Associations with low rates of postpartum glucose screening after gestational diabetes among Indigenous and non-Indigenous Australian women

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Abstract

Objectives: To explore factors associated with postpartum glucose screening among women with Gestational Diabetes Mellitus (GDM).

Methods: A retrospective study using linked records from women with GDM who gave birth at Cairns Hospital in Far North Queensland, Australia, from 1 January 2004 to 31 December 2010.

Results: The rates of postpartum Oral Glucose Tolerance Test (OGTT) screening, while having increased significantly among both Indigenous* and non-Indigenous women from 2004 to 2010 (HR 1.15 per year, 95%CI 1.08–1.22, $p<0.0001$), remain low, particularly among Indigenous women (10% versus 27%, respectively at six months postpartum). Indigenous women in Cairns had a longer time to postpartum OGTT than Indigenous women in remote areas (HR 0.58, 0.38–0.71, $p=0.01$). Non-Indigenous women had a longer time to postpartum OGTT if they: were born in Australia (HR 0.76, 0.59–1.00, 0.05); were aged <25 years (HR 0.45, 0.23–0.89, $p=0.02$); had parity >5 (HR 0.33, 0.12–0.90, $p=0.03$); smoked (HR 0.48, 0.31–0.76, $p=0.001$); and did not breastfeed (HR 0.09, 0.01–0.64, $p=0.02$).

Conclusions: Postpartum diabetes screening rates following GDM in Far North Queensland are low, particularly among Indigenous women, with lower rates seen in the regional centre; and among non-Indigenous women with indicators of low socioeconomic status.

Implications: Strategies are urgently needed to improve postpartum diabetes screening after GDM that reach women most at risk.

Key words: gestational diabetes mellitus, type 2 diabetes mellitus, diabetes, pregnancy, Aboriginal, Indigenous

Gestational diabetes mellitus (GDM), defined as diabetes diagnosed during pregnancy,[1] is increasing in prevalence.[2] In addition to causing serious complications in pregnancy and birth, such as shoulder dystocia, macrosomia, neonatal intensive care admissions, neonatal hypoglycaemia, and caesarean section,[3] women diagnosed with GDM have a very high risk of developing type 2 diabetes mellitus (T2DM) postpartum.[4] Exposure to diabetes in-utero also increases the risk of obesity and diabetes for the infant in the longer term,[5,6] compounding the risk of diabetes in future generations.[7] Delayed T2DM diagnosis and management of hyperglycaemia pose serious risks to subsequent pregnancies, including congenital abnormalities[8,9] and, if left undetected and untreated in the longer term, can lead to multiple comorbidities for the mother.[10] Indigenous women from a number of different countries have been shown to experience particularly high rates of GDM[2,7,11] at a younger age[12,13] and are more likely to develop T2DM postpartum,[14] compared to other women in the same country.

*The term 'Indigenous' is used when referring to Aboriginal and Torres Strait Islander peoples in Australia collectively, and Indigenous peoples in other countries. This is for ease of reading in this paper only, and we respectfully acknowledge the diversity and autonomy of different communities included in this broad term.

The increased understanding of the importance of GDM as a serious health issue for women and their offspring has led to changes to international[1] and national[15] screening guidelines for GDM, including: offering screening in early pregnancy for women at high risk of T2DM, in addition to 24–28 weeks, as is currently recommended; separating 'probable' undiagnosed T2DM from GDM; and changing the diagnostic thresholds for GDM. These changes are likely to significantly increase the prevalence of GDM in Australia,[16] and have particular implications for Indigenous women, who are categorised as having a high risk of T2DM. While these changes offer likely benefits, essential criteria when introducing population-based screening[17,18] include

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ensuring that adequate and acceptable prevention, treatment, and postpartum follow-up are available and provided, wherever possible, to all identified women. There is currently limited evidence that this latter criterion is met,[19] particularly for Indigenous women.[20]

Despite an increased risk of developing T2DM[14] and shorter pregnancy intervals,[21] there are few studies investigating rates of postpartum T2DM screening for Indigenous women with GDM.[20] Low rates of postpartum screening for T2DM have been reported for non-Indigenous women in Australia[22] and internationally,[23] as well as Indigenous women in Canada,[24] New Zealand,[25] and the United States.[26] One study reporting low postpartum screening rates among Indigenous women in Far North Queensland was confined to remote areas and numbers were too small to assess trends or associations.[27] To our knowledge, no studies have reported factors associated with postpartum diabetes screening among Indigenous women with GDM in Australia or overseas.

A number of initiatives have been introduced in Far North Queensland to improve care for women with GDM, including protocols[28-30] that recommend postpartum T2DM screening, promoting breastfeeding and providing lifestyle advice. We recently evaluated the rates of postpartum screening for women with GDM,[31] and found very low rates of postpartum screening among all women, with significantly longer times to first postpartum oral glucose tolerance test (OGTT) (HR 0.62, 95%CI 0.48-0.79, $p<0.0001$) and lower rates of early postpartum screening by six months postpartum among Indigenous women (13.6%, 95%CI 10.5-17.5%) compared to non-Indigenous women (28.3%, 95%CI 25.1-31.9%). This paper aims to investigate factors associated with low postpartum screening in order to inform the development and evaluation of future efforts to address this situation.

Methods

Study setting and sample

The study setting and design details are reported elsewhere.[32] The study is a retrospective cohort design which used linked electronic data validated by medical record reviews. The following data sources were linked: (1) The Cairns Hospital Clinical Coding system (CHCCS) entries for all women who gave birth at Cairns Hospital between 1 January 2004 and 31 December 2010 and had a GDM diagnosis recorded (International Classification Diseases (ICD) code 024.41, 024.42, 024.42, 0.24.43, 0.24.44); (2) Pregnancy and birth details from the Midwives Perinatal Data Collection (MPDC); and (3) postpartum glucose test details from the three local laboratories. Additionally, review of medical records for all Indigenous births (n=578) and a random sample of non-Indigenous births (n=332) enabled validation of GDM diagnosis and identification of postpartum care providers.

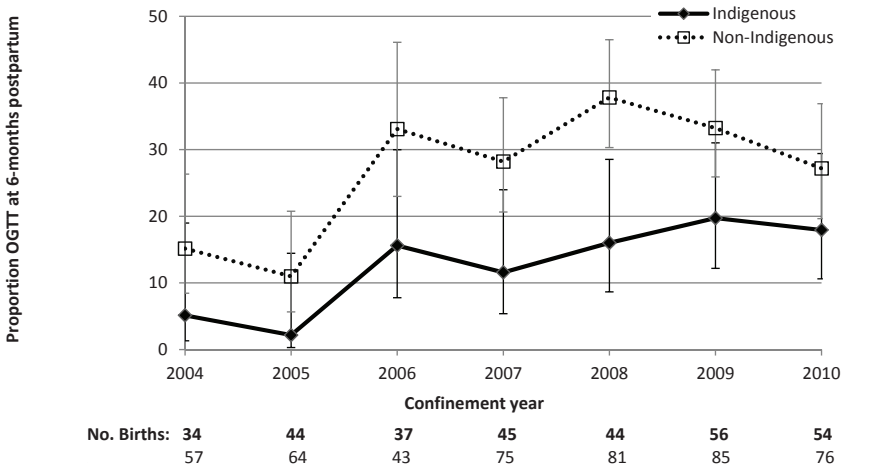
An OGTT is considered the most sensitive test to detect diabetes,[33] and while there is some variation in protocol recommendations during the study period from 2004 to 2010, the local guidelines are broadly based on the previous national guidelines, which advise an early postpartum OGTT at six to eight weeks postpartum, and then one to three yearly, dependant on assessment of risk and likelihood of pregnancy.[34] However, other guidelines relevant to postpartum care for Indigenous women[35-38] overlap and may recommend other screening tests, such as a Glycosated Haemoglobin (HbA1C), or Fasting Plasma Glucose (FPG), therefore analyses were conducted to assess predictors of a postpartum OGTT and sensitivity analysis conducted to assess predictors of 'any' laboratory-based postpartum glucose test. Associated factor variables were selected on the basis that they may be a potential barrier or facilitator to postpartum glucose screening; or a marker of socioeconomic status, T2DM risk or access to care.

Data analysis

De-identified data was exported from Microsoft Access for analysis in Stata 11.[39] Two separate sets of analyses were undertaken. The first set included all GDM births with information on the following factors: confinement date including birth year (Figure 1); country of birth; remoteness; maternal age; number of antenatal care visits; parity; smoking during pregnancy; medical complications; induction of labour; and mode of birth (Table 1). The second set of analyses were restricted only to GDM births where the medical records were reviewed, including: English proficiency; body mass index (BMI) at first antenatal visit; location of antenatal or postnatal care (hospital, private GP clinic, government clinic, community controlled health service, or other); breastfeeding at discharge; and 'probable T2DM' (diagnosed before 17 weeks gestation), see Table 2.

Time to first glucose screening test from confinement date, among pregnancies coded as GDM, was summarised using Kaplan-Meier survival curves and analysed using Cox proportional hazards regression models. Separate models were fitted for time to OGTT and time to 'any' screening. Women were censored from the analysis if they became pregnant or were diagnosed with T2DM as they would then not be advised to have T2DM screening. Timing of pregnancy censoring events were from: time of onset of subsequent pregnancy, calculated as 273 days prior to subsequent confinement; or 20 weeks prior to date of a postpartum test if that test was coded as 'during pregnancy' yet no pregnancy was recorded, including all tests after 1 March 2010 to account for

Figure 1: Proportions of women receiving an OGTT within 6 months postpartum by confinement year (2004-2010) and indigenous status.



women who may be pregnant during the study period but give birth after the study period (31 December 2010). Timing of T2DM censoring events were from the date of T2DM diagnosis from any data source (e.g. medical records, MPDC data, laboratory tests) that indicated the woman had developed T2DM.

Cox models were applied to Indigenous and non-Indigenous women separately for each screening factor of interest. Subsequently all women were included in a Cox proportional hazards regression model which included an interaction term between the screening factor and Indigenous status, with a likelihood ratio test used to calculate a single *p*-value to test for effect modification. Throughout, two tailed tests were conducted and $p<0.05$ was considered statistically significant.

Ethics

Ethical approval was granted for this project by the Cairns Hospital and Hinterland Research Ethics Committee, the Monash University Human Research and Ethics Committee, and the Queensland Health Research Ethics and Governance Unit (no. 201101190).

Results

From 1 January 2004 to 31 December 2010, 1,012 women were identified in the CHCCS as giving birth at Cairns Hospital and having

Table 1: Factors associated with time to first postpartum OGTT after GDM, by Indigenous status (among all GDM births, n=1083).

Characteristics	Combined HR			Indigenous GDM/births: 388/591 (65.7%)				Non-Indigenous GDM/births: 695/912 (76.2%)				Indigenous and non-Indigenous difference
	HR	CI	*p*	n	HR	CI	*p*	n	HR	CI	*p*	*P*-value
Indigenous status												
Non-Indigenous	1											
Indigenous	0.61	0.48-0.79	<0.0001									
Country of Birth												
Outside Australia	1			4	1			225	1			
Australia	0.76	0.58-0.99	0.04	384	0.90	0.13-6.5	0.92	470	0.76	0.59-1.00	0.05	0.83
Remoteness[a]												
Remote or very remote	1			140	1			26	1			
Cairns (outer regional)	0.61	0.43-0.86	0.005	248	0.58	0.38-0.89	0.01	665	0.64	0.35-1.18	0.15	0.81
Maternal age												
35+	1			118	1				1			
30-35	0.93	0.71-1.21	0.59	104	0.75	0.43-1.29	0.30	297,202	1.01	0.75-1.37	0.75	
25-29	0.87	0.64-1.17	0.34	91	0.77	0.44-1.36	0.37	143	0.91	0.64-1.29	0.59	0.53
<25	0.52	0.33-0.83	0.006	75	0.59	0.31-1.14	0.12	53	0.45	0.23-0.89	0.02	
Antenatal visits												
<8	1			111	1			104	1			
8+	1.17	0.86-1.58	0.32	273	1.19	0.73-1.95	0.49	575	1.14	0.78-1.67	0.50	0.85
Parity												
0	1			72,218	1			267	1			
1-4	0.86	0.68-1.10	0.23	97	0.88	0.51-1.54	0.67	393	0.87	0.67-1.14	0.32	0.28
5+	0.60	0.38-0.96	0.03		0.73	0.38-1.40	0.35	29	0.33	0.12-0.90	0.03	
Smoking at 20 weeks gestation												
No	1			224	1			521	1			
Yes	0.61	0.45-0.83	0.002	152	0.79	0.51-1.24	0.31	103	0.48	0.31-0.76	0.001	0.09
Medical complications[b]												
No	1			189	1			502	1			
Yes	1.19	0.94-1.51	0.11	197	1.39	0.90-2.14	0.14	187	1.14	0.85-1.51	0.38	0.44
Induction of labour												
No	1			258	1			406	1			
Yes	1.27	1.02-1.59	0.04	129	1.36	0.87-2.11	0.18	282	1.24	0.96-1.62	0.10	0.93
Mode of Birth												
Unassisted vaginal	1			198	1			338	1			
Assisted vaginal	0.67	0.39-1.14	0.14	5	NA			64	0.71	0.41-1.21	0.21	NA
Caesarean	1.05	0.84-1.32	0.66	184	1.07	0.70-1.64	0.76	287	1.04	0.80-1.37	0.75	0.93

a. Accessibility/Remoteness Index of Australia code

b. Medical complications existing prior to pregnancy

NA=not assessable due to small numbers

GDM, from a total of 16,765 births during the same period. This includes 352 Indigenous women and 660 non-Indigenous women. These women had 1,505 births during the study period and 1,098 (6.5%) of these births were coded as GDM after linkage with MPDC data and medical record review of 912 pregnancies. Two women who died in the early postpartum period were excluded from analysis.

Trends in postpartum OGTT screening over time

The rate of receiving an OGTT postpartum increased over the years of the study among both Indigenous and non-Indigenous women, (HR1.15 per year 95%CI 1.08-1.22, $p<0.0001$) although the rate remains low overall at well below 50% (Figure 1). In 2010, by six months postpartum, only 17.9% (10.6-29.4%) of Indigenous women received an OGTT, compared to 27.2% (19.6-36.9%) of non-Indigenous women. There was a similar increase in the rates for women receiving 'any' laboratory-based glucose test by six months postpartum (HR 1.09 per year, 95%CI 1.04-1.15, $p<0.0001$), with rates approximately 5% higher than OGTT screening rates for both Indigenous and non-Indigenous women.

Factors associated with time to first postpartum OGTT

Indigenous status held a strong association with longer time to first OGTT (HR 0.62, 95%CI 0.48-0.79, $p<0.0001$). Other factors were unable to explain the discrepancy in rates between Indigenous and non-Indigenous since it retained its strong association in multivariate analyses ($p<0.0001$-0.004). While factors associated with screening rates appear to differ by Indigenous status, breastfeeding at discharge from hospital was the only association with screening rates that had conclusive evidence of effect modification, i.e. differing *between* Indigenous and non-Indigenous women ($p=0.01$, Table 2).

Indigenous women

Indigenous women living in the large regional centre of Cairns had significantly longer times to the first postpartum OGTT, compared to Indigenous women living in remote or very remote areas (HR 0.58, 95%CI 0.38-0.59, $p=0.01$), see Table 1. Two Indigenous women receiving hospital-based postnatal care were significantly more likely to receive a postpartum OGTT, but this finding should be regarded with caution as the number is so small (Table 2).

Non-Indigenous women

Non-Indigenous women had a significantly longer time to first OGTT if they: were born in Australia (HR 0.76, 95%CI 0.59-1.00, $p=0.05$); were less than 25 years of age (HR 0.52, 95%CI 0.33-0.83, $p=0.006$); had parity greater than five (HR 0.33, 95%CI 0.12-0.90, $p=0.03$); smoked during pregnancy (HR 0.48, 95%CI 0.31-0.76, $p=0.001$), see Table 1; or were not

Table 2: Factors associated with time to first postpartum OGTT after GDM, by Indigenous status (among all births with medical record review, n=910).

Characteristics MRR GDM/births	Combined HR			Indigenous MRR GDM/births: 381/578 (65.9%)				Non-Indigenous MRR GDM/births: 270/332 (81.3%)				Indigenous and non-Indigenous difference
	HR	CI	*p*	n	HR	CI	*p*	n	HR	CI	*p*	*P*-value
Body Mass Index												
18-24 (ref)	1			59	1			66	1			
<18	NA			3	NA			0	NA			
25-29	0.82	0.54-1.26	0.37	87	0.87	0.42-1.80	0.62	77	0.82	0.48-1.40	0.47	0.48
30+	0.93	0.64-1.36	0.72	212	1.19	0.65-2.18	0.27	110	0.79	0.48-1.30	0.36	
Primary Antenatal Care Location:												
General Practitioner (GP)	1			91	1			207	1			
Hospital	0.98	0.52-1.84	0.94	26	1.57	0.65-3.81	0.32	15	0.67	0.25-1.84	0.44	0.21
Government clinics	1.23	0.84-1.82	0.84	202	1.43	0.82-2.52	0.21	30	1.26	0.70-2.28	0.44	0.68
Community Controlled Org.	0.72	0.35-1.50	0.38	55	0.91	0.40-1.80	0.84	2	NA			NA
Postnatal Care Loc:												
GP	1			105	1			225	225			
Hospital	1.61	0.22-11.55	0.64	2	10.25	1.34-78.42	0.03	1	1			NA
Government clinics	1.35	0.92-1.99	0.12	193	1.44	0.86-2.42	0.17	26	26	0.75-2.52	0.75	0.75
Community Controlled Org.	0.72	0.36-1.45	0.37	61	0.84	0.39-1.79	0.66	3	3			NA
Breastfeeding at discharge												
Fully	1			275	1			188	1			
Partial	0.97	0.66-1.43	0.88	66	0.87	0.48-1.58	0.65	46	1.04	0.63-1.72	0.89	0.62
None	0.53	0.28-1.00	0.05	32	1.23	0.61-2.48	0.56	23	0.09	0.01-0.64	0.02	0.01
'Probable' T2DM in early pregnancy[a]												
No	1			290	1			234	1			
Yes	0.84	0.44-1.59	0.59	30	0.54	0.20-1.40	0.22	14	1.24	0.54-2.83	0.62	0.21
NA/unclear	1.02	0.66-1.62	0.90	61	1.02	0.58-1.82	0.93	22	1.04	0.50-2.16	0.50	0.99

a. assessed as glucose intolerance diagnosed prior to 17 weeks gestation.

MRR=medical record review

NA = not assessable due to small numbers.

Eight (3%) non-Indigenous women were coded as requiring an interpreter, which was too few for analysis and this outcome was therefore excluded from the tables.

breastfeeding at discharge from hospital (HR 0.09, 95%CI 0.01-0.64, p=0.02), see Table 2.

Sensitivity analysis for 'any' laboratory-based glucose screen

Broadly similar results were observed in analysis of 'any' laboratory-based postpartum glucose screen, with a few exceptions meriting a mention. Among Indigenous women, having medical complications (HR 1.66, 95%CI 1.20-2.28, p=0.002); and receiving postnatal care at a government clinic (HR 2.16, 95%CI 1.44-3.26, p<0.0001) were significantly associated with a faster time to 'any' laboratory-based postpartum glucose screen. Among Indigenous (HR 1.52, 95%CI 1.10-2.10, p=0.01) and non-Indigenous (HR 1.26, 95%CI 1.01-1.57, p=0.04) women, an induction of labour was significantly associated with a faster time to 'any' laboratory-based postpartum glucose screen. Among non-Indigenous women, being born in Australia (HR 0.90, 95%CI 0.71-1.13, p=0.36); having parity greater than five (HR 0.84, 95%CI 0.34-1.22, p=0.17); and smoking (HR 0.75, 95%CI 0.54-1.02, p=0.08) were not significantly associated with a longer time to 'any' laboratory-based glucose screen.

Discussion

Summary of main findings

This study is the first to report factors associated with postpartum glucose screening among Indigenous and non-Indigenous women. We found the rates of postpartum OGTT screening have increased significantly from 2004 to 2010 among both Indigenous and non-Indigenous women, but they still remain unacceptably low, despite the introduction of local guidelines in 2006. Overall, we found relatively few factors which were significantly associated with faster times to a postpartum OGTT. Indigenous status remained strongly associated with longer times to a postpartum OGTT, with Indigenous women in the regional centre of Cairns experiencing longer times to OGTT screening than Indigenous women in remote or very remote areas. Among non-Indigenous women, those with several proxy measures for lower socioeconomic status had longer times to a postpartum glucose OGTT, including: being born in Australia; being young (maternal age <25 years); grand-multiparity (>5 previous pregnancies); smoking during pregnancy; and not breastfeeding at discharge from hospital.

Comparisons with other studies

Our findings are similar to other studies reporting predictors for postpartum screening among non-Indigenous women,[40] including 'non-white' ethnic groups, lower maternal age,[23,41,42] higher parity,[23] and smoking[41] being associated with lower screening rates. These studies also report socioeconomic status or income,[23,41,43,44] and other 'proxy-measures' (being overweight, not being married,[41] not using diabetes medication, later GDM diagnosis, and less provider contacts[23]) to be predictive of lower rates of screening. However, as far as we aware, our findings are the first to examine associations with postpartum screening among Indigenous Australian women, and we did not find these same associations, possibly as Indigenous status is such a strong marker of social disadvantage in Australia. Our findings also reinforce calls to ensure that services for Indigenous women living in regional centres and urban areas are adequately provided, as the focus of most Indigenous research and service provision is currently on Indigenous people living in remote areas; in contrast to the reality that most Indigenous Australian people now live in urban areas.[45]

Limitations

There are two main limitations to this study. The first is the absence of 'point of care' tests provided by primary health care professionals, such as HbA1C, FPG and Random Plasma Glucose (RPG). Therefore the time to 'any laboratory-based test' estimates in this study are likely to be a little lower than the true glucose screening rates. Nevertheless, OGTTs are not performed outside a laboratory setting and therefore we conclude the rates of postpartum OGTT screening and predictors are accurate. The second is that the comparison of service providers should be viewed with caution as staff from community-controlled services and general practitioners often work in collaboration with government clinics, so there is a degree of overlap in providers. Therefore we have not focused on these findings in the discussion.

What might be some of the causes of low postpartum glucose screening rates?

This research identified some socio-demographic factors associated with postpartum glucose screening among women at high risk of developing T2DM. We will discuss potential factors affecting postpartum screening rates identified in the literature using a socio-ecological model, in order to enhance our understanding of what may be actually happening.[46] Moreover, this model can assist in translating the research findings to a range of different stakeholders within the broader environment, which other models might have difficulty doing.[46]

At an *individual level*, commonly reported factors include lack of awareness and forgetting about the need for a test, test inconvenience, the unpleasant nature of the test and the fear of results.[47,48] A recent study in Far North Queensland also identified low levels of 'health literacy' among Indigenous people in relation to diabetes,[49] which may be an important factor influencing awareness and remembering about the need for a test. Given the high mortality rates from diabetes in Far North Queensland, fear of results may be another important factor among Indigenous women. A qualitative study among American Indian women with GDM reported a high level of risk perception coupled with a low sense of self-efficacy,[50] which has been identified as a combination of factors which is likely to result in 'avoidance behaviour'.[51]

At an *interpersonal level*, factors such as poor communication and time pressures have been reported as barriers and are likely to be relevant in Far North Queensland.[40] In addition to medical staffing shortages and cross-cultural barriers hindering communication between predominantly non-Indigenous providers and Indigenous clients, historical factors related to the relationship between Indigenous women and non-Indigenous medical experts may inhibit open discussions about their postpartum diabetes screening preferences, particularly if they are not in accordance with medical advice.

At an *institutional level,* factors such as costs, inconsistent guidelines, and lack of GDM documentation[40] are frequently reported as a barrier to screening. Costs may be a factor affecting lower rates of postpartum OGTT screening in regional centres, as there may be limited publicly funded health services in regional areas, and private services can incur substantial fees. While there may be administrative arrangements to cover costs for health care card holders and/or Indigenous women, these arrangements

may not be well understood by women or healthcare providers or even known about. There are a number of guidelines addressing cardio-metabolic risk screening among Indigenous people, who may fall under several diabetes 'risk' categories.[35-38,52,53] There is some variation between these guidelines, and only the GDM guidelines recommend an OGTT be used as a screening test. A factor contributing to this inconsistency is that there remains some debate over the 'right' test to recommend to women at risk of T2DM after GDM. The disadvantage of the OGTT is that it requires fasting, followed by consumption of a sweet drink, which is sometimes perceived as unpleasant, as well as waiting for two hours. Studies have shown that postpartum glucose screening rates can be increased by using more convenient tests like a HbA1C and FPG.[54] However, while the sensitivity of combining the tests may be as high as 90%,[55] current evidence suggests both HbA1C and FPG have lower sensitivity than an OGTT and may not detect impaired glucose tolerance.[56-59] But no matter how 'efficacious' a screening test is, it will not be 'effective' at a population level if it is not acceptable to the target population. Finally, while providing evidence-based guidance for women has been developed in relation to other tests during pregnancy in Australia,[60] there is currently limited evidence-based information for women with GDM available to make an informed decision about which type of test, particularly for Indigenous women.

How can we improve postpartum care for women with GDM?

Systematically developed and tailored strategies are needed to improve postpartum glucose screening for women with GDM. Recent studies show that comparatively simple strategies can improve postpartum glucose screening rates, which has led to calls for them to be to be part of routine postpartum care for women with GDM.[61] Effective strategies include: patient reminders,[40,62,63] physician reminders,[64,] and antenatal education;[65] system changes,[24,56,66] proactive postpartum care plans,[67] registers,[68] clinical protocols and electronic records.[63,69] Factors which have been identified as 'facilitators to screening' include: increasing awareness,[40] providing risk reduction advice, endocrinology care, obstetric care and diabetes education;[22] and improving testing convenience with child-friendly facilities, providing pleasant-tasting drinks or avoiding fasting.[47] The low rates of postpartum T2DM screening among non-Indigenous women are in stark contrast to high rates of postpartum screening for cervical cancer.[70] The success in improving screening for cervical cancer among Indigenous women,[71] which is also an inconvenient test, may also provide important lessons for improving postpartum T2DM screening.

Current initiatives to improve postpartum T2DM screening in Australia include the establishment of a national GDM register as part of the National Diabetes Services Scheme (NDSS) in 2011, which sends annual letters to women who have registered as having GDM to remind them to have a postpartum diabetes test. Queensland Health has supplemented this with an 'enhanced NDSS GDM register', which is linked to the NDSS register and provides additional resources to address the needs of the Queensland population, including trials of text messaging for Indigenous women. However it is unclear how universal the current uptake is, with some suggestions it may be lower among Indigenous women.[72] Other initiatives within Australia include the development of clinical registers for GDM in the Northern Territory,[73] and text-messaging reminders for women in South Australia.[74] While these current strategies address individual level factors such as lack of awareness and forgetting about the need for the test, it is likely there is a need to do more to address other barriers. This may include strategies to: support health literacy and development of appropriate tools to promote informed health decision-making among Indigenous women; minimise anxiety and increase self-efficacy and confidence about postpartum screening and managing diabetes; improve interpersonal communication and enhance cultural liaison roles; improve the consistency between related guidelines or explain the rationale for any discrepancies with existing related guidelines in new guidelines; and ensure free (or affordable) testing is available and that both providers and women know how to access it easily; or there may be other factors we are not yet aware of.

We have highlighted some descriptive data about 'what' is needed, including the need to improve services for Indigenous women, particularly those living in regional centres, and non-Indigenous women with low socioeconomic status. But these findings now need to be supplemented with findings from more mixed methods research, to provide a deeper understanding of barriers ('why') and potential strategies for improving the situation ('how'). We plan to discuss these findings with service providers and women to clarify the actual barriers in Far North Queensland, and to generate potential strategies to improve postpartum screening relevant for this context. Any future strategies which aim to improve postpartum glucose screening rates need to be implemented and evaluated with regards to what are the elements that offer improvements to the health and wellbeing of Indigenous women.

Importantly, GDM, and the progression to T2DM, are preventable[75] and treatable,[76-78] and therefore diagnosis of GDM offers a very important and unique 'window of opportunity'[79] for prevention during their frequent scheduled contacts with health services during and after pregnancy. This includes providing effective treatment to minimise avoidable complications during pregnancy and birth; and supporting women to reduce their risk of developing T2DM and that of their infant[80] by breastfeeding and healthy lifestyle changes. Any effective support during this period can have significant benefits for the woman and her infant, her extended family and many generations to follow.[7] However, there are currently few studies demonstrating effective care for women after GDM,[81] particularly among Indigenous women,[20] which reflects the lack of diabetes intervention research[82] and care[83] among Indigenous peoples more generally. Evidence of effective strategies to prevent GDM among Indigenous women, and to improve care during and after pregnancy for Indigenous women with GDM, is urgently needed.

Conclusions

The introduction of guidelines recommending postpartum screening for women with GDM has not been sufficient. Rates of postpartum screening for women with GDM in Far North Queensland have increased over time but remain very low, particularly among Indigenous women. Strategies to improve postpartum screening for all women with GDM are urgently needed, with particular attention to ensure access for Indigenous women in regional centres and non-Indigenous mothers categorised as having lower socioeconomic status.

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