

Senile cataract extraction and diabetes

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Caird, Hutchinson, and Pirie (1964) and Caird, Pirie, and Ramsell (1969) reported that senile cataract extraction was more common in diabetics than in non-diabetics living in the area of Oxford, England. In the 50-69 age group it was over seven times as common in diabetics as in non-diabetics. Senile cataract in the Oxford study was defined, by exclusion, as all cataracts except those associated with other ocular disease or general disease other than diabetes or attributed to congenital causes.

The object of the study reported here was to determine whether or not similar relationships hold in the United States. To achieve this we used hospital discharge data to estimate US age-race specific odds ratios of senile cataract extractions among diabetics to senile cataract extractions among non-diabetics.

Patients and methods

The Washington Hospital Center (WHC), Washington DC, was selected as a data source because it had a broadly based residency training programme assuring a wide variety of clinical material and also because of its accurate and detailed medical records. For example, for the period January to June 1972 the type of cataract (verified by the physician) was specified in the records on discharge of all but 2.6 per cent of the patients with cataract, while in other hospitals in the area the comparable figure was 30 to 90 per cent. Information on all diagnoses on discharge, age, and race was obtained from WHC for all patients in whom the first listed discharge diagnosis (that is, the condition principally responsible for the patient's hospitalization) was senile cataract extraction, fracture, sprain, or strain during the period from July 1971 to June 1973.

A second data source used was the 1972 Hospital Discharge Survey (HDS) conducted by the National Center for Health Statistics (NCHS), which produced about 225 000 medical abstracts from a stratified random sample of 424 short-stay non-federal hospitals (unpublished data from the 1972 Hospital Discharge Survey, National Center for Health Statistics). The cases taken from this survey were those with a first listed discharge diagnosis of cataract extraction; fracture, sprain or strain; haemorrhoids; and varicose

veins (the last two diagnoses were not readily available from WHC). Their classification was by age only, since information on race was not available for many discharges.

WHC and HDS data differed slightly both in diagnosis/operation coding and the number of diagnoses coded per discharge. The HDS records a maximum of five diagnoses and three operations and codes them according to the eighth revision of the *International Classification of Diseases, Adapted for Use in the United States* (ICDA). WHC records a maximum of six diagnoses or operations per discharge and uses the Hospital Adaptation of the *International Classification of Hospital Diseases* (H-ICDA). The diagnosis/operation codes used are shown in Table I.

The third data source used was the 1973 *Household Interview Survey*, National Center for Health Statistics. NCHS prepared, at our request, estimates of age-race specific rates for prevalence of diabetes (unpublished data from the 1973 Household Interview Survey, National Center for Health Statistics). We calculated age-race specific odds ratios to study the relationship of diabetes to the risk of senile cataract extraction. The odds ratio can be most easily understood by first considering the following 2x2 table subdividing the present total US population into four groups

		Cataract extraction	
		Present	Absent
Diabetic	Yes	A	B
	No	C	D

where A = No. of diabetics who had cataract surgery.

B = No. of diabetics who did not have cataract surgery.

C = No. of non-diabetics who had cataract surgery.

D = No. of non-diabetics who did not have cataract surgery.

A/B = Relative odds of cataract* to non-cataract among diabetics.

C/D = Relative odds of cataract to non-cataract among non-diabetics.

$\frac{A/B}{C/D}$ is the odds ratio. Clearly, if diabetes raises the risk of cataract the odds ratio will be larger than one.

*To save clumsy expression we will often use 'cataract' to designate cases of senile cataract extraction and 'non-cataract' to designate cases without extraction. Clearly this paper deals with only a subset of all lenticular opacities.

Table I *Diagnosis/operation codes*

<i>Diagnosis</i>	<i>Hospital Discharge Survey (ICDA)</i>	<i>Washington Hospital Center (H-ICDA)</i>
Senile cataract in combination with lens extraction	374·9* and 14	374·2 and 12·4-12·6
Fracture, strain, or sprain	800-829 and 840-848	800-829 and 840-848
Haemorrhoids	455	—
Varicose veins of lower extremities	454	—
Diabetes	250	250

*Includes unspecified cataract

An odds ratio of one implies no association between diabetes and cataract and a ratio of less than one implies a negative association. The problem that confronts us is that we do not know the population values A, B, C, and D nor can we directly estimate the ratios A/B and C/D, since the total populations of diabetics and non-diabetics are difficult to sample.

To derive an estimate of the odds ratio we classified samples of cataract cases (from hospital discharges) and non-cataract cases (hospital discharges for each of the controls described above) according to presence or absence of diabetes. The observed frequencies a, b, c, and d are defined as follows:

		First listed discharge diagnosis	
		Cataract	Fracture, etc
Diabetes also listed as discharge diagnosis	yes	a	b
	no	c	d

with $\frac{a/c}{b/d}$ as an estimate of $\frac{A/C}{B/D}$. But since $\frac{A/C}{B/D} = \frac{A/B}{C/D} \cdot \frac{a/c}{b/d}$ is also an estimate of the desired odds ratio $\frac{A/B}{C/D}$. This result is very dependent on whether or not our sample data do in fact provide good estimates of the specified population ratios A/C and B/D. This point will be explored further under 'Discussion'. Confidence limits for odds ratios have been calculated according to Cornfield's method as reported by Gart (1971).

Results

As shown in Table II, the WHC odds ratios have very wide confidence intervals at the ages of 40-49 years but at ages 50-69 and 70 and over the confidence intervals are much narrower and the ratios are about 2 and 1 respectively. There is

little difference between races. The Hospital Discharge Survey data, which are national in scope, show odds ratios for the relationship of diabetes to the risk of senile cataract extraction of 4·7-7·3, 2·1-3·6, and 0·5-1·1 for ages 40-49, 50-69, and 70 and over respectively. The HDS odds ratios at age 40-49 are well within the previously mentioned wide confidence limits for the WHC odds ratios at this age. The odds ratios for 50-69 and 70 and over are quite similar in both sets of data.

Discussion

Before discussing results we first examine whether we have satisfactory control groups. In a standard diabetes textbook (Marble, White, Bradley, and Kroll, 1971), trauma is mentioned only to conclude that it is not an aetiological factor in diabetes. The absence of any discussion of fractures under the various complications of diabetes suggests that they are not known to be more common in diabetics than in non-diabetics. A National Library of Medicine computer search failed to identify any references relating diabetes to fracture, sprain, or strain during the period January 1970 to August 1974.

Clearly, not all patients with fracture, sprain, or strain are hospitalized, and we need to consider whether those who are represent a biased selection from the viewpoint of presence of diabetes. Because of the increased problems in diabetes management associated with physical stress there probably is a greater tendency to hospitalize for fracture when diabetes is also present than when it is not. We observe that the prevalence of diabetes among WHC patients discharged for fracture, etc., is very close to the estimates of national diabetes prevalence from the Household Interview Survey. The prevalence of diabetes among patients discharged for fracture, etc., in the US Hospital Discharge Survey is somewhat lower than the national prevalence estimates based on household interviews. Thus, although we suspect an upward bias in diabetes prevalence among hospital fracture cases as compared to all fracture cases, which is in the direction of making our estimated odds ratios too low, we do not believe that this bias is very strong.

The use of 'fracture, sprain, or strain' as a control may be criticized because fracture is usually associated with a surgical emergency while cataract is an elective procedure. Thus this control group might not be as suitable as some other selected on the basis of elective surgery. Therefore, we have included two additional control groups, both from the elective surgery category: haemorrhoids and varicose veins of lower extremities.

Table II Odds ratios for senile cataract extraction: diabetics compared with non-diabetics. Hospital Discharge Survey (ICDA) 1972 data by age*. Washington Hospital Center (H-ICDA), July 1971 to June 1973 data by age and race

Study population	First listed discharge diagnosis	Age 40-49				Age 50-69				Age 70+				
		No. of patients with diabetes also listed		Odds ratio	95 per cent confidence interval	No. of patients with diabetes also listed		Odds ratio	95 per cent confidence interval	No. of patients with diabetes also listed		Odds ratio	95 per cent confidence interval	
		Yes	No			Yes	No			Yes	No			
HDS (ICDA) (Race not known)	Cataract	7	53	—	—	55	552	—	—	52	813	—	—	
	Fractures, etc.	30	1068	4.7	(1.8-11.9)	84	1927	2.3	(1.6-3.3)	102	1712	1.1	(0.7-1.5)	
	Haemorrhoids	2	165	—†	(2.0-78.5)	12	251	2.1	(1.1-4.2)	8	67	0.5	(0.2-1.3)	
	Varicose veins	6	330	7.3	(2.1-25.6)	11	396	3.6	(1.8-7.4)	5	74	0.9	(0.3-2.8)	
WHC (H-ICDA)	White	Cataract	1	46	—	—	52	480	—	—	45	595	—	—
		Fractures, etc.	2	113	—†	(0.04-17.9)	9	167	2.0	(0.9-4.5)	15	183	0.9	(0.5-1.8)
	Non-White	Cataract	6	15	—	—	32	137	—	—	21	144	—	—
		Fractures, etc.	3	110	—†	(2.8-84.7)	13	124	2.2	(1.1-4.7)	6	52	1.3	(0.4-3.7)

*Sample counts adjusted according to sampling weights for each diagnosis within given age group

†Not shown because of small sample size (fewer than 5 cases in one or more cells)

Recognizing that cataract patients will be older than fracture patients, we have tried to adjust for this by reporting age-specific data. For cases in the Hospital Discharge Survey the average age of the cataract cases compared to the average age of the fracture cases is 46.1-44.4, 62.1-59.3, and 77.4-79.8 for the age groups 40-49, 50-69, and 70 and over respectively. The Washington Hospital Center data reflect average ages and age differences almost identical to those shown for the Hospital Discharge Survey. Although these differences exist they are small, and we think any bias resulting from them would be trivial.

Since cataract extraction outside a hospital was rare or non-existent in the US during the period reported, hospital discharges for cataract extraction should represent new additions to the aphakic population rather well. Of course, possibly the persons discharged from a particular hospital after cataract surgery are a biased representation of the cataract surgery cases in the community. They may be, for example, richer or poorer than the total. However, one of the strengths of this study is that the controls are *from the same hospitals* as the cataract surgery cases. Thus, if we have cataract cases that are wealthier than average probably we also have economically privileged controls.

There is a real possibility that the presence of cataract increases the probability of diabetes being diagnosed, assuming that it is present, and vice versa. This bias of ascertainment would tend to increase the estimated odds ratios. In the absence of specific information, we judge this factor as present to only a minor degree.

On the basis of all the above facts we think that our control groups are comparable with the cataract patients in age-specific categories as presented. We should therefore have reasonably good estimates

of the relevant population ratios required for our estimates of risk associated with diabetes.

We have used the published Oxford data (Caird and others, 1969) to estimate odds ratios for men and women combined of 7.9 for age 50-69 and 4.3 for age 70 or over. Our data (Table II) show odds ratios of about two and three at age 50-69 and of about one at age 70 or over. Thus, our results clearly show a lesser importance of diabetes as a cataract risk factor at ages over 49 than the Oxford study. This is true whether we compare the Oxford data to the White population from the Washington Hospital Center or to our national data which include non-Whites. In all instances our 95 per cent confidence intervals fail to include the Oxford estimates of risk.

Curiously, our data do not differ greatly from the Oxford data with respect to how common diabetes is among those with cataract extractions, but differ sharply as to the general prevalence of known diabetes (Table III). The Oxford estimates of known diabetes prevalence of 1.2 per cent at ages 50-69 and 1.8 per cent at ages over 70 have been criticized as understating the true prevalence (Ciba Foundation Symposium 19, 1973). If the criticism is valid the Oxford estimates overstate the risk, and they may, in fact, not be essentially different from ours.

Although we found little difference in odds ratios between Whites and non-Whites, diabetes prevalence does differ by race, and readers are cautioned that the data for all races in Table III include only about 13 per cent non-Whites for the US national studies (Current Population Reports, No. 511, 1974) such as Hospital Discharge Survey or Household Interview Survey but 33 per cent non-Whites for Washington Hospital Center.

A study in Copenhagen (Norm, 1967) estimated

Table III Prevalence (rate per cent) of known diabetes* by age and race

	Among hospital discharges after senile cataract extraction			Controls Among hospital discharges after fractures, etc.			General survey data	
	US Hospital Discharge Survey ¹	Washington Hospital Center	Oxford Study ²	US Hospital Discharge Survey	Washington Hospital Center	Oxford Study	US Household Interview Survey ³	Oxford Study (working party)
	Age 50-69							
All races	9.1	12.0	—	4.2	7.0	—	5.6	—
White	—	9.8	11.8	—	5.1	—	5.1	1.2
Non-White	—	18.9	—	—	9.5	—	8.4	—
Age 70+								
All races	6.0	8.2	—	5.6	8.2	—	8.2	—
White	—	7.0	9.7	—	7.6	—	7.9	1.8
Non-White	—	12.7	—	—	10.3	—	10.7	—

*Includes cases diagnosed in hospitals at time of cataract surgery

1 Unpublished data from US Hospital Discharge Survey, National Center for Health Statistics, 1972

2 Caird, F. I., Hutchinson, M., and Pirie, A. (1964)

3 Unpublished data from US Household Interview Survey, National Center for Health Statistics, 1973

a fourfold increase in risk of cataract extraction due to diabetes and a study in Mainz (Marquardt and Kirschbaum, 1971) estimated a tripling of risk. We cannot readily compare these results with ours since the Copenhagen data are not age-adjusted and the Mainz study did not clearly specify the control group used.

Our finding that diabetes may be a strong risk factor for cataract extraction below age 50 is in keeping with a nonquantified statement to this effect in a recent diabetes text (Ellenberg and Rifkin, 1970).

Summary

A study of hospital discharge diagnoses from both national data and data from a local medical centre indicates that diabetes substantially increases the

probability of cataract extraction at age 40-49, about doubles or triples the probability for age 50-69, and has little effect on risk at age 70 and over. Strengths and weaknesses of the data are discussed. Other reports, generally estimating a much stronger association between diabetes and probability of cataract extraction, at least at age 50 and above, are critically evaluated.

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