ORIGINAL ARTICLE

Dietary Characteristics of Women With Gestational Diabetes Mellitus

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ABSTRACT

Introduction: The role of dietary intake on maternal glucose is uncertain. This study described the dietary characteristics of women with gestational diabetes mellitus (GDM) and examined the differences in dietary characteristics based on GDM diagnosis. **Methods:** This study recruited GDM women (n =45; age =31.1±5.1 years old) from health clinics in Seremban. Dietary intake, glycemic index (GI) and glycemic load (GL) were assessed using a semi-quantitative food frequency questionnaire (SFFQ) during first and second trimester of pregnancy. GDM diagnosis was made at 28 weeks gestation with the following cut-off for FPG ≥ 5.1 or 2hPG ≥ 7.8 mmol/L following oral glucose tolerance test. **Results:** Women with GDM had a reasonable intake of protein and fat but consumed high-carbohydrate at second trimester and high-sugar diet at both trimesters. Fibre, iron and calcium from the food sources did not meet the recommended nutrient intakes for pregnancy. About 75.6% (n = 34) GDM women had high 2hPG (9.3 ± 1.5 mmol/L) with a normal FPG (4.7 ± 0.7 mmol/L). While dietary characteristics were not significantly different, women with a higher 2hPG tended to take a higher proportion of protein at first trimester and a higher dietary GI, serving of rice, and sugars and creamer at second trimester than high FPG. **Conclusion:** Suboptimal maternal nutrition in women with GDM are of particular concern. Dietary characteristics of women with high fasting and 2-hour glucose were comparable but not optimal. The needs of tailored nutritional intervention are evident in women known to be at high risk of GDM.

Keywords: Dietary characteristics, Maternal 2-hr plasma glucose, Gestational diabetes mellitus (GDM), Rice intake

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INTRODUCTION

Gestational diabetes mellitus (GDM) defines as any varying degree of glucose intolerance with onset or first recognition during pregnancy (1). The prevalence of GDM in Malaysia ranges from 8 – 11% with almost 80% women diagnosed with GDM required medical nutrition therapy (2). Hence, the data emphasised the needs to understand their dietary characteristics in relation to maternal glycemia.

The 2-hour 75-g oral glucose tolerance test (OGTT) is accepted as a diagnostic 'gold standard' for GDM on the basis of associations with adverse outcomes (3). The diagnosis is made if any of the following values is higher than the recommended levels (fasting plasma glucose (FPG) > 5.1 mmol/L or 2-hour plasma glucose (2hPG) ≥ 7.8 mmol/L) (4). While FPG is valuable, increase in postprandial glucose is a common feature of GDM. This is particularly important as in some Asian populations, the FPG is inherently much lower, but the postprandial or 2hPG is very high (3). Asian, in particular, is known to have high insulin resistance, and as a consequence, their 2hPG is higher as compared to Caucasian (4).

Hyperglycemia in pregnancy is independently associated with adverse outcomes for the mothers, fetus and neonate. The individual OGTT glucose measures either fasting or post-load glucose values were associated with different adverse outcomes. High FPG level was associated with perinatal outcomes, macrosomia, large-gestational age (LGA) babies and cesarean delivery (5). Meanwhile, high 2hPG is more likely to have preterm birth, a tendency to have small-gestational age (SGA) babies, and the women herself carry a future diagnosis of type 2 diabetes (3). However, the role of dietary intake on either FPG or 2hPG is uncertain. Certainly, there are a few differences in the outcomes predicted by having a high FPG or 2hPG level. Knowing the type of foods that contributed to a high FPG or 2hPG level can be beneficial for dietitians in planning out their individualized MNT plans.

A pregnant woman requires a modest increase in energy intake to meet nutrient requirements (6). Inadequate nutrition during pregnancy has been reported to have adverse effects on maternal and infant outcomes (7). Several studies have determined the dietary intake and eating habits of women with GDM (8,9). Women with GDM had a higher protein and carbohydrate intake significantly as part of total energy intake (8). However, dietary intake during pregnancy that is obtained from a prior diagnosis of GDM is unclear.

Dietary GI and GL intake have been determined in prospective cohort studies in relation with GDM, but the timing of their assessment differed across the studies. Dietary GI and GL intake assessment during early pregnancy (first trimester) and mid-pregnancy (second trimester) led to different findings. This lack of uniformity in the measurement of risk factors made it difficult to ascertain at which time point dietary GI and GL could influence the incidence of GDM. Hence, this may warrant the assessment of both dietary GI and GL intake for multiple times throughout pregnancy.

Hence, this study aimed to determine the dietary characteristics of patients with newly diagnosed GDM during first and second trimesters. We also examined the differences in dietary characteristics among GDM women according to whether these women had high FPG or high 2hPG following OGTT. Understanding these differences can facilitate the development of individualised MNT plans for pregnant women known to be at high risk of GDM.

MATERIALS AND METHODS

Study design and population

This preliminary study was part of a prospective cohort study, namely the Seremban Cohort Study (SECOST). The study protocol has been published elsewhere (10). It was conducted at three Maternal and Child Health (MCH) Clinics in the Seremban district of Negeri Sembilan: Seremban, Ampangan and Senawang. The inclusion criteria were Malaysian pregnant women above 18 years of age, ≤10 weeks of gestation during screening, pregnancy conceived naturally, and singleton pregnancy. Women were excluded if they had been diagnosed with medical problems (such as hypertension, kidney diseases, thalassemia, type 1 or 2 diabetes mellitus) or already had a GDM diagnosis at screening. Eligible pregnant women who fit the criteria received an information sheet, and they provided their consent before the data collection. The National Medical Research Registry and the Medical Ethics Research Committee of Universiti Putra Malaysia approved the study

Sample size for this study was determined using the formula for cohort studies (11). Based on 18.3% of pregnant women in Malaysia had abnormal OGTT (12), 95% confidence level and 5% probability of missing a true difference, a minimum of 325 respondents were required after accounting for 20% attrition rate. A total of 347 respondents were included in this study after screening for inclusion and exclusion criteria. 53 respondents dropped out (15.3%) before the second trimester.

A total of 294 respondents from the cohort underwent a 75g 2-hour OGTT between 24 and 28 weeks of gestation for GDM diagnosis. The diagnosis was made if FPG ≥ 5.1 or 2hPG ≥ 7.8 mmol/L (13). From this, about 45 women (15.3%) were diagnosed with GDM. Hence, a total of 45 women with GDM were included in the analysis. Subsequently, these women were divided into FPG or high 2hPG based on their OGTT results and their dietary intake during first and second trimesters was compared.

Measurements

Sociodemographic profiles (age, ethnicity, and socioeconomic status) and obstetric history (history of GDM, family history of diabetes mellitus (DM)) were obtained. Body weight was measured using the digital weighing machine (THD-360, Tanita Health Equipment Ltd., Japan) to the nearest 0.1 kg. Height was measured using a stadiometer (SECA 213, Vogel and Halke GmbH & Co., Germany) and self-reported pre-pregnancy body weight was obtained from the respondents. Pre-pregnancy body mass index (BMI) was calculated using the formula: pre-pregnancy BMI (kg/m2) = pre-pregnancy weight (kg)/height (m^2). Pre-pregnancy BMI was then categorized according to the classification by World Health Organization (2015) (14): underweight <18.5 kg/m^2, normal 18.5 - 24.99 kg/m^2, overweight 25 - 29.99 kg/m^2, and obese ≥ 30 kg/m^2.

Dietary intake

Dietary intake for first and second trimester was assessed using a 137-item semi-quantitative food frequency questionnaire (SFFQ) adapted from a Malaysian Adult Nutrition Survey (15). The food and beverage items listed in the FFQ reflected the foods most frequently consumed by the Malaysian adult population. The assessments were completed before OGTT to prevent confounding with GDM treatment (MNT or insulin treatment).

The dietary intake frequency was divided into "per day", "per week", "per month", or "never eaten", and only one of this was chosen. Since food frequency covered one whole month, conversion of food frequency to the amount of daily food intake was carried out using the formula:

Amount of food (g) per day = frequency of intake (conversion factor) x serving size x total number of servings x weight of food per one serving (13).

Energy, nutrients, dietary GI and GL intakes were analysed using DietPLUS® (16). This study followed the algorithm for assigning GI values to food items in the DietPLUS® software which had been extensively explained in Shyam, Ng and Arshad (2012) (17). Dietary GI intake was calculated using the formula: [Glycemic index value of the food x Frequency of servings of the food per day (g) x carbohydrate content of the food (g)] / Total daily carbohydrate (g). Dietary GL intake was calculated using the formula: [Glycemic index value of the food x Frequency of servings of the food per day (g) x carbohydrate content of the food (g)] (18,19). Daily rice intake was calculated from the FFQ using the formula: (Frequency of intake/day + Frequency of intake/week x 7 + Frequency of intake/month x 30) x Weight of rice (g)/120g). A serving of rice was determined as 120g.

The serving size of the food, in grams, entered into the software was according to the US Department of Agriculture database (20). The USDA database was chosen as it was more extensive in terms of the list of foods available and their standard size (in grams). If it was not available in the USDA database, the serving size was obtained from Nutrient Composition of Malaysian Foods instead (21). Adequacy of energy and nutrients intake were checked (18). Under-reporting was determined by dividing total energy with their basal metabolic rate (EI-to-BMR ratio). Under-reporting was defined as EI-to-BMR ratio of less than 1.35, normal-reporting as EI-to-BMR ratio of 1.35 to 2.39, and over-reporting as more than 2.39 (22).

Statistical analysis

Statistical analysis was performed using the SPSS version 22.0. Descriptive data were expressed in percentage, measures of central tendency (mean, mode and median) and measures of dispersion (range and standard deviation). Paired sample t-test was used to compare the energy and nutrient intakes of women between first and second trimester as well as according to individual OGTT measures. Independent t-test was used to compare the difference in dietary characteristics between women with high FPG and those with high 2hPG. The significance level for all statistical tests was set at $p < 0.05$.

RESULTS

Majority of GDM women were between 25 and 34 years of age (75.6%) with the mean age of 31.1 ± 5.1 years old (Table I). Women were predominantly Malays (86.7%)

Table 1: Characteristics of women with gestational diabetes (GDM; n= 45)

	n	%	Mean ± SD
Socio-demographic			
Age (years)			31.1 ± 5.1
18 – 24	2	4.4	
25 – 34	34	75.6	
35 – 49	9	20.0	
Ethnicity			
Malay	39	86.7	
Non-Malay	6	13.3	
Years of education			13.0 ± 2.8
Secondary and lower	22	48.9	
Tertiary	23	51.1	
Occupation			
Not working	13	28.9	
Professionals	17	37.8	
Non-professionals	15	33.3	
Monthly income (RM)			
≤ 500	13	28.9	
501 – 1000	10	22.2	
1001 – 3000	15	33.3	
> 3000	7	15.5	
Obstetrical Information			
Family history of DM			
No	34	75.6	
Yes	11	24.4	
History of GDM			
No	39	86.7	
Yes	6	13.3	
Height (m)			1.67 ± 0.06
Pre-pregnancy weight (kg)			60.3 ± 14.0
Pre-pregnancy BMI (kg/m^2)			24.7 ± 4.7
Underweight (< 18.5)	2	4.4	
Normal (18.5 – 24.9)	23	51.1	
Overweight (25.0 – 29.9)	13	28.9	
Obese (≥ 30.0)	7	15.6	
Oral Glucose Tolerance Test (OGTT)			
OGTT at 28th weeks (mmol/L)	45	100	
Fasting plasma glucose (FPG)			4.9 ± 0.7
2-hour plasma glucose (2hPG)			8.6 ± 1.8
GDM with high FPG	11	24.4	
FPG			5.2 ± 0.3^a
2hPG			6.5 ± 0.7^b
GDM with high 2-hPG	34	75.6	
FPG			4.7 ± 0.7^a
2hPG			9.3 ± 1.5^b

and had a mean education of 13.0 ± 2.8 years, with slightly more than half (51.1%) completed their tertiary education. Occupation categories were almost similarly distributed among not working (28.9%), working as professionals (37.8%) or non-professionals (33.3%). About 51.1% of the women earned a monthly income of ≤ RM 1000. About 13.3% of the women had a history of GDM and a family history of DM (24.4%). While the mean pre-pregnancy BMI (24.7 ± 4.7 kg/m2) was within the normal range, almost half of the women (44.5%) were either overweight or obese prior pregnancy (Table I).

In general, the OGTT results showed relatively normal FPG of 4.9 ± 0.7 mmol/L but with a high 2hPG of 8.6 ± 1.8 mmol/L. Majority of the respondents (75.6%) had a GDM diagnosis with 2hPG (9.3 ± 1.5 mmol/L) and a normal FPG (4.7 ± 0.7 mmol/L). None of them had a high level of both values (Table I).

Table II shows energy and nutrient intakes of respondents at first and second trimester. The mean energy intake was 1769 ± 758 kcal/day in the first trimester and 1883 ± 777 kcal/day in the second trimester (p > 0.05). However, more than two-thirds of respondents (66.7%) under-reported their energy intake in both trimesters. The mean carbohydrate intakes during the first trimester are within the recommended level of 50– 65% but not at the second trimesters (18). Sugar consumptions at both trimesters exceeded the recommended intake of < 10% of total energy (23). Protein and fat intakes for both trimesters were adequate according to the guideline (23). However, intakes of fibre, calcium and iron from food sources alone did not meet the Recommended Nutrient Intakes (RNI) (23). Carbohydrate intakes (percent energy intake) and dietary GI at second trimester were significantly higher than the first trimester (Table II). Based on food groups analysis, starchy foods and dietary GI intake were significantly higher in the second trimester compared to the first trimester (Table II), which led to a high carbohydrate intake during the second trimester.

Table III presents the dietary characteristics according to individual OGTT values. There were no significant differences in dietary characteristics between women with high FPG and high 2hPG. Nevertheless, respondents with high 2hPG tended to take a higher proportion of protein at the first trimester than respondent with high FBG. At the second trimester, they tended to consume a higher serving of rice, dietary GI, and sugars and creamer than high FPG (Table III).

Table II: Dietary intake of women with gestational diabetes (GDM; n= 45)

	First trimester (10 – 13th weeks)	Second trimester (24 – 30th weeks)	p-value
Energy and nutrients			
Energy (kcal)	1769 ± 758	1883 ± 777	0.387
EI/BMR ratio	1.28 ± 0.58	1.30 ± 0.53	
Under-reporting (< 1.35)	30 (66.7)	30 (66.7)	
Normal (1.35 – 2.39)	12 (26.7)	13 (28.9)	
Over-reporting (≥ 2.40)	3 (6.6)	2 (4.4)	
Energy density (kcal/kg)	29.2 ± 14.1	28.1 ± 11.4	0.588
Carbohydrate (g)	250.6 ± 123.9	272.1 ± 107.6	0.211
As % energy	56.2 ± 8.8	66.9 ± 27.6	0.009*
Protein (g)	71.8 ± 38.5	74.1 ± 36.3	0.742
As % energy	16.0 ± 3.4	18.2 ± 9.9	0.182
Fat (g)	50.7 ± 21.5	53.8 ± 33.4	0.558
As % energy	26.2 ± 7.6	30.2 ± 21.8	0.224
Sugar (g)	86.5 ± 62.2	76.8 ± 43.3	0.260
As % energy	18.7 ± 7.3	18.8 ± 11.7	0.967
Total fiber (g/1000 kcal)	8.3 ± 3.7	7.9 ± 3.9	0.327
Calcium (mg)	803.4 ± 596.4	761.7 ± 774.6	0.762
Iron (mg)	18.9 ± 15.7	15.9 ± 7.8	0.157
Dietary GI	58.8 ± 4.4	60.5 ± 3.5	0.010*
Dietary GL	150.3 ± 72.9	164.6 ± 65.7	0.159
Food groups			
Rice intake/day	1.6 + 0.7	1.7 + 0.7	0.294
Starches (g)	479.8 ± 218.9	561.5 ± 235.6	0.027*
Animal protein (g)	69.3 ± 67.0	75.9 ± 52.9	0.518
Fish/seafood protein (g)	95.1 ± 95.6	82.2 ± 64.2	0.290
Plant based protein (g)	27.2 ± 36.0	22.2 ± 25.1	0.340
Milk and dairy products (g)	125.6 ± 175.7	177.8 ± 111.4	0.552
Non-starchy vegetables (g)	194.3 ± 153.3	131.1 ± 118.9	0.069
Fruits (g)	219.2 ± 173.4	179.1 ± 247.2	0.071
Sweetened beverages (g)	406.3 ± 413.8	460.1 ± 238.6	0.128
Sugars and c onfectioneries (g)	63.3 ± 66.8	59.0 ± 39.5	0.678
Sugars and creamer (g)	13.7 ± 14.8	12.5 ± 8.8	0.561
Fats and oils (g)	14.6 ± 11.9	14.3 ± 9.1	0.849

Legend: *EI/BMR ratio* Energy Intake to Basal Metabolic Rate ratio, *GI* Glycemic Index, *GL* Glycemic Load

Table III: Dietary characteristics at first and second trimesters by either high fasting plasma glucose (FPG) or high 2-hour plasma glucose (2hPG) following OGTT

	High FPG (n=11)	High 2hPG (n=34)	P value
First trimester			
Energy (kcal)	1716 ± 854	1786 ± 737	0.794
Energy density (kcal/kg body weight)	25.6 ± 14.6	30.3 ± 14.0	0.348
% energy from carbohydrate	55.9 ± 8.3	56.2 ± 9.1	0.901
% energy from protein	14.8 ± 2.0	16.4 ± 3.6	0.071
% energy from fat	25.6 ± 10.1	26.4 ± 6.7	0.761
% energy from sugar	20.0 ± 6.9	18.3 ± 7.4	0.504
Dietary GI	58.2 ± 5.1	59.0 ± 4.2	0.589
Dietary GL	137.9 ± 63.7	154.4 ± 76.0	0.522
Rice servings/day	2.0 ± 1.1	2.0 ± 1.2	0.859
Starches (g)	454.21 ± 195.5	488.09 ± 228.18	0.661
Animal protein (g)	51.9 ± 35.8	74.9 ± 74.0	0.328
Fish/seafood protein (g)	69.9 ± 64.9	102.5 ± 104.2	0.349
Plant based protein (g)	19.5 ± 25.8	29.8 ± 38.8	0.415
Milk and dairy products (g)	163.8 ± 182.5	113.2 ± 174.4	0.412
Non-starchy vegetables (g)	235.8 ± 314.3	180.91 ± 234.2	0.539
Fruits (g)	322.0 ± 467.4	185.9 ± 169.7	0.365
Sweetened beverages (g)	465.6 ± 396.5	387.1 ± 423.2	0.590
Sugars and confectioneries (g)	70.1 ± 89.0	60.9 ± 59.2	0.675
Sugars and creamer (g)	10.5 ± 10.5	14.7 ± 15.9	0.420
Fats and oils (g)	18.4 + 19.4	13.4 ± 8.2	0.429
Second trimester			
Energy (kcal)	2059 ± 1150	1826 ± 625	0.392
Energy density (kcal/kg body weight)	28 ± 16	28 ± 9	0.905
% energy from carbohydrate	66.7 ± 25.0	67.0 ± 28.7	0.969
% energy from protein	21.8 ± 16.7	16.9 ± 6.2	0.157
% energy from fat	40.5 ± 38.0	26.8 ± 12.2	0.265
% energy from sugar	23.6 ± 16.6	17.2 ± 9.4	0.119
Dietary GI	58.8 ± 3.8	61.1 ± 3.3	0.066
Dietary GL	155.6 ± 63.8	167.5 ± 66.9	0.608
Rice servings/day	2.2 ± 0.9	2.9 ± 1.2	0.081*
Starches (g)	471.9 ± 198.0	590.5 ± 242.1	0.149
Animal protein (g)	72.1 ± 48.6	77.2 ± 54.8	0.784
Fish/seafood protein (g)	87.4 ± 5.3	81.1 ± 67.2	0.777
Plant based protein (g)	21.3 ± 26.2	22.0 ± 24.9	0.934
Milk and dairy products (g)	525.1 ± 182.5	65.4 ± 78.7	0.218
Non-starchy vegetables (g)	190.1 ± 275.4	112.0 ± 70.9	0.132
Fruits (g)	269.1 ± 461.9	149.9 ± 115.1	0.416
Sweetened beverages (g)	582.5 ± 492.0	420.4 ± 420.6	0.590
Sugars and confectioneries (g)	60.1 ± 40.4	58.7 ± 39.8	0.918
Sugars and creamer (g)	8.4 ± 5.0	13.8 ± 9.3	0.074
Fats and oils (g)	12.6 ± 7.0	14.8 ± 9.6	0.488

DISCUSSION

GDM women in this study had a relatively high-carbohydrate and high-sugar diet but lack of fibre, iron and calcium. These are the dietary characteristics reflecting a trend of general Malaysian population (24) and individuals with type 2 diabetes (25). Consuming a balanced, appropriate macronutrient is essential to improve maternal glycemia but at the same time, could prevent excessive gestational weight gain that leads to excessive fetal growth (26).

Despite a consistent energy intake at both trimesters, GDM women took more than 60% of energy as carbohydrate at the second trimester. They also consumed more than 10% sugars from energy intake at both trimesters. The role of sugars, added sugar and sweetened beverages with GDM are consistent. In a prospective cohort study among Canadian pregnant women, added sugar in coffee and tea significantly increased the risk of hyperglycemia even after the adjustment of the covariates (27). Unlike sugars, the role of carbohydrate in GDM is controversial. Previous studies observed an increased risk of GDM with lower carbohydrate intake, but this was in the expenses of a high-fat diet (27). In this study, the high proportion of carbohydrate in the diet was characterised as high in dietary GI, sugars and starch but low in fibre. The primary source of starch consumed by our respondents was rice. We observed that a large proportion of GDM women (53.3 – 68.9%) consumed 2 – 3 times rice per day, and the number of respondents who consumed a large bowl of rice each time increased from 24.4% at the first trimester to 66.7% at the second trimester (data not shown). A high carbohydrate mainly a starchy food and high in GI which has been shown worsened the metabolic status leading to metabolic syndrome in a non-pregnant cohort (28).

Similar to other studies, GDM women in the present study did not meet the RNI for essential nutrients during pregnancy, i.e. dietary calcium and iron (29,30). While specific dietary supplements for pregnancy may compensate the deficit, their compliance is also unsure. It is nonetheless of importance to ensure sufficient overall micronutrient intake as part of a balanced diet. In this regard, a high intake of starch with a refined carbohydrate which usually high in GI was associated with lower micronutrient adequacy in pregnant women (9). The finding reflects the fact that modern starchy foods are extremely processed which lose a substantial amount of nutrients.

The non-fasting 2h post-OGTT correctly identified subjects with GDM and strongly predicted the adverse outcomes for the mother and her offspring. Majority of the women had an increased level of 2-hour postprandial glucose, a hallmark feature of GDM among Asian populations despite having a normal value of fasting glucose which was consistent with other studies in Asia (3,31,32) 6, 28). However, none of these studies characterised the dietary intake at different measures of individual OGTT level. We observed comparable dietary characteristics between women with high FPG and high 2hPG. However, some food components tended to be in excess. As compared to women with high FPG, high 2hPG women tended to consume more energy from protein (16.4% vs 14.8%), more serving of rice (2.9 vs 2.2), high dietary GI (61.1 vs 58.8) and high intake of sugar and creamer (13.8 vs 8.4).

In this study, 75.6% of GDM women had abnormally high 2hPG, whereas 24.4% of them had high FPG. None of the subjects had both elevated 2hPG and FPG. During both trimesters, those with high 2hPG tended to consume more energy from carbohydrate, higher dietary GI and GL, high intake of starches, high intake of sugars and creamers; and less intake of fruits and non-starchy vegetables. Even though the results were not significant, this showed that those with high 2hPG tended to have lower dietary quality than those with high FPG. Hence, postprandial monitoring is especially important during their follow-ups so they can improve their glycemic control.

Similar to the Growing up in Singapore towards healthy outcomes (GUSTO) study, a higher intake of both animal and vegetable protein were associated with higher risk for GDM in Asian women (33). Sugars and creamers in our population may be related to a pre-mixed beverages consumption, but less is known about the role of sugars and creamer with GDM which warrants future investigations. On the other hand, rice consumption and its influence on postprandial glucose responses are well-studied. In a meta-analysis of a cohort study, increased white rice consumption has been associated with 11% increased risk of type 2 diabetes, especially among Asian populations (34). In the GUSTO study, a rice-based diet with fruits and vegetables reduced the likelihood of GDM among Singaporean with Chinese ethnicity but not among Indian and Malay (35). Our respondents were mainly Malay which suggested that the protective effect of rice may not be evident. This is important in the present context because, in Malaysia, more than 97% of its adult population eats rice twice daily mostly in the form of white rice (15). In this study, all the subjects consumed white rice only and not other types of rice (for example, brown rice). Hence, dietary GI and GL were calculated from their white rice intake. White rice is categorised as a high GI food with a GI value of 72 (36). High GI foods have rapid digestion and absorption rates, therefore elevating glucose response faster than low GI food (37).

There were several limitations in this study. The number of respondents in this study was low. Hence, the results might be attenuated due to smaller sample size. There were no statistical differences between women with high FPG and high 2HPG. This might indicate that this study was not powered enough to detect the difference between the two groups. Also, most of the subjects were Malay (86.7%). This unequal distribution in ethnicity may lead to insufficient power to test Chinese and Indian respondents against the over-represented Malay respondents for GDM incidence. It may also have been due to the relative homogeneity of respondents in this study. Majority of the respondents were 25 - 34 years of age (75.6%) and had no family history of DM (74.1%). To our knowledge, none of the respondents were migrants and being South East Asia-born women have already increased their risk of developing GDM. Cultural homogenization may have led to the women in both groups having similar lifestyles throughout the years and hence similar risk of developing GDM.

Furthermore, dietary intake assessments using FFQ was also not ascertained with other methods. The use of FFQ is validated in other epidemiologic studies (38–41). However, it was not explicitly validated to assess dietary GI and GL. The calculation of dietary GI and GL intake using FFQ was limited as well as due to the lack of detail in a specific type of food items. Despite these limitations, dietary GI and GL intake were extensively calculated and explored in this study, which could contribute to the body of knowledge in this field.

CONCLUSION

This study highlighted the suboptimal actual food intake in women with GDM. Dietary characteristics of women with high fasting and 2-hour glucose were comparable but not optimal. The clinical practice implications of the findings reported herein may relate to the longstanding debate regarding the best diet for women with GDM. Further studies with bigger sample size are needed to address the possibility of dual nutritional approaches according to the antepartum. OGTT may be required to optimally capture both obstetrical and metabolic risk in women with GDM. Results from this preliminary study only captured the dietary characteristics of a small sample; hence the results might not be generalizable to the whole population. Thus, there is an urgent need to identify and pursue strategies to improve dietary intake before and during pregnancy particularly in women with high risk of GDM.

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