Risk perception and unrecognized type 2 diabetes in women with previous gestational diabetes mellitus

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Summary: Women with a history of gestational diabetes mellitus (GDM) have a high chance of developing type 2 diabetes mellitus (T2DM) following the index pregnancy, however, little is known of women's perception of this risk. The objectives were to (1) determine women's perception of risk of future development of T2DM following a GDM pregnancy and (2) describe the prevalence of undetected dysglycaemia in a Canadian population. The study was designed as a 9–11 year follow-up study of women previously enrolled in a randomized controlled trial of tight versus minimal intervention for GDM. Women's perception of future risk of diabetes was determined by questionnaire. Fasting lipid profile, height and weight were performed on all participants. Oral glucose tolerance tests were performed on all women without prior history of diabetes mellitus type 2 (DM2). The study was conducted at Ottawa Hospital General Campus and Children's Hospital of Eastern Ontario, in Ottawa, Canada. Eighty-nine of 299 (30%) of the original cohort were recruited. Eighty-eight women completed the questionnaire and 77 women without known diabetes underwent two hour glucose tolerance testing. Twenty-three (30%) felt their risk was no different than other women or did not know, 27 (35%) felt risk was increased a little and 27 (35%) felt risk was increased a lot. Only 52% (40/77) had normal glucose tolerance. Of all, 25/88 (28%) patients had diabetes (11 previously diagnosed and 14 diagnosed within the study). Of those newly diagnosed with DM2, four (29%) were diagnosed by fasting glucose, six (42%) by two hour glucose tolerance test (GTT) alone and four (29%) by both. Twenty-four of the women (27%) had impaired glucose tolerance (IGT). Of those with IGT, 12 (57%) had a fasting food glucose < 5.6 mmol/L. In the high-risk perception group with newly diagnosed diabetes, two were overweight, seven were obese, four had a family history of DM2, and all had a waist circumference > 88 cm. In conclusion the perception of being at high risk for T2DM did not prevent women from having undetected T2DM. Many factors are likely to contribute to this, including the reliance on screening tests (i.e. fasting glucose) rather than a two hour GTT to detect diabetes. Further studies on effective public and health-care provider education and intervention are needed to identify this high-risk population.

Keywords: diabetes type 2, gestational diabetes screening, risk perception

INTRODUCTION

Gestational diabetes mellitus (GDM), defined as a carbohydrate intolerance first recognized in pregnancy, affects 3.5–3.8% of pregnancies in the non-aboriginal Canadian population.^{1,2} Although glucose abnormalities usually resolve immediately postpartum, it is an important marker for future risk of type 2 diabetes mellitus (T2DM), impaired glucose tolerance (IGT) and impaired fasting glucose (IFG).^{3,4} The risk increases dramatically in the first five years, plateauing by 10 years postpartum.⁴ This high risk of progression to T2DM is the basis for clinical practice guideline recommendations for the screening of women with GDM with a two-hour oral glucose tolerance test (OGTT) within six months of the index pregnancy.⁵ Despite this recommendation, few women are screened, and those who do return for screening tend to be those women with a history of less severe GDM.^{6–8}

Postpartum detection of dysglycaemia provides the opportunity for early diagnosis and management and prevention strategies. Lifestyle interventions have been shown to significantly reduce the risk of diabetes among adults with abnormal glucose metabolism and early diagnosis facilitates screening for complications.⁹ Perception of personal risk may be an important factor in a patient's compliance with recommended health behaviours. In a review of health beliefs model, perceived vulnerability was found to be a significant contributor to health behaviours related to coronary heart disease such as surveillance for hypertension.¹⁰ In patients with non-melanoma skin cancer, sun-protective behaviours were found to be improved in individuals who perceived their risk of future development of non-melanoma skin cancer as increased.¹¹ Little is known, however, about women's risk perception of diabetes mellitus type 2 (DM2) following GDM and the impact of their risk perception on postpartum screening. One study has demonstrated that despite the recognition of GDM as a risk for T2DM, only 16% of women felt they themselves had a high risk of developing diabetes. This study did not comment on the screening behaviours or the prevalence of previously undetected diabetes of these women.¹²

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We had previously conducted a randomized controlled trial of women with GDM from 1991 to 1995 comparing tight glycaemic control to minimal intervention on perinatal outcomes.¹³ A follow-up study of this cohort provided an opportunity to determine women's risk perception of T2DM and to describe the prevalence of undetected dysglycaemia in a Canadian population. We hypothesized that women previously diagnosed with GDM who perceived themselves at a higher risk for developing T2DM would be more likely to be screened for T2DM and thus would be less likely to have undetected dysglycaemia postpartum. The purpose of this study was to determine the risk perception among women with previous GDM and to determine whether women with higher perceived risk were less likely to have undetected T2DM.

METHODS

A subanalysis of a 7–11-year follow-up study of a previously conducted randomized control was conducted at the Children's Hospital of Eastern Ontario on 299 women (91% Caucasian) who had previously participated in a randomized controlled trial of GDM management comparing the effect of tight glycaemic control and minimal intervention on perinatal outcomes.¹³ Ethics approval was obtained from the research ethics boards of the Ottawa Hospital and the Children's Hospital of Eastern Ontario. Attempts were made to contact all the families by telephone or mail. As this was a follow-up study, the sample size was dependent on the participation rate.

Women were originally screened for GDM by a 75 g glucose screening test between 24 and 28 weeks of gestation with a one-hour cut-off of 8.0 mmol/L.¹³ Women with a positive screening test underwent an OGTT with a 75 g glucose load. The diagnosis of GDM was made if the two-hour glucose level was 9.6 mmol/L as per the criteria of Hatem *et al.*¹⁴ The criteria used for screening and diagnosis for this study are different from current practice guidelines,⁵ but are reflective of clinical practice from 1990 to 1995 at the Ottawa Hospital.

Maternal perception of risk of future development of disease was determined through a self-reported questionnaire completed while undergoing an OGTT during the follow-up study. Women were asked to simply categorize their future risk of development of diabetes into (1) same as other women or unsure of future risk, (2) increased a little, or (3) increased a lot. All participants had plasma glucose measured after an eight-hour fast. Participants with no prior history of DM2 underwent a two-hour OGTT with a 75 g glucose load. Other risks for T2DM were also evaluated including body mass index (BMI) and waist circumference.

Height was measured by a stadiometer. Weight was measured on the electronic scale. BMI (kg/m^2) was calculated for each participant. Postpartum weight gain was calculated by subtracting the weight prior to index pregnancy from the current weight. Three measurements of waist circumference using a tape measure placed at the midpoint between the top of the iliac crest and the bottom of the rib cage were averaged. Glucose was measured on the Beckman-Coulter LX20 analyser, using the manufacturer's reagents (glucose oxidase method).

Statistical analysis

All statistics were generated using the SAS system version 8.2. Descriptive statistics were generated and unless otherwise

indicated summary statistics were expressed as mean $\pm$ standard deviation (SD). Participants' baseline characteristics were compared between the original study groups using Student's *t*-test. Analysis of variance models and chi-square tests were used to compare participants' baseline characteristics based on their perception group. Mean postpartum weight gain was compared between perception groups with the Student–Newman–Keuls (SNK) test. Chi-square tests were used to determine whether the proportion of diabetes diagnosed in the study was different between risk perception groups.

RESULTS

We were successful in recruiting 30% of the original cohort of participants (89/299 women) (Figure 1). A higher proportion of women originally randomized to the intervention group in the original randomized controlled trial chose to participate in the follow-up study (55/89 [61.8%]). Of the 89 women, one participant did not complete the questionnaire and 11 participants did not undergo OGTT because of a prior diagnosis of diabetes. There was no significant difference in the mean age at delivery ($P = 0.26$), pre-pregnancy weight ($P = 0.74$) or delivery weight ($P = 0.83$) between the group who chose to participate and those who did not participate (data not shown).

Of the 77 women who completed the questionnaire and had no prior history of diabetes, 23 (30%; 95% confidence interval [CI]: 21%, 41%) felt their risk was not different than other women or did not know, 27 (35%; 95% CI: 25%, 46%) felt their risk was increased a little and 27 (35%; 95% CI: 25%, 46%) felt their risk was increased a lot (Table 1). Characteristics of the women within each perception category are presented in Table 1. There was no difference in the

Figure 1 Participant flow diagram

Table 1 Characteristics of participants by risk perception (*N* = 77)

Variable	Total <i>N</i> = 77	Perception category			<i>P</i> value
		Same or no idea (<i>n</i> = 23)	Increased a little (<i>n</i> = 27)	Increased a lot (<i>n</i> = 27)	
Age at time of follow-up (mean, SD)	41 (4)	40.6 (4.9)	41 (3.4)	41 (3.8)	0.90
Family history of DM2 (<i>n</i> , %)	45 (60)	14 (64)	17 (63)	14 (54)	0.73
Smoker (<i>n</i> , %)	18 (24)	14 (61)	5 (19)	8 (32)	0.50
Caucasian (<i>n</i> , %)	70 (92)	5 (22)	27 (100)	25 (93)	0.32
Post secondary education (<i>n</i> , %)	75 (97)	18 (78)	27 (100)	27 (100)	0.25
Postpartum weight gain (weight at time of follow-up – prepartum weight) (mean, SD)	5.9 (7.8)	3.0 (8.4)	5.7 (6.3)	8.4 (7.9)	0.048
Postpartum weight gain >5 kg (<i>n</i> , %)	45 (58)	10 (43)	15 (56)	20 (74)	0.085
Diabetes diagnosed during study (<i>n</i> , %)	14 (18)	2 (9)	5 (19)	7 (26)	0.29
IGT alone (<i>n</i> , %)	15 (19)	5 (23)	7 (26)	3 (11)	0.76
IFG alone (Fbs 6.0–6.9) (<i>n</i> , %)	2 (3)	0 (0)	1 (4)	1 (4)	0.64
IFG and IGT (<i>n</i> , %)	6 (8)	0 (0)	3 (11)	3 (11)	0.25
BMI < 18.5 (<i>n</i> , %)	1 (1)	1 (4)	0 (0)	0 (0)	0.3
BMI 18.5–24.9 (<i>n</i> , %)	25 (32)	10 (43)	10 (37)	5 (19)	0.14
BMI 25–29.9 (<i>n</i> , %)	22 (29)	5 (22)	9 (33)	8 (30)	0.65
BMI > 30 (<i>n</i> , %)	29 (38)	7 (30)	8 (30)	14 (52)	0.16
Waist circumference >88 cm (<i>n</i> , %)	36 (47)	7 (30)	12 (44)	17 (63)	0.07
HDL < 1.3 mmol/L (<i>n</i> , %)	38 (49)	9 (39)	15 (56)	14 (52)	0.49
TG > 1.6 mmol/L (<i>n</i> , %)	29 (38)	9 (39)	9 (33)	11 (41)	0.84

SD, standard deviation; IGT, impaired glucose tolerance; IFG, impaired fasting glucose; BMI, body mass index; DM2, diabetes mellitus type 2; HDL, high-density lipoprotein; TG, triglycerides

participant's age, family history, ethnicity or post-secondary education between the perception groups. There was a significant difference in mean postpartum weight gain ($F = 3.17$, $P = 0.048$) between risk perception groups. Women in the highest risk perception group had the highest weight gain.

In total, 25 patients had diabetes (11 previously diagnosed and 14 diagnosed within the study) for an overall prevalence of 28% (25/88; 95% CI: 20%, 39%), 9–11 years following the index pregnancy. Of the 77 women with no prior history of dysglycaemia, only 52% (40/77; 95% CI: 41%, 63%) of women had a normal glucose profile, i.e. did not meet criteria for DM2, IFG or IGT (Table 2). Of the 14 mothers who met criteria for DM, four (29%; 95% CI: 12%, 55%) were by fasting glucose, six (43%; 95% CI: 21%, 67%) by two-hour GTT alone and four (29%; 95% CI: 12%, 55%) by both. Six women with diabetes would have been missed if an OGTT had only been done in those with a fasting blood sugar (FBS) of <7.0 mmol/L, and two women would have been missed with a cut-off FBS < 5.6 mmol/L. Of the 24 women with IGT, 12 (57%) had a FBG of <5.6 mmol/L.

The proportion of patients with newly diagnosed diabetes was not significantly lower in the group who felt they had

the highest risk ($\chi^2 = 2.48$, $P = 0.30$) (Table 1). The seven patients with newly diagnosed diabetes in the high-risk perception group all had a waist circumference of >88 cm, five had a BMI of >25, and two with a BMI of >30 and four had a family history of DM2.

DISCUSSION

The risk associated with GDM for future glucose abnormalities^{15,16} in mothers makes the diagnosis of GDM an opportune time for education of women concerning their future health. An understanding that they are at increased risk may translate into positive future health behaviours such as postpartum screening for diabetes and healthy lifestyle choices. In our follow-up study of a low-risk mainly Caucasian population, we found that the majority of women felt their risk was increased (69%), although only a 1/3 correctly believed that their risk was increased a lot. This finding was similar to others.^{12,17} Despite this self-reported perception of increased risk and presence of many other risk factors associated with T2DM, including obesity, positive family history and increased waist circumference, the number of women with previously undetected diabetes was higher than the number with known diabetes (14 versus 11 women).

This high rate of undetection raises concerns about the adequacy of postpartum screening of these high-risk women. As these women were self-selected to participate in a trial, it is likely that women who did not choose to participate may even be at higher risk of undetected diabetes.⁸ Women with GDM have limited knowledge about their true risk of DM2 after delivery and do not practise other positive preventative lifestyle changes such as increasing exercise even if they do perceive their risk as high.¹² In fact, Hunt and Conway⁸ have found that women with more severe GDM were less likely to return for postpartum GDM screening. Despite believing that their risk was high, women may not have felt that the disease was serious or that their ability to modify their risk of developing

Table 2 OGTT results of patients with no prior history of DM2 (*N* = 77)

OGTT	Fasting glucose <5.6	Fasting glucose 5.6–5.9	Fasting glucose 6.0–6.9	Fasting glucose >6.9	Total
Two hours <7.8	32	8	2	1	43
Two hours 7.8–11.0	12	3	6	3	24
Two hours >11.0	2	2	2	4	10
Total	46	13	10	8	77

OGTT, oral glucose tolerance test

disease was significant. This may have influenced their postpartum health choices such as compliance with postpartum screening.

On a provider level, lack of provider knowledge about the association between GDM and future risk of DM2 and/or perceived lack of efficacy of preventative measures for pre-diabetes may play a role in inadequate postpartum screening for DM2. A 1998 survey of obstetricians and gynecologists showed only 71% believed that women with GDM are at increased risk of DM2.¹⁸ A follow-up survey in 2004 indicated the number of obstetricians recommending postpartum screening for DM2 was 75%, an increase of only 4% despite the publication of guidelines in the interim.¹⁹ A recent study reported that obstetricians did not provide postpartum screening for 66.7% of women with a history of GDM.²⁰

System factors such as lack of organization, infrastructure or fragmentation of care may also contribute to low rates of screening.⁶ In Canada, women with gestational diabetes are often cared for by an obstetrician and in some cases by an endocrinologist or internist as well. However, postpartum care is mainly provided by primary care physicians. A patient who is knowledgeable both about their disease and the importance of screening may help to bridge the communication gap that can occur between caregivers. Women with a history of GDM who recalled advice concerning postpartum glucose testing and received laboratory slips from their care providers were more likely to report postpartum glucose screening.²¹

Screening may also have been performed, but not with the appropriate test. Current Canadian Guidelines recommend screening of women post-GDM with a two-hour GTT six weeks to six months postpartum, followed by a yearly FBS.⁵ However, at 11 years post-GDM, only 28% of patients with diabetes and none of the women with IGT would have been identified using current guidelines. This was despite the interim publication of a highly publicized clinical practice guideline recommending postpartum screening of women with gestational diabetes.²² Others have shown that the use of an OGTT is important for screening in the first six months postpartum.²³ Our results suggest that the OGTT is an important screening modality for long-term follow-up as well. Failure to detect these women may represent a missed opportunity to prevent or delay progression to diabetes. Recent studies have suggested that screening every three years with OGTT was the screening strategy associated with the lowest cost per case in the United States.²⁴

Our study is limited by a number of factors. As this was not a population-based study, we were unable to compare the prevalence of newly diagnosed diabetes in women with GDM and women without GDM. Our sample may also not be representative of the general population as this was a cohort drawn from a previous randomized controlled trial of tight glycemic control for gestational diabetes. These women may therefore have had a greater concern for their health and different lifestyle practices than the general population. As well, a higher proportion of women originally randomized to the intervention group chose to participate in the follow-up study. These women may also have viewed their diagnosis of GDM as more important as they received more medical attention during the original randomized controlled trial. The prevalence of undetected DM2 post-GDM may therefore be higher than observed in our cohort. This cohort, however, is the largest and longest follow-up of gestational diabetes in a primarily Caucasian Canadian population.

In summary, Caucasian Canadian women are at high risk of diabetes following a gestational diabetes pregnancy. Despite

high perception of risk of diabetes, the diagnosis of T2DM was missed in many women raising concerns about adequacy of postpartum screening. OGTT was more sensitive than fasting glucose in detecting T2DM in this population. Further strategies designed to implement appropriate postpartum screening and positive lifestyle changes in these women are warranted.

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