Prevalence and facility level correlates of need for wheelchair seating assessment among long term care residents

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Abstract

Background—Wheelchairs are frequently prescribed for residents with mobility impairments in long term care. Many residents receive poorly fitting wheelchairs, compromising functional independence and mobility, and contributing to subsequent health issues such as pressure ulcers. The extent of this problem and the factors that predict poor fit are poorly understood; such evidence would contribute greatly to effective and efficient clinical practice in long term care.

Objective—To identify the prevalence of need for wheelchair seating intervention among residents in long term care facilities in Vancouver and explore the relationship between need for seating intervention and facility level factors.

Methods—Logistic regression analysis using secondary data from a cross-sectional study exploring predictors of resident mobility. 263 residents (183 females and 80 males) randomly selected from 11 long term care facilities in the Vancouver health region (mean age 84.2 ± 8.6 years). The Seating Identification Tool was used to establish subject need for wheelchair seating intervention. Individual item frequency was calculated. Six contextual variables were measured at each facility including occupational therapy staffing, funding source, policies regarding wheelchair-related equipment, and decision-making philosophy.

Results—Overall prevalence rate of inappropriate seating was 58.6% (95% CI 52.6 – 64.5%), ranging from 30.4% – 81.8% among the individual facilities. Discomfort, poor positioning and mobility, and skin integrity were the most common issues. Two facility level variables were significant predictors of need for seating assessment: ratio of occupational therapists per 100 residents (OR 0.11 [CI 0.04, 0.31]) and expectation that residents purchase wheelchair equipment beyond the basic level (OR 2.78 [1.11, 6.97]). A negative association between facility prevalence rate and ratio of occupational therapists ($r_p = -0.684$, CI -0.143 – -0.910) was found.

Conclusion—Prevalence of need for seating assessment in long term care is high overall but it varies considerably between facilities. Increasing access to occupational therapy services appears to mediate this need.

Keywords

Wheelchairs; nursing homes; occupational therapy; elderly; mobility; prevalence

Introduction

Mobility impairment is the most common disabling condition among older adults in Canada [1]; to address these mobility limitations, a wheelchair is often prescribed. In long term care (LTC), most residents require a wheelchair for mobility [2]. Wheelchairs are frequently provided without formalized assessment and often by health care workers without specialized training in the area of wheelchair mobility and seating [3]. As a result, many residents have poorly fitting wheelchairs that can create additional issues for health, mobility and function [4, 5].

The extent to which wheelchair seating needs are unmet among LTC residents is poorly understood. Several studies conducted in the United States, most over 15 years old, have found high levels of wheelchair-related problems. Shaw and Taylor found over 80% of LTC residents in their study identified at least one wheelchair-fit issue [6]; Krasilovsky similarly found 80% of residents referred for assessment required substantial seating intervention [7]. Fuchs and Gromack found at least one therapist goal for wheelchair use was unmet in 50% of cases [4]. Simmons and colleagues studied factors impacting wheelchair mobility in California nursing homes and found 46% of residents had inappropriately fitted wheelchairs [8]. Contextual factors related to the facility, such as the physical, cultural, and policy environments, were not identified.

Individually prescribed wheelchairs have been recommended to ensure proper fit and enhance function [9]. A poorly fitting wheelchair can have substantial implications for the user including orthopedic deformity, restricted mobility, pain, and increased risk for pressure ulcers [10]. Finding an optimal match between user needs, wheelchair configuration, and environmental demand requires considerable expertise and experience [9]. Some studies have documented the benefits of using a comprehensive assessment approach to wheelchair prescription. Hoenig and colleagues found that individualized wheelchair assessment by a trained occupational or physical therapist increased frequency of wheelchair use among community-dwelling veterans aged 50 to 75 [3]. Trefler et al measured the impact of providing individualized wheelchair assessment by a trained clinician for LTC residents and found it reduced difficulty with wheelchair propulsion and increased functional reach, sense of well-being, and satisfaction with the wheelchair [11].

The Seating Identification Tool (SIT) was developed to screen for individuals at risk for functional restriction or health complications due to an inadequately fitted wheelchair prescription [12]. As part of a tool development study, Miller reported a prevalence rate of 67% among 43 residents of a single Ontario LTC facility [12]. In an unpublished study, Miller and colleagues found 63% of 169 residents in eleven Ontario LTC facilities required

comprehensive wheelchair assessment [13]. Bourbonniere et al. also used the SIT to measure need for seating intervention among 99 residents at two LTC sites where substantial resources were available related to prescription expertise and wheelchair equipment [14]. The overall prevalence was 22%, with a statistically significant difference between site rates of 12% and 32%. The type of seating issues identified most commonly by the SIT has yet to be explored.

At this stage, it is helpful to acquire prevalence data from a larger sample as it provides a clinically useful picture of impact that can assist in projecting potential resources required [15]. Moreover, the predictive factors of poor wheelchair fit at the facility level are largely unexplored. While some descriptive evidence is available regarding outcomes *following* wheelchair interventions, we are not aware of any study to date that specifically examines contextual factors associated with prevalence of need for individualized wheelchair assessment. Evidence related to facility factors and prevalence of wheelchair seating need could have implications for administrators and health care providers, particularly with regard to cost-effective clinical practice.

The purpose of this study was to identify the extent of need for wheelchair seating assessment in LTC facilities in the Vancouver lower mainland and explore the relationship between need for seating assessment and facility contextual factors. The specific study objectives were to determine the:

1. Overall and facility-specific prevalence rates of need for seating assessment and type of need identified;
2. Facility-level variables associated with need for seating assessment; and
3. Correlation between facility prevalence rates and relevant facility variables.

Materials and Methods

Secondary data analyses were employed with results of a cross-sectional study exploring predictors of resident mobility in LTC, for which ethics approval from the University of British Columbia ethics board [16]. All LTC facilities with a minimum of 100 wheelchair users within a prescribed area of the Lower Mainland of British Columbia were invited to participate in the study; 11 out of 13 potential facilities agreed. In order to be eligible for inclusion, residents were required to be 60 years of age or older, medically stable, English speaking and have resided in the facility for at least one month. In addition, they must have used a wheelchair for at least two hours per day, as their primary means of mobility, for more than one month. The names of eligible residents were compiled into two lists, those able to provide consent and those requiring a proxy, and then randomized. Residents or their proxy were approached in sequence and invitations extended until at least 17 residents from each list were enrolled or until the list was exhausted.

Several descriptive indicators were collected. Health status was estimated using the 18-item Comorbidity Index [17]. Cognitive status was assessed with the Standardized Mini-Mental State Examination [18] and diagnosis of dementia was established from the residents' medical record. Functional status was measured with the Functional Independence Measure

[19]. Trained research assistants administered all standardized socio-demographic and wheelchair-specific measures among 263 residents from 11 LTC facilities within the Vancouver health region. The **dependent variable** was need for comprehensive seating assessment as, measured by the SIT. The SIT contains eleven dichotomous items (yes/no) related to skin integrity, discomfort, positioning, mobility and stability. Affirmative items are tallied to obtain a total SIT score between 0 and 15 (4 items are double-weighted). Interrater reliability (ICC = 0.83) and test-retest reliability (ICC = 0.86) have been demonstrated [12]. Evaluation of the SIT has established a cut-off score of ≥ 2 as a clinical determinant of need (Sensitivity = 100%; Specificity = 65%) [12].

6 **independent variables** were selected for our analysis of facility-level context. The variables selected for inclusion were based on evidence from the research literature and clinical experience, and those with a strong theoretical basis for potential influence were included. We selected variables that would reflect a variety of components within the LTC context, including service provision, financial obligations, facility policies, and the cultural milieu. Since they are the primary providers of wheelchair assessment and prescription in Canadian LTC facilities, the *OT Ratio* (occupational therapists per 100 residents) was considered an indicator of access to seating assessment service. Among the 11 facilities, some had public (government) funding while others had *Private* funding, which might potentially influence services provided. Canadian LTC facilities typically provide a basic wheelchair and cushion from an existing inventory on-site. When seating and mobility needs extend beyond this level, some facilities require residents to *Purchase* such equipment. This may affect the degree to which a wheelchair can be customized, depending upon the willingness and financial ability of the resident or family to make these purchases. The wheelchair prescription process seeks to find an optimal fit between the individual, the mobility device and the contextual environment [20]. For some residents, a scooter or power wheelchair may be more appropriate than a manual wheelchair; however, not all LTC facilities permit use of these devices. *Power wheelchair* and *Scooter* accommodation were therefore considered as potentially influential variables in addressing seating need. Finally, some facilities had adopted the *Eden Alternative*, a philosophical approach to long-term care that advocates resident-centred care and resident participation at the facility decision-making level [21]. A more attentive and humanistic facility culture could potentially result in greater sensitivity to the seating needs of residents.

Statistical Analyses

To calculate overall and facility-specific prevalence rates, the SIT cutoff score of ≥ 2 was used [12]. Prevalence was calculated using affirmative cases divided by number of respondents. Counts of the 11 SIT component items were made for all cases as well as the SIT ≥ 2 and <2 subgroups, and relative frequency (i.e., percent) calculated. Since the outcome variable SIT ≥ 2 was dichotomous, logistic regression was used to explore and identify significant relationships with the facility-level contextual variables. Logistic regression enabled the introduction of both continuous and discrete independent variables and was not restricted by assumptions of normal distribution and equal variance between groups [22]. The limited evidence regarding seating need did not justify a forced entry model; therefore, direct logistic regression was used to discriminate relative importance and

probabilities associated with seating need for each of the six facility variables [22]. The Wald statistic was used to measure the contribution of individual facility-level predictor variables to the model [22]; those statistically significant ($p < .05$) were further explored through correlational analysis with calculated facility prevalence rates for associations (Pearson for continuous variables and Point-biserial for dichotomous binary variables). The Nagelkerke measure was used to determine effect size (i.e., approximation of variance accounted for by the model) [22]. Statistical analysis was performed using Predictive Analytics Software (PASW) 18.0.

Results

Demographic information about the study participants is provided in Table 1. Residents experienced a variety of health conditions, resulting in the need for a wheelchair to address personal mobility limitations, including cerebral vascular accident and other neurological disorders; Alzheimer's disease and dementia; rheumatic diseases; and lower limb amputation, fracture or arthroplasty. Table 2 summarizes participant health, cognitive and functional status by facility.

Among the 11 nursing homes, 8 (72.7%) were publicly funded and the mean number of beds was 175.2 ± 41.9 . The overall prevalence of need for seating assessment was 58.6% (95% CI 52.6 – 64.5). Individual nursing home prevalence rates ranged from 30.4% to 81.8% (see Table 3). Relative frequencies for the component SIT items (i.e. percent of participants identified) are provided in Figure 1. The order of frequency for the eight most common issues (those occurring among more than 10% of respondents) was identical for the total sample and the SIT cutoff subgroup (SIT score of SIT ≥ 2). Discomfort, need for repositioning, independent mobility, and redness on the buttocks were the most common issues identified. Combining the four items related to pressure-related skin integrity (i.e., any redness or open sore) produced a frequency of 46.1% in the SIT cutoff subgroup.

Logistic regression of the full model of facility variables against a constant-only model was statistically significant ($\chi^2 (6, N=263) = 21.78, p = .001$) in discriminating need for seating assessment. The overall effect size is small with a Nagelkerke R^2 value of .107; the model correctly predicted 74.0% of SIT positive cases and 46.8% of SIT negative cases for an overall accuracy of 62.7%. The regression coefficients, Wald statistics, and odds ratios with 95% confidence intervals for each facility variable are presented in Table 4. Diagnostic procedures to identify potential interactions between predictor variables and SIT score revealed no issues. Only ratio of occupational therapists per 100 residents (OR 0.11, 95% CIs [0.04, 0.31]) and resident Wheelchair Purchase (OR 2.78 [1.11, 6.97]) were significant in predicting SIT outcome according to the Wald statistic. The odds ratio suggests that with an increase of one occupational therapist per 100 residents, the probability of seating issues is reduced by nearly 90% and that residents are almost 3 times as likely to experience inadequate seating in facilities that required them to pay for specialized wheelchair and seating components. Post-hoc analysis explored associations between facility-level prevalence of need for seating assessment and these two facility-level contextual variables. Pearson correlation for the occupational therapist ratio analysis revealed a negative association ($N=11, r_p = -0.684, CI -0.143 - -0.910$), explaining 46.8% of the variation (see

Figure 2). The two for-profit private facilities had the highest and lowest prevalence rates, while the not-for-profit private facility was very close to the overall mean. Point-biserial correlation analysis for facility requirement for residents to purchase wheelchair equipment beyond the basic level and the facility prevalence rate was not significant ($N=11$, $r=0.194$, $CI -0.459 - 0.711$).

Discussion

The need for wheelchair seating assessment is substantial, as the prevalence across LTC facilities within the Vancouver health region was nearly 6 in 10 residents. This finding is consistent with smaller studies reporting prevalence of wheelchair seating issues between 46 and 80% [4, 7, 8] and comparable to the 63 and 67% prevalence rates found by Miller et al [12, 13]. This is the first study to consider the type of wheelchair seating issue identified by the SIT tool. The predominant SIT items observed reinforced concerns about the health, mobility, and functional risks of inappropriate seating. Pain and discomfort impact quality of life and are likely a harbinger of subsequent skin-integrity changes. Compromised independence with wheelchair propulsion and positioning illustrate the functional implications of a poorly fitting wheelchair. These findings are salient since this study included a much larger sample, both in participants and facilities accessed, than previous reports. It is striking that prevalence of inadequate wheelchair seating in residential care does not appear to have improved over the last two decades. Perhaps more intriguing is the broad range in prevalence *between facilities* within the Vancouver region.

As far as the authors know, this is the first study to consider facility variables as predictors of seating need. The facility-wide issue of poorly fitting wheelchairs appears to be mediated through access to occupational therapy, which is a primary provider of wheelchair seating assessment and prescription [23]. Prevalence of need for assessment followed a very consistent decline with higher OT staffing ratios. Because the data were collected in a cross-sectional manner, a causal relationship between OT staffing and prevalence of seating need cannot be assumed. It does seem intuitive that increasing therapy staffing would reduce the number of cases of poor seating. Based on the odds ratio calculated, adding .3 occupational therapists per 100 residents would reduce residents' risk of inappropriate wheelchair fit by approximately 50%. Employing more therapists with seating expertise increases institutional costs; however, the potential reduction in inappropriate wheelchair prescription is likely to counterbalance this additional expenditure. For example, a recent randomized controlled trial demonstrated a significant reduction in sitting-acquired pressure ulcers in nursing home residents when a properly fitted wheelchair and cushion were provided by a seating specialist [24]. The 22% prevalence rate in two Vancouver nursing homes reported by Bourbonniere and colleagues is well below those observed in this study [14]. The two facilities in Bourbonniere's study had an occupational therapist ratio of at least 1.3 per 100 residents as well as a wheelchair technician, and had recently obtained three million dollars worth of wheelchair equipment, lending further support to the premise that investment in qualified personnel and equipment can have a large impact on reducing inappropriate wheelchair prescriptions. Such investment may also address other important outcomes such as mobility, participation and health-related expenses, although this has yet to be investigated. There was no apparent association between facility funder and prevalence of

seating need. Both private and publicly funded sites were widely dispersed for both occupational therapist ratio and SIT prevalence rates. A variety of careproviders are employed within each LTC, including nurses, aides, physiotherapists and recreation therapists. As with occupational therapy, there is variability in facility staffing ratios among these disciplines, although most facilities did not employ occupational therapy assistants. In Post-hoc analysis, introducing variables of direct care hours per resident (which included all disciplines) and physiotherapy staffing ratio did not alter the results of the logistic regression or enhance explanation of SIT score variability. The individual-level characteristics of residents specific to each facility, such as level of disability or cognitive impairment, might have also contributed to risk for a poorly fitting wheelchair. The cross-sectional nature of the study, with a single data collection point, did not provide sufficient power to create a stable model for multi-level (individual and facility) analyses, and may have had a confounding effect.

The requirement for residents to pay for equipment, over and above a basic wheelchair and cushion, appears to have only marginal importance. Despite the regression model identifying somewhat higher risk, the overall prevalence of inadequate seating was not significantly different in facilities where this demand was not in place. It may be that purchasing specialized equipment is relevant in concert with other factors, rather than having much predictive value on its own. Access to seating expertise and assessment is probably a more important issue than who pays for wheelchair components.

It is suggested by the Individual SIT item frequency that poor seating often leads to user discomfort and is commonly related to issues of poor postural support and high pressure, which can result in orthopedic deformity and development of pressure ulcers. The societal cost associated with treating and healing a pressure ulcer is high, with estimates of \$500 to \$50,000 per ulcer [25]. Furthermore, the personal costs of pain and compromised quality of life that accompany ill-fitting wheelchairs must be considered [26]. It is very likely that the benefits resulting from appropriate wheelchair assessment and prescription would outweigh the financial burden of providing additional therapist resources.

Several limitations in this study should be noted. The voluntary nature of enrolment created a convenience sample and may limit the generalizability of the results. While two significant facility variables associated with need for seating assessment were identified, the overall explanation of variation was small. Wheelchair fit is a complex and multifaceted construct. It is unlikely that a small number of variables can provide a full explanation for wheelchair fit. The variables identified in this study were consistent with a person-environment fit framework; however, as with any secondary analysis we were limited in using the variables originally selected. Relative to other studies to date, the original database provided a more comprehensive selection of variables related to wheelchair mobility. Measures specifically selected for wheelchair fit might have increased the explanatory power of our analysis and future studies should incorporate fit-related variables such as type, weight and adjustability of the wheelchair. Additional factors to consider could be sitting tolerance, pressure intensity and distribution, and seating configuration for postural alignment and optimal propulsion. Longitudinal studies of wheelchair fit in LTC with multiple time points for data collection would allow for greater exploration of relationships between predictor variables and

improved wheelchair-related outcomes, including both individual- and facility-level factors. Furthermore, examination of the cost-effectiveness of increasing access to wheelchair assessment services and provision of new wheelchair equipment would provide important evidence for improving clinical practice, particularly for stakeholders involved in staffing and funding policy decisions.

Wheelchair use is widespread among LTC residents and a poorly fitting wheelchair is common. Discomfort, impaired positioning and mobility, and compromised skin integrity are issues that frequently need to be addressed. The availability of an occupational therapist to provide appropriate wheelchair seating assessment is often limited and likely contributes to higher prevalence of inappropriate wheelchair prescription. The substantial implications to health, comfort, and system cost with poor wheelchair seating in LTC and the potential for reducing prevalence of poor seating provide a strong justification for increasing occupational therapy resources.

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Figure 1.
Relative frequency of individual SIT items (% of respondents reported as positive)
Note. WC = wheelchair.
* Items weighted as 2 and automatically meet threshold for cutoff score

Figure 2.
Association between prevalence of need for seating assessment and access to seating assessment services (OT Ratio).

Table 1

Participant demographics

Demographic	Mean or N	SD or %
Age	84.2	8.6
Length of stay (mo)	32.3	35.0
MMSE score	15.5	10.8
Medications	8.0	3.4
Hours in WC per day	8.9	3.7
Length of WC use (mo)	44.5	68.4
Female	183	68.5%
Military Veteran ^a	35	13.3%
Smoker	12	4.5%
Dementia diagnosis	122	46.0%

Note. WC = wheelchair; mo = months

^a Access to WC equipment from Department of Veterans Affairs

Table 2

Participants' individual level characteristics by facility (Mean ± SD)

Facility	Individual Level Characteristics			
	FIM ^a	CMI ^b	SMMSE ^c	Dementia ^d
1	52.6 ± 20.2	2.2 ± 1.2	13.8 ± 10.6	48.0%
2	59.1 ± 26.6	2.6 ± 1.6	16.5 ± 10.6	55.9%
3	52.1 ± 21.6	4.2 ± 2.1	13.9 ± 10.1	55.9%
4	46.6 ± 24.1	2.4 ± 1.5	11.9 ± 13.1	59.4%
5	66.4 ± 20.2	3.5 ± 1.4	16.5 ± 7.8	36.4%
6	63.4 ± 25.6	2.8 ± 2.0	13.9 ± 11.7	33.3%
7	58.4 ± 15.2	2.7 ± 1.3	22.3 ± 6.7	23.5%
8	57.2 ± 28.8	2.8 ± 1.6	14.1 ± 9.6	35.7%
9	64.7 ± 31.0	4.2 ± 3.1	16.5 ± 10.6	45.5%
10	82.9 ± 24.0	3.2 ± 2.1	20.6 ± 10.0	30.4%
11	55.3 ± 24.2	3.3 ± 1.7	14.7 ± 9.9	56.5%
Overall	58.9 ± 25.6	3.1 ± 1.9	15.4 ± 10.8	46.0%

^aFunctional Independence Measure.
^bComorbidity Index.
^cStandardized Mini Mental State Examination.
^dPercent of residents with dementia diagnosis.

Table 3

Prevalence of need for seating assessment (SIT 2) by facility

Facility	N*	Number of Residents	Prevalence		Facility Level Variables					
			(%)	95% CI	OT Ratio ^a	Purchase WC ^b	Private ^c	Scooter ^d	Power WC ^d	Eden ^e
1	25	192	64.0	17.2 – 54.8	1.30	0	0	0	1	1
2	33	149	57.6	40.7 – 74.4	1.34	0	0	1	1	1
3	34	221	61.8	45.4 – 78.1	0.68	1	0	1	1	1
4	32	192	78.1	63.8 – 92.5	0.31	1	0	0	1	0
5	10	150	50.0	19.0 – 81.0	0.67	1	1	0	1	0
6	30	143	63.3	46.1 – 80.6	0.70	1	0	0	1	1
7	17	150	70.6	48.9 – 92.3	0.68	0	0	0	1	1
8	14	112	71.4	47.8 – 95.1	0.26	1	0	0	0	0
9	22	236	81.8	65.7 – 97.9	0.00	1	1	1	1	1
10	23	234	30.4	11.6 – 49.2	0.86	1	1	0	1	0
11	23	148	39.1	19.2 – 59.1	0.68	1	0	1	1	1
Overall	263	1927	58.6	52.6 – 64.5	0.68					

Note. OT Ratio = ratio of occupational therapists per 100 residents. WC = wheelchair.

* N = number of study participants from that facility

^a Number of occupational therapists per 100 residents.

^b 1 = Facility expects resident to purchase wheelchair if beyond a 'basic' level.

^c 1 = Facility is privately-funded.

^d 1 = Facility accommodates a scooter/power wheelchair.

^e 1 = Facility adopted the *Eden Alternative*.

Table 4

Logistic regression of facility-level contextual variables for need for seating assessment.

Variable	B	Standard Error	Wald	Sig.	Exp(B)	95% CI	
						Lower	Upper
OT Ratio ^a	-2.24	0.55	16.57	.000	0.11	0.04	0.31
Purchase WC ^b	1.02	0.47	4.72	.030	2.78	1.11	6.97
Private ^c	0.56	0.40	1.93	.165	1.75	0.79	3.84
Scooter ^d	-0.22	0.33	0.45	.504	0.80	0.42	1.53
Power WC ^d	-0.37	0.72	0.26	.612	0.69	0.17	2.85
Eden ^e	0.19	0.46	0.17	.680	1.21	0.50	2.95
(Constant)	1.34	0.49	7.45	.006	3.80		

Note: Variables with statistically significant beta weights bolded. WC = wheelchair.

^aNumber of occupational therapists per 100 residents.

^b1 = Facility expects resident to purchase wheelchair if beyond a 'basic' level.

^c1 = Facility is privately-funded.

^d1 = Facility accommodates a scooter/power wheelchair.

^e1 = Facility adopted the *Eden Alternative*.