

Routine screening for diabetic eye complications in a population based cohort of 4438 persons with type 2 diabetes in a Danish county

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ABSTRACT

Objectives: This study aims to describe the use of routine screening for diabetic eye complications in a large population based cohort of type 2 diabetic patients in the County of Vejle, Denmark. Furthermore, it aims to identify characteristics of patients and general practitioners related to the frequency of eye examinations.

Methods: The type 2 diabetic population alive and resident in the County of Vejle on 1st January 1997. Data concerning eye examinations were collected from public data files for the period of January 1993 to December 1997.

Results: In a population of 4438 type 2 diabetic patients, 46% had had one annual eye examination in 1997 and 26% had not had a single eye examination within the last five years. Patient characteristics related to an eye examination included: treatment with insulin or oral hypoglycaemic agents, females and long duration of diabetes. The number of diabetic patients who had had an eye examination varied substantially between the general practices. The characteristics of general practitioners were not related to this variation.

Conclusion: The results of this study indicate a great need for quality improvement of ophthalmologic service in diabetes care. To achieve this improvement, more focus should be given to cooperation between the general practitioners and the ophthalmologists.

Dan Med Bull 2004;51:104-7.

INTRODUCTION

Diabetes is a common chronic disease that carries a high risk of disabling complications. Diabetes eye complications and in particular diabetic retinopathy is one of the most common causes of blindness among adults in the Western world (1).

Approximately 60% of type 2 diabetic patients develop diabetic retinopathy within 20 years after the diabetes diagnosis (2) and up to 20% of type 2 diabetic patients have already developed retinopathy at the time of diagnosis (3).

Diabetic retinopathy is usually asymptomatic. Left untreated it carries a high risk of permanent visual loss. However, good glycaemic regulation (4) can prevent the development of diabetic retinopathy. Furthermore, early photocoagulation treatment may reduce the risk of blindness due to diabetic retinopathy by up to 90% (5). The prevention of blindness due to diabetic retinopathy has been estimated to be highly cost-effective (6). Thus, a large number of complications such as severe visual loss or blindness can be avoided by regular screening for diabetic retinopathy (7). The number of type 2 diabetic patients regularly screened for diabetic retinopathy is at present unknown.

This study aims to describe the use of routine screening for diabetic eye complications in a large population based cohort of type 2

diabetic patients in the County of Vejle, Denmark. Furthermore, it aims to identify characteristics of patients and general practitioners (GPs) related to the frequency of eye examinations.

PATIENTS AND METHODS

The background population in this study was 342,597 citizens alive and residents in the County of Vejle on 1st January 1997. At birth, all citizens in Denmark are assigned a personal civil registry number (CRN). This CRN facilitates linkage of data over time and across different data sources.

IDENTIFICATION

The type 2 diabetic population was identified by use of several data sources. The details of the method have been given previously (8). Briefly, the National Health Service Registry delivered data from diabetes related services provided by GPs, ophthalmologists, chiropodists and from prescriptions for antidiabetic tablets and insulin. The local hospital registry provided data on everyone in the county with a diagnosis related to diabetes. The regional laboratory database delivered data about HbA1c, glucose and c-peptide measurements performed by all GPs and hospitals in the county. When the collection of data was completed on 1st January 1997 all non-resident persons and deceased persons were excluded.

A record of all identified diabetic patients was sent to the general practice in which the diabetic patients were listed in order to verify the diagnosis and to get the date of diagnosis. The GP was asked to add names of diabetic patients who had not yet been registered in the data files. Only patients listed in practices returning the record were included in the study. These practices represented a study population of 303,250 patients.

The criterion for diabetes was a clinical diabetes diagnosis previously established by a physician. Patients were classified as type 2 diabetic patients if they were treated with diet alone, with antidiabetic tablets or, irrespective of treatment, if they were over 40 years of age at the time of diagnosis.

EYE EXAMINATION

Data concerning eye examinations were collected for the period of January 1993 to December 1997 using the National Health Service Registry. The National Health Service Register is available to counties for administration of the fees for diabetes-related services provided by primary care providers, and ophthalmologists receive a special fee for treatment and control for diabetic retinopathy. However, the register contains no data on diagnosis or method of examination.

PATIENT AND GP-RELATED CHARACTERISTICS

Both the National Health Service Registry and GPs supplied the data related to the diabetic patients, eg type of treatment, time of diagnosis, age and gender. Data concerning HbA1c was provided by the regional laboratory database system. The reference value for individuals without diabetes was 3.6%-5.4%. Good glycaemic regulation of diabetic patients was defined as HbA1c values above mean +3SD (<5.6%), borderline regulation as mean +3-5SD (5.6%-6.3%), and poor regulation as HbA1c values above mean +5SD (>6.3%).

Data related to each GP was provided by the National Health Service Registry, ie age and gender, practice organisation, localisation, number of blood glucose measurements performed in general practice, number of patients listed in practice and the gender and age distribution of patients. All 215 GPs received a questionnaire concerning their attitudes towards diabetes care. This part of the study asked questions concerning the GP's acquaintance with the guideline on diabetes care published by the Danish College of General Practitioners (9), the GP's participation in diabetes training courses within the last two years and the GP's interest in diabetes care.

STATISTICS

Parametric or non-parametric tests were used where appropriate. Multivariate logistic regression analysis was used to evaluate whether certain patient characteristics predict if an eye examination would be performed. Estimates and standard errors were computed by means of the Generalized Estimation Equation (GEE) method to adjust for the cluster effect of one general practice taking care of a group of patients.

The observed proportion of type 2 diabetic patients with an annual eye examination was calculated for each practice to evaluate the inter-practice variation. Furthermore, the predicted proportion of type 2 diabetic patients with an annual eye examination was estimated by logistic regression analysis in order to allow for differences in practice populations, eg in the number of diabetic patients or in the patient characteristics.

Multivariate linear regression analysis was performed to evaluate predictors of practice variation. The regression analysis was weighted, and the dependent variables were transformed into: $2 \times \text{ARCSIN}(\sqrt{p})$ to adjust for the variation in prevalence of diabetic patients in each practice.

ETHICAL APPROVAL

The study was approved by the Scientific Ethics Committee in the counties of Funen and Vejle and by the Danish Data Protection Agency.

RESULTS

A total of 4438 type 2 diabetic patients were identified, 49% were men. The mean age was 67 years (range: 29-99) and the mean duration of diabetes was six years (range: 0-66). Fourteen per cent were treated with insulin, 54% with antidiabetic tablets, 3% with antidiabetic tablets combined with insulin and 29% received dietary treatment only.

Of all the type 2 diabetic patients, 46% had a minimum of one eye examination in 1997 compared with 42% in 1993 (Figure 1). In the group of type 2 diabetic patients diagnosed in 1993 or before, 74% had at least one eye examination between 1993 and 1997 (Figure 2).

Table 1 shows the odds ratio (OR) for patient-related characteristics associated with a minimum of one annual eye examination. Diabetic patients treated with insulin or oral hypoglycaemic agents were more likely to have had an eye examination than diabetic patients treated with diet only. Females and diabetic patients with a long duration of diabetes (>15 years) were also more likely to have

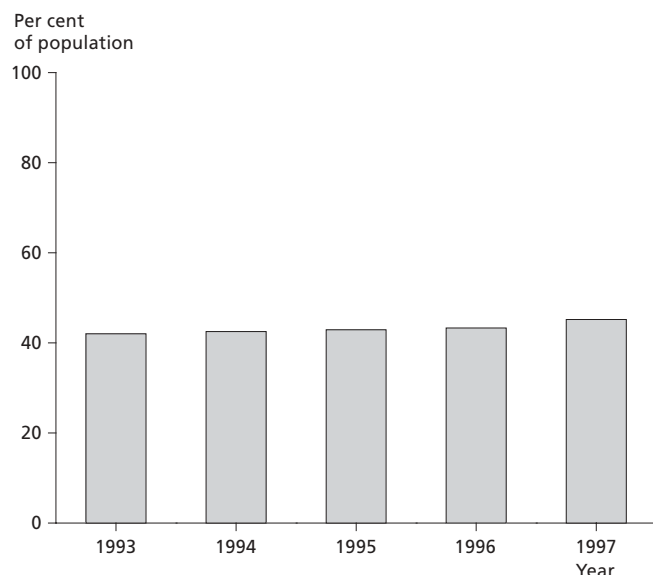


Figure 1. Annual eye examinations of Type 2 diabetic patients during the period 1993 to 1997.

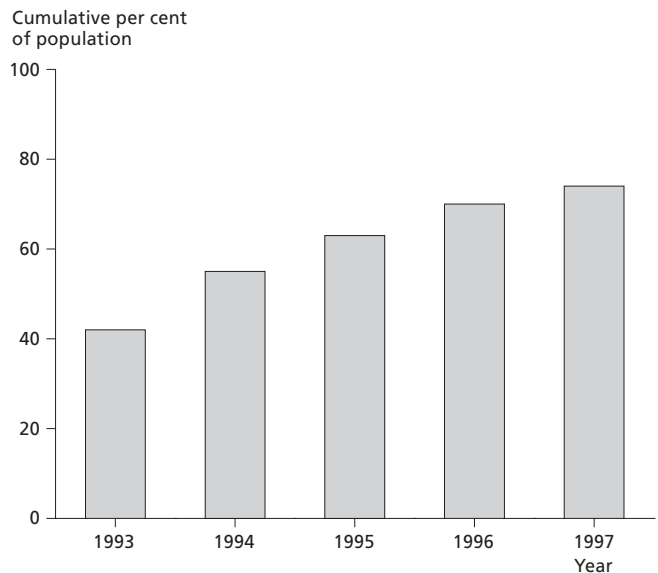


Figure 2. The cumulative proportion of Type 2 diabetic patients diagnosed in 1993 or before with at least one eye examination during the five-year period.

had an eye examination. Furthermore, the probability of having an eye examination rose with increasing age up to the age of 70 years.

HbA1c was measured in 73% of the type 2 diabetic patients in 1997. The proportion of diabetic patients with an eye examination was higher among those whose HbA1c had been measured (OR 2.23, 95% CI:1.94-2.58) than among those whose HbA1c had not been measured. The proportion of diabetic patients with poor glycaemic regulation who had had an eye examination was slightly larger than the proportion of diabetic patients whose glycaemic regulation was good or acceptable (OR 1.35, 95% CI: 1.17-1.56).

VARIATION BETWEEN GENERAL PRACTICES

A total of 106 (88%) general practices in the County of Vejle participated in the study, corresponding to 193 GPs. Table 2 shows the

Table 1. Characteristics of Type 2 diabetic patients associated with annual eye examinations.

	n	Performed examinations %	OR	95%CI	p
<i>Treatment</i>					
Diet*	1,255	33	1.00		
Oral hypoglycaemic agents	2,303	44	1.48	1.28-1.70	<0.001
Insulin	627	61	2.38	1.66-3.41	<0.001
Oral hypoglycaemic agents + insulin	132	58	2.65	2.18-3.23	<0.001
<i>Age</i>					
<50 years*	403	35	1.00		
50-59 years	811	44	1.28	1.00-1.63	0.0495
60-69 years	1,075	49	1.50	1.18-1.91	0.0010
≥ 70 years	2,028	43	1.14	0.91-1.42	0.2437
<i>Duration of diabetes</i>					
>15 years*	366	61	1.00		
11-15 years	456	50	0.74	0.55-0.99	0.0444
6-10 years	973	46	0.69	0.55-0.87	0.0021
0-5 years	2,522	39	0.61	0.48-0.77	<0.001
<i>Sex</i>					
Female*	2,193	47	1.00		
Male	2,124	40	0.75	0.65-0.85	<0.00

n=4,317 (121 patients excluded because of unknown treatment or unknown time of diagnosis).

*) reference group.

Table 2. The characteristics of general practitioners and their attitudes towards diabetes care in 1997.

Question	n	Answer
<i>Characteristics</i>		
Practice organisation	193	Working solo: 29% Working with partners: 71%
Practice localisation	193	Rural area: 32% Urban area: 68%
GP's age	193	49 years (48-50 years)*
GP's gender	193	Males: 74%
GP's years in practice	166	14 years (13-15 years)*.
<i>Attitudes</i>		
GP's awareness of the guideline on diabetes care published by the Danish College of General Practitioners	162	Yes: 88% No: 12%
GP's participation in diabetes training courses within the last two years	163	Yes: 49% No: 51%
GP's having a special interest in diabetes care	164	Just as interested in diabetes care as their colleagues: 58% More interested in diabetes care than their colleagues: 34% Less interested in diabetes care than their colleagues: 8%

*) mean (95%CI).

characteristics of GPs and their attitudes towards diabetes care. The proportion of type 2 diabetic patients in each general practice who had had an annual eye examination performed by an ophthalmologist ranged from a minimum of 20% to a maximum of 88%. When adjusted for the differences in the number of diabetic patients and patient characteristics, the predicted proportion of type 2 diabetic patients with an annual eye examination in each practice ranged from 24% to 87%. The multivariate linear regression analysis showed no relationship between the performance of an eye examination and the following factors: practice organisation, eg one versus more GPs in each general practice, localisation, eg rural versus urban area or the GP's age and gender, the GP's awareness of the guideline on diabetes care published by the Danish College of General Practitioners (9), the GP's participation in diabetes training courses within the last two years, or the GP having a special interest in diabetes care.

DISCUSSION

This study is the first to describe the use of routine screening for diabetic eye complications in a large population of type 2 diabetic patients by use of data from public data files. We find that the identified population is representative and the advantages and weaknesses of our data sampling to identify the population of type 2 diabetic patients have earlier been discussed (8).

In the County of Vejle most type 2 diabetic patients are cared for by their GP. But the GP is not trained in performing ophthalmoscopy, and this service is not included in the fees to GPs reimbursed by the National Health Insurance. There is one department of Ophthalmology in the county. An agreement was made that only ophthalmologists working in primary care setting performed control for diabetic retinopathy of all type 2 diabetic patients. The ophthalmologist located within or outside the county sends an invoice for each patient consultation and diabetes-related services to the National Health Insurance for reimbursement. So everyone taking contact to and receiving services from the health care system will hence be registered in the National Health Service Register.

Collecting information on eye examination from public data files has an advantage over collecting information from medical records because the latter may be inadequate as shown in a previous Danish study (10). The GPs do not necessarily receive any information from the ophthalmologists when a diabetic patient has had an eye exam-

ination, and the diabetic patients do not always inform their GP about their visits to the ophthalmologist. Some ophthalmologists automatically schedule the patients for a new appointment time but many leave this to the GP or the diabetic patients themselves.

THE QUALITY OF DIABETES CARE

This study found that a large proportion of the diabetic patients did not receive an annual eye examination. This result confirms results from international studies (11, 12) and studies from a Danish general practice (10) and Danish hospital outpatient clinics (13).

We cannot expect that neither the annual nor the 5-year proportion of type 2 diabetic patients with an eye examination is 100%, as patients who are blind have no need for eye examinations. Such patients account for a maximum of 7% (14). Furthermore, type 2 diabetes is a complex, multisystemic chronic disease and old diabetic patients often have competing health problems that may be given priority at the expense of the risk of developing disabling complications.

The patients with a long duration of diabetes, poor glycaemic regulation and who were being treated with insulin or oral hypoglycaemic agents were more likely to have had an eye examination. These predictors constitute risk factors for development and progression of diabetic retinopathy, and our results suggest that high-risk patients were more likely to have had an eye examination. This corresponds to the results of the Wisconsin Epidemiologic Study of Diabetic Retinopathy (12). But according to the guideline on care of type 2 diabetes, all diabetic patients and not only patients at high risk were recommended to receive an annual eye examination. It is noticed that males were more unlikely to have had an eye examination than women. This corresponds to the general pattern of males as less frequent attenders in the health care system (15). Furthermore, the probability of having an eye examination decreased after the age of 70 years.

Guidelines from Danish College of General Practitioners have been distributed to all GPs and enjoy widespread acceptance (16). The guidelines recommend annual eye examination for all type 2 diabetic patients (9). Knowledge and acceptance of the guideline are a prerequisite for proper diabetes care, but apparently it is not enough to ensure satisfactory adherence to treatment recommendations (17). This is reflected in the huge variation between practices concerning the proportion of type 2 diabetic patients who were having an annual eye examination. Special interest in diabetes has previously been shown to improve diabetes care (18). This study shows no association between practice characteristics nor between characteristics of GPs and the proportion of type 2 diabetic patients who were having an annual eye examination. This might be due to the questionnaire being unable to detect differences in the general practitioners' attitude towards diabetes care. The remaining variation may be explained by psychological and sociological factors relating to the thinking and behaviour of individual general practitioners, the interaction between doctors and patients and the influence of ophthalmologists.

The problem with lack of adherence to guideline recommendations may be rooted in flaws in the organisation of diabetes care in general practice where lack of recall systems and diabetes specific record systems may obstruct the implementation of relevant procedures and limit the awareness of personal routines. The establishment of a central register with the purpose of prompting the diabetic patients for an annual eye examination might improve the care of type 2 diabetic patients in Denmark (19).

In 1994 the National Board of Health worked out a statement concerning the future organisation of the diabetes care (20). The aim was to ensure that effective care is available to all diabetic patients in Denmark, and the Board recommends that diabetes care is performed by a diabetes team. In general practice this teamwork has not yet been organised, but improved cooperation between GPs and ophthalmologists may be another way to improve the care of type 2 diabetic patients in Denmark.

CONCLUSION

This study provides representative and valid data on insufficient and huge inter-practice variation in retinal examination of type 2 diabetic patients in Denmark. Only 46% had an annual eye examination in 1997 and 26% had not had a single eye examination for five years. This indicates a great need for improvement of the quality of diabetes care. All Danish citizens are assigned a personal civil registry number which allows long-term follow-up of the population identified. This system grants us a privileged position for establishing a continuous quality surveillance system based on information from public data files. A quality surveillance system may prove efficient in improving the quality of diabetes care.

ACKNOWLEDGEMENT

The study was financially supported by The Health Insurance Fund, The Danish Diabetes Association, The Danish Medical Association Research Fund, The General Practitioners' Foundation for Education and Development, Novo Nordisk Farmaka Danmark A/S and the Foundation "Nycomedes udviklingsfond".

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