Knowledge of gestational diabetes among a multi-ethnic cohort in Australia

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Introduction

Gestational Diabetes (GDM) is defined as 'carbohydrate intolerance with onset or first recognition during pregnancy' (Hoffman et al. 1998, p.93). Non-Caucasian ethnicity, particularly, is a specific and well established associated factor (Beischer et al. 1991; Davey & Hamblin 2001; Hoffman et al. 1998; Rosenberg et al. 2005; Solomon et al. 1997; Thorpe et al. 2005) and women from Mediterranean countries, the Middle East, Asia, South America, India and the Pacific region are all overrepresented in gestational diabetes statistics. Estimates of prevalence vary from 3-14% depending on population composition (ADA 2003).

GDM among non-Caucasian women is also associated with significant differences in perinatal outcomes (Chawla et al. 2006; Rao et al. 2006; Scholl et al. 2002; Silva et al. 2006; Sinclair et al. 2007; Sinha et al. 2003). These associations are well recognised though, at present, they are not well understood (Scholl et al. 2002; Silva et al. 2006; Sinclair et al. 2007). It is thought that poorer access to services and late booking for antenatal care may contribute (Gary et al. 2003; Kim et al. 2007b). However, limited access to services alone is not sufficient to explain poorer perinatal outcomes (Doery et al. 2006) and it seems likely that racial and cultural factors may also impact on understandings of GDM, adherence to treatment plans (2007; Hjelm et al. 2005) and timing of antenatal care uptake (Chaudhry et al. 2004; Kim et al. 2007b).

Literature review

Worldwide, the incidence of GDM is increasing and this is particularly the case in developed countries, such as the United States, the United Kingdom, Australia and New Zealand (Ferrara et al. 2004; Joshy & Simmons 2006; Kieffer et al. 2006; Metzger 2006; Sinha et al. 2003). Increasing prevalence relates to a range of factors including advanced maternal age, obesity and migratory patterns (Ferrara 2004, Joshy & Simmons 2006). Of particular interest here is the increase seen among specific ethnic groups (Dabelea et al. 2005; Joshy & Simmons 2006; Kim et al. 2007a) which may relate to ethnic differences in maternal glucose concentrations (Esakoff et al. 2005; Scholl et al. 2002) and recent trends of obesity (Ben-Haroush et al. 2004; Harris et al. 1997; Rosenberg et al. 2005; Xiong et al. 2001). These trends are important as research shows a clear association between gestational diabetes and less than optimum maternal and infant health (Langer et al. 2005; Ostlund et al. 2003). Moreover, women of non-Caucasian ethnicity make up a considerable portion of childbearing populations in developed countries and as rates of obesity and GDM grow, there is a concordant increase in the risk of poorer pregnancy outcomes among these groups. GDM is also associated with an increased maternal likelihood of developing permanent diabetes in later life (Henry & Beischer 1991; Hoffman et al. 1998; Oldfield et al. 2007; Rosenberg et al. 2005; Sinha et al. 2003) and recent research postulates a link between gestational diabetes, childhood obesity and later onset of diabetes in the offspring (Ferrara 2007; Hillier et al. 2007).

When gestational diabetes is well controlled all of these risks are greatly reduced (Hoffman et al. 1998; Salim et al. 2004) and, in general, the literature supports early intervention and management as the key to good outcomes (Beischer et al. 1997; Hoffman et al. 1998; Major et al. 1998; Metzger & Coustan 2003; Turok et al. 2003). Management of GDM is largely dependent on active care measures undertaken by the woman to stabilise and normalise her blood sugar levels (ADA 2003, Solomon et al. 1997). This requires an understanding of food values, dietary restraint and exercise to increase metabolic rate (ADA 2003). Limited understanding of these

factors is likely to lead to poorer adherence to management plans and a lesser appreciation of the seriousness of the condition. Limited adherence to treatment, in turn, gives rise to a whole range of poorer maternal and infant outcomes (Langer et al. 2005, Ostlund et al. 2003).
Finally, the role of health literacy as a factor contributing to knowledge acquisition is an important one to consider. This framework attempts to explain the relationship between interpreting health information and subsequently adopting health promoting behaviours. It also goes beyond the notion that provision of information alone will effect improved outcomes. Health literacy is described, in the literature, as having 4 different dimensions, including: "(1) cultural and conceptual knowledge, (2) oral literacy, including speaking and listening skills, (3) print literacy, including writing and reading skills, and (4) numeracy" (Baker 2006, p.878; IOM 2004). Deficits in any of these areas can result in lower health literacy which impacts on individual comprehension of health literature and instruction. Lower health literacy, in turn, is associated with poorer health (Baker 2006; CLQ 2004; DeWalt et al. 2004; Guralnik et al. 1993; Kripalani et al. 2006; Pawlak 2005) and lesser access to services (ACP 2004; Bennett et al. 2007; Fiscella et al. 2002; Kripalani et al. 2006; Zanchetta & Poureslami 2006).
In Melbourne's Western suburbs, migrants from Vietnam, India, China and the Philippines constitute a large percentage of the population. Women from these backgrounds are disproportionately represented in GDM incidence and there is some suggestion that such women are less likely to understand and to adhere to treatment plans for their condition. The aim of this study, therefore, was to examine general knowledge and understandings of gestational diabetes among women from these ethnic backgrounds, who had been diagnosed with gestational diabetes and who were attending for care at ******* Hospital. Findings were contrasted against Caucasian women attending the same clinic. This was a hospital based initiative which aimed to identify specific areas of knowledge deficit, which could be addressed educationally. The ultimate aim was to effect an improvement in quality of care offered to multi ethnic women attending the clinic.

Methods Design
A cross-sectional survey was chosen as a suitable means of gathering information from as many women as possible during recruitment (Bowling 1999). Questionnaires, information sheets and invitations to participate were translated into: Vietnamese, Punjabi, Cantonese and Tagalog (Filipino). Other than English, these are the languages most frequently encountered at the hospital. NAATI accredited, (National Accreditation Authority for Translators & Interpreters) translators were used, on the understanding that these interpreters were appropriately trained in areas of patient confidentiality and cultural sensitivity. Translation accuracy was checked by hospital based interpreters and minor modifications were made based on their comments. The study was approved by hospital and university ethics committees and it was made clear to women that participation was entirely voluntary and would not in any way impact on the care they would receive.

Measurement
It was not possible to locate a questionnaire which dealt specifically with gestational diabetes and thus the Diabetes Knowledge Scale [DKN], (Dunn et al. 1984) was used together with an additional seven questions focussing specifically on pregnancy and gestational diabetes. These questions were developed in consultation with a group of experienced health professionals including a diabetes nurse educator, an endocrinologist, an obstetrician, a midwife and a hospital based interpreter. Final questions centred on three main areas: (1) general knowledge of GDM, including associated complications and likely clinical management; (2) maternal understanding of diet, food values and exercise in relation to GDM management and (3) maternal

understanding of normal blood glucose readings. In terms of validity, the Diabetes Knowledge Scale [DKN]— (Dunn et al., 1984) is a well known and validated instrument, and it is considered to have a Cronbach's alpha coefficient of 0.92 (Dunn et al., (1984). Some minor modification of this questionnaire was undertaken in a bid to make the instrument more sensitive to gestational diabetes. For example, the term gestational diabetes was substituted for diabetes and Q. 8, which referred to urine testing was altered to refer to blood sugar monitoring as this is the more usual way to test in Australia. When completed, the questionnaire was translated as above. Translated versions were piloted on 2 women for each language, a total of 8 individuals. This initiative was undertaken in a bid to ensure that the women understood the words used in the questionnaire. Following this measure, some further minor alteration was attended. For example, rice was included as an example of carbohydrate rich food on the understanding that a considerable number of participants consumed rice daily and the term 'lamb cutlet' was replaced by 'a small serve of meat' as 'lamb cutlet' was a term unfamiliar to Vietnamese and Indian women. The final questionnaire was composed of 22 multiple-choice questions. Most questions had one correct answer and were scored as correct/incorrect. Questions evaluating levels of knowledge had more than one correct answer and were scored in the range of poor/average/excellent knowledge. Sample questions are included in box 1.

Population and sample

The study was conducted at the Gestational Diabetes Clinic at ******* Hospital, located in the Western suburbs of Melbourne, Australia, a socially deprived area with a large multi-ethnic community. Approximately 300 cases of GDM are treated annually at this hospital and these women constitute the target population. Questionnaires were offered to all women who met the inclusion criteria during the recruitment period. The following criteria were used:

- Pregnant
- Diagnosis of gestational diabetes
- Of Vietnamese, Indian, Chinese, Filipino or Caucasian ethnicity
- Aged 18 or older

Participants were recruited after they had attended educational sessions with the diabetes educator and dietician. Questionnaires were distributed to a total of 200 women who met the above criteria.

Data Collection

Women were invited to participate over a 10 month period from February to December 2007. 238 women met the eligibility criteria and of these 200 agreed to participate. Anonymous questionnaires were distributed to these women, most of whom completed the questionnaires as they waited for their clinic appointment. Completed questionnaires were returned to a sealed box in the waiting area. Women requiring interpreter services were identified by their histories and were approached by an interpreter to explain the study and to elicit their interest in participating. The interpreters used were hospital employees who were working at the diabetes clinic and who were also employed by the study.

Data Analysis

The first author undertook statistical analysis using the SPSS statistical package, version 15.0 (SPSS Inc., Chicago, IL, USA). Expert statistical analysis and testing was conducted independently. To facilitate clear presentations, individuals were stratified into ethnic groups. In order to investigate differences between ethnic groups in terms of continuous variables, means for each group were calculated and compared statistically using ANOVA. For categorical variables, associations with

ethnic group were assessed using the exact Chi-square test. P-values of less than 0.05 were considered statistically significant.

Findings

A total of 143 questionnaires were returned which indicates a return rate of 71.5%. Of these, 3 were not included in the study findings due to damage (torn pages and food stains- 2 questionnaires) and a further questionnaire had multiple answers checked and was undecipherable. Results presented are for the remaining 140 participants.

Demographic characteristics

The participants consisted principally of Vietnamese (n= 45), Indian (n=20), Filipino (n=13) and Caucasian women (n =62). There were no Chinese participants due to low numbers of Chinese women attending the Clinic during recruitment. Sample demographics recorded included: maternal age; completed years of schooling; parity and English fluency. Table 1 shows a comparison between the four ethnic groups in terms of these demographic variables. Findings indicated that Vietnamese women tended to be slightly older than other participants with approximately 9% aged more than 40 years. There were no Vietnamese among the youngest participants (< 25 years). Filipino women, mean 32.2 years SD(4.1), tended to be older than Indian (30.3/4.3) women but younger than Caucasian (32.3/6.1) and Vietnamese women (33.5/4.1). The Caucasian sample had the greatest percentage of younger women (14.5%) and also displayed the greatest age range. Age, however, was not statistically significant (*P*-value = <0.07). Educational level was generally low, by Australian standards (ABS, 2005), and statistically, there was a highly significant association between ethnic group and years of schooling (*P*-value = <0.001). Filipino and Vietnamese women showed the lowest levels of education with over half (53.8% and 53.3% respectively) having 8 years or less of education. The large majority of Caucasian women (80.6%) had between 9-10 years of education while Indian women were the highest educated, with 75% having more than 10 years of schooling.

Parity was variable and Vietnamese women were the most likely to be multiparous (75.6%) with 28.9% having had 3 or more prior children. For Indian women, parity was in the range of 1-3, with 50% primiparous and 50% multiparous. For Filipino women, parity was generally in the range of 1-2, with just 7.7% having had 3 or more prior children. 46.2% were primiparous. Caucasian women were the most likely to be primiparous (51.6%) and 19.4% reported having 3 or more prior children. Parity was not statistically significant between groups (*P*-value = <0.11).

Table 1 Demographic characteristics

	Caucasian (n=62)		Filipino (n=13)		Indian (n=20)		Vietnamese (n=45)		*P*-value
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	
Age group									0.07
< 25 years	9	14.5%	1	7.7%	1	5.0%	0	0.0%	
25-29 years	10	16.1%	2	15.4%	8	40.0%	9	20.0%	
30-34 years	21	33.9%	6	46.2%	8	40.0%	22	48.9%	
35 years or older	22	35.5%	4	30.8%	3	15.0%	14	31.1%	
Schooling									<0.001
8 years or less	1	1.6%	7	53.8%	2	10.0%	24	53.3%	
9-10 years	50	80.6%	4	30.8%	3	15.0%	20	44.4%	
> 10 years	11	17.7%	2	15.4%	15	75.0%	1	2.2%	
Parity									0.11
1	32	51.6%	6	46.2%	10	50.0%	11	24.4%	
2	18	29.0%	6	46.2%	6	30.0%	21	46.7%	
3 or more	12	19.4%	1	7.7%	4	20.0%	13	28.9%	
English Fluency									<0.001
Yes	62	100.0%	13	100.0%	20	100.0%	21	46.7%	

No	0	0.0%	0	0.0%	0	0.0%	24	53.3%	

P-values were obtained using the exact Chi-square test. For English fluency, the test was an exact chi-square test.

General knowledge of GDM

Questions here were focussed on general knowledge of GDM including: fetal effects; maternal predictors; care requirements during pregnancy; the impact of GDM on blood sugar levels [BSL] and the importance of BSL control. Answers were recorded according to question type. A summary of general GDM knowledge by ethnic group is shown below in Table 2. Findings indicated that Filipino women, particularly, had a good understanding of how GDM affected the baby. However, 25% of Indian women, 24.4% of Vietnamese and 19.4% of Caucasians knew little about fetal effects. These findings were statistically significant (*P value* = 0.008).

All groups had a good understanding of predictors for GDM with no scores recorded in the poor range. Filipino women scored best, followed by Caucasian and Indian women. Vietnamese women fared least well however these ethnic group differences were not statistically significant (*P*-value = 0.06). Most study participants understood the care required in terms of additional clinic visits and monitoring of the pregnancy. For this variable, there was a statistically significant association (*P*-value = 0.03) and Vietnamese women had the lowest level of understanding, and Caucasian and Indian women the best level. The effect of diabetes on BSL was well understood by all groups. The importance of control of GDM was generally well understood and Indian and Filipino women scored 100%. Vietnamese and Caucasian groups scored lower than other groups, at 80% and 83.9% respectively. Differences were not statistically significant (*P*-value =0.07).

Table 2 Basic knowledge of GDM

Basic knowledge of GDM	Ethnicity								
	Caucasian		Filipino		Indian		Vietnamese		*P*-value
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	
Effect on baby									0.008
Poor	12	19.4%	0	0.0%	5	25.0%	11	24.4%	
Average	35	56.5%	10	76.9%	5	25.0%	29	64.4%	
Excellent	15	24.2%	3	23.1%	10	50.0%	5	11.1%	
Total	62	100.0%	13	100.0%	20	100.0%	45	100.0%	
Predictors									0.06
Poor	0	0.0%	0	0.0%	0	0.0%	0	0.0%	
Average	44	71.0%	8	61.5%	17	85.0%	40	88.9%	
Excellent	18	29.0%	5	38.5%	3	15.0%	5	11.1%	
Total	62	100.0%	13	100.0%	20	100.0%	45	100.0%	
Care required									0.03
Poor	0	0.0%	0	0.0%	0	0.0%	0	0.0%	
Average	27	44.3%	8	61.5%	11	55.0%	33	73.3%	
Excellent	34	55.7%	5	38.5%	9	45.0%	12	26.7%	
Total	61	100.0%	13	100.0%	20	100.0%	45	100.0%	
Bsl									0.7
Correct	55	90.2%	13	100.0%	19	95.0%	42	93.3%	
Incorrect	6	9.8%	0	0.0%	1	5.0%	3	6.7%	
Total	61	100.0%	13	100.0%	20	100.0%	45	100.0%	
Bsl control									0.07
Correct	52	83.9%	13	100.0%	20	100.0%	36	80.0%	
Incorrect	10	16.1%	0	0.0%	0	0.0%	9	20.0%	
Total	62	100.0%	13	100.0%	20	100.0%	45	100.0%	

P-values were obtained using the exact Chi-square test.

Complications of diabetes

Complications of diabetes were correctly identified by 75% of Indian women, 69.2% of Filipino women, 64.5% Caucasian women and 54.5% Vietnamese women and

there were no statistically significant differences for this variable (*P*-value =0.4). For GDM knowledge, Caucasians scored best with 54.8% indicating an advanced level of knowledge. This is one of the few occasions in which this group scored in a higher range than other groups. 50% of Indian women also answered in the excellent knowledge range compared to 33.3% Vietnamese and 23.1% Filipino women. Ethnic differences were not statistically significant, however, (*P*-value = 0.2).
Treatment of GDM was also generally well understood across all groups and there were no answers recorded in the poor knowledge range. Excellent scores were obtained by Indian (60%) and Caucasian (58.1%) compared to Filipino (46.2%) and Vietnamese women (35.6%). Again, differences were not statistically significant (*P*-value= 0.10). Follow-up care was generally well understood with 100% of the Indian women correctly identifying follow up processes compared to Vietnamese (88.6%), Filipino (84.6%) and Caucasian (80.6%). Again, differences were not statistically significant (*P*-value 0.15).

Table 3 Complications of diabetes

	Ethnicity								
Basic knowledge of GDM	Caucasian		Filipino		Indian		Vietnamese		*P*-value
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	
Complications									0.4
Correct	40	64.5%	9	69.2%	15	75.0%	24	54.5%	
Incorrect	22	35.5%	4	30.8%	5	25.0%	20	45.5%	
Total	62	100.0%	13	100.0%	20	100.0%	44	100.0%	
GDM knowledge									0.2
Poor	12	19.4%	4	30.8%	6	30.0%	16	35.6%	
Average	16	25.8%	6	46.2%	4	20.0%	14	31.1%	
Excellent	34	54.8%	3	23.1%	10	50.0%	15	33.3%	
Total	62	100.0%	13	100.0%	20	100.0%	45	100.0%	
GDM treatment									0.10
Poor	0	0.0%	0	0.0%	0	0.0%	0	0.0%	
Average	26	41.9%	7	53.8%	8	40.0%	29	64.4%	
Excellent	36	58.1%	6	46.2%	12	60.0%	16	35.6%	
Total	62	100.0%	13	100.0%	20	100.0%	45	100.0%	
Follow-up									0.15
Poor	0	0.0%	0	0.0%	0	0.0%	0	0.0%	
Average	12	19.4%	2	15.4%	0	0.0%	5	11.4%	
Excellent	50	80.6%	11	84.6%	20	100.0%	39	88.6%	
Total	62	100.0%	13	100.0%	20	100.0%	44	100.0%	

P-values were obtained using the exact Chi-square test.

Knowledge of food values and substitutions

Food values were understood differently across ethnic groups. Basic food constituents such as fat /carbohydrate content were well understood by Indian (100%/100%) and Caucasian (90.2/88.7%) women, less well by Filipino women (76.9/92.3%%) and least well by Vietnamese women (51.5/46.7%). This may relate to a lack of familiarity with the foods concerned, for example butter, which is not commonly used by Filipino or Vietnamese individuals. Another interesting point of difference was noted in relation to 'free' foods. Women were asked to identify which of the following foods: celery, apples, honey or meat were considered free, meaning there were no restrictions to the amount the woman could eat. Indian women, almost exclusively, choose meat (95%), though this choice was uncommon among other groups and is most likely a cultural variant. Knowledge about food substitutions was

uniformly poor with Caucasian and Vietnamese women again faring least well. These ethnic differences were highly statistically significant (*P*-value <0.001).

Table 4 Knowledge of food values

	Ethnicity								
Diet and food values	Caucasian		Filipino		Indian		Vietnamese		
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	*P*-value
Food values- fat									<0.001
Correct	55	90.2%	10	76.9%	20	100.0%	23	51.1%	
Incorrect	6	9.8%	3	23.1%	0	0.0%	22	48.9%	
Total	61	100.0%	13	100.0%	20	100.0%	45	100.0%	
Food values- carbohydrate									<0.001
Correct	55	88.7%	12	92.3%	20	100.0%	21	46.7%	
Incorrect	7	11.3%	1	7.7%	0	0.0%	24	53.3%	
Total	62	100.0%	13	100.0%	20	100.0%	45	100.0%	
Free foods									<0.001
Meat	10	16.1%	3	23.1%	19	95.0%	12	26.7%	
Celery	24	38.7%	6	46.2%	0	0.0%	17	37.8%	
Apples	28	45.2%	4	30.8%	1	5.0%	16	35.6%	
Honey	0	0%	0	0%	0	0%	0	0%	
Total	62	100.0%	13	100.0%	20	100.0%	45	100.0%	
Food substitutions CHO									0.19
Correct	19	31.1%	6	46.2%	11	55.0%	14	31.1%	
Incorrect	42	68.9%	7	53.8%	9	45.0%	31	68.9%	
Total	61	100.0%	13	100.0%	20	100.0%	45	100.0%	
Food substitutions protein									0.09
Correct	18	29.0%	6	46.2%	12	60.0%	17	38.6%	
Incorrect	44	71.0%	7	53.8%	8	40.0%	27	61.4%	
Total	62	100.0%	13	100.0%	20	100.0%	44	100.0%	

P-values were obtained using the exact Chi-square test.

Knowledge of GDM management

Knowledge about normal BSLs was consistent across ethnic groups (*P*-value = 0.4) and was generally high. 90.0% Indian, 75.6% Vietnamese, 82.3% Caucasian and 69.2% Filipino women correctly identified normal blood sugar levels as between 4-8mmol/L. Knowledge about ketones, in contrast, was poor across all ethnic groups (*P*-value 0.9). Treatment of high BSLs was generally well understood but knowledge was poorest among Vietnamese (75.6%) and Caucasian (69.4%) groups compared to Filipino (84.6%) and Indian (85.0%). These differences were not statistically significant however (*P*-value 0.4). Knowledge about BSL management during illness was uniformly poor (*P*-value = 0.09) with the Filipino women displaying the least knowledge. Only 7.7% of this group correctly identified management strategies, compared to 50% Indian, 33.3% Vietnamese and 30.6% Caucasian. Management of hypoglycaemia (hypo) was generally well understood (*P*-value = 0.07). Indian women scored 90.0% for correct answers while Vietnamese scored 82.2%, Caucasian 80.6% and Filipino women recorded the poorest score at 53.8%. Knowledge about causes of hypo was also poorest among Filipino women and 61.5% failed to identify contributing factors. Caucasian women fared slightly better though 45.2% were also unable to correctly identify causes of hypo compared to 24.4% Vietnamese and 5.0% of Indian women. Statistically, these ethnic differences were highly significant (*P*-value <0.001).

Table 5 Knowledge of GDM management

	Ethnicity								
Knowledge of GDM management	Caucasian		Filipino		Indian		Vietnamese		
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	*P*-value
Bsl normal range									0.4

Correct	51	82.3%	9	69.2%	18	90.0%	34	75.6%	
Incorrect	11	17.7%	4	30.8%	2	10.0%	11	24.4%	
Total	62	100.0%	13	100.0%	20	100.0%	45	100.0%	
Ketones									0.9
Correct	20	32.3%	3	23.1%	7	35.0%	13	28.9%	
Incorrect	42	67.7%	10	76.9%	13	65.0%	32	71.1%	
Total	62	100.0%	13	100.0%	20	100.0%	45	100.0%	
High bsls									0.4
Correct	43	69.4%	11	84.6%	17	85.0%	34	75.6%	
Incorrect	19	30.6%	2	15.4%	3	15.0%	11	24.4%	
Total	62	100.0%	13	100.0%	20	100.0%	45	100.0%	
Bsls and illness									0.09
Correct	19	30.6%	1	7.7%	10	50.0%	15	33.3%	
Incorrect	43	69.4%	12	92.3%	10	50.0%	30	66.7%	
Total	62	100.0%	13	100.0%	20	100.0%	45	100.0%	
Hypo management									0.07
Correct	50	80.6%	7	53.8%	18	90.0%	37	82.2%	
Incorrect	12	19.4%	6	46.2%	2	10.0%	8	17.8%	
Total	62	100.0%	13	100.0%	20	100.0%	45	100.0%	
Hypo causes									<0.001
Poor	28	45.2%	8	61.5%	1	5.0%	11	24.4%	
Average	27	43.5%	4	30.8%	7	35.0%	22	48.9%	
Excellent	7	11.3%	1	7.7%	12	60.0%	12	26.7%	
Total	62	100.0%	13	100.0%	20	100.0%	45	100.0%	

P-values were obtained using the exact Chi-square test.

Discussion

Most questions for this study, were taken from the Diabetes Knowledge Scale [DKN], a recognised and validated instrument (Dunn et al. 1984) and thus responses are clearly measurable. The remaining seven questions, developed in consultation with an expert group were trialled for clarity and internal validity and found to clearly measure what they were intended to measure. The response rate was 71.5%, which is higher than the generally accepted minimum standard of 60% (Badger & Werrett 2005). Furthermore, the study was designed to consider knowledge of GDM among a multi-ethnic community at ******* Hospital, Melbourne and it has achieved this aim by identifying patterns of knowledge deficits across the ethnic groups represented. Nonetheless, there are a number of limitations to study methodology. Firstly, although a Chinese sample was anticipated, there were no Chinese participants due to low numbers of Chinese women attending the Clinic during recruitment. Secondly, the study did not aim to produce findings that were generalizable, although this feature is a key characteristic of quantitative research (Beanland et al. 2004; Burns & Grove 1997; Taylor et al. 2006). The study has, however, offered some original insights and, like Sharp (1998), we would caution against absolute reliance on generalizability, as a measure of worth.

Four important findings arise from this investigation. Firstly, it is clear that Vietnamese women fared less well than other groups and displayed knowledge deficits which are currently not well addressed by hospital educational programs. These women were identified as the group most at risk of misunderstanding GDM and treatment plans and statistically significant differences were found in terms of lower education and English fluency. The finding of markedly poorer comprehension is, however, difficult to understand in context as Vietnamese individuals constitute a major ethnic group at ******* Hospital. As such, interpreter services and information in Vietnamese are widely available. Staff are versed in Vietnamese cultural and food traditions and attend education workshops and presentations by Vietnamese midwives employed in the adjacent maternity unit. Antenatal classes are also

conducted in Vietnamese. The key to understanding this poorer comprehension may rest in the women's generally low educational standards and poorer health literacy. It may also relate to a constellation of other likely demographic factors. For example, Vietnamese participants reported higher parity than other groups and, in this area of Melbourne, Vietnamese women often work long hours in food markets or family shops (Jakubowicz, 2004; Viviani, 1997). These factors may together contribute to an increased burden of care. However, this factor was not examined in the current study but may be worthy of research attention in the future.

Secondly, it was clear that English language proficiency alone was not associated with better comprehension of GDM in this study. Differences in English proficiency were statistically significant but did not explain all poorer comprehension. Filipino women, for example, were all proficient in English, nonetheless they also displayed limited knowledge and comprehension of GDM, particularly in the areas of hypoglycaemia and food values. It is not immediately obvious why this is so, though these differences were significant. It may be that English language information is not concordant with Filipino cultural understandings and values and there was no specifically targeted information available for this group. Poorer comprehension may also relate to poorer general educational status and lower health literacy among the Filipino women.

Thirdly, and perhaps most surprisingly, was the fact that Caucasian women scored quite poorly on GDM knowledge. Particular deficits were obvious in the areas of general knowledge of GDM and knowledge of food substitutions. This finding was all the more surprising because this group displayed good levels of understanding of basic food values and complications of diabetes. This finding of poorer comprehension, in turn, gives rise to an interesting situation. In this study, Caucasian women were recruited as a comparative group on the understanding that they would provide a benchmark against which other ethnicities might be measured. Instead, it became clear that they themselves were at serious risk of misunderstanding GDM and treatment plans. As with Vietnamese and Filipino women, it seems likely that this situation relates to lower educational standards and lower general health literacy among this group.

Fourthly, educational level seemed to be the factor most closely associated with comprehension of GDM and treatment plans. Differences in educational status were statistically significant and women with higher educational status fared better than others in this study. Indian women, for example, had the highest levels of education and also recorded the highest general scores for knowledge across all categories in this study. It therefore, seems reasonable to speculate that the greater health literacy and comprehension of GDM seen here among Indian women may relate to higher educational status. Finally, it was also clear that cultural variation underpinned understandings of food values across ethnic groups and this finding was statistically significant. This factor impacted on the level of knowledge women displayed of basic food constituents and substitutions. However, it was not the only determining factor, as Caucasian women, who displayed good levels of knowledge about food values also paradoxically scored poorly for knowledge of food substitutions.

Poorer knowledge of gestational diabetes, as seen here, seemed to relate primarily to lower education and limited participant comprehension though it is not clear how this sitiuation relates to English language skills. In the literature, lower health literacy has been strongly associated with lower English language proficiency (Bennett et al. 2007; Gucciardi et al. 2006; Hahn & Cella 2003; Pope 2005), but similar to our findings, there are also suggestions that this association is not a simple or single dimensional one (CLQ 2004, Zambrana 2004). Other powerful determinants of lower health literacy are thought to be lower socio economic status and lower educational levels (Dani et al. 2007; Hu et al. 2006; Pawlak 2005; Rose et al. 2004; Von Wagner et al. 2007). When these circumstances co-exist, lower health literacy is more common (Zambrana 2004). Throughout the literature, it is clear that lower general

education impacts negatively on health literacy. This relationship might may be best understood using the CLQ's (2000) evaluation of health literacy as dependent on the ability of individuals to interpret 'the dominant symbol systems of a culture' such as 'alphabets, numbers, visual icons' (CLQ 2000, p.10). Individuals with lower education often have difficulty with general literacy and numeracy (Kripalani et al. 2006; Wallace et al. 2006) and subsequently have difficulty negotiating patient-orientated health literature, medication and diabetes management instructions (Dani et al. 2007; Kripalani et al. 2006; Wallace et al. 2006). In this study, lower educational status appeared to be a more powerful indicator of lower comprehension of GDM than either race or English language proficiency. In this regard, the findings are slightly at odds with the findings of other similar studies, which mostly found that non-Caucasian ethnicity was strongly linked to poorer medical knowledge acquisition. In most of these studies, there is little mention of educational status as an influencing factor. For example, Brown et al. (2007) found that knowledge of diabetes was sketchy among African Carribean individuals who also regarded the condition as not very serious. Baradaran et al. (2006) who examined knowledge of diabetes among a multiethnic sample in Glasgow, Scotland, also found that Indian and Pakistani subjects had less knowledge about diabetes, regarded the disease less seriously and had a lesser comprehension of the relationship between control and complications than the Caucasian population. These trends of lower levels of knowledge and lesser appreciation of the seriousness of diabetes are replicated in other studies among non-Caucasians populations (Baradaran et al. 2006; Chilton et al. 2006; Gunay et al. 2006; Pardhan & Mahomed 2004).

To return to Zambrana's point of low education, low literacy skills and limited proficiency in English as exerting a particularly potent negative effect on health literacy, it is interesting to look at the opposite argument and consider if higher education modifies the effect attributed to ethnicity. Indian women, in the current study, reported the highest educational scores and their general comprehension of diabetes was greater than all other groups, which suggests that educational level was associated with knowledge attainment here. However, in this regard, the literature is very limited and only one source was found that investigated the effects of both ethnicity and educational status on information access. In this study, Kakai et al. (2003), studied the use of health information among Caucasian, Japanese and non-Japanese Pacific Islanders, and found that educational status did indeed influence subject information seeking behaviours. Higher educational status was associated with access to more objective, scientific based information compared to lower educational status, which was associated with 'interpersonally communicated information' (p.851). Nonetheless, these authors concluded that the effects of ethnicity were more powerful determinants of health information access than was educational status. Other studies examining the use of health resources among Caucasian and other ethnic groups reported similar findings (Gucciardi et al. 2006; Williams et al. 2007). For example, Gucciardi et al. (2006) found that poorer English skills and lower educational status were associated with lesser access to informational resources for diabetes management. At this point, however, the evidence is insufficient to examine the effects of higher educational status on information access among multiethnic communities.

Implications for practice and further studies

What then, are the implications of these findings? Findings suggest than lower health literacy and lower educational status significantly impact on uptake of knowledge of gestational diabetes and also that cultural differences exist in understandings of food values. In receipt of this information, midwives and other health professionals need to develop gestational diabetes programs that address both low health literacy and cultural variation. We would also suggest that the availability of language specific information alone is not sufficient to ensure comprehension. Greater emphasis needs

to be placed on ensuring that women comprehend the educational material they are given. Doak et al., (1996) who have extensively examined strategies to facilitate learning among patients with low literacy skills came up with some useful suggestions, which could be adopted for multi-ethnic women with gestational diabetes. Those suggestions include:

- Encouraging interaction with the information, such as having the patient repeat, in their own words, what they are required to do
- Matching the information to the patient's logic, language and experience, which helps them to make sense of the information
- Associating new material with what the patient already knows, thereby building on their knowledge
- Limiting the number of new concepts introduced at any one time
- Taking care not to overwhelm the patient with information

The ACPF Diabetes Guide (ACP, 2007) also provides useful suggestions related specifically to diabetes care, and poorer English literacy. This guide suggests using pictures to convey information about portion sizes, healthy foods and appropriate snacks. It also places emphasis on 'baby steps' or making small and sustainable changes to diet. Instructions are given in simple language (grade 5 English) with just one or two important messages per topic. These suggestions could be used to underpin specifically targeted information for multi-ethnic women with gestational diabetes. For example, pictures of foods commonly eaten in various ethnic groups could be used to discuss portion sizes and substitutions of food. Practical advice such as what to do if still hungry or to treat low blood sugars could be addressed in the same way.

Finally, further research is needed into the effects of ethnicity and cultural attitudes/beliefs on food choices and adherence to treatment plans. Such research may shed light on the means to address these complex issues and how to provide more meaningful maternal support for multi ethnic women with gestational diabetes.

Conclusion

In this study, knowledge of food values and food substitution was deficient among all groups regardless of ethnicity. Knowledge about diabetic treatment during illness and about causes of hypoglycaemia was also noticeably lacking and seemed to relate primarily to lower health literacy and lower educational status. It is clear that current educational programs need to develop to address low health literacy and also to take cultural variations into consideration. This approach will hopefully have the advantage of combating low health literacy among the Caucasian population as well as serving the needs of the multiethnic communities.

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