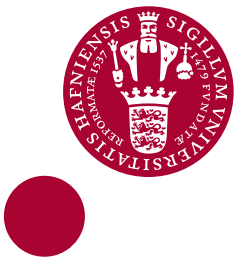

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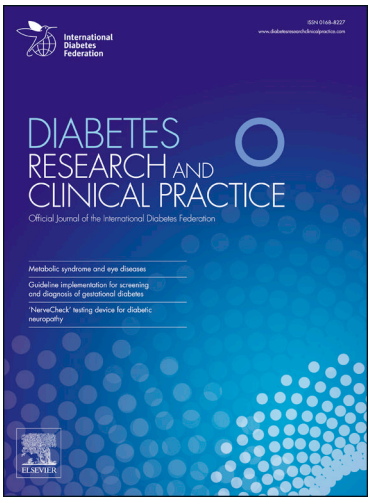

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Original article

Lower daily carbohydrate consumption than recommended by the Institute of Medicine is common among women with type 2 diabetes in early pregnancy in Denmark

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Aims:
To secure adequate carbohydrate supply in pregnancy, the Institute of Medicine (IOM) recommends a minimum amount of carbohydrates of 175 g daily. Currently a low carbohydrate diet is a popular health trend in the general population and this might also be common among overweight and obese pregnant women with type 2 diabetes (T2D). Thus, we explored carbohydrate consumption among pregnant women with T2D including women with type 1 diabetes (T1D) for comparison.

Methods:
A retrospective cohort study of consecutive women with T2D (N=96) and T1D (N=108), where dietary records were collected at the first antenatal visit.

Results:
Among women with T2D and T1D, bodyweight at the first visit was 90.8±22 (mean±SD) and 75.5±15 kg (P<0.001) while HbA1c was 6.6±1.2% (49±13 mmol/mol) and 6.6±0.8% (48±8 mmol/mol), P=0.8, respectively. The average daily carbohydrate consumption from the major carbohydrate sources was similar in the two groups (159±56 and 167±48 g, P=0.3), as was the level of total daily physical activity (median (interquartile range)): 215 (174-289) and 210 (178-267) metabolic equivalent of task-hour/week (P=0.9). A high proportion of women with T2D and T1D (52% and 40%, P=0.08) consumed fewer carbohydrates than recommended by the IOM. The prevalence of ketonuria (≥4 mmol/L) was 1% in both groups.

Conclusions:
In early pregnancy, a lower daily carbohydrate consumption than recommended by the IOM was common among women with T2D. The results were quite similar to women with T1D, despite a markedly higher bodyweight in women with T2D. Reassuringly, ketonuria was rare in both groups.

Keywords: Carbohydrate, pregnancy, type 2 diabetes, type 1 diabetes.

1. Introduction

Pregnancies complicated by diabetes are associated with increased risk of adverse perinatal outcomes including infants born large for gestational age (1,2). This is mostly attributed to the maternal transfer of excessive glucose across the placenta leading to accelerated fetal growth (3). The total amount of carbohydrates is the main dietary factor affecting postprandial blood glucose (4). Therefore a restricted carbohydrate consumption in pregnant women with diabetes could be sensible but as both the maternal and the fetal brain mainly use glucose as an energy source, the Institute of Medicine (IOM) and the American Diabetes Association (ADA) recommend a minimum of 175 g of carbohydrates daily for pregnant women (5,6). The average daily carbohydrate consumption in early pregnancy in healthy women is in general reported to be well above the minimum amount recommended by the IOM (7,8) and excessive gestational weight gain is common (9).

A low carbohydrate diet aiming at reducing plasma glucose levels and obtaining weight loss is a popular health trend in the general population (10) and in patients with type 2 diabetes (T2D) (11) but may be harmful during pregnancy. Insufficient carbohydrate consumption can lead to increased lipolysis and ketone body production and pregnant women are in general more prone to ketosis than non-pregnant women (12-14). Previous observational studies in offspring of women with diabetes suggests that elevated maternal ketone bodies may have a negative effect on the developing fetal central nervous system (15,16). Thus, we speculate that, in pregnant women with diabetes, sufficient daily carbohydrate consumption and avoidance of ketonemia are probably important for normal fetal brain development.

The total amount of macronutrients required to maintain body weight is dependent on the body composition and the level of physical activity. Therefore, the recommendations on carbohydrate consumption are often given per kilo bodyweight which probably can lead to inappropriately high

carbohydrate consumption in obese women where the recommended gestational weight gain is smaller than in normal weight women (14). High prevalence of excessive gestational weight gain has been reported among pregnant women with diabetes (17-19). Recommendations on lower energy percent (E%) of carbohydrates in obese pregnant women with diabetes has been suggested (20).

Modern diabetes treatment respects a flexible lifestyle (21) and the daily amount of carbohydrates varies considerably from day to day in pregnant women with type 1 diabetes (T1D) (22). In a real world, daily dietary intake may therefore vary considerably from the dietary advises given. One small study including 19 women with T2D at 22 gestational weeks found an average carbohydrate consumption of 259 g daily (23). Sufficient intake of lipids and proteins as well as micronutrients during pregnancy is also important for fetal growth (24), but this study is restricted to carbohydrate consumption.

In a real-world setting, we aimed to explore carbohydrate consumption and prevalence of ketonuria in early pregnancy among women with T2D including women with T1D for comparison.

2. Subjects, Materials and Methods

2.1 Study population

As a part of routine care since January 2013, all pregnant women referred to Center for Pregnant Women with Diabetes at Rigshospitalet have been asked to fill out a 3-day dietary record focusing on carbohydrates before their first antenatal visit at the centre. Thus, a dietary record form was sent to the women along with a welcome letter by mail. The inclusion criteria in this retrospective cohort study from August 2013 to September 2017 were: women with T2D or T1D, Danish speaking, singleton pregnancy and first antenatal visit before 20 gestational weeks. Aiming for a comparable number of women in the two diabetes groups and since data on carbohydrate consumption in

pregnant women with T1D have already been published for the period January 2013 to December 2014 (22), we decided to include women with T1D from January 2015 to September 2017.

In the inclusion period the following women did not meet the inclusion criteria: not-Danish speaking (n=47 with T2D and n=1 with T1D), multifetal pregnancy (n=10 and n=8), first antenatal visit later than 20 gestational weeks (n=20 and n=2) and 5 (n=4 and n=1) with previous bariatric surgery, resulting in 171 eligible women with T2D and 248 with T1D of which 96 (56%) and 108 (44%), respectively had completed the dietary records.

2.2 Dietary analysis

At the first antenatal visit, all women had a one-hour appointment with a specialized dietician who used the information from the dietary records as a basis for individualized dietary advice. Based on the dietary records, the dietician counted the recorded carbohydrates and used validated tables (25), photos (26) and a carbohydrate counting app, recommended by the Danish Diabetes Association, when needed. The quantity of the carbohydrates was calculated from the major carbohydrate sources only, i.e. bread products, potatoes, rice, pasta, fruits, dairy products and sweets. The major carbohydrate sources account for the majority of carbohydrates consumed e.g. a commonly recommended Danish diabetes diet for women, regardless of pregnancy, contains 1612 kcal (6743 kJ) including 175 g of carbohydrates in total (46 E%). Of those the major carbohydrate sources account for 86% (150 g) of the total amount of carbohydrates while 700 g of vegetables account for the remaining 25 g of carbohydrates. A pragmatic evaluation of the *glycaemic index* (27) based on an calculation of the total daily carbohydrate consumption was performed by the dietician in the following way: The amount of carbohydrates from low glycaemic index sources was identified and divided by the total amount of carbohydrates consumed. We stratified the glycaemic index score as 0-33%, 34-66% or 67-100% of carbohydrates deriving from low glycaemic index sources. Furthermore, the number of meals and snacks consumed daily and whether the women used

carbohydrate counting in each meal and snack (yes/no) were registered, whereas total E%, glycaemic load, lipid- and protein consumption were not assessed.

In Denmark, the recommended diet for women with diabetes, regardless of pregnancy, consists of approximately 55 E% of carbohydrates mainly from low glycaemic index sources with high amount of fibres (28,29). In general, individualized dietary plans including 3 main meals and 2-3 snacks are tailored with respect of the women's eating habits, cultural, ethnical and economic status and presence of nausea (28,30). With the aim to prevent excessive gestational weight gain and by assuming that eating more than recommended is frequent, a total daily energy intake of approximately 1673 kcal (7000 kJ) regardless of pre-pregnancy BMI or trimester is recommended for pregnant women with diabetes at our centre. The recommendation includes at least 175 g of carbohydrates with 150 g deriving from the major carbohydrate sources. The initially recommended total energy intake can be upregulated during pregnancy according to individual needs including changes in the level of physical activity aiming for appropriate weekly gestational weight gain without hunger or ketonuria. To secure sufficient intake of micro- and macronutrients, a reduction in the total energy intake is not recommended and it is our experience that upregulating the recommended energy intake is seldomly needed.

2.3 Questionnaire on physical activity and early pregnancy events

Since 2015, the women were asked to answer a questionnaire at first antenatal visit. The questionnaire included a validated Pregnancy Physical Activity Questionnaire (PPAQ) (31) consisting of 33 questions grouped into different types of activity (i.e. household/caregiving, occupation, sports). The women could add two physical activities not listed in the questionnaire, where the intensities were individually estimated using the Compendium of Physical Activity (32). In Denmark, bicycling is very common and therefore two questions were added into the questionnaire, one on bicycling as transportation and one on bicycling as leisure activity (33). For

each of the 35 questions, the duration of time spent in each activity was multiplied by the intensity to get the average weekly energy expenditure (metabolic equivalent of task per hour (METs-hr.)/wk.). The questionnaire also included non-validated questions about number of times where the women had eaten extra snacks due to hypoglycaemia the previous week, number of times where the women had eaten less or more due to nausea the previous week, number of episodes of vomiting in the previous week, number of weekly blood glucose measurements before pregnancy as well as during the previous week and average number of sleeping hours. Fifty-two percent of women with T2D and 39% of women with T1D, answered this questionnaire at first antenatal visit.

2.4 Demographic and clinical data

Demographic and clinical data were collected from two standardized forms in the original medical records.

HbA1c was measured at the first antenatal visit in capillary blood and analysed immediately by a DCA 2000 analyser by a latex immunoagglutination inhibition method (DCA 200; Bayer, Mishawaka, IN). Early gestational weight gain was defined as the weight measured at the first antenatal visit minus self-reported weight before pregnancy (kg). Spot urine samples were collected at the clinic in the morning hours of the visits. The occurrence of ketonuria was noted if the concentration of ketone bodies was ≥4.0 mmol/L, detected on a dipstick of sterile urine (analysed by Siemens CLINITEK Status® + Analyzer). If urine ketone bodies ≥4.0 mmol/L were detected, blood ketone bodies were routinely measured (FreeStyle Precision, Abbott). Urine ketone body levels of 4.0-7.9 mmol/L corresponding to +3 on the dipstick was equivalent to a median (range) blood ketone body level of 0.2 (0-0.8) mmol/L (N=18) (unpublished data from our department).

2.5 Routine diabetes care

In Denmark, most non-pregnant women T2D receive diabetes treatment in general practice, while women with T1D are treated at local diabetes centres. The national recommendations for routine

diabetes care aim for HbA1c ≤7.0 % (53 mmol/mol) before pregnancy and ≤6.5 % (48 mmol/mol) in early pregnancy (34). The majority of women with T2D are treated with diet alone or in a combination with oral antidiabetic drugs and/or injections with Glucagon-like Peptide-1 analogue before pregnancy until pregnancy planning or at the latest up to the first antenatal visit where the treatment is changed to an insulin regimen.

2.6 Statistical analysis

Continuous data with normal distribution are reported as mean (± standard deviation (SD)), continuous data with skewed distribution as median (interquartile range (IQR)) and categorical data as number (%). Descriptive results are given for T2D and T1D separately. Comparisons of the groups were performed by student‘s t-test, Mann-Whitney U-test, Chi square test or Fisher‘s exact tests when appropriate.

Since the carbohydrate recommendations and carbohydrate consumption during pregnancy were similar for women with T2D and T1D, univariate regression analysis was performed in the combined cohort (T2D and T1D) as well as in the individual diabetes groups. In the univariate linear regression analyses the carbohydrate consumption per 100 g was used as an independent variable and HbA1c (%) as an outcome variable.

The multivariate regression analysis was performed in the combined cohort only, using carbohydrate consumption per 100 g as independent variable and HbA1c (%) as an outcome variable with the following potential confounders; maternal age, pre-gestational BMI, daily insulin dose/bodyweight (IU/kg/24h), treatment with insulin pump (yes/no) and type of diabetes (T2D and T1D). The results of the linear regression analyses are given as the regression coefficient beta (β) with a 95% confidence interval (CI), expressing the change in the outcome variable for a unit change in the independent variable.

Statistical analyses were performed with IBM statistics SPSS version 22. Statistically significant differences were defined as a two-sided $p < 0.05$.

2.7 Ethics

Approvals from the local Ethic committee (H-15009413) and the Danish Data Protection Agency (2007-58-0015 and 2012-58-0004) were obtained and all patients gave informed consent as appropriate according to Danish laws. The principles of The Helsinki Declaration were observed.

3. Results

Clinical characteristics at first antenatal visit are given in Table 1. The mean HbA1c was comparable in early pregnancy, while the women with T2D had higher prepregnancy BMI and lower weekly gestational weight gain prior to first antenatal visit than the women with T1D.

Daily carbohydrate consumption was similar in the women with T2D vs. T1D (159 ±56 vs. 167 ±48 g, P=0.3) with a carbohydrate consumption per bodyweight of 1.9 ±0.9 vs. 2.3 ±0.8 g/kg, P<0.001, respectively (Table 2). Fifty-two percent of the women with T2D and 40% of the women with T1D consumed fewer carbohydrates than recommended by the IOM (P=0.08) (Table 2). In the combined group of women with diabetes, the women who consumed fewer carbohydrates than recommended by the IOM had comparable HbA1c (6.5 ±1.0% (48 ±11 mmol/mol) vs. 6.6 ±1.0% (49 ±11 mmol/mol), P=0.5) but lower weekly gestational weight gain (126 (13-260) vs. 200 (67-377) g, P=0.02) than the women following the IOM recommendations. Ten (10%) women with T2D and 8 (7%) women with T1D reported consuming <100 g of carbohydrates daily (Table 2) with a mean daily consumption of 83 and 78 g, respectively. None of these 18 women had ketonuria at first antenatal visit. Daily carbohydrate consumption >200 g was reported by 16 (17%) women with T2D and 20 (19%) women with T1D.

Among women with T2D the glycaemic index score of the carbohydrates was less favourable compared with women with T1D (P=0.04) and carbohydrate counting was less frequently used (Table 2).

In an univariate linear regression analysis, a significant association between daily carbohydrate consumption and HbA1c could not be detected in neither the combined cohort (β:0.13 (95% CI: -0.1-0.4) %, P=0.3) or when calculated separately for the women with T2D (β:0.2 (95% CI: -0.2-0.6) %, P=0.4) and T1D (β:0.04 (95% CI: -0.3-0.4) %, P=0.8). Similar no association was found in the multiple regression analysis.

One woman with T2D and one woman with T1D had ketonuria with urine ketone concentration of 4.0-7.9 mmol/L at first antenatal visit (Table 1). The mean carbohydrate consumption was reported to be 160 g/day and 121 g/day, respectively, and only the woman with T2D had a bedtime snack.

Data on physical activity was available in a subgroup of 56% vs. 38% patients, respectively. The total physical activity level was comparable in women with T2D and T1D (Table 3). The women with T2D spent significantly more energy on household/caregiving than the women with T1D while no difference between the groups was found in energy expenditure during occupation and sports (Table 3). A higher energy expenditure during household/caregiving was found among multipara compared to nullipara (100 (66-140) vs. 49 (30-70) METs-hr./wk., P<0.001).

Insulin treated women with T2D reported consuming extra carbohydrates due to episodes of hypoglycaemia twice weekly while women with T1D consumed extra carbohydrates 5.5 times/week (Table 3).

Nausea leading to eating less or more food during the previous week was reported by 54% of the women with T2D and 64% of the women with T1D (Table 3). Nauseous women consumed 165 ±50 g of carbohydrates daily, while women without nausea consumed 148 ±56 g daily (P=0.1).

Among the women with T2D, a high number were of non-North-European Origin. The carbohydrate consumption in the women with T2D of North-European origin was comparable with women of non-North-European origin (165 ±60 vs. 154 ±53 g, P=0.4) as was the number of women consuming ≤150 g carbohydrates daily (46% vs. 58%, P=0.3). HbA1c was 6.8 ±1.3% (51 ±14 mmol/mol) vs. 6.4 ±1% (47 ±11 mmol/mol) P=0.2, in women of North-European origin vs. non-North-European origin.

4. Discussion

This cohort study from Denmark, in a real-world setting, demonstrates that the women with T2D often consumed fewer carbohydrates than recommended by the IOM in early pregnancy. The average carbohydrate consumption from the major carbohydrate sources was similar in women with T2D and T1D. Women with T2D weighted on average 15.3 kg more than women with T1D and ketonuria in early pregnancy was rare in both groups.

The average carbohydrate consumption in this study was lower than previously described for women with T2D (23), T1D (22) and healthy pregnant women where 286 and 393 g daily has been reported (7,8), even if the expected 25 g from the minor sources is added. In healthy women, carbohydrate consumption throughout pregnancy has been reported rather stable with an average 4% higher consumption in late pregnancy (7,8,35). In both our and the Canadian study (23), the average carbohydrate consumption was similar in women with T2D and T1D while the bodyweight was approximately 15 kg higher in women with T2D. This may reflect similar intake of the total energy or a different distribution in the macronutrient consumption with higher fat and/or protein intake in obese women compared with normal weight women.

The minimum amount of carbohydrates required to prevent ketosis is 50 to 100 g daily outside of pregnancy (36). During third trimester, the fetal brain is estimated to use approximately 35 g of

carbohydrates per day as an energy source (6) and additional carbohydrates are used for fetal growth.

A high proportion of women in our study reported an intake of fewer carbohydrates than recommended by the IOM. Older studies have raised concern about the adverse effect of ketone bodies on the developing fetal brain in pregnancies complicated with diabetes (15,16). An inverse correlation between the mothers' third trimester plasma β-hydroxybutyrate and children's intelligence both at the age of 2 and 3-5 years has been reported (15). A recent study from our own group reported lower intelligence in teenage offspring of mothers suffering from ketoacidosis during pregnancy, but numbers were small (37). Therefore, it is reassuring that the occurrence of ketonuria in early pregnancy was low in the present study.

In contrast to our previous findings (22), we did not observe an association between carbohydrate consumption and HbA1c in this cohort. This may be due to a lower number of women with a carbohydrate consumption exceeding 200 g daily and less variation in HbA1c in the present cohort. Carbohydrate counting is important to obtain tight glycaemic control with a flexible lifestyle in patients with T1D who do not have an endogenous insulin production (22,38) and was frequently used in the investigated women. Carbohydrate counting in women with T2D was rare and whether pregnant women with T2D also benefit from carbohydrate counting needs to be investigated.

To our knowledge, this is the largest study to date, evaluating the carbohydrate consumption in early pregnancy as part of routine care in a cohort of women with T2D in a real-world setting, including data on ketonuria, nausea and vomiting. The evaluation of the carbohydrate consumption is meaningful for insulin treated patients and diabetes caregivers. The same dietician (HR) evaluated the amount of carbohydrates consumed and the glycaemic index score which gives consistency of the method.

It is a limitation that the women's carbohydrate consumption was self-reported and the total E%, glycaemic load, lipid- and protein consumption were not recorded. To minimize the recall bias, the women were asked to complete the dietary records prospectively over 3 days before the first antenatal visit. The women may have chosen a healthier diet during the dietary registration and/or omitted to register all carbohydrates from the major carbohydrates consumed. It is known that less healthy eaters are more likely to underreport food intake (39). Despite these limitations, this is one of the best options for evaluation of carbohydrate consumption in a large population. All eligible women reporting at least one day of dietary records were included in the study to improve the external validity of the study, but this might have biased the estimation of the daily carbohydrate consumption. It would have added value to our study, if the women had tested for ketonuria at home the same days as the dietary registration. There is a risk of selection bias as the less compliant women with unhealthy eating habits may not have filled out the dietary records. Data from the PPAQ was only available in 52% and 39% of included women with T2D and T1D, respectively.

4.1 Conclusions

In early pregnancy, a lower daily carbohydrate consumption than recommended by the IOM was common among women with T2D. The results were quite similar to women with T1D, despite a markedly higher bodyweight in women with T2D. Reassuringly, ketonuria was rare in both groups. Future studies should focus on the safety of consuming a low amount of carbohydrates during pregnancy in women with diabetes.

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Author Contributions. E.R.M. and B.Á. contributed to the idea. H.R. conducted the diet analyses in the women. B.Á and M.V. collected the data. B.Á. analysed data and wrote the manuscript. All authors were involved in the interpretation of data, contributed to the discussion, reviewed and edited the manuscript and approved the final version. E.R.M. is the guarantor of this work and, as

such, has full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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Conflicts of interest. No potential conflicts of interest relevant to this article were reported.

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458 Table 1. Clinical characteristics of pregnant women with type 2 diabetes compared with pregnant
459 women with type 1 diabetes at first antenatal visit.

	Type 2 diabetes	Type 1 diabetes	P-value
Number	96	108	
Age (years)	34 ±5	31 ±5	0.001
Duration of diabetes (years)	3 (1-6)	16 (9-22)	<0.001
Prepregnancy weight (kg)	89.5 ±23	73.4 ±15	<0.001
Prepregnancy diet treatment only	23 (24%)		
Prepregnancy oral antidiabetic medication†	60 (63%)		
Prepregnancy treatment with Glucagon-Like-Peptide-1-antagonist‡	9 (9%)		
Height (cm)	165 ±7	168 ±6	0.001
Prepregnancy BMI (kg/m^2)	32.8 ±7	26.0 ±5	<0.001
North-European Origin	52 (55%)	98 (93%)	<0.001
Nulliparous	36 (38%)	55 (51%)	0.06
Smoking	2/49 (4%)	1/43 (2%)	0.6
Gestational age (days)	71 (60-87)	63 (56-76)	0.003
HbA1c (%) (mmol/mol)	6.6 ±1.2 49 ±13	6.6 ±0.8 48 ±8	0.8
Insulin treatment	18 (19%)	108 (100%)	-
Insulin pump treatment	0%	36 (33%)	-
Insulin dose (IU/kg/24h)§	0.67 ±0.40	0.61 ±0.28	0.6
Weight (kg)	90.8 ±22	75.5 ±15	<0.001
Early gestational weight gain (kg)	1.5 ±2.7	2.1 ±2.1	0.07
Early weekly gestational weight gain (g)	145 ±247	233 ±230	0.01
Ketonuria (≥4.0 mmol/L)	1 (1%)	1 (1%)	1.0

460 Data are given as mean ±standard deviation, median (interquartile range) or n (%). †Monotherapy with Biguanide
461 (N=39). Combination therapy with Biguanide and Glucagon-Like-Peptide-1-antagonist (GLP-1-antagonist) (N=6),
462 Dipeptidyl Peptidase-IV (DPP-IV) Inhibitors (N=6), Sodium-Glucose co-Transporter-2 (SGLT2) Inhibitors (N=1)
463 Sulphonylureas (N=1) and insulin (N=6) respectively. Combination therapy with Biguanide, DPP-IV-Inhibitor and
464 SGLT-2-Inhibitor (N=1). ‡Monotherapy with GLP-1-antagonist (N=1). Combination therapy with GLP-1-antagonist
465 and Biguanide (N=6) and insulin (N=2), respectively. §Numbers are given for those on insulin treatment.

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Table 2. Dietary analysis based on dietary records in early pregnancy by women with type 2 diabetes and women with type 1 diabetes.

	Type 2 diabetes	Type 1 diabetes	P-value
Number	96	108	
Dietary records			
• 1 day	12 (12%)	32 (30%)	0.002
• 2 days	15 (16%)	23 (21%)	
• 3 days	69 (72%)	53 (49%)	
Carbohydrate consumption (g/day)	159 ±56	167 ±48	0.3
Carbohydrate consumption/kg bodyweight (g/kg/day)	1.9 ±0.9	2.3 ±0.8	<0.001
Consuming fewer carbohydrates than recommended by the Institute of Medicine†	50 (52%)	43 (40%)	0.08
Consuming <100 g of carbohydrates	10 (10%)	8 (7%)	0.5
The glycaemic index score‡§			
• 0-33%	13 (18%)	6 (6%)	0.04
• 34-66%	21 (30%)	36 (36%)	
• 67-100%	37 (52%)	57 (58%)	
Use of carbohydrate counting	6 (6%)	83 (77%)	<0.001
Number of daily meals and snacks§			
• ≥3 main meals	74 (96%)	75 (94%)	0.7
• Snacks			
○ 3-4	29 (38%)	46 (58%)	0.002
○ 2	17 (22%)	22 (27%)	
○ 0-1	30 (40%)	12 (15%)	

Data are given as n (%) or mean ±standard deviation. Carbohydrates calculated from the major carbohydrate sources. †≤150 g daily. ‡A score of 67-100% means that the majority of recorded carbohydrates derived from low glycaemic index sources. §Data available from 74-92%.

473 Table 3. Eating behaviour and lifestyle in pregnant women with type 2 or type 1 diabetes in early
474 pregnancy.

	Type 2 diabetes	Type 1 diabetes	P-value
Number	54	42	
Total physical activity (METs-h/wk.)†	215 (174-289)	210 (178-267)	0.9
• Household/caregiving	85 (50-136)	57 (36-82)	0.002
• Occupation	71 (0-106)	81 (71-108)	0.06
• Sports	11 (3-19)	10 (4-16)	0.9
• Other	49 (34-67)	63 (44-77)	0.02
Number of extra snacks eaten due to hypoglycaemia in the previous week	2 (0-6)	5.5 (3-8)	0.005
Changed eating behaviour due to nausea in the previous week			
• Eating less due to nausea ≥1/wk.	24 (44%)	19 (49%)	0.7
• Number of times eating less due to nausea/wk.	3 (1.5-6)	2 (1-5)	0.4
• Eating more due to nausea ≥1/wk.	15 (29%)	17 (41%)	0.2
• Number of times eating more due to nausea/wk.	3 (2-7)	6 (2-7)	0.3
• Eating less or more due to nausea ≥1/wk.	29 (54%)	27 (64%)	0.3
Vomiting in the previous week	12 (23%)	14 (34%)	0.2
• Number of vomiting/wk.	2 (1-3)	1.5 (1-5)	0.5
Number of blood glucose measurements/wk. before pregnancy	0.5 (0-5)	30 (7-50)	<0.001
Number of blood glucose measurements in the previous week	48 (24-49)	60 (30-70)	0.001
Sleeping hours/24h in the previous week	7.7 ±1.3	7.9 ±1.0	0.5

475 Data are given as median (interquartile range), n (%) or mean ±standard deviation. Data available from 93-100%.
476 †METs-h/wk.=metabolic equivalent of task per hour/week.

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