (1.00-1.58)	0.05	12.0 (704)
Moderate to Moderate Severe Impairment	1.78 (1.43-2.22)	< 0.0001	16.2 (1639)
Severe to Very Severe Impairment	1.93 (1.54-2.44)	< 0.0001	17.4 (653)
Pain Scale Score			
0	1.00 (reference)		14.7 (2059)
1-2	1.06 (0.98-1.15)	0.17	15.4 (997)
3	0.91 (0.64-1.30)	0.61	13.6 (35)
CHESS Score			
No Health Instability	1.00 (reference)		13.2 (1449)
Minimal to Low Health	1.33 (1.23-1.44)	< 0.0001	16.9 (1475)

	Odds Ratio (95% CI)	P Value	% (n) That Fell
Instability			
Moderate to Very High Health Instability	1.27 (1.07-1.52)	0.007	16.3 (167)
Dizziness/Vertigo in Last 7 Days	1.27 (1.02-1.57)	0.03	18.1 (104)
Parkinson's Disease	1.18 (0.99-1.42)	0.07	17.1 (148)
Other Neurological Condition(s)	1.02 (0.92-1.13)	0.70	15.1 (485)
Use of Trunk Restraint	0.49 (0.33-0.75)	0.0008	8.0 (25)
Use of Chair That Prevents Rising	0.52 (0.33-0.80)	0.003	8.4 (22)

Non-Ambulatory LTC Residents with Dementia

Risk Factor	Odds Ratio (95% CI)	*P* Value	% (n) That Fell
Age in Years			
0 to < 65	0.79 (0.54-1.16)	0.23	5.4 (34)
≥ 65 to < 75	1.00 (reference)		6.7 (142)
≥ 75 to < 85	1.04 (0.86-1.25)	0.70	7.0 (749)
≥ 85 to < 95	1.05 (0.88-1.26)	0.59	7.1 (1255)
≥ 95 to < 115	1.00 (0.81-1.23)	0.99	6.7 (283)
Gender			
Female	1.00 (reference)		6.1 (1586)
Male	1.58 (1.45-1.72)	< 0.0001	9.3 (875)
Other Sex	1.71 (0.52-5.65)	0.38	10.0 (3)
Vision			
Adequate	1.00 (reference)		8.0 (1163)
Impaired/ Moderately Impaired	0.88 (0.81-0.96)	0.004	7.1 (1089)
Highly/Severely Impaired	0.45 (0.39-0.52)	< 0.0001	3.8 (212)
Diabetes Mellitus	1.12 (1.02-1.24)	0.02	7.5 (612)
Arthritis	1.04 (0.95-1.13)	0.40	7.1 (988)
Hip Fracture	1.31 (1.16-1.48)	< 0.0001	8.7 (308)
Diagnosed Cardiovascular Condition(s)	1.24 (1.14-1.35)	< 0.0001	7.5 (1553)
Unsteady Gait	2.65 (2.44-2.88)	< 0.0001	12.5 (1093)
≥ 9 Medications	1.38 (1.26-1.50)	< 0.0001	7.8 (1587)

Medication Use in Last 7 Days			
Antipsychotic	1.19 (1.10-1.29)	< 0.0001	7.6 (1062)
Antianxiety	1.22 (1.09-1.36)	0.0005	8.1 (423)
Antidepressant	1.39 (1.28-1.52)	< 0.0001	8.0 (1428)
Hypnotic	1.29 (1.09-1.53)	0.003	8.7 (157)
Diuretic	1.14 (1.05-1.25)	0.002	7.6 (869)
Bladder Continence in Last 14 Days			
Continent	1.00 (reference)		14.0 (282)
Usually Continent/ Occasionally Incontinent	1.16 (0.97-1.38)	0.11	15.9 (304)
Frequently Incontinent	0.71 (0.61-0.83)	< 0.0001	10.4 (629)
Incontinent	0.32 (0.28-0.36)	< 0.0001	4.9 (1249)
Bowel Continence in Last 14 Days			
Continent	1.00 (reference)		14.7 (678)
Usually Continent to Frequently Incontinent	0.59 (0.53-0.66)	< 0.0001	9.2 (979)
Completely Incontinent	0.24 (0.22-0.27)	< 0.0001	4.0 (807)
ADL Hierarchy Scale Score			
Independent	1.00 (reference)		23.7 (45)
Supervision to Limited Assistance	0.84 (0.58-1.22)	0.36	20.7 (211)
Extensive to Maximal Assistance	0.46 (0.32-0.64)	< 0.0001	12.4 (1274)
Dependent to Total Dependence	0.13 (0.09-0.18)	< 0.0001	3.9 (934)
DRS Score			
0	1.00 (reference)		6.5 (685)
1-2	0.92 (0.83-1.02)	0.13	6.0 (813)
3+	1.33 (1.20-1.48)	< 0.0001	8.5 (966)
CPS Score			
Intact	1.00 (reference)		58 (9.4)
Borderline Intact to Mild Impairment	1.11 (0.83-1.48)	0.49	10.3 (447)
Moderate to Moderate Severe Impairment	1.06 (0.80-1.39)	0.69	9.9 (1273)
Severe to Very Severe	0.39 (0.29-0.51)	< 0.0001	3.9 (686)

Impairment			
Pain Scale Score			
0	1.00 (reference)		6.6 (1542)
1-2	1.18 (1.09-1.29)	0.0001	7.7 (889)
3	0.84 (0.59-1.20)	0.33	5.6 (33)
CHESS Score			
No Health Instability	1.00 (reference)		6.7 (993)
Minimal to Low Health Instability	1.05 (0.96-1.15)	0.26	7.0 (1269)
Moderate to Very High Health Instability	1.28 (1.09-1.50)	0.002	8.4 (202)
Dizziness/Vertigo in Last 7 Days	2.44 (1.90-3.14)	< 0.0001	15.2 (74)
Parkinson's Disease	0.98 (0.84-1.14)	0.77	6.8 (201)
Other Neurological Condition(s)	1.02 (0.93-1.12)	0.68	7.0 (611)
Use of Trunk Restraint	0.53 (0.47-0.59)	< 0.0001	4.3 (399)
Use of Chair That Prevents Rising	0.38 (0.34-0.44)	< 0.0001	3.2 (254)

Ambulatory LTC Residents with PD

Risk Factor	Odds Ratio (95% CI)	*P* Value	% (n) That Fell
Age in Years			
0 to < 65	1.17 (0.54-2.54)	0.69	18.5 (10)
≥ 65 to < 75	1.00 (reference)		16.3 (35)
≥ 75 to < 85	0.85 (0.56-1.29)	0.44	14.1 (99)
≥ 85 to < 95	1.14 (0.75-1.73)	0.55	18.1 (108)
≥ 95 to < 115	1.03 (0.42-2.50)	0.95	16.7 (7)
Gender			
Female	1.00 (reference)		14.7 (128)
Male	1.26 (0.96-1.64)	0.09	17.8 (131)
Other Sex	< 0.001	0.98	0 (0)
Vision			
Adequate	1.00 (reference)		16.2 (161)
Impaired/ Moderately Impaired	1.08 (0.82-1.44)	0.57	17.3 (92)

Highly/Severely Impaired	0.46 (0.20-1.07)	0.07	8.1 (6)
Wandering in Last 7 Days	1.88 (1.38-2.56)	< 0.0001	23.9 (71)
Diabetes Mellitus	1.03 (0.75-1.41)	0.87	16.4 (58)
Arthritis	0.98 (0.74-1.29)	0.87	15.9 (92)
Hip Fracture	1.05 (0.54-2.02)	0.90	16.7 (11)
Diagnosed Cardiovascular Condition(s)	0.79 (0.60-1.03)	0.08	14.6 (130)
Unsteady Gait	1.52 (1.16-2.00)	0.003	18.6 (164)
≥ 9 Medications	1.32 (0.97-1.80)	0.08	17.1 (199)
Medication Use in Last 7 Days			
Antipsychotic	0.91 (0.69-1.19)	0.48	15.3 (92)
Antianxiety	0.83 (0.58-1.18)	0.29	14.1 (43)
Antidepressant	1.21 (0.92-1.58)	0.17	17.3 (148)
Hypnotic	0.84 (0.51-1.37)	0.47	14.0 (20)
Diuretic	0.74 (0.54-0.99)	0.04	13.3 (64)
Bladder Continence in Last 14 Days			
Continent	1.00 (reference)		9.7 (47)
Usually Continent/ Occasionally Incontinent	2.08 (1.39-3.11)	0.0003	18.3 (67)
Frequently Incontinent	2.93 (1.99-4.30)	< 0.0001	23.9 (88)
Incontinent	1.60 (1.06-2.42)	0.03	14.5 (57)
Bowel Continence in Last 14 Days			
Continent	1.00 (reference)		14.9 (141)
Usually Continent to Frequently Incontinent	1.47 (1.10-1.97)	0.01	20.5 (90)
Completely Incontinent	0.83 (0.54-1.28)	0.40	12.7 (28)
ADL Hierarchy Scale Score			
Independent	1.00 (reference)		11.3 (20)
Supervision to Limited Assistance	1.07 (0.63-1.84)	0.80	12.0 (60)
Extensive to Maximal Assistance	2.22 (1.35-3.64)	0.002	22.0 (162)
Dependent to Total Dependence	0.74 (0.38-1.47)	0.39	8.6 (17)
DRS Score			
0	1.00 (reference)		17.5 (108)

1-2	0.73 (0.52-1.01)	0.05	13.3 (70)
3+	0.99 (0.72-1.36)	0.95	17.3 (81)
CPS Score			
Intact	1.00 (reference)		13.0 (41)
Borderline Intact to Mild Impairment	1.09 (0.73-1.63)	0.67	14.0 (81)
Moderate to Moderate Severe Impairment	1.74 (1.18-2.56)	0.005	20.6 (112)
Severe to Very Severe Impairment	1.16 (0.68-1.99)	0.58	14.8 (25)
Pain Scale Score			
0	1.00 (reference)		17.0 (170)
1-2	0.84 (0.63-1.11)	0.21	14.6 (85)
3	0.78 (0.27-2.27)	0.65	13.8 (4)
CHESS Score			
No Health Instability	1.00 (reference)		15.5 (133)
Minimal to Low Health Instability	1.15 (0.88-1.52)	0.31	17.4 (115)
Moderate to Very High Health Instability	0.77 (0.40-1.49)	0.44	12.4 (11)
Dizziness/Vertigo in Last 7 Days	1.11 (0.57-2.15)	0.76	17.5 (11)
Dementia	1.17 (0.89-1.53)	0.26	17.1 (148)
Other Neurological Condition(s)	1.10 (0.77-1.57)	0.61	17.2 (43)
Use of Trunk Restraint	1.14 (0.50-2.62)	0.75	18.0 (7)
Use of Chair That Prevents Rising	0.34 (0.08-1.44)	0.14	6.3 (2)

Non-Ambulatory LTC Residents with PD

Risk Factor	Odds Ratio (95% CI)	*P* Value	% (n) That Fell
Age in Years			
0 to < 65	1.36 (0.68-2.74)	0.39	10.7 (11)
≥ 65 to < 75	1.00 (reference)		8.1 (43)
≥ 75 to < 85	0.96 (0.68-1.37)	0.84	7.8 (157)
≥ 85 to < 95	0.84 (0.59-1.20)	0.34	6.9 (138)

≥ 95 to < 115	0.83 (0.44-1.55)	0.55	6.8 (14)
Gender			
Female	1.00 (reference)		5.9 (165)
Male	1.70 (1.37-2.11)	< 0.0001	9.6 (197)
Other Sex	8.02 (0.72-88.85)	0.09	33.3 (1)
Vision			
Adequate	1.00 (reference)		8.3 (184)
Impaired/ Moderately Impaired	0.84 (0.67-1.05)	0.12	7.1 (148)
Highly/Severely Impaired	0.66 (0.45-0.98)	0.04	5.7 (31)
Diabetes Mellitus	1.08 (0.84-1.39)	0.56	7.9 (84)
Arthritis	0.94 (0.75-1.18)	0.59	7.2 (130)
Hip Fracture	1.31 (0.92-1.85)	0.13	9.3 (39)
Diagnosed Cardiovascular Condition(s)	1.14 (0.92-1.42)	0.22	7.9 (204)
Unsteady Gait	2.78 (2.24-3.45)	< 0.0001	13.2 (182)
≥ 9 Medications	1.10 (0.87-1.40)	0.43	7.7 (263)
Medication Use in Last 7 Days			
Antipsychotic	0.95 (0.75-1.19)	0.65	7.2 (114)
Antianxiety	0.88 (0.65-1.19)	0.40	6.7 (53)
Antidepressant	1.15 (0.93-1.43)	0.20	7.9 (197)
Hypnotic	1.39 (0.94-2.06)	0.10	9.9 (30)
Diuretic	0.95 (0.75-1.20)	0.64	7.2 (107)
Bladder Continence in Last 14 Days			
Continent	1.00 (reference)		13.0 (50)
Usually Continent/ Occasionally Incontinent	0.91 (0.58-1.43)	0.69	12.0 (39)
Frequently Incontinent	0.85 (0.60-1.22)	0.38	11.3 (110)
Incontinent	0.37 (0.26-0.51)	< 0.0001	5.2 (164)
Bowel Continence in Last 14 Days			
Continent	1.00 (reference)		12.6 (126)
Usually Continent to Frequently Incontinent	0.75 (0.59-0.96)	0.02	9.7 (157)
Completely Incontinent	0.26 (0.19-0.34)	< 0.0001	3.6 (80)
ADL Hierarchy Scale Score			

Independent	1.00 (reference)		13.9 (5)
Supervision to Limited Assistance	1.78 (0.64-4.99)	0.27	22.3 (29)
Extensive to Maximal Assistance	0.90 (0.35-2.35)	0.83	12.7 (172)
Dependent to Total Dependence	0.31 (0.12-0.80)	0.02	4.7 (157)
DRS Score			
0	1.00 (reference)		7.7 (117)
1-2	0.94 (0.73-1.21)	0.61	7.3 (140)
3+	0.96 (0.73-1.26)	0.74	7.4 (106)
CPS Score			
Intact	1.00 (reference)		8.3 (34)
Borderline Intact to Mild Impairment	1.27 (0.85-1.91)	0.24	10.3 (109)
Moderate to Moderate Severe Impairment	1.18 (0.80-1.73)	0.41	9.6 (161)
Severe to Very Severe Impairment	0.40 (0.26-0.62)	< 0.0001	3.5 (59)
Pain Scale Score			
0	1.00 (reference)		7.6 (224)
1-2	0.97 (0.78-1.21)	0.78	7.4 (139)
3	0.48 (0.15-1.53)	0.21	3.8 (3)
CHESS Score			
No Health Instability	1.00 (reference)		7.8 (166)
Minimal to Low Health Instability	0.89 (0.72-1.12)	0.32	7.0 (169)
Moderate to Very High Health Instability	1.16 (0.76-1.76)	0.50	8.9 (28)
Dizziness/Vertigo in Last 7 Days	1.19 (0.60-2.38)	0.62	8.7 (9)
Dementia	0.79 (0.64-0.98)	0.03	6.8 (201)
Other Neurological Condition(s)	1.17 (0.91-1.51)	0.22	8.4 (87)
Use of Trunk Restraint	0.64 (0.48-0.85)	0.002	5.3 (57)
Use of Chair That Prevents Rising	0.45 (0.32-0.63)	< 0.0001	4.0 (41)

Ambulatory LTC Residents in the Comparison Group

Risk Factor	Odds Ratio (95% CI)	*P* Value	% (n) That Fell
Age in Years			
0 to < 65	0.68 (0.48-0.95)	0.03	6.1 (55)
≥ 65 to < 75	1.00 (reference)		8.7 (93)
≥ 75 to < 85	1.10 (0.86-1.41)	0.45	9.5 (271)
≥ 85 to < 95	1.19 (0.95-1.51)	0.14	10.2 (476)
≥ 95 to < 115	1.70 (1.29-2.24)	0.0002	14.0 (146)
Gender			
Female	1.00 (reference)		10.3 (744)
Male	0.87 (0.75-1.00)	0.05	9.1 (297)
Other Sex	< 0.001	0.97	0.0 (0)
Vision			
Adequate	1.00 (reference)		9.2 (642)
Impaired/ Moderately Impaired	1.25 (1.09-1.44)	0.001	11.3 (339)
Highly/Severely Impaired	1.20 (0.91-1.58)	0.21	10.9 (60)
Wandering in Last 7 Days	1.80 (1.45-2.23)	< 0.0001	15.9 (111)
Diabetes Mellitus	1.12 (0.97-1.29)	0.12	10.6 (307)
Arthritis	1.19 (1.05-1.35)	0.009	10.8 (468)
Hip Fracture	1.38 (1.03-1.85)	0.03	13.0 (54)
Diagnosed Cardiovascular Condition(s)	1.02 (0.89-1.16)	0.83	9.9 (681)
Unsteady Gait	1.41 (1.24-1.60)	< 0.0001	11.7 (525)
≥ 9 Medications	1.41 (1.22-1.64)	< 0.0001	10.8 (778)
Medication Use in Last 7 Days			
Antipsychotic	1.12 (0.97-1.30)	0.13	10.7 (267)
Antianxiety	1.03 (0.89-1.20)	0.68	10.1 (234)
Antidepressant	1.47 (1.30-1.67)	< 0.0001	11.9 (531)
Hypnotic	1.13 (0.92-1.40)	0.25	10.9 (108)
Diuretic	1.23 (1.08-1.39)	0.002	10.9 (517)
Bladder Continence in Last 14 Days			
Continent	1.00 (reference)		7.9 (423)
Usually Continent/ Occasionally Incontinent	1.40 (1.19-1.64)	< 0.0001	10.8 (269)

Frequently Incontinent	1.98 (1.67-2.35)	< 0.0001	14.6 (228)
Incontinent	1.42 (1.15-1.75)	0.001	10.9 (121)
Bowel Continence in Last 14 Days			
Continent	1.00 (reference)		9.2 (745)
Usually Continent to Frequently Incontinent	1.59 (1.37-1.85)	< 0.0001	13.9 (257)
Completely Incontinent	0.68 (0.49-0.95)	0.02	6.5 (39)
ADL Hierarchy Scale Score			
Independent	1.00 (reference)		8.1 (229)
Supervision to Limited Assistance	1.16 (0.98-1.37)	0.10	9.3 (399)
Extensive to Maximal Assistance	1.77 (1.49-2.11)	< 0.0001	13.5 (365)
Dependent to Total Dependence	0.86 (0.62-1.18)	0.35	7.0 (48)
DRS Score			
0	1.00 (reference)		8.7 (425)
1-2	1.21 (1.04-1.41)	0.02	10.3 (309)
3+	1.38 (1.18-1.62)	< 0.0001	11.6 (307)
CPS Score			
Intact	1.00 (reference)		7.8 (342)
Borderline Intact to Mild Impairment	1.38 (1.19-1.60)	< 0.0001	10.5 (433)
Moderate to Moderate Severe Impairment	1.97 (1.65-2.35)	< 0.0001	14.3 (237)
Severe to Very Severe Impairment	1.15 (0.77-1.71)	0.49	8.9 (29)
Pain Scale Score			
0	1.00 (reference)		9.8 (555)
1-2	1.03 (0.91-1.18)	0.63	10.1 (454)
3	1.03 (0.71-1.50)	0.88	10.0 (32)
CHESS Score			
No Health Instability	1.00 (reference)		8.5 (510)
Minimal to Low Health Instability	1.43 (1.25-1.63)	< 0.0001	11.8 (482)
Moderate to Very High Health Instability	1.39 (1.02-1.90)	0.04	11.5 (49)
Dizziness/Vertigo in Last 7	1.67 (1.28-2.18)	0.0002	15.2 (67)

Days			
Use of Trunk Restraint	0.76 (0.23-2.47)	0.65	7.7 (3)
Use of Chair That Prevents Rising	0.29 (0.04-2.15)	0.23	3.1 (1)

Non-Ambulatory LTC Residents in the Comparison Group

Risk Factor	Odds Ratio (95% CI)	*P* Value	% (n) That Fell
Age in Years			
0 to < 65	0.95 (0.64-1.39)	0.78	6.6 (44)
≥ 65 to < 75	1.00 (reference)		6.9 (74)
≥ 75 to < 85	1.05 (0.80-1.38)	0.70	7.3 (234)
≥ 85 to < 95	1.20 (0.93-1.55)	0.16	8.2 (481)
≥ 95 to < 115	1.22 (0.92-1.63)	0.17	8.3 (159)
Gender			
Female	1.00 (reference)		7.3 (693)
Male	1.25 (1.09-1.44)	0.002	9.0 (299)
Other Sex	< 0.001	0.96	0 (0)
Vision			
Adequate	1.00 (reference)		7.9 (564)
Impaired/ Moderately Impaired	1.01 (0.88-1.64)	0.84	8.0 (360)
Highly/Severely Impaired	0.77 (0.59-1.01)	0.05	6.2 (66)
Diabetes Mellitus	1.14 (0.99-1.31)	0.06	8.4 (324)
Arthritis	0.98 (0.86-1.11)	0.74	7.7 (459)
Hip Fracture	1.18 (0.96-1.45)	0.12	8.9 (109)
Diagnosed Cardiovascular Condition(s)	1.05 (0.91-1.21)	0.50	7.9 (682)
Unsteady Gait	1.99 (1.75-2.27)	< 0.0001	11.5 (455)
≥ 9 Medications	1.33 (1.13-1.56)	0.0005	8.3 (788)
Medication Use in Last 7 Days			
Antipsychotic	1.05 (0.90-1.24)	0.53	8.1 (204)
Antianxiety	1.07 (0.91-1.25)	0.43	8.1 (216)
Antidepressant	1.14 (1.00-1.30)	0.04	8.3 (507)
Hypnotic	1.21 (0.98-1.49)	0.08	9.1 (104)
Diuretic	1.15 (1.01-1.30)	0.04	8.3 (528)

Bladder Continence in Last 14 Days			
Continent	1.00 (reference)		10.3 (280)
Usually Continent/ Occasionally Incontinent	1.01 (0.84-1.23)	0.89	10.4 (199)
Frequently Incontinent	0.83 (0.69-0.99)	0.04	8.7 (249)
Incontinent	0.46 (0.39-0.55)	< 0.0001	5.0 (264)
Bowel Continence in Last 14 Days			
Continent	1.00 (reference)		10.5 (566)
Usually Continent to Frequently Incontinent	0.67 (0.58-0.78)	< 0.0001	7.3 (292)
Completely Incontinent	0.36 (0.29-0.43)	< 0.0001	4.0 (134)
ADL Hierarchy Scale Score			
Independent	1.00 (reference)		12.3 (71)
Supervision to Limited Assistance	1.04 (0.77-1.39)	0.81	12.7 (177)
Extensive to Maximal Assistance	0.72 (0.55-0.93)	0.01	9.1 (528)
Dependent to Total Dependence	0.33 (0.25-0.43)	< 0.0001	4.4 (216)
DRS Score			
0	1.00 (reference)		7.7 (348)
1-2	0.98 (0.83-1.15)	0.78	7.5 (290)
3+	1.10 (0.90-1.23)	0.50	8.1 (354)
CPS Score			
Intact	1.00 (reference)		7.4 (285)
Borderline Intact to Mild Impairment	1.26 (1.07-1.47)	0.004	9.1 (413)
Moderate to Moderate Severe Impairment	1.10 (0.92-1.32)	0.29	8.1 (242)
Severe to Very Severe Impairment	0.51 (0.38-0.70)	< 0.0001	4.0 (52)
Pain Scale Score			
0	1.00 (reference)		7.4 (437)
1-2	1.07 (0.94-1.22)	0.32	7.9 (497)
3	1.33 (1.00-1.77)	0.05	9.6 (58)
CHESS Score			
No Health Instability	1.00 (reference)		7.7 (398)

Minimal to Low Health Instability	1.01 (0.89-1.16)	0.84	7.8 (516)
Moderate to Very High Health Instability	1.00 (0.78-1.29)	1.00	7.7 (78)
Dizziness/Vertigo in Last 7 Days	1.86 (1.35-2.56)	0.0001	13.3 (45)
Use of Trunk Restraint	0.39 (0.27-0.55)	< 0.0001	3.3 (32)
Use of Chair That Prevents Rising	0.37 (0.25-0.55)	< 0.0001	3.2 (27)

APPENDIX B

Model Building and Selection Methods

Ambulatory HC Clients with Dementia

Step 1-Add Parkinson's disease

QICu = 32032.64

P value < 0.0001

Step 2-Add unsteady gait

QICu = 31710.11

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001

Step 3-Add fear of falling

QICu = 31703.88

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001
Fear of Falling	0.009

Step 4-Add bladder continence

QICu = 31650.55

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001
Fear of Falling	0.04
Bladder Cont.	< 0.0001

Step 5-Remove fear of falling, add pain scale score

QICu = 31640.27

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001
Bladder Cont.	< 0.0001
Pain Score	< 0.0001

Step 6-Add age

QICu = 31601.47

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001
Bladder Cont.	< 0.0001
Pain Score	< 0.0001
Age	< 0.0001

Step 7-Add dizziness or lightheadedness

QICu = 31581.24

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001
Bladder Cont.	< 0.0001
Pain Score	< 0.0001
Age	< 0.0001
Dizziness	0.0004

Step 8-Add stair climbing

QICu = 31569.94

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001
Bladder Cont.	< 0.0001
Pain Score	0.0001
Age	< 0.0001
Dizziness	0.0004
Stair Climbing	0.0003

Step 9-Add worsening bladder continence

QICu = 31557.60

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001
Bladder Cont.	< 0.0001
Pain Score	0.0001
Age	< 0.0001
Dizziness	0.0005
Stair Climbing	0.0002
Worsening bladder continence	< 0.0001

Step 10-Add poor self-rated health

QICu = 31557.74

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001
Bladder Cont.	< 0.0001
Pain Score	0.0002
Age	< 0.0001
Dizziness	0.0009
Stair Climbing	0.0002
Worsening bladder continence	< 0.0001
Poor Self-Rated Health	0.02

Step 11-Remove poor self-rated health, add vision

QICu = 31554.46

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001
Bladder Cont.	< 0.0001
Pain Score	0.0003
Age	< 0.0001
Dizziness	0.0007

Stair Climbing	0.0004
Worsening bladder continence	< 0.0001
Vision	0.02

Step 12-Remove vision, add ADL Hierarchy

QICu = 31549.78

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001
Bladder Cont.	< 0.0001
Pain Score	0.0002
Age	< 0.0001
Dizziness	0.0005
Stair Climbing	0.0002
Worsening bladder continence	< 0.0001
ADL Hierarchy	0.003

Step 13- Add ≥ 9 medications

QICu = 31536.09

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001
Bladder Cont.	< 0.0001
Pain Score	0.002
Age	< 0.0001
Dizziness	0.0008
Stair Climbing	0.001
Worsening bladder continence	< 0.0001
ADL Hierarchy	0.003
≥ 9 Medications	< 0.0001

Step 14-Add CHESS Score

QICu = 31540.07

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001
Bladder Cont.	< 0.0001
Pain Score	0.001
Age	< 0.0001
Dizziness	0.001
Stair Climbing	0.001
Worsening bladder continence	< 0.0001
ADL Hierarchy	0.004
≥ 9 Medications	< 0.0001
CHESS Score	0.62

Step 15-Remove CHESS Score, add bowel continence

QICu = 31539.43

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001
Bladder Cont.	< 0.0001
Pain Score	0.002
Age	< 0.0001
Dizziness	0.0008
Stair Climbing	0.001
Worsening bladder continence	< 0.0001
ADL Hierarchy	0.003
≥ 9 Medications	< 0.0001
Bowel Cont.	0.48

Step 16-Remove bowel continence, add arthritis

QICu = 31533.54

Variable	P value
Parkinson's	< 0.0001

Unsteady Gait	< 0.0001
Bladder Cont.	< 0.0001
Pain Score	0.04
Age	< 0.0001
Dizziness	0.0009
Stair Climbing	0.001
Worsening bladder continence	< 0.0001
ADL Hierarchy	0.004
≥ 9 Medications	< 0.0001
Arthritis	0.03

Step 17- Remove arthritis, add other neurological conditions

QICu = 31534.04

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001
Bladder Cont.	< 0.0001
Pain Score	0.002
Age	< 0.0001
Dizziness	0.0009
Stair Climbing	0.001
Worsening bladder continence	< 0.0001
ADL Hierarchy	0.003
≥ 9 Medications	< 0.0001
Other Neuro	0.02

Step 18-Remove other neurological conditions, add antidepressant use

QICu = 31528.07

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001
Bladder Cont.	< 0.0001
Pain Score	0.003
Age	< 0.0001

Dizziness	0.0009
Stair Climbing	0.002
Worsening bladder continence	< 0.0001
ADL Hierarchy	0.003
≥ 9 Medications	< 0.0001
Antidepressant	0.006

Step 19-Add ADL decline

QICu = 31529.73

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001
Bladder Cont.	< 0.0001
Pain Score	0.002
Age	< 0.0001
Dizziness	0.001
Stair Climbing	0.002
Worsening bladder continence	< 0.0001
ADL Hierarchy	0.003
≥ 9 Medications	< 0.0001
Antidepressant	0.005
ADL Decline	0.56

Step 20-Remove ADL decline, add gender

QICu = 31497.68

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001
Bladder Cont.	< 0.0001
Pain Score	0.0009
Age	< 0.0001
Dizziness	0.001
Stair Climbing	0.0002
Worsening bladder continence	< 0.0001

ADL Hierarchy	0.003
≥ 9 Medications	< 0.0001
Antidepressant	0.004
Gender	< 0.0001

Step 21-Add absence of informal support

QICu = 31486.80

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001
Bladder Cont.	< 0.0001
Pain Score	0.0007
Age	< 0.0001
Dizziness	0.001
Stair Climbing	0.0002
Worsening bladder continence	< 0.0001
ADL Hierarchy	0.002
≥ 9 Medications	< 0.0001
Antidepressant	0.004
Gender	< 0.0001
Absence of Informal Support	0.007

Step 22-Add cardiovascular disease

QICu = 31488.67

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001
Bladder Cont.	< 0.0001
Pain Score	0.0008
Age	< 0.0001
Dizziness	0.001
Stair Climbing	0.0002
Worsening bladder continence	< 0.0001
ADL Hierarchy	0.002
≥ 9 Medications	< 0.0001

Antidepressant	0.004
Gender	< 0.0001
Absence of Informal Support	0.007
Cardiovascular Disease	0.83

Step 23-Remove cardiovascular disease, add presence of ≥ 2 environmental hazards

QICu = 31488.09

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001
Bladder Cont.	< 0.0001
Pain Score	0.0008
Age	< 0.0001
Dizziness	0.001
Stair Climbing	0.0002
Worsening bladder continence	< 0.0001
ADL Hierarchy	0.002
≥ 9 Medications	< 0.0001
Antidepressant	0.004
Gender	< 0.0001
Absence of Informal Support	0.007
Presence of ≥ 2 Environmental Hazards	0.39

Step 24-Remove presence of environmental hazards, add use of hypnotic or analgesic

QICu = 31488.69

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001
Bladder Cont.	< 0.0001
Pain Score	0.001
Age	< 0.0001

Dizziness	0.001
Stair Climbing	0.0002
Worsening bladder continence	< 0.0001
ADL Hierarchy	0.002
≥ 9 Medications	< 0.0001
Antidepressant	0.003
Gender	< 0.0001
Absence of Informal Support	0.007
Hypnotic or Analgesic	0.75

Step 25-Remove use of hypnotic or analgesic, try adjusting for assessment interval

QICu = 31480.45

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001
Bladder Cont.	< 0.0001
Pain Score	0.0007
Age	< 0.0001
Dizziness	0.001
Stair Climbing	0.0002
Worsening bladder continence	< 0.0001
ADL Hierarchy	0.002
≥ 9 Medications	< 0.0001
Antidepressant	0.003
Gender	< 0.0001
Absence of Informal Support	0.007
Assessment Interval	0.001

Step 26-Try adding fear of falling again

QICu = 31480.68

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001
Bladder Cont.	< 0.0001
Pain Score	0.001
Age	< 0.0001
Dizziness	0.001
Stair Climbing	0.0002
Worsening bladder continence	< 0.0001
ADL Hierarchy	0.003
≥ 9 Medications	< 0.0001
Antidepressant	0.003
Gender	< 0.0001
Absence of Informal Support	0.008
Assessment Interval	0.001
Fear of Falling	0.25

Step 27-Remove fear of falling, add poor self-rated health

QICu = 31481.75

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001
Bladder Cont.	< 0.0001
Pain Score	0.001
Age	< 0.0001
Dizziness	0.002
Stair Climbing	0.0002
Worsening bladder continence	< 0.0001
ADL Hierarchy	0.002
≥ 9 Medications	< 0.0001
Antidepressant	0.004
Gender	< 0.0001
Absence of Informal Support	0.007
Assessment	0.002

Variable	P value
Interval	
Poor Self-Rated Health	0.12

Step 28-Remove poor self-rated health, add vision

QICu = 31476.99

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001
Bladder Cont.	< 0.0001
Pain Score	0.002
Age	< 0.0001
Dizziness	0.002
Stair Climbing	0.0003
Worsening bladder continence	< 0.0001
ADL Hierarchy	0.002
≥ 9 Medications	< 0.0001
Antidepressant	0.003
Gender	< 0.0001
Absence of Informal Support	0.007
Assessment Interval	0.001
Vision	0.02

Step 29-Remove vision, add CHESS Score

QICu = 31484.43

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001
Bladder Cont.	< 0.0001
Pain Score	0.0004
Age	< 0.0001
Dizziness	0.002
Stair Climbing	0.0002
Worsening bladder	< 0.0001

continence	
ADL Hierarchy	0.003
≥ 9 Medications	< 0.0001
Antidepressant	0.003
Gender	< 0.0001
Absence of Informal Support	0.007
Assessment Interval	0.0009
CHESS Score	0.47

Step 30-Remove CHESS Score, add bowel continence

QICu = 31484.30

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001
Bladder Cont.	< 0.0001
Pain Score	0.0007
Age	< 0.0001
Dizziness	0.001
Stair Climbing	0.0002
Worsening bladder continence	< 0.0001
ADL Hierarchy	0.002
≥ 9 Medications	< 0.0001
Antidepressant	0.003
Gender	< 0.0001
Absence of Informal Support	0.007
Assessment Interval	0.001
Bowel Cont.	0.60

Step 31-Remove bowel continence, add arthritis

QICu = 31475.49

Variable	P value
Parkinson's	< 0.0001

Unsteady Gait	< 0.0001
Bladder Cont.	< 0.0001
Pain Score	0.03
Age	< 0.0001
Dizziness	0.001
Stair Climbing	0.0002
Worsening bladder continence	< 0.0001
ADL Hierarchy	0.003
≥ 9 Medications	< 0.0001
Antidepressant	0.004
Gender	< 0.0001
Absence of Informal Support	0.007
Assessment Interval	0.001
Arthritis	0.003

Step 32-Remove Pain Scale Score, add diagnosis of other neurological conditions

QICu = 31475.96

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001
Bladder Cont.	< 0.0001
Age	< 0.0001
Dizziness	0.0008
Stair Climbing	0.0002
Worsening bladder continence	< 0.0001
ADL Hierarchy	0.002
≥ 9 Medications	< 0.0001
Antidepressant	0.003
Gender	< 0.0001
Absence of Informal Support	0.008
Assessment Interval	0.001
Arthritis	< 0.0001
Other Neuro	0.15

Step 33-Remove diagnosis of other neurological conditions, add ADL decline

QICu = 31477.54

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001
Bladder Cont.	< 0.0001
Age	< 0.0001
Dizziness	0.0009
Stair Climbing	0.0002
Worsening bladder continence	< 0.0001
ADL Hierarchy	0.002
≥ 9 Medications	< 0.0001
Antidepressant	0.003
Gender	< 0.0001
Absence of Informal Support	0.007
Assessment Interval	0.002
Arthritis	< 0.0001
ADL Decline	0.71

Step 34-Remove ADL Decline, add cardiovascular disease

QICu = 31477.53

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001
Bladder Cont.	< 0.0001
Age	< 0.0001
Dizziness	0.0007
Stair Climbing	0.0002
Worsening bladder continence	< 0.0001
ADL Hierarchy	0.002
≥ 9 Medications	< 0.0001
Antidepressant	0.003
Gender	< 0.0001

Absence of Informal Support	0.008
Assessment Interval	0.001
Arthritis	< 0.0001
Cardiovascular Disease	0.83

Step 35-Remove cardiovascular disease, add presence of ≥ 2 environmental hazards

QICu = 31477.00

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001
Bladder Cont.	< 0.0001
Age	< 0.0001
Dizziness	0.0008
Stair Climbing	0.0002
Worsening bladder continence	< 0.0001
ADL Hierarchy	0.002
≥ 9 Medications	< 0.0001
Antidepressant	0.003
Gender	< 0.0001
Absence of Informal Support	0.007
Assessment Interval	0.001
Arthritis	< 0.0001
Presence of ≥ 2 Environmental Hazards	0.41

Step 36-Remove presence of environmental hazards, add use of hypnotic or analgesic

QICu = 31477.52

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001

Bladder Cont.	< 0.0001
Age	< 0.0001
Dizziness	0.0008
Stair Climbing	0.0002
Worsening bladder continence	< 0.0001
ADL Hierarchy	0.002
≥ 9 Medications	< 0.0001
Antidepressant	0.003
Gender	< 0.0001
Absence of Informal Support	0.007
Assessment Interval	0.001
Arthritis	< 0.0001
Hypnotic or Analgesic	0.41

Step 37-FINAL MODEL remove hypnotic or analgesic

QICu = 31475.65

Variable	P value
Parkinson's	< 0.0001
Unsteady Gait	< 0.0001
Bladder Cont.	< 0.0001
Age	< 0.0001
Dizziness	0.0007
Stair Climbing	0.0002
Worsening bladder continence	< 0.0001
ADL Hierarchy	0.002
≥ 9 Medications	< 0.0001
Antidepressant	0.003
Gender	< 0.0001
Absence of Informal Support	0.007
Assessment Interval	0.001
Arthritis	< 0.0001

Non-Ambulatory HC Clients with Dementia

Step 1-Start with ADL Hierarchy

QICu = 1542.50

P value = < 0.0001

Step 2-Add unsteady gait

QICu = 1536.23

Variable	P value
Unsteady gait	0.02
ADL Hierarchy	< 0.0001

Step 3-Add vision

QICu = 1534.11

Variable	P value
Unsteady gait	0.03
ADL Hierarchy	< 0.0001
Vision	0.02

Step 4-Add length of time alone

QICu = 1527.26

Variable	P value
Unsteady gait	0.03
ADL Hierarchy	< 0.0001
Vision	0.03
Length of Time Alone	0.0001

Step 5-Add bowel continence

QICu = 1525.94

Variable	P value
Unsteady gait	0.04
ADL Hierarchy	< 0.0001
Vision	0.04
Length of Time Alone	0.0002
Bowel Cont.	0.01

Step 6-Remove unsteady gait

QICu = 1531.09

Variable	P value
ADL Hierarchy	< 0.0001
Vision	0.05
Length of Time Alone	0.0002
Bowel Cont.	0.004

Step 7-Remove vision

QICu = 1531.40

Variable	P value
ADL Hierarchy	< 0.0001
Length of Time Alone	0.0002
Bowel Cont.	0.001

Step 8-Add ≥ 9 medications

QICu = 1532.85

Variable	P value
ADL Hierarchy	< 0.0001
Length of Time Alone	0.0002
Bowel Cont.	0.002
≥ 9 Meds	0.48

Step 9-Remove ≥ 9 medications, add pain scale score

QICu = 1530.99

Variable	P value
ADL Hierarchy	< 0.0001
Length of Time Alone	0.0002
Bowel Cont.	0.007
Pain Score	0.003

Step 10-Add cardiovascular disease

QICu = 1530.55

Variable	P value
ADL Hierarchy	< 0.0001
Length of Time Alone	0.0002
Bowel Cont.	0.007
Pain Score	0.005
CVD	0.04

Step 11-Remove cardiovascular disease, add antidepressant use

QICu = 1530.93

Variable	P value
ADL Hierarchy	< 0.0001
Length of Time Alone	0.0004
Bowel Cont.	0.01
Pain Score	0.006
Antidepressant	0.06

Step 12-Remove antidepressant use, add DRS score

QICu = 1531.89

Variable	P value
ADL Hierarchy	< 0.0001
Length of Time Alone	0.0003
Bowel Cont.	0.001
Pain Score	0.005
DRS Score	0.22

Step 13-Remove DRS score, add bladder continence

QICu = 1532.76

Variable	P value
ADL Hierarchy	< 0.0001
Length of Time Alone	< 0.0001
Bowel Cont.	0.01
Pain Score	0.004
Bladder Cont.	0.13

Step 14-Remove bladder continence, add CPS score

QICu = 1531.85

Variable	P value
ADL Hierarchy	< 0.0001
Length of Time Alone	0.002
Bowel Cont.	0.02
Pain Score	0.009
CPS Score	0.38

Step 15-Remove CPS Score, add fear of falling

QICu = 1531.48

Variable	P value
ADL Hierarchy	< 0.0001
Length of Time Alone	0.0002
Bowel Cont.	0.009
Pain Score	0.006
Fear of Falling	0.25

Step 16-Remove fear of falling, try adjusting for age and gender

QICu = 1533.86

Variable	P value
ADL Hierarchy	< 0.0001
Length of Time Alone	< 0.0001
Bowel Cont.	0.007
Pain Score	0.003
Age	0.20
Gender	0.10

Step 17-Remove age and gender, try adjusting for assessment interval

QICu = 1530.11

Variable	P value
ADL Hierarchy	< 0.0001
Length of Time Alone	0.0009
Bowel Cont.	0.006
Pain Score	0.004
Assessment Interval	0.08

Step 18-Remove assessment interval

QICu = 1530.99

Variable	P value
ADL Hierarchy	< 0.0001
Length of Time Alone	0.0002
Bowel Cont.	0.007
Pain Score	0.003

Step 19-Remove bowel continence because collinearity test determined that it is a linear combination of other predictors. Try adding unsteady gait again.

QICu = 1527.29

Variable	P value
ADL Hierarchy	< 0.0001
Length of Time Alone	0.0001
Pain Score	0.0005
Unsteady Gait	0.03

Step 20-Remove unsteady gait, add vision

QICu = 1531.54

Variable	P value
ADL Hierarchy	< 0.0001
Length of Time Alone	0.0001
Pain Score	0.0002
Vision	0.04

Step 21-Remove vision, add ≥ 9 medications

QICu = 1534.62

Variable	P value
ADL Hierarchy	< 0.0001
Length of Time Alone	0.0002
Pain Score	0.001
≥ 9 Meds	0.62

Step 22-Remove ≥ 9 medications, add cardiovascular disease

QICu = 1532.27

Variable	P value
ADL Hierarchy	< 0.0001
Length of Time Alone	0.0001
Pain Score	0.0006
Cardiovascular Disease	0.03

Step 23-Remove cardiovascular disease, add antidepressant use

QICu = 1532.38

Variable	P value
ADL Hierarchy	< 0.0001
Length of Time Alone	0.0002
Pain Score	0.0007
Antidepressant	0.05

Step 24-Remove antidepressant use, add DRS Score

QICu = 1533.43

Variable	P value
ADL Hierarchy	< 0.0001
Length of Time Alone	0.0002
Pain Score	0.0006
DRS Score	0.15

Step 25-Remove DRS Score, add CPS Score

QICu = 1531.61

Variable	P value
ADL Hierarchy	< 0.0001
Length of Time Alone	0.002
Pain Score	0.002
CPS Score	0.24

Step 26-Remove CPS Score, add bladder continence

QICu = 1533.18

Variable	P value
ADL Hierarchy	< 0.0001
Length of Time Alone	< 0.0001
Pain Score	0.0008

Bladder Cont.	0.09

Step 27-Remove bladder continence, add fear of falling

QICu = 1532.82

Variable	P value
ADL Hierarchy	< 0.0001
Length of Time Alone	< 0.0001
Pain Score	0.0008
Fear of Falling	0.17

Step 28-Remove fear of falling, try adjusting for age and gender

QICu = 1535.97

Variable	P value
ADL Hierarchy	< 0.0001
Length of Time Alone	< 0.0001
Pain Score	0.0003
Age	0.22
Gender	0.11

Step 29-Remove age and gender, try adjusting for assessment interval

QICu = 1531.91

Variable	P value
ADL Hierarchy	< 0.0001
Length of Time Alone	0.0005
Pain Score	0.0005
Assessment Interval	0.08

Step 30-FINAL MODEL remove
assessment interval

QICu = 1532.87

Variable	P value
ADL Hierarchy	< 0.0001
Length of Time Alone	0.0001
Pain Score	0.0003

Ambulatory HC Clients with PD

Step 1-Start with unsteady gait

QICu = 5609.81

P value < 0.0001

Step 2-Add CPS score

QICu = 5603.27

Variable	P value
Unsteady gait	< 0.0001
CPS Score	0.002

Step 3-Add wandering

QICu = 5593.92

Variable	P value
Unsteady gait	< 0.0001
CPS Score	0.002
Wandering	0.006

Step 4-Add worsening bladder continence

QICu = 5589.67

Variable	P value
Unsteady gait	< 0.0001
CPS Score	0.004
Wandering	0.008
Worsening Bladder Continence	0.04

Step 5-Remove worsening bladder continence and try adjusting for age and gender

QICu = 5594.43

Variable	P value
Unsteady gait	< 0.0001
CPS Score	0.006
Wandering	0.007
Age	0.16
Gender	0.16

Step 6-Remove age and gender; try adjusting for assessment interval

QICu = 5593.36

Variable	P value
Unsteady gait	< 0.0001
CPS Score	0.002
Wandering	0.006
Assessment interval	0.10

Step 7-FINAL MODEL, remove assessment interval

QICu = 5593.92

Variable	P value
Unsteady gait	< 0.0001
CPS Score	0.002
Wandering	0.006

Non-Ambulatory HC Clients with PD

Step 1-Start with unsteady gait

QICu = 695.16

P value < 0.0001

Step 2-Add ADL Hierarchy Scale score

QICU = 640.24

Variable	P value
Unsteady gait	0.002
ADL Hierarchy	< 0.0001

Step 3-Add CPS Score

QICu = 633.43

Variable	P value
Unsteady gait	0.006
ADL Hierarchy	< 0.0001
CPS Score	0.01

Step 4- Add bowel continence

QICu = 634.81

Variable	P value
Unsteady gait	0.008
ADL	< 0.0001
CPS Score	0.009
Bowel continence	0.10

Step 5-Remove bowel continence, add length of time alone

QICu = 637.12

Variable	P value

Unsteady gait	0.01
ADL Hierarchy	< 0.0001
CPS Score	0.004
Length of time alone	0.06

Step 6-Remove length of time alone, add pain scale score

QICu = 637.09

Variable	P value
Unsteady gait	0.006
ADL Hierarchy	< 0.0001
CPS Score	0.01
Pain Score	0.56

Step 7-Remove pain scale, add fear of falling

QICu = 635.02

Variable	P value
Unsteady gait	0.09
ADL Hierarchy	< 0.0001
CPS Score	0.02
Fear of falling	0.40

Step 8-Remove fear of falling, add dementia

QICu = 633.81

Variable	P value
Unsteady gait	0.006
ADL Hierarchy	< 0.0001
CPS Score	0.02
Dementia	0.17

Step 9-Remove dementia, try adjusting for age and gender

QICu = 633.12

Variable	P value
Unsteady gait	0.006
ADL Hierarchy	< 0.0001
CPS Score	0.005
Age	0.008
Gender	0.003

Step 10-Try adjusting for assessment interval

QICu = 633.56

Variable	P value
Unsteady gait	0.005
ADL Hierarchy	< 0.0001
CPS Score	0.005
Age	0.008
Gender	0.004
Assessment interval	0.51

Step 11-FINAL MODEL, remove assessment interval

QICu = 633.12

Variable	P value
Unsteady gait	0.006
ADL Hierarchy	< 0.0001
CPS Score	0.005
Age	0.008
Gender	0.003

Ambulatory HC Clients in the Comparison Group

Step 1-Start with age

QICu = 77999.05

P value < 0.0001

Step 2-Add unsteady gait

QICu = 77580.02

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001

Step 3-Add CHESS Score

QICu = 77482.19

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001

Step 4-Add bladder continence

QICu = 77345.14

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001

Step 5-Add worsening bladder continence

QICu = 77344.30

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
Worsening Bladder Continence	0.06

Step 6-Remove worsening continence, add worsening decision making

QICu = 77336.52

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
Worsening Decision Making	< 0.0001

Step 7-Add CPS Score

QICu = 77277.08

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
Worsening Decision Making	0.09
CPS Score	< 0.0001

Step 8-Remove worsening decision making, add bowel continence

QICu = 77272.89

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001

CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.0003

Step 9-Add antidepressant use

QICu = 77083.28

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.0006
Antidepressant	< 0.0001

Step 10-Add fear of falling

QICu = 77085.18

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.0007
Antidepressant	< 0.0001
Fear of Falling	0.51

Step 11-Remove fear of falling, add stair climbing

QICu = 77082.82

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
CPS Score	< 0.0001

Bowel Cont.	0.0008
Antidepressant	< 0.0001
Stair Climbing	0.07

Step 12-Remove stair climbing, add absence of informal support

QICu = 77070.18

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.0007
Antidepressant	< 0.0001
Absence of Informal Support	< 0.0001

Step 13-Add ≥ 9 medications

QICu = 77019.96

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.0007
Antidepressant	< 0.0001
Absence of Informal Support	< 0.0001
≥ 9 Medications	< 0.0001

Step 14-Add Pain Scale Score

QICu = 77004.31

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001

CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.0006
Antidepressant	< 0.0001
Absence of Informal Support	< 0.0001
≥ 9 Medications	< 0.0001
Pain Scale Score	< 0.0001

Step 15-Add vision

QICu = 77000.25

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.0008
Antidepressant	< 0.0001
Absence of Informal Support	< 0.0001
≥ 9 Medications	< 0.0001
Pain Scale Score	< 0.0001
Vision	< 0.0001

Step 16-Add arthritis

QICu = 77001.48

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.0007
Antidepressant	< 0.0001
Absence of Informal Support	< 0.0001
≥ 9 Medications	< 0.0001
Pain Scale Score	< 0.0001

Vision	< 0.0001
Arthritis	0.22

Step 17-Remove arthritis, add ADL decline

QICu = 77002.13

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.0008
Antidepressant	< 0.0001
Absence of Informal Support	< 0.0001
≥ 9 Medications	< 0.0001
Pain Scale Score	< 0.0001
Vision	< 0.0001
ADL Decline	0.48

Step 18-Remove ADL decline, add ADL Hierarchy

QICu = 76986.98

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.0004
Antidepressant	< 0.0001
Absence of Informal Support	< 0.0001
≥ 9 Medications	< 0.0001
Pain Scale Score	< 0.0001
Vision	< 0.0001
ADL Hierarchy	0.002

Step 19-Add DRS Score

QICu = 76982.85

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.0006
Antidepressant	< 0.0001
Absence of Informal Support	< 0.0001
≥ 9 Medications	< 0.0001
Pain Scale Score	< 0.0001
Vision	0.0001
ADL Hierarchy	0.002
DRS Score	0.003

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.0007
Antidepressant	< 0.0001
Absence of Informal Support	< 0.0001
≥ 9 Medications	< 0.0001
Pain Scale Score	< 0.0001
Vision	0.0002
ADL Hierarchy	0.002
DRS Score	0.007
Dizziness or lightheadedness	< 0.0001

Step 20-Add cardiovascular disease

QICu = 76984.65

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.0006
Antidepressant	< 0.0001
Absence of Informal Support	< 0.0001
≥ 9 Medications	< 0.0001
Pain Scale Score	< 0.0001
Vision	0.0001
ADL Hierarchy	0.002
DRS Score	0.002
Cardiovascular Disease	0.77

Step 21-Remove cardiovascular disease, add dizziness

QICu = 76973.95

Step 22-Add wandering

QICu = 76975.76

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.0007
Antidepressant	< 0.0001
Absence of Informal Support	< 0.0001
≥ 9 Medications	< 0.0001
Pain Scale Score	< 0.0001
Vision	0.0002
ADL Hierarchy	0.002
DRS Score	0.007
Dizziness or lightheadedness	< 0.0001
Wandering	0.71

Step 23-Remove wandering, add length of time alone

QICu = 76961.16

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.0006
Antidepressant	< 0.0001
Absence of Informal Support	< 0.0001
≥ 9 Medications	< 0.0001
Pain Scale Score	< 0.0001
Vision	0.0002
ADL Hierarchy	0.003
DRS Score	0.007
Dizziness or lightheadedness	< 0.0001
Length of Time Alone	< 0.0001

Step 24-Add use of anxiolytic

QICu = 76960.18

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.0006
Antidepressant	< 0.0001
Absence of Informal Support	< 0.0001
≥ 9 Medications	< 0.0001
Pain Scale Score	< 0.0001
Vision	0.0002
ADL Hierarchy	0.003
DRS Score	0.01

Dizziness or lightheadedness	< 0.0001
Length of Time Alone	< 0.0001
Anxiolytic	0.10

Step 25-Remove anxiolytic, add use of hypnotic or analgesic

QICu = 76961.39

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.0006
Antidepressant	< 0.0001
Absence of Informal Support	< 0.0001
≥ 9 Medications	< 0.0001
Pain Scale Score	< 0.0001
Vision	0.0002
ADL Hierarchy	0.003
DRS Score	0.007
Dizziness or lightheadedness	< 0.0001
Length of Time Alone	< 0.0001
Hypnotic or Analgesic	0.36

Step 26-Remove use of hypnotic or analgesic, add poor self-rated health

QICu = 76961.82

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001

CPS Score	< 0.0001
Bowel Cont.	0.0006
Antidepressant	< 0.0001
Absence of Informal Support	< 0.0001
≥ 9 Medications	< 0.0001
Pain Scale Score	< 0.0001
Vision	0.0003
ADL Hierarchy	0.003
DRS Score	0.01
Dizziness or lightheadedness	< 0.0001
Length of Time Alone	< 0.0001
Poor Self-Rated Health	0.10

Step 27-Remove poor self-rated health, add diabetes

QICu = 76937.55

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.001
Antidepressant	< 0.0001
Absence of Informal Support	< 0.0001
≥ 9 Medications	< 0.0001
Pain Scale Score	< 0.0001
Vision	0.0009
ADL Hierarchy	0.004
DRS Score	0.007
Dizziness or lightheadedness	< 0.0001
Length of Time Alone	< 0.0001
Diabetes	< 0.0001

Step 28-Add presence of ≥ 2 environmental hazards

QICu = 76939.45

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.001
Antidepressant	< 0.0001
Absence of Informal Support	< 0.0001
≥ 9 Medications	< 0.0001
Pain Scale Score	< 0.0001
Vision	0.0009
ADL Hierarchy	0.004
DRS Score	0.007
Dizziness or lightheadedness	< 0.0001
Length of Time Alone	< 0.0001
Diabetes	< 0.0001
Presence of ≥ 2 Environmental Hazards	0.73

Step 29-Remove presence of environmental hazards, try adjusting for gender

QICu = 76904.41

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.002
Antidepressant	< 0.0001
Absence of Informal Support	< 0.0001
≥ 9 Medications	< 0.0001

Pain Scale Score	< 0.0001
Vision	0.0005
ADL Hierarchy	0.003
DRS Score	0.004
Dizziness or lightheadedness	< 0.0001
Length of Time Alone	< 0.0001
Diabetes	< 0.0001
Gender	< 0.0001

Step 30-Try adjusting for assessment interval

QICu = 76758.55

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.002
Antidepressant	< 0.0001
Absence of Informal Support	< 0.0001
≥ 9 Medications	< 0.0001
Pain Scale Score	< 0.0001
Vision	0.0005
ADL Hierarchy	0.003
DRS Score	0.01
Dizziness or lightheadedness	< 0.0001
Length of Time Alone	< 0.0001
Diabetes	< 0.0001
Gender	< 0.0001
Assessment Interval	< 0.0001

Step 31-Remove DRS Score

QICu = 76760.18

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.002
Antidepressant	< 0.0001
Absence of Informal Support	< 0.0001
≥ 9 Medications	< 0.0001
Pain Scale Score	< 0.0001
Vision	0.0001
ADL Hierarchy	0.003
Dizziness or lightheadedness	< 0.0001
Length of Time Alone	< 0.0001
Diabetes	< 0.0001
Gender	< 0.0001
Assessment Interval	< 0.0001

Step 32- Remove bowel continence because collinearity test determined that it is a linear combination of other predictors. Try adding worsening bladder continence again.

QICu = 76762.11

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Antidepressant	< 0.0001
Absence of Informal Support	< 0.0001
≥ 9 Medications	< 0.0001
Pain Scale Score	< 0.0001
Vision	0.0001
ADL Hierarchy	0.004
Dizziness or	< 0.0001

lightheadedness	
Length of Time Alone	< 0.0001
Diabetes	< 0.0001
Gender	< 0.0001
Assessment Interval	< 0.0001
Worsening of Bladder Continence	0.14

Step 33-Remove worsening of bladder continence, add worsening decision making

QICu = 76762.08

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Antidepressant	< 0.0001
Absence of Informal Support	< 0.0001
≥ 9 Medications	< 0.0001
Pain Scale Score	< 0.0001
Vision	0.0001
ADL Hierarchy	0.005
Dizziness or lightheadedness	< 0.0001
Length of Time Alone	< 0.0001
Diabetes	< 0.0001
Gender	< 0.0001
Assessment Interval	< 0.0001
Worsening of Decision Making	0.08

Step 34-Remove worsening decision making, add fear of falling

QICu = 76764.00

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Antidepressant	< 0.0001
Absence of Informal Support	< 0.0001
≥ 9 Medications	< 0.0001
Pain Scale Score	< 0.0001
Vision	0.0001
ADL Hierarchy	0.004
Dizziness or lightheadedness	< 0.0001
Length of Time Alone	< 0.0001
Diabetes	< 0.0001
Gender	< 0.0001
Assessment Interval	< 0.0001
Fear of Falling	0.73

Step 35-Remove fear of falling, add stair climbing

QICu = 76762.01

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Antidepressant	< 0.0001
Absence of Informal Support	< 0.0001
≥ 9 Medications	< 0.0001
Pain Scale Score	< 0.0001
Vision	0.0002
ADL Hierarchy	0.004
Dizziness or lightheadedness	< 0.0001
Length of Time	< 0.0001

Alone	
Diabetes	< 0.0001
Gender	< 0.0001
Assessment Interval	< 0.0001
Stair Climbing	0.16

Step 36-Remove stair climbing, add arthritis

QICu = 76761.66

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Antidepressant	< 0.0001
Absence of Informal Support	< 0.0001
≥ 9 Medications	< 0.0001
Pain Scale Score	< 0.0001
Vision	0.0001
ADL Hierarchy	0.004
Dizziness or lightheadedness	< 0.0001
Length of Time Alone	< 0.0001
Diabetes	< 0.0001
Gender	< 0.0001
Assessment Interval	< 0.0001
Arthritis	0.01

Step 37-Remove arthritis, add ADL decline

QICu = 76763.86

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	0.0001
Bladder Cont.	< 0.0001
CPS Score	< 0.0001

Antidepressant	< 0.0001
Absence of Informal Support	< 0.0001
≥ 9 Medications	< 0.0001
Pain Scale Score	< 0.0001
Vision	0.0001
ADL Hierarchy	0.004
Dizziness or lightheadedness	< 0.0001
Length of Time Alone	< 0.0001
Diabetes	< 0.0001
Gender	< 0.0001
Assessment Interval	< 0.0001
ADL Decline	0.62

Step 38-Remove ADL decline, add DRS Score

QICu = 76760.18

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Antidepressant	< 0.0001
Absence of Informal Support	< 0.0001
≥ 9 Medications	< 0.0001
Pain Scale Score	< 0.0001
Vision	0.0005
ADL Hierarchy	0.004
Dizziness or lightheadedness	< 0.0001
Length of Time Alone	< 0.0001
Diabetes	< 0.0001
Gender	< 0.0001
Assessment Interval	< 0.0001
DRS Score	0.01

Step 39-Remove DRS, add cardiovascular disease

QICu = 76763.97

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Antidepressant	< 0.0001
Absence of Informal Support	< 0.0001
≥ 9 Medications	< 0.0001
Pain Scale Score	< 0.0001
Vision	0.0001
ADL Hierarchy	0.004
Dizziness or lightheadedness	< 0.0001
Length of Time Alone	< 0.0001
Diabetes	< 0.0001
Gender	< 0.0001
Assessment Interval	< 0.0001
Cardiovascular Disease	0.97

Step 40-Remove cardiovascular disease, add wandering

QICu = 76763.72

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Antidepressant	< 0.0001
Absence of Informal Support	< 0.0001
≥ 9 Medications	< 0.0001
Pain Scale Score	< 0.0001

Vision	0.0001
ADL Hierarchy	0.005
Dizziness or lightheadedness	< 0.0001
Length of Time Alone	< 0.0001
Diabetes	< 0.0001
Gender	< 0.0001
Assessment Interval	< 0.0001
Wandering	0.65

Step 41-FINAL MODEL remove wandering

QICu = 76761.97

Variable	P value
Age	< 0.0001
Unsteady Gait	< 0.0001
CHESS Score	< 0.0001
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Antidepressant	< 0.0001
Absence of Informal Support	< 0.0001
≥ 9 Medications	< 0.0001
Pain Scale Score	< 0.0001
Vision	0.0001
ADL Hierarchy	0.004
Dizziness or lightheadedness	< 0.0001
Length of Time Alone	< 0.0001
Diabetes	< 0.0001
Gender	< 0.0001
Assessment Interval	< 0.0001

Non-Ambulatory HC Clients in the Comparison Group

<u>Step 1</u>-Start with ADL Hierarchy
QICu = 5243.91

P value < 0.0001

<u>Step 2</u>-Add length of time alone

QICu = 5245.71

Variable	P value
ADL Hierarchy	< 0.0001
Length of Time Alone	0.06

<u>Step 3</u>-Remove length of time alone, add unsteady gait

QICu = 5214.58

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	0.0001

Step 4-Add CHESS Score

QICu = 5194.79

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	0.0005
CHESS Score	< 0.0001

Step 5-Add use of antidepressant

QICu = 5165.97

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	0.0004
CHESS Score	< 0.0001
Antidepressant	< 0.0001

<u>Step 6</u>-Add CPS Score

QICu = 5149.38

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	0.001
CHESS Score	< 0.0001
Antidepressant	< 0.0001
CPS Score	< 0.0001

<u>Step 7</u>-Add bowel continence

QICu = 5146.88

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	0.002
CHESS Score	< 0.0001
Antidepressant	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.004

<u>Step 8</u>-Add cardiovascular disease

QICu = 5147.57

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	0.002
CHESS Score	< 0.0001
Antidepressant	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.004
Cardiovascular Disease	0.05

Step 9-Remove cardiovascular disease, add bladder continence

QICu = 5142.25

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	0.005
CHESS Score	< 0.0001
Antidepressant	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.003
Bladder Cont.	0.005

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	0.008
CHESS Score	0.003
Antidepressant	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.003
Bladder Cont.	0.005
ADL Decline	0.26

Step 10-Add ≥ 9 medications

QICu = 5144.25

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	0.005
CHESS Score	< 0.0001
Antidepressant	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.002
Bladder Cont.	0.005
≥ 9 Medications	0.99

Step 11-Remove ≥ 9 medications, add arthritis

QICu = 5143.97

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	0.004
CHESS Score	< 0.0001
Antidepressant	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.003
Bladder Cont.	0.01
Arthritis	0.73

Step 12-Remove arthritis, add ADL decline

QICu = 5141.90

Variable	P value

Step 13-Remove ADL decline, add fear of falling

QICu = 5144.23

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	0.001
CHESS Score	< 0.0001
Antidepressant	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.003
Bladder Cont.	0.007
Fear of Falling	0.91

Step 14-Remove fear of falling, add diabetes

QICu = 5141.29

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	0.005
CHESS Score	< 0.0001
Antidepressant	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.002
Bladder Cont.	0.005
Diabetes	0.09

Step 15-Remove diabetes, add dizziness

QICu =5140.30

Variable	P value

ADL Hierarchy	< 0.0001
Unsteady Gait	0.005
CHESS Score	< 0.0001
Antidepressant	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.003
Bladder Cont.	0.007
Dizziness	0.008

Step 16-Add Pain Scale Score

QICu = 5143.18

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	0.005
CHESS Score	< 0.0001
Antidepressant	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.003
Bladder Cont.	0.007
Dizziness	0.009
Pain Score	0.14

Step 17-Remove Pain Scale Score, add DRS Score

QICu = 5141.48

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	0.006
CHESS Score	0.0001
Antidepressant	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.002
Bladder Cont.	0.007
Dizziness	0.02
DRS	0.13

Step 18-Remove DRS, add poor self-rated health

QICu = 5141.45

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	0.006
CHESS Score	0.0001
Antidepressant	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.002
Bladder Cont.	0.007
Dizziness	0.02
Poor Self-Rated Health	0.13

Step 19-Remove poor self-rated health, try adjusting for age and gender

QICu = 5144.69

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	0.008
CHESS Score	< 0.0001
Antidepressant	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.003
Bladder Cont.	0.01
Dizziness	0.006
Age	0.22
Gender	0.41

Step 20-Remove age and gender, try adjusting for assessment interval

QICu = 5129.14

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	0.007
CHESS Score	0.0006
Antidepressant	< 0.0001
CPS Score	< 0.0001
Bowel Cont.	0.003
Bladder Cont.	0.007
Dizziness	0.01
Assessment	0.0002

Interval	

Step 21-Remove bowel continence because collinearity test determined that it is a linear combination of other predictors.

QICu = 5132.54

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	0.005
CHESS Score	0.0005
Antidepressant	< 0.0001
CPS Score	< 0.0001
Bladder Cont.	0.03
Dizziness	0.01
Assessment Interval	0.0002

Step 22-Remove bladder continence

QICu = 5135.70

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	0.002
CHESS Score	0.0003
Antidepressant	< 0.0001
CPS Score	< 0.0001
Dizziness	0.007
Assessment Interval	0.0003

Step 23-Add length of time alone

QICu = 5136.08

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	0.002
CHESS Score	0.0002

Antidepressant	< 0.0001
CPS Score	< 0.0001
Dizziness	0.006
Assessment Interval	0.0002
Length of Time Alone	0.02

Step 24-Remove length of time alone, add cardiovascular disease

QICu = 5136.67

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	0.003
CHESS Score	0.0005
Antidepressant	< 0.0001
CPS Score	< 0.0001
Dizziness	0.007
Assessment Interval	0.0004
Cardiovascular Disease	0.10

Step 25-Remove cardiovascular disease, add ≥ 9 medications

QICu = 5137.70

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	0.002
CHESS Score	0.0001
Antidepressant	< 0.0001
CPS Score	< 0.0001
Dizziness	0.008
Assessment Interval	0.0004
≥ 9 Medications	0.97

Step 26-Remove ≥ 9 medications, add arthritis

QICu = 5136.85

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	0.002
CHESS Score	0.0002
Antidepressant	< 0.0001
CPS Score	< 0.0001
Dizziness	0.007
Assessment Interval	0.0003
Arthritis	0.53

Step 27-Remove arthritis, add ADL decline

QICu = 5136.28

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	0.003
CHESS Score	0.006
Antidepressant	< 0.0001
CPS Score	< 0.0001
Dizziness	0.007
Assessment Interval	0.0003
ADL Decline	0.38

Step 28-Remove ADL Decline, add fear of falling

QICu = 5137.69

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	0.0006
CHESS Score	0.0002
Antidepressant	< 0.0001
CPS Score	< 0.0001
Dizziness	0.006
Assessment Interval	0.0003
Fear of Falling	0.93

Step 29-Remove fear of falling, add diabetes

QICu = 5135.20

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	0.002
CHESS Score	0.0003
Antidepressant	< 0.0001
CPS Score	< 0.0001
Dizziness	0.007
Assessment Interval	0.0003
Diabetes	0.13

Step 30-Remove diabetes, add Pain Scale Score

QICu = 5138.37

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	0.002
CHESS Score	0.0004
Antidepressant	< 0.0001
CPS Score	< 0.0001
Dizziness	0.008
Assessment Interval	0.0003
Pain Score	0.11

Step 31-Remove Pain Scale Score, add DRS Score

QICu = 5137.36

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	0.002
CHESS Score	0.0003
Antidepressant	< 0.0001
CPS Score	< 0.0001
Dizziness	0.01
Assessment Interval	0.0003
DRS Score	0.18

Step 32-Remove DRS Score, add poor self-rated health

QICu = 5136.79

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	0.003
CHESS Score	0.0004
Antidepressant	< 0.0001
CPS Score	< 0.0001
Dizziness	0.01
Assessment Interval	0.0003
Poor Self-Rated Health	0.23

CPS Score	< 0.0001
Dizziness	0.007
Assessment Interval	0.0003

Step 33-Remove poor self-rated health, try adjusting for age and gender

QICu = 5141.28

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	0.005
CHESS Score	0.0003
Antidepressant	< 0.0001
CPS Score	< 0.0001
Dizziness	0.006
Assessment Interval	0.0007
Age	0.18
Gender	0.84

Step 34-FINAL MODEL remove age and gender

QICu = 5135.70

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	0.002
CHESS Score	0.0003
Antidepressant	< 0.0001

Ambulatory LTC Residents with Dementia

Wandering	< 0.0001
Unsteady Gait	< 0.0001

Step 1-Start with ADL Hierarchy

QICu = 17196.49

P value < 0.0001

Step 2-Add CPS Score

QICu = 17155.81

Variable	P value
ADL Hierarchy	< 0.0001
CPS Score	< 0.0001

Step 3-Add bladder continence

QICu = 17131.09

Variable	P value
ADL Hierarchy	< 0.0001
CPS Score	0.0001
Bladder Cont.	< 0.0001

Step 4-Add wandering

QICu = 17077.04

Variable	P value
ADL Hierarchy	< 0.0001
CPS Score	0.02
Bladder Cont.	< 0.0001
Wandering	< 0.0001

Step 5-Remove CPS Score, add unsteady gait

QICu = 17023.39

Variable	P value
ADL Hierarchy	< 0.0001
Bladder Cont.	< 0.0001

Step 6-Add DRS Score

QICu = 17009.65

Variable	P value
ADL Hierarchy	< 0.0001
Bladder Cont.	< 0.0001
Wandering	< 0.0001
Unsteady Gait	< 0.0001
DRS Score	< 0.0001

Step 7-Add age

QICu = 16982.97

Variable	P value
ADL Hierarchy	< 0.0001
Bladder Cont.	< 0.0001
Wandering	< 0.0001
Unsteady Gait	< 0.0001
DRS Score	< 0.0001
Age	< 0.0001

Step 8-Add bowel continence

QICu = 16978.64

Variable	P value
ADL Hierarchy	< 0.0001
Bladder Cont.	< 0.0001
Wandering	< 0.0001
Unsteady Gait	< 0.0001
DRS Score	< 0.0001
Age	< 0.0001
Bowel Cont.	0.08

Step 9-Remove bowel continence, add CHESS Score

QICu = 16970.19

Variable	P value
ADL Hierarchy	< 0.0001
Bladder Cont.	< 0.0001
Wandering	< 0.0001
Unsteady Gait	< 0.0001
DRS Score	< 0.0001
Age	0.0001
CHESS Score	0.0002

Step 10-Add vision

QICu = 16963.96

Variable	P value
ADL Hierarchy	< 0.0001
Bladder Cont.	< 0.0001
Wandering	< 0.0001
Unsteady Gait	< 0.0001
DRS Score	0.0001
Age	0.0002
CHESS Score	0.0002
Vision	< 0.0001

Step 11-Add use of antianxiety medication

QICu = 16953.12

Variable	P value
ADL Hierarchy	< 0.0001
Bladder Cont.	< 0.0001
Wandering	< 0.0001
Unsteady Gait	< 0.0001
DRS Score	0.001
Age	0.0002
CHESS Score	0.0002
Vision	< 0.0001
Antianxiety	0.007

Step 12-Add use of antipsychotic medication

QICu = 16949.12

Variable	P value

ADL Hierarchy	< 0.0001
Bladder Cont.	< 0.0001
Wandering	< 0.0001
Unsteady Gait	< 0.0001
DRS Score	0.004
Age	< 0.0001
CHESS Score	0.0002
Vision	< 0.0001
Antianxiety	0.009
Antipsychotic	0.0005

Step 13-Add use of antidepressant

QICu = 16940.65

Variable	P value
ADL Hierarchy	< 0.0001
Bladder Cont.	< 0.0001
Wandering	< 0.0001
Unsteady Gait	< 0.0001
DRS Score	0.01
Age	< 0.0001
CHESS Score	0.0003
Vision	< 0.0001
Antianxiety	0.01
Antipsychotic	0.004
Antidepressant	0.002

Step 14-Remove DRS Score

QICu = 16943.45

Variable	P value
ADL Hierarchy	< 0.0001
Bladder Cont.	< 0.0001
Wandering	< 0.0001
Unsteady Gait	< 0.0001
Age	< 0.0001
CHESS Score	0.0003
Vision	< 0.0001
Antianxiety	0.007
Antipsychotic	0.001
Antidepressant	0.0005

Step 15-Add DRS Score, remove use of antianxiety medication

QICu = 16949.43

Variable	P value
ADL Hierarchy	< 0.0001
Bladder Cont.	< 0.0001
Wandering	< 0.0001
Unsteady Gait	< 0.0001
DRS Score	0.004
Age	< 0.0001
CHESS Score	0.0002
Vision	< 0.0001
Antipsychotic	0.003
Antidepressant	0.001

Step 16-Remove DRS Score, add use of antianxiety medication and gender

QICu = 16920.86

Variable	P value
ADL Hierarchy	< 0.0001
Bladder Cont.	< 0.0001
Wandering	< 0.0001
Unsteady Gait	< 0.0001
Age	< 0.0001
CHESS Score	0.0001
Vision	< 0.0001
Antianxiety	0.005
Antipsychotic	0.004
Antidepressant	0.0002
Gender	< 0.0001

Step 17-Add use of trunk restraint

QICu = 16911.71

Variable	P value
ADL Hierarchy	< 0.0001
Bladder Cont.	< 0.0001
Wandering	< 0.0001
Unsteady Gait	< 0.0001

Age	< 0.0001
CHESS Score	0.0001
Vision	< 0.0001
Antianxiety	0.005
Antipsychotic	0.002
Antidepressant	0.0002
Gender	< 0.0001
Trunk Restraint	0.02

Step 18-Remove use of trunk restraint, add use of ≥ 9 medications

QICu = 16919.23

Variable	P value
ADL Hierarchy	< 0.0001
Bladder Cont.	< 0.0001
Wandering	< 0.0001
Unsteady Gait	< 0.0001
Age	< 0.0001
CHESS Score	0.0001
Vision	< 0.0001
Antianxiety	0.01
Antipsychotic	0.01
Antidepressant	0.0002
Gender	< 0.0001
≥ 9 Medications	0.19

Step 19-Remove use of ≥ 9 medications, add use of chair that prevents rising

QICu = 16917.23

Variable	P value
ADL Hierarchy	< 0.0001
Bladder Cont.	< 0.0001
Wandering	< 0.0001
Unsteady Gait	< 0.0001
Age	< 0.0001
CHESS Score	0.0001
Vision	< 0.0001
Antianxiety	0.004
Antipsychotic	0.003
Antidepressant	0.0002

Gender	< 0.0001
Chair That Prevents Rising	0.01

Step 20-FINAL MODEL # 1 remove use of chair that prevents rising

QICu = 16920.86

Variable	P value
ADL Hierarchy	< 0.0001
Bladder Cont.	< 0.0001
Wandering	< 0.0001
Unsteady Gait	< 0.0001
Age	< 0.0001
CHESS Score	0.0001
Vision	< 0.0001
Antianxiety	0.005
Antipsychotic	0.004
Antidepressant	0.0002
Gender	< 0.0001

Step 21-FINAL MODEL # 2 adjust for use of trunk restraint

QICu = 16911.71

Variable	P value
ADL Hierarchy	< 0.0001
Bladder Cont.	< 0.0001
Wandering	< 0.0001
Unsteady Gait	< 0.0001
Age	< 0.0001
CHESS Score	0.0001
Vision	< 0.0001
Antianxiety	0.005
Antipsychotic	0.002
Antidepressant	0.0002
Gender	< 0.0001
Trunk Restraint	0.02

Non-Ambulatory LTC Residents with Dementia

Step 1-Start with unsteady gait

QICu = 17400.92

P value < 0.0001

Step 2-Add dizziness

QICu = 17389.23

Variable	P value
Unsteady Gait	< 0.0001
Dizziness	0.003

Step 3-Add ADL Hierarchy

QICu = 16642.08

Variable	P value
Unsteady Gait	< 0.0001
Dizziness	0.04
ADL Hierarchy	< 0.0001

Step 4-Remove dizziness, add bowel continence

QICu = 16528.26

Variable	P value
Unsteady Gait	< 0.0001
ADL Hierarchy	< 0.0001
Bowel Cont.	< 0.0001

Step 5-Add use of a chair that prevents rising

QICu = 16500.18

Variable	P value
Unsteady Gait	< 0.0001
ADL Hierarchy	< 0.0001

Bowel Cont.	< 0.0001
Chair That Prevents Rising	< 0.0001

Step 6-Add bladder continence

QICu = 16479.25

Variable	P value
Unsteady Gait	< 0.0001
ADL Hierarchy	< 0.0001
Bowel Cont.	< 0.0001
Chair That Prevents Rising	< 0.0001
Bladder Cont.	< 0.0001

Step 7-Add gender

QICu = 16419.29

Variable	P value
Unsteady Gait	< 0.0001
ADL Hierarchy	< 0.0001
Bowel Cont.	< 0.0001
Chair That Prevents Rising	< 0.0001
Bladder Cont.	< 0.0001
Gender	< 0.0001

Step 8-Add use of trunk restraint

QICu = 16405.08

Variable	P value
Unsteady Gait	< 0.0001
ADL Hierarchy	< 0.0001
Bowel Cont.	< 0.0001
Chair That Prevents Rising	0.0005
Bladder Cont.	< 0.0001
Gender	< 0.0001
Trunk Restraint	< 0.0001

Step 9-Add CPS Score

QICu = 16340.32

Variable	P value
Unsteady Gait	< 0.0001
ADL Hierarchy	< 0.0001
Bowel Cont.	< 0.0001
Chair That Prevents Rising	0.0009
Bladder Cont.	< 0.0001
Gender	< 0.0001
Trunk Restraint	< 0.0001
CPS Score	< 0.0001

Step 10-Add vision

QICu = 16337.40

Variable	P value
Unsteady Gait	< 0.0001
ADL Hierarchy	< 0.0001
Bowel Cont.	< 0.0001
Chair That Prevents Rising	0.001
Bladder Cont.	< 0.0001
Gender	< 0.0001
Trunk Restraint	< 0.0001
CPS Score	< 0.0001
Vision	0.02

Step 11-Remove vision, add use of antidepressant

QICu = 16316.88

Variable	P value
Unsteady Gait	< 0.0001
ADL Hierarchy	< 0.0001
Bowel Cont.	< 0.0001
Chair That Prevents Rising	0.0007
Bladder Cont.	< 0.0001
Gender	< 0.0001

Trunk Restraint	< 0.0001
CPS Score	< 0.0001
Antidepressant	< 0.0001

Step 12-Add use of ≥ 9 medications

QICu = 16318.77

Variable	P value
Unsteady Gait	< 0.0001
ADL Hierarchy	< 0.0001
Bowel Cont.	< 0.0001
Chair That Prevents Rising	0.0007
Bladder Cont.	< 0.0001
Gender	< 0.0001
Trunk Restraint	< 0.0001
CPS Score	< 0.0001
Antidepressant	< 0.0001
≥ 9 Medications	0.97

Step13-Remove use of ≥ 9 medications, add DRS Score

QICu =16309.60

Variable	P value
Unsteady Gait	< 0.0001
ADL Hierarchy	< 0.0001
Bowel Cont.	< 0.0001
Chair That Prevents Rising	0.0007
Bladder Cont.	< 0.0001
Gender	< 0.0001
Trunk Restraint	< 0.0001
CPS Score	< 0.0001
Antidepressant	< 0.0001
DRS Score	0.05

Step 14-Remove DRS Score, add hip fracture

QICu = 16307.54

Variable	P value
Unsteady Gait	< 0.0001
ADL Hierarchy	< 0.0001
Bowel Cont.	< 0.0001
Chair That Prevents Rising	0.0007
Bladder Cont.	< 0.0001
Gender	< 0.0001
Trunk Restraint	< 0.0001
CPS Score	< 0.0001
Antidepressant	< 0.0001
Hip Fracture	0.0003

Step 15-Add diagnosed cardiovascular disease

QICu = 16309.28

Variable	P value
Unsteady Gait	< 0.0001
ADL Hierarchy	< 0.0001
Bowel Cont.	< 0.0001
Chair That Prevents Rising	0.0007
Bladder Cont.	< 0.0001
Gender	< 0.0001
Trunk Restraint	< 0.0001
CPS Score	< 0.0001
Antidepressant	< 0.0001
Hip Fracture	0.0003
Cardiovascular Disease	0.65

Step 16-Remove diagnosed cardiovascular disease, add use of antipsychotic medication

QICu = 16295.33

Variable	P value
Unsteady Gait	< 0.0001
ADL Hierarchy	< 0.0001
Bowel Cont.	< 0.0001
Chair That Prevents Rising	0.0006

Bladder Cont.	< 0.0001
Gender	< 0.0001
Trunk Restraint	< 0.0001
CPS Score	< 0.0001
Antidepressant	< 0.0001
Hip Fracture	0.0003
Antipsychotic	0.0003

Step 17-Add Pain Scale Score

QICu = 16296.45

Variable	P value
Unsteady Gait	< 0.0001
ADL Hierarchy	< 0.0001
Bowel Cont.	< 0.0001
Chair That Prevents Rising	0.0006
Bladder Cont.	< 0.0001
Gender	< 0.0001
Trunk Restraint	< 0.0001
CPS Score	< 0.0001
Antidepressant	< 0.0001
Hip Fracture	0.0002
Antipsychotic	0.0003
Pain Score	0.13

Step 18-Remove Pain Scale Score, add use of antianxiety medication

QICu = 16291.42

Variable	P value
Unsteady Gait	< 0.0001
ADL Hierarchy	< 0.0001
Bowel Cont.	< 0.0001
Chair That Prevents Rising	0.0006
Bladder Cont.	< 0.0001
Gender	< 0.0001
Trunk Restraint	< 0.0001
CPS Score	< 0.0001
Antidepressant	0.0002
Hip Fracture	0.0002
Antipsychotic	0.001
Antianxiety	0.04

Step 19-Remove antianxiety medication, add use of hypnotic medication

QICu = 16296.40

Variable	P value
Unsteady Gait	< 0.0001
ADL Hierarchy	< 0.0001
Bowel Cont.	< 0.0001
Chair That Prevents Rising	0.0006
Bladder Cont.	< 0.0001
Gender	< 0.0001
Trunk Restraint	< 0.0001
CPS Score	< 0.0001
Antidepressant	< 0.0001
Hip Fracture	0.0003
Antipsychotic	0.0003
Hypnotic	0.40

Step 20-Remove use of hypnotic medication, add CHESS Score

QICu = 16290.69

Variable	P value
Unsteady Gait	< 0.0001
ADL Hierarchy	< 0.0001
Bowel Cont.	< 0.0001
Chair That Prevents Rising	0.0009
Bladder Cont.	< 0.0001
Gender	< 0.0001
Trunk Restraint	< 0.0001
CPS Score	< 0.0001
Antidepressant	< 0.0001
Hip Fracture	0.0003
Antipsychotic	0.0004
CHESS Score	0.0006

Step 21-Add use of diuretic

QICu = 16288.77

Variable	P value
Unsteady Gait	< 0.0001
ADL Hierarchy	< 0.0001
Bowel Cont.	< 0.0001
Chair That Prevents Rising	0.0008
Bladder Cont.	< 0.0001
Gender	< 0.0001
Trunk Restraint	< 0.0001
CPS Score	< 0.0001
Antidepressant	< 0.0001
Hip Fracture	0.0005
Antipsychotic	0.0003
CHESS Score	0.0003
Diuretic	0.004

Step 22-Try adjusting for age

QICu = 16285.63

Variable	P value
Unsteady Gait	< 0.0001
ADL Hierarchy	< 0.0001
Bowel Cont.	< 0.0001
Chair That Prevents Rising	0.0008
Bladder Cont.	< 0.0001
Gender	< 0.0001
Trunk Restraint	< 0.0001
CPS Score	< 0.0001
Antidepressant	< 0.0001
Hip Fracture	0.0005
Antipsychotic	0.0003
CHESS Score	0.0003
Diuretic	0.001
Age	0.11

Step 23-FINAL MODEL remove age

QICu = 16282.92

Variable	P value
Unsteady Gait	< 0.0001
ADL Hierarchy	< 0.0001

Bowel Cont.	< 0.0001
Chair That Prevents Rising	0.0008
Bladder Cont.	< 0.0001
Gender	< 0.0001
Trunk Restraint	< 0.0001
CPS Score	< 0.0001
Antidepressant	< 0.0001
Hip Fracture	0.0004
Antipsychotic	0.0004
CHESS Score	0.0003
Diuretic	0.003

Ambulatory LTC Residents with PD

Step 1-Start with bladder continence

QICu = 1394.32

P value < 0.0001

Step 2-Add wandering

QICu = 1385.86

Variable	P value
Bladder Cont.	< 0.0001
Wandering	< 0.0001

Step 3-Add ADL Hierarchy

QICu = 1374.47

Variable	P value
Bladder Cont.	0.0001
Wandering	0.009
ADL Hierarchy	0.22

Step 4-Remove ADL Hierarchy, add unsteady gait

QICu = 1384.28

Variable	P value
Bladder Cont.	< 0.0001
Wandering	0.0003
Unsteady Gait	0.13

Step 5-Remove unsteady gait, add CPS Score

QICu = 1388.66

Variable	P value
Bladder Cont.	< 0.0001
Wandering	0.008
CPS Score	0.43

Step 6-Remove CPS Score, add bowel continence

QICu = 1388.42

Variable	P value
Bladder Cont.	< 0.0001
Wandering	< 0.0001
Bowel Cont.	0.31

Step 7-Remove bowel continence, try adjusting for age and gender

QICu = 1387.24

Variable	P value
Bladder Cont.	< 0.0001
Wandering	< 0.0001
Gender	0.03
Age	0.18

Step 8-FINAL MODEL # 1 remove age and gender

QICu = 1385.86

Variable	P value
Bladder Cont.	< 0.0001
Wandering	< 0.0001

Step 9-FINAL MODEL # 2 adjust for ADL Hierarchy

QICu = 1374.47

Variable	P value
Bladder Cont.	0.0001
Wandering	0.009
ADL	0.22

Non-Ambulatory LTC Residents with PD

Step 1-Start with unsteady gait

QICu = 2497.66

P value < 0.0001

Step 2-Add bowel continence

QICu = 2436.65

Variable	P value
Unsteady Gait	< 0.0001
Bowel Cont.	< 0.0001

Step 3-Add gender

QICu = 2418.56

Variable	P value
Unsteady Gait	< 0.0001
Bowel Cont.	< 0.0001
Gender	< 0.0001

Step 4-Add bladder continence

QICu = 2417.42

Variable	P value
Unsteady Gait	< 0.0001
Bowel Cont.	< 0.0001
Gender	< 0.0001
Bladder Cont.	0.14

Step 5-Remove bladder continence, add CPS Score

QICu = 2406.14

Variable	P value
Unsteady Gait	< 0.0001
Bowel Cont.	< 0.0001

Gender	< 0.0001
CPS Score	0.08

Step 6-Remove CPS Score, add use of chair that prevents rising

QICu = 2413.52

Variable	P value
Unsteady Gait	< 0.0001
Bowel Cont.	< 0.0001
Gender	< 0.0001
Chair That Prevents Rising	0.008

Step 7-Add use of trunk restraint

QICu = 2415.17

Variable	P value
Unsteady Gait	< 0.0001
Bowel Cont.	< 0.0001
Gender	< 0.0001
Chair That Prevents Rising	0.01
Trunk Restraint	0.50

Step 8-Remove use of trunk restraint, try adjusting for age

QICu = 2420.55

Variable	P value
Unsteady Gait	< 0.0001
Bowel Cont.	< 0.0001
Gender	< 0.0001
Chair That Prevents Rising	0.009
Age	0.45

Step 9-FINAL MODEL # 1 remove age

QICu = 2413.52

Variable	P value
Unsteady Gait	< 0.0001
Bowel Cont.	< 0.0001
Gender	< 0.0001
Chair That Prevents Rising	0.008

Step 10-FINAL MODEL # 2 adjust for CPS Score

QICu = 2402.75

Variable	P value
Unsteady Gait	< 0.0001
Bowel Cont.	< 0.0001
Gender	< 0.0001
Chair That Prevents Rising	0.02
CPS Score	0.05

Ambulatory LTC Residents in the

Comparison Group

<u>Step 1</u>-Start with bladder continence

QICu = 6732.76

P value < 0.0001

<u>Step 2</u>-Add CPS Score

QICu = 6701.46

Variable	P value
Bladder Cont.	< 0.0001
CPS Score	< 0.0001

<u>Step 3</u>-Add wandering

QICu = 6692.96

Variable	P value
Bladder Cont.	< 0.0001
CPS Score	0.0006
Wandering	< 0.0001

<u>Step 4</u>-Add ADL Hierarchy

QICu = 6679.29

Variable	P value
Bladder Cont.	< 0.0001
CPS Score	0.001
Wandering	0.0005
ADL Hierarchy	0.002

<u>Step 5</u>-Add bowel continence

QICu = 6667.79

Variable	P value
Bladder Cont.	< 0.0001
CPS Score	0.001
Wandering	0.0003
ADL Hierarchy	0.05
Bowel Cont.	0.002

<u>Step 6</u>-Remove ADL Hierarchy, add antidepressant use

QICu = 6651.71

Variable	P value
Bladder Cont.	< 0.0001
CPS Score	0.001
Wandering	< 0.0001
Bowel Cont.	0.0005
Antidepressant	< 0.0001

<u>Step 7</u>-Add CHESS Score

QICu = 6636.49

Variable	P value
Bladder Cont.	< 0.0001
CPS Score	0.002
Wandering	< 0.0001
Bowel Cont.	0.0004
Antidepressant	< 0.0001
CHESS Score	< 0.0001

<u>Step 8</u>-Add unsteady gait

QICu = 6629.73

Variable	P value
Bladder Cont.	< 0.0001
CPS Score	0.002
Wandering	< 0.0001
Bowel Cont.	0.002
Antidepressant	< 0.0001

CHESS Score	0.0005
Unsteady Gait	0.01

Step 9-Add use of ≥ 9 medications

QICu = 6619.66

Variable	P value
Bladder Cont.	< 0.0001
CPS Score	0.002
Wandering	< 0.0001
Bowel Cont.	0.002
Antidepressant	< 0.0001
CHESS Score	0.002
Unsteady Gait	0.02
≥ 9 Medications	0.003

Step 10-Remove unsteady gait, add DRS Score

QICu = 6629.35

Variable	P value
Bladder Cont.	< 0.0001
CPS Score	0.0009
Wandering	< 0.0001
Bowel Cont.	0.0003
Antidepressant	< 0.0001
CHESS Score	0.001
≥ 9 Medications	0.001
DRS Score	0.65

Step 11-Remove DRS Score, add age

QICu = 6596.18

Variable	P value
Bladder Cont.	< 0.0001
CPS Score	0.001
Wandering	< 0.0001
Bowel Cont.	0.0003
Antidepressant	< 0.0001
CHESS Score	0.002
≥ 9 Medications	0.002
Age	< 0.0001

Step 12-Add dizziness

QICu = 6591.31

Variable	P value
Bladder Cont.	< 0.0001
CPS Score	0.001
Wandering	< 0.0001
Bowel Cont.	0.0003
Antidepressant	< 0.0001
CHESS Score	0.003
≥ 9 Medications	0.002
Age	< 0.0001
Dizziness	< 0.0001

Step 13-Add vision

QICu = 6593.87

Variable	P value
Bladder Cont.	< 0.0001
CPS Score	0.003
Wandering	< 0.0001
Bowel Cont.	0.0003
Antidepressant	< 0.0001
CHESS Score	0.004
≥ 9 Medications	0.003
Age	0.0002
Dizziness	< 0.0001
Vision	0.10

Step 14-Remove vision, add use of diuretic

QICu = 6591.82

Variable	P value
Bladder Cont.	< 0.0001
CPS Score	0.001
Wandering	< 0.0001
Bowel Cont.	0.0005
Antidepressant	< 0.0001
CHESS Score	0.004
≥ 9 Medications	0.006
Age	0.0001

Dizziness	< 0.0001
Diuretic	0.23

Step 15-Remove use of diuretic, add arthritis

QICu = 6591.55

Variable	P value
Bladder Cont.	< 0.0001
CPS Score	0.001
Wandering	< 0.0001
Bowel Cont.	0.0004
Antidepressant	< 0.0001
CHESS Score	0.004
≥ 9 Medications	0.002
Age	< 0.0001
Dizziness	< 0.0001
Arthritis	0.03

Step 16-Remove arthritis, try adjusting for gender

QICu = 6593.09

Variable	P value
Bladder Cont.	< 0.0001
CPS Score	0.001
Wandering	< 0.0001
Bowel Cont.	0.0004
Antidepressant	< 0.0001
CHESS Score	0.003
≥ 9 Medications	0.002
Age	< 0.0001
Dizziness	< 0.0001
Gender	0.56

Step 17-Remove gender, try adding ADL Hierarchy again

QICu = 6584.06

Variable	P value
Bladder Cont.	< 0.0001
CPS Score	0.002
Wandering	< 0.0001
Bowel Cont.	0.003
Antidepressant	< 0.0001
CHESS Score	0.002
≥ 9 Medications	0.002
Age	< 0.0001
Dizziness	< 0.0001
ADL	0.02

Step 18-Remove ADL Hierarchy, try adding unsteady gait again

QICu = 6589.51

Variable	P value
Bladder Cont.	< 0.0001
CPS Score	0.002
Wandering	< 0.0001
Bowel Cont.	0.001
Antidepressant	< 0.0001
CHESS Score	0.007
≥ 9 Medications	0.003
Age	0.0002
Dizziness	0.0003
Unsteady Gait	0.02

Step 19-FINAL MODEL # 1 remove unsteady gait

QICu = 6591.31

Variable	P value
Bladder Cont.	< 0.0001
CPS Score	0.001
Wandering	< 0.0001
Bowel Cont.	0.0003
Antidepressant	< 0.0001
CHESS Score	0.003
≥ 9 Medications	0.002
Age	< 0.0001
Dizziness	< 0.0001

Step 20-FINAL MODEL # 2 adjust for ADL
Hierarchy

QICu = 6584.06

Variable	P value
Bladder Cont.	< 0.0001
CPS Score	0.002
Wandering	< 0.0001
Bowel Cont.	0.003
Antidepressant	< 0.0001
CHESS Score	0.002
≥ 9 Medications	0.002
Age	< 0.0001
Dizziness	< 0.0001
ADL Hierarchy	0.02

Non-Ambulatory LTC Residents in the Comparison Group

Step 1-Start with unsteady gait

QICu = 6859.98

P value < 0.0001

Step 2-Add ADL Hierarchy

QICu = 6742.72

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	< 0.0001

Step 3-Add bowel continence

QICu = 6715.52

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	< 0.0001
Bowel Cont.	< 0.0001

Step 4-Add use of chair that prevents rising

QICu = 6713.67

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	< 0.0001
Bowel Cont.	< 0.0001
Chair That Prevents Rising	0.009

Step 5-Add use of trunk restraint

QICu = 6709.53

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	< 0.0001

Bowel Cont.	< 0.0001
Chair That Prevents Rising	0.05
Trunk Restraint	0.002

Step 6-Remove use of chair that prevents rising, add bladder continence

QICu = 6709.32

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	< 0.0001
Bowel Cont.	0.003
Trunk Restraint	0.001
Bladder Cont.	0.0008

Step 7-Add CPS Score

QICu = 6673.53

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	< 0.0001
Bowel Cont.	0.0002
Trunk Restraint	0.0002
Bladder Cont.	< 0.0001
CPS Score	< 0.0001

Step 8-Add dizziness

QICu = 6671.30

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	< 0.0001
Bowel Cont.	0.0002
Trunk Restraint	0.0002
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Dizziness	0.01

Step 9-Add ≥ 9 medications

QICu = 6667.06

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	< 0.0001
Bowel Cont.	0.0002
Trunk Restraint	0.0002
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Dizziness	0.01
≥ 9 Medications	0.003

Step 10-Add gender

QICu = 6666.44

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	< 0.0001
Bowel Cont.	0.0002
Trunk Restraint	0.0002
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Dizziness	0.01
≥ 9 Medications	0.002
Gender	0.14

Step 11-Remove gender, try adjusting for age

QICu = 6666.84

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	< 0.0001
Bowel Cont.	0.0002
Trunk Restraint	0.0002
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
Dizziness	0.02
≥ 9 Medications	0.001
Age	0.02

Step 12-FINAL MODEL remove age and dizziness

QICu = 6668.62

Variable	P value
ADL Hierarchy	< 0.0001
Unsteady Gait	< 0.0001
Bowel Cont.	0.0002
Trunk Restraint	0.0002
Bladder Cont.	< 0.0001
CPS Score	< 0.0001
≥ 9 Medications	0.003