

Wheelchair Use Among Community-Dwelling Older Adults: Prevalence and Risk Factors in a National Sample

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RÉSUMÉ

Les aînés constituent le groupe le plus important d'utilisateurs de fauteuils roulants. Cependant, il n'existe à ce jour aucune étude révisée par des pairs qui dresse un profil national des aînés qui se servent de fauteuils roulants au Canada. Nous avons étudié les caractéristiques d'utilisateurs de fauteuils roulants provenant d'un échantillon national d'aînés vivant dans la collectivité tiré de l'*Étude sur la santé et le vieillissement au Canada* (ESVC-2). Des questions sur l'utilisation des aides fonctionnelles ont été posées à 5 395 Canadiens (âgés de 65 ans et plus) et 4,6 p. 100 d'entre eux ont déclaré utiliser un fauteuil roulant. Un modèle de régression logistique a été utilisé pour représenter les facteurs liés à l'utilisation d'un fauteuil roulant. Si l'on tient compte de l'âge, du sexe et des troubles cognitifs, on constate que les aînés qui ont déclaré dépendre davantage des soins personnels de base et des activités instrumentales de la vie quotidienne ont davantage de chances d'utiliser un fauteuil roulant. Cependant, l'incidence de la dépendance aux soins personnels sur l'utilisation d'un fauteuil roulant varie selon le sexe, les hommes ayant davantage tendance que les femmes à utiliser un fauteuil roulant lorsque leur dépendance aux soins personnels augmente. La quantité de problèmes de santé chroniques ainsi que le célibat ont également tendance à accroître la probabilité d'utiliser un fauteuil roulant. Cet article quantifie les chances d'utiliser un fauteuil roulant en fonction de facteurs critiques dont on peut se servir pour prévoir et pour planifier les services nécessaires.

ABSTRACT

Older adults are the largest group of wheelchair users yet there are no peer-reviewed studies on the national profile of older wheelchair users in Canada. We investigated the characteristics of wheelchair users in a national sample of community-dwelling older adults from the Canadian Study of Health and Aging (CSHA-2). Questions on the use of assistive technology were asked of 5395 Canadians (over 64), and 4.6 per cent reported using a wheelchair. Logistic regression was used to model the factors associated with wheelchair use. Controlling for age, gender, and cognitive impairment, older adults who reported greater dependence in basic self-care and instrumental activities of daily living were more likely to use a wheelchair. However, the effects of self-care dependence on wheelchair use varied by gender, with men more likely than women to use wheelchairs with increasing self-care dependence. The number of chronic health conditions and being unmarried also increased the odds of wheelchair use. This paper quantifies the risk of wheelchair use according to critical factors that can be used to project use and plan for services.

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Introduction

Older adults are the largest group of consumers of assistive technology (Kaye, Kang, & LaPlante, 2000; LaPlante, Hendershot, & Moss, 1992; Russell, Hendershot, LeClere, Howie, & Adler, 1997; Shields, 2004; Statistics Canada, 2003) such as wheelchairs. Prevalence data from both Canada (Shields) and the United States (Kaye et al.; LaPlante et al.; Russell et al.) indicate that adults 65 years of age and over are more than four times likely than the total population to use wheelchairs. Figures from longitudinal data indicate that the use of these mobility devices has been rapidly increasing: 863,000 Americans over 65 used wheelchairs in 1994, an 83 per cent increase in use from 1980 (Russell et al.). Yet, there is a dearth of data on the characteristics of wheelchair users from national samples. No peer-reviewed publications have gone beyond estimating incidence and prevalence in national populations to include more detailed information that describes the socio-demographic and health characteristics of wheelchair users. We therefore have little understanding of the characteristics of individuals who seek assistance from wheelchairs, and we do not fully comprehend the characteristics of those who do not use these devices.

Results from studies of assistive-device use generally suggest that both *need* and *enabling* factors operate to influence use in later life. Adapting the health-behaviour model of access to medical care (Andersen & Newman, 1973) to the study of assistive-device use in older adults, researchers have identified need characteristics as the predominant factors associated with the use of assistive technology. Health problems as well as impaired functioning in daily activities have repeatedly been identified (Gitlin, Schemm, Landsberg, & Burgh, 1996; Mathieson, Kronenfeld, & Keith, 2002; Tomita, Mann, Fraas, & Stanton, 2004; Zimmer & Chappell, 1994) as need factors that increase the likelihood of use. In addition, various enabling factors (resources, or a lack of them, that make the use of devices more likely) have been identified that increase the probability of assistive-device use, including higher income (LaPlante et al., 1997; Mathieson et al.; Tomita, Mann, Fraas, & Burns, 1997), supplemental health

insurance (Mathieson et al.), and living alone (Hartke, Prohaska, & Furner, 1998; Tomita et al., 1997; Tomita et al., 2004). Marital status and education, also hypothesized to be enabling resources, have been inconsistently related to assistive-device use (Hartke et al.; Mathieson et al.; Tomita et al., 1997; Tomita et al., 2004; Zimmer & Chappel), likely as a result of selective samples as well as variations in the devices studied.

While the above findings focus on the use of assistive technology in general, no similar analyses have been conducted for wheelchair use specifically. In this paper we use data from a national sample of Canadians age 65 and over to identify the factors associated with wheelchair use in older adults. Our analyses are guided by the literature on assistive-device use more generally, leading us to hypothesize that "need" factors, including health problems and dependence in activities of daily living, are associated with wheelchair use in older adults. We also expect that social and economic resources (e.g., marital status, social support, income) operate as "enabling" factors, such that greater economic resources and a lack of social resources in later life increase the probability of wheelchair use. In Canada, only four provinces (Alberta, Saskatchewan, Ontario, and Quebec) have comprehensive assistive-device programs to help cover the costs of approved aids such as wheelchairs. Personal financial resources are therefore likely to be a determining factor in the ability to obtain the use of a wheelchair.

The use of equipment assistance can be a powerful tool to help older adults overcome functional limitations to achieve more autonomous and independent lives (Verbrugge, Rennert, & Madans, 1997). As the population ages, a better understanding of the characteristics of older wheelchair users will help to project use and appropriately target the needs of users. The aim of this paper is to provide prevalence estimates of wheelchair use among community-dwelling older adults. We then use multiple logistic regression analyses to identify factors associated with increased probability of wheelchair use.

Methods

Data

This paper is based on a secondary analysis of data from the second wave of the Canadian Study of Health and Aging (CSHA). The CSHA was designed to collect information on the prevalence and incidence of cognitive impairment and dementia in Canada, but the study also included a wider range of health issues of concern to older Canadians. Details of the study methods have been previously published (Canadian Study of Health and Aging Working Group, 1994). Briefly, the first wave of the study (CSHA-1) began in 1991 with a representative sample ($n = 9008$) of community-dwelling Canadians age 65 years and older from 36 urban and surrounding rural areas in all 10 Canadian provinces. A second wave of the study (CSHA-2) was conducted four years later (1995–1996) when surviving subjects from the first wave were re-contacted for follow-up.

Of the original community sample of 9008 older adults, 5395 (59.9%) community-dwelling seniors were interviewed at CSHA-2, while 3613 (40.1%) did not participate for various reasons: 1867 (20.7%) died between the two waves of the study, 308 (3.4%) had moved to an institutional setting, 402 (4.5%) were diagnosed with dementia, 587 (6.5%) refused, 251 (2.8%) could not be contacted, and 198 (2.2%) were unable to participate because of severe cognitive problems. The procedures followed in CSHA were approved by the ethics review board in each of the 18 study centres. Informed consent was given by all participating subjects.

Measures

Wheelchair use was assessed in the second wave of the survey. (The question was not asked in the first wave of CSHA.) Respondents were asked, "Do you ever use a wheelchair to get around?" The question referred to the time of the interview, and answers were coded dichotomously as "yes/no." If respondents indicated that they used a wheelchair only in the winter, or only for shopping or for long distances, or only for a short-term ailment (e.g., a broken hip), these were also considered to be affirmative responses. On the other hand, wheelchair use that was limited only to the airport or the hospital was coded as "no."

We focus on two key *need characteristics*: dependence in activities of daily living (ADL) and the number of chronic health conditions. Dependence in ADL was assessed with the Duke Older Americans Resources and Services (Fillenbaum, 1988) instrument. Seven questions probed dependence in basic self-care

activities (ADL) (eating, dressing, grooming, walking, transferring, bathing, and toileting), and a further seven items probed dependence in more complex instrumental ADLs (IADL) (using the telephone, getting around outside the home, shopping, preparing meals, doing housework, managing money, and taking medications). Respondents were given a score of 0 if they could perform the activity without any help, and a score of 1 if they reported that they needed some help; a score of 2 indicated that the respondent could not perform the activity at all. Continuous summary scores of dependence in ADL and IADL were created by summing the scores on the seven questions for each dimension. Scores ranged from 0 to 14, with a high score indicating greater dependence (Cronbach's $\alpha = .72$ for ADL, $.77$ for IADL).

Respondents were also asked about the occurrence of 16 common health problems (e.g., arthritis, heart problems, hypertension, diabetes, stroke), and an index of the number of health conditions was created by summing the number of health problems to capture the additive effects of co-morbidity among chronic illnesses (Stewart et al., 1989).

Enabling characteristics include social and economic resources. Social resources were assessed by (1) marital status, (2) social support, and (3) living arrangements. Marital status was dichotomized as married (married or common-law) or unmarried (widowed, never married, divorced, or separated), because the vast majority of respondents were either married (47.6%) or widowed (41.7%) at CSHA-2. Social support was assessed with two questions. Respondents were first asked about the number of people they could count on for general help and support, as an indication of their support network. Satisfaction with social support was assessed with the question "Do you ever feel that you need more support?" The responses "often" and "sometimes" were collapsed to indicate dissatisfaction with social support, while the response "never" was used to indicate satisfaction with social support. Respondents were also asked whether they lived alone.

Socioeconomic resources were assessed through income and education. Educational level was captured in years of completed education. Annual household income was documented according to 12 ordinal \$5,000 income categories. Income satisfaction was also assessed by asking respondents to indicate the extent to which their current income met their needs. Responses were coded on a five-point scale, but for the analyses in this paper a dichotomous indicator of income satisfaction was created to differentiate adequate income (income met needs "adequately" or "very well") from inadequate

income (income met needs “with some difficulty,” “not very well,” or “totally inadequately”).

We include three *control variables* in our analyses: age, gender, and cognitive impairment. Gender and age could account for the relationship between need characteristics and wheelchair use, since women and older adults are more likely to use assistive devices (Mathieson et al., 2002; Zimmer & Chappell, 1994) and are also more likely to experience health problems and difficulty performing daily activities. The greater propensity for women and older adults to be unmarried and live alone could also render any association between enabling characteristics and wheelchair use spurious. Cognitive function could act as a potential suppressor variable in our analyses if cognitive limitations are negatively associated with wheelchair use (Yang, Mann, Nochajski, & Tomita, 1997) but positively associated with ADL dependence and health problems. Cognitive impairment was assessed with the Modified Mini Mental State Examination (3MS) (Teng & Chui, 1987), which ranges from 0 to 100, with a high score indicating higher cognitive function. A score of 78 or lower was used to indicate cognitive impairment.

Statistical Analyses

Multiple logistic regression analyses were conducted to examine the effects of need and enabling factors on wheelchair use. First-order interactions were used to test for differential effects by gender. All statistical analyses were performed using the Statistical Analysis System (SAS) Version 8.02 for Windows. Statistical significance was assessed using a two-tailed alpha of .05. Because the original CSHA-1 survey included an intentional over-sample of adults in older age groups (age 75+) and in less populated regions of Canada, we used weighted data to correct for over-sampling in all analyses.

Results

Descriptive characteristics for the study sample are summarized in Table 1. Of the 5395 community-dwelling older adults interviewed at CSHA-2, 298 (5.5%) reported that they used a wheelchair, 4989 (92.5%) reported that they did not use a wheelchair, 31 (0.6%) refused to answer the question, one person reported “don’t know,” and 76 (1.4%) had missing responses to the question. Using weighted data, the 298 older adults who reported using a wheelchair represent approximately 4.6% of all seniors in the community who answered the question on wheelchair use. With the use of expansion weights, this is estimated to represent a population prevalence of

Table 1: Health and socio-demographic characteristics for study sample (n = 5287) (Canadian Study of Health and Aging, 1995–1996)

Variable	%
Wheelchair Use	
User	4.6
Non-user	95.4
Gender	
Male	42.0
Female	58.0
Marital Status	
Married	47.6
Not married	52.4
Living Arrangements	
Live alone	36.9
Live with someone	63.1
Social Support	
Satisfied	76.9
Dissatisfied	23.1
Annual Income	
Less than \$10,000	5.3
\$10,000 to \$24,999	44.8
\$25,000 to \$49,999	36.6
\$50,000 or more	13.3
Income Satisfaction	
Adequate	90.0
Inadequate	10.0
Variable	Mean (SD)
Age (years)	75.7 (5.4)
Number of health conditions	3.7 (2.3)
ADL dependence	0.3 (.9)
IADL dependence	1.0 (1.9)
Cognitive impairment (3MS)	87.3 (10.6)
Social network size	3.8 (2.6)
Education (years)	10.6 (3.9)

SD = standard deviation

ADL = activities of daily living

IADL = instrumental activities of daily living

3MS = Modified Mini Mental State Examination

88,300 community-dwelling older adults using wheelchairs in Canada in 1995–1996.

On average, older Canadians report almost four co-morbid health conditions (Table 1). However, they are generally independent in activities of daily living (mean scores on the summary ADL indices ≤ 1.0). Over 98 per cent report independence in self care activities, such as dressing, eating, and grooming, while 14 per cent require assistance with bathing (Table 2). Over 95 per cent are independent in more instrumental activities, including using the telephone and taking medications, while over 10 per cent require assistance with shopping or meal preparation.

Results from the multiple logistic regression model are presented in Table 3. Analyses are based on the CSHA-2 sample with complete data on wheelchair use ($n = 5287$). In these analyses we sought to identify factors that increase the likelihood of wheelchair use when considered in a multivariate context. Similar to other studies on assistive-device use more generally, we found that both need and enabling characteristics are significantly associated with wheelchair use. Controlling for age, gender, and cognitive impairment, older adults with a greater number of health problems are more likely to use a wheelchair ($p < .002$). For each additional health condition reported by respondents, the odds of using a wheelchair increase by 1.12.

Increasing dependence in both instrumental and self-care activities of daily living is also associated with an increased likelihood of wheelchair use in community-dwelling older adults. The odds of wheelchair use increase by 1.32 for each unit increase on the IADL scale. Dependence in basic self-care ADL is

also associated with an increase in the log odds of wheelchair use, but the rate of increase varies by gender, as indicated by a statistically significant interaction effect between female and ADL ($p < .002$). This difference is plotted in Figure 1 in terms of

Table 2: Independence in self-care and instrumental activities of daily living (Canadian Study of Health and Aging, 1995–1996)

Item	% Independent*
Self-Care Activities	
Eating	99.3
Dressing	97.6
Grooming	98.5
Walking	93.0
Transferring	98.5
Bathing	86.4
Toileting	97.9
Instrumental Activities	
Using the telephone	95.6
Travelling outside the home	88.7
Shopping	83.4
Meal preparation	89.9
Housework	67.1
Taking medications	95.6
Managing money	93.8

* $n = 5287$

Table 3: Multiple logistic regression results – modelling the probability of wheelchair use in community-dwelling Canadian seniors (Canadian Study of Health and Aging, 1995–1996)

Variable	Parameter Estimate	Odds Ratio (OR)	95% Confidence Interval for OR
Age	-.032*	.970*	(.940, .998)
Female	.230	-	-
Cognitive Impairment	-.114	.797	(.505, 1.26)
Number of Health Conditions	.109 [†]	1.12 [†]	(1.04, 1.20)
IADL	.280 [‡]	1.32 [‡]	(1.23, 1.43)
ADL	.972 [‡]	-	-
Female*ADL	-.236 [†]	-	-
Unmarried	.273 [†]	1.73 [†]	(1.18, 2.53)

* $p < .05$ [†] $p < .01$ [‡] $p < .0001$

ADL = dependence in basic self-care activities of daily living

IADL = dependence in instrumental activities of daily living

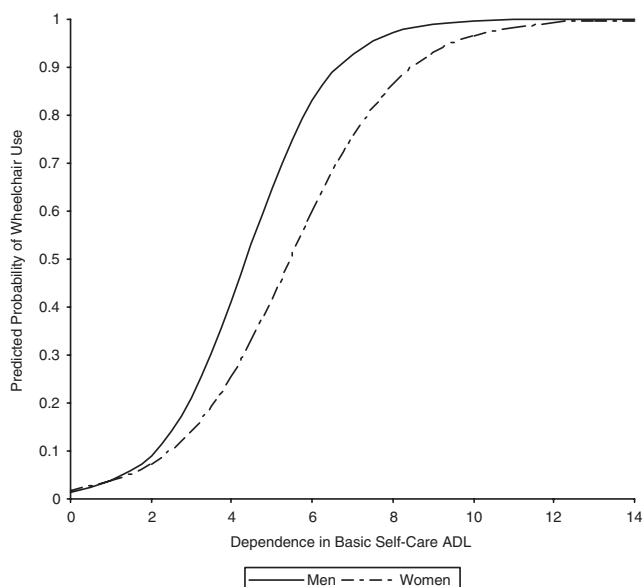


Figure 1: The effect of increasing self-care dependence on the probability of wheelchair use by gender

the predicted probabilities. As dependence in self-care increases, the probability of using a wheelchair increases, but the rate of increase is greater for men than for women. For example, the probability of wheelchair use for a man with an ADL score of 7 is .171 higher than that for a woman with a similar level of ADL dependence.

In terms of enabling factors, the results in Table 3 show that marriage is protective against wheelchair use. Even when controlling for gender, age, health problems, cognitive impairment, and dependence in IADL/ADL, there remains a statistically significant increase in the log odds of wheelchair use for older adults who are unmarried, compared to those who are married ($p < 0.005$), with an adjusted odds ratio of 1.73. Wheelchair use is not associated with other enabling factors, including social support (size of network, or satisfaction with support), socio-economic status (education, income, or satisfaction with income), or whether the respondent lives alone. Although age has a small protective effect against wheelchair use, the confidence interval surrounding the odds ratio estimate is very close to 1.0, indicating that this effect is only marginally significant.

Discussion

Although older adults are the largest group of wheelchair users, we know very little about their characteristics from national samples. Our purpose in this paper was to use national data to provide

prevalence estimates of wheelchair use among non-institutionalized older adults, and to identify the characteristics associated with an increased probability of use. Because the survey question on wheelchair use was asked only in the second wave of CSHA, our results are based on a survivor cohort (sample attrition due to death, institutionalization, and dementia) and thus likely underestimate the proportion of community-dwelling older adults who use wheelchairs in Canada. Nonetheless, prevalence estimates from CSHA in 1995–1996 ($n = 88,3000$ wheelchair users) are in keeping with recent estimates from the Canadian Community Health Survey in 2000–2001 ($n = 81,3000$) (Shields, 2004), which did not focus specifically on older adults.

Similar to other studies on assistive-device use more generally, we found that older adults use wheelchairs on the basis of need. Individuals with a greater number of chronic health conditions and who experience more difficulty with activities of daily living are more likely to use wheelchairs. However, need factors appear to operate differently for men and women. With increasing dependence in self-care activities of daily living, men are more likely than women to turn to wheelchairs as an assistive device. This result may be due to gender differences in choices and decision making between personal and equipment assistance (Penning & Strain, 1994; Verbrugge et al., 1997). Women's stronger social orientation may lead them to seek personal assistance from others in the face of self-care limitations, while men's inclination towards self-reliance may lead them instead to choose assistive devices (Verbrugge et al.).

It should also be noted that because the ADL index was a summary of ordinal ratings across seven items, gender differences in the probability of wheelchair use at a given level of ADL dependence may reflect differences in the degree of dependence across self-care activities between men and women. For example, a woman may need limited assistance in six of the seven self-care items (for a score of 6), while a man may be fully dependent in only three items but still receive the same score of 6. Hence, gendered patterns of ADL dependence could have different consequences for the probability of wheelchair use between men and women. Further work should address possible gender differences in patterns of self-care dependence and the subsequent use of wheelchairs. In addition, future research should consider gender differences in attitudes and perceptions towards wheelchair use (Roelands, Van Oost, Depoorter, & Buysse, 2002), as well as perceived obstacles, including strength or mechanical issues that may exist among women.

We also found that social factors are associated with an increased risk of wheelchair use. Although we hypothesized that social and economic resources “enable” probability of use, only marital status is associated with use. In later life, unmarried adults are more likely to use wheelchairs than those who are married. This finding is consistent with results reported elsewhere (Allen, Foster, & Berg, 2001; Hoenig, Taylor, & Sloan, 2003) that technological assistance is a substitute for personal assistance in disabled adults. Because unmarried seniors have less immediate access to personal help, they may be more likely to turn to assistive devices.

With increasing numbers of older adults in our population, a better understanding of the factors associated with wheelchair use will help to identify those in need as well as potential barriers to use. This paper is a first step in an essential area of research that is often overlooked. We identify the characteristics of older adults who are more likely to use wheelchairs, and our results suggest that multiple chronic health conditions, difficulty performing daily activities, and being unmarried, increase the risk of wheelchair use in later life.

Our conceptual model is based on the assumption that health problems and ADL/IADL dependence operate as need characteristics. An alternative explanation, however, cannot be ruled out. Because our analyses are based on cross-sectional data, we are unable to ascertain whether the causal relationships are in fact working in the *opposite* direction. That is, does wheelchair use actually lead to more difficulty performing activities of daily life and ultimately more health problems? For example, if older adults use wheelchairs because of mobility restrictions, are they subsequently more likely to experience difficulty performing other activities, such as travelling alone on buses or taxis, shopping for food and clothing, or doing housework? Furthermore, if older adults become less active after being prescribed a wheelchair, are they more likely to develop muscle weakness, to have reduced cardiopulmonary function, and to become obese – all of which are conditions that generate risks for other health conditions? These are questions for further investigation with longitudinal data, and raise issues surrounding the appropriate prescription of wheelchairs to older adults, as well as adequate training in the use of wheelchairs for optimal health and engagement in daily life activities. We hope our findings provide impetus and direction for such research.

Our results are also based on individual-level data, but a more complete picture would evolve from an examination of extra-individual factors, such as

the structure of the home and local built environment (e.g., sidewalks, ramps, stairs) that may facilitate or discourage the use of wheelchairs by older adults. Also, we were prevented from investigating more complex patterns of selective use across home and community environments (Hoenig, Pieper, Zolkewitz, Schenkman, & Branch, 2002), because our data are restricted to examining any versus no use of wheelchairs. This field of inquiry would benefit from research that examines more detailed patterns of wheelchair use in conjunction with structural environment characteristics in both the home and local community.

References

- Allen, S.M., Foster, A., & Berg, K. (2001). Receiving help at home: The interplay of human and technological assistance. *Journal of Gerontology: Social Sciences*, 56B, S374–S382.
- Andersen, R.M., & Newman, J. (1973). Societal and individual determinants of medical care utilization in the United States. *Milbank Memorial Fund Quarterly*, 51, 95–124.
- Canadian Study of Health and Aging Working Group. (1994). Canadian Study of Health and Aging: Study methods and prevalence of dementia. *Canadian Medical Association Journal*, 150, 899–913.
- Fillenbaum, G.G. (1988). *Multidimensional functional assessment of older adults: The Duke older Americans resources and services procedures*. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.
- Gitlin, L.N., Schemm, R.L., Landsberg, L., & Burgh, D. (1996). Factors predicting assistive device use in the home by older people following rehabilitation. *Journal of Aging and Health*, 8, 554–575.
- Hartke, R.J., Prohaska, T.R., & Furner, S.E. (1998). Older adults and assistive devices: Use, multiple-device use, and need. *Journal of Aging and Health*, 10, 99–116.
- Hoenig, H., Pieper, C., Zolkewitz, M., Schenkman, M., & Branch, L.G. (2002). Wheelchair users are not necessarily wheelchair bound. *Journal of the American Geriatrics Society*, 50, 645–654.
- Hoenig, H., Taylor, D.H., & Sloan, F.A. (2003). Does assistive technology substitute for personal assistance among the disabled elderly? *American Journal of Public Health*, 93, 330–337.
- Kaye, H.S., Kang, T., & LaPlante, M.P. (2000). Mobility device use in the United States. *Disability statistics report* (No. 14). Washington, D.C.: U.S. Department of Education, National Institute on Disability and Rehabilitation Research.

- LaPlante, M.P., Hendershot, G.E., & Moss, A.J. (1992). Assistive technology devices and home accessibility features: Prevalence, payment, need, and trends. *Advance data from vital and health statistics* (No. 217). Hyattsville, MD: National Center for Health Statistics.
- Mathieson, K.M., Kronenfeld, J.J., & Keith, V.M. (2002). Maintaining functional independence in elderly adults: The roles of health status and financial resources in predicting home modifications and use of mobility equipment. *Gerontologist*, *42*, 24–31.
- Penning, M.J., & Strain, L.A. (1994). Gender differences in disability, assistance, and subjective well-being in later life. *Journal of Gerontology: Social Sciences*, *49*, S202–S208.
- Roelands, M., Van Oost, P., Depoorter, A., & Buysse, A. (2002). A social-cognitive model to predict the use of assistive devices for mobility and self-care in elderly people. *Gerontologist*, *42*, 39–50.
- Russell, J.N., Hendershot, G.E., LeClere, F., Howie, J.F., & Adler, M. (1997). Trends and differential use of assistive technology devices: United States, 1994. *Advance data from vital and health statistics* (No. 292). Hyattsville, MD: National Centre for Health Statistics.
- Shields, M. (2004). Use of wheelchairs and other mobility support devices. *Health Reports*, *15*, 37–41.
- Statistics Canada. (2003). *Disability supports in Canada, 2001—tables: Participation and activity limitation survey, 2001* (Statistics Canada catalogue no. 89-581-X1E). Ottawa: Minister of Industry, 2003. Retrieved March 20, 2005, from <http://www.statcan.ca:8096/bsolc/english/bsolc?catno=89-581-X&CHROPG=1>.
- Stewart, A.L., Greenfield, S., Hays, R.D., Wells, K., Rogers, W.H., Berry, S.D., McGlynn, E.A., & Ware, J.E. (1989). Functional status and well-being of patients with chronic conditions: Results from the Medical Outcomes Study. *Journal of the American Medical Association*, *262*, 907–913.
- Teng, E.L., & Chui, H.C. (1987). The modified mini-mental state (3MS) examination. *Journal of Clinical Psychiatry*, *48*, 314–318.
- Tomita, M., Mann, W., Fraas, L., & Burns, L. (1997). Racial difference of frail elders in assistive technology. *Assistive Technology*, *9*, 140–151.
- Tomita, M.R., Mann, W.C., Fraas, L.F., & Stanton, K.M. (2004). Predictors of the use of assistive devices that address physical impairments among community-based frail elders. *Journal of Applied Gerontology*, *23*, 141–155.
- Verbrugge, L.M., Rennert, C., & Madans, J.H. (1997). The great efficacy of personal and equipment assistance in reducing disability. *American Journal of Public Health*, *87*, 384–392.
- Yang, J.J., Mann, W.C., Nochajski, S., & Tomita, M.R. (1997). Use of assistive devices among elders with cognitive impairment: A follow-up study. *Topics in Geriatric Rehabilitation*, *13*, 13–31.
- Zimmer, Z., & Chappell, N. (1994). Mobility restriction and the use of devices among seniors. *Journal of Aging and Health*, *6*, 185–208.