ABSTRACT

Seniors 85 years of age and older (85+) make up the fastest-growing segment of the Canadian population. There is a need for longitudinal data on the health status of this group. We used data collected as part of the Canadian Study of Health and Aging to examine how health status changed over five years in a large (n=1799) cohort of Canadians 85+. By the time of the follow-up assessment, 60.1% had died and 33.9% of those who had been residing in the community when the cohort was initially formed had been institutionalized. Most (79.2%) of the community survivors felt that their health had stayed the same or improved, even though over two thirds (67.9%) reported a decline in their functional abilities. Potential predictors of both good and adverse outcomes were explored. While disease prevention, health promotion and environmental modifications may decrease the personal and societal impacts of these age-associated findings, health care planning for the very old should take these data into account.

ABRÉGÉ

Les personnes âgées de 85 ans et plus (85 +) constituent le segment de la population canadienne dont la croissance est la plus rapide. Il existe un besoin de données longitudinales sur l'état de santé de ce groupe. Nous nous sommes servis de données recueillies dans le cadre de l'Étude canadienne sur la santé et le vieillissement pour étudier comment l'état de santé d'une importante cohorte (N = 1 799) de Canadiens âgés de 85 ans et plus avait changé sur cinq ans. Au moment de l'évaluation de suivi, 60,1 % d'entre eux étaient décédés et 33,9 % de ceux qui résidaient dans la collectivité au moment de la constitution de la cohorte avaient été placés en institutions. La plupart (79,2 %) des survivants estimaient que leur santé n'avait pas changé ou s'était améliorée, même si plus de deux tiers d'entre eux (67,9 %) déclaraient constater une diminution de leurs capacités fonctionnelles. On a étudié les prédicteurs potentiels de résultats positifs et négatifs. Bien que la prévention de la maladie, la promotion de la santé et les modifications de l'environnement puissent faire diminuer l'impact personnel et social de ces résultats associés à l'âge, la planification des soins de santé pour les personnes très âgées devrait prendre en considération ces données.

Health, Function and Survival of a Cohort of Very Old Canadians: Results from the Second Wave of the Canadian Study of Health and Aging

David B. Hogan, MD,^{1,2} Tak S. Fung, PhD,³ Erika M. Ebly, PhD¹

Over the next twenty years those 85 years and older (85+) will constitute the most rapidly growing segment of the Canadian population.^{1,2} There are few prospective studies which deal with their health outcomes and these generally limit themselves to a single issue such as dementia.³

The goals of this study were to describe changes in functional capabilities, self-rated health and cognition, as well as institutionalization and mortality in a representative group of Canadians 85+. We were interested in examining the variables associated with these health outcomes and describing the subset of individuals who aged successfully.

METHODS

The Canadian Study of Health and Aging (CSHA) was a national, population-based cohort study. Subjects were first seen in 1990-1991 (this baseline assessment will be referred to as CSHA1). Individuals 85+ were over-sampled using an optimal allocation technique.⁴ Data were collected on 1,332 community and 503 institutional residents 85+. In the second phase (called CSHA2;1996-1997), the study cohort was recontacted. The same research methodology with only minor modifications was used. The study methods are described in further detail elsewhere.⁴

Individuals living in the community at the time of CSHA1 were initially inter-

viewed using a standardized questionnaire. Cognition was assessed with the Modified Mini-Mental State (3MS) examination.⁵ Self-rated health (SRH) was evaluated using the question, "How would you say your health is these days? Would you say your health is very good, pretty good, not too good, poor or very poor?" The Older Americans Resources and Services (OARS) Activities of Daily Living Scale was used to examine basic activities of daily living (ADL; eating, dressing, grooming, getting in and out of bed, taking a bath or shower, and bladder/bowel control), instrumental activities of daily living (IADL; using the telephone, getting to places out of walking distance, going shopping, preparing meals, doing housework, taking medication(s), and handling money) and the ability to ambulate.^{6,7} Independence for these functions was defined as needing no help or encountering no difficulty in performing the activity. Overall function of subjects was categorized as excellent/good, mild impairment, moderate impairment, severe impairment or total impairment using the OARS classification scheme.^{6,7} Self-report was used to determine the presence of current health problems (e.g., hypertension, heart problems, stroke).

Community residents with 3MS scores <78, a random sample of those who scored higher and all subjects who were residing in an institution at CSHA1 were asked to undergo a comprehensive clinical examination. This was designed to determine whether dementia was present and to make a specific diagnosis. The examination, described in detail elsewhere,^{4,8} included a clinical history, physical examination and neuropsychological testing (for those with 3MS scores of 50 or higher). DSM-III-R criteria were used

University of Calgary, Calgary, Alberta

1. Department of Medicine

2. Department of Clinical Neurosciences

3. Department of University Computing Services

Correspondence: Dr. David Hogan, Health Sciences Centre, University of Calgary, 3330 Hospital Dr., NW, Calgary, AB, T2N 4N1, Tel: 403-283-8474, Fax: 403-283-4740, E-mail: dhogan@ucalgary.ca

for the diagnosis of dementia and to grade its severity.⁹ Individuals who did not meet criteria for dementia were categorized as either no cognitive impairment (NCL) or cognitive impairment no dementia (CIND).⁸ The final diagnosis for each participant was reached at a consensus conference that utilized all available data.⁴

We limited our analysis to CSHA subjects who were 85+ at CSHA1. Data were examined using bivariate associations (cross tabulations and chi-square tests of significance for categorical variables, Student-t test for continuous variables), multivariate logistic regression, and Cox proportional hazards analyses. Data on SRH, self-reported function, and self-reported diseases/conditions were only available for participants who were residing in the community at the time of CSHA1 and had the screening interview. As such, proportional hazards and logistic regression analyses were limited to this group.

Variables that were considered as potential predictors for the proportional hazards models for mortality (with survival time as the dependent variable) and institutionalization (with time to institutionalization as the dependent variable) were age, gender, education, CSHA1 3MS score, CSHA1 OARS overall functional rating, CSHA1 SRH, and the CSHA1 self-report (presence/absence) of high blood pressure, heart problems, stroke, arthritis, chest problems, diabetes, fractures, vision problems, hearing problems, and feeling tired. Cox proportional hazards regression models estimated the relative risk (RR) and 95% confidence interval for the association of these CSHA1 variables with mortality and institutionalization while controlling for differences in covariates that could influence each outcome.

The same independent variables were used as potential explanatory variables in logistic regression analyses to predict CSHA2 SRH, CSHA2 OARS functional rating, and successful aging. We defined successful aging as being both alive and living in the community at the time of CSHA2 with a clinical diagnosis of NCL (or a screening 3MS >78 if not examined) and mild impairment or better on the OARS functional scale.

TABLE I
Proportion of Community Sample at CSHA1 who became Institutionalized by CSHA1 Cognitive Category or 3MS Score

CSHA1 category	n	Institutionalized
Clinical Diagnosis*		
NCL	182	30.7%
CIND	164	39.1%
Dementia	92	89.1%
3MS score†		
≥78	639	25.9%
<78	178	38.8%

* For those who had a clinical examination

† For those who only had a screening interview

TABLE II
Change in Self-rated Health for Those Living at the Time of CSHA2

	CSHA2 Rating				
	Very Good	Pretty Good	Not Too Good	Poor	Very Poor
CSHA1 rating					
Very good (108)	40.7%	50.9%	7.4%	0.9%	—
Pretty good (256)	17.6%	55.5%	22.3%	4.7%	—
Not too good (64)	6.2%	50.0%	29.7%	10.9%	3.1%
Poor (12)	—	41.7%	25.0%	16.7%	16.7%
Very poor (3)	33.3%	33.3%	—	33.3%	—

TABLE III
Change in Function in Those Living at the Time of CSHA2

	CSHA2 Function				Total
	Excellent/Good	Mild	Moderate	Severe	
CSHA1 Function					
Excellent/good (128)	17.2%	30.5%	31.3%	10.9%	10.2%
Mild (192)	4.7%	27.6%	24.0%	28.1%	15.6%
Moderate (89)	1.1%	10.1%	30.3%	23.6%	34.8%
Severe (16)	NA	6.3%	6.3%	31.3%	56.3%
Total impairment (12)	NA	NA	8.3%	NA	91.7%

TABLE IV
Changes in Cognitive Category or 3MS Status Among the 85+ Survivors

	Living at time of CSHA2 (n)	CSHA2 Status			
		NCL	CIND	Dementia	Status Unknown*
CSHA1 Clinical Diagnosis†					
NCL	112	28.6%	28.6%	25.0%	17.8%
CIND	109	5.5%	22.9%	52.3%	19.3%
Dementia	86	1.2%	3.5%	89.5%	5.8%
CSHA1 3MS Score‡					
3MS ≥78	337	19.0%	21.1%	20.5%	39.4%
3MS <78	73	9.6%	17.8%	31.5%	41.1%

* This includes those who screened negative (3MS >77) and did not require a clinical, those who screened positive (3MS ≤77) but refused a clinical, and those who refused to be screened and/or examined.

† Individuals who had a clinical diagnosis at CSHA1 and CSHA2.

‡ Individuals who participated in only the screening phase of CSHA1.

Goodness of fit (X^2) of logistic models is described by providing Hosmer-Lemeshow (H-L) p values where H-L p values of 1 indicate that the predicted values from the model fit the data perfectly. Analyses were performed using Minitab, SPSS and BMDP software.

RESULTS

Institutionalization

More than one quarter (27.4%) of subjects 85+ were residing in institutions at the time of CSHA1. Of those who were living in the community at CSHA1, over one

third (33.9%) had been institutionalized by CSHA2. Table I shows institutionalization rates according to cognitive category or 3MS scores at the time of CSHA1. The factors statistically associated with an increased likelihood of institutionalization in the Cox proportional hazards model were lower 3MS scores ($b_1 = -0.02$, $\text{coef/se} = 5.0$, $\text{RR} = 0.98$ (0.97-0.99), $p < 0.0001$), worse function ($b_2 = 0.20$, $\text{coef/se} = -3.76$, $\text{RR} = 1.22$ (1.1-1.36), $p = 0.0002$) and feeling tired ($b_3 = 0.26$, $\text{coef/se} = 2.09$, $\text{RR} = 1.29$ (1.02-1.66), $p = 0.04$). Figure 1 shows the estimated probability of institutionalization at the mean of the covariates as a function of time.

Function

Two thirds (67.9%) of survivors reported decreased abilities, 27% reported no change and 4.3% reported an improvement (see Table II). Worse initial function ($b_0 = 10.5$, $\text{coef/se} = 0.73$; $b_1 = 1.3$, $\text{coef/se} = 4.71$, $\text{OR} = 3.72$ (2.15-6.42), $p < 0.0001$), higher 3MS score ($b_2 = 0.09$, $\text{coef/se} = 2.53$, $\text{OR} = 1.09$ (1.02-1.17), $p = 0.01$), better SRH ($b_3 = -0.76$, $\text{coef/se} = -1.87$, $\text{OR} = 0.47$ (0.21-1.04), $p = 0.06$), and lower age ($b_4 = -0.28$, $\text{coef/se} = -1.74$, $\text{OR} = 0.76$ (0.56-1.03), $p = 0.076$) were significant explanatory

variables for a decline in function (H-L $p = 0.77$).

Cognition

Nearly two thirds (65.2%) of subjects who were NCL at CSHA1 and had a follow-up diagnostic assessment were classified as impaired (CIND or demented) at the time of CSHA2. More than half of the CSHA1 CIND cases who were examined at CSHA2 became demented (see Table III).

Self-rated health

Nearly half of surviving participants (46.7%) had the same SRH at CSHA2 as at CSHA1. Approximately one third (32.5%) reported an improvement and 20.8% reported a decline (see Table IV). The proportion of individuals who had died increased significantly with worse SRH at CSHA1 (from 40.9% for very good to 63.9% for very poor, $p < 0.001$). The proportion of community participants who became institutionalized increased significantly with a worse SRH at CSHA1 (from 26.9% for very good to 45.4% for very poor, $p < 0.001$). All of those who reported poor/very poor SRH at CSHA1 were either institutionalized or had died by CSHA2. In the logistic regression model,

better initial SRH ($b_0 = 2.4$, $\text{coef/se} = 3.9$; $b_1 = -1.6$, $\text{coef/se} = 1.84$, $\text{OR} = 0.21$ (0.14-0.32), $p < 0.0001$), fewer years of formal education ($b_2 = -0.13$, $\text{coef/se} = -4.0$, $\text{OR} = 0.88$ (0.82-0.94), $p = 0.0001$), feeling tired ($b_3 = 0.87$, $\text{coef/se} = 2.9$, $\text{OR} = 2.4$ (1.3-4.3), $p = 0.004$), chest problems ($b_4 = 0.83$, $\text{coef/se} = 2.5$, $\text{OR} = 2.3$ (1.2-4.4), $p = 0.013$) and worse function at CSHA1 ($b_5 = 0.23$, $\text{coef/se} = 1.84$, $\text{OR} = 1.3$ (0.98-1.6), $p = 0.07$) were significant explanatory variables for poorer SRH health by CSHA2 (H-L $p = 0.84$).

Successful Aging

Seventy-three (4.1%) participants met our criteria for successful aging. Table V compares baseline characteristics of subjects who aged successfully with those who did not. Higher initial 3MS scores ($b_0 = 5.7$, $\text{coef/se} = 0.86$; $b_1 = 0.10$, $\text{coef/se} = 5.59$, $\text{OR} = 1.11$ (1.07-1.15), $p < 0.0001$), better initial function ($b_2 = -0.55$, $\text{coef/se} = -3.12$, $\text{OR} = 0.58$ (0.41-0.81), $p < 0.0001$), younger age ($b_3 = -0.16$, $\text{coef/se} = -2.3$, $\text{OR} = 0.85$ (0.74-0.98), $p < 0.014$), good hearing ($b_4 = -0.405$, $\text{coef/se} = -1.50$, $\text{OR} = 0.667$ (0.392-1.13), $p = 0.103$) and better SRH ($b_5 = -0.31$, $\text{coef/se} = -1.52$, $\text{OR} = 0.733$ (0.49-1.09), $p = 0.103$) were explanatory variables in the logistic model for aging successfully (H-L $p = 0.78$).

Mortality

Of the 1,799 individuals 85+ whose survival status was known, 1,082 (60.1%) had died by the time of CSHA2. Significantly more men had died than women (67.2% vs 56.4%; $p < 0.0001$) and more institutional residents at the time of CSHA1 had died than community residents (83.2% vs 50.6%; $p < 0.0001$). Of the 515 subjects with a CSHA1 diagnosis of dementia, 82.5% had died. Table VI compares baseline characteristics of subjects living with those who died. Worse function ($b_1 = 0.24$, $\text{coef/se} = 5.9$, $\text{RR} = 1.27$ (95% CL 1.2-1.4; $p < 0.0001$), male gender ($b_2 = -0.50$, $\text{coef/se} = -5.65$, $\text{RR} = 0.60$ (0.51-0.72), $p < 0.0001$), lower 3MS scores ($b_3 = -0.012$, $\text{coef/se} = -4.10$, $\text{RR} = 0.988$ (0.98-0.99), $p < 0.0001$), chest problems ($b_4 = 0.29$, $\text{coef/se} = 2.67$, $\text{RR} = 1.33$ (1.08-1.65), $p = 0.008$), increasing age ($b_5 = 0.04$, $\text{coef/se} = 2.59$, $\text{RR} = 1.04$ (1.01-1.07),

TABLE V
Comparison of Those Who Aged Successfully with Those Who Did Not

	Successful (73)	Not Successful (972)	p
CSHA1 age*	86.5 ± 1.6	87.7 ± 2.7	<0.001
% female	75.3	69.3	0.29
Education*	10.8 ± 3.7	9.2 ± 4.0	0.001
3MS CSHA1	88.4 ± 6.9	76.4 ± 14.9	<0.001

* years, mean and standard deviation

TABLE VI
Comparison of Living Subjects and Decedents

	Living (717)	Decedents (1082)	p
CSHA1 age*	87.4 ± 2.6	88.9 ± 3.6	<0.001
% female	77.9%	68.4%	<0.001
Education*	9.4 ± 3.8 (700)	8.9 ± 3.9 (964)	0.012
3MS CSHA1	79.7 ± 12.4 (627)	73.4 ± 17.6 (645)	<0.001

* years, mean and standard deviation

Figure 2. Estimated probability of institutionalization at the mean of the covariates over time.

$p = 0.009$) and heart problems ($b_6 = 0.22$, $\text{coef/se} = 2.48$, $\text{RR} = 1.24$ (1.05-1.47), $p = 0.01$) at CSHA1 were associated with a decreased likelihood of survival. Figure 2 shows the estimated probability of survival at the mean of the covariates as a function of time.

DISCUSSION

We found that the five-year prognosis for those 85+ was generally poor. Most of those who survived developed functional

and cognitive impairment, often requiring institutionalization. Very few individuals "aged successfully" as we defined it.

In North America, 35-45% of those 85+ live in institutions.^{10,11} Important predictors for incident institutionalization in our group were impaired cognition and function. Impaired functioning was predictive of institutionalization in several other studies.¹²⁻¹⁵ Similar findings have been reported for cognitive problems.¹⁵ Although tiredness is a non-specific complaint,¹⁶ it does

have a significant impact on the quality of life of frail seniors.¹⁷ Caregiver factors not evaluated here also likely play an important role in institutionalization.¹⁸

Most surviving subjects rated their health as the same or better. This was in the face of a decline in self-rated function. Other studies have shown that the older the person, the more likely they are to report very good health status.¹⁹ Subjects may feel that other seniors are worse off. Relative to others they rate their health as above average.¹⁹ Disability is only one of several determinants of perceived health.²⁰ The factors associated with a greater likelihood of a worse SRH at the time of CSHA2 present a mixed picture. The association with a higher SRH at the time of CSHA1 is possibly explained by being at risk for a drop. Those who rated their health as pretty good or better (364/448, 81.3%) had little if any room for improvement. The better SRH also may have been predictive of an increased likelihood of survival until CSHA2.

The factors we found associated with worse function at the time of CSHA2 included some (i.e., lower age, higher 3MS, better SRH) that probably predicted an increased likelihood of survival. Although other researchers have suggested that functional change in the oldest old is not necessarily one of continuous decline,^{13,21,22} we found that very few of our subjects improved after five years. Disability has been shown to increase with age in the community²³ and is frequently associated with cognitive impairment.¹⁴ Specific disabilities have been associated with particular diseases or conditions.^{14,24,25} Other work has shown that in this age group, disability can occur even in those without overt diseases or cognitive impairment.²⁶ Disease prevention alone may not be sufficient to decrease disability in the very old. Interventions such as physical training, better nutrition and environmental modifications may be quite useful in promoting the independence of the very old. While prevention of disability is a desirable goal, its seeming inevitability at very advanced ages emphasizes the importance of developing interventions which will minimize the impact of disability.

Significant explanatory variables for mortality included worse function at the initial evaluation, male gender and a lower initial 3MS score. Our data showed that even at the extreme of age, women had preferential survival. Self-rated functional ability has elsewhere been reported to be associated with survival in older adults²⁷ with a direct relationship between the risk of mortality and the degree of disability.²² Johansson et al.²⁸ found that poorer cognitive performance at a prior examination predicted death. The self-reported presence of cardiac and respiratory problems was also associated with mortality in our study. Both of these are major causes of death in seniors.²⁹⁻³¹

Our study had some limitations. The population was predominantly Caucasian (98.5%). Follow-up time was relatively long (mean 5 years) and the high mortality rate resulted in the loss of valuable follow-up information on cognitive and functional ability. A number of the variables we found associated with outcomes such as worsening self-reported health were predictors of an increased chance of survival until CSHA2.

Less than one in twenty seniors 85+ met our criteria for aging successfully. The health status of the very old may be quite different in the future. Over the 1970s, improved survival of seniors appeared to be at the cost of worse average health.³² Recent American studies suggest that over the 1980s, the prevalence of disability has declined.³³⁻³⁵ Whether these trends will continue is debatable. One hopes that improvements in determinants of health and access to effective preventive care might increase the overall well-being of this segment of the population while simultaneously reducing health care expenditures for institutional and other types of care. In the meantime, the needs of this growing segment of the population have important implications for both health care and social services planning.

ACKNOWLEDGEMENTS

The data reported in this article were collected as part of the Canadian Study of Health and Aging. The core study was funded by the Seniors' Independence Research Program, through the National Health Research and Development

Program (NHRDP) of Health Canada (project no. 6606-3954-MC(S)). Additional funding was provided by Pfizer Canada Incorporated through the Medical Research Council/Pharmaceutical Manufacturers Association of Canada Health Activity Program, NHRDP (project no. 6603-1417-302(R)), Bayer Incorporated, and the British Columbia Health Research Foundation (projects no. 38 (93-2) and no. 34 (96-1)). The study was coordinated through the University of Ottawa and the Division of Aging and Seniors, Health Canada.

REFERENCES

1. Statistics Canada. Population Projections of Canada, Provinces and Territories. Catalogue 91-520. Ottawa: Statistics Canada, 1994.
2. Statistics Canada. *Annual Demographics Statistics*. Catalogue 91-213. Ottawa: Statistics Canada, 1998.
3. Aevrsson O, Skoog I. A population-based study on the incidence of dementia disorders between 85 and 88 years of age. *J Am Geriatr Soc* 1996;44:1455-60.
4. Canadian Study of Health and Aging Working Group. Canadian Study of Health and Aging: Study methods and prevalence of dementia. *Can Med Assoc J* 1994;150(6):899-914.
5. Teng EL, Chui HC. The modified mini-mental state (3MS) examination. *J Clin Psychiatry* 1987;48(8):314-18.
6. McDowell I, Newell C. *Measuring Health: A Guide to Rating Scales and Questionnaires*. New York: Oxford University Press, 1987.
7. Fillenbaum GG. *Multidimensional Functional Assessment of Older Adults: The Duke Older Americans Resources and Services Procedures*. Hillsdale, NJ: Lawrence Erlbaum Associates, 1988.
8. Ebly EM, Hogan DB, Parhad IM. Cognitive impairment in the nondemented elderly: Results from the Canadian Study of Health and Aging. *Arch Neurol* 1995;52:612-19.
9. American Psychiatric Association. *Diagnostic and Statistical Manual*, 3rd ed, revised. Washington, DC: American Psychiatric Association, 1987.
10. Stone L, Frenken H. Declines in the proportion of institutional residents among those under 85. In: *Focus on Canada: Canada's Seniors*. Ottawa: Statistics Canada, 1986.
11. Schnieder EL, Guralnik JM. The aging of America: Impact on health care costs. *JAMA* 1990;263:2335-40.
12. Branch LG, Jette AM. A prospective study of long-term care institutionalization among the aged. *Am J Public Health* 1982;72:1373-79.
13. Branch LG, Katz S, Knipman K, et al. A prospective study of functional status among community elders. *Am J Public Health* 1984;74:266-68.
14. Fried LP, Ettinger WH, Lind B, et al. Physical disability in older adults: A physiological approach. *J Clin Epidemiol* 1994;47(7):747-60.
15. Wolinsky FD, Callahan CM, Fitzgerald JF, et al. Changes in functional status and the risks of subsequent nursing home placement and death. *J Gerontology* 1993;48(3):S93-S101.
16. Hart FD (Ed.). *French's Index of Differential Diagnosis*. 12th ed. Bristol: Wright, 1985; 273.
17. Guyatt GH, Eagle DJ, Sackett B, et al. Measuring quality of life in the frail elderly. *J Clin Epidemiol* 1993;46(12):1433-44.
18. Freedman VA. Family structure and the risk of nursing home admission. *J Gerontology* 1996;51B(2):S61-69.
19. Ebly EM, Hogan DB, Fung TS. Correlates of self-rated health in persons aged 85 and over: Results from the Canadian Study of Health and Aging. *Can J Public Health* 1996;87(1):28-31.
20. Johnson RJ, Wolinsky FD. The structure of health status among older adults: Disease, disability, functional limitation, and perceived health. *J Health Soc Behav* 1993;34(2):105-21.
21. Suzman RM, Harris T, Hadley EC, et al. The robust oldest old: Optimistic perspectives for increasing healthy life expectancy. In: Suzman RM, Willis DP, Manton KG (Eds.), *The Oldest Old*. New York: Oxford University Press, 1992; 341-58.
22. Manton KG. A longitudinal study of functional change and mortality in the United States. *J Gerontology* 1988;43(5):S153-61.
23. Guralnik JM, Lacroix AZ, Branch LG, et al. Morbidity and disability in older persons in the years prior to death. *Am J Public Health* 1991;81:443-47.
24. Fried LP, Guralnik JM. Disability in older adults: Evidence regarding significance, etiology and risk. *J Am Geriatr Soc* 1997;45:92-100.
25. Guccione AA, Felson DT, Anderson JJ, et al. The effects of specific medical conditions on the functional limitations of elders in the Framingham Study. *Am J Public Health* 1994;84:351-58.
26. Hogan DB, Ebly EM, Fung TS. Disease, disability and age in cognitively intact seniors: Results from the Canadian Study of Health and Aging. *J Gerontology* 1999; 54A (2):M77-M82.
27. Bernard SL, Kincade JE, Konrad TR, et al. Predicting mortality from community surveys of older adults: The importance of self-rated functional ability. *J Gerontology* 1997;52(3):S155-63.
28. Johansson B, Zarit SH. Early cognitive markers of the incidence of dementia and mortality: A longitudinal population-based study of the oldest old. *Int J Geriatr Psychiatry* 1997;12:53-59.
29. Hadley EC. Causes of death among the oldest old. In: Suzman RM, Willis DP, Manton KG (Eds.), *The Oldest Old*. New York: Oxford University Press, 1992;183-96.
30. Thomas SP, Hruddy SE. *Risk of Death in Canada: What We Know and How We Know it*. Edmonton: University of Alberta Press, 1997.
31. Statistics Canada. *Causes of Death*, 1994. Catalogue 84-208. Ottawa, 1996.
32. Roos NP, Havens B, Black C. Living longer but doing worse: Assessing health status in elderly persons at two points in time in Manitoba, Canada, 1971 and 1983. *Soc Sci Med* 1993;36(3):272-82.
33. Manton KG, Corder L, Stallard E. Chronic disability trends in elderly United States populations: 1982-1994. *Proc Natl Acad Sci USA* 1997;94:2593-98.
34. Singer BH, Manton KG. The effects of health changes on projections of health service needs for the elderly population of the United States. *Proc Natl Acad Sci USA* 1998;95:15618-22.
35. Crimmins EM, Saito Y, Reynolds SL. Further evidence on recent trends in the prevalence and incidence of disability among older Americans from two sources: The LSOA and the NHIS. *J Gerontology* 1997;52B(2):S59-71.

Received: December 10, 1998

Accepted: May 4, 1999