Comparative mortality trends, indexed to 1981, by broad age groups

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# Suggested paper structure

* *Introduction*
* Life expectancy in Scotland has tended to lag behind neighbouring nations
* In Scotland there are also relatively high rates of mortality in working age groups, and high heath inequalities.
* Since 2012 there has been a stalling of life expectancy improvements in many affluent world nations, with Scotland experiencing one of the worst stallings.
  + In Scotland, this has also contributed to increasing health inequalities.
* Aim
  + The aim of this descriptive paper is to explore trends in mortality rates experienced in different age groups in Scotland, since 1981, in comparison with our nearest neighours:
  + Neighbour to the South: England & Wales
  + Neighbour to the East: France
  + Neighbour to the West: United States of America
  + We are particularly interested in the extent to which the worsening rates of improvement in life expectancy since 2012 have been present in each of the four countries, and are expressed similarly in different age groups within and between countries.
* *Methods*
* We produce a series of graphs which show how trends in mortality have changed in a range of age groups, indexed to 1981. These indexed trends control for changing population structure within each of the age groups.
* We also summarise some of the values shown in these graphs to illustrate how the trends in mortality rates within age groups have narrowed or widened over time between countries.
* *Results*
* As below
* *Discussion*
* Based on results shown below, and other analyses to be determined
* Key questions/queries
* To what extent should the results below also include life expectancy index values along side age-specifc trends?
* To what extent should this paper be combined with decomposition analysis?

# Introduction

This short report shows how mortality rates have changed in Scotland, for males and females separately, for a number of broadly defined age groups. Mortality rates are shown indexed to their value in 1981. (e.g. a value of 70 means the mortality rate for that particular age group was 70% of their rate in 1981, and so on.) Mortality rate indixes are also presented for three other countries/country groups (HMD codes shown in parentheses):

* England & Wales (GBRTENW)
* France (FRANTP)
* United States (USA)

# Methodology

All data were extracted from the Human Mortality Database (HMD). The mortality rates at each age in single years were calculated from the population exposures and numbers of deaths. A small continuity correction of 5 was added to the numerators and denominators before calculating age-specific mortality rates.

Each age-specific mortality rate was then indexed to its value in 1981 so that, for example, a value of 110 means a death rate 10% higher than that in 1981, and a value of 90 means a death rate 90% of that observed in 1981. These age-specific mortality indices were then weighted to produce indices for a smaller number of broader age categories using the following approach:

* Each age in single years was assigned to a broader age category comprising multiple ages in single years;
* The proportion of the population at each age in single years within each specific broad age category, in each specific year, was calculated to produce a within-category weighting factor;
* For each year, and each age category, the age-specific mortality indices were multiplied by the weighted factors, then summed, in order to produce a year-specific population weighted mortality index for that age group.

The age categories are as follows:

* 0 to 14 years
* 15 to 34 years
* 35 to 54 years
* 55 to 74 years
* 75 to 89 years
* 90 years and above (up to 110 years of age exclusive)

This approach was used in order to adjust for changes in within-age category population structure, which could lead to mortality rates changing for artefactual reasons alone. For example, if the average age within the 55 to 74 year old age strata changes from (say) 62 to 65 between 1981 and 1991, then the overall crude mortality rate within this strata could increase through change in population composition alone, even if the mortality rates at each age in single years within this strata have fallen.

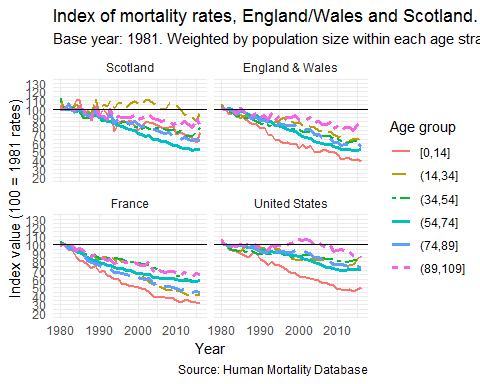
The above calculations were produced separately for each of the countries, and within each country for males and females separately.

## Parsed with column specification:  
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## Age = col\_integer(),  
## gender = col\_character(),  
## num\_deaths = col\_double(),  
## num\_population = col\_double(),  
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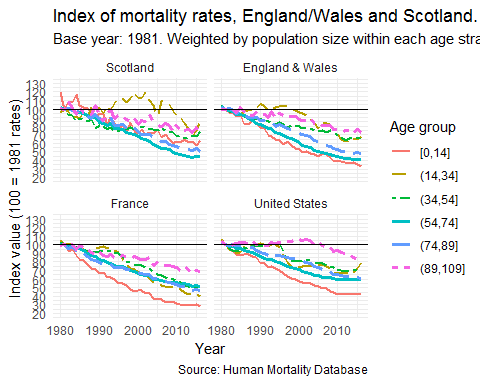
# Results

Figures showing how the weighted indices changed since 1981 are shown separately for females and males below.

## Figure for females



## Figure for males



## Discussion of results

There has been a clear trend towards towards falling mortality rates in all countries, and for both males and females, but there are also clear differences by age group, gender and country. This discussion will look at each age group, from infants and children at the start of the life course, to the very elderly at the end of the life course, and within each age category discuss the general trends, gender differences, and how Scotland compares with the other countries selected.

### Infants and young children

Weighted mortality rate indices have fallen faster amongst 0-14 year olds than amongst any other age groups, for males and females, in every country *except Scotland* since 1981. The following table shows how the weighted index has changed since 1981 for each population under consideration.

Weighted index of mortality rates in 0-14 year olds (1981 = 100), selected countries.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| country | gender | 1990 | 2000 | 2010 | 2016 |
| Scotland | Female | 92 | 75 | 70 | 73 |
| Scotland | Male | 94 | 72 | 62 | 63 |
| England & Wales | Female | 78 | 54 | 47 | 39 |
| England & Wales | Male | 79 | 53 | 40 | 33 |
| France | Female | 68 | 50 | 35 | 32 |
| France | Male | 66 | 47 | 31 | 28 |
| United States | Female | 83 | 64 | 48 | 50 |
| United States | Male | 79 | 57 | 42 | 42 |

Within this age group, mortality rates fell to to between 60-70% of their 1981 rates in Scotland, compared to around 30-40% in France, and 40-50% in England & Wales and the USA.

Though the trends in mortality rate improvements in these age groups have been less favourable in Scotland than in these other populations, only a small proportion of all deaths that occur, occur in infancy and childhood, so these trends alone do little to explain either Scotland’s relative disadvantage in longevity overall, or differences in trends after around 2012.

### Older children and younger adults (15-34 year olds)

The trends in this age group are generally less favourable than other age groups in each of the populations being compared, and are particularly unfavourable in Scotland. Whereas the trends in most other age groups have been towards considerable improvements ( falling mortality rates) since 1981, in this age group there is more evidence of stalling in the other countries, and worsening in Scotland. The table below shows how index values in this age group compares in the eight population groups of interest.

Weighted index of mortality rates in 15-34 year olds (1981 = 100), selected countries.

country

gender

1990

2000

2010

2016

Scotland

Female

95

107

105

97

Scotland

Male

102

112

93

84

England & Wales

Female

89

84

68

67

England & Wales

Male

106

96

71

68

France

Female

83

64

45

42

France

Male

96

68

50

40

United States

Female

95

82

75

89

United States

Male

101

73

67

80

Mortality rates in these age groups were between a tenth and an eighth higher in Scotland by 2000 compared with 1981, and by 2016 fell only marginally for women, and to around 85% of their 1981 values in Scotland. At their peak, in the late 1990s/early 2000s, mortality rates in males were around a fifth higher, and in females a tenth higher, than in 1981.

Trends had also stalled in the USA throughout the 1980s, before falling in the early/mid 1990s. Mortality rates also remained stalled in England & Wales for males, before improving in the mid/late 1990s, and continued to improve for females; by 2016 mortality rate improvements had become roughly equal for both gender. In France, the mid 1990s marked an acceleration in improvements for both genders, which continued in subsequent periods, such that by 2016 mortality rates in this age group were less than half their level in 1981.

### Middle working age (35-54 year olds)

Mortality rate improvements in the middle of working age have tended to be more persistent in this age group than in the 15-34 year old age group, with more gradual improvements observed in each country and both genders. *However, it is also within this age group that sudden changes towards either stagnation (England/Wales) or worsenings (Scotland, and to a lesser extent USA) since around 2012 can be observed.* The increase in mortality rates between 2010 and 2016 can be seen in the graphs above, and the table below.

Weighted index of mortality rates in 35-54 year olds (1981 = 100), selected countries.

country

gender

1990

2000

2010

2016

Scotland

Female

90

80

71

78

Scotland

Male

80

76

68

74

England & Wales

Female

84

76

65

62

England & Wales

Male

88

79

70

66

France

Female

84

78

65

55

France

Male

92

76

58

48

United States

Female

89

86

80

85

United States

Male

98

81

70

75

In Scotland, mortality rates in this age group increased by almost a tenth in both males and females between 2010 and 2016. In the USA, they increased by around an eighth. Over the same period, they fell by around 5% in England & Wales, and around 15-20% in France.

### Late working age and early retirement ages (55-74 years of age)

Mortality rates in this age group have seen the fastest rates of improvement in Scotland since 1981, compared with other popualtion groups, but have been stalling in recent years. They fell by around 10-15% from 1981 to 1990, by around 20% from 1990 to 2000, by around a quarter from 2000 to 2010, but by only around 8-10% between 2010 and 2016. Though this latter comparison is of a shorter time period, a slowdown in the trends seems evident from the figures.

Similar slowdowns are also seen in England & Wales, and France, and flattening mortality improvements have been observed in the USA.

Weighted index of mortality rates in 55-74 year olds (1981 = 100), selected countries.

country

gender

1990

2000

2010

2016

Scotland

Female

90

71

57

53

Scotland

Male

84

68

49

44

England & Wales

Female

89

70

55

53

England & Wales

Male

82

60

45

41

France

Female

79

67

60

58

France

Male

83

67

56

51

United States

Female

94

86

71

71

United States

Male

86

71

59

60

### Central retirement ages (75-89 year olds)

The table below shows the index values for this age group in each of the population gruops.

Weighted index of mortality rates in 75-89 year olds (1981 = 100), selected countries.

country

gender

1990

2000

2010

2016

Scotland

Female

90

82

66

63

Scotland

Male

89

73

56

51

England & Wales

Female

86

77

61

57

England & Wales

Male

87

72

52

49

France

Female

76

62

49

44

France

Male

80

68

53

47

United States

Female

93

93

77

73

United States

Male

92

83

65

61

Within this age band, the relative improvements between 1981 and 2016 were larger for males than females in Scotland (51 for males compared with 63 for females), in England & Wales (49 compared with 57), and in the USA (61 comapred with 73), whereas in France the index of improvement was slightly greater in females (44) than males.

There have been very consistent trends in mortality rate improvement in both genders and all four countries in this age group. However, annual rates of improvement have been more modest in recent years. The table below shows the average change in the index values for each of the eight population groups over the 1980s, 1990s, 2000s, and between 2010 and 2016. With the exception of females in the 1980s, average rates of annual improvement have been substantially less in the 2010-2016 period than in earlier decades. In Scotland, annual improvements in the 2000s were around three times larger than improvements over this latter period in women, and around twice as large in men. The equivalent relative improvement ratios, were around 2.6 times (females) and 3.0 times (males) in England & Wales, 1.7 (females) and 1.4 (males) in France, and around 2.5 times greater in the USA for both males and females.

Average annual change in index values for 75-89 year olds, by period, selected countries.

country

gender

1980s

1990s

2000s

2010-2016

Scotland

Female

-1.11

-0.83

-1.56

-0.53

Scotland

Male

-1.26

-1.53

-1.72

-0.84

England & Wales

Female

-1.55

-0.93

-1.64

-0.63

England & Wales

Male

-1.53

-1.50

-1.93

-0.64

France

Female

-2.33

-1.42

-1.30

-0.75

France

Male

-1.98

-1.21

-1.45

-1.07

United States

Female

-1.05

0.02

-1.60

-0.63

United States

Male

-1.07

-0.90

-1.75

-0.70

Though there have not been clear increases in mortality risks in this age group, because a large proportion of all deaths that occur, tend to occur in these age groups, the clear slowdown in improvements in this age group is likely to be an important driver of falling and stalling life expectancies. The international comparison shows that, unlike the trends in some younger age groups, this phenomenon is not specific to Scotland.

### Older pensioners (90 year olds and above)

The table below shows the index values for this age group in each of the population groups. General tendencies towards continually improving mortality at these ages were observed for Scotland, England & Wales, and France since the early 1980s, but not in the USA, where mortality rates increased modestly until the early 2000s, before starting to fall. In Scotland, England & Wales, and France there are indications of stalling improvements after around 2010-2012, consistent with that observed in the previous age groups, whereas trends in the USA are continuing to improve as they catch up towards the other three countries.

Weighted index of mortality rates in 90 year olds and above (1981 = 100), selected countries.

country

gender

1990

2000

2010

2016

Scotland

Female

93

87

83

81

Scotland

Male

91

82

80

74

England & Wales

Female

90

87

79

77

England & Wales

Male

92

88

76

72

France

Female

87

77

67

65

France

Male

91

84

73

69

United States

Female

96

106

94

85

United States

Male

100

106

93

80

The table below shows the average annual change in index values over the 1980s, 1990s, 2000s, and the period 2010-2016. This illustrates some additional complications in the trends. As with males and females in the USA, there is some evidence of ‘catch up’ in the latest period for males in Scotland, with a *higher* average rate of improvement for males in the 2010s than the 2000s; for Scottish females, the rates of improvement are similar in the 2010s than the 2000s.

In France, and in England & Wales, average rates of improvement in the 2010s were considerably smaller than in the 2000s, whereas improvements accelerated over the latter compared with previous period for both genders in the USA.

Average annual change in index values for 90 year olds and older, by period, selected countries.

country

gender

1980s

1990s

2000s

2010-2016

Scotland

Female

-0.78

-0.52

-0.40

-0.44

Scotland

Male

-0.98

-0.95

-0.13

-1.12

England & Wales

Female

-1.09

-0.32

-0.80

-0.29

England & Wales

Male

-0.80

-0.40

-1.17

-0.68

France

Female

-1.23

-0.98

-0.99

-0.37

France

Male

-0.78

-0.66

-1.09

-0.71

United States

Female

-0.72

0.92

-1.19

-1.49

United States

Male

-0.43

0.64

-1.31

-2.19

# Summary

This document has shown how the population weighted indices of mortality change since 1981 differ between age groups and genders within Scotland and three comparator populations. Overall, there have been marked improvements in mortality in each of these age groups, but with considerable variation between populations. Mortality trends in Scotland departed most from the comparator countries in 15-34 year olds, and improvements in infant and childhood mortality (0-14 years old), in particular, have been much slower than in other countries. There is also evidence of catch-up in mortality trends, however, such as within the 55-74 year old age strata.

In rich countries, majority of deaths occur at older ages, and so more modest changes in trends at these older ages are likely to impact life expectancy much more than larger changes at younger ages. Scotland has been similar to the comparator countries in seeing slow downs in mortality rate improvements in these older ages in the 2010s, though there is also evidence of mortality rates increasing, rather than simply falling more slowly, at many ages in Scotland in recent years.