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# Examining the Role of Early Life Social Conditions on Adult Mortality through Historical Record Linkage: Implications for Contemporary Public Policy

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**Examining the role of early life social  
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historical record linkage:  
Implications for Contemporary Public Policy**

Discussion Paper No. 08-06

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## *Abstract*

This study examines the effect of early life conditions on adult mortality. The individual, household and community details of children residing in Quebec in 1901 are linked to their subsequent ages at death in late adulthood using the 1901 Canadian Census and Quebec death registers. Preliminary results of logistic regression and Cox proportional hazards regression analyses indicate that childhood poverty status is not significantly associated with risk of death after age forty. Sex, birth cohort, parental literacy status, farm status and number of siblings in the childhood household are found to significantly effect mortality after age 40. Gender differentials in the role of early life conditions are found, with males being affected by a greater number of childhood conditions than females. A forthcoming updated analysis will contain approximately 3-4 times the amount of cases available for the preliminary analyses.

## INTRODUCTION

Despite the improvements made in population health and longevity in the last century, socio-economic status continues to be a strong predictor of mortality in developed nations. Although the link between socio-economic status and risk of mortality in adulthood is well established, scholars endorsing a life course perspective emphasize that early life conditions play also play a role in predicting adult mortality.

Drawing on the life course perspective, the purpose of this study is to investigate whether individuals exposed to conditions of relative poverty as children (before age fourteen) experience an increased risk of mortality in later adulthood (after age forty). The individual, household and community details of a sample of approximately 2000 children recorded as residing in the province of Quebec in the 1901 Canadian Census are linked to death registers from the Institut de la Statistique du Quebec. The resulting event history database of sampled individuals is analyzed through logistic regression and survival analysis. Specifically, logistic regressions are utilized to investigate the influence of early life conditions on the relative odds of dying before ages 60, 70, 80 and 90, respectively. Cox Proportional Hazards models are used to examine whether early life conditions influence the overall hazard of death after age forty. In addition to childhood poverty status, other aspects of early life social environmental conditions, sex and cohort are also examined. As the first study to incorporate early twentieth-century Canadian data, the results of this analysis will provide new information about the experiences and long-reaching health consequences for Canadians raised in poverty in the early 1900s.

Although the experience of child poverty at the turn of the twentieth century was very different from the experience of children living in poverty today, the results of this study have implications for contemporary social policy. Today's elderly individuals have experienced great improvements in income security, but a sustained, and by some accounts increasing, income

inequality among young Canadian families remains (Crossley and Curtis, 2006; Phipps and Lethbridge, 2005). Evidence of a link between childhood social disadvantage and adult mortality would indicate that failing to decrease current socio-economic disparities among today's children will set the stage for a great divide in both the quality and length of life for the upcoming generation of Canadians.

## LITERATURE REVIEW

The association between socio-economic status and health has been well established by scholars. Whether measured via income, occupation or education, socio-economic status is routinely positively correlated with longevity and good health (Hayward, Pienta and McLaughlin, 1997; Beckett, 2000; Oh, 2001; Alwin and Wray, 2005; Hummer, Rogers and Eberstein, 1998; Lynch et al, 2000; George, 2005). Less established in the literature is the nature of the relationship between SES and health; that is, why does this association occur, what is the causal direction of the relationship, how does it operate over time, and how is it mediated by other variables?

The causal direction of the relationship between socio-economic status and health remains a point of discussion among social scientists. Many social demographers approach the subject with an assumption that socio-economic status unidirectionally shapes health outcomes, but the reciprocal influence of the two variables has surfaced as a more realistic proposition, though difficult to disentangle empirically (Hayward, Pienta and McLaughlin, 1997; Van den Berg, Lindeboom and Lopez, 2007). The differential strength of the relationship between socio-economic status and health at different stages of the life course is a source of dispute among scholars. Beckett (2000) found that the role of socio-economic status in predicting individual health peaks at midlife and subsequently diminishes. This convergence of mortality risk across social strata at very old ages has been found even after controlling for gender, race and/or

ethnicity (Preston, Hill and Drevenstedt, 1998; Beckett, 2000; Bengtsson and Lindstrom, 2000). Contrastingly, Lynch (2003) and Willson, Shuey and Elder (2007) found the role of socio-economic status on health to be sustained over the life course. Indeed, Stone (2000) found that a multitude of childhood socio-economic status factors all independently influenced survival even among “supercentenarians” (those living to age 110).

The linearity of the relationship between socio-economic status and health has been questioned not only at different stages of the life course, but also at different levels of socio-economic status. Daly et al (1998) found that large health improvements were associated with incremental gains in status at the lowest end of the socio-economic gradient, but that the health benefits of higher relative socio-economic status diminished at the highest levels of the gradient. As well, individual experience of socio-economic status, and thus its relation to health, is shaped by ascribed social constructions such as race and gender interacting with historical and cultural contexts (McDonough, Sacker and Wiggins, 2005; Sakamoto, 1990; Shuey and Willson, 2008). Thus, although there is clearly an association between socio-economic status and health, this association is moulded by a variety of contextual, individual and temporal factors.

In addition to debates over the direction, strength, and linearity of the link between socio-economic status and health is the debate about the relative importance of socio-economic status in relation to other determinants of health. Many scholars focus on the role of adult lifestyle behaviours, such as smoking, diet and exercise, as mediating determinants of the effect of socio-economic status on health. Hummer et al (1998) argue that these proximate determinants are ultimately of more pragmatic policy importance, but Daly et al (1998) stress that lifestyle behaviours are highly predicted by socio-economic status, and thus reducing socio-economic inequality should be the focus of policy efforts.

Alternatively, George (2005) posits that ascribed social statuses such as race, gender and ethnicity are more crucial to determining health and longevity than achieved statuses such as socio-economic status. Yet early life disadvantages such as child poverty can hardly be considered an achieved status, as children are not responsible for the family income situation in which they find themselves (Crossley and Curtis, 2006). If low socio-economic status in childhood were found to be predictive not only of childhood health but also of adult health and longevity, its legitimacy as a target of social amelioration among policy makers would be further enhanced.

Theoretical backing for studies of early life conditions as a specific factor in adult health has predominantly drawn on the life course perspective. Alwin and Wray's (2005) comprehensive life course framework applies a lifespan development perspective to social status and health, acknowledging the multidimensional and multidirectional processes of growth across the entire lifespan, the setting of these processes in multiple social contexts, and the accumulation of the effects of social inequalities magnifying over time. Specifically, the theories of fundamental social causes, the critical period model and cumulative disadvantage have been utilized as conceptual guidelines for studies of the role of early life conditions on adult health and longevity.

Cumulative disadvantage, running parallel to Merton's (1968) groundbreaking work on cumulative advantage, posits that inequality (in this case applied to health and longevity) is invoked by mechanisms of individual or group disadvantage which magnify or accumulate over time via key resources in the stratification process such as income, occupation and education (DiPrete and Eirich, 2006).

Alternatively, scholars endorsing the critical period model dismiss the concept of cumulative disadvantage. Instead, specific windows of time in the life course are considered

critical to health status for the remainder of one's life. Adverse exposures in early life, ranging from epidemic exposure to mother's death in infancy, have been linked to adult mortality (Fitch and Crimmons, 2000; Pavard et al, 2005). Most scholarship in this area has focused on gestation, infancy or the first year of life as being the 'critical period' that permanently alters health and risk of chronic disease for individuals (Barker, 1992; Fogel 1993, Bengtsson and Lindstrom, 2000).

Additionally, Link and Phelan's (1995) concept of fundamental social causes claims that socio-economic status, while more distal than proximal mortality risk factors, is permanently and unequivocally tied to risk of disease, as those who command the most resources are best able to avoid risks and minimize the consequences of disease once it occurs. This link between socio-economic status and health remains regardless of what historical or cultural context is being examined, as inequality in society will always produce inequities in health protective and disease-minimizing behaviours (Ibid, 1996).

Childhood socio-economic disadvantage can take a variety of forms; including residency and parental nativity (Hayward, Pienta and McLaughlin, 1997; Stone, 2000), macro-economic climate (Vandenberg, Lidneboom and Lopez, 2007), race and ethnicity (Preston, Hill and Drevenstedt, 1998; Hayward and Gorman, 2004), childhood illness and lack of access to medical services (O'Rand and Hamil-Luker, 2005; Yi, Gu and Land, 2007), or more traditional socio-economic measures of parental education, occupation or income (Moody-Ayers et al, 2007; Hamil-Luker and O'Rand, 2007; Willson, Shuey and Elder, 2007). Regardless of approach, early life disadvantage regularly correlates with adult well being, as indicated by mortality risk, disability, risk of specific diseases, or self-rated health (Elo and Preston, 1992).

The availability of and access to longitudinal, nationally representative surveys in recent history permit testing of models that investigate the pathway processes between early life disadvantage and adult survival. However, as the majority of these longitudinal surveys



commence in adulthood, researchers are often forced to rely on the recalling ability of respondents to ascertain childhood circumstances. This reliance on retrospective data is a major challenge to the quality of research (O’Rand and Hamil-Luker, 2005). The accuracy of respondent answers is questionable, and relying on recall narrows the range of values with which to measure childhood variables (see, for example, Yi, Gu and Land’s (2007) study of the oldest-old in China). Moreover, employing an adult health survey immediately adds the issue of selection bias, as those old respondents who are alive, living in the community and able to communicate, are a selective group of survivors from the base population (George, 2005; Hayward and Gorman, 2004).

To date, few researchers have met Alwin and Wray’s (2005) call for innovative research designs with more valid assessments of early life conditions, mostly due to the lack of sufficient data in historical demography (Hayward and Gorman, 2004; Manton and Soldo, 1985). The recent database release of a five-percent sample of the 1901 Canadian Census through the Canadian Families Project (Sager and Baskerville, 2007) provides this study with an historical measure of annual family earnings for all employed individuals. The unique historical qualities of the 1901 Canadian Census allow us to categorize families living in relative poverty in the province of Quebec, as indicated by cost-of-living estimates and income distributions (Orstein, 2000; Sager, 2000; McCann, Buck and Heggen, 2007; Sager and Baskerville, 1997; Baskerville, 2001; Bradbury, 2000; Gauvreau, Gossage and Gingras, 2000). Echoing the design of Preston et al (1998), this study incorporates the earliest available Canadian Census data on income among employed wage earners to gauge childhood poverty, a substantial methodological improvement over the recall bias associated with retrospective designs. By linking the household income and other childhood conditions of a random sample of individuals to their eventual age at death using official death registers, the issues of selection bias associated with national longitudinal health

surveys are minimized. This study will be the first to explore the socio-economic conditions of early twentieth-century Canadian children and their subsequent patterns of mortality, providing a unique setting for analysis.

## METHODOLOGY

An event-history database is compiled linking individual information from the Canadian Families Project five-percent 1901 Canadian Census sample to the Institut de la Statistique du Quebec death register records. This event history consists of data at two points in time: April 1<sup>st</sup>, 1901, and the date of death of each individual.

To examine the relationship between early life conditions and adult mortality, a series of analyses are conducted using both logistic regression and Cox proportional hazards regression. For each method of analysis, two models are utilized. The first model examines early life social conditions with the exclusion of relative poverty status, utilizing the full sample available. The second model examines childhood poverty specifically, resulting in a reduced sample size due to the absence of household earnings data for roughly half of the sample. All analyses are run on the full sample (males and females together), as well as separately by sex to examine possible sex differences in the role of early life conditions on adult mortality.

Logistic regression analysis is utilized to examine whether early life conditions significantly affect the relative odds of dying before ages 90, 80, 70 and 60. These age categories are examined to ascertain whether the influence of early life conditions differentiate by stage of adulthood.

The Cox Proportional Hazards model is utilized to examine whether early life conditions produce a significant difference in the overall hazard, or risk, of death after age forty as measured in years between groups. This can alternatively be considered as survival time; for

example, do children raised in conditions of relative poverty have significantly lower survival times after age forty, as a group, than children not raised in conditions of relative poverty?

The Cox model is a preferred method in longitudinal analysis because it makes no assumption about the shape of the underlying hazard over time (i.e. that it is U-shaped, linear and increasing, linear and decreasing, or constant). Instead, the Cox model focuses on the differences between individuals or groups and assumes that the hazard of failure (in this case, death) between groups is proportionate (in ratio) across all points in time (Allison, 1984).

*Target Population and Sample:*

The target population is Canadian individuals whose childhood conditions were recorded in the 1901 Canadian Census and who survived at least to age forty. Age forty was required as a cut-off as available death register records only commenced in 1926. While this will allow analysis to focus on the role of early life conditions in predicting mortality in late adulthood, there are drawbacks to the omission early death records. The process which led individuals to be selected out of our sample, urban status of the home, has been confirmed as significantly relating to our variables of interest by Heckman selection modelling (Berk, 1983). Thus, the sample of individuals who live at least to age forty is considered to have selection bias, though this bias effectively serves to make our estimates more conservative (as individuals raised in conditions of poverty are more likely to be selected out of the sample via early death) (Appendix C).

The full sample consists of individuals recorded as being under the age of fifteen and residing in the province of Quebec in the 1901 Canadian Census, who went on to live at least to age forty as confirmed by official death records. Quebec residents were further specified, as historically, French Roman Catholics in Canada included the maiden name of females in death register records; allowing records linkage between childhood and late adulthood to be optimized. For the specific analysis of childhood poverty status in Model 2, individuals are further specified

as living in a household where the household head was a wage earner with a measure of annual earnings recorded in the 1901 Census.

These data were derived from the five percent sample of the 1901 Canadian Census collected by the Canadian Families Project, available to the public at large in both SPSS and MS Access formats (Sager, Thompson and Trottier, 2002). The Canadian Families Project five-percent sample of the 1901 Canadian Census consists of a stratified random sample by household. These household samples, for which information was gathered for every household member, involve two levels of sampling: a simple random sample of households is first selected, and the resulting sample of individuals in the household is a stratified cluster sample of the household sample (Orstein, 2000). Thus, the sampling point is the count of dwellings entered by the 1901 Census enumerator in column 1 of Schedule 1, with the selection probabilities being identical for individuals and households. The individual is thus the primary unit of analysis, though household and community level variables are aggregated to the individual event history.

From the five-percent sample created by the Canadian Families Project (CFP), a further purposive sample was taken of the province of Quebec at five percent of the CFP sample, selecting only households which contained a child of age fourteen or younger. Of the sampled households, 1,916 children have been matched to death records to be used in the general early life analyses (Model 1). Among the 1,916 children, 986 have been matched to both family earnings and death records to be used in the investigation of the relationship between childhood poverty and mortality in late adulthood (Model 2). The sample of children are all born in the province of Quebec between the years 1887 and 1901, of French ethnicity and Roman Catholic religious affiliation.

*Key Concepts/Variables:*

The dependent variable is age at death in years, as verified in official death registers. The principal independent variable is relative poverty status of the household in childhood. Data constraints lead this study to a very specific conceptual definition of childhood poverty. As noted by Sager (2007), a poverty line in 1901 Canada is difficult to conceptualize, as comprehensive cost-of-living information is lacking. The 1901 Census provides data on annual individual income only among wage earners who are not self-employed. No additional measures of assets or savings are provided, with the exception of property ownership status. Thus, children of professionals, entrepreneurs and most farmers are not included in this analysis, as these individuals have no earnings information recorded in the 1901 Canadian Census. This is a limitation to analysis, as farming households in particular encompassed a large percentage of the 1901 Quebec population. Limiting the range of economic statuses only to wage earners will provide an incomplete picture at best of the true range and depth of economic strata in 1901 Quebec.

For the purposes of this analysis, relative childhood poverty is defined as an individual under the age of fifteen living in a household where the principal wage earner (or household head as defined by the 1901 Canadian Census) was recorded as receiving annual earnings below what would be considered an adequate living wage in 1901 Quebec. After consultation with historical research regarding cost of living and average earnings in the 1901 Quebec population, four categories of family earnings were created (\$1-299 per year, \$300-399, \$400-499 and \$500+) (Sager and Baskerville, 1997). These categories were later reduced to binary (poor versus not-poor categories of income) after finding no distinguishing effects between the upper categories of income.

The lowest income category (\$1-299 per year) is considered a condition of relative (if not necessarily absolute) poverty as it is considerably below the mean annual income in 1901 Canada of \$387 (Sager, 2000). Additionally, earnings less than \$300 per year are considered by Sager and Baskerville (1997) to represent close to zero real-income in 1901 urban Quebec, based on a conservative average yearly cost-of-living estimate of \$220 per family in Montreal (including food, shelter, clothing and other essential items costs). Thus, an annual income below \$300 in 1901 Quebec is assumed an insufficient “living wage”; unable to see the family through anticipated times of joblessness or other difficulties, or to allow the family to save and accumulate wealth (Ibid).

To measure childhood poverty, the annual earnings of the household head is aggregated to the child of interest. This information is taken from the 1901 Canadian Census, in which Census enumerators asked all employed individuals to state their annual earnings from their principal occupation (Sager, Thompson and Trottier, 2002). Sager and Baskerville (1997) note that the stage of the family cycle (whether children are present, age and number of children) is crucial to determining the extent of poverty which a given annual income implies. To account for this, the age of the household head is controlled for, as well as the number of siblings present in the household.

Sex of the child is considered a primary covariate of interest, i.e. how does sex mediate or interact with childhood poverty to predict adult mortality? Based on past research by Sakamoto (1990) and Hamil-Luker and O’Rand (2007), it is expected that the risk of adult mortality given certain childhood conditions will differentiate by sex, with sex acting as a mediator between the experience of childhood poverty and eventual risk of adult death. The following covariates concerning social-environmental conditions in childhood are also tested for significant effects on risk of death in adulthood: age of the individual in 1901, urban/rural status of the household in

1901, farmer status of the household head and literacy status of the household head (See Appendix A for further variable descriptions).

The 1901 Canadian Census data provides simultaneous access to individual (sex, birth rank), household (number and age of siblings, occupation and earnings of the household head) and community (urban/rural status) measures of childhood environmental conditions, offering a multilevel analytic approach which many past studies could not access. Additionally, the sampled population of this study offers a unique set of demographic characteristics that might allow the effect of socio-economic status on adult mortality to become more apparent than in other studies of more heterogeneous populations. The sample consists only of individuals of French-Canadian, Roman-Catholic heritage. This homogeneity of race and ethnicity potentially allows the effects of socio-economic status to be measured with less interference from other social structural factors.

By incorporating historical Census records, this study has access to a clustered random sample of individuals in childhood who are linked to their subsequent death records in adulthood. Because data are directly collected in the census records, this approach does not encounter the sample selection biases, memory recall problems and respondent bias issues that retrospective studies of this topic must grapple with. Moreover, due to the retrospective nature of most past studies, the study of family earnings in childhood has rarely been measured with a reliable, varied range of values. By measuring the effect of childhood family income (specifically conditions of relative poverty) on adult mortality, this study accesses what is arguably the most discriminating measure of socio-economic status. In comparison to measures of income, education and occupation have neither the same range of categories nor the same direct (the ability to purchase food and shelter) and indirect (the ability to pursue higher education) effects on health and well

being. Thus, the internal validity of the measures in this study is strong and a considerable improvement over retrospective survey studies on the topic.

In addition to strong internal validity, the strong external validity of this database to the larger population of Quebec has been confirmed through a comparison of the Canadian Human Mortality Database 1895 Quebec cohort to that of the sample (See Appendix B).

### Results

A series of logistic regressions were run in Stata software (version 9.x) to test the relative odds of dying before certain ages of adulthood (ages 90, 80, 70, and 60) given certain early life conditions. Model 1 examined all early life conditions with the exception of household income. Model 2 included the earnings criteria with a reduced sample size resulting.

**Table 1: Effects of Early Life Conditions on the Relative Odds of Dying Before Age X**

Variable	Age 90		Age 80		Age 70		Age 60	
	Model 1 <sup>^</sup>	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Poor Household		0.993		0.722		0.736		0.77
Male	2.759***	3.697***	1.940***	2.180***	1.535***	1.609**	1.160	1.486*
Urban Household	1.351	1.590&	1.219	1.327&	1.104	1.086	1.103	1.139
Head is Literate	0.853	0.371	0.960	0.582&	1.199	0.721	1.498&	1.050
Head is Farmer	0.804	0.745	0.762	0.816	0.799	0.561&	0.891	0.706
Age in 1901	1.054**	1.080*	1.008	1.024	0.996	0.991	1.026	1.012
Age of Head in 1901	1.000	1.000	1.007	1.010	1.004	1.009	0.998	0.999
Number of Siblings	1.022	0.986	0.966	0.953	0.945&	0.926&	0.924*	0.960
N	1916	986	1916	986	1916	986	1916	986

&p<0.10; \*p<0.050; \*\*p<0.010; \*\*\*p<0.001

<sup>^</sup>Model 1 = Full Sample without controlling for earnings data, Model 2 = reduced sample containing those with earnings data

As seen in Table 1, childhood poverty status was not found to significantly affect the odds of dying before any of the ages analyzed in the logistic regression. The largest and most significant effect was that of sex, with males holding significantly higher odds of dying, relative to females, at all ages analyzed and in both models. The sex differential widened at older ages,



with males holding 1.54x higher odds of dying before age 70 than females ( $p<0.001$ ), and 2.76x higher odds of dying before age 90 than females ( $p<0.001$ ). Cohort of the individual, or age in 1901, was also found to significantly effect the relative odds of dying before age 90; with each year increase in age in 1901, the relative odds of dying before age 90 increased 0.05x ( $p<0.010$ ) in Model 1, with similar results in Model 2. Each additional sibling in the childhood household was found to significantly decrease the relative odds of dying before age 60 by .016x ( $p<0.050$ ). In Model 2 (which controlled for childhood poverty status), urban status of the household, literacy status of the household and farmer status of the household were found to be marginally significant predictors of the relative odds of dying at various stages of adulthood with  $p$ -values  $<0.10$  (see Table 1). Age of the household head in 1901 was not found to be a significant predictor of the relative odds of dying in any model or analysis.

Logistic regression analyses were also run for each sex separately, as seen in Table 2. Poverty status in childhood was not found to significantly effect the relative odds of dying at any age of adulthood for either males or females, as seen in Model 2 results of Table 2. Among females, only cohort was found to significantly affect the relative odds of dying before ages 90, 80 and 60, with older cohorts holding slightly higher odds of dying than younger cohorts (coefficients between 1.044 and 1.095 at the  $p<0.050$  level). None of the other childhood circumstances included in analysis were found to significantly effect the relative odds of dying among females.

Unlike the female pattern of results, cohort was not a significant predictor of the relative odds of dying among males (See Table 2). Instead, having a parental head in childhood who was a farmer significantly reduced the odds of dying among males by 0.33x before age 80 ( $p<0.040$ ), 0.33x before age 70 ( $p<0.050$ ) and 0.38x before age 60 ( $p<0.050$ ). Moreover, each additional sibling in the childhood home reduced the relative odds of dying among males by 0.10x before

age 70 ( $p < 0.050$ ) and 0.12x before age 60 ( $p < 0.050$ ). Thus, there was no overlap between males and females in terms of what kinds of early life conditions affected adult mortality.

**Table 2: Effects of Childhood Environmental Conditions on Relative Odds of Dying Before Age X, Males and Females**

Variable	Age 90				Age 80				Age 70				Age 60			
	Model 1 <sup>^</sup>		Model 2		Model 1		Model 2		Model 1		Model 2		Model 1		Model 2	
	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males
Poor Household			1.627	0.286	0.803	0.690			0.842	0.699			0.518	1.044		
Urban Household	1.246	1.694	1.602&	1.589	1.214	1.503	1.428&	1.098	1.205	1.050	1.158	1.050	1.003	1.203	0.892	1.375
Head is Literate	0.867	0.805	0.453	0.214	0.529	0.705	1.441&	0.695&	0.685	1.384	1.052	1.384	1.336	1.750	1.029	1.067
Head is Farmer	0.837	0.733	0.451	-	0.859	0.973	0.669*	0.770	0.546	0.664*	0.991	0.664*	1.271	0.623*	0.546	0.933
Age in 1901	1.061*	1.044	1.095*	1.096	1.044*	1.075*	0.968	1.044*	1.028	0.967&	1.029	0.967&	1.060*	1.007	1.032	0.988
Age of Head in 1901	0.993	0.969	0.983	0.976	1.010	1.001	1.006	1.008	1.010	1.000	1.006	1.000	0.993	1.008	1.007	0.987
Number of Siblings	0.993	1.146&	0.946	1.142	0.967	0.935	0.960	0.973	0.978	0.907**	0.984	0.907**	0.968	0.877*	0.995	0.926
N	989	927	481	427	989	481	927	481	481	927	989	927	989	927	481	445

<sup>&</sup> p<0.10; <sup>\*</sup> p<0.050; <sup>\*\*</sup> p<0.010; <sup>\*\*\*</sup> p<0.001

<sup>^</sup>Model 1 = Full Sample without controlling for earnings data, Model 2 = reduced sample containing those with earnings data

**Table 3: Effects of Childhood Environmental Conditions on Relative Hazard of Mortality After Age 40**

Variable	Model 1 <sup>^</sup>			Model 2		
	All	Females	Males	All	Females	Males
Poor Household				0.912	1.016	0.828
Male	1.476***			1.613***		
Urban Household	1.131&	1.081	1.192&	1.183*	1.167	1.225&
Head is Literate	0.891*	0.973	0.815*	0.925	0.871	1.121
Head is Farmer	0.999	0.922	1.086	0.821	0.782	0.864
Number of Siblings	0.984	0.984	0.986	0.965&	0.968	0.969
Age in 1901	1.016*	1.032***	1.001	1.014	1.031*	0.995
N	1916	989	927	926	481	445

<sup>&</sup> p<0.1; <sup>\*</sup> p<0.050; <sup>\*\*</sup> p<0.010; <sup>\*\*\*</sup> p<0.001

<sup>^</sup>Model 1 = Full Sample without controlling for earnings data, Model 2 = reduced sample containing those with earnings data



To examine risk of adult mortality using another method, Cox proportional hazards regressions were also utilized in Stata software to examine the overall relative risk or hazard of dying at all points in time after age 40. As seen in Model 2 of Table 3, poverty status in childhood was not found to significant effect the relative risk of dying after age 40, either in the full sample or among females and males separately. As with the logistic regression analysis, sex was the largest and most significant effect on the relative risk of death after age 40, with males holding approximately 47.6% higher risk of death at all points in time after age 40 than females ( $p<0.001$ ) (Model 1 of Table 3). Additionally, having a literate parental head in childhood reduced the overall risk of dying after age 40 by 11.9% relative to individuals who had illiterate heads ( $p<0.050$ ). Finally, older cohorts of individuals (as expressed by age in 1901) were found to have approximately 1.4% higher overall risk of dying after age 40 than younger cohorts ( $p<0.050$ ).

Both Cox models were additionally run with each sex separately, again producing differential significant effects of childhood circumstances by sex (Table 3). Among females, only cohort was found to significantly influence the overall risk of dying after age 40, with older cohorts of females having 3.2% higher risk of dying than younger cohorts of females ( $p<0.001$ ). Among males, however, only literacy status of the household head was found to significantly influence the risk of dying after age 40, with males raised by a literate parental head holding approximately 19.9% lower risk of dying than males raised by an illiterate parental head ( $p<0.050$ ). Finally, urban status of the childhood household was found to be a marginally significant predictor of risk of death among males, with males raised in urban household having a 19.2% higher risk of death after age 40 than males raised in rural areas ( $p<0.10$ ).

*Discussion:*

Poverty status in childhood was not found to be a significant predictor of adult mortality in any of the analyses utilized. This lack of a childhood poverty effect could be due to the limitations of the source data on annual family earnings. The 1901 Census enumerators asked individuals to provide their own estimate of annual earnings. This method of questioning is fraught with the potential for human error of calculation, misinterpretation and/or intentional deception. Moreover, among individuals recorded as being employees in the 1901 Census, approximately one-third did not have any annual earnings recorded. This omission of earnings does not appear to be related to occupation, region or even enumerator, and we currently assume the omission process to be randomly distributed. Regardless, this significant omission has resulted in a diminished sample size (as fewer sampled children lived in households with earnings available in order to distinguish poverty status). As previously mentioned, the distribution of income in the sample is a truncated version of the actual socio-economic status gradient in 1901 Quebec; missing both professional/self-employed and unemployed parental heads from analysis. Making an assumption of the presumed annual earnings of these occupational classes in a future analysis of this kind might provide a more accurate portrayal of differences in adult mortality across childhood social strata.

Apart from the absence of a childhood poverty effect, the results of this study found evidence that many aspects of childhood social-environmental conditions do hold a lasting and significant influence on risk of death in late adulthood. Sex, farmer status of the household head, number of siblings living in the childhood home, literacy status of the household head, cohort and urban status were all found to be at least marginally significant predictors of adult mortality in some form. Possible explanations for the patterns revealed in this analysis are found in both historical research and previous studies of this nature.

While sex is not considered a purely childhood condition, males had the largest disadvantage in adult survival in this study, mimicking the results found by Preston, Hill and Drevenstedt (1998) and Hayward and Gorman (2004). The protective effect of being raised in a rural setting, as well as being raised by a father who was a farmer, are historical effects of the period. As noted by Preston et al (1998), farmers in the early 20<sup>th</sup> century were healthier than urban dwellers, as a result of the poor sanitation in urban areas that led to the spread of infectious diseases.

The protective effect of farming experienced by males (but not by females) in this study also seems to support the finding of Preston, Hill and Drevenstedt (1998), who found the protective effect of farming was much larger among males than among females. This differential gender farming effect could be attributed to the fact that most males raised by farmers became farmers themselves in adulthood, maintaining the health advantages or protective effects bestowed on them in childhood. Females raised by farmers during this period, on the other hand, were more apt to move to the city in adulthood, as they did not inherit farmland as males could during that period (Gossage, 1999). Additionally, the detrimental health effects associated with urban living in the early twentieth-century might have disproportionately affected males, who at that time were more subject to unsafe industrial working conditions than females (Ibid).

The significant protective effect of having a literate parent in childhood is a compelling argument for the predictive role of early-life socio-economic status in adult health and longevity, especially after controlling for urban status (which is moderately correlated with literacy status). This finding is similar to that of Hayward and Gorman (2004) and O'Rand and Hamil-Luker (2005), who found that parental education and literacy provided protective health effects in adulthood.

The finding that additional siblings in the childhood home decreased the relative odds of dying among males is especially compelling. This could indicate that more social support in childhood is a health advantage for males. Contrastingly, a greater number of siblings could be a marker for strong genes in the family or origin and/or optimal living conditions, as the mother managed to raise multiple surviving children in a time of high infant mortality. Further historical research is required to better understand why additional siblings provided a protective effect for males of this generation but not so for females

Overall, our findings indicate that males appear to be more sensitive to childhood social conditions than females in terms of the relative odds of dying at younger ages of adulthood (60 and 70). At ages 70 and younger, the odds of dying among adult males are significantly affected by farmer status of the household head and number of siblings in the household; neither of these factors affected females at the same ages. Additionally, males were significantly affected by literacy status of the household head in terms of overall risk of death after age 40, while females were only slightly affected by cohort (which does not relate to socio-economic status). This may be partly explained by the fact that females during that historical period experienced greater social mobility from childhood to adulthood, and thus were able to attain associated health benefits associated with social gains, while the social status of males was less fluid throughout the life course (Gossage, 1999).

The overall pattern of results also indicate that at younger ages of adulthood (70 years and under), variables relating to childhood socio-economic status play a more prominent role in the odds of dying. However, at the very old ages of adulthood (80+), sex is the most significant predictor in the odds of dying, which does not relate to childhood socio-economic status. This finding seems to support the abundance of literature that finds a convergence of mortality risk at very old ages regardless of socio-economic status (Beckett, 2000; Bengtsson and Lindstrom,



2000). It appears that a levelling effect occurs at very old ages, as those who make it to that age are a select group with a shared strength of constitution that overcomes social disadvantages throughout the life course, including early life disadvantages.

### *Limitations*

Although this study reaps the causal inference benefits of a longitudinal design, it meets only the most basic requirements for a longitudinal study (two points of time are measured – one point in childhood and death). This brings with it a number of limitations. As childhood conditions are measured at only one historical point in time, there is a large risk that the family conditions being measured do not provide an accurate picture of the entire childhood experience of the individual. For instance, the household head may have been temporarily unemployed in the particular year of the Census, or have undergone a recent change in occupation. Significant household events that could happen after the recording of the 1901 Census (such as loss of a parent, change of residence, etc.) will be missed entirely in this study. Thus, the single-point-in-time measure of childhood environmental condition comes with obvious drawbacks.

Another drawback of the limited longitudinal nature of this study is the complete absence of measures of adult lifestyle behaviours and/or adult socio-economic status, that have been established as key mediating processes in the link between childhood conditions and adult mortality. Hayward and Gorman (2004) found that after taking into consideration adult lifestyle behaviours and adult socio-economic status, almost all of the effects of childhood on adult mortality were removed. Thus, any effect of childhood conditions on adult mortality found in this study must be considered as an incomplete picture of the broader causal pathways involving adult experiences.

In addition to the omissions of wealth and income information previously discussed, the historical Census data have a number of missing data issues. Given the historical socio-cultural

context, the true numbers of females engaged in paid work, as well as the number of female household heads, are considered undercounted by Census enumerators (Bradbury, 2000). Unfortunately, the severity of this bias is unknown (Sager, 2001). This bias is somewhat lessened by the other historical reality that female wage earners were extremely underpaid in relation to men at the time (Sager and Baskerville, 2007). Thus, it can be assumed that any female earnings that are missed by the 1901 Canadian Census would provide minimal alteration to the poverty status of sampled households.

*Policy Implications:*

Contemporary policy implications are difficult to conclude with any certainty, as many of the findings relate specifically to historical period effects no longer present today. The effects of urban and rural status on health have completely flipped in direction from 1901 to today. While being raised by a rural farmer may have been a great benefit to health in 1901, today, urban dwellers reap health benefits over rural individuals due to improved sanitation and other urban amenities. Moreover, the large chasm in risk of death between males and females found in the results of this study have slowly diminished over time, with males becoming less disadvantaged in terms of longevity. Additionally, it is difficult to imagine a contemporary counterpart to the effect of parental literacy status, as few individuals in Canada are illiterate today. It could be argued, however, that literacy status in 1901 parallels parental educational attainment today, and thus children raised by parents with lower educational attainment today might have increased risk of death in adulthood. Individuals raised in disadvantaged socio-economic conditions in 1901, however, did not have access to the social welfare programs that benefit low-income individuals today; which arguably lessen the detrimental effects of childhood socio-economic disadvantage on adult health longevity.

Despite the non-negligible historical effects found in this study, the finding that detrimental early life conditions in any setting were found to have significant negative effects on adult longevity should advocate increased attention and resources into improving the socio-economic status of young families today; or alternatively, reducing the level of inequality present in contemporary Canadian society. According to Link and Phelan's (1996) concept of fundamental social causes of disease, an unchanging link exists between socio-economic status and risk of disease regardless of geographic or historical context. This permanent link exists due to the fact that socio-economic status determines the level of social resources such as knowledge, money and power that, from childhood, highly influence an individual's ability to both minimize risk of disease and combat the effects of disease once it occurs. Thus, efforts by policy makers to reduce risk by targeting individual behaviours might be largely ineffective without a thorough understanding of the social, cultural and economic forces that lead to exposure to disease, and thus premature death (Ibid).

Indeed, recent research by health sociologists has focused on what Link and Phelan deem proximal causes of disease; individual behaviours such as diet and exercise which more directly effect health. While in theory these proximate risk factors are controllable at the individual level, it is the more distal yet fundamental socio-economic causes involving access to resources that help individuals maintain good health, regardless of what historical or contemporary period is in question. Gaining a thorough understanding of these social causes, that "put people at risk of risks" (Link and Phelan, 1995:80), and attempting to change them, has been deemed less crucial by many health policy experts because reducing inequality seems impossible or at least much less feasible than targeting individual behaviours.

As Canada experiences an increasing widening of socio-economic inequality, however, there are long-term consequences of today's childhood social disadvantage for Canadian society.

Canada's rapidly aging population will require a healthy and productive new generation of workers to replace the labour losses caused by the mass of baby boomers exiting the labour force in the next two decades. Continued social scientific research in the area of early life conditions as an influence on adult health and longevity will encourage a new health policy outlook that focuses on reducing the fundamental social disadvantages rather than the less efficient and effective process of targeting individual behaviour. Through this new outlook on population health policy, upcoming generations of Canadians might experienced lower risk of early death as well as healthier and more productive years in the labour force; simultaneously reducing social inequality and easing the economic burdens associated with Canada's aging population.

In conclusion, childhood poverty status was not found to significantly relate to adult mortality in this study. This study did find evidence, however, that many aspects of childhood social environmental conditions have a long-lasting influence on adult mortality. Particularly compelling is the differential effect of childhood conditions on adult mortality by sex, which suggests that males might be more sensitive to early life disadvantage than females. The limitations to this study are compensated for by the unique methodology, sample and quality of the sampling procedure. The historical record-linkage design used in this study, while possessing its own set of methodological issues, is considered preferable over the retrospective survey designs which dominate the study of early life conditions as an influence on adult mortality. An historical record linkage method of investigating early life conditions and adult mortality, as indicated by the results of this study, has relevant implications for contemporary health policy design and research in lieu of Canada's forecasted overloaded health system in the near future.

## REFERENCES

- Allison, P.D. (1984). *Event History Analysis: Regression for Longitudinal Event Data*. Series: Quantitative Applications in the Social Sciences: Sage Publications.
- Alwin, D.F. and Wray, L.A. (2005). A life-span developmental perspective on social status and health. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences* 60:S7-S14.
- Barker, D.J. (1992). The fetal origins of diseases of old age. *European Journal of Clinical Nutrition* 46(3): S3-9.
- Baskerville, P. (2001). Home ownership and spacious homes: Equity under stress in early-twentieth-century Canada. *Journal of Family History* 26: 272-288.
- Beckett, M. (2000). Converging health inequalities in later life- an artifact of mortality selection? *Journal of Health and Social Behavior* 41(1): 106-119.
- Bengtsson, T. and Lindstrom, M. (2000). Childhood misery and disease in later life: The effects on mortality in old age of hazards experienced in early life, Southern Sweden, 1760-1894. *Population Studies* 54(3): 263-277.
- Bengtsson, T. and Lindstrom, M. (2003). Airborne infectious diseases during infancy and mortality in later life in southern Sweden, 1766-1894. *International Journal of Epidemiology* 32: 286-294.
- Berk, R.A. (1983). An introduction to sample selection bias in sociological data. *American Sociological Review* 48: 386-398.
- Bradbury, B. (2000). Single parenthood in the past: Canadian census categories, 1891-1951, and the "normal" family. *Historical Methods* 33(4): 211-217.
- Burke, S.D.A. (2007). Transitions in household and family structure: Canada in 1901 and 1991. In E.W. Sager and P.A Baskerville (Eds) *Houshold Counts: Canadian Households and Families in 1901*. (pp.17-57) University of Toronto Press.
- Canadian Human Mortality Database (2008). "Canada - Quebec, Life tables (period 1x1), Males". Retrieved February 11, 2008 from [http://www.prhd.umontreal.ca/BDLC/data/que/mltper\\_1x1.txt](http://www.prhd.umontreal.ca/BDLC/data/que/mltper_1x1.txt)
- Crossley, T.F., and Curtis, L.J. (2006). Child poverty in Canada. *The Review of Income and Wealth* 52(2): 237-260.
- Daly, M.C., Duncan, G.J., Kaplan, G.A. and Lynch, J.W. (1998). Macro-to-Micro links in the relation between income inequality and mortality. *The Milbank Quarterly* 76(3), Socioeconomic Differences in Health: 315-339.

- Dannefer, D. (2003). Cumulative advantage/disadvantage and the life course: Cross-fertilizing age and social science theory. *Journal of Gerontology* 58B(6): S327-S337.
- DiPrete, T.A. and Eirich, G.M. (2006). Cumulative advantage as a mechanism for inequality: A review of theoretical and empirical developments. *Annual Review of Sociology* 32: 271-297.
- Elo, I.T., and Preston, S.H. (1992). Effects of early-life conditions on adult mortality: a review. *Population Index* 58(2): 186-212.
- Finch, C.E. and Crimmins, E.M. (2004). Inflammatory exposure and historical changes in human life-spans. *Science* 305: 1736-1739.
- Fogel, R. (1993). New sources and new techniques for the study of secular trends in nutritional status, health, mortality and the process of aging. *Historical Methods* 26: 5-43.
- Furstenberg, F.F. and Hughes, M.E. (1995). Social capital and successful development among at-risk youth. *Journal of Marriage and the Family* 57(3): 580-601.
- Gagnon, A. and Mazan, R. (2006). Influences of early life conditions on old age mortality in old Quebec. Discussion Paper no. 06-05. *Population Studies Centre, University of Western Ontario*. Retrieved January 8, 2008 from <http://sociology.uwo.ca/popstudies/dp/dp06-05.pdf>
- Gauvreau, D., Gossage, P. and Gingras, L. (2000). Measuring fertility with the 1901 Canadian Census: A critical assessment. *Historical Methods* 33(4): 219-228.
- George, J. (2005). Socioeconomic status and health across the life course: Progress and prospects. *Journals of Gerontology Series B: Psychological Sciences and Social Sciences* 60: S135-S139.
- Gossage, P. (1999). *Families in Transition: Industry and Population in Nineteenth-Century Saint-Hyacinthe*. McGill Queen's University Press.
- Hamil-Luker, J. and O'Rand, A.M. (2007). Gender differences in the link between childhood socio-economic conditions and heart attack risk in adulthood. *Demography* 44(1): 137-158.
- Hayward, M.D. and Gorman, B.K. (2004). The long arm of childhood: The influence of early-life social conditions on men's mortality. *Demography* 41(1): 87-107.
- Hayward, M.D., Pienta, A.M. and McLaughlin, D.K. (1997). Inequality in men's mortality: The socio-economic status gradient and geographic context. *Journal of Health and Social Behavior* 38(4): 313-330.

- Hummer, R.A., Rogers, R.G., and Eberstein, I.W. (1998). Sociodemographic differentials in adult mortality: A review of analytic approaches. *Population and Development Review* 24(3): 553-578.
- Link, B.G. and Phelan, J.C. (1995). Social conditions as fundamental causes of disease. *Journal of Health and Social Behaviour* 35: Spec:80-94.
- Link, B.G. and Phelan, J.C. (1996). Understanding sociodemographic differences in health: The role of fundamental social causes. *American Journal of Public Health* 86(4): 471-473.
- Lynch, S.M. (2003). Cohort and life-course patterns in the relationship between education and health: A hierarchical approach. *Demography* 40(2): 309.
- Lynch, J.W., Smith, G.D., Kaplan, G.A., and House, J.S. (2000). Income inequality and mortality: Importance to health of individual income, psychosocial environment, or material conditions. *British Medical Journal* 320: 1200-1204.
- Manton, K.G. and Soldo, B.J. (1985). Dynamics of health changes in the oldest old: New perspectives and evidence. *The Milbank Memorial Fund Quarterly, Health and Society* 63(2), Special Issue: The Oldest Old: 206-285.
- McCann, L., Buck, I., and Heggen, O. (2007). Family geographies: Montreal, Canada's metropolis. In E.W. Sager and P.A Baskerville (Eds) *Houshold Counts: Canadian Households and Families in 1901*. (pp.180-197) University of Toronto Press.
- McDonough, P., Sacker, A. and Wiggins, R.D. (2005). Time on my side? Lifecourse trajectories of poverty and health. *Social Science and Medicine* 61:1795-1808.
- Merton, R.K. (1968). The Matthew effect in science. *Science* 159: 56-63.
- Moody-Ayers, S., Lindquist, K., Sen, S. and Covinsky, K.E. (2007). Childhood social and economic well-being and health in older age. *American Journal of Epidemiology* 166(9): 1059-1067.
- Oh, H.J. (2001). An exploration of the influence of household poverty spells on mortality risk. *Journal of Marriage and the Family* 63(1): 224-234.
- O'Rand, A.M. and Hamil-Luker, J. (2005). Processes of cumulative adversity: Childhood disadvantages and increased risk of heart attack across the life course. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences* 60: S117-S124.
- Orstein, M. (2000). Analysis of household samples: The 1901 Census of Canada. *Historical Methods* 33(4): 195-198.
- Pavard, S., Gagnon, A., Desjardins, B., and Heyer, E. (2005). Mother's death and child survival: the case of early Quebec. *Journal of Biosocial Science* 37: 209-227.

- Phipps, S., and Lethbridge, L. (2006). Income and the Outcomes of Children. *Analytical Studies Branch Research Paper Series*. Statistics Canada Catalogue 11F0019MIE- no. 281.
- Preston, S.H., Hill, M.E. and Drevenstedt, G.L. (1998). Childhood conditions that predict survival to advanced ages among African-Americans. *Social Science Medicine* 46(9): 1231-1246.
- Sager, E.W. (2000). National data on working-class earnings: The 1901 Census of Canada. *Historical Methods* 33(4): 235-241.
- Sager, E.W. (2001). Introduction: The Canadian families project. *Journal of Family History* 26: 157-161.
- Sager, E.W. and Baskerville, P.A. (1997). Unemployment, living standards, and the working-class family in urban Canada in 1901. *The History of the Family* 2(3): 229-254.
- Sager, E.W. and Baskerville, P.A. (2007). *Household Counts: Canadian Households and Families in 1901*. University of Toronto Press.
- Sager, E.W. (2007). Inequality, earnings and the Canadian working class in 1901. In E.W. Sager and P.A. Baskerville (Eds) *Household Counts: Canadian Households and Families in 1901*. (pp. 328-369) University of Toronto Press.
- Sakamoto, A. (1990). Gender differentials in poverty-mortality well-being. *Sociological Perspectives* 33(4): 429-445.
- Shuey, K.M. and Willson, A.E. (2008). Cumulative disadvantage and black-white disparities in life-course health trajectories. *Research on Aging* 30(2): 200-225.
- Stone, L.F. (2000). Early-life conditions and survival to age 110 in the United States. Philadelphia: University of Pennsylvania.
- Van den Berg, G.J., Lindeboom, M. and Lopez, M. (2007). Inequality in individual mortality and economic conditions earlier in life. *IFAU Institute for Labour Market Policy Evaluation Working Paper 2007:7*.
- Willson, A.E., Shuey, K.M. and Elder, G.H. (2007). Cumulative advantage processes as mechanisms of inequality in life course health. *American Journal of Sociology* 112 (6): 1886-1924.
- Yi, Z., Gu, D. and Land, K.C. (2007). The association of childhood socio-economic conditions with healthy longevity at the oldest-old ages in China. *Demography* 44(3): 497-518.



**Appendix A:**

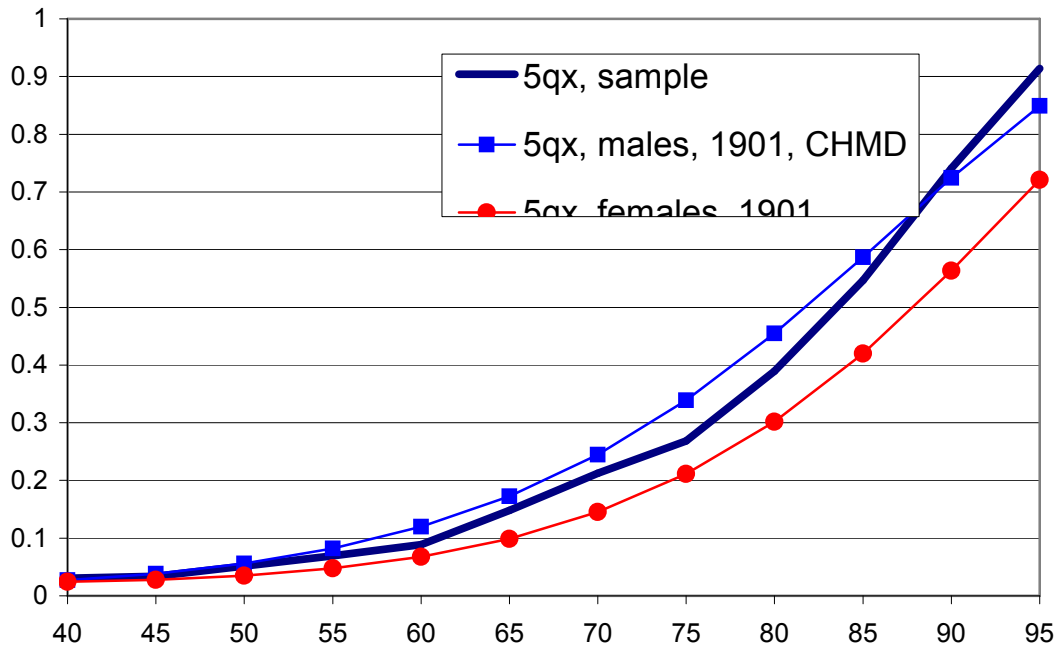
**Table 4: Variable Descriptions and Frequencies**

Variable	Purpose	Coding	N	Percent	Mean	Std.Dev	Min	Max
<i>Age at death</i>	Dependent Variable of Interest	Years	2103		73.94	13.48	40.12	106.4
<i>1901 Household Earnings Poverty Status</i>	Independent Variable of Interest	Annual Earnings <\$300 (Relative Poverty Status)	254	25.53				
		\$300>=399	204	20.5				
		Earnings \$400>=499	205	20.6				
		Earnings >=\$500	332	33.37				
		Total	995	100				
<i>Sex of the Individual</i>	Covariate	Female	1077	51.21				
		Male	1026	48.79				
		Total	2103	100				
<i>Age of the Individual in 1901</i>	Controls for the fourteen-year range of birthdates in the sample	Years	2103		5.161	3.764	0	14
<i>Urban/Rural Status of the Household in 1901</i>	Covariate	Rural	1546	74.76				
		Urban	519	25.24				
		Total	2068	100				
<i>Farmer Status of the Household Head in 1901</i>	Covariate	Not a Farmer	1162	55.25				
		Farmer	941	44.75				
		Total	2103	100				
<i>Number of Siblings Living in the 1901 Household</i>	Covariate	Number of Siblings	2103		3.418	1.951	0	9
<i>Literacy Status of the Household Head in 1901</i>	Attempts to control for the educational level of the individual's parents	Head is Illiterate	247	12.65				
		Head is Literate	1706	87.35				
		Total	1953	100				
<i>Age of the Household Head in 1901</i>	Covariate	Years	2103		35.37	6.331	21	73

## Appendix B : Life Table Comparison

The risk of death ( $q_x$ ) of sampled individuals born in 1895 was followed from age forty to the extinction of the sampled cohort. The resulting life table produced a life expectancy at age-forty ( $e_{40}$ ) of 33.28 years, which is remarkably similar to the  $e_{40}$  estimate of 33.19 years provided by the Canadian Human Mortality Database for the 1895 Quebec cohort (Canadian Human Mortality Database, 2008). Thus, it can be assumed that the sampling procedure used to create this database of individuals has been conducted in a way that it is highly generalizable to its target population of individuals residing as children in the province of Quebec in 1901.

**Figure 1: Risk of Death at Age X, Sample and Canadian Human Mortality Database Estimates, 1891-1901**



### Appendix C

<b>Heckman Selection Model in Stata</b>				
Instrumental variable = urban status of the household in 1901				
	Coef.	Std. Err.	z	P> z
Age at Death				
Sex	-2.142	1.082	-1.980	0.048*
Head is Farmer	1.208	1.106	1.090	0.275
Head is Literate	-0.110	2.100	-0.050	0.958
No. Siblings	0.133	0.244	0.550	0.585
Age	0.209	0.116	1.810	0.071
cons	72.081	10.997	6.550	0.000
select				
Sex	-0.088	0.040	-2.210	0.027*
<b>Urban Status</b>	0.138	0.053	2.620	<b>0.009**</b>
Head is Farmer	0.150	0.046	3.290	0.001*
Head is Literate	0.206	0.056	3.670	<0.001***
No. Siblings	0.015	0.011	1.440	0.151
Age	-0.001	0.001	-1.100	0.272
cons	-0.182	0.077	-2.360	0.018*
mills				
lambda	-3.118	12.471	-0.250	0.803
rho	-0.167			
sigma	18.632			
lambda	-3.118	12.471		

<b>Test of Proportional Hazards Assumption</b>				
Variable	Rho	chi2	df	Prob>chi2
Poverty Status	0.05	2.23	1	0.135
Sex	0.05	2.36	1	0.124
Urban Status	0.026	0.67	1	0.415
Head is Farmer	0.055	2.7	1	0.1
Head is Literate	-0.036	1.17	1	0.28
Age	0.033	1.01	1	0.314
No. Siblings	0.009	0.09	1	0.767
Global Test		11.99	7	0.1007