Ethnic inequities in screening for diabetes in pregnancy in New Zealand—adherence to national guidelines

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ABSTRACT

AIM: The aim of this study was to assess adherence to the 2014 Ministry of Health (MoH) screening guidelines for diabetes in pregnancy (DiP) by Māori and non-Māori in the Waikato region.

METHODS: Clinical records were reviewed for women without known diabetes before pregnancy who delivered in hospitals or community birth centres in the Waikato region during June–August 2017. Screening rates for DiP were assessed using HbA_{1c}, glucose challenge and/or glucose tolerance tests.

RESULTS: Of a total of 807 women, 94% received some form of screening for DiP; 527 (65.3%) underwent HbA_{1c} screening at <20 weeks and 267 (33.1%) underwent testing for gestational diabetes at 24–28 weeks' gestation. However, only 213 (26.4%) received all screening as per the MoH guideline. HbA_{1c} testing was the most common screening performed (83.9% of all pregnancies), and three quarters of women had a glucose load screen at some point during pregnancy. In all measures, screening rates were lower in Māori, with only 17.5% (46 of 263 women) receiving both HbA_{1c} and further glucose load screening in the recommended gestation windows (versus 31.6% (171 of 541) for non-Māori; P<0.0005).

CONCLUSIONS: Adherence to screening guidelines for DiP was poor with a marked ethnic inequity. Further work is needed to investigate the barriers to care that drive these differences.

Diabetes mellitus (DM) in pregnancy (DiP) may be due to either undiagnosed or previously unrecognised pre-gestational diabetes mellitus (type 1 or type 2 DM (T1D, T2D), or gestational diabetes mellitus (GDM). In Aotearoa/New Zealand the incidence of DiP continues to rise, with at least 8–10% of pregnancies now affected by GDM or DM.[1] This rise in DiP incidence is concerning, as it poses a significant threat to both maternal and fetal health. In general, risks of hyperglycaemia in pregnancy include miscarriage, preterm labour, pre-eclampsia, macrosomia, neonatal hypoglycaemia and perinatal death.[2] In addition, exposure to hyperglycaemia *in utero* is associated with long-term risks to the offspring.[3,4]

Appropriate screening for DiP is important to promote the best clinical management of women and their neonates. Yet, in the past, there have been marked variations in the practice of screening, diagnosing and treating DiP in Aotearoa/New Zealand.[5,6] In response to this, in December 2014, the Ministry of Health (MoH) introduced national evidence-based guidelines to streamline DiP care.[7] These guidelines include a screening pathway (outlined in Figure 1). Recommendations include the use of glycated haemoglobin (HbA_{1c}) measurements before 20 weeks' gestation to detect previously undiagnosed diabetes or impaired glucose tolerance (IGT) and a two-step glucose load test at 24–28 weeks' gestation to screen for GDM. However, the

initial 50g oral glucose challenge test (GCT) offered to women who are considered to be at low risk of GDM has a low positive predictive value,[8] hence midwives and obstetricians have anecdotally been reported to offer a 75g oral glucose tolerance test (GTT) in the first instance, irrespective of the presentation of additional DiP risk. Further, in New Zealand the management of those identified with IGT in early pregnancy (HbA_{1c} 41–49mmol/mol) remains debated and therefore variable, though the guideline recommends they are treated as high risk of GDM with a GTT at time of GDM screening.

Inequities in healthcare delivery for Māori, and in particular for screening for GDM, have been well documented.[5] While no disparity was seen for Māori DiP screening in a cohort from 1994–1995 in Auckland,[5] more recent studies from before the introduction of the national MoH guideline indicate that screening rates for GDM have been lower in Māori women.[9,10] These lower screening rates are in spite of an increased risk, given that T2D and GDM both disproportionately affect Māori.[7,9,10]

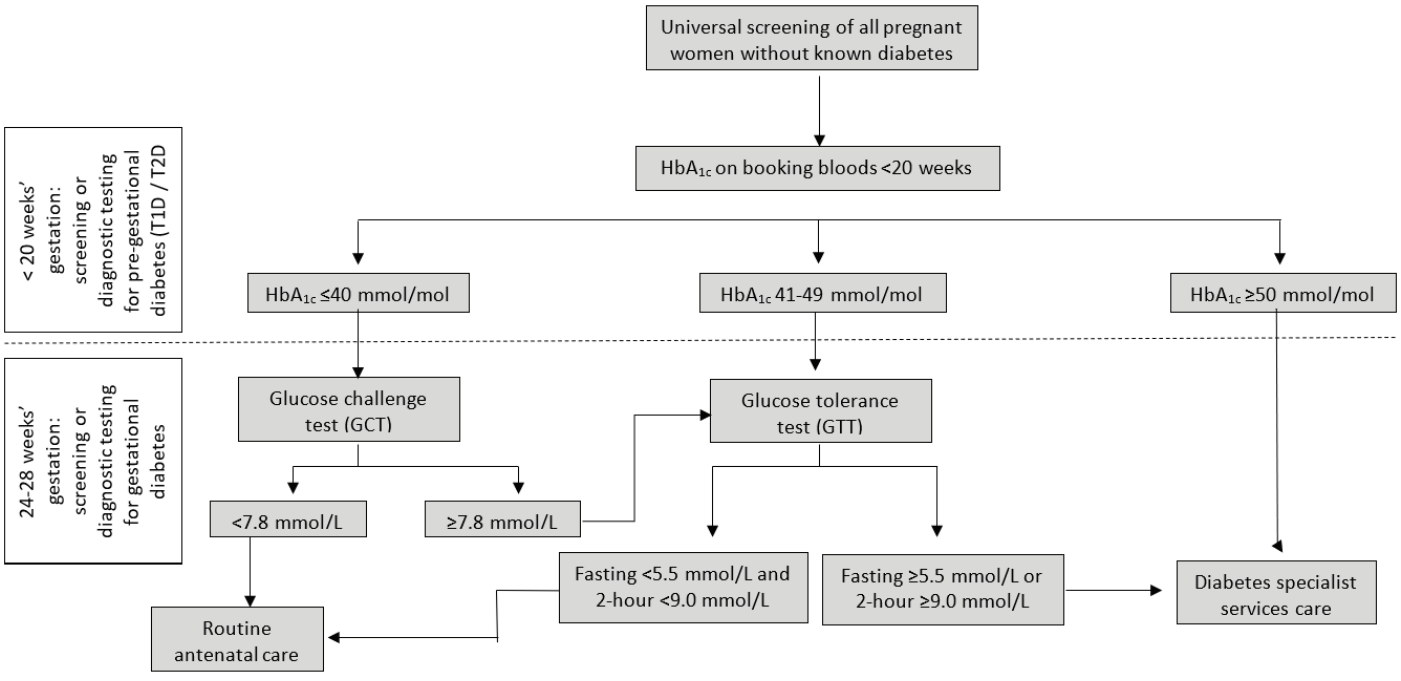
Thus, the aim of this study was to assess adherence to the MoH guidelines for screening for DiP in a cohort of pregnant women from the Waikato region, and to determine whether inequities in screening rates between Māori and non-Māori women remain following the introduction of these guidelines.

Materials and methods

A retrospective review of clinical records was performed of all women without a pre-pregnancy diagnosis of DM, who delivered in hospitals or community birth centres in the Waikato region between 1 June 2017–31 August 2017 (n=807). Previously undiagnosed diabetes was defined as an HbA_{1c} ≥50mmol/mol performed before 20 weeks' gestation. GDM was defined as a fasting glucose ≥5.5mmol/L and/or a two-hour glucose ≥9.0mmol/L on a GTT. The length of gestation at screening points were calculated from the gestational age recorded at delivery. When the latter was not available (n=51; 6.3%), the gestational age at delivery was imputed at 40 weeks. These 51 deliveries occurred at peripheral birth centre sites and thus were very unlikely to include deliveries of the extremes of gestations (ie, <38 or >41 weeks). For those who received more than one GCT and/or GTT, the gestation at the first was considered as the screening test.

Ethnicity was categorised as Māori or non-Māori, based on hospital recorded self-identified ethnicity, using prioritisation to manage multiple ethnicities.[11] Women with no recorded ethnicity (n=3) were included in the overall analysis, but not in comparisons between Māori vs non-Māori women.

Figure 1: Screening pathways for Diabetes in Pregnancy in Aotearoa/New Zealand (adapted from Ministry of Health guidelines[7]).



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All data were analysed using SPSS version 25. Mann-Whitney *U* tests and Pearson's Chi-square tests were used for comparisons between groups for continuous and dichotomous variables, respectively. Spearman correlations were used to evaluate factors contributing to screening rates. Logistic regression was used to assess factors influencing screening between Māori and non-Māori. Significance was defined as a P value <0.05.

Results

The study included 807 women including 263 Māori women (median age at delivery 26.7 years) and 541 non-Māori women (72.1% NZE, 17.6% Asian, 6.1% Pasifika; 4.3% other; median age at delivery 30.2 years (P<0.001)).

Screening for unknown pre-gestational diabetes or IGT

Overall, at least 80% of women completed an HbA_{1c} test, and this did not differ between Māori and non-Māori (84.8% vs 83.4%; Table 1). However, there was some deviation from the MoH guidelines. Only 65.3% of all women (77.8% of those screened) had an HbA_{1c} performed before 20 weeks' gestation (Table 1). Further, differences in HbA_{1c} screening were observed between Māori and non-Māori, with Māori being more likely to be screened after 20 weeks (29.6% vs 18.7% of those screened, p<0.001; Table 1). Similarly, the median gestational age at HbA_{1c} was later in Māori women (9.4w vs 6.7w for non-Māori; Table 1).

HbA_{1c} testing detected only one woman (Pasifika) with a level above 50mmol/mol (0.2%) and a further eight (1.4%) with levels consistent with IGT.

Screening for gestational diabetes (GCT and/or GTT)

Three quarters of all women were screened for GDM via a GCT or GTT, though this was lower in Māori women (64.3% vs 81.2%; P<0.001; Table 1). The cumulative proportions of GDM screening is shown in Figure 2 indicating both reduced and delayed screening for Māori women. Of those screened for GDM, 43.8% had their initial GCT or GTT carried out at 24–28w gestation, though half were screened after 28 weeks. Māori women were more likely to be screened late for GDM, with only a third being tested at 24–28w, and 60.3% being tested after 28w (Table 1). The median gestational age at GDM testing was 29w for Māori and 28w for non-Māori (P<0.0005; Table 1).

Figure 2: Cumulative proportion of initial gestational diabetes screening (GCT or GTT).

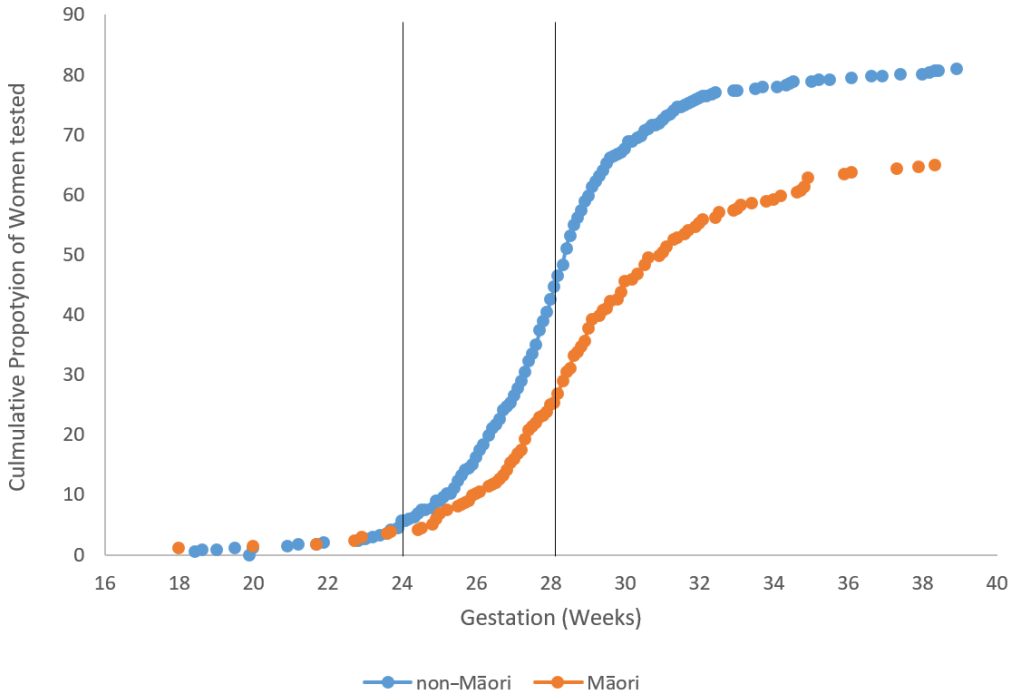

Table 1: Rates (%) of screening for diabetes mellitus in pregnancy. This includes HbA1c for detection of undiagnosed pre-gestational diabetes mellitus, and glucose load testing for detection of gestational diabetes.

Test[1]	All women[1] (n=807)			Māori women (n=263)			Non-Māori women (n=541)			P (Māori vs non-Māori)
		% of all	% of those screened		% of all	% of those screened		% of all	% of those screened	
HbA_{1c} measured (%)	677	83.9	-	223	84.8	-	451	83.4	-	0.606
<20w (%)	527	65.3	77.8	157	59.7	70.4	367	67.8	81.3	<0.001
≥20w (%)	150	18.6	22.2	66	25.1	29.6	84	15.5	18.7	
Median gestation of HbA_{1c} test (IQR)[2]	7.3 (5.4, 12.3)			9.4 (6.2, 18.4)			6.7 (5.1, 10.0)			<0.001
GDM testing via GCT or GTT (%)	609	75.5	-	169	64.3	-	439	81.2	-	<0.001
Initial test <24w (%)	34	4.2	5.6	10	3.8	5.9	24	4.4	5.5	<0.001
Initial test 24–28w (%)	267	33.1	43.8	57	21.7	33.7	210	38.8	47.8	
Initial test >28w (%)	307	38.0	50.4	102	38.8	60.3	205	37.9	46.7	
Median gestation of initial GCT/GTT test[4] (IQR)[2]	28.1 (26.5, 29.4)			28.6 (26.9, 30.5)			28.1 (26.3, 28.9)			<0.001
Women screened as per MoH guideline[3]	213	26.4	-	46	17.5	-	171	31.6	-	<0.001
Women who received no screening during pregnancy	48	5.9	-	21	8.0	-	27	5.0	-	0.093

GCT = Glucose challenge test; GTT = Glucose tolerance test; w = weeks of gestation; MoH = Ministry of Health.
[1]Includes three women on unknown ethnicity.
[2]Only includes those who completed the test.
[3]MoH guidelines suggest that pregnant women should be screened with HbA_{1c} prior to 20 weeks' gestation, and with GCT/GTT at 24–28 weeks.[7]

Of the 609 women who had been screened for GDM, 125 (20.5%) had both a GCT and a GTT, though only 88 of those GTTs were clinically indicated by an elevated GCT result. Further, eight women who had a positive GCT did not go on to have a GTT, and none of these were reviewed by the Specialist Diabetes Service.

Of the 198 women not screened for GDM using GCT and/or GTT, 146 had had an HbA_{1c} test, with 56 of these occurring after 20w gestation. Similarly of those who completed an HbA_{1c} after 20w (n=150), one third (n=58) did not go on to have a GCT or GTT to screen for GDM. This was disproportionately higher in Māori, with 57.7% of those with a late HbA_{1c} not being screened via GCT/GTT compared to 23.8% of non-Māori ($P < 0.001$). Of the eight women with IGT, six had a GCT/GTT during the remainder of their pregnancy but only one of these occurred at between 24–28 weeks' gestation.

GDM was diagnosed in 47 women (nine Māori, 34 non-Māori), giving a prevalence of 7.7% in the screened population and 5.8% of all women overall. Almost all (98%) women diagnosed with GDM were referred to the Specialist Diabetes Services. Of the nine Māori women with GDM, six (66.7%) had an elevated fasting glucose in their OGTT while only three (33.3%) had an elevated two-hour glucose level. In contrast, in non-Māori, the opposite was seen with only 32.4% having an elevated fasting glucose, and 67.6% having an elevated two-hour glucose level in the OGTT.

Complete screening as per Ministry of Health guidelines

Overall, only 26.4% of women were screened in accordance with all parts of the MoH guidelines, including 17.5% of Māori and 31.6% of non-Māori ($P<0.001$, Table 1).

Discussion

Screening for DiP throughout Aotearoa/New Zealand has been variable, ranging from 51–85%.[5,8,9] Of concern, our study shows that despite implementation of national guidelines, screening for GDM remains suboptimal. Only a quarter of women had screening for DiP at the recommended time points and nearly 25% did not have GCT and/or GTT screening for GDM at all. In addition, completed screening rates continue to be lower in Māori women, despite a greater risk of pre-gestational T2D and GDM, indicating a greater importance for screening in this population.[12]

In total, 47 women were diagnosed with GDM in this cohort, giving an overall prevalence of 5.8%. This is similar to that reported previously in Aotearoa/New Zealand,[13] though it does not account for any cases missed in unscreened women. Indeed, assuming that the non-screened population have similar GDM risk, we estimate that a further five Māori and eight non-Māori women with GDM were missed because of under-screening. This is concerning given the complications known to associate with GDM,[2–4] though this is speculative as pregnancy outcomes were not assessed in this cohort.

In our study, the overall rates of women receiving any DiP screening were high, with only 5.9% of women receiving no test for DiP. However, completion of all components of screening at the correct times was low. HbA_{1c} was the more commonly used test, though substantially lower rates of GCT and/or GTT testing illustrate ongoing gaps in screening for GDM in the community. Furthermore, the finding that approximately four out of five women with a normal HbA1c did not have further screening for GDM raises the possibility that a normal HbA_{1c} result alone may be falsely reassuring, The purpose of HbA1c testing in early pregnancy is to identify previously undiagnosed prenatal diabetes mellitus but it is not an established measure of determining future GDM risk. However, there is some conflicting data around the efficacy of using HbA_{1c} later in pregnancy to support a diagnosis of GDM. Some studies suggest that a mid-pregnancy HbA_{1c} of ≥40mmol/mol may support the diagnosis of GDM,[14] though late HbA_{1c} results have been considered to be less reliable because of increased red cell turnover and iron deficiency of pregnancy.[15] The 2014 national guideline, against which this cohort is compared, does not propose a role for HbA_{1c} (after 20 weeks) for the diagnosis of GDM. However, if alternate options for screening are considered to improve access and acceptability then a pregnancy-adjusted HbA_{1c} may have a role, as it has also been shown to detect up to a third of patients with GDM when used in the third trimester, without the need for a GTT.[16]

It is also concerning that half the women with IGT detected with an HbA_{1c} in early pregnancy had no further screening for GDM or management of hyperglycaemia despite being a high-risk group. This supports the argument that women with IGT in pregnancy may not be appropriately managed by the current MoH guideline.[17] Further work is needed to understand the best way to work with pregnant women with previously undiagnosed IGT.

The MoH guidelines have led to a mixed response in reducing ethnic disparity in DiP screening. The addition of HbA_{1c}, to the antenatal booking blood tests has improved access to screening for undiagnosed T1D or T2D for Māori, and this has been reported previously.[10] This indicates that systemic solutions aimed at known barriers can improve access to testing, though in our study, Māori women were nearly twice as likely than non-Māori women to have their HbA_{1c} measured after the recommended 20 weeks, potentially due to delayed access to early antenatal care and thus a later gestation at booking. The almost three-fold lower prevalence of pre-existing T2D and IGT in our study compared with others,[10] supports groups who suggest that HbA_{1c} may not be a cost-effective means of prenatal diabetes screening.[15,18] However, despite this improvement in HbA1c testing inequity continues to exist in GDM screening between Māori and non-Māori with only one fifth of Māori women completing a GCT or GTT at 24–28w and a further third received no screening for GDM at all. Overall, the reasons for reduced or delayed testing of HbA1c and/or GDM screening for Māori women cannot be ascertained from this study, though this finding may be clinically important, as

treatment of GDM in late gestation may be less effective than earlier intervention in preventing adverse outcomes.[19] Systemic delays and inequities in routine antenatal care for Māori,[12,20] as well as timely DiP screening for Māori and other indigenous women,[17] are well documented. Missed opportunities for GDM screening in Māori women have also been previously identified.[18,21] The fact that inequities continue after the introduction of MoH guidelines indicate that urgent and targeted interventions are required to improve screening for DiP for Māori women. However, any adjustment to practice or guideline needs to consider the improved access to screening in indigenous populations seen with early antenatal HbA1c.[21]

The current screening recommendations present different pathways dependent on risk of GDM (ie, two-step GCT screening followed by GTT if indicated for those at low risk, compared to direct testing with GTT for those at high risk). It is argued that this pathway adds unnecessary complication or delay,[17] and our study appears to supports this as only a quarter of women received the 'correct' screening along the pathway. Furthermore, in our study, many women received a GTT when it was not clinically indicated, and the eight women who should have had a GTT based on their GCT result, did not. This suggests that there may be some misunderstanding of the guidelines by lead maternity carers which need to be evaluated further.

A review of this national guideline that considers alternative woman-centred pathways of screening for GDM is needed, and alternative screening options need to be assessed for their potential to improve access for Māori. If alternate options for screening are considered to improve access and acceptability, a pregnancy-adjusted HbA_{1c} may have a role for some women, as it has also been shown to detect up to a third of patients with GDM when used in the third trimester, without the need for a GTT.[16] Fasting blood glucose has also been reported to be cheap and reliable with good patient compliance.[22] This may be particularly useful for screening of Māori women, as two thirds of Māori women with GDM in our study had an elevated fasting glucose result, compared with non-Māori women who were more likely to have an elevated two-hour glucose result. Thus, this needs to be evaluated in a significantly larger sample of women, as it may be an option for women in whom completion of a GTT or GCT is not appropriate or accessible.

This study is the first of its kind in Aotearoa/New Zealand to assess adherence to screening for DiP as per the 2014 MoH guidelines, and it is strengthened by the fact that included the records of all women who delivered within our region during the time period of study. However, we acknowledge that some women may have completed pregnancy screening outside of the region which would have skewed these results. Ideally, for completeness, in future studies laboratory data should be sourced from other regional laboratories as well as from those in the Waikato region. A further limitation is that the exact gestation age at delivery was not available in 6.3% of patients, and thus gestation at times of screening were calculated from an imputed gestation at delivery of 40 weeks (though as these deliveries all occurred at peripheral community birth centres, these women should have been between 38–41 weeks' gestation). However, our calculations suggest that the data from these 51 women did not significantly alter any of the results even when imputed at 38 or 41 weeks. Further, while we used exact cut-off gestation dates to define screening as per the MoH recommendations, we recognise that some women may have been screened just days outside of these dates. Indeed, as Figure 2 shows, a significant number of women were screened at 28–29 weeks' gestation. Thus, it would be worth exploring this in future studies to determine what proportion of women are screened just outside of the defined recommendations to determine how this impacts on screening adherence.

Conclusion

It is clear, at least in our region, that much work is required to increase adherence to the MoH guidelines for DIP screening, which likely includes targeted programmes aimed at health professionals and services, considering the needs and care of the community. Additionally, the screening pathway may need to be reviewed to account for the

ongoing ethnic disparity seen and consideration of whanau-centred screening that is acceptable and acceptable for women. Focused work is also required to reduce inequities in antenatal care, improve screening rates for GDM in Māori women and mitigate the barriers that are limiting screening, particularly for Māori, in order to have a system with equitable, high-quality access and clinical outcomes.

Competing interests:
Nil.

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REFERENCES:

1. Auckland District Health Board. National Women's Health Annual Clinical Report 2015. http://nationalwomenshealth.adhb.govt.nz [accessed May 16 2018]; 2015.
2. Wendland EM, Torloni MR, Falavigna M, Trujillo J, Dode MA, Campos MA, et al. Gestational diabetes and pregnancy outcomes-a systematic review of the World Health Organization (WHO) and the International Association of Diabetes in Pregnancy Study Groups (IADPSG) diagnostic criteria. BMC pregnancy and childbirth. 2012; 12(1):23.
3. Dabelea D, Hanson RL, Lindsay RS, Pettitt DJ, Imperatore G, Gabir MM, et al. Intrauterine exposure to diabetes conveys risks for type 2 diabetes and obesity: a study of discordant sibships. Diabetes. 2000; 49(12):2208–11.
4. Landon MB, Rice MM, Varner MW, Casey BM, Reddy UM, Wapner RJ, et al. Mild gestational diabetes mellitus and long-term child health. Diabetes Care. 2015; 38(3):445–52.
5. Yapa M, Simmons D. Screening for gestational diabetes mellitus in a multiethnic population in New Zealand. Diabetes Research and Clinical Practice. 2000; 48(3):217–23.
6. Simmons D, Rowan J, Reid R, Campbell N. Screening, diagnosis and services for women with gestational diabetes mellitus (GDM) in New Zealand: a technical report from the National GDM Technical Working Party. 100 Years Ago in the NZMJ. 2008.
7. Ministry of Health. Screening, Diagnosis and Management of Gestational Diabetes in New Zealand: A clinical practice guideline. Wellington; 2014. Available from http://www.health.

govt.nz/system/files/documents/publications/screening-diagnosis-management-of-gestational-diabetes-in-nz-clinical-practive-guideline-dec14-v2.pdf [accessed Jan 2019]

8. Ekeroma AJ, Chandran GS, McCowan L, Ansell D, Eagleton C, Kenealy T. Impact of using the international association of diabetes and pregnancy study groups criteria in South Auckland: prevalence, interventions and outcomes. Australian and New Zealand Journal of Obstetrics and Gynaecology. 2015; 55(1):34–41.
9. Daly B, Raiman I, Goodson J. Screening for diabetes in pregnancy in a regional area with a high Maori population. New Zealand Medical Journal, 2017; 130(1450):25–31.
10. Hughes R, Williman J, Gullam J. Universal HbA1c measurement in early pregnancy to detect type 2 diabetes reduces ethnic disparities in antenatal diabetes screening: a population-based observational study. PloS One. 2016; 11(6):e0156926.
11. Ministry of Health. Health Information Standards Organisation 10001:2017 Ethnicity Data Protocols. Available from www.health.govt.nz [accessed Feb 2018]. 2017.
12. Payne O, Pillai A, Wise M, Stone P. Inequity in timing of prenatal screening in New Zealand: Who are our most vulnerable? Australian and New Zealand Journal of Obstetrics and Gynaecology. 2017; 57(6):609–16.
13. Lawrence RL, Wall CR, Bloomfield FH. Prevalence of gestational diabetes according to commonly used data sources: an observational study. BMC Pregnancy and Childbirth. 2019; 19(1):1–9.
14. Ho YR, Wang P, Lu MC, Tseng ST, Yang CP, Yan YH. Associations of mid-pregnancy HbA1c with gestational diabetes and risk of adverse pregnancy outcomes in high-risk Taiwanese women. PloS One. 2017 May 15; 12(5):e0177563.
15. Claire B, Sharon H. Should HbA1C be used to screen pregnant women for undiagnosed diabetes in the first trimester? A review of the evidence. Journal of Public Health. 2019.
16. Renz PB, Cavagnolli G, Weinert LS, Silveiro SP, Camargo JL. HbA1c test as a tool in the diagnosis of gestational diabetes mellitus. PLoS One. 2015 Aug 20; 10(8):e0135989.
17. Rowan J, Allen H, Budden A, Elder R, Farrant M, Hughes R, et al. New Zealand National GDM Guidelines: an alternative view of some good practice points. Australian and New Zealand Journal of Obstetrics and Gynaecology. 2015; 55(1):17–20.
18. Coop C, Edlin R, Brown J, Farquhar C. Cost-effectiveness of the New Zealand diabetes in pregnancy guideline screening recommendations. BMJ Open. 2015; 5(6):e006996.
19. Immanuel J, Simmons D. Screening and treatment for early-onset gestational diabetes mellitus: a systematic review and meta-analysis. Current Diabetes Reports. 2017; 17(11):115.
20. Makowharemahihi C, Lawton BA, Cram F, Ngata T, Brown S, Robson B. Initiation of maternity care for young Māori women under 20 years of age. New Zealand Medical Journal. 2014; 127(1393):2010–9.
21. Chamberlain C, McNamara B, Williams ED, Yore D, Oldenburg B, Oats J, et al. Diabetes in pregnancy among indigenous women in Australia, Canada, New Zealand and the United States: a systematic review of the evidence for screening in early pregnancy. Diabetes Metabolism Research and Reviews. 2013; 29(4):241–56.
22. Agarwal MM. Gestational diabetes mellitus: Screening with fasting plasma glucose. World Journal of Diabetes. 2016 Jul 25; 7(14):279.