Sex Differences in Predictors of Health Decline:

Results from a 16-Year Longitudinal Cohort Study

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Abstract

This study uses longitudinal data to examine predictors of health decline in a large sample cohort of Canadian men and women over a 16-year period. The results show the effect of age on health decline was more pronounced for men than women. Men who were never married were also more likely to report a deterioration in health compared to married men; no such difference was observed among women. However, being divorced, separated or widowed had a similar negative effect for women. Race and education were significantly related to health decline for both sexes, although the effects were stronger for women than men. On the other hand, urban/rural residence was linked to change in health status for men but not for women. Interestingly, females who consumed alcohol on either a regular or occasional basis had a lower risk of becoming unhealthy compared with females who were lifetime abstainers; similar effects were less pronounced for males. The effects of smoking and body mass index on health decline were stronger for men, while the effect of exercise was stronger for women. Men and women with work-related stress were equally likely to report a shift toward poor health, while personal-related stress had a stronger association for men and distress for women. Overall, the results show that factors associated with change in health status over the life course differ by sex. Policies and programs promoting optimal health and well-being should consider how health risks and outcomes confront men and women in different ways as they age.

Introduction

Numerous studies have found that health status differs by sex (Case and Paxson 2005; Denton, Prus, and Walters 2004; Gorman and Read 2006; Health Canada 2004; Macintyre, Hunt, and Sweeting 1996; World Health Organization 2009). Studies also show that sex interacts with biological, sociodemographic, lifestyle and psychological factors to influence health (Benyamini, Leventhal, and Leventhal 2000; Courtenay, McCreary, and Merighi 2002; Denton, Prus, and Walter 2004; Hosseinpoor et al. 2012; Public Health Agency of Canada 2012; Shields and Shooshtari 2001). Yet, much of what is known about the relationship between sex and health is based on data collected at a single point in time, which does not permit assessment of change in health status over time and the risk factors linked to it; to consider these issues, longitudinal data are required.

The relatively few sex-based studies using longitudinal data have focused on specific predictors of health status change and/or specific populations. The current study contributes to the literature by using population-level longitudinal data to examine sex differences in the effect of a wide-range of sociodemographic, behavioral and psychosocial factors on health decline over the adult life course of a large sample cohort.

Methods

Data

Data used in the study come from the longitudinal household file of the National Population Health Survey (NPHS). Conducted by Statistics Canada, the NPHS was designed to collect self-reported health data on a panel of individuals over time. The NPHS boasts one of the largest samples in the world, and has an observation period of 16 years, offering a substantial amount of analytical power to examine factors associated with health decline.

Data collection began in 1994–95 with a representative sample of 17,276 Canadians from all provinces excluding people living on First Nations reserves or military bases or in health institutions and some remote areas. Respondents of the 1994–95 sample formed a longitudinal cohort that was re-interviewed every two years.

Interviews were primarily conducted in-person at the beginning of the study and by telephone in follow-up interviews. Upon termination of the NPHS program in 2010–11, the cohort was interviewed a total of nine times: in cycle 1 (1994–95), cycle 2 (1996–97), cycle 3 (1998–99), cycle 4 (2000–01), cycle 5 (2002–03), cycle 6 (2004–05), cycle 7 (2006–07), cycle 8 (2008–09) and cycle 9 (2010–11). Data from the NPHS longitudinal "square" file, which includes all 17,276 panel members regardless of their response pattern in cycles 1 to 9, were used in this study. See Statistics Canada (2012) for more detail on the NPHS sample design, sampling procedures, data collection and response rates by cycles.

Health Measure

The event of interest, or dependent variable, in this study is health decline or more specifically, transition from good to poor health at any time over the observation period. (Death was treated in the study as a loss of good health).

Health is assessed using a self-reported health measure, where respondents rate their health on a five-point scale: poor, fair, good, very good and excellent. Self-rated health (SRH) is collapsed into "poor" (poor, fair) and "good" (good, very good, excellent) health. It has been shown that a dichotomized self-rated health measure produces results similar to those obtained with an uncollapsed, ordered measure (Manor, Matthews, and Power 2000). Studies have also demonstrated that self-rated health provides a valid, reliable measure of general physical health (Benyamini and Idler 1999; Brazier et al. 1992; DeSalvo et al. 2006; Idler and Kasl 1995, 1991; Idler, Russell, and Davis 2000; Idler and Benyamini 1997; Kaplan et al. 1993, 1996; Lundberg and Manderbacka 1996; Miilunpalo et al. 1997; Mossey and Shapiro 1982; Cousins 1997; Shields and Shooshtari 2001).

Covariates

Selection of covariates was guided by the social determinants of health model (e.g., Evans and Stoddart 1990; Hertzman, Frank and Evans 1994). According to this model, health is a function of a wide range of socioeconomic and environmental conditions, and individual-level (biological, behavioral and psychological) factors. At the same time, the analysis focused on those social determinants of health that are well documented in the gender and health research literature.

The selected covariates for this study were measured at baseline and organized in three domains:

1. sociodemographic (age, marital status, race, nativity, urban/rural residence, education)
2. behavioral (smoking, alcohol consumption, exercise, body weight)
3. psychological (work-related stress; personal-related stress, such as financial, family and relationship; distress)

A variable representing whether or not a respondent has a "chronic health condition(s)" was also considered in the analysis. Stress and distress indices were dichotomized into low and high categories at their median values.

Study Sample

The sample cohort was restricted to respondents who were 18 or older and in good health at the initial baseline (1994–95) interview and who provided information on self-rated health in all cycles. Of the original 17,276 sample participants, the following numbers of cases were excluded from the study cohort: 3,159 who were younger than 18 in 1994–95, 1,908 who reported poor health in 1994–95, and 4,145 who provided incomplete SRH information. Missing data on the covariates were coded into dummy variables to maximize sample size; their coefficients are not reported here. This resulted in the inclusion of 8,064 respondents (n = 3,551 men; n = 4,513 women) in the final cohort used in this study.

Statistical Analysis

Proportional hazards modeling was used to examine the effect of the covariates on the time it takes to transition from good to poor self-rated health. Starting with a healthy population at baseline, an event occurred if a respondent reported poor health after 1994–95. Sex-specific models were constructed to show the effect of each covariate on risk of health decline for men and women, adjusted for all other covariates in the model. Adjusted relative risk (RR) values

3

greater than 1 indicate that the variable is positively associated with health decline. The 95 percent confidence interval for each value is also provided.

All estimates were weighted using sample weights to represent the Canadian population in 1994–95, and standard errors for the estimates were adjusted for survey design effects using bootstrap resampling techniques. Analyses were conducted in Stata 12.

Findings

Dynamics of Health

The data depicted in figure 1 show that women and men were equally likely to report a decline in their health. About 47.8 percent of the cohort of women became unhealthy at some point during the observation period. The comparable figure for men was 48.7 percent.

Figure 1. Loss of good health for men and women 18+, 1994–95 to 2010–11
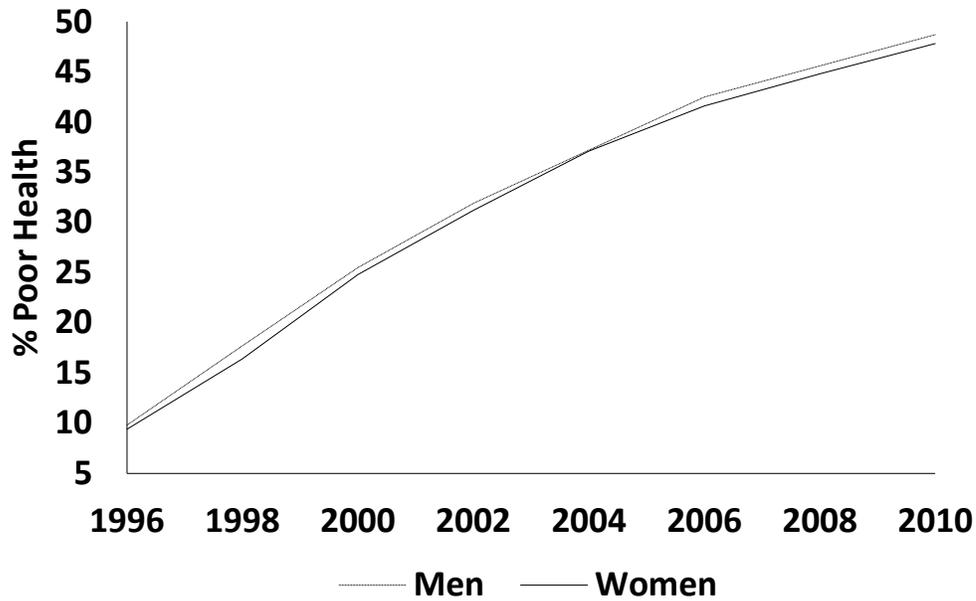
However, sex differences in health decline were revealed after breaking down the data into age groups: 18 to 44 (figure 2), 45 to 64 (figure 3), and 65 or older (figure 4). So, for instance, men age 45 to 64 were more likely to report a decline in health compared to their female counterparts, with 53 percent of men losing their good health at some point during the 16-year period compared to just 48 percent of women. The next section considers the effects of age and other predictors of health decline across the two sexes using multivariate analysis.

**Figure 2.** Loss of good health for men and women 18–44, 1994–95 to 2010–11
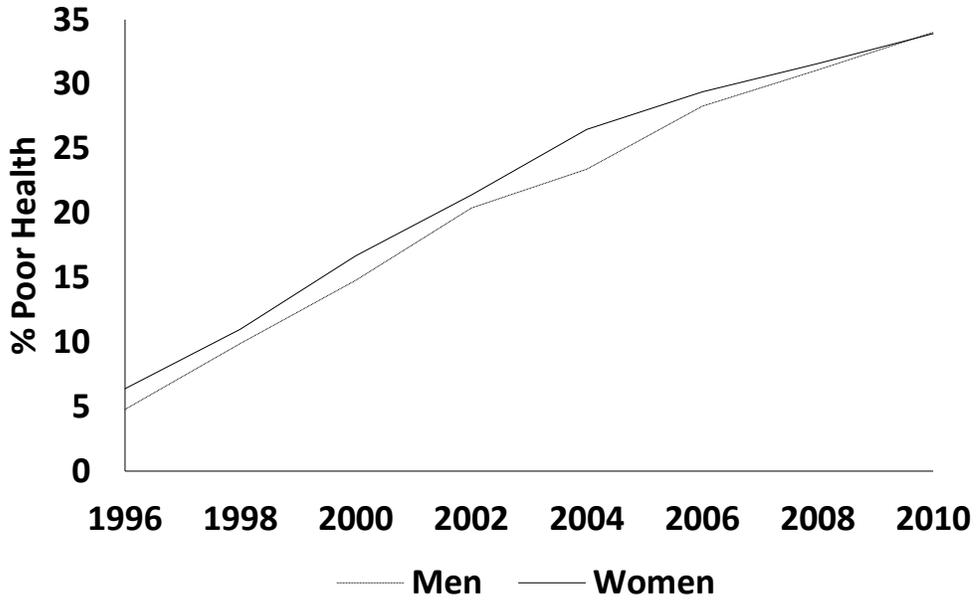
Figure 3. Loss of good health for men and women 45–64, 1994–95 to 2010–11
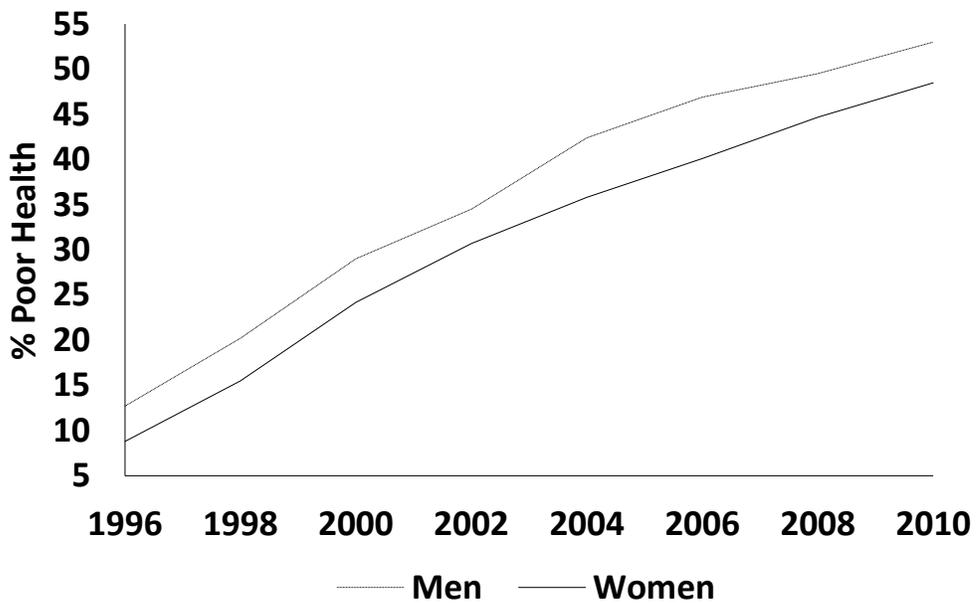
Figure 4. Loss of good health for men and women 65+, 1994–95 to 2010–11
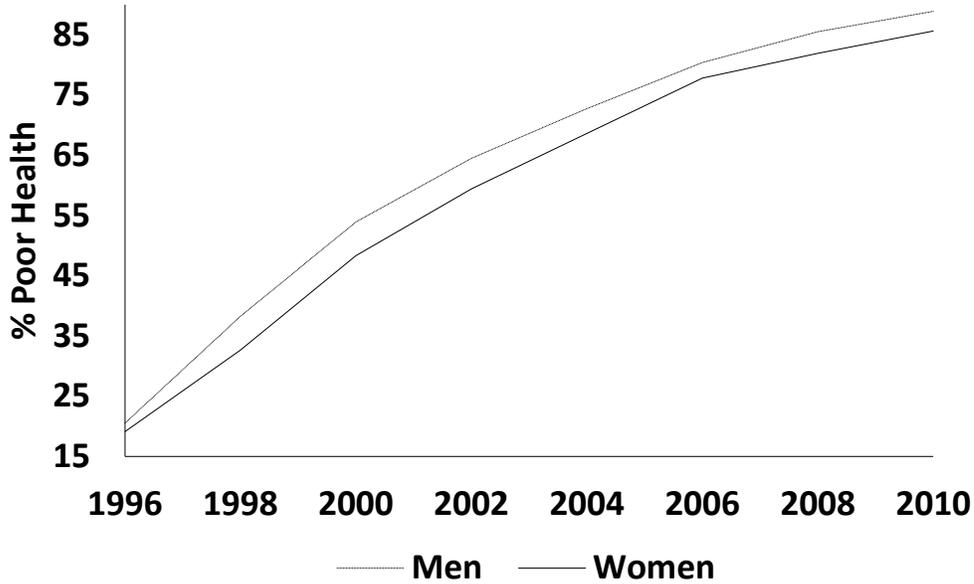
Determinants of Health Decline

Table 1a shows the adjusted relative risk of health decline by each sociodemographic covariate, separately for men and women. It is no surprise that older people had a much greater risk of reporting a deterioration in their health compared to younger people; however, the effect is greater among men. For example, men 65 and older were 2.72 times as likely as men age 18 to 44 to report a decline in health, whereas senior women were 2.55 times as likely to report a decline compared to their youngest counterparts.

Table 1a. Adjusted relative risk of transition from good to poor health between 1994–95 and 2010–11 by baseline sociodemographic characteristics of men and women

	Men		Women	
Baseline characteristics	Adjusted Relative Risk	95% Confidence Interval	Adjusted Relative Risk	95% Confidence Interval
Age				
18–44 (ref)	1.00	…	1.00	…
45–64	1.64***	1.38,1.96	1.42***	1.21,1.67
65+	2.72***	2.23,3.14	2.55***	2.14,3.04
Marital status				
Never married	1.18+	0.98,1.41	1.13	0.93,1.38
Div/sep/widow	1.09	0.93,1.27	1.20**	1.08,1.35
Married (ref)	1.00	…	1.00	…
Race				
Nonwhite	1.36*	1.00,1.84	1.67***	1.25,2.22
White (ref)	1.00	…	1.00	…
Years since immigration				
>10	0.97	0.82,1.16	1.22**	1.05,1.42
10 or less	1.43+	0.95,2.16	1.34	0.93,1.94
Canadian-born (ref)	1.00	…	1.00	…
Residence				
Rural	0.90+	0.80,1.01	1.00	0.89,1.12
Urban (ref)	1.00	…	1.00	…
Education				
<HS	1.52***	1.29,1.78	1.67***	1.43,1.96
HS	1.18+	0.98,1.42	1.22*	1.01,1.49
Some post-secondary	1.06	0.92,1.22	1.19*	1.02,1.39
Post-secondary (ref)	1.00	…	1.00	…
n	3,551		4,513	

+ Significantly different from estimate for reference group (p <0.1)
* Significantly different from estimate for reference group (p <0.05)
** Significantly different from estimate for reference group (p <0.01)
*** Significantly different from estimate for reference group (p <0.001)

Marital status also had sex-specific effects on health decline. Never-married men had an elevated risk of reporting a deterioration in health compared to married men (RR = 1.18, p <0.1). By contrast, women who were divorced, separated or widowed were significantly more likely than their married counterparts to report a deterioration in health (RR = 1.20, p <0.001).

While race and education were significant predictors of transition in health status for both sexes, the effects were stronger among women despite the fact that all other sociodemographic, behavioral, psychological and chronic health factors had been controlled for. On the other hand, living in rural areas as opposed to urban ones made a significant difference to the health maintenance of men but not women.

Turning to behavioral factors in table 1b, there is an increased risk associated with daily smoking for both sexes, notably for men. Interestingly, females who drank on either a regular or occasional basis had at a *lower* risk of becoming unhealthy compared with females who were lifetime abstainers.

Table 1b. Adjusted relative risk of transition from good to poor health between 1994–95 and 2010–11 by baseline behavioral characteristics of men and women

Baseline characteristics	Men		Women	
	Adjusted Relative Risk	95% Confidence Interval	Adjusted Relative Risk	95% Confidence Interval
Type of smoker				
Daily/former daily	1.54***	1.33,1.77	1.40***	1.25,1.56
Occasional/former occ.	1.19	0.94,1.50	1.05	0.86,1.28
Never (ref)	1.00	…	1.00	…
Alcohol consumption				
Regular	0.73*	0.55,0.99	0.67***	0.57,0.80
Occasional	0.85	0.62,1.17	0.81*	0.67,0.97
Former	0.88	0.65,1.20	0.93	0.77,1.12
Never (ref)	1.00	…	1.00	…
Physical activity				
Infrequent	1.17*	1.03,1.33	1.25***	1.11,1.41
Regular/occasional (ref)	1.00	…	1.00	…
BMI				
Underweight/overweight	1.03	0.91,1.17	1.03	0.92,1.14
Obese	1.33**	1.11,1.59	1.04	0.89,1.21
Normal (ref)	1.00	…	1.00	…
n	3,551		4,513	

+ Significantly different from estimate for reference group (p < 0.1)
* Significantly different from estimate for reference group (p < 0.05)
** Significantly different from estimate for reference group (p < 0.01)
*** Significantly different from estimate for reference group (p < 0.001)

The risk of deterioration in health was also significantly higher among women who exercised infrequently compared with women who exercised. Men's health status was not as affected by exercise. On the other hand, body mass index (BMI) was a significant risk factor only for men. The risk of becoming unhealthy was 33 percent higher for men considered obese compared with men whose weight was in the acceptable range.

Table 1c shows the relative risk of health decline by psychological characteristics as well as number of chronic health conditions. Work stress was significantly associated with health deterioration for both men and women. Personal (financial, family and relationship) stress was associated with becoming unhealthy, particularly for men. Men who reported a high level of personal stress were 26 percent more likely to report a decline in their health than were men with a low level of stress. Women with high personal stress were just 16 percent more likely to report

poor health compared with women with low stress. Distressed people, especially women, had an elevated risk of reporting a deterioration in health. Women and men who reported a high level of distress were 1.54 and 1.45 times, respectively, more likely to become unhealthy compared to women and men with low distress.

Finally, as expected, having a chronic health problem had a significant influence on reporting a change from good to poor health, particularly among men. For instance, the risk of becoming unhealthy was 20 percent higher for men with a single chronic condition compared to men without a chronic condition (RR = 1.20, p <0.05). Women with one chronic condition had a 13 percent higher risk of reporting a deterioration in health compared to women without one (RR = 1.13, p <0.1).

Table 1c. Adjusted relative risk of transition from good to poor health between 1994–95 and 2010–11 by baseline psychosocial characteristics and chronic health condition of men and women

	Men		Women	
Baseline characteristics	Adjusted Relative Risk	95% Confidence Interval	Adjusted Relative Risk	95% Confidence Interval
Psychological				
Work stress				
High	1.40***	1.15,1.70	1.36**	1.09,1.69
Low (ref)	1.00	…	1.00	…
Personal stress				
High	1.26***	1.09,1.46	1.16*	1.03,1.30
Low (ref)	1.00	…	1.00	…
Distress				
High	1.45**	1.11,1.91	1.54***	1.28,1.85
Low (ref)	1.00	…	1.00	…
Chronic health condition				
Number of conditions				
0 (ref)	1.00	…	1.00	…
1	1.20*	1.03,1.39	1.13+	0.98,1.30
2+	1.58***	1.36,1.83	1.50***	1.30,1.73
n	3,551		4,513	

+ Significantly different from estimate for reference group (p <0.1)
* Significantly different from estimate for reference group (p <0.05)
** Significantly different from estimate for reference group (p <0.01)
*** Significantly different from estimate for reference group (p <0.001)

Conclusion

Using a large sample cohort to examine sex-based differences in predictors of health decline over a 16-year period, the data show that what is significant for one sex is not necessarily significant, or as significant, for the other sex. For women, divorce, separation or widowhood increased the

risk of becoming unhealthy. The education-gradient in health was particularly evident among women, while regular and occasional alcohol consumption decreased the risk of reporting a deterioration in their health. Physical activity and distress were also highly significant predictors of transition in health status for women. For men, the link between age and health decline was particularly strong, and never being married increased the risk of becoming unhealthy. Residing in rural areas provided some protection against poor health, while daily smoking, obesity, personal stress and having a chronic health condition were more likely to elevate the risk of reporting a deterioration in health among men.

While more research is needed, these findings provide some level of information to help policymakers understand and address the influence of sex on healthy aging. The results may help in the expansion or improvement of services and programs to construct conditions that reduce sex-specific risks and barriers to healthy aging.

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