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Title Page

Type: Letter to the Editor

Title: Visualising the historical and contemporary differences in mortality between the US and Canada using Lexis diagrams.

Shorten title: Visualising mortality differences.

Word count: 491

20 To better appreciate mortality differences between two countries, it is useful to compare sex
21 specific rates across both age-groups and time. Lexis diagrams facilitate this [1], but have
22 remained under-utilised. Combining two Lexis diagrams allows us to effectively visualise
23 changes in comparative mortality ratios between two countries both over time, between years
24 and within cohorts. To highlight this, the example of comparing the ratio of mortality rates in
25 the US and Canada is presented.

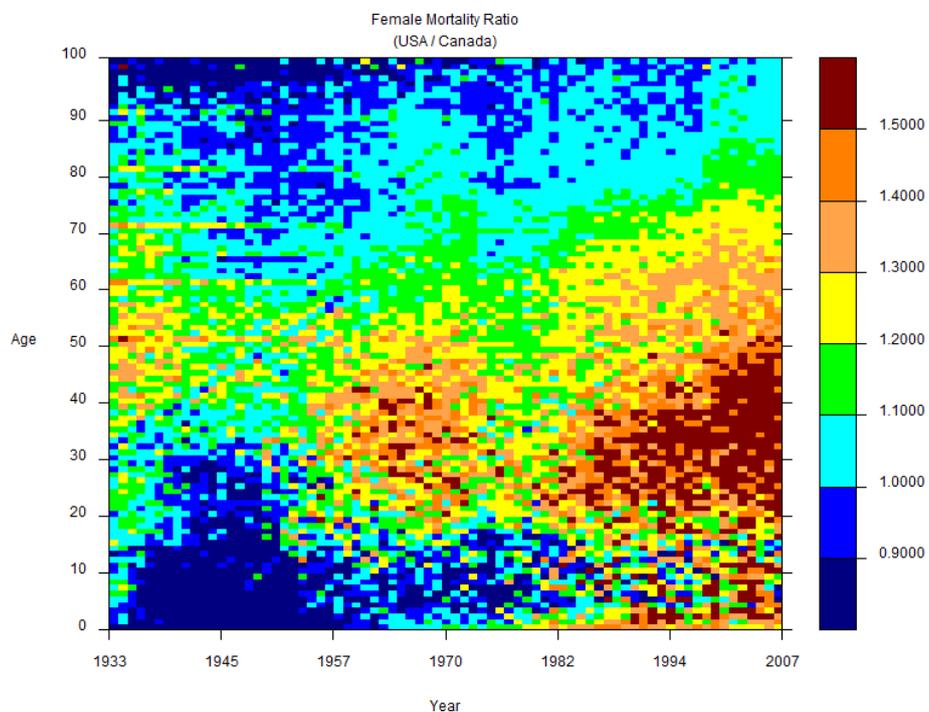
26 Mortality data was gathered from the 'Human Mortality Database' [2], which provides both
27 birth and death counts for 37 countries. Mortality rates were collected for individual (1933-
28 2007) years and ages (0-100). This was input into the software 'Lexis', to produce the
29 figures shown here illustrating the variation in mortality ratios between the two countries [3].
30 Both the data and software are freely available for any researcher to be able to replicate this
31 study.

32 Figures 1 and 2 show the ratio of US and Canadian mortality rates, split by sex. Canada has
33 consistently had lower rates of mortality for those aged 20 to 60 over the time period shown.
34 This difference appears to have strengthened since the 1980s, around the time of the
35 introduction of the Canadian Health Act, which prohibited the use of fees and extra billing by
36 doctors [4]. Whilst Canada has generally benefited from suffering lower mortality below the
37 age of 60 than the USA, until the 1980s mortality rates were higher for those in Canada under
38 the age of under 20, as compared to the same age groups in the USA. The gradual reversal in
39 this pattern started from around the period of the introduction of the current health care
40 system, leading to a widening gap which has been recognised in infants since 1996, but not
41 for the wider age group or time period [5].

42 In the US, mortality has generally been lower than in Canada at older ages, although this
43 advantage has also reduced in recent years. We do not plot values above the age 100 due to

44 the low numbers involved, but especially due to there being few Canadian's reported as
 45 living past 100, unlike in the more populous USA. Whilst Canada has traditionally enjoyed
 46 lower mortality rates than the USA, it does not experience much extreme longevity.
 47 Inequality in mortality in the USA, with more people dying young and more living to be very
 48 old, continues to be far higher than in Canada. However, since the mid-nineties (especially
 49 with females), the relative advantages for older citizens of the USA have been diminishing
 50 and the disadvantages for younger adults have been growing.

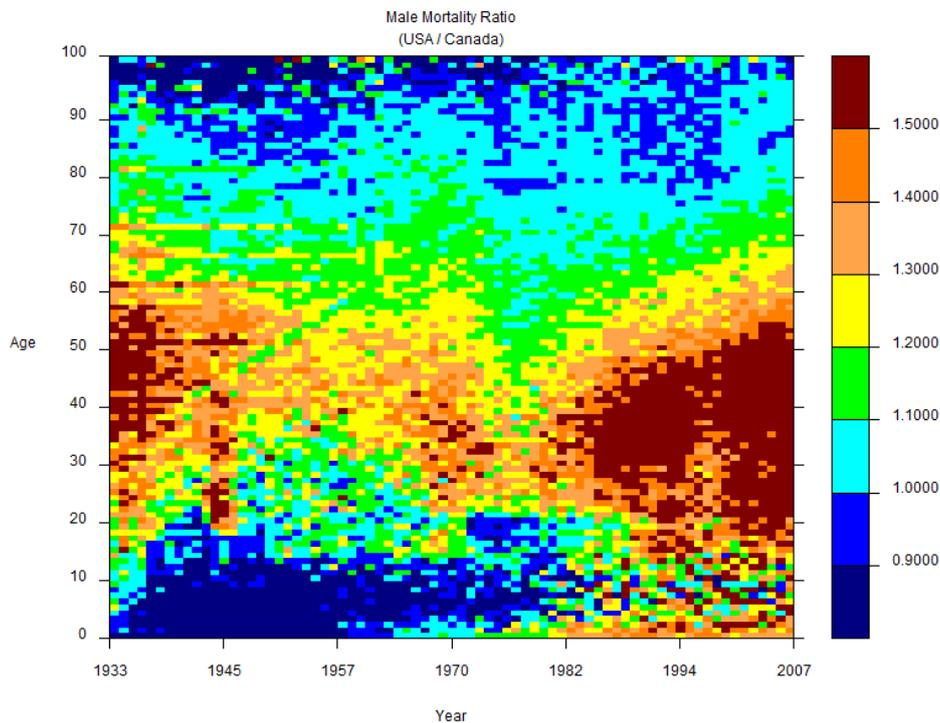
51 There have been many studies that have tried to understand why mortality rates vary as they
 52 do between Canada and the US. These often concentrate on particular medical interventions
 53 [6]. Few take a more historical and societal overview. Lexis diagrams effectively visualise
 54 these changing patterns and trends efficiently, improving our understanding of the processes
 55 that have led to these inequalities.



56

57 **Figure 1.** A Lexis diagram comparing female mortality patterns between USA and Canada.

58 Key: The diagram presents a ratio of mortality rates (the mortality rate of the USA divided by
 59 the Canadian mortality rate), with each pixel representing a specific single year and single
 60 year-of-age-group. A value greater than one indicates that the female mortality rate in
 61 America is higher than in Canada for that specific age and time period, and vice versa. For
 62 example a value of 1.4 reveals that in America, the mortality rate is 40 per cent higher than
 63 for the equivalent year and age group of people living then in Canada.



64

65 **Figure 2.** A Lexis diagram comparing male mortality patterns between USA and Canada (see
 66 key to Figure 1 for details on interpretation).

67

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70

71 Conflicts of interest: None.

72

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