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The Relationship between Age, Socio-Economic Status, and Health among Adult Canadians

Steven G. Prus

SEDAP Research Paper No. 57

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Requests for further information may be addressed to:
Secretary, SEDAP Research Program
Kenneth Taylor Hall, Room 426
McMaster University
Hamilton, Ontario, Canada
L8S 4M4
FAX: 905 521 8232
e-mail: qsep@mcmaster.ca

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Steven G. Prus

Abstract

The relationship between socio-economic status and the health status of Canadians is well documented. However, the dynamics of this relationship over the adult life course remain largely unexplored. This paper uses data from the 1998-1999 Canadian National Population Health Survey to examine differences in global measures of health status (functional health, activity restriction, and self-rated health) between education groups across age categories. The results show that the gap in health status across education groups varies over the life course. The strength of the relationship increases from ages 25 to 64, and then decreases in later life. The data also show that education-based differences in health over the adult years almost disappear when controlling for economic, lifestyle, and psychosocial resources. Implications of these findings for health-related policy and methodological issues are discussed.

Keywords

Socio-economic Status, Morbidity, Disability, Social/Psychological Resources, Life Course, Canada

Steven G. Prus, Ph.D.
Teaching Postdoctoral Fellow
McMaster Centre for Gerontological Studies
1280 Main St. W., KTH-206A
Hamilton, Ontario, Canada
L8S 4M4

Telephone: (905)525-9140, ext.27866
Fax: (905)525-4198
sprus@mcmaster.ca

Introduction

A higher probability of health problems in later life means that health status becomes more important with age. People generally encounter a decline in health with old age, as they begin to experience minor ailments (e.g., deteriorating vision and hearing) in the earlier part of the later life course and more severe health problems, such as mobility problems, in the later part. However, is the decline in health with age experienced at the same rate or way by individuals? Further, are older Canadians a more homogeneous group in terms of health status compared to younger Canadians? This paper provides insight into these questions by mapping changes in socioeconomic-based inequalities in health over the life course of adult Canadians.

Despite universal access to essential health care in Canada, a strong relationship between socio-economic status (SES) and health is well documented (e.g., Cairney, 2000; Cairney & Arnold, 1998; Cairney & Arnold 1996; Hay, 1988; Hirdes & Forbes, 1989; Hirdes, Brown, Forbes, Vigoda, & Crawford, 1986; Mustard, Derksen, Berthelot, Wolfson, & Roos, 1997; Wilkins, Adams, & Brancker, 1991; Wolfson, Rowe, Gentleman, & Tomiak, 1993). Social groups closer to the top of the socio-economic latter, notably the well-educated and higher income classes, have lower rates of morbidity and mortality compared to those at the bottom.

It is commonly argued that the impact of universal health insurance in reducing socioeconomic inequalities in relation to health is outweighed by the impact of differences in the experiences of individuals. However, there is some debate in the literature as to whether SES-based inequalities in health among adults are a consequence of childhood experiences or more immediate (adulthood) experiences. Research tends to show that the latter are more important (e.g., Power, 1991; Power, Manor, Fox, & Fogelman, 1990). Adulthood experiences that influence health differences between SES groups are principally related to financial/material, lifestyle, and psychosocial factors (Ross & Wu, 1995).

In terms of financial factors, education, for example, affects life-course experiences related to labour market participation and history, including earnings profile and job security/conditions, which ultimately influence health status (Crompton & Kemeny, 1999). Specifically, education is important to health because those with higher education have adequate financial resources to support the purchase of good housing, nutrition, and private health care (e.g., prescription drug care, dental care, home care). They are also more likely to have financial security and better employment options and safer working conditions, all of which are tied to better health.

Differences in the prevalence of lifestyle (i.e., health-related behavioural) risk factors between socio-economic groups are also cited as a major cause of SES gaps in health among Canadians (e.g., Gilmore, 1999; Millar, 1996; Millar & Stephens, 1993; Roberge, Berthelot, & Wolfson, 1995; Villeneuve, Morrison, & Elaguppillai, 1994). Research shows that smoking, sedentary living, and obesity, which are closely linked to many chronic illnesses, functional limitations, and disabilities, are much higher among persons with lower SES.

The relationship between SES and lifestyle largely reflects SES differences in 1) access and utilization of health-care services, 2) acquisition and interpretation of health information, and 3) exposure to social environments that support healthy lifestyle

(Crompton & Kemeny, 1999; Millar, 1996; Millar & Stephens, 1993). Individuals with higher SES generally have better access to and more use of preventative health-care services, such as medical check-ups, and therapeutic care. They are also more likely to be familiar with health education information that leads to more informed decisions about personal health and health-care services, including the ability to accurately interpret health-related symptoms.

Psychosocial factors, such as self-esteem, personal sense of satisfaction, stressful life events, and social support, additionally influence health status. They also vary by SES (House, Lepkowski, Kinney, Mero, Kessler, & Herzog, 1994). In terms of social integration, for instance, higher SES persons are more likely to have someone to provide morale support, health-promoting knowledge, and help in avoiding or reducing stress, resulting in a healthier lifestyle and better health status.

In the end, description and explanation of SES-based inequalities in health are well documented in the Canadian literature. The study of changes in the SES gap in health with age, on the other hand, is less developed. This paper contributes to the Canadian literature on the social production of health, and to the international social epidemiology literature, by looking at health dynamics on two distinct levels: an individual level and a population level. At the individual level, the goal of this study is to measure the extent to which persons with early-life health advantages (i.e., those with high SES) maintain their health status relative to those with early-life health disadvantages (those with low SES) over the adult life course. At the population level, the other goal is to estimate the overall rate of inequality in the distribution of health outcomes over the adult life course.

Theoretical Perspectives on Social Stratification of Health and Age

Status Divergence

Although dynamics of changes in health occur on two distinct levels, they are related. Change in the overall extent of inequality in the distribution of health over the life course (a population-level issue) is a consequence of the process at the individual level. For example, the assumption that the health of individuals with early SES advantages, such as those with high education, on average deteriorates more slowly relative to their counterparts over the life course (i.e., the SES gap in health diverges with age) suggests an increase in the overall level of health inequality within a cohort as it grows old.

The assumption that inequalities increase with age is often referred to as the cumulative advantage/disadvantage theory, status divergence theory, or the Matthew effect. Robert Merton (1968) made the cumulative advantage/disadvantage hypothesis prominent. He argued that inequalities in careers among scientists grow over time as productivity (e.g., number of publications) results in recognition (e.g., number of citations), leading to more resources for further productivity. This eventually increases the advantage of a minority of scientists and the disadvantage of the majority, producing greater inequality in the distribution of productivity and recognition over time. Merton termed this the "Matthew" effect. More recently, Dannefer (1987) expanded the use of Merton's model to explain the relationship between cumulative advantage over the life course and greater heterogeneity in various resources among the aged, while others have used it to explain patterns of economic outcomes in later life (e.g., Crystal & Shea 1990;

Crystal & Waehrer, 1996; Crystal, Shea, & Krishnaswami, 1992; O'Rand, 1996; Pampel & Hardy, 1994).

Applied to health outcomes, the cumulative advantage/disadvantage theory predicts that the SES-based gap in health diverges over the life course (Ross & Wu, 1996). This reflects the fact that persons endure the cumulative effects of early-life behaviours and experiences on their health. Specifically, high status attainment (e.g., high education) increases health-related behavioural, economic (i.e., income), and psychosocial resources that contribute to good health. Because these resources cumulate over the life course, SES differences in health diverge as individuals grow older.

Ross & Wu (1996) point out that the cumulative effects of healthier living, for instance, over the life course help postpone or compress morbidity and disability into a very short period of the last years of life for high SES persons (as indicated above, those with high SES are less likely to regularly smoke and drink alcohol and more likely to exercise). By contrast, individuals with less healthy lifestyles become less and less fit and more and more overweight with age, increasing the risk of muscle/joint, respiratory, heart, and other chronic conditions, resulting in an ever increasing sedentary lifestyle and poorer and poorer health. The risky lifestyles of low SES groups therefore have their largest impact on health in later life, as long-term exposure to these factors eventually produces morbidity and disability at an age (i.e., old age) when people are generally more susceptible to disease and illness.

In the end, differences in health lifestyle and other personal resources between SES groups produce relatively few inequalities in health in earlier parts of the life course since most younger persons are in good health. However, as health advantages and disadvantages associated with lifestyle, material, and psychosocial resources cumulate with age, SES-based inequalities in health widen. The cumulative advantage/disadvantage theory further suggests that social policies and programs, such as Medicare, are ineffective at countering the health advantages associated with higher SES during later life, and that while there is a convergence in the health gap between SES groups, it does not occur until near or at the end of the human life span (i.e., death).

Status Divergence/Convergence

There are alternative assumptions about how the impact of age on health is conditioned by SES: a steady convergence over the life course; neither a divergence nor a convergence with age; and a divergence then convergence with age. The last assumption has received particular support in the literature.

House et al. (1994) and House, Kessler, Herzog, Mero, & Kinney (1990) maintain that the health gap between SES groups diverges up to middle age and early-old age then converges, reflecting socio-economic differences in the extent of exposure to health-related psychosocial and behavioural risk factors and their impact on health at various stages of life. House & Robbins (1983) specify that the size of SES differentials in the exposure to psychosocial/behavioural risk factors associated with morbidity and disability are greatest in middle and early-old age. Likewise, the impact of many of these factors on health is greatest at these ages as people become more biologically vulnerable to disease and illness as they grow older, and as lack of social support, mastery, and competence become more challenging with age. Hence, since exposure to risky health behaviours, lack of social support, high stress, low mastery/competence, and other psychosocial risk factors among lower relative to higher SES groups (and their impact on health) are greatest in middle and early-old age, socioeconomic-based gaps in health should also be largest at this point in the life course.

However, health is less stratified along socio-economic lines (i.e., SES-based gaps in health converge) among both young and old adults. This reflects the fact that while SES differences in exposure to psychosocial/behavioural risk factors are large among young adults, their impact on health is negligible. Conversely, SES differences in exposure to psychosocial/behavioural risk factors fade away among old adults, even though their impact on health is still strong. House et al. (1994) point out that SES differences in exposure to some health risks are much smaller in old age compared to other ages because of extensive public welfare policies (principally Medicare and Social Security) aimed at reducing health-care and economic, and thus health, inequalities in old age, as well as changes in lifestyle (e.g., persons with low SES are more likely to have retired and/or quit smoking and drinking alcohol).

As opposed to this “psychosocial/behavioural exposure/impact” explanation, (House et al., 1994) point out that biological forces can also help explain why SES-based inequalities in health divergence then converge over the adult life course. First, the relatively weak SES-health relationship among young and old adults may reflect a general biological robustness in earlier life and universal biological frailty in later life. Second, an SES-bias in morbidity and mortality may produce a divergence/convergence pattern. Relative to their counterparts, persons with low SES are less healthy at middle ages and have a higher probability of being deceased, institutionalized, or too ill to participate in a survey by old age. Since this leaves a healthier population of lower status seniors, coupled with an ever-increasing prevalence of morbidity and disability among higher status persons, SES differences in health may converge in old age.

Research on Age, SES, and Health

Various research has been conducted on socio-economic health inequalities over the life course (e.g., Aneshensel, Frerichs, & Huba, 1984; Ford, Ecob, & Hunt, 1994; House et al., 1990; House et al., 1994; Maddox & Clark, 1992; Newacheck, Butler, Harper, Piontkowski, & Franks, 1980; Pincus, Callahan, & Burkhauser, 1987; Ross & Wu, 1996; Ugnat & Mark, 1987). Primarily based on U.S. data, this research has not conclusively shown support for either the status divergence or status divergence/convergence model. House et al. (1994) find that the SES gap in chronic conditions and disabilities increases with age up to the early part of old age, and then decreases in the later part of old age. Maddox & Clark (1992), on the other hand, find that this gap is constant over the later life course, while Ross & Wu (1996) find support for the cumulative advantage/disadvantage (status divergence) model.

Canadian research is limited to a handful of studies. Looking at disparities in mortality and morbidity, Mustard, Derksen, Berthelot, Wolfson, & Roos (1997) find a negative relationship between SES and mortality and specific chronic health conditions over the life course of Manitobans, but it is strongest in early and late midlife. Using panel data from the administrative Canada Pension Plan database, Wolfson et al. (1993) find that the relationship between SES and health is primarily one of social causation (i.e., social position affecting health status), rather than the opposite (i.e., social selection). That is, higher levels of middle-life career earnings cause, and help individuals maintain, higher levels of health in late-life (measured by odds of survival past age 65). Based on data from the 20-year Ontario Longitudinal Study of Aging, Hirdes & Forbes (1989) also find that SES is causally prior to health.

Research Questions

This paper contributes to the literature on social epidemiology by looking at how health advantages and health disadvantages of Canadian persons with higher and lower SES, respectively, change over the adult life course. That is, does the SES-based gap in health increase with age as predicted by the status divergence model or increase throughout middle age then decrease during old age as predicted by the status divergence/convergence model? The related and implied question regarding socio-economic differences in exposure to and impact of economic and psychosocial/behavioural risk factors on health is also considered; that is, is the compression of morbidity and disability among higher SES persons a function of healthier lifestyle, more social support, and higher economic (i.e., income) status? These individual-level questions are supplemented with the associated population-level question: do changes in the overall extent of inequality in the distribution of health outcomes over the adult life course follow the pattern observed at the individual level (i.e., is there a steady increase or increase/decrease in the total rate of health inequality during the adult years)? The methodological choices made in this paper are detailed below.

Methods

Data

Longitudinal data are best suited to test models of age, SES, and health. Such data have recently been created in Canada, but have not matured to the point where they are suitable for this study. Health changes over the life course, therefore, are estimated by comparing age groups/cohorts in cross-sectional data. The data come from the master (i.e., unrestricted) file of the third cycle (1998-1999) of the National Population Health Survey (NPHS). The NPHS, produced by Statistics Canada, looks at health status, use of health services, determinants of health (e.g., alcohol consumption, physical activity, and access to health care), and demographic and economic characteristics of Canadians. The target population of the NPHS includes household residents in all Canadian provinces, except for people residing in First Nations communities, institutions, and Canadian Forces bases.

The NPHS uses the Statistics Canada's Labour Force Survey sampling frame to draw its sample of households. The basic Labour Force Survey sampling design is a multi-stage stratified probability sample. While limited data in the NPHS is collected from all household members, one person over 12 years of age in each household is randomly selected for a more in-depth interview. The data used here come from these in-depth interviews, which include 17,244 cases. The data are weighted to take into consideration the sampling design and population representation. The sample weights are re-scaled so that the average weight is equal to one (i.e., survey weights are rescaled to sum to the sample size). This method produces generalizable results since it takes into consideration the unequal probabilities of selection of the sample's design.

Measurement

To provide a more comprehensive measure of health status, and a more complete understanding of the aging and health process, health is measured on a subject level and on a more objective one (i.e., self-reported indicators of physical health). Subjective health status, which provides a respondent's global assessment of his/her overall health, is based on the question "In general, how would you say your health is?" and has a five-point scale: poor, fair, good, very good, and excellent. It can be assumed that self-perceived health is based on a respondent's information concerning his/her functional/chronic health status, hence providing an indicator of how an individual *perceives* his/her physical health. This variable is collapsed into two divergent groups: "positive" health perception (good, very good, or excellent) and "negative" health perception (fair or poor).

Two tangible global measures of health status are also used. Together, they provide a fairly objective measure of overall functional limitations and disabilities. First, the Health Utility Index (HUI) provides an overall index of functional ability. The HUI is based on respondents' answers to questions about their vision, hearing, speech, mobility, dexterity, cognition, emotions, and pain and discomfort. Scores range from about 0 (completely unfunctional) to 1 (perfect functional health), and a score of 0.80 or greater is typically used to indicate a high level of functional health (Roberge et al., 1995).

The second objective measure looks at any health limitations that affect one's daily activities. Restriction of activities is measured in the NPHS by asking respondents "Because of a long-term physical or mental condition or a health problem (including a disability or handicap), are you limited in the kind or amount of activity you can do?" "Long-term conditions" refer to conditions that have lasted or are expected to last 6 months or more. Activity restriction is often considered a very broad measure of individual health.

In terms of measuring SES, most researchers use occupation, income, and/or education as an indicator. Given the life-course focus of this analysis, education is used to measure SES because it is generally fixed after early adulthood, and usually occurs prior and thus is causally related to occupation and income (and change in health) (Ross & Wu, 1996). Overall, education provides a good measure of lifetime SES. Further, House et al. (1990) find that the results of their analysis on age, SES, and health are similar if income and education are used to measure SES or just education alone is used. This study is restricted to those aged 25 and over since most persons this age have completed their formal education. Further, age is collapsed into six stages of the life course (i.e., age groups): 25-34 (n = 2,237), 35-44 (n = 3,000), 45-54 (n = 2,204), 55-64 (n = 1,448), 65-74 (n = 1,082), and 75+ (n = 807).

Education is a continuous variable computed by merging number of years of elementary and high school completed with, if relevant, highest level of post-secondary education attained. However, education is collapsed into age-specific quartiles to reduce the impact of cohort effects (i.e., younger adults are better educated than older adults) and to make comparisons of SES groups of equal size (Mustard et al., 1997). Each quartile represents 25% of the cases for a given age cohort/group. Hence, for each of the six age cohorts, respondents are rank-ordered by education then divided into four equal groups, where the first quartile is made-up of those with the lowest 25% of educational attainment, the second quartile comprises those with the next lowest 25% of education, the third quartile comprises those with the following lowest 25% of education, and the fourth quartile comprises those with the highest 25% of education.

Finally, personal resources are measured as follows: 1) multiple indicators are used to measure lifestyle - level of physical activity (coded as active versus inactive), number of years smoked, and body mass index (coded as acceptable weight versus underweight/overweight); 2) level of coherence, distress, and social support are used to measure one's psychosocial resources and; 3) household income (adjusted for household size) is used as an indicator of economic resources.

Analysis

As stated above, the examination of health dynamics occurs on both an individual level and a population level. At the individual level, ANOVA (Analysis of Variance) and logistic regression techniques are used to test which model (i.e., status divergence or status divergence/convergence) best fits the data. ANOVA is used to test for statistically significant differences in average HUI scores between education quartiles over the life course. Binary logistic regression is used to estimate both the odds of *positive* health perception (good, very good, or excellent self-rated health) and the odds of *not* having a long-term activity restriction for each education quartile at different stages of life course.

Given that gender and marital status are well-known determinants of both SES and health, they are controlled in these analyses to partial out their influence.

A consequence of the status divergence or status divergence/convergence pattern in individual health is a steady increase or an increase/decrease, respectively, in the overall level of inequality in the distribution of health outcomes with age. This population-level issue is tested here by mapping changes in the Gini coefficient (G) for the HUI across age groups - Gini coefficients are computed for the HUI because of its continuous nature. The Gini coefficient is one of the most commonly used measures of overall inequality, given its robustness and intuitive ease of interpretation. It is a summary device that provides a single number measure of relative inequality within a distribution. The G ranges from zero to one. If everyone had the same health, G would be zero; conversely, if just one individual was healthy and all others unhealthy, the coefficient would be one. For that reason, the higher the G, the more inequality that exists.

In the end, many technical issues must be addressed when estimating well-being over the life course. While no methodological approach is perfect, the choices made here are based on the validity and reliability of the measures and techniques of analysis. The estimates of well-being produced in this study are therefore interpreted with a high level of confidence.

Results

Individual-level Health Dynamics

The findings in **Tables 1-3** map changes in the health of individuals with higher and lower SES over the adult life course. **Table 1** describes the relationship between age, education, and average HUI score, and **Tables 2** and **3** look at this relationship but in terms of limitation of daily activities and self-rated health, respectively. All findings are adjusted for gender and marital status.

Three basic trends are observed in **Table 1**. First, higher educated persons are advantaged in functional health at every stage of the adult life course. Second, age has a negative influence on mean HUI scores - functional health steadily declines with age for all education categories. Third, the average decline in HUI over the middle part of the life course (ages 25-64), however, is slower for the better educated.

In terms of the third trend, health decreases at a decelerated rate for those in the fourth (Q4) and third (Q3) education quartiles relative to the other education quartiles (i.e., Q1 and Q2). Ranging from about 0 to 1, where 1 equals perfect or full health, the mean HUI score for the best-educated persons (Q4), for example, aged 25-34 is .952 or around 95% of perfect health. The comparable figure at ages 55-64 is almost .90 or 90% of full health - a drop of just under 6%. Conversely, those in the first education quartile have much lower average HUI scores, which drop more sharply over the middle part of the life course - the mean HUI score falls from .901 at ages 25-34 to .827 at ages 55-64 (a drop of 8.2%). Hence, higher educated persons tend to largely postpone functional limitations into the later part of the life course, while lower educated persons experience a steady decline in functional health in middle age.

Table 1 about here

Because health declines at an accelerated rate for some and at a decelerated rate for others, the SES-gap in functional health tends to diverge during middle age. Looking at age-specific relationships between HUI and education quartile rank in **Table 1**, the mean HUI score for the first quartile is statistically different from all other quartiles at ages 25-34. By ages 35-44, there is evidence of increasing divergence - all education groups have statistically different average HUI scores, except between the second and third quartiles. Further, the gaps that reach significance are between the best educated (Q4) and the other education groups at ages 45-54 and 55-64. Education-based inequalities in functional health, however, get smaller beyond this age. There are no statistically significant mean differences in HUI at ages 65-74, and only because of Q1's extremely low mean (.638) is it statistically different from the other education quartiles in very old age (75+). (It is important to note that while statistically significant differences in health between SES groups partly depend on sample size - which is larger for middle-aged cohorts, - Mustard, Derksen, Berthelot, Wolfson, Roos, & Carrier (1995) show that socio-economic differences in health among middle-aged persons cannot be simply reduced their larger samples).

Socio-economic differences regarding aging and limitation of daily activities are described in **Table 2.** The data in this table also suggest that SES-based inequalities in physical health converge in old age. The odds ratio for *not* having a limitation of activity among individuals aged 25-34 in the highest education quartile, relative to the lowest education quartile, is 2.3 ($p < .001$). Within the 35-44 age group, the odds of not having an activity restriction for persons in Q4 are also significantly different from Q1 (1.6, $p < .01$). The corresponding figures for the second and third education quartiles are not statistically different from the first quartile during middle age (i.e., 25-44).

Table 2 about here

By early-old age (ages 55-64), the number of statistically significant gaps between education quartiles increases, with odds ratios of 1.5 ($p < .05$) and 1.6 ($p < .01$) for not having an activity limitation among persons in the second and fourth education quartiles, respectively, relative to the first quartile. By contrast, the gaps between education groups all but disappear in later-old age - no statistically significant differences are observed for persons aged 65+.

A divergence/convergence pattern also appears in **Table 3** – in how individuals *perceive* their physical health. Of the differences in self-assessed health between education groups at ages 25-34 and 35-44, only the Q4 logistic regression coefficient is statistically significant. Individuals with the highest education are 2.3 and 3.4 times, respectively, more likely on average to report positive health relative to individuals who fall into the lowest education quintile.

Table 3 about here

However, the positive effect of education on self-rated health increases (i.e., diverges) in late-middle and early-old age – ages 45-64. For example, individuals aged 55-64 in the second and third education categories are about twice as likely to rate their health as good or better relative to the least educated persons, while the best educated are over four times more likely to rate their health in a positive manner. The odds of good health are moderately smaller but still statistically significant for these education groups at ages 65-74. By contrast, the only gap that is statistically significant in very-old age (75+) is between Q1 and Q4 - the later relative to the former are about twice as likely to rate their health as good to excellent.

In sum, while there is some variation in the age at which convergence occurs for the three global measures of health used here, the health gap between education quartiles is generally widest in middle and early-old age (ages 35-64), and narrower in both the earlier (25-34) and the later (65+) stages of the adult life course. This pattern is similar to that predicted by the status divergence/convergence model. According to this model, the stronger then weaker positive effect of education on health with age reflects the greater exposure to and impact of financial, lifestyle, and psychosocial factors on health in middle age. That is, as exposure to financial deprivation, unhealthy lifestyle, and social and psychological deficiencies grows, and as people become more biologically susceptible to disease and illness with age, socio-economic-based inequalities in health increase over the middle life course. In other words, while morbidity and disability for higher SES persons - who tend to have less exposure to these conditions – are compressed into a short period at the end of life, they are increasing experienced by lower SES persons over the middle stages of life. In old age, socio-economic differences in health converge for a variety of reasons including: vulnerableness to disease and illness of higher SES persons due to biological forces; a greater likelihood of quitting smoking and drinking, for example, among lower SES persons; and the equalization of access to health care services and of the distribution of income due to government interventions.

Explaining Divergence/Convergence Patterns in Age, SES, and Health

Since economic, lifestyle, and psychosocial resources are a consequence of education, mid- and early-late life health advantages and disadvantages of higher and lower educated persons, respectively, should fade once these factors are introduced. **Tables 4a-c** look at how the relationship between education and age-specific health is mediated by these resources. All findings are also adjusted for gender and marital status.

The data in **Table 4a** indicate that the mediating effects of economic, lifestyle, and psychosocial resources explain a substantial portion of the relationship between education and functional health. The introduction of these variables eliminates most of the statistically significant gaps in HUI between education categories in early-middle age (35-44) observed in **Table 1**. These resources are also related to education and HUI at ages 45-64. In fact, the average HUI score for persons in the first education quartile is improved to about .89 at ages 45-54 and .86 at ages 55-64 when controlling for economic, lifestyle, and psychosocial factors (**Table 4a**) from .86 and .82 without holding these variables constant (**Table 1**). On the other hand, the comparable figures for individuals in the top education quartile are reduced at these ages - from about .92 and .90 to .90 and .88. Accordingly, unlike the observations in **Table 1**, the decline in HUI from ages 25-64 is similar for the better and poorer educated (e.g., functional health decreases at rate of about 6% for both the fourth and first education quartiles), and most of the gaps between the best and least educated in middle age and early-old age are no longer statistically significant.

Table 4a about here

Economic, lifestyle, and psychosocial factors also mediate the positive relationship between education and both activity restriction and self-rated health (**Tables 4b** and **4c**, respectively). As a matter of fact, the relationship between education and activity restriction is more than neutralized. Many of the logistic regression coefficients in **Table 4b** are less than one, indicating that persons with the least educational attainment (Q1) are more likely *not* to report an activity restriction. For instance, the odds of not having an activity restriction for persons in Q2 are about 50% less compared to those in Q1 at ages 45-54.

Tables 4b & 4c about here

Population-level Health Dynamics

It is reasonable to assume that change in the overall rate of inequality in the distribution of health outcomes with age (i.e., population-level analysis) is a consequence of the relative maintenance in the health of persons with early-life SES advantages (i.e., individual-level analysis). The dispersion of health should therefore increase in middle and early-old age, and subsequently decrease. **Table 5** describes change in the overall extent of inequality in HUI to determine if population-level health dynamics follow the pattern observed at the individual level (i.e., **Table 1)**.

The findings show that total inequality in functional health, measured with the Gini coefficient, steadily increases over the entire adult life course. In fact, the most significant increases occur in old age. At ages 65-74, inequality is significantly higher compared to the preceding age category - .142 versus .108, or an increase of over 30%. There is a trend toward even greater inequality over the very-late life course, as the level of inequality rises to .220 at ages 75+.

Table 5 about here

These findings do not fully mirror the divergence/convergence pattern observed at the individual level. While the health advantages of higher educated persons and the health disadvantages of lower educated persons generally converge in old age, the overall level of inequality in the distribution of functional health dramatically diverges. This suggests that socioeconomic-based gaps in health are unlikely to be largely responsible for increases in the overall level of inequality in the distribution of health outcomes across older cohorts.

Discussion

This study provides various insights and answers about healthy aging. The findings show that education-based gaps in health vary over the adult life course. Persons with higher education tend to experience a postponement of morbidity and disability until the later stages of the life course, whereas health problems begin to appear much earlier in the life course of those with lower education. Hence, health gaps generally increase during middle and early-old age. Nevertheless, they do decrease in old age.

Since higher educated persons are better able to maintain their relative physical health into old age, there is the potential for postponing morbidity and disability among entire cohorts. The relationship between SES and health is substantially weakened when controls for economic, lifestyle, and psychosocial resources are introduced, revealing that education is not likely at the core of successful aging. Instead, these resources act as a conduit through which education influences health. Therefore, to achieve postponement of morbidity and disability for all persons further efforts need to focus on lower SES groups, especially the poorest of the poor.

Public policies can help reduce socioeconomic-based health inequalities, notably in middle and early-old age, by reducing the exposure to and impact of health-related psychosocial/behavioural risk factors among lower SES groups. The potential for healthy aging also hinges on economic resources. Socio-economic differences in health dip in old age in part due to old-age income security and welfare programs that help individuals maintain pre-retirement standings of living and that prevent elderly persons from living in poverty. Strengthening public policies aimed at reducing economic inequalities in the total population would likely change how the relation of age to health varies across socio-economic groups. More research and debate in the social epidemiological literature on how to best smooth SES-based gaps in health over the life course of Canadians is needed.

While the methodological choices made here endeavor to produce the most valid findings, this study also raises important methodological issues that need to be consider in future research on age, SES, and health. First, explanations for the convergence in SES-related gaps in health during old age likely reflect a combination of factors, such as reduced exposure to health-related psychosocial/behavioural/economic risk factors in later life, as well as SES differences in mortality. In terms of the last issue, SES differences in health, especially in very old age, reported in this paper may be underestimated because a disproportionate amount of those with lower SES have died, or have been institutionalized or are unable to participate in a survey due to poor health. Underestimating the poorer health of lower SES persons may produce a convergence in the health gap between SES groups. However, when compensating for the selective effects of mortality levels (i.e., by weighing the data used here to adjust for age-specific education differences in mortality using figures derived from a mortality study by Mustard et al., 1997), measures of health status (i.e., the divergence/convergence pattern in education-based gaps in health with age) changed very little. Long-term longitudinal data, nonetheless, are necessary to replicate the findings observed here, and to more precisely determine to what extent the SES-bias in mortality and each of the other factors described above influence patterns of age, SES, and health.

Second, using lifetime health data would also help separate age effects from cohort and period effects, which is not possible with cross-sectional data. It is also difficult to establish causal order without longitudinal data; that is, to what degree are SES inequalities in health status the result of social section vis-à-vis social causation? While longitudinal studies on SES, health, and aging overwhelmingly support the social causation position (e.g., Wolfson et al., 1993), it can only be surmised that SES is more likely to affect health, than health to affect status attainment, with cross-sectional data.

Third, the findings suggest that changes in the overall rate of inequality in the distribution of health outcomes with age are to some extent a consequence of the relative maintenance in the health of persons with early-life SES advantages. Stated differently, the dynamics of population-level health do not entirely follow the patterns observed at the individual level. Further investigation about the forces behind the steady increase in health inequality with age is needed. For example, to what extent, if any, do the well-known gender-based inequalities in the occurrence of mortality and morbidity account for the patterns in the overall rate of inequality across age cohorts observed here; or, to what extent do within-group (e.g., within SES groups) health inequalities play a role in this process? In the end, these methodological issues and questions must be addressed to help build a strong base of knowledge about the socio-economic stratification of health and how it varies over the life course of Canadians.

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Table 1: Mean Health Utility Index (HUI) score by Education Quartile, Ages 25+

Education	Age 25-34	35-44	45-54	55-64	65-74	75+
Q1	0.901 [a]	0.895 [a]	0.861	0.827	0.788	0.638 [a]
Q2	0.933	0.918 [b]	0.878	0.849	0.820	0.719
Q3	0.934	0.920 [c]	0.882	0.870	0.834	0.730
Q4	0.952	0.944	0.920 [d]	0.895 [e]	0.829	0.754

[a] Q1 is statistically different from Q2, Q3, Q4 at $p<.05$.

[b] Q2 is statistically different from Q4 at $p<.05$.

[c] Q3 is statistically different from Q4 at $p<.05$.

[d] Q4 is statistically different from Q1, Q2, Q3 at $p<.05$.

[e] Q4 is statistically different from Q1, Q2, at $p<.05$.

Source: 1998/1999 National Population Health Survey, Master Health File

Table 2: Odds of *not* having an Activity Restriction by Education Quartile, Ages 25+

Education	Age 25-34	35-44	45-54	55-64	65-74	75+
Q1	1.000	1.000	1.000	1.000	1.000	1.000
Q2	1.352	1.161	0.722	1.541*	0.927	0.910
Q3	1.297	1.065	0.946	1.116	1.125	1.118
Q4	2.365***	1.632**	1.266	1.630**	1.205	0.880

Statistically different from Q1 at *p<.05, **p<.01, ***p<.001.

Source: 1998/1999 National Population Health Survey, Master Health File

Table 3: Odds of *Positive* Health Perception by Education Quartile, Ages 25+

Education	Age 25-34	35-44	45-54	55-64	65-74	75+
Q1	1.000	1.000	1.000	1.000	1.000	1.000
Q2	1.352	1.324	1.853***	2.060***	2.136***	1.124
Q3	1.297	1.227	2.386***	2.296***	2.043***	1.650
Q4	2.365***	3.408***	3.866***	4.321***	3.473***	2.156***

Statistically different from Q1 at *p<.05, **p<.01, ***p<.001.

Source: 1998/1999 National Population Health Survey, Master Health File

Table 4a: Mean Health Utility Index (HUI) score by Education Quartile, Controlling for Economic, Lifestyle, and Psychosocial Resources, Ages 25+

	Age					
Education	***25-34***	***35-44***	***45-54***	***55-64***	***65-74***	***75+***
Q1	0.914 [a]	0.906 [b]	0.892	0.863	0.820	0.722
Q2	0.940	0.927	0.875	0.859	0.838	0.729
Q3	0.927	0.916	0.902	0.865	0.844	0.756
Q4	0.938	0.930	0.899	0.881	0.816	0.764

[a] Q1 is statistically different from Q2 at $p<.05$.
[b] Q1 is statistically different from Q4 at $p<.05$.

Source: 1998/1999 National Population Health Survey, Master Health File

Table 4b: Odds of *not* having an Activity Restriction by Education Quartile, Controlling for Economic, Lifestyle, and Psychosocial Resources, Ages 25+

	Age					
Education	***25-34***	***35-44***	***45-54***	***55-64***	***65-74***	***75+***
Q1	1.000	1.000	1.000	1.000	1.000	1.000
Q2	1.077	1.052	0.508***	1.326	0.809	0.497*
Q3	0.853	0.849	0.703	0.955	0.947	0.951
Q4	1.215	1.085	0.736	1.296	0.748	0.594

Statistically different from Q1 at *p<.05, **p<.01, ***p<.001.

Source: 1998/1999 National Population Health Survey, Master Health File

Table 4c: Odds of *Positive* Health Perception by Education Quartile, Controlling for Economic, Lifestyle, and Psychosocial Resources, Ages 25+

	Age					
Education	***25-34***	***35-44***	***45-54***	***55-64***	***65-74***	***75+***
Q1	1.000	1.000	1.000	1.000	1.000	1.000
Q2	1.092	1.114	1.419	1.075	1.695	0.899
Q3	1.106	0.850	1.647	1.313	1.408	1.055
Q4	6.835**	2.385*	1.639	2.180**	1.498	2.043

Statistically different from Q1 at *p<.05, **p<.01, ***p<.001.

Source: 1998/1999 National Population Health Survey, Master Health File

Table 5: Gini Coefficients of Health Utility Index (HUI) Inequality, Ages 25+

Age					
25-34	***35-44***	***45-54***	***55-64***	***65-74***	***75+***
0.058	0.072	0.092	0.108	0.142	0.220

Source: 1998/1999 National Population Health Survey, Master Health File

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