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Pierre-Carl Michaud, Kevin Milligan, Tammy Schirle

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Life Expectancy of Couples in Canada

MARWA ALFAKHRI
RAND Corporation, Santa Monica, California, United States

JANICE COMPTON
Department of Economics, University of Manitoba, Winnipeg, Manitoba, Canada

Si l'on trouve facilement des estimations de l'espérance de vie individuelle, ce n'est pas le cas des estimations pour le couple. L'absence de ces estimations peut être préjudiciable aux couples qui prennent ensemble des décisions importantes concernant notamment la retraite, l'épargne et d'autres considérations qui viennent avec l'âge. De plus, l'utilisation des mesures disponibles pour les individus peut conduire à des erreurs, car cela produit une surestimation du nombre d'années que le couple peut s'attendre à vivre ensemble (espérance de vie commune) et une sous-estimation du nombre d'années que la personne veuve peut s'attendre à survivre à son conjoint ou à sa conjointe (espérance de vie du conjoint survivant ou de la conjointe survivante). Dans cet article, nous utilisons les données de la Banque de données administratives longitudinales pour fournir des estimations de référence quant à l'espérance de vie commune et à l'espérance de vie du conjoint survivant ou de la conjointe survivante des couples canadiens, et montrer que ces estimations varient selon le revenu et la situation d'emploi des couples qui approchent de la retraite.

Mots clés : espérance de vie, mortalité, mariage, longévité

Although individual estimates of life expectancy are readily available, analogous couple-based estimates are not. The dearth of such estimates can be detrimental for couples undertaking important decisions together, such as retirement, savings, and other later-life considerations. Moreover, relying on available individual measures can be misleading because it results in overestimating the number of years the couple should expect to live together (joint life expectancy) and underestimating the number of years the widowed spouse expects to live (survivor life expectancy). In this article, we use data from the Longitudinal Administrative Database to provide benchmark estimates for joint and survivor life expectancy for Canadian couples and show how these estimates vary with the income and employment status of couples approaching retirement.

Keywords: life expectancy, mortality, marriage, longevity

Introduction

As individuals age, expectations of longevity become increasingly important to decisions regarding savings, health behaviours, pension take-up, long-term-care plans, and residential location. Many individuals face these decisions as part of a couple, so these decisions are influenced not only by their individual life expectancies but also by their joint life expectancy (expected number of years that they will both be alive) and survivor life expectancy (number of years each spouse may expect to live as a widow or widower). Although benchmark information on individual life expectancies in Canada is well researched (see, e.g., Baker, Currie, and Schwandt 2019; Etches 2009; Milligan and Schirle 2021) and easily determined with online calculators, there is a dearth of available information on couple-based summary mortality measures. This lack of information could be detrimental to couples planning for their advanced years. As we illustrate, if couples naively use individual life expectancies when making decisions and do not incorporate their

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overlapping mortality distributions, they will overestimate their expected number of years together and underestimate the time the surviving spouse lives as a widow or widower. In this article, we provide benchmark figures for joint and survivor life expectancy for Canadian opposite-sex couples and estimate the variations in these calculations by couple's income and employment.

Although calculations of joint and survivor life expectancy have long been understood and used in actuarial science (Carriere 2000; Frees, Carriere, and Valdez 1996; Sanders and Melenberg 2016), they are not carefully considered in other disciplines or easily accessible. Economists have focused on annual mortality rates when conceptualizing decisions surrounding retirement, pensions, and annuities (Brown 2001; De Nardi, French, and Jones 2009; Mitchell et al. 1999; Van der Klaauw and Wolpin 2008). Mortality rates are essential for calculating individual life expectancies; however, they are not intuitive for long-term planning and decision making. Without an understanding of the joint and survivor life expectancies, couples may erroneously use individual life expectancies to infer couple mortality and inform decisions.

Consider an older Canadian couple approaching retirement age, with both the wife and the husband aged 65 years. Suppose in the year that this couple turns 65, the Statistics Canada life tables indicate that the life expectancy for women aged 65 is 19.8 years and the life expectancy for men aged 65 is 15.7 years.[1] Suppose even that the couple understands that married individuals live longer than the average population on which the Statistics Canada life tables are based and that the Statistics Canada life expectancy figures are based on period mortality rates and therefore do not account for improvements in health as people age. More accurate cohort life expectancy measures for married women and married men aged 65 years are 21.4 years and 16.8 years, respectively. Without further information, this couple may use these figures as benchmarks and naively assume that, on average, they should expect to live for 16.8 years together (the minimum of the two life expectancies), the husband dies first, and the wife lives for approximately 4.4 years after her husband's death. Even if the couple uses these naïve figures only as benchmarks and considers the distribution around these means, they will overestimate average joint life expectancy and underestimate average survivor life expectancy. In fact, our analysis shows that for the same couple, the average number of years that they will both be alive (joint life expectancy) is 14.1 years, and the husband predeceases his wife only 66% of the time. If the wife is the surviving spouse, she lives for 11.6 years on average after her husband's death, and if the husband outlives the wife, he lives for an additional 8.3 years after his wife dies.

This article builds on existing work in the literature that estimates couple-based mortality measures (Compton and Pollak 2021; Goldman and Lord 1983; Sanders, Compton, and Pollak 2021). To our knowledge, this work is the first to provide such estimates for the Canadian context. Wolfson et al. (1993) examine the income mortality connection in Canada using Canadian pension data but focus only on men. Mustard et al. (2013) use the 1991 census data linked to mortality data to determine the impact of unemployment on mortality. Their focus is on men and women separately. Baker et al. (2019) focus on mortality differences across geographies, and Ahmadi and Brown (2018) are concerned with the links between mortality and employment information. Finally, Milligan and Schirle (2021) calculate cohort mortality rates and life expectancies for men and women over multiple decades. They use administrative records from the Canada Pension Plan and highlight both the link between income and mortality in Canada and the important distinction between period and cohort measures of mortality. Again, their focus is on the individual calculations.

In this article, we use data from the Longitudinal Administrative Database (LAD) and Gompertz regression analysis to estimate life expectancies for married individuals. We combine these estimates to calculate joint and survivor life expectancies for couples. Our calculations highlight that estimates of joint and survivor life expectancies cannot be inferred from individual life expectancy measures and must instead be derived directly from age-specific mortality rates. The calculation of these mortality rates will differ depending on data availability, and the specific figures that are calculated should be interpreted as benchmarks rather than accurate estimates.

We also consider the impact of couple-based income measures, employment, and share of income on joint and survivor life expectancy. Consistent with previous literature that shows a positive correlation between income and life expectancy (Milligan and Schirle 2021; Wolfson et al. 1993), we find that joint life expectancy is positively related to the income quintile of married men and women. Joint life expectancy is higher when the husband is the primary earner, higher if the husband is working, and even higher if both spouses are working (at age 65 y). Men's mortality rates decline more rapidly with income than do women's. As a result, as income quintile increases, men's survivor life expectancy increases and women's declines. A wife's expected years of widowhood are increased if her spouse is not working or contributing little income at age 65 years.

Our focus in this article is on the mean indicator (life expectancy) rather than the distribution of mortality. For joint and survivor life expectancies, the distribution is more sensitive to the data and methodology used than are the means (Compton and Pollak 2021).

Although this work is primarily descriptive in approach, it offers important policy implications. Most Canadians entering retirement age are married or in common-law unions.[2] As these couples approach decisions concerning savings, retirement, and pensions, it is necessary to have better benchmarks in place to understand their mortality probabilities. In the following section, we discuss the difficulties in calculating joint and survivor life expectancy estimates. Nonetheless, the estimates that can be calculated—although not perfect—are a step forward.

Data Availability and the Calculation of Joint and Survivor Life Expectancy

The appropriate method to calculate life expectancies is largely determined by data availability. With longitudinal data, one is able to calculate individual life expectancy as the mean age of death for a particular cohort. With longitudinal data that follows both spouses till their deaths, one could similarly calculate couple life expectancy as the mean age of "couple death"—that is, when the first spouse dies. Survivor life expectancy could be calculated in a similar manner, as the mean number of years lived after the death of a spouse. Such calculations are straightforward and do not require parametric assumptions; however, the required length of a panel to allow for this type of calculation is rarely available. In the absence of a long panel, it is necessary to estimate life expectancies using age-specific mortality rates as building blocks.

The most common age-specific mortality rates are period (cross-section) mortality rates calculated at each age—that is, the probability in a particular year that an individual aged t dies before reaching age $t + 1$. For example, the Statistics Canada Life Tables provide period mortality rates (Statistics Canada 2022). Compton and Pollak (2021) and Goldman and Lord (1983) use annual age-specific mortality rates for men and women to calculate joint and survivor life expectancies. Calculating life expectancies from annual mortality rates allows researchers to use the most current annual mortality information to predict longevity. Define $QH(t)$ as the probability that a man aged t will die before reaching age $t + 1$ and $QW(t)$ similarly for women.[3] The mortality rates of men and women are combined to construct a life table for couples, where for each age t, the probability that the couple dies, $QC(t)$, is the probability that at least either the husband, $QH(t)$, or wife, $QW(t)$, dies at that age:

$$QC(t)=QH(t)QW(t)+(QW(t)[1-QH(t)]+QH(t)[1-QW(t)]) \quad (1)$$

With these couple mortality rates, the life expectancy of the couple (joint life expectancy) is calculated with the standard methodology, as outlined in Appendix A. Survivor life expectancy for the wife is defined as the weighted average of her individual life expectancy at each age, where the weight is the probability that she is widowed at that age, conditional on her being the spouse who is widowed. The same is calculated for the husband.[4] When joint and survivor life expectancies are calculated in this manner, that is, from the Statistics Canada Life Tables of men and women, they are the period couple life expectancies that would arise if all men and all women were randomly matched into couples. We refer to these measures as *synthetic couple life expectancies.* Although these are easily accessible calculations, there are three major disadvantages in using these period life tables for calculating joint and survivor life expectancies.

First, incorporating period mortality rates in the calculation of life expectancy assumes that age-specific mortality rates remain stable over time (see Milligan and Schirle 2021 for a comparison of period and cohort life expectancies in the Canadian context). Second, the life table estimates are average rates across all men and women of a particular age. Annual mortality rates differ by marital status (married individuals have lower annual mortality rates than unmarried individuals); thus, using the population life tables will underestimate the life expectancies for couples.[5] Third, using life tables of men and women to calculate joint life expectancy requires the assumption that spouses' mortalities are not correlated. It is unlikely that the mortality rates of husbands and wives are independent, as a result of assortative matching, shared environments, and shared behaviours.

Addressing the first two of these issues requires cohort (longitudinal) data that follow individuals and allow the calculation of age-specific mortality rates for a particular birth cohort. If the panel is not sufficiently long to capture the mortality rates over time of all individuals, the mortality rates of missing older ages are typically estimated using a Gompertz regression, which assumes a log-linear relationship between age and mortality (Gompertz 1825). The following baseline hazard rates without covariates are the mortality rates of men ($QH_0[t]$) and women ($QW_0[t]$) for each age t:

$$QH_0(t)=\exp(\gamma t)$$

$$QW_0(t)=\exp(\gamma t), \quad (2)$$

where γ is an ancillary parameter estimated from the data that determines the shape of the hazard. These estimated mortality (i.e., hazard) rates for married men and married women are then combined as outlined in Eq. (1). This allows us to calculate the cohort joint and survivor life expectancies of synthetic couples from samples of individuals rather than calculating the joint and survivor life expectancies of observed couples, which is less data intensive. However, this method requires the assumption of no correlation in mortality of spouses.

Incorporating the correlation in mortality of couples into the calculation of cohort joint and survivor life expectancies requires longitudinal data that follow both spouses. With information on couples and age of death for spouses, we can determine the age at which the couple dies (i.e., when the first spouse dies) and calculate couple mortality rates for the couples directly. The life expectancy measures are then calculated using the standard methodology.

Longitudinal Administrative Database

The data requirements for accurate calculation of joint and survivor life expectancy are demanding. In the Canadian context, the most promising data for such calculations is the LAD. The LAD is a 20 percent random sample of Canadian T1 tax filers. Although the LAD is not a representative sample of the Canadian population, the coverage for those aged older than 60 years is above 90 percent.[6] Etches (2009) provides an excellent summary of the coverage of LAD compared with the Statistics Canada mortality rates. He notes that there is a marked convergence in the mortality rates after retirement, likely because of both decreased T1 filing for those living and increased filing at estate closure. Moreover, he notes that the mortality rates in the LAD also converge with the Statistics Canada numbers over time, especially for those aged older than 70 years.

We create samples of individuals who turn ages $a = 60$, 65, 70, and 75 between 1987 and 2001. Once entering the sample, individuals are followed in all subsequent years until they exit the sample through death or attrition or are alive and censored in 2018. Many records have gaps in coverage and then are picked up again in the year of death, but because we are only concerned with the initial point and the year of death, these gaps are irrelevant. Attrition therefore only occurs when the gap in coverage is censored in 2018. For these observations, we are unable to identify whether they were alive in 2018, died earlier but the death was not captured in the T1 files, or exited the population through emigration. The completeness of the data in terms of mortality is dependent on the age and year the individual entered the sample. To ensure that we observe sufficient deaths for each sample, we include only those birth cohorts for which at least half of the observations have known death years. Appendix B shows the birth cohorts that are included in each age sample analysis, and Appendix C provides the proportions of each sample that exit the data through death, attrition, or censoring in 2018.

The main disadvantage of the LAD is that demographic information is limited to that which is collected on tax files—age, family status, and geography.[7] Unfortunately, the LAD does not include information on occupation, education, health status, and non-resident children, all of which are likely to be correlated with mortality. Hence, we are able to include mortality estimates by marital status, income, and employment and do so in the following section.[8]

We begin with the life expectancy calculations without controls. Table 1 presents a comparison of individual, joint, and survivor life expectancy measures at age 65 years using different samples. As we move through the five estimates, the data requirements increase. The first row in each category uses Statistics Canada period life tables for all men and all women, averaged over 1987–1996.[9] The next three rows use Gompertz projected mortality rates (without covariates) estimated on LAD samples that include (a) the full sample of men or women, (b) the sample of married men or women, and (c) the sample of men or women who are married to spouses of the same age.[10] The mortality rates for these samples of men and women are combined to calculate the joint and survivor life expectancies of synthetic couples. Finally, we present the calculations for the sample of couples in the data, that is, for the cases in which both spouses in a couple are randomly selected to be included in the LAD (i.e., actual couples).[11]

The calculations for individual life expectancies using the readily available Statistics Canada period mortality rates are approximately 0.7–1.0 years shorter than those using LAD cohort rates covering the full sample of individuals. This difference reflects two properties of the data: first, the period life tables assume stability in age-specific mortality over time; second, the LAD may overestimate full population life expectancy if the sample of tax filers is healthier on average than those who do not file taxes. Using the LAD sample of married individuals increases individual and joint life expectancy, reflecting the lower mortality (higher life expectancy) of married individuals.[12] These life expectancies change only slightly when we further restrict the sample of married individuals to those with spouses of the same age.

The results for actual couples observed in the data are higher than the synthetic couple estimations; however, we believe that these are less reliable measures for two reasons. First, although the use of Gompertz projections for individual mortality rates has been well established, this is not the case for joint mortality rates, casting doubt on the projections of the joint mortality rates. Second, the representability of the LAD to the Canadian population is less likely for couples—where both spouses are randomly chosen to be included in the dataset—than for individuals. In particular, inclusion of the couple in our dataset requires that both spouses file taxes for the year they turn 65. We show in the next section that the employment status and contribution to household income of one's spouse is correlated with own life expectancy, especially for men. Thus, it is probable that whether one's spouse files a tax form is also correlated with the mortality of married individuals.

Table 1: Comparison of Average Life Expectancies of Individuals and Couples Reaching Age 65 Years in the Period 1987–1996

Estimate	2.50%	Mean	97.50%
Her life expectancy			
Statistics Canada Life Tables		19.80	
LAD: all women aged 65 y	20.44	20.49	20.52
LAD: married women aged 65 y	21.10	21.14	21.19
LAD: women aged 65, married to men aged 65 y	21.25	21.40	21.55
LAD: actual couples	21.50	22.00	22.50
His life expectancy			
Statistics Canada Life Tables		15.70	
LAD: all men aged 65 y	16.68	16.72	16.78
LAD: married men aged 65 y	17.07	17.12	17.17
LAD: men aged 65, married to women aged 65 y	16.68	16.81	16.97
LAD: actual couples	17.50	17.80	18.20
Joint life expectancy			
Statistics Canada Life Tables		12.50	
LAD: synthetic couples (all)	13.65	13.68	13.73
LAD: synthetic couples (married)	14.20	14.24	14.28
LAD: synthetic couples (married, same age)	14.00	14.13	14.27
LAD: actual couples	14.60	14.90	15.10
Her survivor life expectancy			
Statistics Canada Life Tables		11.90	
LAD: synthetic couples (all)	11.27	11.30	11.33
LAD: synthetic couples (married)	11.27	11.30	11.35
LAD: synthetic couples (married, same age)	11.40	11.56	11.67
LAD: actual couples	11.20	11.70	12.30
His survivor life expectancy			
Statistics Canada Life Tables		9.00	
LAD: synthetic couples (all)	8.62	8.64	8.67
LAD: synthetic couples (married)	8.43	8.46	8.49
LAD: synthetic couples (married, same age)	8.19	8.33	8.43
LAD: Actual Couples	8.30	8.70	9.20
Probability he dies first			
Statistics Canada Life Tables		0.600	
LAD: synthetic couples (all)	0.634	0.632	0.630
LAD: synthetic couples (married)	0.645	0.642	0.640
LAD: synthetic couples (married, same age)	0.668	0.661	0.653
LAD: actual couples	0.620	0.640	0.660

Notes: Confidence intervals are determined from 100 bootstrapped samples of men and women and reflect the 95% confidence interval around the mean values across bootstraps. LAD = Longitudinal Administrative Database.

Sources: Authors' calculations from Statistics Canada Table 13-10-0114-01, LAD 1987–2018.

For this reason, we move away from the calculations for actual couples and focus on the calculation of joint and survivor life expectancies derived from the combination of mortality rates for married individuals. However, the use of synthetic couples imposes the assumption of no correlation in the mortality of spouses, which limits our ability to discuss the distribution of mortality. Figure 1 shows the predicted status of couples (both alive, both deceased, only wife alive, only husband alive) for those entering the sample at age 65 years. Solid lines are estimations based on the Gompertz regressions of bootstrapped samples of married men and married women. The dotted lines are the calculations from the actual couples observed in the data.[13] Actual couples are more likely to both be alive, and more likely to both be deceased, relative to the predicted paths, indicating a correlation in mortality of couples.

Overall, although the distribution of mortality differs, the life expectancies (means of the survival distributions) are sufficiently close to justify the use of the larger dataset of married individuals and synthetic couples to calculate the summary measures of joint and survivor life expectancies. Moreover, the larger sample size for the sample of married individuals allows us to better explore the differences in joint and survivor life expectancies across subgroups. It is impossible to say which of the measures in Table 1 is "correct." These are summary measures over a wide distribution and can be calculated with numerous methodologies. We are less concerned about the calculation of one particular statistic but are instead seeking to highlight the relationships between the individual and joint statistics.

Table 2 presents the individual, joint, and survivor life expectancies for the samples of married individuals with spouses of the same age, without controls. Joint life expectancy is two to three years lower than husband's life expectancy, again highlighting that a naïve interpretation that uses individual life expectancies to predict joint life expectancy will overestimate the number of years the couple is alive together. Survival life expectancy falls at a relatively slow rate across the ages, with a decline of approximately one year for each five-year increase. For a married woman aged 75 years, the expected age at which she will become widowed is close to her current age, so that the expected average number of years spent in widowhood (8.7 y) is relatively close to their own life expectancy (13.3 y). In contrast, for a married woman aged 60 years, the expected age at which she will become widowed is far from her current age, so that the expected average number of years spent in widowhood (12.7 y) is relatively far from her own life expectancy (25.9 y).

In the following sections, we expand on these estimates of life expectancy to include controls for income and work. We then use these regression estimates to

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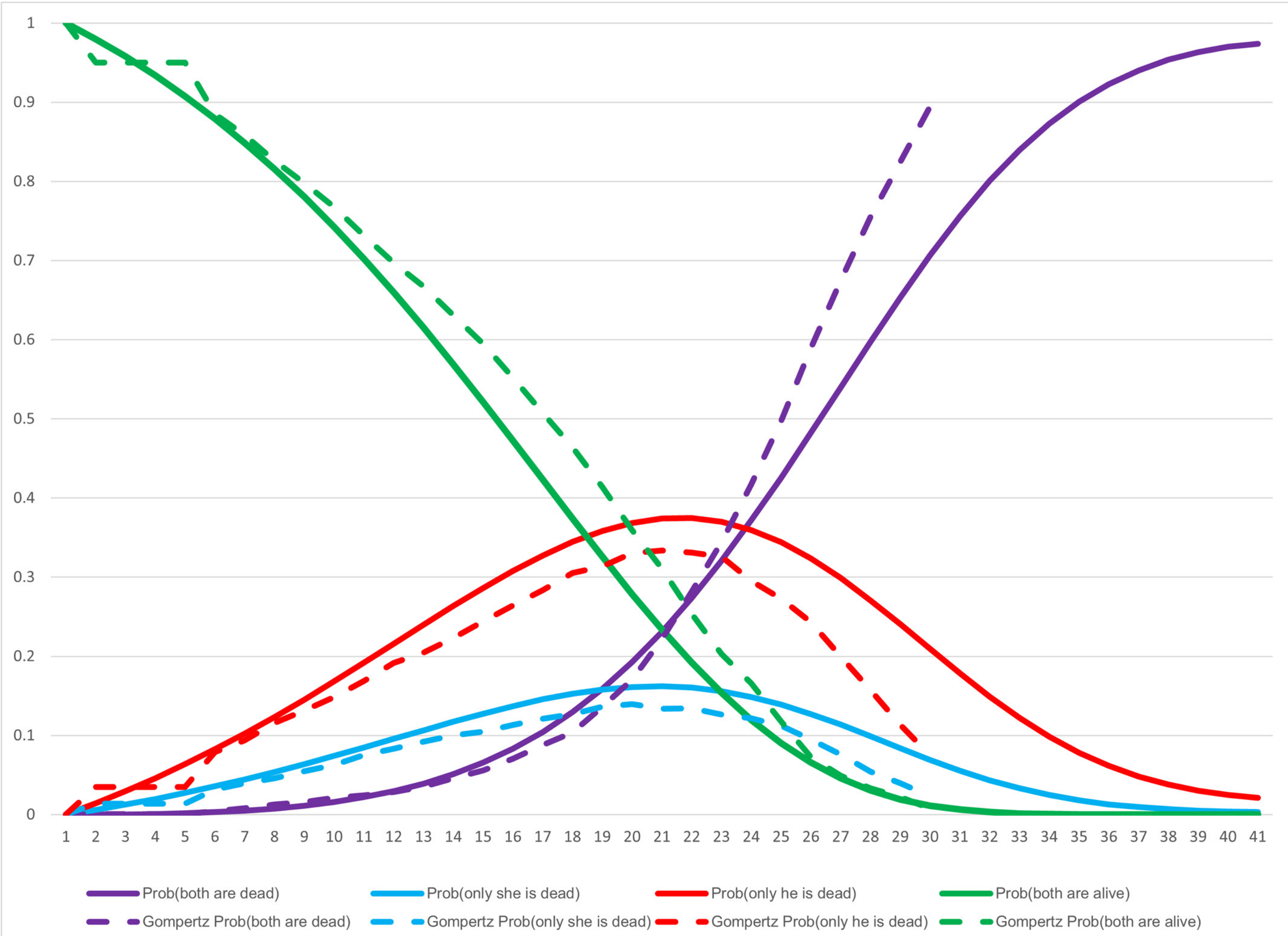

Figure 1: Comparing Distribution of Couple Death, Estimated versus Actual

Notes: Solid lines show the mortality probabilities for estimated couples, based on married men and women aged 65 years married to a spouse aged 65 years. Dotted lines show the smoothed observed mortality categories for actual couples observed from age 65 onward.

Source: Authors' calculations from the Longitudinal Administrative Database, 1987–2018.

Table 2: Comparing Life Expectancies at Different Ages, Synthetic Couples of the Same Age

Life Expectancy Estimates	Aged 60 y			Aged 65 y			Aged 70 y			Aged 75 y		
	2.50%	Mean	97.50%	2.50%	Mean	97.50%	2.50%	Mean	97.50%	2.50%	Mean	97.50%
Her LE	25.62	25.90	26.12	21.25	21.40	21.55	17.10	17.19	17.32	13.21	13.33	13.43
His LE	20.83	21.00	21.26	16.68	16.81	16.97	13.16	13.26	13.36	9.90	9.98	10.06
Joint LE	17.81	17.98	18.21	14.00	14.13	14.27	10.80	10.88	10.95	7.87	7.94	8.00
Her survivor LE	12.47	12.67	12.89	11.40	11.56	11.67	10.01	10.12	10.21	8.59	8.68	8.77
His survivor LE	9.08	9.22	9.45	8.19	8.33	8.43	7.26	7.31	7.39	6.18	6.24	6.31
Probability she dies first	0.33	0.34	0.35	0.33	0.34	0.35	0.34	0.34	0.35	0.34	0.34	0.35
No. of observations												
Men		113,705			79,190			52,845			13,2035	
Women		68,220			58,360			46,020			104375	

Notes: Confidence intervals are determined from 100 bootstrapped samples of men and women and reflect the 95 percent confidence interval around the mean values across bootstraps. LE = life expectancy.
Sources: Authors' calculations from the Longitudinal Administrative Database, 1987–2018.

calculate joint and survivor life expectancies for different income and work characteristics.

Correlation of Income, Work, and Mortality

We expand the Gompertz estimation on the samples of married individuals to incorporate a select number of characteristics, which are captured in the initial year observed. The proportional hazard regression Eq. (2) is expanded to include coefficients:

$$QH(t) = exp(\boldsymbol{X}_i \beta)\, exp(\gamma t)$$

$$QW(t) = exp(\boldsymbol{X}_i \beta)\; exp(\gamma t) \quad (3)$$

where $exp(\gamma t)$ is the baseline hazard noted earlier and $\boldsymbol{X}i$ is a vector of couple characteristics that shift the hazard at each age and includes quintile of income, proportion of income earned by each spouse, work status, birth cohort, and province. Spouses' age gap is included in categories. Income quintile is calculated over the sample of all couples of the same age and year, using the average total income the couple received in the previous five years.[14] To determine whether relative income is important for mortality, we use the same five-year average to determine the proportion of total income attributed to the wife. Finally, we create a categorical variable to note which of the spouses is employed (non-zero employment income) in the current year (neither, only wife, only husband, or both). Incorporating these variables into the analysis allows us to determine whether spouses' characteristics affect the mortality of married individuals.

We do not include the death of one's spouse or any marital transitions (divorce or remarriage). Our aim is to project life expectancy at age *t*, based on information available at age *t*. Moreover, as a result of the large number of gaps in individual records between entry into the sample and year of death (years in which T1 forms were not filed), these transitions will not be complete.

Regression Results

Focusing on the samples of married men and women, we restrict the sample to those individuals who self-report as married in the year in which they entered the sample (the year they turned age a = 60, 65, 70, 75). With these individual mortalities, we are able to calculate constructed joint and survivor life expectancies for synthetic couples, under the assumption of no correlation in mortality across spouses. The large sample size allows us to include numerous controls in the regression analysis. Summary statistics for this sample are presented in Table 3.

Table 4 presents the Gompertz regression coefficients for the samples of married men and married women aged 65 years. All regressions include controls for province of residence and birth cohort. The coefficients on age gap indicate that the mortality rate for men increases almost monotonically with wife's age. Consistent with previous literature (Drefahl 2010; Fox, Bulusu, and Kinlen 1979; Klinger-Vartabedian and Wispe 1989), we find that men with younger wives live longer and men with older wives die earlier. For women, the relationship is more U-shaped, with mortality higher if the age gap is large in either direction. Note that we are not estimating a causal relationship, and it is likely that the age gap between spouses is related to unobserved characteristics such as the age at first marriage, whether the individual has been married previously, age of children, and so forth.

Mortality rates are negatively correlated with couple income quintile, but notable here is that the slope is steeper for married men than for married women. This difference will have an impact on joint and survivor life expectancies. Men who contribute less than half of the household income have higher mortality rates than those who contribute more than half, and women's mortality rates decline with their proportion of household income. This result is potentially related to health status—men who are aged 65 years and are contributing less than one-quarter of the household income are more likely to be in poor health than those contributing more. However, health status is unobserved. Finally, we control for which of the spouses is earning positive employment income. For both men and women aged 65 years, being employed is associated with a lower mortality rate. For women, there is no impact of spouse's employment (mortality is similar if only she or both are working or if neither or only he is working). In contrast, husband's mortality is higher when only the wife is working, compared with neither working. The results for other ages (60, 70, 75) are available as Online Appendix A. The steepness of the relationship between income quintile and mortality is higher for those aged 60 years and weaker for those aged 70 and 75 years. Controlling for income quintile, non-zero employment income continues to have a negative relationship with mortality at all ages.

Overall, the regressions results indicate that spousal characteristics are more correlated with mortality for men than for women. One is cautioned not to attribute causality to these correlations. For example, we find that mortality is lower among couples in which both spouses work, relative to neither working. This does not imply that a couple may lower their mortality by continuing to work. It is likely that these employment and income characteristics are associated with health status and education and that the causality may work in the opposite direction.

Joint and Survivor Life Expectancy of Couples

The regressions presented in Table 4 are used to calculate life tables and life expectancies for couples. The mortality rates are calculated for couples of the same age

Table 3: Summary Statistics, Married Sample

	Married Women, %				Married Men, %			
Variable	Age 60 y	Age 65 y	Age 70 y	Age 75 y	Age 60 y	Age 65 y	Age 70 y	Age 75 y
Sample size	253,795	471,005	607,140	369,500	433,970	804,185	1,004,540	694,585
Spouses' age gap								
Spouse >7 y younger	1.4	1.8	2.2	3.0	15.6	16.6	17.7	20.1
Spouse 4 –7 y younger	3.8	4.7	5.6	6.9	26.7	27.0	28.0	29.3
Spouse 2–3 y younger	6.6	7.4	7.9	9.0	21.5	21.0	20.8	19.9
Spouse within 2 y	27.9	28.8	28.8	29.7	25.4	24.5	23.3	21.4
Spouse 2–3 y older	22.5	21.8	21.3	20.3	5.8	6.0	5.6	5.3
Spouse 4–7 y older	25.8	24.2	23.9	22.5	3.8	3.8	3.6	3.2
Spouse >7 y older	11.9	11.3	10.4	8.5	1.3	1.2	1.0	0.8
Income quintile								
First (lowest)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Second	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Third	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Fourth	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Fifth (highest)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Proportion of couple income from wife								
0–0.25	36.6	40.4	24.2	19.5	58.0	56.7	49.2	41.4
0.25–0.50	41.1	40.5	57.6	62.0	30.2	29.9	39.3	47.9
0.50–0.75	15.8	14.6	15.3	16.0	9.6	11.0	10.2	9.7
0.75–1.00	6.6	4.5	2.9	2.5	2.2	2.5	1.2	1.0
Spouses with positive earnings income								
Neither spouse	20.9	52.3	72.9	80.9	13.4	40.7	67.8	78.7
Only wife	17.4	12.1	4.5	2.5	6.0	10.3	8.3	4.5
Only husband	19.1	19.4	16.1	12.9	39.1	28.7	15.8	12.6
Both	42.6	16.2	6.5	3.7	41.5	20.3	8.2	4.2
Year entered sample								
1987–1991	100.0	43.9	22.9	20.1	100.0	47.3	28.1	27.1
1992–1996	0.0	56.1	33.2	31.7	0.0	52.7	34.1	33.1
1997–2001	0.0	0.0	43.9	48.2	0.0	0.0	37.8	39.9

Source: Authors' calculations from the Longitudinal Administrative Database, 1987–2001.

(age gap = 0) and combined to determine the joint and survivor life expectancies.

In Figures 2 and 3, we present the estimates for joint and survivor life expectancies for the different subgroups of couples aged 65 years.[15] The first bar in Figure 2 is the calculated joint life expectancy for all couples aged 65 years without controls.[16] Because the mortality of both married men and married women declines with income, we have a monotonically increasing joint life expectancy across income quintiles. Joint life expectancy is higher for couples in which the husband is the primary contributor of income but not the sole contributor and lowest for couples where the wife is contributing more than 75 percent of the household income. Joint life expectancy is highest for those couples in which both spouses work and lowest for couples in which neither are working.

The first bars in Figure 3 show the no-control survivor life expectancies—11.6 years for wives and 8.3 years for husbands. The probability that the wife will be predeceased by her husband is 0.67. As we move from the lowest to the third income quintile, her survivor life expectancy falls, his increases, and the probability that he is the surviving spouse increases. The figures level out between the third and fifth quintile. This pattern is due to the steeper relationship between income quintile and male mortality.

There is a substantial increase in survivor life expectancy when the wife is contributing more than 75 percent of the household income. This situation is correlated with a higher mortality for the husband and a lower mortality for the wife. The survivor life expectancies by work status again reflect the positive impact that work has on one's own mortality.

Table 4: Gompertz Regression: Mortality of Married Men and Women Aged 65 y

	Married Men Aged 65 y		Married Women Aged 65 y	
Estimate	(A)	(B)	(C)	(D)
γ	1.108***	1.108***	1.135***	1.135***
	(0.000315)	(0.000315)	(0.000500)	(0.000500)
Spouses' age gap (ref.: ≤2 y)				
Spouse >7 y younger	0.928***	0.927***	1.146***	1.154***
	(0.00593)	(0.00607)	(0.0251)	(0.0255)
Spouse 4–7 y younger	0.923***	0.922***	1.051***	1.055***
	(0.00514)	(0.00518)	(0.0151)	(0.0152)
Spouse 2–3 y younger	0.963***	0.962***	1.021*	1.022*
	(0.00569)	(0.00569)	(0.0122)	(0.0122)
Spouse 2–3 y older	1.036***	1.037***	1.010	1.006
	(0.00932)	(0.00934)	(0.00837)	(0.00838)
Spouse 4–7 y older	1.105***	1.105***	1.009	1.004
	(0.0120)	(0.0121)	(0.00815)	(0.00818)
Spouse >7 y older	1.193***	1.192***	1.024**	1.018*
	(0.0218)	(0.0218)	(0.0105)	(0.0105)
Couple income quintile (ref.: lowest)				
Second	0.944***	0.948***	0.984*	0.994
	(0.00587)	(0.00592)	(0.00895)	(0.00904)
Third	0.879***	0.886***	0.920***	0.934***
	(0.00552)	(0.00561)	(0.00848)	(0.00863)
Fourth	0.827***	0.837***	0.900***	0.919***
	(0.00527)	(0.00543)	(0.00839)	(0.00862)
Fifth (highest)	0.706***	0.725***	0.809***	0.838***
	(0.00462)	(0.00495)	(0.00772)	(0.00825)
Proportion of couple income from wife (ref.: 0–0.25)				
0.25–0.50	0.999		0.964***	
	(0.00570)		(0.00711)	
0.50–0.75	1.100***		0.943***	
	(0.00974)		(0.0108)	
0.75–1.00	1.154***		0.879***	
	(0.0210)		(0.0178)	
Spouses with positive earnings income (ref.: neither)				
Only wife		1.093***		0.891***
		(0.00787)		(0.00844)
Only husband		0.892***		1.003
		(0.00441)		(0.00811)
Both		0.909***		0.887***
		(0.00543)		(0.00796)
No. of observations	243,765	243,765	151,060	151,060

Note: ref. = reference group.
*$p < 0.1$; **$p < 0.05$; ***$p < 0.01$.
Source: Authors' estimates from the Longitudinal Administrative Database, 1987–2001.

Conclusion

In this article, we provide benchmark estimates for joint and survivor life expectancies of couples in Canada. Although these calculations are important for older couples facing retirement, savings, and long-term-care decisions, the data are not readily available. In contrast, individual calculators of life expectancy abound. If couples naively use the individual measures to infer their joint and survivor life expectancies, they will overestimate the number of years they can expect to be alive together

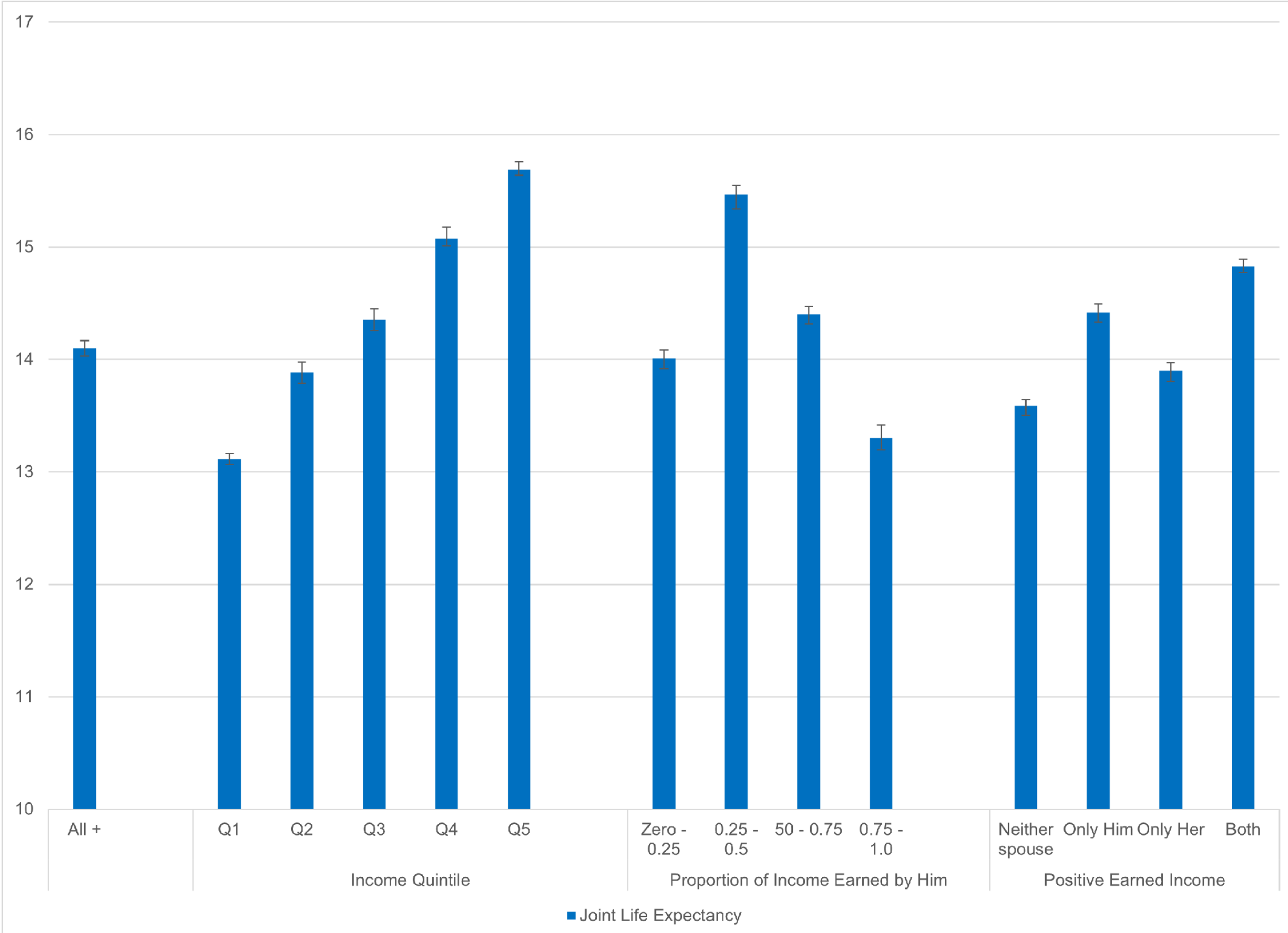

Figure 2: Joint Life Expectancy of Synthetic Couples, Both Spouses Aged 65 y

Note: Calculations are based on regressions from Table 4. Confidence intervals are determined from 100 bootstrapped samples of men and women and reflect the 95 percent confidence interval around the mean values across bootstraps.

Source: Authors' calculations from the Longitudinal Administrative Database, 1987–2018.

and greatly underestimate the number of years they can expect to live after the death of their spouse. The underestimation of length of widowhood may lead to savings rates that are lower than would occur with better information, potentially contributing to higher rates of poverty among widows.

As with individual life expectancies, the joint and survivor calculations are mean values of a wide distribution. Couples' private information about their own health status and behaviours will allow them to estimate whether their joint longevity probabilities are higher or lower than the average, but to do so requires an understanding of the average. Policy-makers should consider expanding the online life expectancy calculators to include calculations of joint and survivor life expectancies.

Although the estimates in this article only provide benchmark figures for a select group of couples, the aim is to provide a cautionary tale about naively using individual life expectancies when considering the overlapping mortality distributions for couples. This article is therefore only an initial step in outlining patterns of joint and survival life expectancy in Canada. More precise calculations that consider health status and marital transitions will refine the estimates. Information on the distribution will allow couples to better understand the likelihood of being at different points on the joint mortality distribution. Finally, correlation between spouses should be addressed with more complete data.

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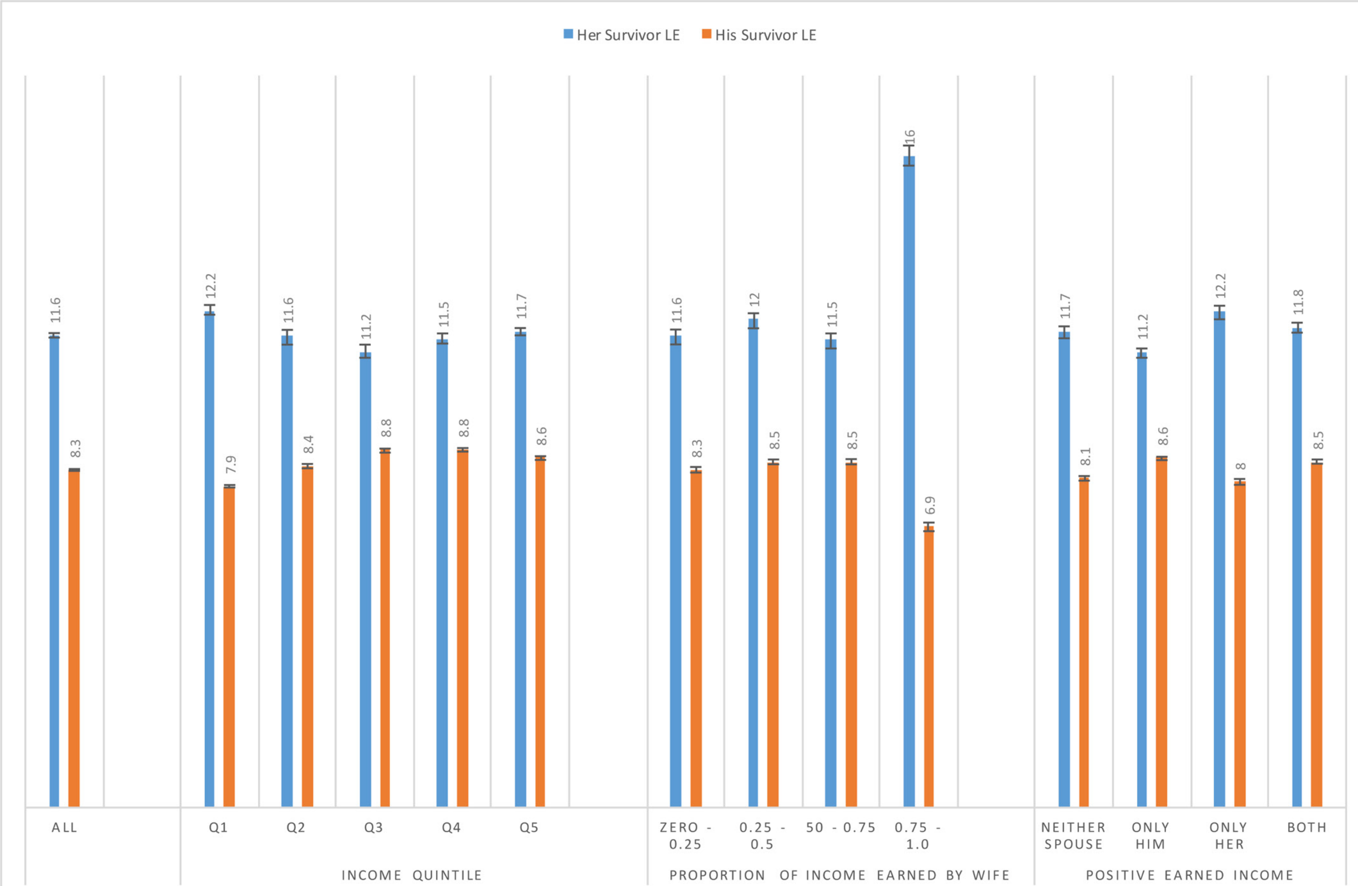

Figure 3: Survivor Life Expectancies, Both Spouses Aged 65 y

Note: Calculations are based on regressions from Table 4. Confidence interval bars are determined from 100 bootstrapped samples of men and women and reflect the 95 percent confidence interval around the mean values across bootstraps.

Source: Authors' calculations from the Longitudinal Administrative Database, 1987–2018.

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Notes

1 Figures used for this example are calculated averages over the 1996–2006 time frame, using the Statistics Canada Life Tables (Table 39-10-0007-01)

2 In 2021, the proportions of Canadian men who were married or in common-law unions were 75, 77, 78, and 76 percent, respectively, for the age groups 60–64, 65–69, 70–75, and 75–79 years. The proportion of women who are married or in common-law unions was lower for these age groups—68, 64, 58, and 48 percent, respectively—because men are more likely to remarry after divorce or widowhood (Statistics Canada Table 17-10-0060-01)

3 For simplicity, we have defined t as being equal for men and women (i.e., the husband and wife are the same age). This could be adjusted to have differing initial ages, t_h and t_w, for husbands and wives, respectively.

4 The survivor life expectancy calculations are done on the full sample, not on the subsample of widows and widowers. The survivor life expectancies do not make an assumption about the marital status after a spouse's death. Years widowed should be interpreted as years after a spouse's death regardless of any subsequent marital status transitions.

5 This is not to say that one should use annual mortality rates of married individuals when calculating couple life expectancies, if they are available. Annual mortality rates by marital status only account for marital status at the time of death, not at the initial (base)

year. Using these rates to calculate life expectancies of married individuals assumes that all married individuals are married when they die and do not take into account that half of the spouses will have been widowed before death. In other words, using annual mortality rates to calculate life expectancy assumes that calculations are for the first spouse to die, which is necessarily false in half the cases.

6 The introduction of the federal sales tax in 1986 and the Goods and Services Tax Credit in 1989 substantially increased the proportion of the elderly population filing taxes. We include only those samples post-1986 (Statistics Canada 2021).

7 The LAD also allows for linkages to the Longitudinal Immigration Database, providing more complete information for recent immigrants. Immigrant status and details were not incorporated into this study because of the relatively small sample size for the age cohort of interest.

8 Disability benefit income and health expenditure deductions may be incorporated as a proxy for health status. We do not include these measures in this study. The complications of these variables—disentangling who may or may not receive pension disability income, the ability to claim health deductions for spouses or dependent children, the delays in claiming relative to the onset of health issues, and the coverage of these variables—would distract from the key point of the article. We leave this avenue for future research.

9 This time frame is used to ensure that the timing of death is observed for a sufficient proportion of the sample. This is outlined in more detail in the following section.

10 We use the self-reported marital status available in the LAD. Because marital status is self-reported, individuals may not be providing their legal marital status. We include the self-reported measure with the assumption that an individual's own consideration of their marital status is likely to be more relevant for mortality than the legal definition. Same-sex marriages are not included in this analysis. Cohabiting couples are included as married. Common-law status is available for individuals who entered the survey in or following the 1992 wave. For the age groups considered here, common-law status is rare (less than 2 percent of the combined married–common-law group). It is likely that the common-law–married distinction is correlated with mortality rates, but we do not explore this here. See Denton, Spencer, and Yip (2021) for related discussion on marriage self-reporting and duration in the LAD. Throughout the article, we include common-law in the category of couples.

11 The confidence intervals presented in Table 1 for the LAD samples are the 95% confidence interval of the statistic, from 100 bootstrapped calculations. Confidence intervals are not available for the Statistics Canada estimates because only one set of mortality rates is used in the calculation.

12 In Appendix D, we present calculations using the LAD to confirm that the relationship between marital status and mortality is present in the LAD data.

13 The kinks in the raw data are due to the necessary combining and averaging of the first four years of data, as a result of Statistics Canada censoring of data that rely on cell counts of less than five. For example, we observe fewer than five observations where both spouses have died within one year of observing them alive at age 65 years.

14 For example, for married women aged 60 years, we calculate the income quintile of the combined income of themselves and their husbands while they were aged 55–59 years. Total income includes earned income, investment income, and retirement income (including government transfers).

15 The statistics for couples aged 60, 65, 70, and 75 years are available in Online Appendix B.

16 Recall that this calculation is based on the estimated life tables of 100 bootstrapped samples of married men aged 65 years whose spouses are aged 65 and married women aged 65 years whose spouses are aged 65.

17 Full regression results available on request. The addition of income quintile (calculated by gender and year and based on average total income in the previous five years) and an indicator for positive employment income in turn does not alter the coefficients on marital status. As expected, we find a negative relationship between income quintile and mortality: individuals in the highest quintile have lower mortality. Men who are working at ages 60 and 65 years have lower mortality than those who are not working at these ages; men who are working at ages 70 and 75 have higher mortality than those not working at these age. A similar pattern is found for women, although the positive relationship between employment and mortality is found earlier, at age 65 years.

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Appendix A: Calculation of Life Expectancy from Mortality Rates

Wife's Age	Husband's Age	a	*QW(t)*	*QH(t)*	*QC(t)*	*CM(t)*	*CL(t)*	*CD(t)*	*CLD(t)*	*CT(t)*	*CE(t)*
60	60	0	0.005	0.007	0.012	0.012	100,000	1,179.7	99,410.2	1,924,000	**19.2**
61	61	1	0.005	0.008	0.013	0.013	98,820.3	1,277.8	98,181.5	1,824,590	18.5
62	62	2	0.006	0.009	0.014	0.014	97,542.6	1,382.4	96,851.4	1,726,409	17.7
63	63	3	0.006	0.010	0.016	0.016	96,160.2	1,495.5	95,412.5	1,629,557	16.9
64	64	4	0.007	0.010	0.017	0.017	94,664.7	1,615.9	93,856.7	1,534,145	16.2
65	65	5	0.007	0.012	0.019	0.019	93,048.8	1,744.3	92,176.6	1,440,288	15.5
…..	…..	…..	…..	…..	…..	…..	…..	…..	…..	…..	…..
108	108	48	0.490	0.513	0.752	1.393	0.016	0.01	0.01	0.01	0.81
109	109	49	0.508	0.528	0.768	1.461	0.00397	0.00	0.00	0.00	0.73
110	110	50	1.000	1.000	1.000	0.000	0.00092	0.00	0.00	0.00	0.00

Notes: Boldface indicates the life expectancy calculated in the table. $CD(t)$ = deaths per age = $CL(t) - CL(t + 1)$; $CE(t)$ = Couple joint life expectancy = $T(a)/L(a)$; $CL(t)$ = cohort; $CL(a + 1) = CL(t) \times \mathrm{EXP}[-CM(t)]$; $CL(0) = 10{,}000$; $CLD(t)$ = couples lived between a and $a + 1 = CL(t + 1) + 0.5\ CD(t)$; $CM(t)$ = mortality rate = $-\ln[1 - QC(t)]$; CT(t) = Person years remaining – sum of CLD(t) from t to 110; $QC(t)$ = probability that couple "dies" between ages t and $t + 1$; $QH(t)$ = man's probability of dying between ages t and $t + 1$; $QW(t)$ = woman's probability of dying between ages t and $t + 1$.
Sources: $QW(t)$ and $QH(t)$ from Statistics Canada Table 39-10-0007-01; Anderson (1999).

Appendix B: Sample Birth Cohorts, Longitudinal Administrative Database

		Age 60	Age 65	Age 70	Age 75
	1987	1927	1922	1917	1912
	1988	1928	1923	1918	1913
	1989	1929	1924	1919	1914
	1990	1930	1925	1920	1915
	1991	1931	1926	1921	1916
	1992		1927	1922	1917
Initial Year Entering the LAD Sample	1993		1928	1923	1918
	1994		1929	1924	1919
	1995		1930	1925	1920
	1996		1931	1926	1921
	1997			1927	1922
	1998			1928	1923
	1999			1929	1924
	2000			1930	1925
	2001			1931	1926
Maximum Age Observed					
	2018	87-91	87-96	87-101	91-106

Appendix C: Longitudinal Administrative Database Sample Statistics

Sample Characteristic	Age, years							
	60	65	70	75	60	65	70	75
	All men				All women			
Sample by first year observed								
1987-1991	542,065	475,400	354,465	246,840	424,840	409,220	343,100	270,020
1992-1996		534,310	439,730	304,230		479,670	455,295	366,195
1997-2001			486,955	368,090			515,935	457,960
Total	542,065	1,009,710	1,281,150	919,160	424,840	888,890	1,314,330	1,094,175
Proportion who exit the sample through								
Death	0.73	0.79	0.81	0.89	0.57	0.65	0.7	0.83
Attrition	0.21	0.15	0.12	0.04	0.36	0.27	0.22	0.09
Censored	0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.08
	Married men				Married women			
Sample by first year observed								
1987-1991	437,165	385,860	289,085	194,155	268,845	231,150	172,765	107,920
1992-1996		423,710	342,600	229,925		264,460	201,895	117,120
1997-2001			379,700	277,095			266,655	178,385
Total	437,165	809,570	1,011,385	701,175	268,845	495,610	641,315	403,425
Proportion who exit the sample through								
Death	0.73	0.79	0.81	0.89	0.57	0.65	0.7	0.83
Attrition	0.21	0.15	0.12	0.04	0.36	0.27	0.22	0.09
Censored	0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.08

Source: Authors' calculations from the Longitudinal Administrative Database, 1987–2001.

Appendix D: LAD Differences in Mortality and Life Expectancy by Marital Status

Marital status is self-reported as single, married, common-law, widowed, divorced, or separated in the initial year (i.e., at age *t*). We combine married and common-law and estimate longitudinal mortality rates and life expectancies of individuals by marital status at age t = 60, 65, 70, and 75. We estimate the Gompertz regression as outlined in the text, controlling for marital status as well as province, birth cohort, individual income quintile, and work status (indicator for earning non-zero income). We then calculate the life tables of predicted mortality rates for each subgroup of age and marital status, averaging over all other variables.

The regression coefficients on marital status categories for men and women are presented in Appendix Table D1, and the calculated life expectancies are presented in Appendix Figure D1, along with life expectancies for the full population, calculated using the Statistics Canada Life Tables. For all ages, marital status in the base year is strongly correlated with mortality. Individuals in all three non-married categories (single, widowed, divorced, or separated) have higher mortality than those who are married. Explanations for the negative relationship between mortality rates and marriage include positive selection in marriage (healthier and more highly educated individuals have lower mortality and are more likely to be married at any age) or a causal effect of marriage or cohabitation itself. An explanation of the marriage–mortality relationship is beyond the scope of this article; however, with the addition of income and employment statistics, these regression results provide evidence to suggest that the negative relationship between mortality rates and marriage is not merely reflective of income or employment differences by marital status.[17]

Table D1: Gompertz Mortality Estimation, All Men and All Women

	Age, y			
Variable	60	65	70	75
	All women			
γ	1.124***	1.127***	1.131***	1.130***
	(0.001)	(0.000)	(0.000)	(0.000)
Marital status (Ref.: married or common-law)				
Single	1.287***	1.292***	1.235***	1.177***
	(0.014)	(0.009)	(0.007)	(0.006)
Divorced or separated	1.269***	1.225***	1.190***	1.142***
	(0.009)	(0.005)	(0.004)	(0.004)
Widowed	1.263***	1.259***	1.193***	1.145***
	(0.010)	(0.007)	(0.006)	(0.007)
No. of observations	126,670	268,320	394,220	327,900
Prob F > **test**				
Single = divorced/separated	0.235	0.000	0.000	0.000
Single = widowed	0.125	0.001	0.000	0.000
Divorced or separated = widowed	0.582	0.000	0.719	0.613
	All men			
γ	1.103***	1.105***	1.109***	1.110***
	(0.000)	(0.000)	(0.000)	(0.000)
Marital status (Ref.: married or common-law)				
Single	1.268***	1.288***	1.289***	1.227***
	(0.011)	(0.007)	(0.007)	(0.007)
Divorced or separated	1.215***	1.220***	1.218***	1.170***
	(0.013)	(0.008)	(0.006)	(0.005)
Widowed	1.225***	1.214***	1.209***	1.172***
	(0.009)	(0.007)	(0.007)	(0.008)
No. of observations	161,350	303,670	384,790	275,770
Prob F **> test**				
Single = divorced/separated	0.001	0.000	0.000	0.000
Single = widowed	0.001	0.000	0.000	0.000
Divorced or separated = widowed	0.482	0.609	0.293	0.788

Notes: Standard errors are in parentheses. All regressions include controls for province, birth cohort, income quintile, and positive earnings. Ref. = reference group.
$^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.
Source: Authors' calculations from the Longitudinal Administrative Database, 1997–2018.

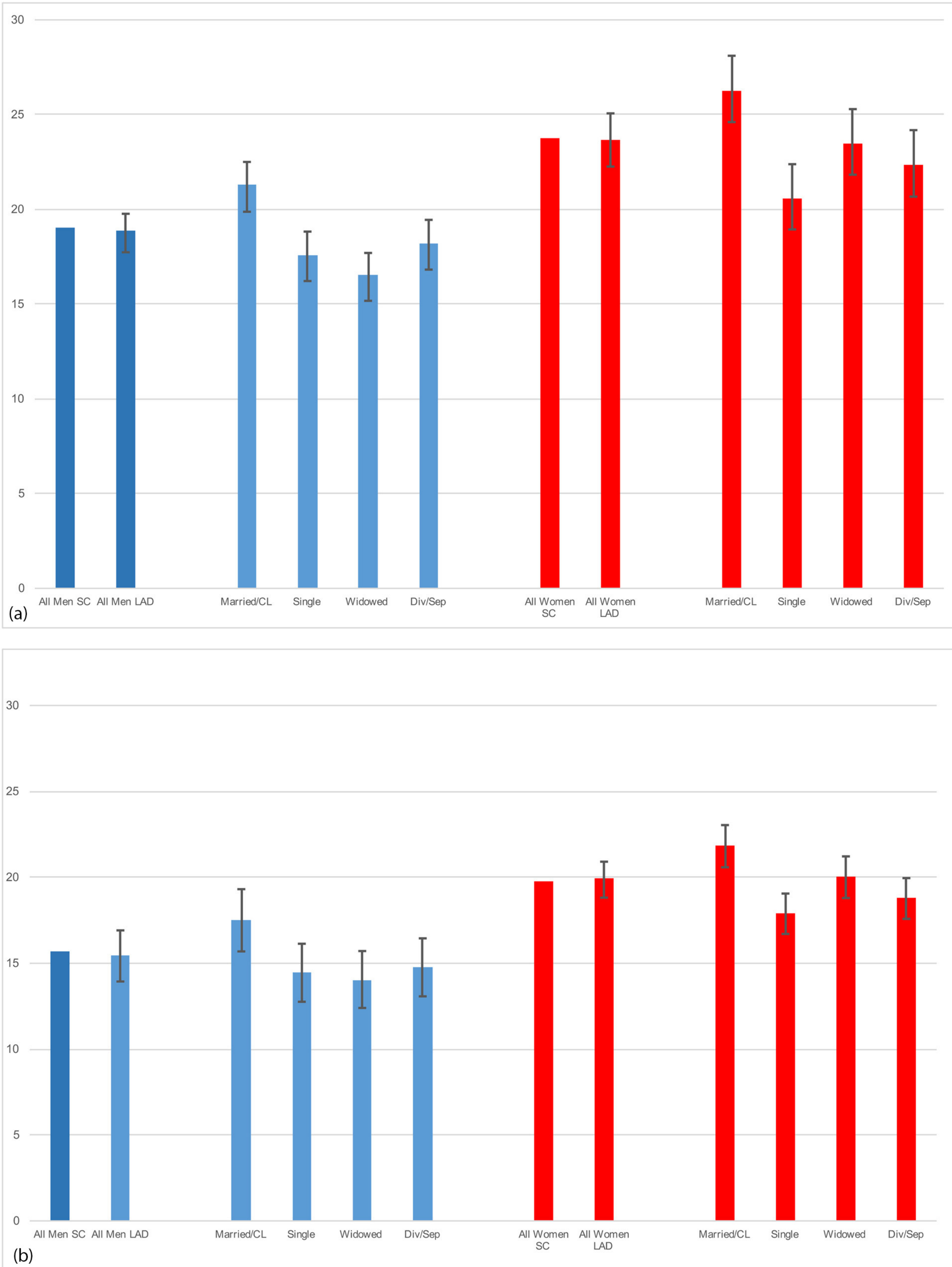

Figure D1: Estimated Individual Life Expectancies: (a) Age 60 y, (b) Age 65 y, (c) Age 70 y, and (d) Age 75 y.

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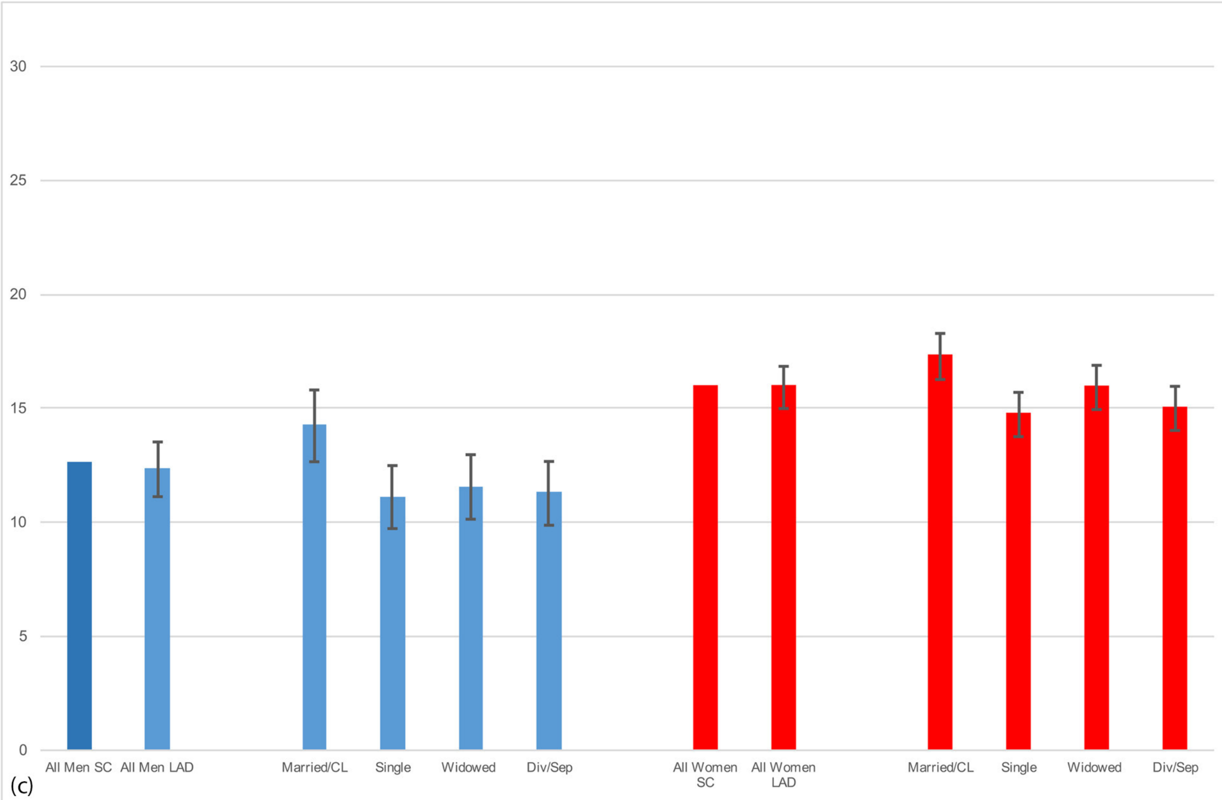

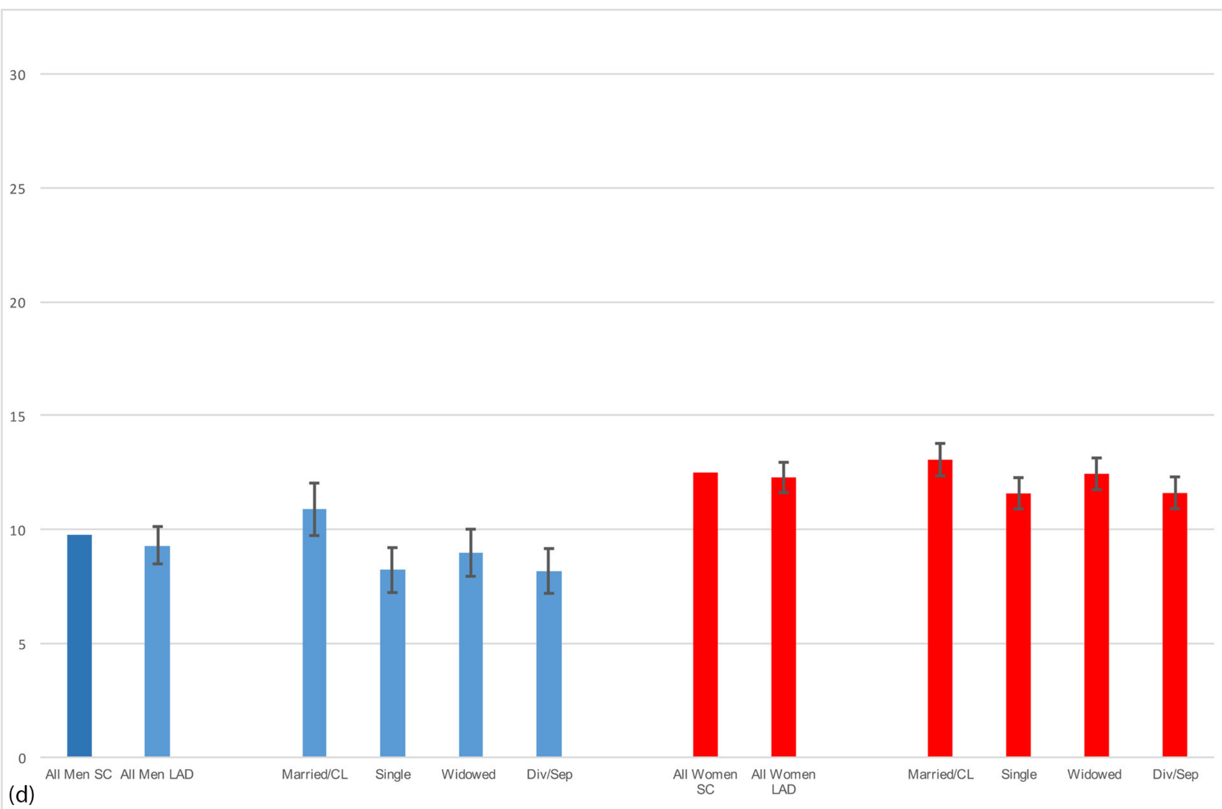

Figure D1: Continued

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