The Recurrence Rate of Gestational Diabetes in Subsequent Pregnancies

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OBJECTIVE — To define the recurrence rate of gestational diabetes mellitus (GDM) in a subsequent pregnancy and to determine what factors could be predictive.

RESEARCH DESIGN AND METHODS — The subjects of the index pregnancy were 480 personally cared for women with GDM. One hundred women had had a subsequent pregnancy and had been tested for GDM.

RESULTS — The recurrence rate of GDM was 35% (95% CI, 25.5–44.5). An increase in weight between the two pregnancies and a higher maternal age and parity were risk associates for a recurrence. A recurrence of GDM was not associated with a higher glucose level, insulin use, or fetal birth weight in the index pregnancy.

CONCLUSIONS — GDM occurs in only one-third of subsequent pregnancies. Those women who had a recurrence of their GDM were older, more parous, and also had an increase in weight between the pregnancies.

Gestational diabetes mellitus (GDM) is carbohydrate intolerance of variable severity with onset or first recognition during the current pregnancy (1). A diagnosis of GDM has immediate implications for the outcome of the pregnancy (2) and long-term implications for the future health of both the offspring (3) and the mother (4). The prevalence of GDM will depend on the diagnostic criteria used and the ethnic background of the population being tested. Using data from the Illawarra area of Australia, which has a predominantly Caucasian population, and using diagnostic criteria based on the recommendations of the Australasian Diabetes in Pregnancy Society (ADIPS) (5), the incidence rate is 7.2% (6).

GDM does not inevitably recur in subsequent pregnancies. In North America, the reported rates have been slightly above 50%, with certain maternal factors being predictive (7,8). In The Netherlands (9) and Australia (10), the recurrence rate is ~30%.

Those factors that may lead to a recurrence, or could be influenced to prevent a recurrence, are likely to assume considerable importance if a subsequent pregnancy with GDM can accelerate the conversion to NIDDM (10,11).

The purpose of this study is to examine the recurrence rate of GDM in Australia and to determine what maternal factors may be associated.

RESEARCH DESIGN AND METHODS

— This research was conducted in the Illawarra area of New South Wales, Australia. The area has a population of ~280,000 and is well defined and relatively isolated, making it ideal for epidemiological research. All deliveries, both for women attending either of the two public hospital–based prenatal clinics and for women attending private obstetricians, take place in the two hospitals. Testing for GDM is currently done on an estimated 95% of pregnancies. The subjects studied were consecutive women referred to an endocrinologist for the medical management of their GDM and personally seen over a 5-year period, January 1990 to December 1994. The obstetric management was left entirely to the obstetrician or prenatal clinic staff responsible for each individual pregnancy. Only those women seen with their initial presentation of GDM in the above period and who had had a singleton live pregnancy have been included.

The hospital records of all the index patients were reviewed to determine if there had been any further pregnancies. In the event of there having been more than one subsequent pregnancy, only the first pregnancy after the index pregnancy was considered. For inclusion in the study, the pregnancy had to be concluded by the end of December 1995. The maternal data sought included age, pre-conception weight (kg) by recall (12), height (m), the fasting and/or 2-h plasma glucose level after the glucose tolerance test (GTT) done at the beginning of the 3rd trimester, whether insulin had been used for glucose control, and the total daily dose at time of delivery. In some instances, data regarding maternal weight and/or height were not available. Data were obtained from diverse sources, including hospital records, obstetrician's records, general practitioner's files, and the personal patient files of R.G.M. The fetal birth weight and gestational age of delivery were obtained from the New South Wales Midwives data collection form.

The diagnosis of GDM was based on the recommendations of ADIPS (5). No challenge test was used. All patients had a standard 75-g GTT in the fasting state at the beginning of the 3rd trimester. GDM was diagnosed if the fasting plasma glucose was ≥5.5 mmol/l and/or the 2-h glucose level was ≥8.0 mmol/l. In some instances, a modification of the above test was performed, with only the 2-h sample being taken after the GTT (13). In no instance was the fasting glucose level raised without the 2-h value being elevated, and, hence, only the 2-h glucose level has been considered in the data. All women received standard treatment (14). During the pregnancy, they received an individualized carbohydrate-regulated diet. The kilojoule content of the diet was designed to achieve normal

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ADIPS, Australasian Diabetes in Pregnancy Society; GDM, gestational diabetes mellitus; GTT, glucose tolerance test.

Table 1—*Maternal details and fetal outcomes for women with GDM who have had a subsequent pregnancy*

	GDM recurrence		No GDM recurrence	
	Index pregnancy	Subsequent pregnancy	Index pregnancy	Subsequent pregnancy
Age (years)	29.3 ± 4.3	31.8 ± 4.2	27.4 ± 4.2	29.6 ± 4.5
Parity	1.0 ± 1.3	2.0 ± 1.3	0.5 ± 0.9	1.5 ± 0.9
BMI (kg/m²)	26.4 ± 6.2	27.4 ± 6.4	27.1 ± 6.4	26.4 ± 8.4
2-h glucose after the GTT (mmol/l)	9.1 ± 0.8	9.1 ± 0.7	9.0 ± 1.0	6.0 ± 1.1
Birth weight (kg)	3.4 ± 0.6	3.5 ± 0.7	3.4 ± 0.9	3.7 ± 0.5
Gestational age of delivery (weeks)	39.3 ± 1.4	38.9 ± 1.2	39.1 ± 1.3	39.5 ± 1.5

Data are means ± SD. n = 35 for GDM recurrence, and n = 65 for no GDM recurrence. Women who had a recurrence of GDM were older in both the index (P = 0.011) and the subsequent pregnancy (P = 0.003) compared with women who did not have a recurrence. The parity of the women who had a recurrence of GDM was higher in both the index (P = 0.02) and the subsequent pregnancy (P = 0.02) compared with women who did not have a recurrence. The BMI of women who had a recurrence of GDM was higher (P = 0.018) in the subsequent pregnancy. The reduction in BMI of those women who did not have a recurrence of GDM was not significant. The fetal birth weight of the women with no recurrence of their GDM was higher than their fetal birth weight in the index pregnancy (P = 0.0001).

weight gain during the last trimester. Complex carbohydrates constituted between 45 and 55% of the total energy intake and were distributed as evenly as practical throughout the day. All women did home glucose monitoring. Insulin therapy was used if the fasting glucose was ≥5.5 mmol/l and/or >10% of the 2-h postprandial glucose levels were ≥7.0 mmol/l (1990–1992) or the 1-h postprandial glucose levels were ≥8.0 mmol/l (1993–1995). After delivery, and before discharge from the hospital, the majority of women were reviewed by a dietitian and offered general advice. No post-discharge dietary follow-up was possible.

All data were stored on a Macintosh I.C using Statview (Abacus, Berkeley, CA). Unless otherwise specified, results have been expressed as a percentage or as a mean with ± 1 SD in parentheses. Statistical tests included the t test, χ^2 test, and logistic regression analysis. Results were considered significant if $P < 0.05$.

Ethical approval for this research was provided by the Human Research and Ethics Committee of the University of Wollongong.

RESULTS — There were 480 women with GDM seen over the 5-year period of 1990–1994. For the index pregnancy, they were aged 29.8 ± 5.1 years, had a parity of 1.1 ± 1.3, a BMI of 26.0 ± 5.5 kg/m², and were tested at 29.7 ± 3.3 weeks of gestation. The fetal birth weight was 3,393 ± 504 g at 39.1 ± 1.4 weeks of gestation. Of the 480 women, 88 (18.3%) were treated with insulin, with a total daily dose of 37.0 ± 14.7 U.

Of these 480 women, 101 (21.0%) had completed another pregnancy by the end of 1995. Only one patient did not have a test for GDM during the subsequent pregnancy, and her results have been excluded. Of the remaining 100 patients, 35 (35%, 95% confidence range, 25.5–44.5) had GDM in their next pregnancy, while 65 (65%) did not. The maternal details and fetal outcomes for women with GDM who have had a subsequent pregnancy are shown in Table 1. The women who did not have GDM in the subsequent pregnancy were younger, less parous, and did not increase their weight between pregnancies. With logistic regression analysis, both a lower age (P = 0.033) and a lower parity (P = 0.045) were predictive of the nonrecurrence of GDM.

While 88 of the original 480 women had been treated with insulin, only 7 of these 88 (7.9%) women have had a subsequent pregnancy. This was significantly lower than the 93 subsequent pregnancies from the 392 (23.7%) women who had not been insulin treated (P = 0.001). There were no significant differences between the 88 women who had been treated with insulin and the 392 who had not with respect to age, parity, and BMI. Of the seven women who had insulin in the index pregnancy, only two required insulin in the subsequent pregnancy. Of the eight women requiring insulin in the subsequent pregnancy, six did so for the first time.

CONCLUSIONS — The medical management of GDM in the index pregnancy was under the care of one clinician, and of the 35 women with recurrent GDM, all but 2 were subsequently cared for by the same clinician. There was thus a remarkable continuity of medical management. In addition, the diagnostic criteria for GDM in both the index and the subsequent pregnancy were the same. Only one woman did not have a test for GDM in her subsequent pregnancy. The 99% re-testing rate indicated a high degree of acceptance of both the need for testing and of the testing procedure by the patients and a very responsible attitude by the different clinicians responsible for obstetric care. This is particularly remarkable when it is considered that this aspect of obstetric management is carried out either by the rotating resident staff of the prenatal clinics, obstetricians in private practice, or general practitioners.

There have been four substantive reports about the recurrence rate of GDM. The first of these was by Coelingh Bennink (9) from The Netherlands, who found a recurrence rate of 25–30% (depending on the criteria used) in 58 women who had had an index pregnancy with GDM. A 50-g glucose load was used for testing, and the diagnostic criteria varied with the number of weeks of gestation. The weight change of the women between the two pregnancies did not appear to be a risk associate for the recurrence of GDM. It was considered that the lower-than-anticipated recurrence rate was probably related to favorable dietary changes. Subsequently, a recurrence rate of 32.5% was found by Grant et al. (10) in Australia and also by using a 50-g glucose load.

In 1989, Philipson et al. (7) found a recurrence rate of 53% in 36 women who had had previous GDM. A 100-g glucose load had been used for testing, and the glucose criteria for the diagnosis of GDM were higher than in the two reports mentioned above. The women who developed a recurrence were mainly non-Caucasian, obese, and had used insulin more often in the index pregnancy. The women who had a recurrence of their GDM generally weighed more in their subsequent preg-

nancy than they had weighed in their index pregnancy.

In 1992, Gaudier et al. (8) reported a recurrence rate of 52% among 90 women who had had previous GDM. The diagnostic criteria were the same as those of Philipson and Super (7), and again the majority of women were black. A recurrence was associated with a higher BMI, more LGA neonates (defined as being > the 90th centile), and an increased rate of insulin use in the index pregnancy.

The study reported here has both similarities and differences to the four reports mentioned above. A 75-g glucose load was used for diagnosis, which is higher than the first two studies and lower than the second two. In addition, the 2-h glucose level of ≥8.0 mmol/l used for the diagnosis of GDM was also intermediate. Differences in the glucose load and the diagnostic criteria may account for some variation, but it is improbable that these variables could be the major explanation for the overall recurrence rate or for differences in the recurrence rate.

In the series reported here, there was an overall recurrence rate of GDM of 35% in the first subsequent pregnancy after an index pregnancy with GDM. When the relatively small numbers in all of the studies are considered, recurrence rates between 30 and 50% are probably proximate. While in this study women who developed a recurrence of their GDM were older and had a higher parity than the non-recurrers, differences in age and parity, while undoubtedly of importance, are unlikely to provide the explanation as to why only one-third of women develop a recurrence. However, as a group, those women who had a recurrence of GDM increased their BMI between the two pregnancies to a significant extent, while the BMI of the non-recurrers did not change. These observations are in accord with other studies, suggesting that weight gain is very important as a risk associate. It remains to be determined whether it is the weight gain per se or the dietary factors that lead to the weight gain that may be important.

In this study, the previous use of insulin did not appear to be a risk associate for the recurrence of GDM. Most women who used insulin in the first pregnancy did not require it in the second, and most women using insulin in the second pregnancy did so for the first time. When it is considered that the criteria for insulin use were well defined and virtually all women were cared for by the one clinician, then this finding is unexpected. Overall, women who had used insulin in the index pregnancy and who, as a group, were not different from non–insulin users with respect to age, parity, and BMI, were less likely to have a subsequent pregnancy. The reason for this is not apparent and will require additional study.

Another unexpected finding was a significantly higher fetal birth weight among the women who did not have a recurrence of GDM. There are at least two possible explanations for this observation. First, the observed birth weight could be the "normal," and the fetal birth weight of the women with treated GDM could be lower because of the effects of the prescribed diet (15). Second, women who have had the advantage of dietary advice in their first pregnancy may have learned that the result of the GTT can be influenced by dietary modification and have done so, consciously or otherwise, at the time of testing and then subsequently resumed their usual diet.

The reasons as to why GDM does not recur in a high proportion of subsequent pregnancies is still a matter of speculation. The method of testing and the diagnostic criteria are undoubtedly confounding factors, as is the lack of reproducibility of the GTT. Dietary manipulation of the result of the GTT during subsequent pregnancies could also be a factor. However, a consistent feature of recent studies has been the observation that in most instances, a recurrence of GDM is associated with a weight gain between pregnancies. Just as dietary modification during a pregnancy complicated by GDM can favorably alter the outcome, learned dietary modifications applied before and/or during a subsequent pregnancy may render that pregnancy "nondiabetic" to testing. Prospective studies will be necessary to determine what dietary changes, if any, are made after an index pregnancy complicated by GDM and whether these changes provide the explanation for the lower-than-anticipated recurrence rate.

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