Are Spouses of Patients With Type 2 Diabetes at Increased Risk of Developing Diabetes?

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OBJECTIVE — To determine whether spouses of patients with type 2 diabetes have an increased risk of diabetes compared with spouses of subjects with normal glucose tolerance.

RESEARCH DESIGN AND METHODS — A random sample of spouses of patients with type 2 diabetes (group 1S) attending a general practice diabetes clinic was compared with spouses of nondiabetic subjects (as determined by oral glucose tolerance test [OGTT]) (group 2S). Spouses in both groups underwent OGTT, fasting lipid profile, and blood pressure (BP) measurements.

RESULTS — A total of 245 subjects in group 1S and 234 subjects in group 2S underwent OGTT. Group 1S had a significantly higher incidence of fasting glucose, impaired glucose tolerance, or type 2 diabetes (19.1 vs. 9.4%). Group 1S also had higher fasting glucose and triglyceride levels, higher BMI, and a trend toward higher BP. Multivariate logistic regression analysis, adjusted for BMI and age, showed the risk of diabetes in the spouse of a patient with diabetes was 2.11 (95% CI 1.74–5.1), as compared with the spouse of a subject with normal glucose tolerance. Similarly, the risk of any degree of glucose intolerance in a spouse of a patient with type 2 diabetes was 2.32 (1.87–3.98), as compared with a spouse of a subject with normal glucose tolerance.

CONCLUSIONS — Spouses of patients with type 2 diabetes have a significantly increased risk of glucose intolerance and type 2 diabetes, and they should be classified as high risk for diabetes. This finding has implications for screening programs, which should include spouses of subjects with diabetes.

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In many parts of the world, type 2 diabetes is increasing in prevalence, particularly among high-risk ethnic populations (1). While genetic influences on the risk of type 2 diabetes are likely to be significant (2), genetic factors do not fully explain the rapid increase in prevalence of the condition; hence, environmental factors have a major influence. These factors include obesity, diet, and physical activity. Spouses may share a number of environmental factors, including dietary habits and physical activity (3). Previous studies have shown a higher risk of coronary risk factors (4), cancer (5), hypertension (6), depression (7), asthma, peptic ulcer disease, and hyperlipidemia (8) in spouses of patients with these conditions. This study aimed to determine whether diabetes is more common among spouses of patients with diabetes.

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Abbreviations: BP, blood pressure; IFG, impaired fasting glucose; IGT, impaired glucose tolerance; OGTT, oral glucose tolerance test.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

RESEARCH DESIGN AND METHODS

— Ethical approval was obtained for the study, and full informed consent was obtained from all patients. Four groups of patients were studied. Group 1 comprised all patients with type 2 diabetes of at least 5 years' duration attending an inner London general practice diabetic clinic, whose spouses were alive and living with them. Diabetes was diagnosed on the basis of at least two fasting plasma glucose levels >7.0 mmol/l or random plasma glucose levels >11.1 mmol/l, and type 2 diabetes was defined by the lack of absolute requirement for insulin, absence of ketonuria, and treatment with adequate control without insulin for at least 6 months from diagnosis of diabetes. Group 1S comprised spouses of the patients with type 2 diabetes (group 1), who were not known to have diabetes. Group 2 comprised subjects randomly selected from a general practice population who were not known to have diabetes and whose spouses were not known to have diabetes. These subjects underwent a standard 75-g oral glucose tolerance test (OGTT). Patients diagnosed with impaired fasting glucose (IFG) (glucose 6.0–6.9 mmol/l), impaired glucose tolerance (IGT) (2-h glucose 7.8–11.0 mmol/l), or type 2 diabetes on the OGTT were excluded. The fourth group (group 2S) were spouses of subjects who did not have diabetes. Any consanguinous marriages were excluded.

Subjects from groups 1S and 2S were invited to a health screening check and were asked about any known history of diabetes or, in women, previous history of gestational diabetes. Blood pressure was recorded as the mean of three supine readings taken 5 min apart. Diastolic blood pressure was taken as Korotkov phase V. Blood was taken for fasting serum total cholesterol, LDL cholesterol, HDL cholesterol, and triglycerides. The patients then underwent a 75-g OGTT.

Data are presented as means (±SD) or medians (range) unless otherwise stated. To examine differences in variables between the two groups, Student's *t* test was

Table 1—*Demographic characteristics of groups studied*

	Group 1 (diabetic)	Group 2 (nondiabetic)	*P*	Group 1S (spouses of diabetic)	Group 2S (spouses of nondiabetic)	*P*
n	245	234	—	245	234	—
Age (years)	58.3 ± 6.7	57.5 ± 7.4	0.328	57.1 ± 7.2	57.4 ± 8.2	0.62
Male	137 ± 55.9	129 ± 55.1	0.751	108 ± 44.1	105 ± 44.9	0.732
Ethnic origin						
White	127 ± 51.8	114 ± 48.7	0.845	126 ± 51.4	114 ± 48.7	0.856
Black	64 ± 26.1	63 ± 26.9		65 ± 26.5	63 ± 26.9	
Asian	54 ± 22.1	57 ± 24.3		54 ± 22.1	57 ± 24.3	
Previous GDM in women	10 ± 9.3	6 ± 5.7	0.078	10 ± 7.3	9 ± 6.8	0.712

Data are means ± SD or *n* (%). GDM, gestational diabetes mellitus.

used. To compare the prevalence of complications or risk factors between the two groups, a χ^2 test was performed for discrete variables and the Mann-Whitney *U* test was performed for continuous variables. Statistical significance was achieved if $P < 0.05$. To determine which factors were most likely to contribute to diabetes in a spouse, a multivariate logistic regression analysis was performed to calculate the odds ratio and 95% CIs for risk of diabetes in a spouse of a subject with diabetes, as compared with a spouse of a subject without diabetes. Adjustment was made for BMI and age. Statistical methods were carried out using the statistical package Minitab (State College, PA).

RESULTS — All patients who attended the general practice diabetic clinic with type 2 diabetes for >5 years were invited to participate in the study (326). Of these, 43 did not have a surviving spouse, 16 had a spouse with known type 2 diabetes, 5 marriages were consanguinous, and 17 spouses did not agree to be tested. Thus, a total of 245 patients with type 2 diabetes for at least 5 years (group 1) and their spouses (group 1S) agreed to participate. Median duration of diabetes in group 1 was 9.2 years (range 5.1–20.5). A random sample of 300 subjects who were not known to have type 2 diabetes, whose spouses were not known to have type 2 diabetes, and whose marriages were nonconsanguinous were invited to participate. Of this group (group 2), 267 agreed to undergo an OGTT. Nine (3.4%) patients were diagnosed with type 2 diabetes, 16 (6.0%) had IGT, and 8 (3.7%) had IFG and were, hence, excluded. Thus, 234 nondiabetic patients (group 2) and all of their spouses ($n = 234$; group 2S) agreed to be included in the study.

There was no significant difference between group 1 and group 2 in age, sex distribution, or ethnic origin (Table 1). Similarly, there was no significant difference in these factors between group 1S and group 2S (Table 1).

Prevalence of IFG, IGT, and type 2 diabetes diagnosed according to an OGTT in groups 1S and 2S are shown in Table 2. Spouses of patients with type 2 diabetes (group 1S) had a higher prevalence of IFG, IGT, or type 2 diabetes (19.1 vs. 9.4%), although only IGT and type 2 diabetes reached significance. Spouses of patients with type 2 diabetes had a significantly higher fasting blood glucose than spouses of nondiabetic patients. In addition, there was a trend toward higher blood pressure levels in the spouses of patients with diabetes, and this group also had significantly higher fasting triglyceride levels. There was a significant difference in BMI between group 1S and group 2S, with spouses of patients with type 2 diabetes having a significantly increased BMI compared with spouses of subjects with normal glucose tolerance.

On multivariate logistic regression

Table 2—*Clinical characteristics of spouses of diabetic subjects and spouses of nondiabetic subjects*

	Group 1S (spouses of diabetic subjects)	Group 2S (spouses of nondiabetic subjects)	*P*
n	245	234	—
BMI (kg/m^2)	27.2 (23.5–36.8)	25.5 (22.4–30.4)	0.033
Fasting glucose (mmol/l)	5.4 (3.8–7.6)	4.6 (3.8–7.1)	0.026
2-h glucose (mmol/l) median (range)	7.5 (5.6–16.7)	6.7 (4.5–11.4)	0.047
Number with IFG	12 (4.9)	8 (3.4)	0.57
Number with IGT	16 (6.5)	7 (3.0)	0.02
Number with type 2 diabetes	19 (7.8)	7 (3.0)	<0.001
Systolic BP (mmHg)	144 (98–180)	135 (95–180)	0.077
Diastolic BP (mmHg)	85 (65–110)	80 (65–110)	0.096
Total cholesterol (mmol/l)	4.9 (3.2–7.2)	4.7 (3.1–6.9)	0.435
LDL cholesterol (mmol/l)	2.9 (1.6–5.2)	2.7 (1.6–4.9)	0.576
HDL cholesterol (mmol/l)	1.0 (0.6–1.5)	1.1 (0.6–1.4)	0.552
Fasting triglycerides (mmol/l)	2.0 (1.2–6.8)	1.6 (1.4–4.4)	0.049

Data are median (range) or *n* (%).

analysis, adjusted for BMI and age of the patient, the risk of diabetes in the spouse of a patient with diabetes was 2.11 (95% CI 1.74–5.1), as compared with the risk of diabetes in the spouse of a subject with no diabetes. Similarly, the risk of any degree of glucose intolerance (IFG, IGT, or diabetes) in a spouse of a patient with type 2 diabetes was 2.32 (1.87–3.98), as compared with a spouse of a subject with no diabetes.

CONCLUSIONS — Our results show that spouses of patients with type 2 diabetes had a significantly increased risk of developing diabetes. As the spouses were genetically different (though ethnically similar), our results show that shared environmental factors or exposures during married life may contribute to the risk of developing type 2 diabetes. Our study also showed a trend toward higher blood pressure in spouses of diabetic patients, in addition to significantly higher levels of serum triglycerides and BMI in these spouses. Overall, almost one in five spouses of patients with diabetes had evidence of glucose intolerance.

A number of previous studies have shown some concordance in married couples for disease status, including coronary risk factors (4), cancer incidence (5), depression (7), hypertension, and hyperlipidemia (8). This is the first study to our knowledge that has found an association between spouses' diabetes status. One previous study examined concordance in spouses for a variety of medical conditions, including diabetes (8). The researchers examined the computerized health records of 8,386 couples, and they found significant increased risk of asthma (RR 1.69), depression (RR 2.08), hypertension (RR 1.32), hyperlipidemia (RR 1.44), and peptic ulcer disease (RR 2.01). Interestingly, no significant association for diabetes was seen, although the authors acknowledged that their study was not powered to take into account the low prevalence of diabetes in their sample. In addition, there may have been a significant number of undiagnosed patients in their study. The study was a cross-sectional survey of medical records, while our study undertook OGTTs in cohorts of patients with known diabetes and known normal glucose tolerance.

Increased prevalence of conditions in spouses could be due to "associative mating," whereby people tend to marry people of similar physical appearance to themselves (9). Thus, shorter people may more frequently marry shorter people, and more obese people may be more likely to have obese partners. Our data do suggest a significantly higher BMI in spouses of diabetic patients compared with spouses of nondiabetic subjects, but even after adjustment for BMI, the risk of diabetes in the spouse remained strong if the spouse was diabetic. A previous study has shown similarities between spouses in smoking, drinking, and dietary habits, and this may be a possible explanation for the increased risk of diabetes among spouses of diabetic patients (3). Our study is limited by the fact that we did not examine diet and physical activity levels in our cohorts to look for similarities between spouses, and this merits further study.

The findings of the present study have important implications for the screening of patients for diabetes. A number of authorities have advocated regular screening of high-risk individuals for glucose intolerance (10). From this study, the risk of diabetes in a spouse of a patient with type 2 diabetes is over twice that of a spouse of a subject with normal glucose tolerance. The only excess risk factor for type 2 diabetes in spouses of patients with type 2 diabetes was BMI. Therefore, we advocate that this group of subjects should also be classified as high risk by virtue of their higher BMI, and as having increased risk of type 2 diabetes due to other unknown factors, and should be regularly screened for diabetes.

A previous study has suggested that risk factor manipulation in men with high risk of coronary heart disease can produce a significant benefit in risk factor reduction in their wives—a so-called "spin-off effect" (11). This suggests that intervention to change health behavior could be targeted at both the patient and their spouse in order to improve risk factors in both. This may have the added benefit of reducing risk in the offspring. With the current epidemic of obesity and type 2 diabetes in the young, it may be of great benefit for the future to target whole families, including spouses and children.

In summary, we have shown that spouses of patients with type 2 diabetes have a significantly increased risk of type 2 diabetes compared with spouses of subjects with no diabetes; therefore, these individuals should be classified as being at high risk for diabetes.

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