CONTINUOUS MORTALITY INVESTIGATION

MORTALITY OF ASSURED LIVES:
EXPERIENCE FOR 1953–58

THE experience of assured lives, medical and non-medical combined, for the period 1953–58, has been compared with the A 1949–52 table and the results are summarized in Table 1. Reference to individual years will be found in the periodical notes prepared by Mr H. A. R. Barnett under the title *Population Mortality and Assured Lives' Mortality in Great Britain—A Comparison of Trends* (the last such note related to 1948–55 and was published in *J.I.A.* **84**, 287, and *T.F.A.* **26**, 115).

The results show appreciable reductions in mortality, compared with the A 1949–52 table, and these reductions are most marked at ages under 50 in the ultimate section, i.e. at durations 2 and over. It can be seen from Table 1 that, whereas the ratios of actual to expected deaths lie generally between 90 % and 100 % at durations 0 and 1 and also at ages over 50 at durations 2 and over, for deaths at ages below 50 at durations 2 and over the ratios are all less than 90 %. This reduction at younger ages accords with the experience of the general population as revealed by the statistics of the Registrar General.

Certain of the features in Table 1 arise from the graduation of the 1949–52 data. Thus the graduated curve cut through the slight 'hump' caused by heavy accident deaths in the age-group 20–24 so that the rates of mortality at these ages in the A 1949–52 table are lower than the ungraduated rates—particularly at durations 0 and 1. Other age-groups where the percentages are materially affected by variations between the graduated curve and the ungraduated data are: 30–34, 65–69 and 95–99.

In order to provide a more exact comparison with the period 1949–52, Table 2 has been compiled showing percentages of actual deaths in 1953–58 to expected deaths on the basis of actual experience in 1949–52. The corresponding percentages from Table 1 have been set out along-side for comparison. The upward trend of the percentages with increasing age at durations 2 and over is even clearer when the expected deaths are calculated on an experience basis and the only important interruption is at the age-group $55\frac{1}{2}$–$59\frac{1}{2}$ where actual deaths in 1953–58 were 99 % of those expected by the 1949–52 experience. The growing steepness of the mortality curve between ages 40 and 55, which was noted when the A 1949–52 table was prepared, has been accentuated.

At durations 0 and 1 the data are less numerous and the percentages more variable. Nevertheless, it is noteworthy that in the age-group

$20\frac{1}{2}$–$24\frac{1}{2}$ the percentages remain high (100% at duration o and 102% at duration 1) even after they have been reduced by being related to the actual experience of the earlier period.

Experiment has shown that the assured lives' mortality for 1953–58 at durations 2 and over may be approximately related to the A 1949–52 table by the following formula:

$$q_x (1953\text{–}58) = \cdot95\, q_x\, (\text{A}\,1949\text{–}52) - \cdot0002.$$

Expected deaths have been computed on the basis of the right-hand side of this equation and the resulting percentages of actual to expected deaths are as follows:

Age-group	100 A/E	Age-group	100 A/E
$-19\frac{1}{2}$	91	$65\frac{1}{2}$–$69\frac{1}{2}$	96
$20\frac{1}{2}$–$24\frac{1}{2}$	108	$70\frac{1}{2}$–$74\frac{1}{2}$	98
$25\frac{1}{2}$–$29\frac{1}{2}$	97	$75\frac{1}{2}$–$79\frac{1}{2}$	100
$30\frac{1}{2}$–$34\frac{1}{2}$	99	$80\frac{1}{2}$–$84\frac{1}{2}$	100
$35\frac{1}{2}$–$39\frac{1}{2}$	101	$85\frac{1}{2}$–$89\frac{1}{2}$	104
$40\frac{1}{2}$–$44\frac{1}{2}$	98	$90\frac{1}{2}$–$94\frac{1}{2}$	101
$45\frac{1}{2}$–$49\frac{1}{2}$	96	$95\frac{1}{2}$–$99\frac{1}{2}$	93
$50\frac{1}{2}$–$54\frac{1}{2}$	101	$100\frac{1}{2}$–	70
$55\frac{1}{2}$–$59\frac{1}{2}$	104	All ages	100
$60\frac{1}{2}$–$64\frac{1}{2}$	100		

Table 1. *Assured Lives* 1953–58: *Comparison of actual and expected deaths by the* A 1949–52 *table*

Age-group	Duration o			Duration 1			Durations 2 and over		
	Actual deaths	Expected deaths	100 A/E	Actual deaths	Expected deaths	100 A/E	Actual deaths	Expected deaths	100 A/E
$-19\frac{1}{2}$	58	55	105	42	42	100	52	74	70
$20\frac{1}{2}$–$24\frac{1}{2}$	200	183	109	171	152	113	387	466	83
$25\frac{1}{2}$–$29\frac{1}{2}$	160	204	78	181	220	82	1,031	1,379	75
$30\frac{1}{2}$–$34\frac{1}{2}$	177	190	93	194	220	88	1,808	2,326	78
$35\frac{1}{2}$–$39\frac{1}{2}$	194	196	99	220	240	92	2,982	3,589	83
$40\frac{1}{2}$–$44\frac{1}{2}$	298	282	106	335	371	90	6,393	7,463	86
$45\frac{1}{2}$–$49\frac{1}{2}$	336	371	91	488	513	95	12,459	14,307	87
$50\frac{1}{2}$–$54\frac{1}{2}$	333	337	99	504	519	97	19,738	21,115	93
$55\frac{1}{2}$–$59\frac{1}{2}$	202	212	95	327	353	93	22,085	22,794	97
$60\frac{1}{2}$–$64\frac{1}{2}$	106	111	95	166	192	86	17,007	18,003	94
$65\frac{1}{2}$–$69\frac{1}{2}$	46	48	96	60	98	61	10,479	11,512	91
$70\frac{1}{2}$–$74\frac{1}{2}$	8	14	57	22	31	71	11,002	11,816	93
$75\frac{1}{2}$–$79\frac{1}{2}$							11,810	12,504	94
$80\frac{1}{2}$–$84\frac{1}{2}$							9,455	9,919	95
$85\frac{1}{2}$–$89\frac{1}{2}$							5,230	5,303	99
$90\frac{1}{2}$–$94\frac{1}{2}$	—	—	—	—	—	—	1,757	1,826	96
$95\frac{1}{2}$–$99\frac{1}{2}$	—	—	—	—	—	—	273	307	89
$100\frac{1}{2}$–	—	—	—	—	—	—	21	32	66
All ages	2,118	2,203	96	2,710	2,951	92	133,969	144,735	93

Table 2. *Percentages of actual deaths for* 1953–58 *to deaths expected on* (A) *the ungraduated data for* 1949–52, *and* (B) *the* A 1949–52 *table*

Age-group	Duration 0		Duration 1		Durations 2 and over	
	A	B	A	B	A	B
20½–24½	100	109	102	113	77	83
25½–29½	79	78	68	82	75	75
30½–34½	86	93	87	88	82	78
35½–39½	95	99	97	92	81	83
40½–44½	107	106	89	90	86	86
45½–49½	85	91	94	95	86	87
50½–54½	89	99	99	97	92	93
55½–59½	102	95	81	93	99	97
60½–64½	90	95	123	86	95	94
65½–69½	—	—	—	—	95	91
70½–74½	—	—	—	—	94	93
75½–79½	—	—	—	—	97	94
80½–84½	—	—	—	—	94	95
85½–89½	—	—	—	—	102	99
90½–94½	—	—	—	—	98	96
95½–99½	—	—	—	—	111	89

EXPERIENCE OF CHILDREN'S DEFERRED
ASSURANCES 1949–58

IN *J.I.A.* **77**, 106, and *T.F.A.* **20**, 86, the deaths under children's deferred assurances in 1947–48 were compared with those expected according to the mortality rates experienced by assured lives at durations 3 and over during the same two years. The comparison is recapitulated in Table 1.

Table 1. *Children's deferred assurances, 1947–48. Comparison of actual deaths with expected deaths on the basis of the 1947–48 experience of assured lives, durations 3 and over*

Age-group	Actual deaths	Expected deaths	100 A/E
21–25	37	38	97
26–30	34	27	126
31–35	14	13	108
36–40	12	13	92
41–45	12	12	100
46–50	7	10	70
51–55	7	5	140
56–	5	4	125
All ages	128	122	105

It was suggested, from the figures reproduced in Table 1, that there might be no significant difference between the mortality of children's deferred assurances after vesting and that of the main body of assured lives. Although the figures at most ages supported this suggestion, it is at the same time surprising that there was no apparent evidence of the effects of any negative selection on the exercise of the option, which would be likely to cause an excess of actual deaths soon after vesting— i.e. in the youngest age-group. If, in fact, any such negative selection was present in the 1947–48 data, it showed itself in the 26–30 age-group only.

The experience of the ten years 1949–58 has now been investigated, subdivided into three periods, 1949–52, 1953–55 and 1956–58. The actual deaths in each period were compared with the deaths expected according to the ungraduated experience of the main body of assured lives at durations 5 and over during the same period. Unlike the 1947–48 investigation already mentioned, the differences between actual and expected deaths were quite significant in the younger age-groups. The comparison is given in Table 2. It must of course be remembered that the great majority of the assurances vested at age 21, and a small minority

only at age 25, whilst the assured lives experience upon which the expected deaths were based consisted of only scanty data at the durations in question in the lowest age-group.

Table 2. *Children's deferred assurances, 1949–58, subdivided into three periods. Comparison of actual deaths in each period with expected deaths on the basis of the ungraduated experience of assured lives at durations 5 and over during the same period*

Age-group	Actual deaths	Expected deaths	100 A/E	Actual deaths	Expected deaths	100 A/E
		1949–52			1953–55	
−25	86	59	146	52	39	133
26–30	70	50	140	63	34	185
31–35	41	30	137	32	31	103
36–40	33	25	132	18	19	95
41–45	26	26	100	26	21	124
46–50	32	25	128	26	24	108
51–55	21	18	117	13	19	68
56–60	14	12	117	11	13	85
61–	8	8	100	11	14	79
All ages	331	253	131	252	214	118
		1956–58			1949–58	
−25	52	29	179	190	127	150
26–30	42	32	131	175	116	151
31–35	36	29	124	109	90	121
36–40	26	25	104	77	69	112
41–45	26	22	118	78	69	113
46–50	24	28	86	82	77	106
51–55	19	25	76	53	62	85
56–60	18	19	95	43	44	98
61–	18	24	75	37	46	80
All ages	261	233	112	844	700	121

The differences between actual and expected deaths displayed by Table 2 suggest that the results already published for 1947–48 may have themselves been abnormal in their lack of significant differences between the experience of children's deferred assurances and that of the main body of assured lives. Although this is mere speculation, a possible explanation may lie in the fact that for the years immediately following the end of World War II the main assured lives' data were exceptionally short of exposures at the shorter durations, particularly at the younger ages, so that in 1947–48, roughly eight years after the outbreak of war, the shortages might extend as far as duration 7. This would mean that the duration 3 and over exposures, upon which the comparison reprinted in Table 1 was based, would be of a higher average duration than

in normal times, giving a heavier than normal mortality experience, and thus the number of expected deaths based on such experience would also be unusually high. In other words, it is possible that the actual deaths in 1947–48 in the children's deferred assurance experience at the younger ages were close to the expected deaths only because the expected deaths themselves were abnormally numerous. The relative figures of exposures at durations 3, 4, and 5 and over have been examined and confirm that this could be the case, and it does seem that the suggestion made in the earlier report should not be regarded by itself as in any way conclusive.

The statistics given in Table 2 are difficult to interpret. An examination of the three separate periods suggests that differences between actual and expected deaths were significant at least up to age 40 in 1949–52, although possibly only to age 30 in 1953–55 and age 35 in 1956–58. It is possible that the data have been affected by the exercise of options in abnormal conditions during and shortly after the war; but consideration of the figures for the whole 10 years leaves no doubt that the excess mortality was significant at least to age 35.

It is therefore suggested that:

(1) The 1947–48 comparison between children's deferred assurances and the main body of assured lives was probably distorted by special features in both sets of data.

(2) Negative selection at the option date remains in evidence probably for at least 10 years in normal times.

The effect of (2), though statistically significant, is very small financially in terms of the theoretical premium for a child's deferred assurance, since the rates of mortality at the ages where the negative selection persists are still very low. It is accordingly considered that the investigation has served its purpose in indicating the presence and approximate extent of the negative selection, and no further data for this class of business are being collected from the contributing offices.