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Carbohydrate Knowledge Observed to be Low in Vietnamese Women With Gestational Diabetes Mellitus

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ABSTRACT

Objective: To assess carbohydrate knowledge of Vietnamese women with gestational diabetes mellitus (GDM) and explore factors associated with carbohydrate knowledge.

Methods: Vietnamese women (n = 100) with GDM completed an online questionnaire about self-efficacy in managing blood glucose, the habit of regularly self-monitoring blood glucose activities at home, and an adapted culturally tailored carbohydrate quiz for the target population.

Results: Participants (30 ± 4 years) answered on average 51% of the carbohydrate knowledge questions correctly, showing most difficulty in identifying honey, milk, and orange juice as carbohydrate sources. Only 46% of participants correctly identified carbohydrate content on nutrition labels, and 58% practice self-monitoring blood glucose activities at home. Carbohydrate knowledge was positively associated with self-efficacy in blood glucose management ($r^2 = 0.101$, $P = 0.003$) and practicing self-monitoring blood glucose ($r^2 = 0.064$, $P = 0.013$).

Conclusions and Implications: There is a need to provide nutrition education about carbohydrate knowledge and blood glucose control to Vietnamese women to manage GDM.

Key Words: gestational diabetes, nutrition literacy, carbohydrate knowledge, glucose control self-monitoring, self-efficacy (*J Nutr Educ Behav.* 2022;54:551−556.)

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INTRODUCTION

Gestational diabetes mellitus (GDM) is a medical condition in which women develop glucose intolerance during pregnancy and is associated with significant adverse prenatal outcomes, including preterm birth, macrosomia, respiratory distress, birth trauma, and cardiac malformations.[1] This form of diabetes is also associated with increased maternal risk for Cesarean section, preeclampsia/eclampsia, and subsequent chronic health conditions such as type 2 diabetes and cardiovascular diseases.[2] The prevalence of GDM worldwide has been on the rise. The International Diabetes Federation estimated that in 2017 approximately 21.3 million births, or 16.2% of all live births from mothers aged 20−49 years, were affected by hyperglycemia in pregnancy. Geographical differences were observed, with Southeast Asia reportedly having the highest prevalence of hyperglycemia in pregnancy at 27% compared with the lowest in Africa at 10%.[3]

Medical nutrition therapy and physical activity are the recommended first-line treatment of GDM, and pregnant women should be referred to a registered dietitian nutritionist promptly after diagnosis.[4,5] The goal of medical nutrition therapy for GDM is to maintain normal blood glucose levels and ensure adequate nutrient intake to promote fetal growth and appropriate maternal weight gain.[5] A meta-analysis of 18 randomized controlled trials assessing the impact of medical nutrition therapy on maternal glucose levels and neonatal birth weight found a decrease of 4.1 mg/dL in fasting and 7.8 mg/dL in postprandial blood glucose levels. In addition, this analysis found a 35% reduction in medication use and reduction in infant birth weights by 170 g compared with women who did not receive similar care.[6]

One of the key recommendations from the Gestational Diabetes Evidence-Based Nutrition Practice Guidelines are individualized prescriptions for carbohydrate amount and type to achieve desired glycemic targets.[5] To successfully follow such guidelines, women with GDM must be equipped with basic carbohydrate knowledge to support decisions related to food intake, but few studies have evaluated the food and carbohydrate knowledge of women with GDM. A study conducted in the United Arab Emirates reported that women with GDM had limited knowledge about food items that could increase blood glucose levels; many did not identify whole wheat bread, fruit juice, and low-fat milk as carbohydrate-containing items.[7] Another study

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including a multiethnic sample in Australia found that Vietnamese women with GDM had the lowest understanding of food knowledge compared with Caucasians, Filipinos, and Indians.[8]

Vietnam reported a concerning GDM prevalence of 22.8% using World Health Organization diagnostic criteria.[9] A qualitative study revealed that dietary changes and confusion regarding carbohydrate intake were the main areas of concern among Vietnamese women with GDM.[10] Given the increasing prevalence of GDM and long-term health consequences for both the mother and child, it is important to assess the carbohydrate knowledge of women with GDM living in Vietnam to assist the development of effective educational interventions. To address this gap, this study aimed to (1) assess participants' carbohydrate knowledge and (2) explore the factors associated with carbohydrate knowledge.

METHODS

This cross-sectional study included Vietnamese women aged > 18 years with a self-reported diagnosis of GDM. Women with type 1 or type 2 diabetes before pregnancy or not pregnant at the time of the survey were excluded. The survey included the following screening questions: (1) are you aged > 18 years? (2) do you have type 1, type 2 diabetes, or gestational diabetes (check all that apply)? (3) are you currently pregnant? (4) do you live in Vietnam? Participants who did not meet the inclusion criteria were taken to the end of the survey. Data were collected from January to February of 2020. The Institutional Review Board of San José State University approved the study, and all participants were given consent notice. Using convenience sampling, participants were recruited from a social media community group (Facebook, Meta Platforms, Inc) for Vietnamese women with GDM, including > 5,600 members. This group enables its members to interact and exchange information about GDM, but it is not moderated by health professionals. The recruitment posting included a hyperlink to the self-administered online questionnaire (Qualtrics), and participation was anonymous. Of the 118 participants who clicked on the survey, 15 did not answer any questions, and 3 were not pregnant at the time of the survey. The final sample included 100 participants. According to sample size calculations using G*Power (version 3.1, Heinrich-Heine-Universität Düsseldorf, 2020) for linear regression (2-sided test and alpha of 0.05), a sample of 81 participants or greater would provide a minimum of 80% power to detect small effects ($f^2 = 0.1$, $r^2 = 0.09$) in the association between predictors and the carbohydrate knowledge score.

The survey was developed in English first and then translated to Vietnamese by the primary researcher, a first-generation Vietnamese American, and an independent reviewer then verified the translation for accuracy. The survey had 33 questions related to demographics, pregnancy, carbohydrate knowledge assessment, and blood glucose management. Demographic and pregnancy characteristics included age (years), number of prior pregnancies, current week of pregnancy, the timing of GDM diagnosis (weeks), use of insulin (yes or no), and residence location, which was converted into a dichotomous variable including urban (Ho Chi Minh City and Ha Noi) or rural (provinces in Vietnam). Participants self-reported their height (cm) and weight (kg) for the body mass index calculation (kg/m^2). In addition, the survey asked 1 question about the frequency of measuring blood glucose levels at home (times/d), and self-monitoring blood glucose activities were dichotomized (yes and no). Self-efficacy was measured with a single-item scale from 0 to 10 (10 being the highest) with the question "how confident are you that you can manage your blood glucose within the recommended range?"

Carbohydrate knowledge was assessed using 18 questions adapted from the validated AdultCarbQuiz, which determines the need for carbohydrate education in US patients with type 2 diabetes (Kuder-Richardson 20 coefficient = 0.90).[11] The questions used in this study were modified for brevity and to include culturally relevant foods tailored to the Vietnamese population. Some items were removed, such as blackberry jam, canned spaghetti sauce, and maple syrup, whereas others were substituted for items more commonly consumed in Vietnam, such as sweet potatoes for baked potatoes and orange juice for apple juice. The survey was then pretested by 3 first-generation Vietnamese American women that were not pregnant or had GDM. Small modifications were incorporated to clarify some questions after respondent debriefing; for example, "milk" was replaced with "cow milk (unsweetened)." The first 10 questions assessed the ability to identify carbohydrate-containing foods. Then participants were asked if specific food items, such as rice or chicken, contained carbohydrates. Three possible answers were given for each food item: yes, no, and don't know. Food items containing ≥ 5 g or more of carbohydrate per serving were considered carbohydrate-containing foods. One question asked participants to identify the amount of carbohydrates in a food label. Two questions asked participants to select the food item that can raise blood glucose the highest among 3 different food items, and 5 questions assessed the ability to identify the specific amount in grams of carbohydrate in foods. Six possible answers were given: 0 g, 5 g, 15 g, 30 g, 45 g, and don't know. Each correct answer was given a score of 1, whereas incorrect answers and "don't know" were scored as zero, adding up to a total of 18 possible points.

The data set was cleaned, coded, and analyzed using SPSS statistical software (version 25, IBM Corp, 2017). The descriptive analysis provided frequencies and percentages for categorical variables and means and standard deviations for continuous variables. Bivariate analysis using simple linear regressions were used to assess the relationship between carbohydrate knowledge scores (dependent variable) and several independent variables: age, body mass index, parity, week of gestation, number of weeks since GDM diagnosis, insulin use (yes or no), residence location (urban or rural), self-monitoring blood glucose at home

Table 1. Characteristics of Vietnamese Women With Gestational Diabetes Mellitus (GDM)

Characteristics	n[a]	Mean ± SD or n (%)
Age, y	100	30.2 ± 4.1
Prepregnancy body mass index, kg/m^2	100	24.1 ± 3.2
Parity	97	1.5 ± 0.7
Current week of gestation	100	29.9 ± 4.8
Gestation week of GDM diagnosis	100	24.5 ± 4.3
Time since GDM diagnosis, wk	100	5.3 ± 4.0
Frequency of blood glucose measurement, times/d	96	3.1 ± 2.1
Self-efficacy in managing blood glucose (0–10)	84	5.7 ± 1.9
Carbohydrate knowledge (0–18)	100	9.2 ± 2.5
Geographical location	95	
Urban (HCMC and Ha Noi)		49 (52)
Rural		46 (48)
GDM treatment	99	
Insulin		13 (13)
Diet and exercise		86 (87)
Self-monitoring blood glucose	96	
Yes		56 (58)
No		40 (42)

HCMC indicates Ho Chi Minh City.
[a]Sample size values for each variable do not always equate to the total sample size because of nonresponses to specific questions.

(yes or no), and self-efficacy in blood glucose management. The cutoff point for statistical significance used was $P \leq 0.05$.

RESULTS

The descriptive characteristics of participants are reported in Table 1. The mean age for the participants was 30.2 ± 4.1 years. Most participants (57%) were pregnant with their first child. The average gestational week was 29.9 ± 4.8 and the average gestational week of GDM diagnosis was 24.5 ± 4.3. About 13% of respondents were managing their blood glucose with insulin. Participants indicated that their self-efficacy in blood glucose management was on average 5.7 ± 1.9 (scale from 0 to 10). In addition, 58% of participants engaged in self-monitoring blood glucose activities at home. Participants on average reported testing their blood glucose 3.1 ± 2.1 times/d at home.

In assessing carbohydrate-containing foods (Table 2), participants were able to successfully identify some starchy food items that can raise blood glucose, such as brown rice (88% answered correctly), sweet potatoes (97%), and bread (100%). The items that participants had most difficulty correctly identifying as containing carbohydrates were orange juice (19%), unsweetened cow's milk (22%), and honey (28%). Forty-six percent of participants could correctly identify the listed grams of carbohydrates when reading a nutrition label. Less than half of the participants were able to identify the correct amount of carbohydrate in rice (41%), chicken (30%), cabbage (23%), a medium-size banana (21%), and unsweetened cow's milk (12%). The average score on all 18 assessment questions was 9.2 ± 2.5 (51%).

Table 3 shows the results of simple linear regressions to assess individual relationships between carbohydrate knowledge scores and their correlates. Of the 9 factors analyzed, 2 were significantly associated with carbohydrate knowledge: measuring blood glucose at home was associated with a 1.26 higher carbohydrate knowledge score with an r^2 of 0.064 ($P = 0.013$), and carbohydrate knowledge score increased 0.42 points for each 1-unit increase of the self-efficacy in blood glucose management score with an r^2 of 0.101 ($P = 0.003$).

DISCUSSION

The main findings of this study of women with GDM in Vietnam were that participants had a low overall score (51%) of carbohydrate knowledge, including the ability to identify sources of carbohydrates and amount of carbohydrates in food and the ability to read nutrition labels. In addition, only 58% of participants reported regularly measuring blood glucose levels at home. Higher carbohydrate knowledge scores were associated with confidence in blood glucose management and measuring blood glucose at home, although it was a small effect size, explaining about 10% and 6% of the variance in knowledge scores, respectively.

Consistent with other research, the current study found that participants performed poorly on the carbohydrate knowledge quiz, which was tailored to include culturally relevant foods in Vietnam, with an average total score of 51%. A similar study conducted in the United Arab Emirates among women with GDM found that 61% of participants scored correctly on a carbohydrate-containing food assessment.[7] One of the possible explanations for low values of overall carbohydrate knowledge observed in this study compared with the United Arab Emirates study could be related to more complex factual knowledge questions, such as interpreting carbohydrate content in food and nutrition labels. In another study including a multiethnic sample residing in Australia, Vietnamese women with GDM were identified to have the greatest risk of misunderstanding GDM because they had the lowest health literacy scores compared with other ethnicities. For example, food macronutrient values, such as fat/carbohydrates content, were well understood by Indians (100%) and least understood by Vietnamese women (47%).[8] The low carbohydrate knowledge score observed in our study is concerning considering that carbohydrate amount, type,

Table 2. Carbohydrate Knowledge Scores of Vietnamese Women With Gestational Diabetes Mellitus

Carbohydrate Knowledge	Correct Responses (n = 100)
Identify carbohydrate-containing foods	
Bread	100
Sweet potatoes	97
Chicken	96
Brown rice	88
Cheese	66
Sausages	42
Beans	31
Honey	28
Cow's milk (unsweetened)	22
Orange juice	19
Ability to read a food label	
Identify the grams of carbohydrates in a food label	46
Identify food that can raise blood glucose	
15 g of carb, 15 g of protein, and 15 g of fat, which one can raise blood glucose the highest?	97
1 cup of chicken, 1 cup of boiled cabbage, and 1 cup of orange juice, which one can raise blood glucose the highest?	80
Identify the amount of carbohydrates in food	
1 cup of boiled rice	41
1 cup boiled chicken	30
1 cup of boiled cabbage	23
1 cup of banana	21
1 cup of cow's milk (unsweetened)	11

and timing are key aspects of nutrition education for successful management of GDM.[5]

Overall, participants did well in correctly identifying certain food items as carbohydrate or noncarbohydrate containing such as bread (100%), sweet potatoes (97%), chicken (96%), and brown rice (88%). However, participants had problems identifying honey (28%), milk (22%), and orange juice (19%) as carbohydrate sources. Milk and fruit juice were also identified in the United Arab Emirates study as 2 out of 3 food items with the lowest correct responses; the other item was whole wheat bread.[7] We speculate that honey, milk, and fruit juice could be perceived as natural foods leading to this misconception. In addition, improving nutrition label literacy could help women with GDM correctly identify these sources as carbohydrate-containing foods. In the current study, only 46% of participants could correctly read the nutrition label on the carbohydrate assessment. There is an emerging interest in nutrition labeling in Vietnam because of the recent signs of nutrition transition combined with increasing rates of obesity and diet-related health conditions such as diabetes.[12,13] A recent study conducted in Vietnam observed a negative association between nutrition label reading by the household's main food shopper and added sugar consumption.[13]

Frequent self-monitoring of blood glucose has been an important component in achieving glycemic targets and reducing maternal and neonatal complications.[14] Despite the importance of self-monitoring blood glucose activities, this study found that only 58% of the participants regularly measured blood glucose at home. Participants who did not practice self-monitoring measurement, combined with limited carbohydrate knowledge, could be at risk of undiagnosed hyperglycemia episodes potentially leading to costly health complications. It has been estimated that the financial burden of pregnancy with GDM was 95% more costly on average than a pregnancy without GDM.[15] Barriers to self-

Table 3. Associations Between Carbohydrate Knowledge Score and Demographic and Behavioral Correlates in Vietnamese Women With Gestational Diabetes Mellitus (GDM)

Variables	β	SE β	r^2	*P*
Age, y	0.059	0.063	0.009	0.350
Prepregnancy body mass index, kg/m^2	−0.005	0.080	0.000	0.953
Parity	−0.224	0.374	0.004	0.552
Current week of gestation	0.027	0.054	0.003	0.610
Time since GDM diagnosis, wk	0.023	0.064	0.001	0.721
Residence location (urban = 1, rural = 0)	0.499	0.488	0.011	0.309
Insulin use (yes = 1, no = 0)	0.583	0.735	0.006	0.429
Self-monitoring blood glucose (yes = 1, no = 0)	10.264	0.500	0.064	0.013[a]
Self-efficacy in managing blood glucose, score	0.420	0.138	0.101	0.003[a]

β indicates unstandardized regression coefficients.
[a] $P \leq 0.05$.
Note: Bivariate analysis using simple linear regression with carbohydrate knowledge score as the dependent variable.

monitoring of blood glucose testing reported by women with GDM include the cost of monitoring supplies, inconsistent recommendations by health care providers, and fear and anxiety about testing.[16]

Diabetes self-care encompasses knowledge, skills, and abilities needed to implement behaviors that support successful diabetes management, such as blood glucose monitoring, healthy eating, and physical activity.[17] In the current study, participants with higher carbohydrate knowledge scores were more likely to measure blood glucose levels at home and have higher self-efficacy in managing blood glucose. These findings should be interpreted with caution because of the small effect size, and it should be considered that the study intended to assess the relationship between factors associated with carbohydrate knowledge and not to predict outcomes. Nonetheless, constant blood glucose monitoring works as a feedback mechanism on how specific foods affect postprandial blood glucose levels and may influence carbohydrate knowledge over time. Although this study did not evaluate blood glucose levels, evidence supports that higher knowledge scores are associated with better blood glucose control. A study conducted in Malaysia has shown that increased knowledge scores related to GDM, including dietary and food values, were negatively correlated with fasting plasma glucose.[18] Similar findings have also been shown in patients with type 2 diabetes, in which higher overall diabetes knowledge and carbohydrate knowledge were associated with lower glycated hemoglobin levels.[11,19] In addition, self-efficacy has been shown to be predictive of self-care behavior in women with GDM and is suggested to be a critical component of behavioral and medical adherence.[20,21]

Study participants were recruited from an online group for women with GDM in which they shared information related to this condition and may have influenced participants' carbohydrate knowledge and GDM care behaviors. Widespread cell phone usage and access to an online community group could contribute to democratizing valuable health information across physical boundaries. In contrast, misinformation may occur considering that the quality of the information found on the internet is generally suboptimal, and the readability level is not targeted for general public use.[22] According to a systematic review, pregnant women, increasingly rely on the internet to find health information, especially in fetal development and nutrition guidance.[23] In addition, social media provides an opportunity to find relevant peer support groups and connect with those dealing with similar medical challenges; such connections would be otherwise difficult to form. The current study did not evaluate the accuracy of nutrition information shared among members, and health professionals did not moderate this group. Evidence shows that professionally moderated social media groups can improve access to reliable information and social support during pregnancy.[24]

This study addresses some gaps in the literature as there is a scarcity of data related to carbohydrate knowledge in women with GDM and factors that may be associated with improved knowledge. However, our results should be interpreted with caution. Considering this is a cross-sectional study, we cannot infer causality or the direction of the associations. This study relied on self-reported data such as the habit of engaging in blood glucose self-monitoring at home. We could not independently verify their accuracies or directly measure their glucose levels. Self-efficacy was measured using a single-item question instead of a more comprehensive diabetes self-efficacy scale. In addition, information about educational level, income, and social support was not collected, and these factors are associated with nutrition and health literacy levels.[25,26] The carbohydrate knowledge questionnaire was adapted from an instrument previously validated in US adults with type 2 diabetes[11] but not in women with GDM. Modifications also accounted for culturally relevant foods in Vietnam. The survey was pretested with first-generation Vietnamese American women without GDM instead of the target audience of women with GDM living in Vietnam. Finally, the sample size is relatively small, and participants were recruited from an online community group on Facebook for women with GDM limiting the generalizability of our findings. The online group frequently shared best practices on foods and blood glucose management, but they could have also shared misinformation. In contrast, this recruitment approach allowed us to recruit a hard-to-reach population of pregnant women with GDM living in Vietnam's rural areas that have been understudied.

IMPLICATIONS FOR RESEARCH AND PRACTICE

The results of this study highlighted an important need to provide nutrition education for women with GDM in Vietnam. Our data from a culturally tailored carbohydrate quiz supports nutrition education focusing on food sources of carbohydrates, especially nonstarch forms of carbohydrates such as fruit juices, honey, and milk, as most participants did not identify these items as carbohydrate-containing food. In addition, many participants could not correctly read nutrition labels to assess carbohydrate content. Further research could explore how cultural food beliefs affect nutrition literacy. The inclusion of culturally relevant recipes to improve adherence to dietary patterns and carbohydrate-counting for the most popular dishes as a reference point may facilitate knowledge application. In addition, timely referrals to dietitians at the time of GDM diagnosis by health care providers for in-depth nutrition counseling sessions may help address knowledge gaps about carbohydrate-containing foods and diabetes self-care. Considering the limited data on carbohydrate knowledge among women with GDM, additional research on larger samples and in different high-risk populations is merited to develop and promote culturally appropriate nutrition education. Future research may also consider the role of supporting resources such as curated open-access websites and professionally moderated social media groups to improve the provision of practical,

trustworthy, and timely information for women with GDM in Vietnam. Such easily-accessible information is especially helpful for hard-to-reach populations that cannot meet with health care providers on a timely basis.

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