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The influence of carbohydrate consumption on glycemic control in pregnant women with type 1 diabetes

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ABSTRACT

Aims: To study the influence of the quantity and the quality of carbohydrate consumption on glycemic control in early pregnancy among women with type 1 diabetes.
Methods: A retrospective study of 107 women with type 1 diabetes who completed 1–3 days of diet recording before first antenatal visit, as a part of routine care. The total daily carbohydrate consumption from the major sources (e.g. bread, potatoes, rice, pasta, dairy products, fruits, candy) was calculated. A dietician estimated the overall glycemic index score (scale 0–7).
Results: At least two days of diet recording were available in 75% of the 107 women at mean 64 (SD ± 14) gestational days. The quantity of carbohydrate consumption from major sources was 180 (±51) g/day. HbA1c was positively associated with the quantity of carbohydrate consumption ($\beta = 0.41$; 95% CI 0.13–0.70, $P = 0.005$), corresponding to an increase of 0.4% in HbA1c per 100 g carbohydrates consumed daily, when adjusted for insulin dose/-bodyweight and use of insulin pump treatment. The median (IQR) glycemic index score was 2 (0–3). An adjusted association between HbA1c and glycemic index score was not demonstrated. The women using carbohydrate counting daily (45%) had lower HbA1c compared to the remaining women (6.4 (±0.5) vs. 6.8 (±0.9)% (47 ± 6 vs. 51 ± 10 mmol/mol), $P = 0.01$).
Conclusions: HbA1c in early pregnancy was positively associated with the quantity of carbohydrate consumption regardless of insulin treatment. Carbohydrate counting is probably important for glycemic control in pregnant women with type 1 diabetes.
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1. Introduction

Pregestational diabetes is one of the commonest chronic conditions affecting pregnancy; in the UK 1 in every 250 pregnancies is complicated by pregestational diabetes [1]. Pregnancy in women with type 1 diabetes is associated with increased risk of adverse perinatal outcomes, with 5–10% of the infants suffering from major malformations and up to half being born large for gestational age [2–6]. The prevalence of malformations is positively associated to the obtained HbA1c value in early pregnancy [4,6]. The treatment of women with type 1 diabetes therefore aims at achieving HbA1c values as close to normal as possible before and in early pregnancy in order to prevent malformations and to obtain the best pregnancy outcome [4,6,7]. Appropriate glucose monitoring and insulin treatment are well-established tools for optimizing glycemic control. The quantity of carbohydrates in a meal is the main dietary factor affecting postprandial glucose levels, but other factors, such as the quality of the carbohydrate, are also of importance [8,9]. The effect of the actual diet, carbohydrate consumption in particular, on glycemic control is to our knowledge only sparsely investigated in pregnant women with type 1 diabetes [10].

Excessive gestational weight gain (GWG) is a major contributor to excessive fetal growth both in women without [11] and with diabetes independent of glycemic control [12,13]. More than half of the pregnant women with type 1 diabetes gain more weight than recommended [13,14] implicating that excessive food intake also is an important modifiable factor contributing to fetal overgrowth. High intake of carbohydrates in obese pregnant women without diabetes is associated with increased fetal fat mass [15].

Carbohydrate counting is a useful tool to improve glycemic control outside of pregnancy [16,17], and may be relevant both for improving glycemic control and for restricting gestational weight gain in pregnant women with type 1 diabetes.

The aim of the present study was to evaluate the quantity and quality of daily carbohydrate consumption and their effect on HbA1c in early pregnancy, and whether carbohydrate counting may be beneficial in pregnant women with type 1 diabetes.

2. Subjects, materials and methods

2.1. Study population

Starting in January 2013, as part of the routine care at Center for Pregnant Women with Diabetes at Rigshospitalet, all pregnant women with type 1 diabetes receive a diet recording form along with the welcome letter by mail and are asked to complete a 3 days diet recording before the first antenatal visit. This retrospective study includes all pregnant women with type 1 diabetes referred to our center from January 2013 to December 2014. Women with former bariatric surgery ($n = 2$) and known coeliac disease ($n = 3$) as well as women without at least one day of diet recording ($n = 59$) were excluded, leaving 107 (63%) out of 171 women included in the study. Despite the women were asked to complete a 3 days diet recording, some women only delivered 1 or 2 days diet recording. All diet records were included in the analyses of this study. Data on self-reported daily use of carbohydrate counting was available in 92 women, and presence of nausea and ketonuria in 100 women. None of the included women had known conditions that interfered with the measurement of the HbA1c.

2.2. The diet analysis

At the first antenatal visit, the dietician (HR) in collaboration with each woman used the diet record, in combination with validated tables [18], photos [19] and a carbohydrate counting app [20] to estimate the quantity of daily carbohydrate consumption. The quantity of carbohydrates was calculated from the major carbohydrate sources only (e.g. bread, potatoes, rice, pasta, fruits, dairy products, candy).

Exact information on the glycemic index of the carbohydrate consumption is difficult to obtain. In this study a practical estimation that was easy to perform under routine condition and suitable for future implementation in clinical care was chosen. Therefore, based on the available information, the dietician performed a pragmatic estimation of the proportion of the total amount of carbohydrates consumed with a high glycemic index. This was categorized on a glycemic index score, a scale from 0 to 7, with a score of 7 indicating that the woman consumed all carbohydrates from high glycemic index sources while score of 0 indicated that all the carbohydrates consumed derived from low glycemic index sources. This pragmatic glycemic index score was developed for the purpose of this study and is at present not evaluated further. Lipid and protein consumption were not analyzed.

The dietician collected data on the woman's knowledge about carbohydrate counting graded as follows: knowing almost nothing, knowing some, knowing how to count carbohydrates but not using it or using carbohydrate counting on a daily basis. The number of meals and snacks consumed per day and whether the woman reported having nausea (yes/no) was also noted.

2.3. Demographic and clinical data

Demographic and clinical data were obtained from two standard forms prospectively recorded in the original medical records.

The main outcome was HbA1c at first antenatal visit. A capillary blood sample was obtained and analyzed immediately by a DCA 2000 analyzer by a latex immunoagglutination inhibition method (DCA 2000; Bayer, Mishawaka, IN) and calibrated to the IFCC unit. The detection limit was 7–24 g/dL of total hemoglobin. None of our patients exceeded these limits. The quality control of the DCA 2000 analyzer was run as recommended by the producer. Early gestational weight gain [21] was defined as the difference between self-reported weight before pregnancy and measured weight at first antenatal visit.

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