

Primary care

Screening for diabetes in general practice: cross sectional population study

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Abstract

Objective To assess the policy proposed by the American Diabetes Association of universal screening in general practice of all patients aged over 45 years for diabetes.

Design Cross sectional population study.

Setting Local general practice in the United Kingdom.

Participants All patients aged over 45 not known to have diabetes.

Main outcome measures Prevalence of diabetes in the screened population, cardiovascular risk profile of patients diagnosed as having diabetes after screening.

Results Of 2481 patients aged over 45 and not known to have diabetes, 876 attended for screening. There were no significant demographic differences between the screened and unscreened patients. Prevalence of diabetes in patients with age as a sole risk factor was 0.2% (95% confidence interval 0% to 1.4%). Prevalence of diabetes in patients with age and one or more other risk factors (hypertension, obesity, or a family history of diabetes) was 2.8% (1.6% to 4.7%). Four hours a week for a year would be needed to screen all people over 45 in the practice's population; about half this time would be needed to screen patients with risk factors other than age. More than 80% of patients newly diagnosed as having diabetes had a 10 year risk of coronary heart disease > 15%, 73% (45% to 92%) were hypertensive, and 73% (45% to 92%) had a cholesterol concentration > 5 mmol/l.

Conclusions Screening for diabetes in general practice by measuring fasting blood glucose is feasible but has a very low yield in patients whose sole risk factor for diabetes is age over 45. Screening in a low risk population would best be targeted at patients with multiple risk factors.

Introduction

The American Diabetes Association has proposed the screening of all patients aged over 45 years by measuring fasting blood glucose every three years, in addition to screening patients from high risk ethnic groups and younger patients with hypertension, obesity, a family history of diabetes in a first degree relative, or a family history of gestational diabetes.¹

Such a policy has major resource implications for the NHS, and the debate on diabetes screening in the United Kingdom continues.² We undertook a study in a local general practice with a mostly white (relatively low risk) population to assess the feasibility of implementing the American Diabetes Association's policy in the United Kingdom. We also assessed the cardiovascular risk profile of patients diagnosed as having diabetes as a result of screening to see whether we were identifying a previously unrecognised high risk population.

Methods

We sent letters inviting all 2481 patients of a local general practice who were aged over 45 (total practice population 5448) and not known to have diabetes to take part in the study. We asked patients to fast for at least eight hours before attending the surgery first thing in the morning. After asking each patient to give full consent we discussed the follow up of a positive screening test and the implications of a diagnosis of diabetes. Patients were questioned about previous hypertension and antihypertensive treatment, their smoking history, and family history of diabetes. Patients' weight and height were measured and their body mass index calculated. We measured blood pressure after at least five minutes' rest and drew venous blood into a fluoride tube to measure plasma glucose concentration. These initial consultations each took 10 minutes. Three screening sessions of an hour were held each week. The study was completed over a year.

Any patient whose fasting plasma glucose concentration was ≥ 6.1 mmol/l was sent a letter inviting them back for diagnostic testing. Patients whose fasting plasma glucose concentration was ≥ 7 mmol/l also took a second fasting glucose test. Patients whose initial fasting plasma glucose concentration was 6.1-6.9 mmol/l had a standard 75 g oral glucose tolerance test: blood was drawn after fasting and then two hours after a glucose load, in keeping with Diabetes UK's recent guidelines.³ Patients were classified in two ways. They were classified according to the American Diabetes Association's diagnostic criteria as having normal glucose tolerance, impaired fasting glucose, or diabetes, and according to the World Health Organization's diagnostic criteria as having normal glucose tolerance,

impaired glucose tolerance, impaired fasting glucose, or diabetes.¹⁻⁴ Patients were informed of the test result by letter; if the result was abnormal, patients were offered the opportunity to see the diabetes team, and follow up was arranged with the patient's general practitioner.

For patients who had a second visit we also determined full lipid profiles, including measurement of total cholesterol, high density lipoprotein cholesterol, and triglycerides, and we calculated their 10 year risk of coronary heart disease using the charts accompanying the joint British recommendations on prevention of coronary heart disease in clinical practice.⁵

We used the practice's computerised records to compare age, body mass index, and blood pressure of the screened and unscreened populations. The study had full ethical approval.

Results

Among the 2596 patients aged over 45 in the practice, 115 cases of diabetes were already diagnosed. Of the remaining 2481 patients 876 took up the invitation to have their fasting blood glucose measured. Table 1 shows the characteristics of the screened and unscreened patients. Sixty patients had a plasma glucose concentration ≥ 6.1 mmol/l and were invited to reattend for diagnostic testing. Table 2 shows the diagnoses of the 45 patients who returned for the second session.

Table 1 Patients aged >45 who were not known to have diabetes and who were invited to undergo screening by measurement of fasting plasma glucose concentration. Values are means (SDs) unless otherwise stated

	Screened (n=876)	Unscreened (n=1605)
Men (%)	42.2	45.8
Age (years)	63.8 (10.2)	63.7 (12.3)
Body mass index (kg/m ²)	25.4 (4.1)	26.1 (4.4)
Systolic blood pressure (mm Hg)	140 (21)	137 (20)
Diastolic blood pressure (mm Hg)	81 (11)	80 (9.7)

Only one of the patients diagnosed as having diabetes, impaired fasting glucose, or impaired glucose tolerance had age as a sole risk factor. In the screened population 495 patients had other risk factors (hypertension, a family history of diabetes in a first degree relative, or a body mass index >27 kg/m²). From practice records we ascertained that 1027 of all patients aged over 45 had one or more additional risk factors. This is likely to be an underestimate, as few records stated whether there was a family history of diabetes.

We used 6.1 mmol/l as the cut-off level for a positive result on screening by plasma glucose concentra-

tion and an oral glucose tolerance test to make diagnoses in all patients with impaired fasting glucose (as recommended by Diabetes UK). This method gave a prevalence of previously undiagnosed diabetes of 1.7% (95% confidence interval 0.7% to 2.8%) in the screened population as a whole, 2.8% (1.6% to 4.7%) in patients with risk factors other than age, and 0.2% (0% to 1.4%) in patients without additional risk factors. In the screened population 312 patients had one other risk factor, of whom two were diagnosed as having diabetes (prevalence 0.6% (0.1% to 2.3%)); 159 had two other risk factors, of whom seven were diagnosed as having diabetes (4.4% (1.8% to 8.9%)); and 24 had three other risk factors, of whom four were diagnosed as having diabetes (16.7% (4.7% to 37%)). Table 3 shows the cardiovascular risk profiles of patients diagnosed as having diabetes, impaired fasting glucose, or impaired glucose tolerance.

Discussion

After screening by measurement of fasting plasma glucose we found a prevalence of new cases of diabetes of 2.8% (1.6% to 4.7%) in patients aged over 45 and with one or more additional risk factors for diabetes. This compares with a prevalence of 0.2% (0% to 1.4%) in patients whose sole risk factor was age over 45. We estimated that 120 hours of staff time would be needed in this practice to screen patients with age alone as a risk factor. With such a low diagnostic yield in this group, screening in our relatively low risk population would best be targeted instead at patients with additional risk factors. The diagnostic yield would be further enhanced if screening were focused on patients with three or four risk factors for diabetes, but at the cost of missing a greater number of cases.

Uptake of screening

The low proportion of patients (35%) who were willing to undergo screening may reflect the requirement that they fast. Furthermore, we contacted the patients only once, and by letter. Over the past three years, 96% of patients in the target group have seen their general practitioner; this contact could allow discussion of diabetes and risk factors and potentially increase the uptake of screening.

Comparison with national rate

Before the screening intervention in our practice the prevalence of diabetes diagnosed among patients aged over 45 was 4.4%, which is rather higher than that seen in large epidemiological studies in the United Kingdom.⁶ The age distribution of our practice population is similar to that seen in the previous studies. This higher prevalence may reflect the increasing prevalence of diabetes nationally. Alternatively, the

Table 2 Results of diagnostic testing of patients whose fasting plasma glucose concentration was ≥ 6.1 mmol/l at initial screening

Plasma glucose concentration (mmol/l) at initial screening	No of patients		Diagnosis			
	Initial screening	Diagnostic testing	Diabetes	Impaired glucose tolerance + impaired fasting glucose	Impaired fasting glucose	Normal
6.1- <7.1	47*	34	9	2	6	17
≥ 7.1	13	11	6	3†	1	1

In total 39 oral glucose tolerance tests were done.

*All patients with impaired fasting glucose on initial screening had an oral glucose tolerance test.

†All patients whose plasma glucose concentration was ≥ 7.1 mmol/l at the initial screening but was <7 mmol/l on repeat testing had an oral glucose tolerance test.

proportion of cases of diabetes that are diagnosed in this practice may be increasing. The unexpectedly low number of cases that were diagnosed after screening in our study is consistent with the second possibility, but this second explanation is unlikely, for the following reasons.

Firstly, we ascertained from practice records that a relatively low number of patients (103) without diabetes had had a plasma glucose measurement in the past three years. Secondly, the cut-off level that we used for a positive result of screening plasma glucose, 6.1 mmol/l, is not 100% sensitive. The DECODE study showed that 31% of cases of diabetes that were diagnosed by 2 hour value on a glucose tolerance test would not have been diagnosed had only fasting plasma glucose concentration been used for diagnosis.⁷ Using a stepwise strategy, whereby an oral glucose tolerance test was given if patients' fasting plasma glucose was 6.1-6.9 mmol/l (as recommended by Diabetes UK), the study found that 82% of cases of diabetes were diagnosed, with the proportion increasing to 93% if the lower threshold was reduced to 5.5 mmol/l.

Our practice population was older than that in the DECODE study. The sensitivity of any given threshold of plasma glucose concentration in detecting patients with diabetes decreases with age, reflecting the increased prevalence in elderly patients of hyperglycaemia after a glucose load.^{8,9} We would therefore expect the proportion of patients whose diabetes was not recognised by screening at a threshold of 6.1 mmol/l to be greater than the 18% seen in the DECODE study. This would mean that the true prevalence of undiagnosed diabetes in our population would be at least 2.1%—and at least a third of cases in our population would be undiagnosed. This is consistent with data from the third national health and nutrition examination survey.¹⁰

Diabetes screening and cardiovascular risk factors

Is 6.1 mmol/l fasting plasma glucose the appropriate threshold for a positive result on a screening test? If patients aged over 45 with other risk factors are screened every three years, and those with impaired fasting glucose have an oral glucose tolerance test, nearly all cases of diabetes will be identified in a preclinical phase. This will precipitate screening for microvascular complications and may result in greater attention being paid to and more active treatment of cardiovascular risk factors. In determining whether intervention is required to reduce patients' risk of coronary heart disease, health staff are currently advised to assess patients' 10 year risk of coronary heart disease

What is already known on this topic

Between a third and a half of cases of diabetes are undiagnosed at any one time

New cases can be identified by screening groups of patients at risk

The American Diabetes Association has proposed the screening of all patients aged over 45 every three years

What this study adds

Screening for diabetes in general practice by measuring fasting blood glucose is feasible but requires much staff time

Screening solely on the basis of age has a very low yield and screening would best be targeted at patients with multiple risk factors for diabetes

using charts such as those accompanying the joint British recommendations on prevention of coronary heart disease in clinical practice.⁵ Intervention should be given, if appropriate, to any patient with a 10 year risk >30%, and patients with a risk >15% should be treated as resources allow. Although no patients whose diabetes was identified after our screening had a 10 year risk >30%, 60% of these patients had a 10 year risk >15%, even before the diagnosis was made. Also, 73% (45% to 92%) had a cholesterol concentration >5 mmol/l, and 73% (45 to 92%) had a blood pressure, whether treated or untreated, >140/80 mm Hg, the thresholds above which treatment should be considered. The diagnosis of diabetes will almost certainly focus attention on more active management of these risk factors in the future.

Patients with plasma glucose concentrations that are abnormal but below the diagnostic threshold for diabetes are at increased risk of cardiovascular but not microvascular disease. Much of this risk is due to the clustering of established risk factors, such as hypertension and dyslipidaemia, in these patients, but several studies indicate that hyperglycaemia itself may be an independent risk factor.¹¹⁻¹³ The predicted 10 year risk of coronary heart disease in patients in our study with impaired fasting glucose or impaired glucose tolerance was similar to that of patients with newly diagnosed diabetes, but the number of patients who were found to have impaired glucose tolerance was small.

The DECODE study indicated that the 6.1 mmol/l threshold has a very low sensitivity for detecting impaired glucose tolerance, with only 29% of patients being identified.⁷ If the threshold were lowered to 5.5 mmol/l an extra 122 glucose tolerance tests would have had to be carried out in our population, which would be likely to identify six extra patients with diabetes (93% of the total number, according to DECODE data) and 28 extra patients with impaired glucose tolerance (69% of the total), and would increase time spent on testing by one hour a week for a year. These patients would be likely to have a high risk of cardiovascular disease and require active inter-

Table 3 Cardiovascular risk in patients diagnosed after screening as having diabetes, impaired glucose tolerance, or impaired fasting glucose

Diagnosis	10 year risk of coronary heart disease risk >15%*	Hypertension or blood pressure >140/90 mm Hg	Total cholesterol >5 mmol/l
Diabetes (n=15):			
Before diagnosis	9		
After diagnosis	13	11	11
Impaired glucose tolerance + impaired fasting glucose (n=5)	1	5	1
Impaired fasting glucose (n=7)	3	7	4

*Calculated using the charts accompanying the joint British recommendations on prevention of coronary heart disease in clinical practice.⁵

vention. A reduction in the threshold for a positive screening test for diabetes could identify a larger number of patients with lesser degrees of glucose intolerance but who have a high risk of coronary heart disease, although a reduction would not be necessary if greater attention was paid to recognition of risk factors and intervention across the whole population. Measures that have been shown to be highly effective in reducing long term cardiovascular risk are grossly underused, even in groups of patients at highest risk.¹⁴

Conclusion

Screening for diabetes by measuring fasting blood glucose is feasible within general practices and would identify a cohort of new patients with a high risk of cardiovascular disease, but much staff time would be needed. In this mostly white population the diagnostic yield of screening was very low in patients whose only risk factor for diabetes was age, and screening would be better targeted at patients with multiple risk factors.

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A short case prolonged

As a senior house officer who had worked only at district general hospitals, I made my first attempt at the MRCP clinical examination at a prestigious London teaching hospital in a state of nervous dread. The "short cases"—when you are taken by two examiners and a nurse to a succession of patients—are seen as the most challenging part of the exam. Half way through my short cases, I was taken to see a frail elderly man and asked to examine his chest. Unlike the other patients I had examined, he was fully dressed. After introducing myself, I helped him remove his shirt and vest, examined his respiratory system under the watchful eyes of the examiners, described my clinical findings, and gave my diagnosis. Impassively, they turned around and disappeared through the closed curtains surrounding the bed, accompanied by the nurse.

As I began to follow them, I heard a plaintive voice say, "Isn't anyone going to help me dress again?" This was an important exam for me, and the advice of my seniors was to see and diagnose as many short cases as possible in the given time. On the other hand, you don't normally walk away from a patient you have undressed without first helping him or her to dress

again. Notwithstanding a strong urge to pretend I hadn't heard, I decided, MRCP or not, the examiners would have to wait. I turned back and began to help him dress. It wasn't long before the now perplexed examiners and nurse reappeared to find their candidate. Their irritation disappeared when, as I asked the nurse to finish dressing the man, they realised what had occurred, and the exam continued.

A few months later I received a letter from the Royal College of Physicians saying I had passed. To this day I wonder if the "dressing challenge" tipped the balance in favour of a successful result.

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We welcome articles up to 600 words on topics such as *A memorable patient, A paper that changed my practice, My most unfortunate mistake*, or any other piece conveying instruction, pathos, or humour. If possible the article should be supplied on a disk. Permission is needed from the patient or a relative if an identifiable patient is referred to. We also welcome contributions for "Endpieces," consisting of quotations of up to 80 words (but most are considerably shorter) from any source, ancient or modern, which have appealed to the reader.