AN INVESTIGATION INTO THE MORTALITY OF DIABETIC PATIENTS ATTENDING THE DIABETIC CLINIC OF KING'S COLLEGE HOSPITAL

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In 1946, the data available in the records of the diabetic clinic of King's College Hospital, Denmark Hill, London, S.E., were made available by the courtesy of the Physician-in-charge, R. D. Lawrence, M.D., F.R.C.P. This note describes the investigations made and suggests improvements which should be made in the data when a further investigation is contemplated.

All the lives included in the data were diabetics; we are not concerned here with the problem of diagnosis. It was not possible to make any distinction between diabetics controlled by insulin and diabetics controlled by diet only. The data relate to the calendar years 1936–45, both inclusive. It is greatly to be regretted that the ten years covered by the investigation include all the war years with the complications following evacuation and the special conditions of those six years.

The particulars of each diabetic are recorded on cards kept at the clinic; the following particulars were extracted:

(1) Name.

(2) Sex.

(3) Age on admission to the clinic.

(4) Calendar year of diagnosis.

(5) Year of admission to the clinic.

(6) Year of exit.

(7) Year of expiry of contact with the clinic.

(8) Mode of exit: (*a*) by death, (*b*) by survival established either by reply to the circular or by attendance, (*c*) by default.

These particulars require some explanation; the cards kept at the clinic were not ideal from a statistical point of view, though the records were perfectly satisfactory for the clinic. Broad assumptions had to be made in order to produce any results.

Age on admission was assumed to be 'age last birthday'; no proof of age was obtained, as the clinic has no particular concern with the accuracy of the ages stated.

Year of diagnosis was established by inquiry; in many cases it differed from the year of first attendance. In cases where the year of diagnosis was not stated, the year of first attendance at the clinic was recorded. With this data, an investigation according to 'duration since diagnosis' was impossible; this was unfortunate, as it seems probable that duration is an important factor.

Difficulties with the mode of exit proved the main drawback to the data. The fundamental rule in any mortality investigation is that the recorded deaths

should be accurately related to the exposed to risk. It is impossible to be satisfied that this requirement was met. Naturally, attendance at the clinic is voluntary; in cases well controlled either by insulin or diet or both, there may be little incentive to make the periodic attendances recommended by the clinic. If these attendances are maintained, no problem should arise; cases would either be 'survivors' on 31 December 1945 or 'deaths' at some earlier date. In fact, mode of exit (*b*) was recorded on some cases years before the close of the ten-year period; it was therefore assumed that after the date of exit in such cases the history of the patient was uncertain, and those cases were treated as exits on the date recorded.

Where attendance is neglected, the clinic endeavours to keep in touch by sending out circulars as a reminder; by attendance following the reminder or by reply by letter, the survival of a patient may be established. Unfortunately, many do not reply to the circular; for a variable period, at least 2 years, these circulars are sent out; if no reply is obtained to successive circulars, the case concerned is written off and no further attempts at contact are made. A good deal of speculation is possible regarding those patients who do not reply to circulars; some may have died and, of these deaths, some may have been reported and some may not. It was finally decided to cut out all exposure after the date on which the last circular was sent. It must be admitted that the problem of these untraced lives is unsolved. However, it is felt that the difficult conditions of the war years were responsible for the large number untraced; since the war, the clinic has made strenuous attempts to improve the results of their follow-up, and it is possible that the problem may be less important in future.

At one time, it was hoped to use further details; the amount of insulin taken, heights and weights, blood pressures and pulse rates are all items which may have a direct bearing on the mortality of diabetics. These details were not uniformly obtainable so that further elaboration was impossible.

Though the diabetic clinic of King's College Hospital is believed to be the largest in the United Kingdom, the number of lives involved proved disappointing. The actual data were:

	Males	Females
Lives	1,987	2,867
Years of exposure	6,846	10,621
Deaths	305	430

It will be observed that the ratio of males to females is approximately 2:3, a feature which it is believed is usual. It may be mentioned that Dr R. D. Lawrence has estimated the number of diabetics in the United Kingdom to be 150,000.

The data were sorted and tabulated with the help of Hollerith machines; an assumed year of birth was obtained mechanically, by deducting the age at entry from the year of entry. It was expected that the experience would be disrupted by the war years; the data were therefore tabulated so that the exposed to risk were obtained for each separate year. The convenient assumption was made that entry and exit took place on the average half-way through the year. In view of the small numbers, the data were arranged in quinary age-groups.

The following schedule shows the exposed to risk, deaths, entrants and other exits for each calendar year:

Calendar year	Exposed to risk	Deaths	Entrants	Exits other than by death
		Males		
1936	472	31	125	50
1937	524	24	140	48
1938	594	31	170	73
1939	662	33	157	58
1940	709	38	151	89
1941	743	32	148	65
1942	792	34	157	79
1943	828	37	175	113
1944	807	30	130	160
1945	715	15	200	295
	6846	305		
		Females		
1936	757	38	231	85
1937	864	48	221	77
1938	953	56	265	135
1939	1041	54	240	83
1940	1097	47	172	108
1941	1120	39	169	93
1942	1183	44	207	79
1943	1243	45	217	136
1944	1238	34	197	199
1945	1125	25	264	421
	10621	430		

It will be apparent that the deaths recorded in 1945 are extremely low compared with the previous years; this applies to both sexes.

The following schedules show the actual deaths by age groups and the ratio of (actual − expected deaths) to the deaths expected according to E.L. No. 10 for the following periods:

(1) 1936–40 inclusive,

(2) 1941–44 inclusive,

(3) 1936–44 inclusive.

Data relating to ages above age 80 and below age 20 have been omitted because the deaths recorded are too few.

Fig. 1 shows, for two of the three broad age groups and for the three groups combined, the progression of (A − E)/E expressed as a percentage for each calendar year.

It will be observed that the data relating to 1945 has been excluded; the tables showing the movement by calendar years will show why this was done; in 1945 there was an exceptionally large number of exits 'by default', and in view of this it was considered that the results for 1945 were unreliable. The

Age group	1936–40		1941–44		1936–44	
	Actual deaths	$\frac{A-E}{E}$ %	Actual deaths	$\frac{A-E}{E}$ %	Actual deaths	$\frac{A-E}{E}$ %
			Males			
21–25	1	100	4	400	5	285
26–30	4	700	1	43	5	317
31–35	5	525	3	275	8	400
36–40	7	483	4	186	11	323
41–45	5	257	2	18	7	126
46–50	4	100	9	260	12	189
51–55	10	203	5	79	15	146
56–60	19	192	14	112	33	152
61–65	23	100	23	117	46	108
66–70	32	118	26	70	58	93
71–75	22	63	24	85	46	74
76–80	16	122	9	20	25	70
21–40	17	467	12	224	29	333
41–60	38	188	30	121	68	154
61–80	93	98	82	77	175	88
21–80	148	135	124	95	272	115
			Females			
21–25	2	300	1	150	3	233
26–30	3	500	6	1400	9	900
31–35	3	400	6	650	9	543
36–40	4	344	2	122	6	233
41–45	5	317	6	300	11	307
46–50	4	60	13	442	17	247
51–55	10	96	6	20	16	58
56–60	32	196	16	72	48	139
61–65	48	144	20	9	68	79
66–70	43	103	30	19	73	57
71–75	53	152	31	55	84	105
76–80	24	83	16	48	40	67
21–40	12	380	15	500	27	440
41–60	51	160	41	125	92	143
61–80	168	124	97	31	265	78
21–80	231	138	153	61	384	100

large number of these exits 'by default' for this particular year is probably explained by the dates when the data were extracted from the cards of the clinic, the dates being October and November 1946; it is probable that the follow-up of patients failing to attend in 1945 had not been completed. It will also be seen that the deaths recorded for 1945 are exceptionally low; this leads to the suggestion that some deaths may have failed to be recorded for 1945, and those cases may have been regarded as exits 'by default'.

The statistical defects of this investigation may be considered to be so serious that no conclusions, however tentative, should be drawn from it. The two main defects are:

(i) the unsolved problem of exits 'by default',
(ii) the comparatively small numbers involved.

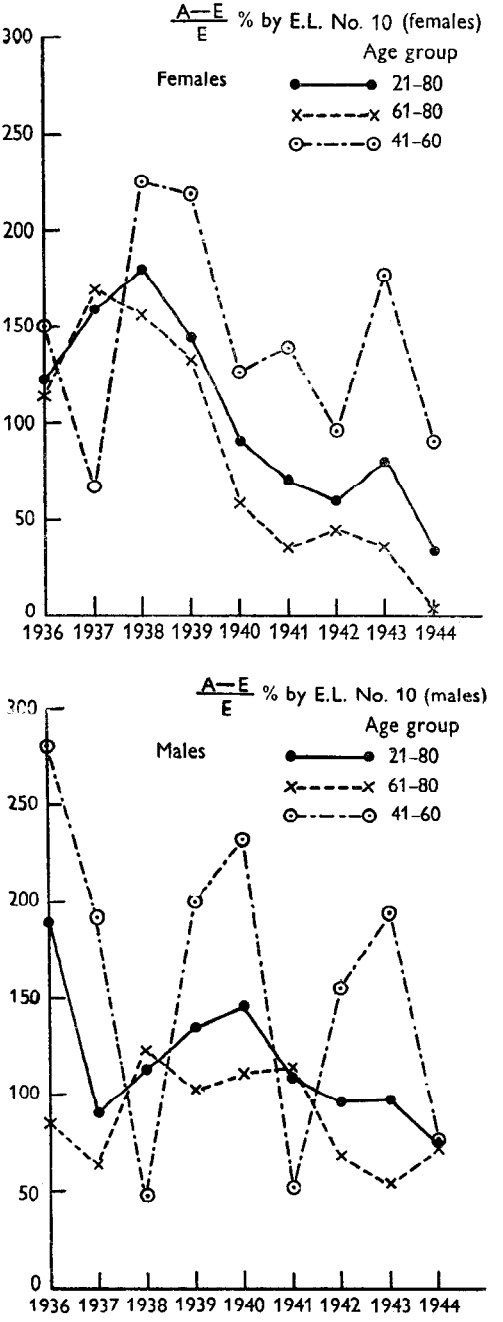
A—E / E % by E.L. No. 10 (females)
Age group
Females
21–80
61–80
41–60
300
250
200
150
100
50
0
1936 1937 1938 1939 1940 1941 1942 1943 1944
A—E / E % by E.L. No. 10 (males)
Age group
Males
21–80
61–80
41–60
300
250
200
150
100
50
0
1936 1937 1938 1939 1940 1941 1942 1943 1944

Fig. 1

However, the following points may be mentioned:

(*a*) The degree of extra mortality appears to decrease as the age increases; extremely high percentages (based on very few actual deaths) decrease to remarkably low percentages at the older ages. This tendency is present for both sexes; indeed, there is a similarity between the figures for the two sexes both relatively and absolutely.

This decrease with increasing age is not altogether surprising; it is considered that there are two forms of diabetes, the more serious generally occurring in early life, the less serious being the form in which the disease attacks older people. It is also believed that the mortality in the years immediately after the onset is extremely high, decreasing as the diabetic becomes stabilized and adapts his way of life to the diabetic regimen. This point might be clarified by an investigation in a 'select' form.

(*b*) Although the figures progress erratically, there appears to be an improving trend over the period. This seems a more definite trend for females than for males.

In the U.S.A., an investigation into the mortality experience of the diabetic patients of the George F. Baker Clinic of the New England Deaconess Hospital at Boston was made by the Statistical Bureau of the Metropolitan Life Insurance Company. It is not known how many lives were involved; the experience of both sexes was aggregated. The following 'death-rates per 1000' for the period 1939–45 were published in the *Statistical Bulletin of the Metropolitan Life Insurance Company* in August 1947, Vol. XXVIII, no. 8.

Age	Death-rates per 1000
10	4·6
15	5·6
20	7·6
25	10·1
30	9·8
35	9·4
40	10·4
45	15·2
50	24·3
55	36·4
60	52·4

Up to age 50, these rates are lighter than those of the experience described in this note; at ages 55 and 60 the rates are heavier. However, a detailed comparison was not considered worth while, as the conditions under which the two clinics work may be entirely different.

It is hoped that any future investigation of the experience of this, or any other, clinic will lead to more positive results. If this is to be the case, it will be necessary to ensure that contact with the patients is efficiently maintained; also, as a 'select' investigation is desirable, an accurate record of the year of diagnosis is required. However, it is believed that this is the first investigation into the mortality of diabetics to be carried out in this country, and it is hoped that it will be of interest.

It is tempting to draw some conclusions regarding the terms on which selected diabetics could be accepted for life assurance; but it is considered that no definite conclusions can be drawn.

First, is the sample of diabetics attending the clinic a representative sample of the whole population? Subject to the fact that the patients are drawn from Greater London and the Home Counties, it is believed that the sample is representative as far as age, sex and social status are concerned; but the patients of the clinic may be obtaining better treatment than is uniformly secured, and this may be reflected in the mortality experience.

Secondly, what special characteristics would be expected of a body of diabetic lives accepted for life assurance? Several points arise:

(*a*) Assured diabetics would not be accepted if there were additional adverse features such as overweight or high blood pressure.

(*b*) Assured diabetics would almost certainly not include cases of recent diagnosis; stabilization over a period of years would be considered essential, and therefore the high mortality believed to prevail in the early years after onset of the disease should be avoided.

(*c*) Assured diabetics would probably tend to be drawn from the wealthier section of the diabetic population; this might have an adverse or a favourable effect. It is likely that the incidence of diabetes would be higher in the higher income groups, but it is not known if the mortality would also be higher.

(*d*) Some self-selection by proposing diabetics might be found; the best diabetics might feel that the terms offered were too severe and might decline to proceed. Since the health of a diabetic rests to a large extent in his own hands, this may be important.