

# Depression and Functional Mobility Decline in Long Term Care Home Residents with Dementia: a Prospective Cohort Study



Charlene H. Chu, RN, GNC(c), PhD<sup>1,2</sup>, Amanda My Linh Quan, MPH<sup>3</sup>, Katherine S. McGilton, RN, PhD, FAAN<sup>1,4</sup>

<sup>1</sup>Lawrence S. Bloomberg Faculty of Nursing, University of Toronto, Toronto; <sup>2</sup>Institute for Life Course and Aging, University of Toronto, Toronto; <sup>3</sup>Dalla Lana School of Public Health, University of Toronto, Toronto; <sup>4</sup>Rehabilitation Sciences Institute, University of Toronto, Toronto, ON

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## ABSTRACT

### Objective

Assess the association between depression among new long-term care residents (<3 months stay) with dementia and functional mobility decline.

### Methods

A multi-site prospective cohort study was carried out among 26 participants diagnosed with dementia. Functional mobility was measured by Timed-Up-and-Go (TUG) and 2-Minute walk test (2MWT) at baseline, and 60-day post-baseline while participants received usual care. Linear mixed models were applied to examine the association between depression and functional mobility decline.

### Results

Residents experienced a statistically significant decline in functional mobility in as soon as 60 days. Each additional year of age was associated with a 2% increase in TUG. The interaction between depression and time spent in LTC was statistically significant. Age and time living in LTC were significantly associated with functional mobility decline in new residents with dementia.

### Discussion

Further work determining why residents with dementia experience decline in functional mobility at an accelerated rate is needed.

**Key words:** functional decline, mobility decline, long-term care, depression, cohort study, regression

## INTRODUCTION

Decline in functional mobility among older adults (OAs) results in a loss of activities of daily living (ADLs) independency, and

is associated with numerous adverse health outcomes such as admission into long-term care homes (LTCHs)<sup>(1,2)</sup> and mortality.<sup>(3)</sup> LTCHs provide on-site, 24-hour nursing care including medical care for complex issues, physical activities, and recreational programming, to help people live as independently and safely as possible. Impairments in cognition and function mobility are associated, and impairment in one domain often results in an accompanying impairment in the other.<sup>(4)</sup> The likelihood of functional mobility loss increases with worsening severity of cognitive impairment, and the loss of function is exacerbated by the presence of impaired cognitive function.<sup>(4)</sup>

Depression is also an established risk factor of functional impairment, worsening cognitive impairment<sup>(5-7)</sup> and lowering quality of life in those with dementia.<sup>(8,9)</sup> The prevalence of depression in newly admitted residents is 30%<sup>(10)</sup> and about a third (26-30%)<sup>(11)</sup> among residents with dementia. Depressive symptoms, such as low-energy levels or fatigue, loss of interest or pleasure in activities that used to be enjoyable, and difficulty in carrying out activities, can have a profound impact on behaviour and physical activity patterns.<sup>(12)</sup> Changes in motivation and emotional affect among depressed residents result in an overall reluctance to engage in activities that require residents to leave their rooms, and thus are barriers to frontline clinicians who attempt to provide standardized physical activity routines.<sup>(9,13,14)</sup> As a result, residents with dementia and depression are more likely to be less physically active compared to non-depressed residents and may lose functional mobility sooner. Extant literature has shown that clinically relevant depressive symptoms is a predictor of less walking in older adults, compared to older adults without clinically relevant depressive symptoms.<sup>(15)</sup>

In the face of LTCHs providing much needed care services, the results of previous longitudinal studies suggest that residents with dementia will experience some functional loss in their activities of daily living or mobility.<sup>(16-18)</sup> The longitudinal study with the shortest duration was six months

and demonstrated that 27% of residents experienced walking decline,<sup>(18)</sup> which was comparable to a study finding 41% of residents over a one-year period following admission into a LTCH.<sup>(16)</sup> The same Canadian study reported that 61% of this decline is in excess of what would be expected from dementia alone.<sup>(16)</sup>

Research suggests functional decline in residents with dementia can be measured over a six-month time period,<sup>(18)</sup> however, in order to prevent this physical decline, understanding when this downward trajectory begins after admission is imperative to program planning and priority setting. The relevancy of this knowledge gap is under-scored by the broader context of aging-in-place policy priorities in North America which have sought to delay LTCH admissions.<sup>(19)</sup> Such policies have resulted in individuals being admitted into LTCs with more advanced stages of dementia and who are increasingly more physically and cognitively impaired.<sup>(20)</sup> There is a dire need for further research examining longitudinal function loss in LTC residents to more accurately reflect the increased comorbidity and complexity of to-day's older adults population.<sup>(21)</sup> Specifically, little research has been devoted to the complex relationship between depression and functional mobility impairment in residents with dementia who are newly admitted into LTCHs.

The purpose of this study is to explore the association between depression and functional mobility decline within residents with dementia who are newly admitted (defined as residing for less than three months) to LTCH. We hypothesize that there is a negative correlation between depression and decline in functional mobility over time among residents with dementia newly admitted to LTCHs. Understanding how functional mobility changes in residents with dementia and depression may contribute to the design of treatments and the timing of intervention implementation, and highlight a greater vulnerability of decline among these residents. This information is of clinical importance to health-care providers and staff of LTCH. Furthermore, it provides stakeholders and policy makers with updated evidence that supports improved care for residents with dementia, in general.

## METHODS

### Study Design

The data for this cohort study from September 2016 to May 2017 was nested within a longitudinal time-series study conducted at two non-profit LTCH facilities (one large 350-bed facility, and one mid-sized 128-bed facility) in Toronto, Canada. The overarching study results were published elsewhere<sup>(22)</sup> and evaluated the feasibility, acceptability, and efficacy of a multifaceted walking intervention (MWI) among LTC home residents with dementia over a four-month period. This nested study uses data collected during the control phase of the MWI study (Figure 1), during which time study participants received usual care and programming. Written informed consent was provided by their substitute decision-makers present for the consent process.

### Subjects

Subjects were recruited on a voluntary basis by LTCH staff and screened based on inclusion and exclusion criteria. Study inclusion criteria were as follows: newly admitted residents (defined as being at the home for no longer than three months when approached), diagnosed with dementia as reported in their medical chart, spoke English, Mini-Mental Status Exam (MMSE) score of >10 and <24, and could walk for 2 minutes with or without gait aids. Those who were unable to stand or walk, had surgery or were deemed palliative with a life expectancy of less than six months, or had unstable cardiac conditions, were diagnosed with Parkinson's disease (due to bradykinesia and high risk of falls), schizophrenia, personality disorder, or focal brain disorder (due to motor-related impairments and unpredictability in behaviours) were excluded. All participants had their substitute decision-makers present for the consent process and were approved to enroll in the study by their primary physicians.

### Data Collection

Data collection was led by a research assistant who was blinded to the study purpose.

### Sociodemographic and Health Variables

Baseline characteristics including age, gender, number of comorbidities, marital status, highest completed level of education, cognition (i.e., MMSE score), use of a gait aid, number of comorbidities, and environment (LTC facility name, and length of stay in months) were obtained. The Cornell Scale for Depression in Dementia (CSDD),<sup>(23)</sup> a validated tool for use in this population, was used to assess depressive symptoms of each participant. Interpretation of the CSDD score used the following cut-offs: >10 for probable major depression and above 18 for definite major depression.<sup>(24)</sup> Scores were compared before and after the 60-day trial period to determine significance.

### Dependent Variables

The Timed Up and Go (TUG)<sup>(25)</sup> test and the 2-Minute Walk Test (2MWT),<sup>(26)</sup> both clinically validated, were the metrics used to assess functional mobility. The TUG test is widely used among older adults. It is recommended by the National Institute of Clinical Evidence (NICE) guidelines as an assessment of gait and balance in the prevention of falls in older people,<sup>(27)</sup> and requires no special equipment or training to be carried out. The TUG test has demonstrated high reliability and validity among older adults.<sup>(28,29)</sup> The 2MWT, measured as a distance, is a measurement of endurance that assesses walking distance over 2 minutes; it has also been widely used among older adults living in LTCH.<sup>(30)</sup> The clinical tests to measure functional mobility were applied at time of enrollment into the study (T1) and 60-days later (T2) by a research assistant who used a digital stopwatch and calibrated wheel to measure the distance walked.

### Statistical Analyses

Means and standard deviations (SD), or frequencies and percentages, were used to present demographic and clinical

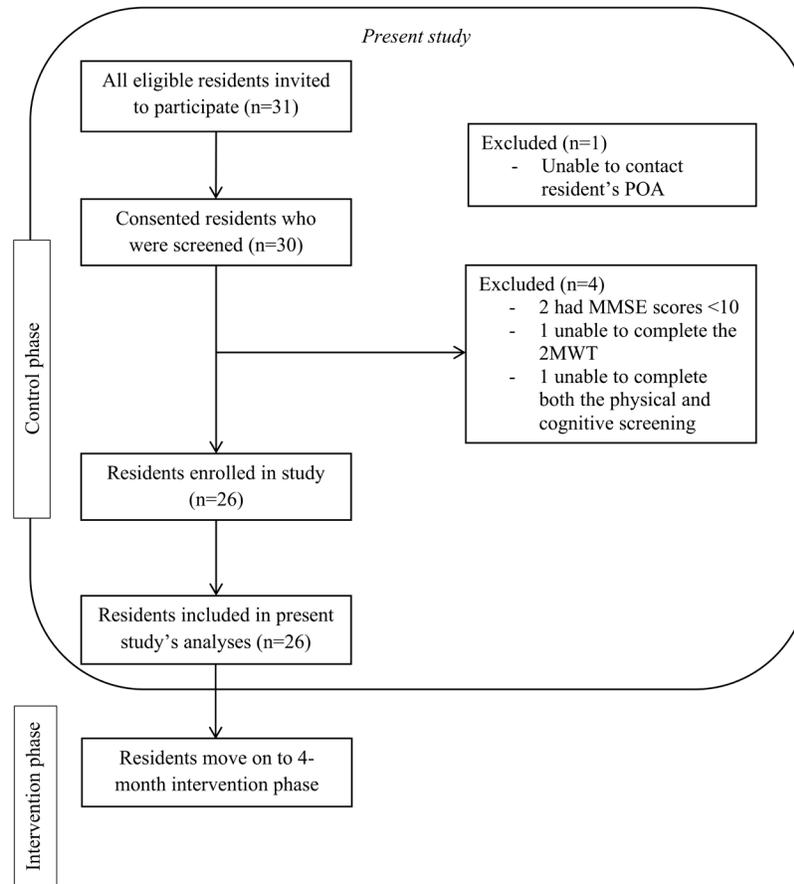


FIGURE 1. Study flow diagram

characteristics. To investigate the association between depression among newly admitted LTCH residents with dementia and functional mobility decline, the dependent variables (TUG and 2MWT scores) were analyzed in STATA 14.1 (StataCorp LLC, College Station, TX; www.stata.com) using linear mixed models (LMM). Given our heterogeneous study population, LMM were selected instead of traditional linear regression models, as LMM enables us to test for intrasubject random effects and correlation of subjects' measures over time (T1: time of study enrolment, and T2: 60-days after enrolment). The models included random effects for participants and fixed effects for characteristics. The models were adjusted for pre-defined confounding variables: age, sex, and cognitive impairment (measured by MMSE score). The data fitting goodness of the regression models were assessed using Akaike information criterion (AIC) and  $R^2_{adj}$  value. An interaction between study duration (first 60 days in LTCH) and functional mobility decline metrics was also explored through a likelihood ratio test (LRT). Functional mobility decline would be indicated by an increase in TUG or a decrease in 2MWT distance. A pairwise *t*-test was also conducted to compare TUG and 2MWT group mean scores. Results with *p* values < .05 were considered statistically significant. Standard regression model diagnostics were done to assess the model.

## RESULTS

### Study Participants

The present study included 26 newly admitted LTCH residents assessed at two different time points, there was no loss to follow-up. The main characteristics of the study population at base-line (T1) are provided in Table 1. The mean age of the sample (n=26) was 86.8 years old and 81% were female; participants were moderately cognitively impaired (MMSE score of 15.5) and had an average of six co-morbidities. Seventy-three per cent (n=19) of participants did not have depression according to measured CSDD score; 19% (n=5) and 7% (n=2) of the residents had probable major depression or definite major depression, respectively.

### Mean TUG Score and 2MWT Distances Over Time

Time trend in mean TUG scores and 2MWT distances are presented in Figure 2. Data used to construct Figure 2 are available in Appendix A. Pairwise *t*-test results indicate that there was statistically significant decline in the TUG scores and 2MWT distances indicative of functional mobility. Overall TUG time increased by 4.02 sec (SD=7.3; 17% change, *p*=.009) and the 2MWT distance decreased by 7.31 m (SD=14.74; -12% change, *p*=.018). Decline in 2MWT

TABLE 1.

Study participant clinical and demographic characteristics (n = 26)

<i>Demographic Variables</i>	<i>% or Mean ± SD</i>
Age	86.8 (6.98)
75-80	23.0%
81-85	23.0%
86-90	15.4%
91-95	30.7%
>95	7.6%
Female	80.8%
Number of months in home	2 (1.3)
Marriage status	
Married	23.0%
Widowed	57.8%
Single	7.7%
Divorced	11.5%
Ethnicity	
Caucasian	96.2%
Other	3.8%
Education level	
Grade school	23.0%
High school graduate	34.6%
College/university graduate or higher	42.3%
<i>Health-Related Variables</i>	
MMSE score	15.5 (5.0)
FAST score	5.01 (0.8)
Alzheimer's disease (=Yes)	23.1%
Unspecified dementia	76.9%
CSDD Score <sup>a</sup>	8 (6.0)
<10	73.1%
10-18	19.2%
>18	7.7%
Comorbidities	
Number of comorbidities per resident	6.1 (3.0)
Hypertension	57.7%
Congestive heart failure	11.5%
Depression	34.6%
Arthritis	30.7%
Diabetes	19.2%
Medications	
Medications prescribed per resident	9.8 (4.4)
Use of antidepressants	61.5%
Use of analgesics	57.7%
Use of ACE-I	46.1%
Use of cognitive enhancers	34.6%
Use of benzodiazepines	42.3%
Gait aid use	
No gait aid needed	23.0%
Walker or rollator throughout the day	42.3%
Wheelchair for majority of the day, rollator occasionally	34.7%

<sup>a</sup>Scores above 10 indicate a probable major depression. CSDD = Cornell Scale for Depression in Dementia (CSSD); MMSE = Mini-Mental State Exam; FAST = Functional Assessment STaging scale.

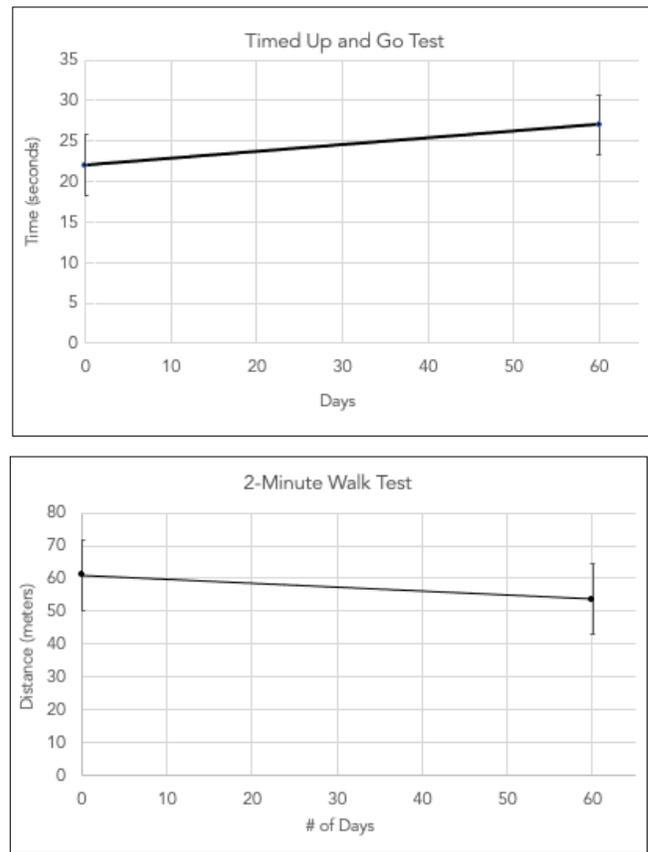


FIGURE 2. Time trend in mean TUG score and 2MWT distance (95% CI), unadjusted

distance was relatively less among residents who were not depressed (with a CSDD score < 10);<sup>(24)</sup> greater CSDD score resulted in lower 2MWT distance; the same negative correlation was not present with TUG times.

### Association Between Depression and Functional Mobility Decline

The LRT to determine if it was appropriate to use study duration (time) as an interaction term had a chi-square value of 8.78 ( $p=.0030$ ) with one degree of freedom. Adding study duration, or time, as an interaction term resulted in a statistically significant improvement in model fit; thus it was included in the model used for analyses. This model also had the best fit according to Akaike information criterion (AIC) model selection. The association between depression, assessed by mean CSDD, and functional mobility decline, assessed by mean TUG score and 2MWT distance over time, was studied through LMM. In the adjusted LMM analysis for functional mobility decline, the only statistically significant factors associated with decline were age and time spent living in the LTCH (included as an interaction). Each additional year of age was associated with a 2% increase in TUG (Table 2), but there was no association with 2MWT distance; time spent in LTCH was significantly associated with 2MWT distance.

TABLE 2.  
Repeated measures regression results for resident outcomes  
(repeated measures on n = 26 individuals, where each was measured at baseline and then again 60 days later)

<i>Fixed-Effect Parameter</i>	<i>β (95% CI)</i>	
	<i>TUG, seconds log transformed</i>	<i>2MWT, meters</i>
Change in outcome from baseline to 60 days later (time)	0.18 <sup>a</sup> (0.02, 0.35)	2.47 ( -4.93, 9.87)
CSDD score at baseline	0.004 (-0.018, 0.026)	0.77 -2.03, 2.32)
Time living in LTCH	-0.0006 (-0.02, 0.02)	-1.26 <sup>a</sup> -2.03, -0.49)
<i>Confounding Covariates</i>		
Age	0.02 <sup>a</sup> (0.002, 0.04)	-1.2 (-2.5, 0.08)
Sex (=Female)	0.05 (-0.27, 0.37)	-9.0 (-32.8, 14.7)
MMSE score	0.02 (-0.01, 0.04)	-1.22 (-3.11, 0.66)
Constant	0.99 (-0.63, 2.62)	185 <sup>a</sup> (65, 304)
<i>Random-Effects Parameters</i>		
Variance of repeated measures	0.08 (0.04, 0.16)	494.95 (276, 887.4)
Variance of residual measures	0.04 (0.02, 0.06)	70 (41.1, 122.1)

<sup>a</sup>*p* ≤ .05.

CSDD = Cornell Scale for Depression in Dementia; MMSE = Mini-Mental State Exam; TUG = Timed-up and Go test; 2MWT = 2-minute walk test.

## DISCUSSION

This study suggests that short-stay LTCH residents with dementia experience a statistically significant decline in functional mobility within the first 60 days after admission, and that this can be measured by the TUG and 2MWT. This decline is greater than the rates of mobility loss reported in previous longitudinal studies<sup>(16,18)</sup> and underlines the vulnerability of residents with dementia and depression. These novel findings highlight how quickly function decline is experienced and how easily it can be detected, and supports calls to action to protect LTC residents and improve LTC. In the adjusted analysis, the interaction of time spent living in the LTCH was significantly associated with 2MWT distance, suggesting that within the first 60 days of stay there is increasing decline in 2MWT distance. Our findings are consistent with previous longitudinal work that showed cognitive impairment and depressive symptoms contributes to the loss of physical skills and functional independence.<sup>(31)</sup> This work highlights how prone newly admitted residents with dementia and depression are to functional decline, which may be occurring at a higher rate, and thus underscores the urgent need and ethical imperative for more research focused on this population.

The results showed that depressive symptoms were related to increased 2MWT distances, but this relationship was not present with TUG scores. This did not surprise the authors as older adults with depressive symptoms are highly associated with slowed gait speeds,<sup>(32,33)</sup> and have been shown to have a bidirectional reciprocal relationship.<sup>(34,35)</sup> Previous studies have found that older adults with depressive symptoms have accentuated postural sways,<sup>(36)</sup> and slowed motor and

movement velocity with increased reaction times,<sup>(37)</sup> which contribute to an increased risk of falls and fear of falling.<sup>(38)</sup> As a consequence, residents may have a fear of falling and restriction of activities<sup>(39)</sup> which would disproportionately impact their ability to walk freely independently for 2 min (as in the 2MWT), compared to the TUG where the resident is standing up from—and sitting down in—a chair that is in close proximity. Similar results from a national longitudinal cohort study found that depression did not predict TUG performance once adjusted for clinical covariates.<sup>(40)</sup> Consistent with previous studies, our results suggest that depression may have an additive effect in functional decline and disability,<sup>(41)</sup> and older people with dementia and depression may, therefore, be an appropriate target for multifaceted interventions aimed at reducing functional decline.<sup>(40,41)</sup>

The present study has significant strengths, such as using well-known, internationally recognized metrics for assessing depressive symptoms (CSDD), and direct measures of functional mobility (TUG score and 2MWT distance). The CSDD assessment is commonly used in nursing home studies as an accepted method to identify and measure depression.<sup>(42,43)</sup> In addition, the data collected about newly admitted residents were recent and up-to-date, compared to research examining the same population.<sup>(10)</sup>

Limitations of this study include the small sample size and event rate (n=26; prevalence of depression based on CSDD score 27%) which limits the precision of study estimates and ability to fully describe the relationship between function mobility decline and time. This is reflected in wide confidence intervals, and the study findings should be interpreted with this in mind. The small sample size also reflects

the study inclusion/exclusion criteria and inherent nature of the LTC sector; the turnover rate of residents in LTC is minimal, on average five months in Ontario<sup>(44)</sup> (and an even longer wait, two to five years, in the study-specific LTCH facilities). The cross-sectional study design did not allow us to establish temporal sequence and draw causal conclusions. In addition, the study sample was moderately-to-severely cognitively impaired and were likely already experiencing decline in functional mobility that universally contributed to their admissions;<sup>(18)</sup> therefore caution must be taken when generalizing these results to all residents with cognitive impairment.

## CONCLUSIONS

Findings from this study suggest that older adults ( $\geq 65$  years of age) with dementia experience significant declines in functional mobility within 60 days of being admitted to LTCH. This decline is further compounded by increasing age in years and higher scores of depression (as indicated by CSDD). Implementation of effective interventions that encourage physical activity and reduce social isolation are needed to prevent this decline. Further research is necessary to confirm the findings from this study and to better understand the current trajectory of functional mobility after admission into LTCHs. Such work will inform planning of health services for the growing number of residents admitted with dementia and depression.

## CONFLICT OF INTEREST DISCLOSURES

The authors declare that no conflicts of interest exist.

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**Correspondence to:** Charlene H. Chu, RN, GNC(c), PhD, University of Toronto—Lawrence S. Bloomberg Faculty of Nursing, 155 College St., Suite 130, Toronto, ON M5T 1P8  
**E-mail:** charlene.chu@utoronto.ca

**APPENDIX A. DESCRIPTIVE STATISTICS OF RESIDENT OUTCOMES (N=26)**

Outcome	Mean (SD)	SE	95% CI	Range (min–max)	Median (Q1–Q3)	IQR
TUG <sub>T1</sub>	22.0 (9.53)	1.87	19.12–26.80	11–49	20.00 (16.00–25.7)	11
TUG <sub>T2</sub>	27.01 (9.32)	1.82	23.23–30.72	11–45	24.30 (20.18–32)	13
2MW <sub>T1</sub>	61.00 (27.02)	5.37	50.19–71.9	20.63–120	24.65 (39.01–73.15)	40.3
2MW <sub>T2</sub>	53.69 (27.67)	5.36	42.52–64.86	10.61–109.1	55.55 (34.74–74.67)	41.3