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Higher glycemic load diet is associated with poorer nutrient intake in women with gestational diabetes mellitus

Jimmy Chun Yu Louie[a,b,*], *Tania P. Markovic*[a,c], *Glynis P. Ross*[c], *Deborah Foote*[d], *Jennie C. Brand-Miller*[a]

[a] *School of Molecular Bioscience and Boden Institute of Obesity, Nutrition, Exercise and Eating Disorders, University of Sydney NSW 2006 Australia*
[b] *School of Health Sciences, Faculty of Health and Behavioral Sciences, The University of Wollongong NSW 2522 Australia*
[c] *Department of Endocrinology, Royal Prince Alfred Hospital, Camperdown NSW 2050 Australia*
[d] *Department of Nutrition and Dietetics, Royal Prince Alfred Hospital, Camperdown NSW 2050 Australia*

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ABSTRACT

Changes in the quality and quantity of carbohydrate foods may compromise nutrient intake in women with gestational diabetes mellitus (GDM). We hypothesized that glycemic index, glycemic load (GL), carbohydrate intake, grains, and cereal product consumption would be associated with nutrient adequacy. Eighty-two women with GDM (61% of Asian background, 34% whites) completed a 3-day food record following their routine group nutrition education session. Nutrient intakes were compared to Nutrient Reference Values (NRV) for Australia and New Zealand. Nutrient intake across energy-adjusted tertiles of glycemic index, GL, carbohydrate intake, and intake of grains and cereal products were assessed. The majority of women (66%-99%) did not meet the NRV for fiber, folate, vitamin D, iodine, and iron, and exceeded NRV for saturated fat and sodium. Higher dietary GL was associated with lower intakes of total, monounsaturated, and polyunsaturated fat; vitamin E; and potassium (all $P < .001$). Higher grain intake was not significantly associated with intake of any micronutrients. In Australian women with GDM, high dietary GL predicts greater risk of poor nutrition.

1. Introduction

Dietary modifications are recognized as an important part of the medical management of gestational diabetes mellitus (GDM) [1]. The main focus of dietary advice for GDM is the identification of carbohydrate rich foods and moderation of total carbohydrate intake [2]. GDM nutrition education often focuses on the relationship between quantity of carbohydrates and postprandial glycemia. However, in real-life settings, where time and resources for nutrition education are limited, other aspects of nutrition, such as the higher nutritional requirements of pregnancy may be underemphasized [3]. The markedly increased requirement for some micronutrients (eg, iron, folate, and iodine) is difficult to achieve even in normal pregnancy, so supplements are routinely recommended [4]. On the other hand, the higher need for zinc, vitamin C, and vitamin A should be achievable through diet alone. Women with GDM, however, are expected to moderate carbohydrate intake while increasing overall micronutrient intake, a combination that may be challenging.

Abbreviations: AI, adequate intake; BMI, body mass index; GDM, gestational diabetes mellitus; GI, glycemic index; GL, glycemic load; LCn3PUFA, long-chain n-3 polyunsaturated fatty acids; NRV, Nutrient Reference Values; UL, upper level.

* *Corresponding author.* Tel.: +61 2 4298 1441; fax: + 61 2 4221 3486.
E-mail address: jlouie@uow.edu.au (J.C.Y. Louie).

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It is also conceivable that women with GDM, in practice, over-restrict nutritious carbohydrate-rich foods such as fruits and whole grains to avoid the need for insulin treatment [5]. Studies in the UK and Spain have suggested that women with GDM have suboptimal nutrient intakes [6,7].

Low-glycemic-index (GI) foods are by definition moderate to high sources of carbohydrates, yet some are also particularly rich in micronutrients (eg, fruits, intact whole grains, and dairy products). Hence, apart from the potential to improve postprandial glycemic control in GDM [8,9], a low GI eating pattern may offer additional advantages in settings where total carbohydrate intake is capped [10–12]. Glycemic load (GL), the product of the GI and available carbohydrate content of a food, is also relevant in GDM because it takes both the quality (ie, GI) and the quantity of the carbohydrate in the diet into account. In this situation, women of Asian background may be more compromised nutritionally because of the absence of dairy products [13]. South East Asian women, in particular, are more likely to consume white rice, a high GI carbohydrate food with low micronutrient density.

We aimed to investigate the nutritional intakes of a group of Australian women with GDM and compare that to Australian recommendations. In addition, because Australia is a multicultural society, we explored the effect of ethnicity. Our hypotheses were (1) that many women with GDM would not meet the Nutrient Reference Values for Australia and New Zealand (NRV), particularly those of Asian origin; (2) that lower intake of carbohydrates, grains, and cereal products would be associated with lower nutrient density; and (3) that a lower dietary GI and GL would be associated with superior dietary quality.

2. Methods and materials

2.1. Participants, demographics, and data collection

This was a sub-analysis of data collected from a randomized controlled trial [14]. In brief, 99 women who were diagnosed with GDM with a 75 g oral glucose tolerance test were recruited from the diabetes antenatal clinical of the Royal Prince Alfred Hospital, Camperdown, NSW, Australia. In Australia, screening for GDM is universal at 26 to 28 weeks of gestation [15] and based on the following criteria: fasting glucose 5.5 mmol/L or more and/or 1 h post-load glucose of 10.0 mmol/L or more and/or 2 h post-load glucose of 8.0 mmol/L or more. After a routine group education session, participants were asked to complete a three-day food record (including 2 weekdays and 1 weekend day) for the assessment of baseline diet. They were provided with a 2D food model booklet to assist them with portion size estimation, and any ambiguous entries were clarified with the study dietitian. From 99 participants, 82 complete food records were available for analysis. Information about demographics and ethnicity was also gathered and participants were asked to recall pre-pregnancy weight. Information on use of dietary supplements was not collected as the aim of the study was to examine the nutrient adequacy of dietary intake.

2.2. Nutritional and food group analyses

The food records were entered into a nutrition analysis software package (FoodWorks Professional 2009, Xyris Software, Brisbane, QLD, Australia) to assess intakes of energy, macro- and micronutrients, and fiber based on an Australian specific food composition database, AUSNUT2007 [16]. To account for the mandatory fortification of folate to breads introduced by Food Standards Australia and New Zealand in September 2009, all breads (except organic breads exempt from mandatory fortification) consumed after September 2009 were coded as folate-fortified.

The macro- and micronutrient intake was compared to NRVs for Australia and New Zealand [4] for pregnancy. For protein, calcium, iodine, iron, zinc, magnesium, thiamin, riboflavin, vitamin C, dietary folate equivalents, and vitamin A (as retinol equivalents), intakes lower than the Estimated Average Requirement were considered as not meeting the NRV; for long-chain n-3 polyunsaturated fatty acids (LCn3PUFA), dietary fiber, vitamin D and E, and potassium, intakes lower than the Adequate Intake (AI) were considered inadequate; and for sodium, intakes higher than the Upper Level (UL) were considered as not meeting the NRV. Individuals with percentage energy intake from saturated fat greater than 10% were considered as not meeting the saturated fat target. Food items were grouped into broad categories as defined in the 2007 Australian National Children's Nutrition and Physical Activity Survey [17], where "cereal grains and cereal products" included all cereal grains, and products made from cereal grains or flour, including breakfast cereals but excluding cakes and biscuits.

Because dietary intake during pregnancy is highly variable due to nausea and vomiting, usual methods to assess under- or over-reporting of the food intake (based on reported energy intake) were deemed unsuitable.

2.3. GI and GL analyses

GI values were assigned to individual food items according to a previously published method [18]. Dietary GL was calculated as $\sum$ (GI × available carbohydrate of each food in a day/100). Dietary GI was calculated as (dietary GL/total daily available carbohydrate) × 100.

2.4. Ethical approval

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human participants were approved by the Human Research Ethics Committee of the Sydney South West Area Health Service (Royal Prince Alfred Hospital Zone; Reference number: X08-0121). Informed consent was obtained.

2.5. Statistical analyses

All statistical analyses were performed in IBM SPSS version 19 (IBM Corporation, New York, NY, USA, 2010). Nutrient intakes were analyzed as the mean of three days, and values were presented as means ± SEM. Pearson χ^2 was used to test for differences in the proportion of participants not meeting the