

CONTINUOUS MORTALITY INVESTIGATION: PENSIONERS UNDER LIFE-OFFICE PENSION SCHEMES

CONTINUOUS INVESTIGATION RESULTS FOR 1951

A REPORT published in *J.I.A.* 78, 362, and *T.F.A.* 21, 219, gave results for the years 1948-50 in respect of male lives in the pensioners' section of the Continuous Mortality Investigation.

The statistics for 1951 have now become available and the experience for male lives retiring at or after the normal age is shown in Table 1, expected deaths having been calculated by the $a(m)$ ultimate table. Mortality in Britain was heavy in 1951, owing to the influenza epidemic which occurred during the early months of the year. This feature is reflected in the pensioners' experience at all ages. As the exposed to risk has been increasing from year to year, the data for 1951 constitute a disproportionately large element in the combined statistics for 1948-51. Consequently the results for the four-year period cannot be regarded as a reliable estimate of current pensioner mortality.

Table 2 provides similar information in respect of male lives retiring before the normal age. Again the experience of 1951 is shown to have been heavier than in 1948-50. However, the features noted in the previous report, namely that the percentage of actual deaths to those expected by the $a(m)$ ultimate table declines sharply with increasing age, has been sustained.

FOUR OFFICES' PILOT INVESTIGATION, 1947-51

In the previous report consideration was given to the possibility of 'negative selection' at retirement. To examine this question further it was decided to conduct a pilot investigation, on a select basis, into the mortality experienced by four large offices during the five years 1947-51 among male pensioners retiring at or after the normal age. A policy-year method was used, details of which will be found in the Appendix. In addition to the experience for the year 1947, the pilot investigation included a quantity of data which, for administrative reasons, it had not been possible to include in the main investigation. Thus, although the two investigations overlap, they are not closely comparable.

The exposed to risk and deaths for the pilot investigation are shown in Tables 3 and 4. Table 5 sets out the ratios of actual deaths to the deaths expected by the $a(m)$ ultimate table and is in three sections, namely:

- A. an analysis by attained age and duration;
- B. an analysis by age at retirement;
- C. a comparison in durations between retirement age 65 and retirement ages 66-70.

These results do not provide any statistically significant evidence that the mortality experienced varies either by duration or by retirement age. Thus no support has been found for the suggestion that there may be 'negative selection' at retirement. In the previous report it was shown that when the pensioners' experience was compared both with annuitants and with assured lives, the percentage of actual to expected deaths in the $65\frac{1}{2}$ - $69\frac{1}{2}$ age-group was considerably higher than in the $70\frac{1}{2}$ - $74\frac{1}{2}$ age-group. However, further

Table 1. Continuous investigation into the mortality of male pensioners who retire at or after the normal age

Age	Exposed to risk			Expected deaths by $a(m)$ ultimate			Actual deaths			Percentage of actual to expected deaths		
	1948-50	1951	1948-51	1948-50	1951	1948-51	1948-50	1951	1948-51	1948-50	1951	1948-51
65½	7,312	3,057	10,369	232	97	329	282	138	420	122	142	128
66½	6,785	3,205	9,990	232	110	342	240	120	360	103	109	105
67½	5,443	3,002	8,535	201	114	315	217	133	350	108	117	111
68½	4,220	2,565	6,791	168	102	270	191	132	323	114	129	120
69½	3,547	1,899	5,446	152	82	234	156	113	269	103	138	115
70½	3,155	1,467	4,622	146	68	214	151	94	245	103	138	114
71½	2,631	1,245	3,876	132	62	194	156	91	247	118	147	127
72½	2,141	1,039	3,180	117	57	174	124	76	200	106	133	115
73½	1,694	849	2,543	101	51	152	116	54	170	115	106	112
74½	1,277	661	1,938	83	43	126	88	55	143	106	128	113
75½	927	501	1,428	67	36	103	78	41	119	116	114	116
76½	584	388	972	47	31	78	61	50	111	130	161	142
77½	362	258	620	32	23	55	35	21	56	109	91	102
78½	244	154	398	23	15	38	17	15	32	74	100	84
79½	174	91	265	18	10	28	27	7	34	150	70	121
Under 65½	4,861	1,941	6,802	132	53	185	150	80	230	114	151	124
65½-69½	27,313	13,818	41,131	985	595	1,490	1,086	636	1,722	110	126	116
70½-74½	10,898	5,261	16,159	579	281	860	635	370	1,005	110	132	117
75½-79½	2,291	1,392	3,683	187	115	302	218	134	352	117	117	117
Over 79½	400	204	604	51	27	78	44	31	75	86	115	96
All ages	45,763	22,616	68,379	1,934	981	2,915	2,133	1,251	3,384	110	128	117

Table 2. Continuous investigation into the mortality of male pensioners who retire before the normal age

Age group	Exposed to risk			Expected deaths by $a(m)$ ultimate			Actual deaths			Percentage of actual to expected deaths		
	1948-50	1951	1948-51	1948-50	1951	1948-51	1948-50	1951	1948-51	1948-50	1951	1948-51
Under 60½	1,112	524	1,636	18	9	27	68	43	111	378	478	411
60½-64½	2,767	1,245	4,012	71	32	103	206	70	276	290	219	268
65½-69½	1,849	932	2,781	66	34	100	91	57	148	138	168	148
Over 69½	711	334	1,045	41	20	61	39	43	82	95	215	134
All ages	6,439	3,035	9,474	196	95	291	404	213	617	206	224	212

investigation has revealed that when the expected deaths are calculated by a population table the percentages of actual to expected deaths are similar for the two age-groups. In fact, as might be expected, the mortality of pensioners is related to that of the general population rather than to the experience of annuitants or assured lives.

Table 3. Four Offices' Pilot Experience, 1947-51

Exposed to risk

Age	Duration					
	0	1	2	3	4	5 and over
60	228	—	—	—	—	—
61	59	213	—	—	—	—
62	38	63	193	—	—	—
63	30	46	54	176	—	—
64	129	29	43	44	159	—
65	10,129	121	27	40	33	156
66	1,921	8,897	106	26	35	147
67	1,209	1,761	7,575	94	21	135
68	823	1,169	1,478	6,356	89	111
69	605	852	1,040	1,205	5,240	157
70	730	651	804	903	994	4,416
71	293	711	602	702	774	4,362
72	210	315	632	516	575	4,108
73	122	214	284	546	418	3,812
74	63	115	187	234	421	3,409
75	54	60	90	158	189	2,870
76	24	43	53	62	120	2,221
77	13	19	32	45	48	1,595
78	3	9	16	23	34	1,035
79	4	1	7	12	18	629
80	2	2	—	7	6	393
81	—	2	3	1	5	236
82	—	—	1	2	1	137
83	—	—	—	—	2	86
84	—	—	—	—	—	54
85	—	—	—	—	—	29
Total	16,689	15,293	13,227	11,152	9,182	30,098

In view of the results obtained from the pilot investigation, there seems to be no particular justification for reconstituting the main investigation on a select basis. Consideration has also been given to the possibility that a policy-year method might be more accurate than the census method, and to examine this question a supplementary investigation was carried out by one of the offices, using its own data. The rates of mortality resulting from the two methods proved almost identical, except at age $64\frac{1}{2}$, where there was some distortion under the census method owing to the uneven spread of new entrants over the calendar year. Data below $64\frac{1}{2}$ are scanty and, since the census method provides satisfactory mortality rates at all ages from $65\frac{1}{2}$ upwards, there seems no sufficient reason for supplanting it by a policy-year method—particularly as it is understood that some of the contributing offices would find difficulty in

adapting their records to produce returns in the form which would then be required.

As a result of the foregoing tests it has been decided to maintain the existing aggregate investigation and to continue to employ the census method. The question of class variations remains, for the time being, unsolved. As was remarked in the earlier report cited above, the experience is an amalgam of many social classes. Consequently, discrimination and caution are needed when interpreting the emerging mortality.

APPENDIX

The experience for the Four Offices' Pilot Investigation, 1947-51, was taken out on a five years select basis by a policy-year method, using nearest age at the policy anniversary. The formulae for building up the exposed to risk were:

$$\text{Duration 0} \quad E_{[x]} = n_{[x]} + (1-s) b_{[x]} - (1-s) e_{[x]},$$

$$\begin{aligned} \text{Durations 1-4} \quad E_{[x]+t} = & E_{[x]+t-1} + s b_{[x]+t-1} + (1-s) b_{[x]+t} \\ & - s e_{[x]+t-1} - (1-s) e_{[x]+t} - \theta_{[x]+t-1}, \end{aligned}$$

$$\begin{aligned} \text{Ultimate} \quad E_x = & E_{x-1} + s b_{x-1} + (1-s) b_x - s e_{x-1} - (1-s) e_x - \theta_{x-1} \\ & + E_{[x-5]+4} + s b_{[x-5]+4} - s e_{[x-5]+4} - \theta_{[x-5]+4}, \end{aligned}$$

where s = mean period from date of retirement to end of calendar year, calculated separately for each of the four offices. In practice it was found to vary between .55 and .6.

Withdrawals were very few in number and were ignored.

Table 4. Four Offices' Pilot Experience, 1947-51

Deaths

Age	Duration						All durations
	0	1	2	3	4	5 and over	
60	7	—	—	—	—	—	7
61	—	2	—	—	—	—	2
62	1	1	4	—	—	—	6
63	3	1	2	3	—	—	9
64	9	1	3	3	—	—	16
65	344	7	1	—	2	4	358
66	73	325	6	—	1	6	411
67	61	64	304	3	2	4	438
68	37	51	84	292	3	4	471
69	35	30	51	56	253	10	435
70	41	40	42	44	48	236	451
71	9	44	36	34	46	282	451
72	12	15	33	34	38	255	387
73	5	12	25	40	28	226	336
74	4	9	9	15	33	253	323
75	6	4	11	14	10	231	276
76	1	3	6	4	16	200	230
77	—	—	3	4	1	156	164
78	—	—	1	2	7	124	134
79	1	—	—	1	5	59	66
80	—	—	—	1	2	49	52
81	—	1	—	—	—	33	34
82	—	—	—	—	—	18	18
83	—	—	—	—	—	12	12
84	—	—	—	—	—	11	11
85	—	—	—	—	—	3	3
Total	649	610	621	550	495	2176	5101

Table 5. Four Offices' Pilot Experience, 1947-51
Percentages of actual to expected deaths by $a(m)$ ultimate

A. Analysis by attained age and duration

Age	Duration						All durations
	0	1	2	3	4	5 and over	
65	111	—	—	—	—	—	112
66	116	111	—	—	—	—	112
67	142	102	113	—	—	—	114
68	116	113	147	120	—	—	122
69	140	86	119	112	117	—	116
70	124	138	117	110	109	120	119
71	—	129	124	100	124	134	126
72	—	—	100	126	127	119	117
73	—	—	—	129	117	104	109
74	—	—	—	—	127	119	117
75	—	—	—	—	—	117	117
76	—	—	—	—	—	118	120
77	—	—	—	—	—	131	111
78	—	—	—	—	—	131	131
79	—	—	—	—	—	94	99
80	—	—	—	—	—	114	116
65-80	116	110	119	116	118	118	116

B. Analysis by retirement age

Retirement age	65	66	67	68	69	70
Durations 0-4	114	117	122	108	129	122

C. Comparison between retirement age 65 and retirement ages 66-70

Duration	0	1	2	3	4	0-4
Retirement age 65	111	111	113	120	117	114
Retirement ages 66-70	126	111	124	114	114	119