Kirke et al. BMC Pregnancy and Childbirth (2025) 25:1069
https://doi.org/10.1186/s12884-025-08225-4

BMC Pregnancy and Childbirth

RESEARCH

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Patient and contextual factors influence clinicians' decision making regarding universal screening for gestational diabetes: results of a factorial survey set in rural and remote Western Australia

Andrew B. Kirke[1*], Julia V. Marley[2], David Atkinson[2], Erica P. Spry[2,3] and Craig Sinclair[4]

Abstract

Background Universal screening of all pregnant women for gestational diabetes mellitus (GDM) with an oral glucose tolerance test (OGTT) is recommended in Australia, however in rural and remote areas substantial numbers are not tested. Rural and remote clinicians have considerable influence over the delivery of screening. To improve screening it is important to understand factors that might affect their approach to screening. This study explores the impact of a range of predictors on clinicians' decision making in relation to gestational diabetes screening.

Methods We conducted a factorial survey of 67 rural and remote clinicians active in antenatal care in Western Australia between Jan 31st and June 4th, 2024. Clinicians were presented with vignettes of hypothetical patients presenting for antenatal care at 24 weeks gestation, which asked about the OGTT. Seven factors were manipulated in the vignettes, with varying levels of each factor presented. Demographic data on clinicians was collected. Survey data was analysed using Linear Mixed Effects Regression.

Results Clinicians judged they were highly likely to request the OGTT (mean 86/100, standard deviation (SD) 23.5). Clinicians scored lower when judging how likely an OGTT was completed (59.5/100, SD 19.6) and how likely they would request an alternative test (52.7/100 SD 30.5).

Patient contextual factors were a barrier to requesting the OGTT: nausea and vomiting (β=-6.2, 95% confidence interval (CI) -9.4 to -3.0); health beliefs (β=-7.0, 95% CI -10.2 to -3.8). Patient contextual factors were a barrier to completing the OGTT: nausea and vomiting (β=-13.5, 95%CI -16.9 to -10.1), Aboriginal ethnicity (β=-15.3, 95%CI -19.6 to -11.1), health beliefs (β=-16.0, 95%CI -19.6 to -12.4) and childcare (β=-3.8, 95%CI -6.8 to -0.8). General practitioner obstetricians were more likely than midwives to request the OGTT (β=8.9, 95%CI 1.3 to 16.5), and less likely to request alternative tests (β=-19.6, 95%CI -36.3 to -0.3). Risk factors for GDM (age, weight, family history) did not impact clinicians' judgement.

*Correspondence:
Andrew B. Kirke
andrew.kirke@uwa.edu.au
Full list of author information is available at the end of the article

Conclusions While sensitivity and specificity of screening tests are important, so too is being able to deliver that service to the whole population. In rural and remote settings patient contextual factors should be central to achieving truly universal screening for GDM.

Keywords Gestational diabetes, Oral glucose tolerance test, Rural and remote, Factorial survey, Clinician decision making

Background

Gestational diabetes mellitus (GDM) is the most common maternal antenatal complication of pregnancy. It impacts perinatal outcomes for mother and baby, and long term risk for developing type 2 diabetes in in later years [1]. Level one evidence supports the treatment of GDM. The Australian Carbohydrate Intolerance Study in Pregnant women, a randomised controlled trial involving 1000 women showed a significant reduction in infant perinatal morbidity with treatment of GDM [2]. Landon et al. showed, in a randomised multi-centre trial of 958 women, that treating mild gestational diabetes reduced the risk of fetal overgrowth, shoulder dystocia, caesarean section and hypertensive disorders [3]. In 2008 the Hyperglycaemia and Adverse Pregnancy Outcomes (HAPO) study demonstrated that birth weight and cord blood serum C-peptide levels were closely and continuously associated with increasing maternal glucose measurements from the Oral Glucose Tolerance Test (OGTT), including at levels under the diagnostic threshold for diabetes [4].

Australian and international consensus statements have recommended universal GDM screening [5, 6]. In Australia that involves a 75 g glucose load, two hour OGTT between 24 and 28 weeks gestation [5]. Australian guidelines in place during 2014–2025 included ethnicity (e.g., Aboriginal and Torres Strait Islander, South Pacific Islander) as a risk factor for GDM [5]. Ethnicity has commonly been used in health research to differentiate groups within populations [7]. Ethnicity is a complex social construct representing common characteristics such as language, religion, nationality, ancestry or geographic origin [7]. Ethnicity may be used as a proxy description relating to common clusters of Social Determinants of Health (SDoH). However it needs to be carefully defined to better understand the associations of factors and disease [7]. There is a risk that indiscriminate use of ethnicity may imply an intrinsic biological association of ethnicity with an adverse outcome where no such association exists [7].

The World Health Organisation (WHO) in the most recent report on SDoH stated "… avoidable differences in health are largely due to the social determinants of health equity" [8]. Structural SDoH include economic systems, social infrastructure, structural discrimination including racism, conflict and megatrends such as climate change. Addressing health inequity requires addressing inequity in these structural determinants [8]. For example, in a recent study of 48,000 US adults unfavourable SDoH explained all the difference between premature all-cause mortality in Black and White populations after adjustment for age and gender [9].

The impact of SDoH on diagnosis, treatment and outcomes of diabetes in pregnancy is increasingly supported by emerging evidence [10]. SDoH have been shown to significantly increase the diagnosis of GDM in Aboriginal women in Canada and ethnic minorities in the United States [10–12]. Similarly for Australian Aboriginal women it is critical that the health services understand and account for the impact of SDoH to effectively provide maternal and early childhood care [13].

A systematic review of GDM services, including screening, found that overall adherence to current screening guidelines was sub-optimal in developed, as well as low and middle income countries [14]. Published screening rates in jurisdictions with recommended universal screening with the OGTT include: regional, rural and remote Western Australia (WA): 50%; [15] regional Ghana: 54%; [16] French Rhone Alps: 59%; [17] United States of America single pathology provider: 68%; HAPO study: 89%; [4] Australian east coast single jurisdiction: 92%; [18] and regional Sweden: 93% [19].

Evidence based guidelines have a history of being poorly followed across a range of health settings [20, 21]. Beyond awareness of guidelines supported by good quality evidence, clinicians also need to agree with the guidelines, adopt them and adhere to them [22]. In a survey of Australian general practitioner (GP) decision making regarding antibiotic prescriptions, GPs were found to persist in prescribing antibiotics for likely viral infections in contradiction to current guidelines, of which they were aware [23]. The GPs reported disappointment and discomfort in these situations. They justified their judgements with mitigating factors including coping with demanding patients and giving delayed scripts. The authors ascribed this phenomenon to a form of cognitive dissonance they called "knowledge-practice dissonance" [23].

Factors thought to influence judgements about screening for GDM included recognised risk factors for acquiring GDM, such as maternal age, ethnicity (as a proxy of unfavourable SDoH), family history, obesity, medications, previous GDM or neonatal macrosomia [15, 24, 25]. Other factors related to the patient's personal circumstances such as having persistent nausea and vomiting, consequences of a positive OGTT impacting on the patient's choice regarding the birth, patient's health beliefs such as the glucose load in the OGTT being harmful to mother or the baby, and social pressures such as controlling partners or young children needing care [15, 25]. Remoteness has been identified by clinicians to contribute to late presentation or failure to present for screening, aggravated by dislocation of patient records if they travel between regions.

Factorial surveys (FS) are a tool developed in the social sciences and more recently used in health, to test multiple factors influencing the attitude or behaviour of a study population [26, 27]. This paper examines the effect of patient factors (e.g., age, ethnicity, maternal BMI, nausea and vomiting, family history of diabetes, health beliefs) and clinician factors (e.g. clinical experience, gender, professional background, remoteness location, clinical setting) on clinician decision making in GDM screening in rural and remote WA, using a factorial survey.

Methods

Survey development

The factorial survey was chosen as an appropriate tool to explore the judgements of practicing clinicians. It enables presentation of a series of clinical vignettes, with pseudo-randomised manipulation of selected experimental factors thought to be influential on clinical decision-making. The vignette factors included those identified in the literature as risk factors for GDM (age, BMI, family history of diabetes) and factors believed to be barriers to screening with the OGTT (nausea and vomiting, childcare duties, and health beliefs averse to an OGTT) [25, 28–30]. For a composite of social, economic, cultural and historical reasons Aboriginal and South Pacific Islander people are at higher risk for GDM [5], but are also potentially less likely to be screened [31]. Recent papers exploring the impact of ethnicity on maternal health and pregnancy in the Australian and WA context showed Aboriginal status along with socioeconomic status and geographic remoteness is associated with increased rates of GDM and all the major maternal complications of pregnancy [31–34]. Aboriginal ethnicity is also associated with reduced access to care, later presentation for antenatal care, and fewer attendances for care [31]. Aboriginal ethnicity is associated with these outcomes due to a legacy of racialised policies [31]. The most recent Australian guidelines (2025) no longer specify ethnicity as a risk factor but advise clinicians to consider early screening for any woman who may be more likely to be diagnosed with hyperglycaemia in pregnancy [35]. In this study ethnicity was analysed as a patient factor, not a risk factor. While the possible numbers of factors that could have been included was extensive, following guidelines on efficient factorial design we limited the number of factors to seven [26].

The survey comprised three parts (see Appendix 1). The first was a description of the 2014–2025 Australian guidelines for GDM screening using the OGTT [5]. The second part surveyed participant demographic data, including professional background, gender, clinical settings worked in, rural or remote region worked in, and years of experience working in antenatal care. The third part was the clinical vignettes. The survey questions were developed using a consensus process between the research team members. The survey was trialled on two local antenatal care providers and one research colleague with only minor editing changes made, before being finalised.

The vignettes were designed to present a possible pregnant woman presenting in routine antenatal care at 24–28 weeks' gestation. Each vignette had the same basic template (see Appendix 1). Within that template the details of the patient were specified by manipulating seven scenario factors to appear at levels predesigned by the researchers (see Appendix 2). The seven factors were age, ethnicity, body mass index (BMI), nausea and vomiting, childcare responsibilities, family history and Health beliefs averse to the OGTT. Each participant was presented with ten different versions of the clinical vignette, pseudo-randomly selected from a matrix of 432 possible vignettes. For each vignette they were asked to make judgments in response to four questions about the vignette: (1) how frequent the scenario was in their usual clinical practice; (2) how likely they were to request the patient complete the OGTT as recommended; (3) how likely they thought the patient was to complete the OGTT; and (4) how likely were they to request an alternative to the OGTT for the hypothetical patients. The answers were recorded on a 100 point sliding scale ranging from "not at all" to "extremely".

Survey questions were written into Qualtrics (Qualtrics CoreXM copyright 2024 Qualtrics) using a pre-specified design suitable for Factorial Surveys [36]. Factors were automatically randomised within the vignettes using a randomiser function built into Qualtrics [36]. An edit count function within Qualtrics allowed review of the cumulative count of levels within factors and ensured that the total presentation of individual levels within factors was evenly distributed. This was checked again later when the data set was imported into Stata (Stata 18.0 SE Copyright 1985–2023 StataCorp LLC, College Station, Texas 77845 USA) for analysis.

Participant eligibility and recruitment

Participants were eligible to participate in the study if they were health professionals providing antenatal care in non-urban (regional, rural or remote) settings in WA during the last 12 months. Each participant answered four questions from at least one of the ten vignette scenarios provided in the survey. The intended participant groups were Midwives, GP Obstetricians, and specialist Obstetricians. There was no predetermined level of antenatal care experience required. There was limited published information on the likely total population of Health professionals within each target group. Senior midwifery colleagues estimated the pool of midwives working in rural and remote WA to be around 300 people based on their internal workforce data. The most recent published data on rural and remote medical workforce in WA reported there were 90 GP Obstetricians [37]. The specialist Obstetrician workforce was estimated by a remote WA specialist Obstetric colleague to be 18 doctors, based on known recruitment within Western Australian Country Health Service.

The participant recruitment process is outlined in Fig. 1. Participants provided a total of 614 responses to the vignettes with a mean response rate of 9.2 vignettes (range 1–10). The median time taken to complete the whole survey was 8.5 min. This is at the longer end of the observed range of times taken to complete a factorial survey of this size and complexity [26]. Most participants, 57 (85%) completed all vignette questions. The remaining 10 participants completed between 1 and 9 vignettes.

Sampling process

The survey was published on January 31st, 2024, and closed on June 6th, 2024. Health professionals were contacted by sharing the survey link through multiple professional networks. This included Midwifery, GP Obstetrician and specialist Obstetrician networks, and snowball sampling through known professional contacts, primarily of one author (AK). Invitations to participate in the survey were distributed by email and professional social media groups managed by key individuals within the local health service. Participant information and consent was presented to the potential participants once they clicked on the survey link. Progress to the survey was only possible once the study participant information had been read and consent provided by the participant. Participants were able to leave the survey at any time even if they had not completed it.

Ethics

This study forms part of a broader research project aimed at improving screening for and management of hyperglycaemia in pregnancy (ORCHID Study) in regional, rural and remote WA. Ethics approval for this sub-study was obtained from the Western Australian Aboriginal Health Ethics Committee WAAHEC Approval number 584. All participants in the study provided written consent.

Software

The survey was developed and presented online in QualtricsXM. The data was exported in Excel spreadsheet format into Stata 18.0 SE for data cleaning and analysis.

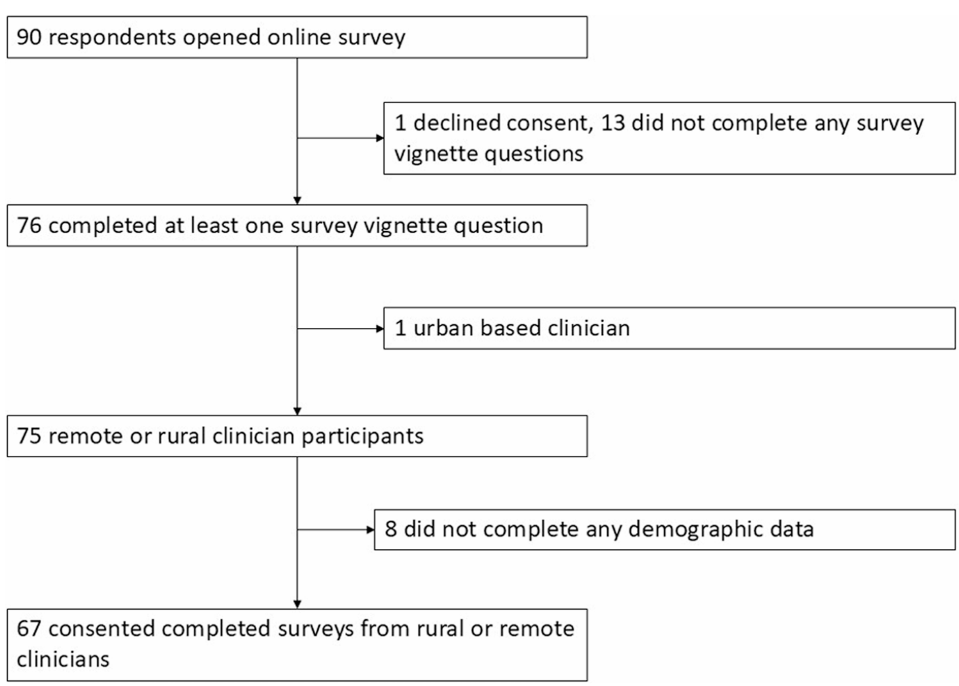


Fig. 1 Selection process for completed survey responses

Table 1 Demographic characteristics of the survey participants

Variable	(% of total)
N (total participants)	67
Gender (female)[a]	58 (86.6)
Obstetric experience (years)	
0–5	10 (14.9)
6–10	14 (20.9)
11–15	13 (19.4)
> 15	30 (44.8)
Location of practice	
Regional (MMM2)	16 (23.9)
Rural (MMM3-5)	31 (46.3)
Remote (MMM6-7)	20 (29.9)
Professional background	
Midwife	37 (55.2)
GP Obstetrician	22 (32.8)
Specialist Obstetrician	6 (9.0)
Aboriginal Health Worker	1 (1.5)
Specialist Physician	1 (1.5)
Primary Care (GP, MGP, ACCHS)	33 (49.2)
Hospital Based Care	55 (82.1)

*GP*General practitioner or general practice, *MGP* Midwifery Group Practice, *ACCHS* Aboriginal Community Controlled Health Service, *MMM* Modified Monash Model of remoteness

[a]Eight participants identified as male, and one declined to comment. All midwives were female. Male participants were either general practitioners (4/22) or other specialist doctors (4/7)

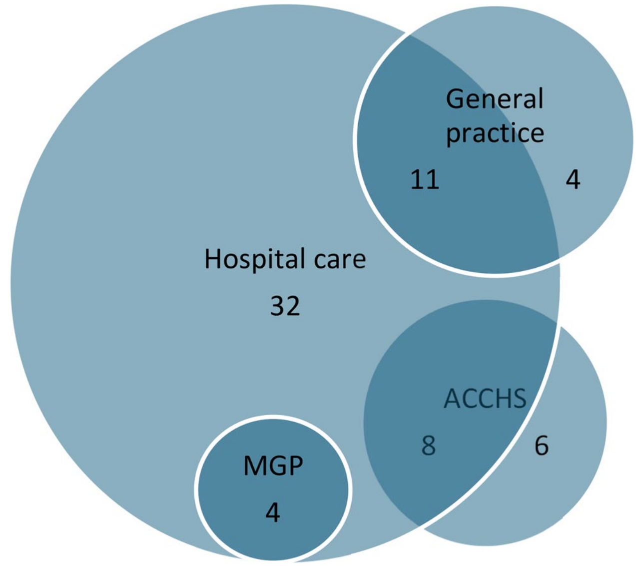


Fig. 2 Clinicians in Primary care and Hospital care. Overlap indicates those working in more than one setting. *ACCHS* Aboriginal Community Controlled Health Service, *MGP* Midwifery Group Practice. Number (n) refers to number of participants in each setting

Statistical analysis

Sample size Estimation

Power and sample size calculations were performed with the aid of the Statistical Analysis System (SAS, version 9.4) software. Calculations of sample size were made using estimations of likelihood of a significant difference between the levels of each factor. Estimations were based on a mixture of evidence from the literature and personal clinical experience of one researcher (AK) [29, 30, 38–41]. A sample size of $n = 86$ practitioner participants (across roles/professions) was deemed adequate for the purpose of hypothesis testing involving each of the four questions posed for each vignette, affording a statistical power level of at least 0.8 at the statistical significance threshold of $\alpha = 0.05$.

Linear mixed effects regression

Linear mixed effects regression (LMER) is an extension of simple linear regression which accommodates analysis of clustered data. In our study multiple vignette observations were clustered within clinicians. LMER allows analysis of fixed effects (vignette factors: age, BMI, etc.) and random effects (clinician variability), modelling variance associated with both vignette and clinician level factors [42]. Initial inspection of the data included calculating the intraclass correlation (ICC), as a measure of variance at the vignette and clinician levels. Using LMER we started with an empty model and then added random effects clustered around the clinician level. Final models for each survey question were reached by an iterative process starting with inclusion of all vignette predictors and sequentially dropping those that were not significant at $p < 0.05$. Random slope elements were calculated and included where significant at $p < 0.05$. Clinician level factors were then added to complete the model. Model fit was calculated at each step using Likelihood Ratio (LR) tests. The final model was analysed with R-squared measures for mixed models to give an estimation of the proportion of variance with a 95% confidence interval (CI) explained by each model.

Results

Participants demographic data can be seen in Table 1. All midwives were female, and male participants were either GPs or specialist doctors. Based on local rural workforce data we estimate we surveyed 16% of the total population of eligible participants. The overlap of participants working in primary care clinics and hospital-based care is illustrated in Fig. 2. About half of the participants, 31/67 (46%) worked across multiple clinical settings, for example hospital and general practice.

The summary statistics for each survey question and ICC are presented in Table 2. Consistent with expectations of the current screening guidelines, the likelihood that clinicians would request the OGTT ("OGTT requested") was highly skewed to the right. The mean score (86.0/100) indicates that most clinicians thought they were very likely to request the OGTT for most of the vignettes presented in this survey.

Table 2 Summary of individual responses to survey, averaged within individual then across the whole participant cohort

Question	Mean	SD	Median	p25	p75	ICC	[95% conf.	interval]
Scenario common	42.9	23.5	43.2	24	55.4	0.45	0.35	0.55
OGTT requested	86	21.9	94.8	86.5	100	0.65	0.56	0.73
OGTT completed	59.5	19.6	59.7	44.9	74.7	0.37	0.28	0.48
Alternate test	52.7	30.5	53.5	26.4	80.2	0.62	0.53	0.71

ICC Intraclass Correlation, *SD* Standard deviation, *OGTT* Oral Glucose Tolerance Test

The p25 and p75 are first and third quartiles around the median

The 95% CI reflects intervals around the ICC estimate

Scenario common = How frequent is this scenario in your clinical practice?

OGTT requested = How likely are you to request OGTT?

OGTT completed = How likely is the patient to complete the OGTT?

Alternate test = How likely are you to request an alternative test to the OGTT?

Table 3 Significant predictors of clinicians judging the frequency of vignette scenarios in their usual clinical practice (Scenario common)

Predictors		Coefficient	Std. err.	*P* value	[95% conf.	interval]
Intercept		74.1	3.7	0.000	66.9	81.3
Vignette factors						
Ethnicity	Caucasian	ref.				
	Aboriginal	0.0	3.2	0.989	−6.2	6.3
	South Pacific Islander	−10.8	2.6	0.000	−15.9	−5.6
Health beliefs	No health beliefs averse to OGTT	ref.				
	Health beliefs averse to completing OGTT	−18.0	2.1	0.000	−22.2	−13.8

ref. reference level, *OGTT* Oral Glucose Tolerance Test

Table 4 Significant predictors of clinicians requesting the oral glucose tolerance test in the survey vignettes (OGTT requested)

Predictors		Coefficient	Std. err.	*P* value	[95% conf.	interval]
Intercept		103.1	34.2	0.000	97.2	109.0
Vignette factors						
Nausea vomiting	No nausea and vomiting	ref.				
	Nausea and vomiting	−6.2	−3.8	0.000	−9.4	−3.0
Health beliefs	No health beliefs averse to OGTT	ref.				
	Health beliefs averse to completing OGTT	−7.0	−4.3	0.000	−10.2	−3.8
Clinician factors						
Profession	Midwives	ref.				
	GP Obstetricians	8.9	2.3	0.022	1.3	16.5
	Specialist Obstetricians	3.3	0.5	0.599	−8.9	15.5

ref. reference level, *OGTT* Oral Glucose Tolerance Test, *GP* General practitioner

The outcomes of the LMER analysis showed clinicians rated the vignette scenario was significantly less common in their clinical practice if the vignette patient held health beliefs averse to the OGTT (β=−18.0, 95%CI −22.2 to −13.8) or was South Pacific Islander (β=−11.0, 95%CI −15.9 to −5.6) (see Table 3). The absence of a significant effect of Aboriginal ethnicity here is consistent with the clinicians being familiar with treating Aboriginal women in their rural and remote settings. Clinician level predictors did not significantly affect this model, which explained 78% of the variance.

Clinicians rated that they were significantly less likely to request an OGTT if the vignette patient held health beliefs averse to the OGTT (β=−7.0, 95%CI −10.2 to −3.8) or had previously experienced nausea and vomiting with the OGTT (β=−6.2, 95% −9.4 to −3.0) (see Table 4). GP Obstetricians were more likely to request an OGTT than midwives (β = 8.9, 95%CI 1.3 to 16.5). This model explained 78% of the variance.

Clinicians rated the likelihood that the patient would complete the OGTT was significantly decreased if the vignette patient held health beliefs averse to the OGTT (β=−16.0 95%CI −19.6 to −12.4), was Aboriginal (β=−15.3, 95%CI −19.6 to −11.1), South Pacific Islander (β=−5.5, 95%CI −9.8 to −1.2), had childcare commitments (β=−3.8,95%CI −6.8 to −0.8) or had previously experienced nausea and vomiting with the OGTT (β=−13.5, 95%CI −16.9 to −10.1) (see Table 5). Clinician predictors did not significantly affect this model, which explained 65% of the variance.

Table 5 Significant predictors of clinicians' judgement that the patient would complete the oral glucose tolerance test (OGTT completed)

Predictors		Coefficient	Std. err.	*P* value	[95% conf.	interval]
Intercept		116.5	4.1	0.000	108.3	124.6
Vignette factors						
Ethnicity	Caucasian	ref.				
	Aboriginal	−15.3	2.2	0.000	−19.6	−11.1
	South Pacific Islander	−5.5	2.2	0.012	−9.8	−1.2
Nausea vomiting	No nausea and vomiting	ref.				
	Nausea and vomiting	−13.5	1.7	0.000	−16.9	−10.1
Childcare	No childcare commitments	ref.				
	Childcare commitments	−3.8	1.5	0.012	−6.8	−0.8
Health beliefs	No health beliefs averse to OGTT	ref.				
	Health beliefs averse to completing OGTT	−16.0	1.9	0.000	−19.6	−12.4

ref. reference level, *OGTT* Oral Glucose Tolerance Test

Table 6 Significant predictors of clinicians requesting alternative test to the oral glucose tolerance test (Alternate test)

Predictors		Coefficient	Std. err.	*P* value	[95% conf.	interval]
Intercept		17.2	5.9	0.004	5.6	28.9
Vignette factors						
Ethnicity	Caucasian	ref.				
	Aboriginal	12.8	2.4	0.000	8.1	17.6
	South Pacific Islander	9.2	2.3	0.000	4.7	13.7
Nausea vomiting	No nausea and vomiting	ref.				
	Nausea and vomiting	12.1	2.0	0.000	8.2	16.0
Health beliefs	No health beliefs averse to OGTT	ref.				
	Health beliefs averse to completing OGTT	9.6	2.1	0.000	5.5	13.7
Clinician factors						
Gender	Female	ref.				
	Male	35.7	13.9	0.011	8.3	63.0
Profession	Midwives	ref.				
	GP Obstetricians	−19.6	8.4	0.020	−36.1	−3.0
	Specialist Obstetricians	−22.5	16.4	0.170	−54.6	9.6
Two-way interactions						
	Female x midwife	17.2	5.9	0.004	5.6	28.8
	Female x GP Obstetrician	22.9	31.3	0.465	−38.5	84.3

ref. reference level, *OGTT* Oral Glucose Tolerance Test, *GP* =\General practitioner

Clinicians rated the likelihood they would request an alternative test was significantly increased if the vignette patient was Aboriginal (β = 12.8, 95%CI 8.1 to 17.6), South Pacific Islander (β = 9.2, 95%CI 4.7 to 13.7), had previously experienced nausea and vomiting with the OGTT (β = 12.1, 95%CI 8.2 to 16.0), or held health beliefs averse to the OGTT (β = 9.6, 95%CI 5.5 to 13.7) (see Table 6). Male clinicians were significantly more likely than female clinicians to request alternative tests (β = 35.7, 95%CI 8.3 to 63.0), however this is based on small numbers of male participants. Overall GP Obstetricians were significantly less likely to request an alternative test compared to Midwives (β= −19.6, 95%CI −36.1 to −3.0). This model explained 79% of the variance.

Discussion

This study demonstrates that patient factors such as ethnicity, nausea and vomiting, childcare demands and health beliefs averse to the OGTT significantly influenced rural and remote antenatal clinicians' judgement of OGTT completion. These factors have previously been reported as a barrier for pregnant women to complete the OGTT [28, 29]. Patient factors also significantly influenced whether they would request an OGTT or an alternative test. Previously published low OGTT screening rates in regional, rural and remote WA also reported the challenges of getting the OGTT completed in these settings [15]. Clinician responsiveness to these factors in the factorial survey likely reflects their real world experience of managing the challenges their patients have in completing the OGTT. This is consistent with previous studies recognising the balance of working with women towards an overall goal of complete antenatal care, as opposed to achieving one test result mandated by evidence based medicine [25, 43].

By contrast, recognised risk factors for GDM (age, BMI and family history) appeared to have no impact on clinician decision making in this survey. Conflicting results have previously been published, with the actual likelihood of GDM screening decreasing as maternal weight increased in one study [44], but increasing in others [45, 46]. Screening also increased for older women and those with a positive family history of diabetes [45, 46]. The absence of impact of these factors in our study may reflect the clinicians' belief they are already highly likely to request an OGTT (median 94.8%), and adding to the risk does not change this significantly.

Ethnicity had a significant impact on clinical decision making in our study. While not explaining why, our study demonstrated that Aboriginal ethnicity impacted negatively on clinicians' judgement that the OGTT would be completed, and positively on their willingness to try alternative tests in screening for GDM. Barriers to screening for different ethnic groups have been shown in other countries such as New Zealand and the UK [28, 47]. Aboriginal people in Australia have reduced access to clinics, clinicians and testing facilities and this is exacerbated in remote communities, an example of structural racism [48].

Social and emotional wellbeing is a foundational element of health in Aboriginal cultures, a holistic view that includes physical and mental health, and cultural aspects such as connectedness to community and country [48]. Prioritising these cultural differences in conjunction with physical barriers to services may be a barrier to other health priorities such as getting tests done and attending clinics [49]. Coupled with documented examples of the OGTT being an unacceptable test to some Aboriginal women in remote settings [49], it is not surprising that the expectation of OGTT completion is low. This is a striking example of the Inverse Care Law, a term coined to describe the phenomenon of medical care being least available and least accessed by the people most in need of that care [50].

The latest Australian guidelines, updated in June 2025, defined a higher risk of GDM to include previous GDM, HbA1c between 6.0 and 6.4%, or local policy or individualised assessment that indicate early screening required [35]. This is on contrast to the previous Australian guidelines from 2014 which detailed an extensive list of factors thought to be associated with increased risk of diabetes including identifying specific ethnicities [5]. The updated guidelines still include an OGTT for all women not previously diagnosed with GDM and an early OGTT for those women thought to be at risk in early pregnancy. This does not address the needs for the screening of women unable or unwilling to do the OGTT. The impact of these changes is not yet known although the specified intention of the update was to reduce the numbers of borderline GDM diagnoses. The inclusion of HbA1c guidelines in early pregnancy may increase the pick-up of previously undiagnosed type 2 diabetes and prediabetes. The deferral of early screening decisions to local policy validates changes that have been made in the Kimberley in northern WA, where an early pregnancy HbA1c has been normal practice since 2017 [51].

The effect of participant factors on the survey responses was less obvious. Remote and rural antenatal care is provided by a collaborative network across multiple clinical settings [25]. Participants reported working in these clinical settings, with a large number working across multiple settings. In particular, Midwives and GP Obstetricians often worked in primary care settings (general practice, Midwife Group Practice and Aboriginal Community Controlled Health Services), as well as in local and regional hospitals. The complexity of antenatal care in remote WA and how it impacts on Aboriginal women has been noted previously [49]. This is of relevance when organising tests like the OGTT. Gaps in communicating OGTT results and loss of follow up of patients moving between towns and clinical settings is a risk for incomplete care. By contrast the HAPO study, which provided evidence for the current guidelines, was conducted in 15 tertiary level hospitals with their own laboratory facilities and clinics [4].

This study is limited by relatively small numbers and hence had limited power to more clearly assess the impact of clinician factors on GDM screening. The small number of male participants precluded elucidating interactions between gender and occupation. Limiting the survey design to include only seven vignette factors contributed to a more efficient design for analysis meant that other potential factors of significance were unable to be tested. The findings of this study are relevant to the rural and remote communities we surveyed but may not be transferrable to other settings. We are unable to determine why the clinicians responded as they did to the different levels of the vignette factors. In interpreting the results, we are making assumptions as to the reasons they responded to the vignettes as presented. The factorial survey only records the clinicians' judgement on the vignettes they were presented, which may differ from real life. Finally, this study focussed on the clinicians' responses. The patients' views also need to be explored. This is the subject of a further study.

To our knowledge this is the first study to use a factorial survey to explore predictors influencing clinicians' decision making in gestational diabetes screening. The current literature around barriers and enablers for screening GDM comes from a mixture of qualitative and observational studies [14–16, 52–55]. The use of the factorial survey in our study allowed us to quantify the relative impact of different predictors on clinicians' decisions.

The poor completion of GDM screening guidelines in rural and remote populations is not an isolated example in health service delivery. However, the opportunity that pregnancy brings for screening women and the consequences for the mother and the baby of failing to identify GDM in some of the most vulnerable groups in our community increases the importance of screening more women. Our study suggests clinicians are well aware of the recommended guidelines for GDM screening but are struggling with the challenges of their setting and the circumstances of their patients to achieve universal screening with the OGTT. Other studies also support the case for a different test in screening vulnerable, low resource communities for GDM [28, 47]. A test that is more reliable, flexible and more easily completed may be the difference in developing a truly universal screening program. We believe further work in this direction urgently needs to be done.

Conclusions

Incomplete screening for GDM entrenches existing inequities in antenatal care experienced by rural and remote women. Contextual factors including aspects of SDoH regarding rural and remote patients are more significant than risk factors for GDM in influencing clinicians' decisions regarding screening for GDM with the OGTT. In rural and remote settings patient contextual factors should be central to achieving truly universal screening for GDM. While sensitivity and specificity of screening tests are important, so too is being able to deliver that service to the whole population. Specifically, we need to ensure that women who are unable to complete the OGTT are still adequately assessed. Our study identifies several factors likely to be contributing to the current gap in GDM screening in rural and remote women.

Appendix

Appendix 1 Survey

Start of Block: Participant Demographic Data

Start of Block: Participant Demographic Data

Obstetric experience Please indicate your experience in Obstetrics in years?

o 0-5 years (1)

o 6-10 years (2)

o 11-15 years (3)

o greater than 15 years (4)

Gender What is your identified gender?

o Female (1)

o Male (2)

o Non-binary (3)

o Prefer not to say (4)

Profession What is your Professional Background?

o Midwife (1)

o GP Obstetrician (2)

o Specialist Obstetrician (3)

o Other (4) ____

Location What is your location of usual current clinical practice? You can choose how to describe this e.g. town name, postcode, remoteness (Modified Monash Model score)____

Clinical setting What settings do you practice in? Choose as many as relevant

▢ Public hospital (1)

▢ Private hospital (2)

▢ Public clinic (3)

▢ Private clinic (4)

▢ Aboriginal Community Controlled Health Service ACCHS (5)

▢ General Practice (6)

▢ Other (7) ____

End of Block: Participant Demographic Data

Start of Block: Setting

Setting This applies to all the vignettes You are a health professional working in an antenatal clinic seeing a pregnant woman who is 24 weeks gestation. She is questioning you about taking the two-hour oral glucose tolerance (OGTT) test to screen for gestational diabetes mellitus (GDM). The current guidelines for GDM screening are all women not previously diagnosed with diabetes are recommended to have a standard 75 g OGTT between 24–28 weeks gestation. (IADPSG)

Start of Block: Vignette1

Vignette 1

Your patient is a (Age) year old (Ethnicity) woman.

She has a pre-conception BMI of (BMI) kg/m2.

She (had/did not have) nausea and vomiting previously.

She (has/does not have) childcare responsibilities.

She (does/does not have) a family history of diabetes.

She (does/does not have) health beliefs averse to completing the OGTT.

Not at all Extremely

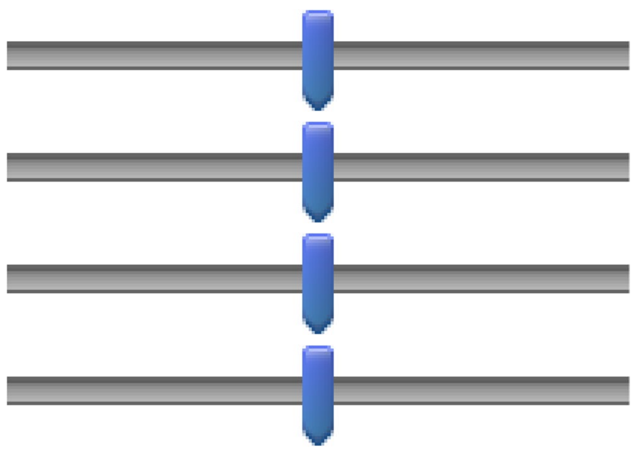
0 10 20 30 40 50 60 70 80 90 100

How frequent is this scenario in your clinical practice? ()

In your opinion how likely are you to request an OGTT? ()

In your opinion how likely is she to complete the OGTT? ()

In your opinion how likely are you to request an alternative test to the OGTT? ()



End of Block: Vignette1

Appendix 2 Clinical information used to specify levels in the clinical vignettes

Predictor	**Level**	**Vignette text**
Age	1	Your patient is a 19 year old
	2	Your patient is a 28 year old
	3	Your patient is a 37 year old
Ethnicity	1	Caucasian woman
	2	Aboriginal woman
	3	South Pacific Island woman
BMI	1	She has a pre-conception BMI of 23kg/m2
	2	She has a pre-conception BMI of 31kg/m2
	3	She has a pre-conception BMI of 38kg/m2
Nausea and Vomiting	1	She had no nausea and vomiting with the OGTT sugar load previously
	2	She had nausea and vomiting with the OGTT sugar load previously
Childcare duties	1	She is not currently caring for any other children
	2	She has a three year old child to care for
Family history of diabetes	1	There is no family history of diabetes in her immediate family
	2	There is a family history of diabetes. Her mother has type 2 diabetes
Health beliefs	1	With regards to the risk of harm from the OGTT sugar load she has no concerns about possible harm to herself or the baby
	2	She expresses concern the OGTT sugar load is harmful to her and/or the baby

Abbreviations

ACCHS	Aboriginal Community Controlled Health Service
BMI	Body mass index
CI	Confidence interval
FS	Factorial surveys
GDM	Gestational diabetes
GP	General practice, general practitioner
HAPO	Hyperglycaemia and Adverse Pregnancy Outcomes study
ICC	Intraclass correlation
LMER	Linear mixed effects regression
LR	Likelihood ratio test
MGP	Midwifery group practice
MMM	Modified Monash Model of remoteness
OGTT	Oral glucose tolerance test
ORCHID	Optimisation of Rural, Clinical and Haematological Indicators of Hyperglycaemia study
SAS	Statistical Analysis Systems
SD	Standard deviation
SDoH	Social Determinants of Health
UK	United Kingdom
WA	Western Australia
WAAHEC	Western Australian Aboriginal Health Ethics Committee

Acknowledgements
We extend our thanks to the rural and remote clinicians who participated in this study. Thanks go to Dr Hahn Ngo for sample size calculations and to Dr Len Kelly for reviewing the final manuscript. This manuscript will form part of a submission for a PhD thesis by publication by AK.

Authors' contributions
Conceived the study: ABK, CS, JVM and DADesigned the methodology: CS, ABK and JVMCollected the data: ABKPerformed statistical analysis. ABK and CSConducted the data analysis and interpretation: ABK, CS, JVM and DA Drafted the original manuscript: ABK Contributed to the writing and revision of the manuscript: ABK, CS, JVM, DA and EPS Managed the overall project: ABK, JVMContributed to the manuscript's final editing and approval: ABK, CS, JVM, DA and EPS.

Funding
This study received funding from the University of Western Australia for cost of statistical and survey software costs. There was no other project funding.

Data availability
Data for this study is stored in the UWA data repository. The dataset used and analysed during the current study is available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
This study forms part of a broader research project aimed at improving screening for and management of hyperglycaemia in pregnancy (ORCHID Study) in regional, rural and remote WA. Ethics approval for this sub-study was obtained from the Western Australian Aboriginal Health Ethics Committee WAAHEC Approval number 584.
All participants in the study provided written consent.

Competing interests
The authors declare no competing interests.

Author details
[1]The Rural Clinical School of Western Australia, University of Western Australia, Bunbury, Australia
[2]The Rural Clinical School of Western Australia, University of Western Australia, Broome, Australia
[3]Kimberley Aboriginal Medical Service, Broome, WA, Australia
[4]University of New South Wales, Sydney, Australia

Received: 18 May 2025 / Accepted: 11 September 2025
Published online: 10 October 2025

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