
RECENT TRENDS IN THE MORTALITY OF PENSIONERS IN THE UNITED KINGDOM

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Introduction

In the United Kingdom national demographic statistics are gathered separately for the three "provinces" of England & Wales, Scotland, and Northern Ireland. England & Wales has almost 90% of the total population, so little is lost by using only figures for England & Wales, as is done in this paper.

The Continuous Mortality Investigation Bureau was set up by the Institute of Actuaries and the Faculty of Actuaries in the 1920s to gather mortality data from life offices, and to publish the results. The CMI Bureau has been gathering statistics for the mortality of those drawing pensions from insured pension schemes since 1955. The CMI investigations cover a substantial proportion of the insured pensions business in the UK, but do not include the much larger experience of self-administered company schemes, nor of government-sponsored schemes (e.g. civil service, armed forces, health service and education).

National demographic statistics are available annually, but the CMI Bureau publishes reports for quadrennial periods. In this paper results are presented for these quadrennial periods.

Population Mortality

Population mortality experience is conveniently summarised in crude central mortality rates for broad age groups. Details for individual ages are available in separate annual reports, but it is laborious to pick these out. The two age-groups that cover the bulk of pensioners are 65-74 and 75-84. The normal retirement age for females is 60, and many males also retire before 65, but the broad trend can be seen by a consideration of the two main age-groups alone. National data for ages 85 and over is lumped together into a single age-group, but changes in the age distribution within this wide group make it less satisfactory to use for comparison.

The crude central mortality rates are calculated simply by dividing the number of deaths within the age group in each year by the estimated mid-year population. The crude rates for the four years of each quadrennium have then been averaged, thus weighting the years equally. They have then been scaled, so that the rates for the latest quadrennium, 1987-90, are taken as 100, with previous quadrennia shown in proportion.

The results are shown in Table 1. The two sexes are shown separately. It can be seen that the reduction in mortality for each of the groups shown has been considerable, equivalent to a reduction of about 1% per annum over the whole 32-year period in each case. (A 1% per annum reduction, compound, would be from 138 to 100.) The mortality of females has improved faster than that of males over the whole period, but it has also happened rather more uniformly over the period, whereas the mortality of males reduced more slowly over the first half and more rapidly over the second half of the period shown.

Table 1. England and Wales Population

Crude mortality rates for age groups shown
Average for 4 years scaled to 1987-90 = 100

	Males		Females	
	65-74	75-84	65-74	75-84
1955-58	135	131	139	147
1959-62	135	129	134	144
1963-66	134	125	128	135
1967-70	133	121	123	128
1971-74	129	122	118	126
1975-78	124	120	113	121
1979-82	117	113	108	113
1983-86	111	107	105	105
1987-90	100	100	100	100

CMI Pensioners

By "CMI Pensioners" are meant pensioners drawing pensions from schemes insured by those life offices that send returns to the CMI Bureau. The experiences are separated between those who retired at or after the normal retirement age (normals and lates), and those who retired before the normal retirement age (earlies). The experience is also gathered counting each pensioner as 1 ("lives") and counting the

number of pounds of pension paid ("amounts"). It is possible that an individual receives pensions from more than one life office scheme, and so counts as more than 1 in the "lives" investigation, but it is thought that the number of "duplicates" in this investigation is quite small.

The quadrennial results published by the CMI Bureau (in earlier years in Journal of the Institute of Actuaries and Transactions of the Faculty of Actuaries, in more recent years in Continuous Mortality Investigation Reports) show actual deaths as a percentage of those expected according to a suitable comparison table. In recent years the table used has been the PA(90) table, which will be described further below. Earlier years have been rescaled to give an approximate comparison with results on the PA(90) table. Figures for "100A/E", i.e. actual deaths as a percentage of those expected, for the CMI pensioners, males and females separately, both for lives and amounts, for the available quadrennia, are shown in Table 2. Data for 1990 is not yet available so the last "quadrennium" contains only the three years 1987-89.

Table 2. CMI Pensioners

100A/E - all ages - normal and late retirements
Basis - PA(90) - earlier years rescaled to PA(90)

	Males		Females	
	Lives	Amounts	Lives	Amounts
1955-58	139	—	132	—
1959-62	128	117	136	133
1963-66	126	116	123	114
1967-70	122	110	120	112
1971-74	122	109	116	114
1975-78	121	107	114	106
1979-82	114	96	110	98
1983-86	104	86	101	89
1987-89	100	78	100	91

It so happens that the experience by lives for this final period for both sexes is exactly 100, so these columns have not been rescaled. These results cover all ages, but the bulk of the male data is from ages 65 to 85, with the female data extending both below and above that.

Comparison of Tables 1 and 2 shows that the mortality experience of CMI "normals and lates", measured by lives, has improved at about the same rate as the population experience.

The experience by amounts is lower than that by lives, indicating that those with larger pensions have lighter mortality than those with smaller pensions. But, since the amounts experience has improved more rapidly than the lives experience, it seems as though the differential must have widened.

As with the national population, the improvement in the second half of the period for males has been faster than in the first half, whereas the mortality of females has been reducing more evenly.

The CMI Tables

From time to time the CMI Bureau publishes new mortality tables based on the experience available to it. Besides preparing graduated tables, it has been usual to prepare forecast tables, so that actuaries advising life offices and pension funds can allow for possible improvements in mortality rates.

One such set of tables was based on the experience for 1967-70. After looking at the rate of improvement in mortality up to that date, the then CMI Committee suggested that an appropriate rate of improvement could be represented by deducting one year of age for each 20 calendar years passed through. The PA(90) tables were based on the graduated amounts experience, for males and females separately, projected to the calendar year 1990. They were therefore intended to be broadly suitable for use during the 1970s and 1980s.

The amounts experience for 1967-70, for both males and females, was about 10% lighter than the lives experience. If the experience had been exactly in line with that forecast, the bottom line of Table 2 would have shown 110 for each of the lives columns and 100 for each of the amounts columns. This level was reached around 1980, rather than 1990, which shows that the actual rate of improvement has been about twice as fast as the then CMI Committee expected. Broadly, the improvement has been at the rate of about one year of age in ten calendar years, rather than one year of age in twenty calendar years. One year of age is roughly equivalent to 10% in the rate of mortality (or rather 9% for males, 11% for females on PA(90)).

The CMI Committee has recently prepared a new set of forecast tables, based on the experience for 1979-82, and including forecasting on a new basis. The new tables for the base year, 1980, are denoted PML80Base, PMA80Base, PFL80Base and PFA80Base, for males lives, males amounts, females lives and females amounts respectively. Calendar year tables for each future year can be derived and are

denoted by C., e.g. PML80C90 for males lives for calendar year 1990. Further, tables for individual years of birth can be derived and are denoted by B., e.g. PFA80B40, for females amounts born in 1940, who will reach the age of 60 in the year 2000.

The new forecast tables assume a more rapid rate of improvement at younger ages than at older, with the rate of improvement slowing as time progresses. The precise projection formula is: denote by $q_{x,t}$, the value of q_x for calendar year 1980 + t , so that $q_{x,0}$ is the value of q_x for the base year 1980. Then $q_{x,t} = q_{x,0} RF(x,t)$,

$$\text{where } RF(x,t) = \alpha(x) + [1 - \alpha(x)](0.4)^{t/20}$$

$$\text{and } \alpha(x) = \begin{matrix} 0.5 & x \leq 60 \\ (x-10)/100 & 60 < x < 110 \\ 1 & 110 \leq x \end{matrix}$$

It is convenient to start by comparing specimen mortality rates for PA(90) with those for PMA80C90 and PFA80C90, the rates on the new tables projected to calendar year 1990. These are shown in Table 3. It can be seen how the new tables are already forecasting a substantially lower level at younger pensioner ages for 1990 than the earlier forecast tables. This is true also for females at higher ages, but the basic rates of mortality at these ages are less reliable, and depend very much on the shape of the tail of the graduation formula used.

Table 3. Values of q_x forecast to 1990.

Age	Males			Females		
	(1) PA(90)M	(2) PMA80C90	(3) 100(2)/(1)	(4) PA(90)F	(5) PFA80C90	(6) 100(5)/(4)
60	0.016127	0.009477	59	0.006961	0.005310	76
65	0.025015	0.017034	68	0.011937	0.009010	75
70	0.038608	0.030200	78	0.020396	0.015494	76
75	0.059139	0.051689	87	0.034641	0.029080	84
80	0.089572	0.084392	94	0.058243	0.054024	93
85	0.133444	0.130538	98	0.096321	0.092342	96
90	0.194221	0.190609	98	0.155192	0.140718	91
95	0.273928	0.263527	96	0.240469	0.189749	79
100	0.371274	0.353080	95	0.353024	0.244952	69

Table 4 moves forward to mortality rates forecast to 2010. For the PA(90) forecast tables this just means taking one year off the age. The differences in forecast rates of improvement at younger ages are striking.

Table 4. Values of q_x forecast to 2010.

Age	Males			Females		
	(1) PA(90)M - 1 year	(2) PMA80C10	(3) 100(2)/(1)	(4) PA(90)F -1 year	(5) PFA80C10	(6) 100(5)/(4)
60	0.014765	0.007274	49	0.006247	0.004075	65
65	0.022920	0.013549	59	0.010719	0.007166	67
70	0.035416	0.024826	70	0.018331	0.012737	69
75	0.054346	0.043810	81	0.031179	0.024647	79
80	0.082528	0.073594	89	0.052551	0.047112	90
85	0.123418	0.116901	95	0.087253	0.082696	95
90	0.180580	0.174995	97	0.141448	0.129191	91
95	0.256471	0.247651	97	0.221150	0.178318	81
100	0.350609	0.339170	97	0.328574	0.235302	72

The rates of improvement with the new forecasts, expressed as one year of age per so many calendar years passed through, are shown below.

Age	Males	Females
65	9	7
75	12	12
85	13	16
95	20	16

The pattern varies both by age and by sex as opposed to the uniform one year in 20 for all ages and both sexes for the forecast tables of which the PA(90) table forms one cross-section.

CMI Early Retirements

The experience reported in Table 2 was based only on the normal and late retirements, and the CMI standard tables have also been based only on this

experience. There has, however, been a substantial increase over the years in the number of people retiring before the normal retirement age. The mortality experience of early retirements, particularly at younger ages, has always been very much worse than that of the normals and lates, indicating that the earlies include quite large numbers of people retiring because of ill-health. It is possible that the larger numbers now retiring before the normal retirement age include many who are far from being in bad health, but nevertheless are in less than perfect health; if this were so, it would be possible for the mortality experiences of both the normals and lates and also of the earlies to improve, even though the overall experience did not change. Table 5 shows the experience of early retirements with, unfortunately, a discontinuity. Up to 1971-74 the expected deaths are those according to the 1947 table for annuitants, and after that date those according to PA(90). There is no linking year which allows the experiences to be rescaled.

Table 5. CMI Pensioners

100A/E - all ages - early retirements
 Bases - 1947 table up to 1971-74, PA(90) from 1975-78

	Males		Females	
	Lives	Amounts	Lives	Amounts
1955-58	220	—	174	—
1959-62	211	181	144	116
1963-66	198	163	126	121
1967-70	171	140	112	106
1971-74	147	126	113	109
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1975-78	151	126	149	150
1979-82	134	112	138	133
1983-86	119	100	123	124
1987-89	107	89	119	107

It is clear that the mortality rates of early retirements had improved substantially by 1974, and have continued to improve substantially since then. The latest experience shows the mortality rates of early retirements roughly 10% higher than those for normals and lates for males and 20% higher for females.

The experience of the combined normal, late and early retirements is available since 1975-78, and Table 6 shows this, all on PA(90) as the expected basis. These figures

show the combined experience to be a little higher than that of normals and lates, shown in Table 2, but the improvements in mortality have been roughly the same. The rapid improvements in recent years cannot, therefore, be explained away by a change in the pattern of retirement.

Table 6. CMI Pensioners

100A/E - all ages - combined normal, late and early retirements
Basis - PA(90)

	Males		Females	
	Lives	Amounts	Lives	Amounts
1975-78	126	111	118	111
1979-82	118	100	113	103
1983-86	108	90	104	95
1987-89	102	82	103	94

Other pension schemes

Published data are not available for self-administered company schemes nor for government sponsored schemes. It would be likely that the experience of individual schemes is at a different level from that of the CMI insured schemes. It would be interesting to know whether the mortality experience of pensioners of such schemes had improved as rapidly as that of the population and of the CMI pensioners. It would seem reasonable to assume that it had, but there may be other factors that have affected particular schemes in particular ways.

Financial consequences

The financial consequences for pension schemes of this rapid improvement in mortality are significant. Not only is mortality now at a lower level than was forecast, it seems reasonable to assume, at least for the time being, that it will continue to improve at a more rapid rate than was previously expected.

The financial consequences can be seen from the following values for \bar{a}_{65} for males and \bar{a}_{60} for females, using 4% interest (an appropriate rate in the UK to allow for escalation roughly in line with prices).

\ddot{a}_{65} on PA(90)M	= 10.833	
\ddot{a}_{65} on PMA80C90	= 11.567	$\equiv \ddot{a}_{63}$ on PA(90)M ie -2 years
\ddot{a}_{65} on PMA80B25	= 11.875	$\approx \ddot{a}_{64}$ on PMA80C90 (11.954) ie -1 year
		$\approx \ddot{a}_{62}$ on PA(90)M (11.908) ie -3 years
		$\approx \ddot{a}_{65}$ on PMA80C90 at 3.65 % (11.877)
\ddot{a}_{60} on PA(90)F	= 14.713	
\ddot{a}_{60} on PFA80C90	= 15.302	$\approx \ddot{a}_{58}$ on PA(90)F (15.398) ie -2 years
\ddot{a}_{60} on PFA80B30	= 15.647	$\approx \ddot{a}_{59}$ on PFA80C90 (15.642) ie -1 year
		$\approx \ddot{a}_{57}$ on PA(90)F (15.731) ie -3 years
		$\approx \ddot{a}_{60}$ on PFA80C90 at 3.78 % (15.645)

Thus, using the new calendar year table for 1990 instead of PA(90) adds about 6.8% to the value of a (straight) pension at 65 for a male, and 4% at age 60 for a female. To shift to the "correct" forecast table, i.e. taking account of forecast improvements in mortality beyond 1990 adds a further 2.7% for a male, 2.3% for a female. The allowance for forecasting is equivalent to only a small change in the interest rates, -0.35% for a male, -0.22% for a female, but the effect is nevertheless significant for all UK pension schemes to which the lower mortality applies.

It would be interesting to hear about comparable experiences in other countries.