INCIDENCE OF DIABETES MELLITUS IN OSLO, NORWAY 1925 TO 1954

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The main purpose of the present report is to describe the fluctuations of diabetes incidence in Oslo (including Aker) in relation to the second world war.

The study is based on hospital records. Accordingly, some consideration will be given to the adequacy of hospital records in the epidemiological study of diabetes. The use of hospital records for epidemiological purposes has recently been discussed in general terms by Masi (1965).

Finally, the report will examine how closely an analysis based on death certificates can approximate the findings of the hospital material analysis.

MATERIAL AND METHODS

The study includes residents of Oslo* who in the period 1925-55 were hospitalized for the first time with a diagnosis of diabetes mellitus. Data have been collected from thirteen departments of paediatrics or internal medicine, nine of which were in operation during the entire period 1925-55, and diabetics have been identified by means of diagnostic indexes or discharge protocols from all years. Two departments started their work in 1948 and 1951 respectively, and data have been collected from then onwards. In one department, which had been functioning throughout the period, it was possible to identify diabetics only from 1932 onwards. One

department, situated outside Oslo, received Oslo patients during the period 1925-29 and data have been included for these years.

The records were studied and relevant information extracted, but in 24 cases the record could not be found. 660 patients were excluded from the survey because they had been hospitalized with diabetes before their first registered admission to the departments in the study. Roughly 25 per cent. of these patients were known to have been hospitalized with diabetes before 1925, and another 25 per cent. had been hospitalized in 1925 or later outside Oslo and were probably non-residents at the time. The remaining half of the 660 patients excluded had been previously hospitalized in an Oslo department in 1925 or later (mostly in surgical or other non-medical departments), but it was decided to omit them because of the difficulty of ascertaining from the records such information as the year of first diagnosis, the time and reason for first hospital admission, and the place of residence at first admission.

Included in the survey are 4,251 diabetics, residents of Oslo and Aker at the time of first hospitalization with a diabetes diagnosis. In preparing incidence estimates each patient was referred to the year of diagnosis and to the age at diagnosis. Patients with year of diagnosis outside 1925-54 or not known were not taken into account in the rate computations. The population of Oslo and Aker was estimated by age for each of the years 1925-54. Because census data are not available between 1931 and 1946, the estimates are unreliable for the intervening years, but hardly to an extent which is important for the present study.

The material was collected from the following hospitals:
Ullevål, Dept I, VII, VIII, IX, and Krohgstøtten
Aker, Medical Dept A and B
Rikshospitalet, Paediatrics Dept and Medical Dept A and B
Lovisenberg, Medical Dept
Diakonhjemmet, Medical Dept
Bærum, Medical Dept

The information in the hospital records was coded by Helge Heistø, M.D. and Knut Westlund, M.D.
Machine tabulations were prepared by the Statistical Office of the Norwegian Life Insurance Companies.

* Oslo is taken to include also the suburbs of Aker.

No attempt was made to evaluate the quality of the diagnostic information. Obviously, there were great diagnostic variations with time, department, and age of patient. Table I shows the type of the diabetes diagnosis on the record. Very few had a question mark attached, but in many cases the diabetes diagnosis was subsidiary to some other disease.

TABLE I
DIABETES DIAGNOSIS ON HOSPITAL RECORD
IN INCLUDED CASES

Diagnosis		Sex		
		Males	Females	Total
Main	Without question mark	1,313	2,092	3,405
	With question mark	4	10	14
Subsidiary	Without question mark	347	407	754
	With question mark	13	21	34
Doubtful, Unavailable, Other		17	27	44
Total		1,694	2,557	4,251

Diabetes, even if recognized, was not always entered as a discharge diagnosis on the record if some other disease had caused the hospital stay. However, although most patients in the present study have been admitted repeatedly to one or more of the included departments, only very few were found in which the first admission had not been picked up through the diagnostic files. Therefore, the number of diabetics missed from the included departments is probably small compared with that of those patients who were never hospitalized, or were hospitalized in some other department only.

The degree of completeness of this material was tested by comparing it with lists of deaths in Oslo and Aker where diabetes had been mentioned as a main or contributory cause on the certificate. Such lists had been prepared by the Central Bureau of Statistics for the years 1937-39 and 1941-55 and were kindly placed at our disposal by Dr Harald Bjelke. These lists were also used for computing death rates with mention of diabetes.

To interpret the results of this comparison with the list of dead diabetics, it was necessary to determine how often diabetes is mentioned on the death certificates of diabetics. This was accomplished in the course of a mortality follow-up of the 3,832 patients who were discharged alive after their first hospital stay. The results of this mortality study are to be dealt with in a future report.

RESULTS

(A) COMPLETENESS OF HOSPITAL MATERIAL

Naturally, many patients in the series had had their diabetes for a long time when they were first hospitalized. Table II shows the relationship between year of diagnosis and year of first hospital discharge.

Of patients registered within 10 years of diagnosis, more than 80 per cent. had their first hospital discharge in the calendar year of diagnosis or the following year. The percentage is higher for males than for females in the period 1925-34, but the sex difference is slight thereafter. An analysis by age showed, as might be expected, that younger patients

TABLE II
DISTRIBUTION OF CASES ACCORDING TO INTERVAL BETWEEN YEAR OF REGISTRATION AND YEAR OF DIAGNOSIS

Sex	Year of Diagnosis	Year of Registration minus Year of Diagnosis						0 + 1 as Percentage of 0 - 9
		0	1	2-4	5-9	10-19	20+	
Male	Prior to 1925							
	1925-29	110	29	14	10	22	13	65
	1930-34	154	29	22	17	17	2	198
	1935-39	170	25	23	17	26	0	241
	1940-44	100	11	5	12	9	—	261
	1945-49	206	25	16	20	0	—	137
	1950-54	327	44	24	3	—	—	267
	1955	81	—	—	—	—	—	398
	Not known	—	—	—	—	—	—	81
	Total							46
Female	Prior to 1925							
	1925-29	180	27	38	21	30	6	84
	1930-34	225	50	51	38	25	6	302
	1935-39	292	38	43	22	28	0	395
	1940-44	151	13	13	7	4	—	423
	1945-49	321	56	35	23	0	—	188
	1950-54	471	49	24	2	—	—	435
	1955	113	—	—	—	—	—	546
	Not known	—	—	—	—	—	—	113
	Total							71
Total								2,557

tend to go into hospital sooner than older patients.

Of particular importance is the observation in Table II that patients whose diabetes was diagnosed in the war years, 1940-44, showed about the same pattern of delay in hospitalization as patients from other years.

It is obvious from Table II that, by prolonging the period of registration beyond 1955, one could pick up many cases in which the diagnosis was made in previous years. Nevertheless, the percentage addition to the series is likely to be small for years of diagnosis prior to 1950. Even for 1954 the downward bias is likely to be moderate. Therefore, incidence estimates will be presented for years up to and including 1954.

Table III shows that most persons in Oslo for whom diabetes was mentioned on the death certificate during the years 1937-55, were hospitalized at one time or another in the departments included in the present study. For the years 1951-55 this percentage reaches 84.8.

Conversely, Table IV shows that two-thirds of the patients discharged alive after their first stay had diabetes mentioned on the death certificate. The percentage is somewhat higher (72.7) in the last calendar year, presumably because of the introduction of the International Form of Medical Certificate of Cause of Death in 1951.

TABLE IV

PERCENTAGE PATIENTS DISCHARGED ALIVE AND FOLLOWED UNTIL 1961, WHO HAD DIABETES MENTIONED ON DEATH CERTIFICATE, BY AGE AT DEATH AND CALENDAR YEAR OF DEATH
(In parentheses: Number of deaths for which death certificate was found)

Year of Death	Age at Death		All Ages
	< 70	70+	
1925-40	64.0 (358)	60.2 (259)	62.4 (617)
1941-50	62.1 (335)	63.4 (432)	62.8 (767)
1951-61	72.0 (514)	73.3 (766)	72.7 (1,280)
All Years	66.9 (1,207)	68.0 (1,457)	67.5 (2,664)

Follow-up studies of Joslin's patients have shown that diabetes was mentioned on the certificate in 75 to 77 per cent. of deaths (Joslin and Krall, 1959).

Patients with a very mild diabetes are likely to have a smaller chance of hospitalization than other diabetics and also a smaller chance of having diabetes mentioned on the death certificate. If, however, we assume independence of the two risks, we should be able to discover $85 + 15 \times 0.73 = 96$ per cent. of all diagnosed diabetics in Oslo by utilizing death certificates and the files of departments of paediatrics and internal medicine. If surgical and other departments were included, the percentage could be increased.

This is not to belittle the possibilities for bias that would remain, even after such a coverage.

Table V shows that the probability that diabetes will be mentioned on the death certificate varies considerably with the cause of death. There was no difference between the sexes within cause groups.

TABLE V

PATIENTS DISCHARGED ALIVE AND FOLLOWED UNTIL 1961, WHO HAD DIABETES MENTIONED ON DEATH CERTIFICATE, BY CAUSE OF DEATH.

Underlying Cause of Death (as revised on basis of all available information)	No. of Deaths	Diabetes Mentioned	
		No.	Per cent.
Tuberculosis	93	67	72.0
Malignant tumours of digestive organs	154	73	47.4
Other malignant tumours	93	61	65.6
Diabetes mellitus	311	299	96.1
Apoplexy	472	322	68.2
Coronary heart disease	545	342	62.8
Diseases of respiratory system	209	148	70.8
Diseases of digestive organs	96	43	44.8
Diseases of urinary and genital organs	127	94	74.0
Suicide	13	4	30.8
Accidents	57	30	52.6
Other and unknown causes	494	315	63.8
Total	2,664	1,798	67.5
Death certificate not found	13		
Grand Total	2,677		

Of more importance is the fact that it is often of doubtful value to find a diabetic through the death certificate. In contrast to the situation with myocardial infarction, it will be difficult to obtain information from the certifying doctor as to year of diagnosis, not to mention other information which may be relevant in an epidemiological survey. In

TABLE III

DEATHS IN OSLO (inc. Aker) 1937-1955, WITH DIABETES MENTIONED ON CERTIFICATE, MATCHED WITH HOSPITAL SERIES

Year of Death	1937-39	1941-45	1946-50	1951-55
Diabetes on Death Certificate	243	307	456	586
Those who had been in included departments in 1925 or later with diabetes	174 71.6	235 76.5	372 81.6	497 84.8
Non-resident at time of hospitalization, or previous hospitalization, or record not found	29	33	52	64
Included in incidence material	145	202	320	433
Total	174	235	372	497

any event, the delay between diagnosis and death (or hospitalization) is frequently so long as to prevent anything like complete discovery of patients diagnosed in recent years.

One way of testing the adequacy of incidence rates based on the first admission to hospital is to compare the Oslo rates for 1925-39 with corresponding rates computed by Hanssen (1946) for Bergen. Hanssen made his survey in 1941-43 and utilized hospital records, death certificates, rationing cards, and requests to doctors to report cases. He probably compiled a very complete file of diagnosed diabetics in Bergen, but information about year of onset was lacking in about 10 per cent. of the patients. There is little reason to think that the true incidence rates were materially different in Oslo and Bergen during the years 1925-39.

Table VI compares the Bergen rates with the Oslo rates from the present study. For ages below 50 years the rates are very similar in the two studies. At age 50-69 the Bergen rates are so much higher

that the difference cannot be explained as chance variation, whereas the relationship is reversed at age 70 and above. These differences lie in the direction which would be expected from Hanssen's more comprehensive survey and from the fact that the Oslo rates in Table VI refer to age at diagnosis and the Bergen rates to age at onset.

The Tables suggest that the present series of cases, even if based on hospital records before 1956 only, is comprehensive enough to reflect with a fair degree of accuracy the real changes in disease incidence which occurred in connexion with the second world war.

(B) SOME CHARACTERISTICS OF THE SERIES

Table VII shows, by age and sex, the interval between diagnosis and hospital admission in the present series.

In about two-thirds of the patients, the diagnosis had either not been made, or had been made not more than one month before admission. There is little sex difference, but some variation with age. The percentage with a short duration of disease is lowest when the age at onset is 20 to 49 years.

The time of onset of symptoms is frequently difficult to assess on basis of the records. For only a few patients, however, did the history report symptoms for more than a few months before diagnosis.

The reason for detection of the disease can be seen from Table VIII (opposite).

Age is obviously of importance here. Below 20 years of age the diagnosis was established in about 80 per cent. of cases because the patients consulted a doctor for symptoms of diabetes. Above age 50,

TABLE VI
OSLO AND BERGEN, 1925-1939.
ESTIMATES OF DIABETES INCIDENCE PER 10,000
PER YEAR, BY SEX AND AGE.
(In parentheses: No. of cases 1925-39)

Age at Diagnosis/Onset (yrs)	Males		Females	
	Oslo	Bergen	Oslo	Bergen
0-9	.6 (19)	.6 (6)	.3 (11)	.4 (4)
10-19	1.2 (44)	1.1 (15)	1.0 (39)	.9 (12)
20-29	.9 (43)	.7 (11)	.7 (41)	.9 (15)
30-39	1.8 (76)	1.5 (18)	1.3 (67)	.8 (12)
40-49	3.8 (117)	3.2 (28)	3.4 (130)	3.6 (40)
50-59	7.3 (172)	10.2 (66)	10.0 (304)	10.6 (89)
60-69	11.1 (154)	15.0 (62)	15.9 (327)	21.4 (130)
70-79	10.1 (66)	7.8 (15)	15.7 (179)	11.3 (39)
80+	6.1 (9)	3.9 (2)	6.5 (22)	1.6 (2)

TABLE VII
INTERVAL BETWEEN DIABETES DIAGNOSIS AND FIRST HOSPITAL ADMISSION

Sex	Interval	Age at Diagnosis (yrs)								
		<20		20-49		50+		Un- known No.	Total	
		No.	Per cent.	No.	Per cent.	No.	Per cent.		No.	Per cent.
Male	Not diagnosed before admission	10	} 87·7	64	} 63·4	288	} 66·5	0	362	21·4
	Not more than 1 month	90		249		424		0	763	45·1
	More than 1 month, not more than 1 year	1	} 12·3	44	} 36·6	116	} 33·5	0	161	9·5
	More than 1 year	13		135		220		9	387	22·8
Doubtful	0	2		12		7		21	1·2	
	Total	114	100·0	494	100·0	1,070	100·0	16	1,694	100·0
Female	Not diagnosed before admission	10	} 80·5	60	} 63·3	499	} 66·4	0	569	22·3
	Not more than 1 month	73		237		800		0	1,110	43·4
	More than 1 month, not more than 1 year	4	} 19·5	50	} 36·7	211	} 33·6	0	265	10·3
	More than 1 year	16		120		423		18	577	22·6
Doubtful	0	2		23		11		36	1·4	
	Total	103	100·0	469	100·0	1,956	100·0	29	2,557	100·0

TABLE VIII
REASON FOR DETECTION OF DIABETES, BY AGE AT DIAGNOSIS AND SEX

Sex	Reason for Detection	Age at Diagnosis (yrs)								
		<20		20-49		50+		Un- known No.	Total	
		No.	Per cent.	No.	Per cent.	No.	Per cent.		No.	Per cent.
Male	Consulted doctor because of symptoms of diabetes	96	84.2	279	56.5	458	42.8	0	833	49.2
	Coma in previously unrecognized diabetes	0	—	2	.4	2	.2	0	4	.2
	Examination in connexion with some other disease or injury	5	4.4	96	19.4	374	34.9	1	476	28.1
	Health check	0	—	31	6.3	52	4.9	0	83	4.9
	Other and doubtful	13	11.4	86	17.4	184	17.2	15	298	17.6
	Total	114	100.0	494	100.0	1,070	100.0	16	1,694	100.0
Female	Consulted doctor because of symptoms of diabetes	82	79.7	307	65.5	1,033	52.8	2	1,424	55.6
	Coma in previously unrecognized diabetes	0	—	6	1.3	13	.7	0	19	.8
	Examination in connexion with some other disease or injury	10	9.7	77	16.4	580	29.7	0	667	26.1
	Health check	2	1.9	11	2.3	22	1.1	0	35	1.3
	Other and doubtful	9	8.7	68	14.5	308	15.7	27	412	16.2
	Total	103	100.0	469	100.0	1,956	100.0	29	2,557	100.0

this percentage was about 50, and one-third of the patients were diagnosed at the time of an examination for some other disease or injury.

The same age difference is seen in Table IX, which shows the reason for the first admission to hospital. Diabetes was usually the cause at ages below 20,

whereas at age 50 and above more than 30 per cent. were admitted because of other diseases. It is worth noting that twice as many females as males were admitted in coma or pre-coma, whereas the sex ratio is reversed for cases of insulin shock.

Because most of the cases were recently detected,

TABLE IX
REASON FOR FIRST HOSPITAL ADMISSION, BY AGE AT DIAGNOSIS AND SEX

Sex	Reason for Admission	Age at Diagnosis (yrs)								
		< 20		20-49		50+		Un- known No.	Total	
		No.	Per cent.	No.	Per cent.	No.	Per cent.		No.	Per cent.
Male	Coma or precoma	5	4.4	15	3.0	25	2.3	3	48	2.8
	Insulin shock	4	3.5	4	.8	8	.7		16	.9
	Other diabetic complications	0	—	6	1.2	57	5.3	2	65	3.8
	For adjustment of recently discovered diabetes	86	75.4	249	50.4	390	36.5	0	725	42.9
	For adjustment of previously recognized diabetes	6	5.3	84	17.0	135	12.6	3	228	13.5
	Other diseases	4	3.5	105	21.3	395	37.0	5	509	30.0
	Injuries	0	—	3	.6	8	.7	2	13	.8
	Other and doubtful	9	7.9	28	5.7	52	4.9	1	90	5.3
	Total	114	100.0	494	100.0	1,070	100.0	16	1,694	100.0
Female	Coma or precoma	7	6.8	23	4.9	65	3.3	2	97	3.8
	Insulin shock	1	1.0	3	.6	4	.2		8	.3
	Other diabetic complications	1	1.0	10	2.1	74	3.8	2	87	3.4
	For adjustment of recently discovered diabetes	72	69.8	235	50.2	791	40.4	0	1,098	42.9
	For adjustment of previously recognized diabetes	8	7.8	94	20.1	312	16.0	6	420	16.4
	Other diseases	8	7.8	86	18.3	589	30.1	10	693	27.1
	Injuries	0	—	3	.6	28	1.4	1	32	1.3
	Other and doubtful	6	5.8	15	3.2	93	4.8	8	122	4.8
	Total	103	100.0	469	100.0	1,956	100.0	29	2,557	100.0

TABLE X
PATIENTS WHO HAD EVER RECEIVED INSULIN BEFORE ADMISSION, BY AGE AT DIAGNOSIS AND SEX

Sex	Insulin Received before admission	Age at Diagnosis (yrs)								
		<20		20—49		50+		Un- known No.	Total	
		No.	Per cent.	No.	Per cent.	No.	Per cent.		No.	Per cent.
Male	Yes	13	11.4	57	11.5	66	6.2	1	137	8.1
	No	101	88.6	437	88.5	1,001	93.5	11	1,550	91.5
	Doubtful	0	—	0	—	3	.3	4	7	.4
	Total	114	100.0	494	100.0	1,070	100.0	16	1,694	100.0
Female	Yes	14	13.6	65	13.9	85	4.3	7	171	6.7
	No	89	86.4	404	86.1	1,867	95.5	19	2,379	93.0
	Doubtful	0	—	0	—	4	.2	3	7	.3
	Total	103	100.0	469	100.0	1,956	100.0	29	2,557	100.0

few patients had ever received insulin before admission. Table X shows that the percentage is smallest at ages above 50 years (around 5 per cent.).

At discharge more than half the patients had been put on an insulin regimen.

(C) INCIDENCE

The time trend for each sex by age group is shown in Table XI and in Fig. 1 (opposite). Cases are referred to year of diagnosis. Not all the patients will have

been residents at the time of diagnosis. The assumption is that in- and out-migration between diagnosis and first hospitalization introduces no serious bias.

For ages below 30 years at diagnosis the incidence has remained practically constant throughout the 30-year period. For ages 30-59 at diagnosis the incidence drops distinctly during the war of 1940-45, with a minimum in 1944 for males and in 1945 for females. Females in this age group show declining

TABLE XI
DIABETES INCIDENCE ESTIMATES, PER 10,000 PER YEAR, OSLO, 1925-54, BY AGE AT DIAGNOSIS AND SEX
(In parentheses: Number of patients diagnosed)

Sex	Age at Diagnosis	Male			Female		
		0-29	30-59	60+	0-29	30-59	60+
Year of Diagnosis	1925	1.0 (8)	3.9 (21)	8.4 (10)	.9 (8)	4.0 (27)	10.7 (21)
	1926	.6 (5)	3.8 (21)	9.0 (11)	.4 (4)	2.3 (16)	15.9 (32)
	1927	.3 (2)	3.1 (18)	11.1 (14)	.6 (5)	4.2 (30)	14.6 (30)
	1928	1.3 (10)	5.3 (31)	10.1 (13)	.6 (5)	3.3 (24)	16.1 (34)
	1929	.8 (6)	3.2 (19)	6.8 (9)	.6 (5)	4.7 (35)	12.0 (26)
	1930	.5 (4)	3.6 (22)	7.4 (10)	.8 (7)	3.8 (29)	12.2 (27)
	1931	1.2 (9)	3.6 (23)	12.9 (18)	.1 (1)	4.5 (35)	14.1 (32)
	1932	.9 (7)	4.6 (30)	8.3 (12)	— (0)	3.9 (31)	18.4 (43)
	1933	.9 (7)	4.5 (30)	16.8 (25)	.9 (8)	6.9 (57)	21.6 (52)
	1934	.5 (4)	3.8 (26)	7.1 (11)	.8 (7)	4.3 (36)	12.1 (30)
	1935	.7 (5)	4.3 (30)	14.5 (23)	1.0 (9)	5.0 (43)	12.2 (31)
	1936	1.6 (12)	2.4 (17)	10.4 (17)	.3 (3)	5.4 (48)	14.9 (39)
	1937	.8 (6)	3.1 (23)	10.1 (17)	1.0 (9)	2.9 (26)	18.3 (49)
	1938	1.0 (8)	4.4 (33)	11.0 (19)	1.0 (9)	3.7 (34)	17.5 (48)
	1939	1.3 (10)	2.7 (21)	11.2 (20)	1.3 (11)	3.2 (30)	12.1 (34)
	1940	.5 (4)	2.4 (19)	12.6 (23)	.9 (8)	2.6 (25)	11.4 (33)
Year of Diagnosis	1941	.9 (7)	2.0 (16)	5.9 (11)	.8 (7)	1.7 (17)	5.8 (17)
	1942	1.2 (9)	1.0 (8)	3.1 (6)	.9 (8)	.9 (9)	4.3 (13)
	1943	.4 (3)	1.3 (11)	3.0 (6)	.6 (5)	1.1 (11)	3.6 (11)
	1944	.8 (6)	.6 (5)	1.5 (3)	.7 (6)	1.0 (11)	2.2 (7)
	1945	.9 (7)	1.3 (11)	5.8 (12)	.5 (4)	.8 (9)	8.1 (26)
	1946	.7 (5)	3.0 (27)	11.4 (24)	.5 (4)	3.1 (34)	14.9 (49)
	1947	.8 (6)	2.8 (25)	11.9 (26)	.7 (6)	2.3 (26)	15.1 (51)
	1948	.4 (3)	2.8 (26)	8.8 (20)	.7 (6)	3.1 (35)	19.5 (68)
	1949	.6 (5)	3.4 (32)	16.2 (38)	.5 (4)	3.4 (38)	20.9 (75)
	1950	1.0 (8)	3.4 (32)	14.8 (36)	1.0 (9)	3.9 (44)	14.4 (53)
	1951	.5 (4)	3.3 (31)	11.5 (29)	1.0 (8)	3.0 (34)	17.3 (66)
	1952	1.1 (9)	3.4 (33)	14.4 (38)	.4 (3)	1.9 (22)	18.8 (75)
	1953	1.1 (9)	4.2 (40)	14.9 (41)	.6 (5)	2.5 (29)	21.3 (88)
	1954	.7 (6)	3.2 (31)	17.8 (51)	.7 (6)	1.7 (19)	19.8 (85)

FIG. 1.—Incidence of diabetes diagnoses in Oslo males and females, 1925–54, by year of diagnosis and age at diagnosis.

rates in 1950–54, well below the pre-war level. The decline can hardly be due purely to chance, but its cause is unknown.

For ages 60 and above at diagnosis the drop during the war is precipitous, with a minimum in 1944 almost down to the level of that in the younger age groups. Recovery is rapid, 1945 rates already exceed the rates of 1941, and in 1946 one is back on the pre-war level.

These changes in incidence during the war are quite different from those seen for myocardial infarction. Westlund (1965) has compiled a hospital series from Oslo for the years 1935–49 and again for 1956–61, which is thought to be comprehensive enough to reflect the true incidence of infarction. Fig. 2 is taken from that study. It shows that, for the age group 55–64 years, there was a drop during the war, but for males only. After the war the rise is much more rapid for males, and the incidence soars far above the pre-war level. For females the post-war rise is no greater than might conceivably

be ascribed to diagnostic and terminological artefacts. The findings for the age group 45–54 were similar.

That diabetes and myocardial infarction, despite the association that undoubtedly exists, are epidemiologically quite distinct, is also known from prospective studies. Fig. 3 (overleaf) is based on data from a 3-year follow-up of 6,886 men in Oslo by Westlund and Nicolaysen (1966).

Only 25 new cases of diabetes were diagnosed in the observation period, so that the risk relationships are imprecisely determined. The mean serum cholesterol for the 25 cases was 284 mg. per cent. compared with 271 mg. per cent. for those at risk who did not develop diabetes, a non-significant difference. Correspondingly, Fig. 3 shows no distinct trend with serum cholesterol, whereas the risk of a diabetes diagnosis is strongly associated with the weight/height ratio. In contrast, the risk of myocardial infarction in the same study was closely related to serum cholesterol, but unrelated to the weight/height ratio. It seems reasonable, therefore, to attribute the drop in diabetes incidence during the war to the disappearance of overweight. The reduction in infarction incidence indicates that not only the body weight but the serum cholesterol as well may have been lowered by the circumstances of wartime life and diet.

Numerous studies have been made of the effect of the war on Norwegian morbidity and mortality from a variety of non-infectious diseases.

Adelsten Jensen (1952) determined the number of post-operative thromboses or emboli per 1,000 operations in Oslo during the war. He found a sharp reduction, about equal for the two sexes and for the

FIG. 2.—First myocardial infarction diagnoses in Oslo residents at age 55–64 in five departments of internal medicine, per 10,000 population per year, 1935–49 and 1956–61.

FIG. 3—Incidence of diabetes diagnoses in relation to serum cholesterol and weight/height ratio in a 3-year follow-up of 6,886 males aged 40–59 years.

age groups 20–39, 40–59, and 60+. At the end of the war the two older age groups showed a rise, whereas the group 20–39 continued to show a low rate. Changes in the number of postoperative days in bed may be a partial explanation for the observed failure to reach pre-war levels.

Swank, Lerstad, Strøm, and Backer (1952) made a survey of cases of multiple sclerosis diagnosed in Norway during the period 1935–48. They found at most a slight reduction of cases diagnosed during the war.

Kolstad (1955) surveyed pernicious anaemia in the county of Buskerud in 1935–53. The mean number of new cases per year was only fourteen, but there was a suggestion of a levelling off during the war period of a long-term rise in diagnosed cases. A survey of pernicious anaemia in Oslo in 1935–60 is at present in progress.

Hospitalizations for peptic ulcer certainly increased in Norway during the war, but it is difficult to say how much of this is due to an increase in incidence. An increase in the ratio between gastric and duodenal ulcers was observed in several areas (Norbye, 1952). Andersen (1966) studied hospital statistics for six abdominal diseases in ten Norwegian hospitals 1921–60. During the second world war he found a fall in hospitalizations for cholecystitis and urolithiasis, a rise for peptic ulcer, inguinal hernia, and volvulus, and not much change in the long-term downward trend of hospitalizations for appendicitis. He concludes: "It appears therefore that the war years had a specific and characteristic effect on the incidence of abdominal diseases, in which diet played a large part."

Mortality studies, difficult to interpret in terms of incidence, by Strøm and Adelsten Jensen (1950) and

by Ustvedt (1959), suggest that apoplexy, which is very closely associated with blood pressure, declined in Norway during the war, about equally in both sexes. The return to pre-war levels was incomplete for ages under 60, but the mortality exceeded pre-war levels at higher ages, possibly because of diagnostic transfers. Strøm and Adelsten Jensen (1950) also gave blood pressure data from Oslo which show a reduction in mean pressure during the war.

Pedersen and Magnus (1959) have analysed the mortality time trends for the different types of malignant tumours in Norway. For cancer of the pancreas and for Hodgkin's disease they observed a small but distinct drop in the rates in 1944–46 compared with 1939–41 and 1949–51. This they attributed to a deterioration of the diagnostic services in Norway towards the end of the war. For other tumours, like lung cancer, the 1944–46 rate was slightly below the long-term trend line. For still other tumour types, like leukaemia and cancer of the uterus, the mortality rates appeared to be uninfluenced by the war.

Thus, it would seem that the influence of the war on Norwegian morbidity and mortality from non-infectious diseases is a very complex phenomenon, the distinction between reality and artefact being often difficult to draw.

There were epidemics of mumps in Oslo 1927–28, 1933–34, 1938–39, 1942–43, 1947–48, and 1952–53. No relationship is detectable to the number of diagnosed diabetes cases.

Table XII and Fig. 4 (opposite) give time trends for each 10-year age group, with 5-year calendar groups. Three different ordinate scales have been used in the Figure.

TABLE XII
DIABETES INCIDENCE PER 10,000 PER YEAR, BY AGE AND SEX IN DIFFERENT QUINQUENNIA
(In parentheses: Number of patients diagnosed)

Sex	Quinquennium of Diagnosis	Age at Diagnosis (yrs)								
		0-9	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80+
Male	1926-30	1.0 (10)	.9 (12)	.5 (8)	1.8 (24)	4.4 (40)	6.8 (47)	10.1 (42)	7.5 (14)	2.5 (1)
	1931-35	.3 (3)	1.0 (12)	1.1 (17)	1.7 (26)	4.0 (42)	8.9 (71)	12.7 (60)	10.8 (24)	9.8 (5)
	1936-40	.6 (7)	1.7 (19)	.9 (14)	1.5 (24)	2.9 (36)	5.6 (53)	11.5 (62)	11.3 (30)	6.3 (4)
	1941-45	.5 (6)	1.0 (10)	1.0 (16)	.7 (11)	1.1 (16)	2.2 (24)	4.3 (26)	3.6 (11)	1.3 (1)
	1946-50	.4 (5)	.6 (6)	1.0 (16)	1.7 (29)	2.3 (37)	6.0 (76)	12.6 (86)	14.5 (52)	6.7 (6)
	1951-54	.7 (8)	.7 (6)	1.2 (14)	1.5 (21)	2.7 (36)	6.9 (78)	12.8 (85)	16.1 (53)	24.4 (21)
Female	1926-30	.5 (5)	.9 (12)	.4 (9)	1.3 (21)	3.1 (35)	8.6 (78)	15.3 (95)	14.5 (49)	5.2 (5)
	1931-35	.4 (4)	.6 (8)	.6 (13)	1.6 (29)	3.9 (51)	11.9 (122)	15.9 (111)	17.4 (68)	7.8 (9)
	1936-40	.4 (4)	1.6 (19)	.8 (17)	.9 (17)	2.8 (44)	8.7 (102)	15.8 (124)	15.2 (68)	7.8 (11)
	1941-45	.1 (1)	1.1 (12)	.8 (17)	.8 (17)	1.1 (20)	1.5 (20)	5.2 (45)	4.6 (23)	3.6 (6)
	1946-50	.2 (3)	1.0 (10)	.8 (16)	.8 (17)	2.1 (43)	7.6 (117)	15.3 (149)	20.2 (117)	15.7 (30)
	1951-54	.6 (7)	1.1 (10)	.4 (5)	1.0 (15)	1.0 (17)	5.1 (72)	14.0 (128)	25.4 (135)	28.4 (51)

FIG. 4—Incidence of diabetes diagnoses in Oslo 1926-54, by sex, age at diagnosis, and calendar year group of diagnosis.

There is a tendency for males to have the higher incidence at ages under 50, with a reversal thereafter.

In Table XIII the rates for ages below 30 are given in 5-year age groups for the entire period 1925-54.

TABLE XIII

DIABETES INCIDENCE PER 10,000 PER YEAR, OSLO, 1925-54, IN 5-YEAR DIAGNOSTIC AGE GROUPS BELOW AGE 30, BY SEX

(In parentheses: Number of patients diagnosed)

Age at Diagnosis (yrs)	Males	Females
0-4	.31 (12)	.16 (6)
5-9	.86 (29)	.54 (18)
10-14	.94 (30)	.89 (28)
15-19	1.06 (37)	1.15 (46)
20-24	.83 (37)	.59 (34)
25-29	1.05 (52)	.78 (48)

The age group 15-19 shows the maximum incidence in both sexes, being most distinct in females.

Bimodal age at onset is also detectable in the Bergen material for 1925-39 (Hanssen, 1946).

(D) DEATH RATE (BASED ON ALL CERTIFICATES MENTIONING DIABETES) AS AN INDEX OF INCIDENCE

Because of drastic changes in selection rules in the past, statistics based on the underlying cause of death are of little use in diabetes epidemiology. More hope is offered by statistics based on multiple coding and tabulation, recently discussed by Dorn and Moriyama (1964).

However, even if the presence of a chronic disease were always mentioned on the death certificate, mortality data could not be expected to be useful for all types of epidemiological contrasts. In particular, changes in incidence time trends will be dampened and delayed. This was the case for diabetes even before the advent of insulin. Thus, Joslin, Dublin, and Marks (1934) have summarized the diabetes mortality experience in connexion with the first world war as follows: "... (1) these declines were not immediate; (2) they did not end until 2 or 3 years

after the close of the war; and (3) they were not limited to the fighting nations . . ." On the whole, the mortality reduction of the first world war was considerably smaller than the reduction in incidence noted in the present study. For instance, in Prussia, the number of deaths from diabetes at age 60-70 in 1918-19 was 57 per cent. of the number in 1913-14 (von Noorden and Isaac, 1927). In England and Wales the mortality at age 55-65 in 1918 for males was 72 per cent. of the mortality in 1901-10 and for females 80 per cent. (Registrar-General, 1927a). In Norway, as well as in Oslo, there was only a slight reduction in the female diabetes mortality in connexion with the first world war, with no change for males (Scheel, 1933).

On the other hand, mortality statistics may bring out social contrasts very strikingly. In the 1921-23 occupational mortality analysis for England and Wales, standardized diabetes mortality for males aged 20-65 was twice as high in Social Class I as in Social Class V (Registrar-General, 1927b), and for those aged 65-70 it was almost six times as high in Class I as in Class V.

The data of the present study permit a direct comparison of the effect of the second world war on incidence and mortality (derived from multiple cause coding). Table XIV shows death rates based on the lists mentioned previously of deaths in Oslo and Aker in 1937-39 and 1941-55 with diabetes on the certificate. Incidence estimates for the same years are based on the hospital series. For age groups 30-59, 60-79, and 80+, the rates are presented graphically in Fig. 5 (opposite).

Obviously, the absolute size of the age-specific incidence rates cannot be approximated by mortality data in a disease of such long duration. The male/female ratio might be expected to be higher in the mortality data because of the higher total mortality for males. The differences among causes of death with respect to the mention of diabetes on the

TABLE XIV

DIAGNOSED CASES AND DEATHS WITH DIABETES ON CERTIFICATE PER 10,000 PER YEAR, BY AGE AT DIAGNOSIS OR DEATH, AND CALENDAR YEAR PERIOD OF DIAGNOSIS OR DEATH, BY SEX

(In parentheses: Number of cases or deaths)

Sex	Year of Diagnosis or Death	Age at Diagnosis or Death (yrs)							
		0-29		30-59		60-79		80+	
		Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases	Deaths
Male	1937-39	1.0 (24)	.3 (7)	3.4 (77)	.9 (21)	11.2 (54)	12.5 (60)	5.2 (2)	42.0 (16)
	1941-45	.8 (32)	.1 (2)	1.2 (51)	.6 (23)	4.1 (37)	9.7 (88)	1.3 (1)	19.7 (15)
	1946-50	.7 (27)	.1 (4)	3.1 (142)	.5 (22)	13.2 (138)	9.6 (100)	6.7 (6)	26.7 (24)
	1951-54	.9 (28)	.2 (6)	3.5 (135)	1.1 (41)	13.9 (138)	10.9 (108)	24.4 (21)	39.4 (34)
Female	1937-39	1.1 (29)	— (0)	3.2 (90)	.9 (24)	17.0 (126)	12.9 (95)	5.9 (5)	23.6 (20)
	1941-45	.7 (30)	.0 (2)	1.1 (57)	.5 (25)	4.9 (68)	8.4 (116)	3.6 (6)	21.6 (36)
	1946-50	.7 (29)	.2 (8)	3.2 (177)	.6 (32)	17.1 (266)	12.1 (188)	15.7 (30)	40.8 (78)
	1951-54	.7 (22)	.1 (3)	2.3 (104)	.7 (30)	18.2 (263)	10.9 (157)	28.4 (51)	34.0 (61)

SUMMARY

Resident diabetes patients who were hospitalized for the first time have been registered for the period 1925-55 in thirteen hospital departments in Oslo. The series so obtained includes 4,251 such patients. The diagnosis had been made not more than one month before admission in two-thirds of the cases, but there were also many cases in which several years had passed between diagnosis and first admission. For computation of incidence the cases have been referred to year of diagnosis and age at diagnosis.

The patient file was matched with nominal lists of deaths in Oslo and Aker for 1937-39 and 1941-55, where diabetes had been mentioned on the certificate. Of the decedents from 1951-55 almost 85 per cent. had been previously hospitalized in one of the thirteen departments included in the survey.

Those patients in the survey who were discharged alive have been subjected to a mortality follow-up, which disclosed that for about 70 per cent. diabetes was eventually mentioned on the death certificate. The percentage varied with cause of death, but not much with sex.

The incidence rates for the period 1925-39 based on the present hospital series were similar to those of Hanssen's comprehensive series from Bergen from the same period.

For ages below 30 years the incidence has remained practically constant throughout the period 1925-54. There is an incidence maximum at age 15-19 in both sexes. At older ages there is a pronounced drop in incidence during the 1940-45 war, and a return to pre-war levels is completed by 1946. The pre-war level is not exceeded, however, except in age groups 70 and over. The post-war rise in incidence in the elderly is probably due to more efficient case-finding.

The time trend for diabetes is contrasted with that of myocardial infarction in Oslo.

Death rates based on all certificates mentioning diabetes indicate correctly the long-term constancy of incidence rates. However, the reduction in incidence during the 1940-45 war is not distinctly portrayed by the mortality data.

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FIG. 5.—Incidence of diabetes diagnoses and death rates (based on all certificates mentioning diabetes) in Oslo 1937-54, by sex, age at diagnosis, and calendar year group of diagnosis.

certificate (Table V) might also affect the sex ratio. However, the net result is no gross distortion, even if the age groups 60-79 and 80+ show mostly higher male/female ratios of the mortality than of the incidence rates.

The effect of the war is poorly visible in the mortality data. Only the age group 80+ has the minimum for both sexes in the 1941-45 period. On the other hand, the mortality rates reflect well the fact that the incidence in Oslo in 1951-54 was about the same as before the war. In fact, for the age group 80+, where the incidence rates show an increase which is probably purely artificial, the mortality data depict the true situation better.

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