Title: Dietary Intakes of Women with Type 1 Diabetes Before and During Pregnancy: A pre-specified secondary subgroup analysis among CONCEPTT participants

Running Title: The CONCEPTT-Diet Study

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Novelty Statement:

- Maternal glycaemic control is the main modifiable determinant of pregnancy outcomes in Type 1 diabetes. Maternal diet influences insulin dosing and glycaemia; and contributes to the overall health of the mother, yet this has not been previously described.
- This study demonstrates that pregnant women with type 1 diabetes have higher than recommended intakes of fat and inadequate intakes of fibre, fruit and vegetables.
- 1 in 4 women are at risk of micronutrient deficiencies suggesting substantial scope for improvement.
- Further research is required to understand how to optimise maternal nutrition both for achieving glucose control targets and for improving overall maternal and infant health.

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Abstract

Aim: To describe the dietary intakes of women with type 1 diabetes before and during pregnancy.

Methods: This was a pre-specified subgroup analysis of CONCEPTT involving 63 women planning pregnancy and 93 pregnant women from 14 sites in England, Scotland and Ireland. 246 three-day food diaries (104 planning pregnancy, 142 pregnant) were matched to data-source and food-reference codes and analysed using dietary software. Participants were informed that food diaries would be de-identified and used only for research purposes.

Results: Mean (SD) daily energy intake was 1588 kcal (346) and 1673 kcal (384) in women planning pregnancy and in pregnant women respectively. Total carbohydrate intake was consistent with dietary guideline recommendations (180g (52) planning pregnancy, 198g (54) pregnant), but non-recommended sources (e.g. sugars, preserves, confectionery, biscuits, cakes) contributed to 46% of total daily carbohydrate intake. Fat consumption exceeded guideline recommendations (70g (21) planning pregnancy, 72g (21) pregnant). Fibre (15.5g (5.3) planning pregnancy, 15.4g (5.1) pregnant), fruit and vegetable intakes (3.5 (2.2) and 3.1 (1.8) serves/day) were inadequate. 12 women planning pregnancy (19%) and 24 pregnant women (26%) did not meet micronutrient requirements.

Conclusions: The diets of pregnant women from England, Scotland and Ireland are characterised by high fat, low fibre and poor quality carbohydrate intakes. Fruit and vegetable consumption is inadequate, with one in four women at risk of micronutrient deficiencies. Further research is needed to optimise maternal nutrition for glycaemic control and for maternal and offspring health.

Keywords (MeSH): Diabetes Mellitus, Type 1; pregnancy, diet, micronutrients, energy intake, sugars, dietary fibre

Abbreviations:

CGM	Continuous Glucose Monitoring
DRV	Dietary Recommended Values
HSE	Health Service Executive
LRNI	Lower Reference Nutrient Intake
NDNS	National Dietary Nutrional Survey
NHS	National Health Service
RNI	Recommended Nutrient Intakes
SMBG	Self Monitoring of Blood Glucose
UK	United Kingdom

Introduction

Women with type 1 diabetes enter pregnancy at increased risk of maternal and neonatal complications, such as pre-eclampsia, preterm and caesarean delivery (1,2). In the United Kingdom (UK), babies of mothers with diabetes are nearly five times as likely to be stillborn and twice as likely to have a major congenital anomaly (3). Foetal macrosomia rates remain high (4,5) and this is associated with the longer-term development of obesity, metabolic and lipid abnormalities in the offspring (6,7).

Maternal glycaemic control is widely accepted as the key potentially modifiable determinant of obstetric and neonatal complications. This is reflected in clinical guidelines, which recommend that pregnant women aim for optimal glucose control, with maternal HbA1c <43 or < 48 mmol/mol (6.0% or 6.5%) (8,9). In reality, such tight glycaemic control is difficult to achieve, even among women who plan for pregnancy and attend prepregnancy care services (10).

Maternal diet is an important consideration when improving glycaemic control. Carbohydrate is the primary macronutrient contributing to postprandial hyperglycaemia and insulin dosing at mealtimes should be matched to anticipated consumption. At large quantities, dietary fat and protein are also relevant to glycaemic control with recent studies demonstrating additive effects resulting in sustained and late postprandial hyperglycaemia (11–13).

The American Diabetes Association's (ADA) recommendations for all pregnant women with diabetes are 175g of carbohydrate per day, including 28g of fibre, aiming for optimal glycaemic control without hypoglycaemia or ketonaemia. Adequate protein consumption is defined as 1.1g per kg per day (14). A registered dietitian should also be involved in antenatal care to establish a food plan, determine gestational weight gain goals and help women with type 1 diabetes balance the demands of glucose control, insulin dosing and healthy eating during pregnancy (8).

Although nutritional guidelines exist, data regarding curent dietary habits of pregnant women with type 1 diabetes are limited. Our aim is to describe the detailed dietary intakes of women before and during pregnancy. Additionally, we describe the spread of carbohydrate consumption; fibre, fruit and vegetable intakes and closeness to current dietary recommendations.

Methods

CONCEPTT Study Design

CONCEPTT (NCT01788527) was an open-label, multicentre, randomised controlled trial with two parallel arms: one of women planning pregnancy and the other of pregnant women. Participants were aged between 18- 40 years and had type 1 diabetes of greater than 12 months' duration treated with intensive insulin therapy. Women planning pregnancy were eligible if their baseline HbA1c was between 53-86 mmol/mol (7.0-10.0%). Pregnant women were eligible if the HbA1c level was between 48-86 mmol/mol (6.5-10%) at less than 13 weeks 6 days gestation with a singleton foetus.

Participants entered a seven-day run-in phase wearing masked Continuous Glucose Monitoring (CGM) (iPro2, Medtronic, USA) and performing self-monitoring of blood glucose (SMBG). CGM and SMBG data were reviewed to determine device use. If satisfactory, participants were randomised to either real time-CGM (intervention) or SMBG (control) for 24 weeks in those planning pregnancy or until delivery in those who were pregnant. Full details of the clinical study protocol were previously published (15).

CONCEPTT-Diet Protocol

All participants from England, Scotland and Ireland were invited to the dietary study. Women who consented completed three-day baseline food diaries during the CGM run-in phase. For pregnant women, these were completed no later than 13 weeks six days gestation. Women planning pregnancy repeated a follow-up food diary at 24 weeks from randomisation. Pregnant women completed their follow-up food diary at 34 weeks gestation (approximately 24 weeks from randomisation). Ethics approval for the dietary study was obtained from the Essex NRES East of England Research Ethics Committee (Ref:12/EE/0310).

Baseline Data

The age, ethnicity, obstetric history, education level, duration of diabetes, history of hypoglycaemia, method of insulin delivery and presence of diabetes complications were self-reported to site investigators. A standard physical examination (vital signs, weight and height) was performed. Bloods for HbA1c were drawn at randomisation and analysed at a central laboratory. Further details regarding the CONCEPTT study protocol are available (5,15).

Food Diaries

Local study coordinators (comprising specialist diabetes nurse educators, specialist dietitians, diabetes midwives and endocrinologists) provided participants with three-day food diaries to complete at baseline and follow-up. Participants were asked to record their diets on two weekdays and one weekend day, choosing typical days of diet and activity. The diaries were structured into main meals (breakfast, lunch and dinner) and snack times (morning tea, afternoon tea and supper), typically eaten mid-morning, mid-afternoon and after dinner and/or before bed. Participants were encouraged to include portion weights, carbohydrate contents and brand names for foods where possible. An example of a completed food diary was provided for reference. Participants were informed that their food diaries would be de-identified and used only for research purposes.

Food Coding

Dietary analysis was performed using Dietplan 6.70.75 (Forestfield Sofware Ltd, UK). This software is supplied with data from the UK Nutrient Databank, mainly comprising McCance & Widdowson's The Composition of Foods 6th edition and the Composition of Foods Integrated Data Set (IDS) (16). Recorded food and drink items were matched to data-source and food-reference codes.

Portion sizes were determined using weight and carbohydrate information from the food diaries. For items without this information, "medium" portions were selected using default portion sizes in Dietplan 6.70.75, or, by referencing the Food Standards Agency's "Food Portion Sizes" (17). All food and drink coding was performed by one researcher (SLN), who was blinded to treatment allocation. Queries regarding food coding were resolved by discussion with the study dietitian (JAG), who also independently reassessed the diaries of outliers reporting extreme quantities.

Dietary Analysis

Data containing macronutrient and micronutrient content of each food diary were exported to Microsoft Excel v14.7.3 (Microsoft, USA). Baseline and follow-up diaries for women planning pregnancy were combined to provide one set of pre-pregnant food data. Analysis of baseline and follow-up diaries for pregnant women demonstrated no statistically significant differences in macronutrient intakes between timepoints (Supplemental Table 1) and diaries were therefore pooled to provide one set of food data collected during pregnancy. Women in the planning pregnancy group who became pregnant completed food diaries on conception and these were used in the pregnancy group. Each day of a food diary was treated equally and the results represent total data for the two cohorts divided by the number of participant-days.

The percentage of underreporters was determined using the Henry equation (18,19) and the Goldberg Method (20). The ratio of Energy Intake to Basal Metabolic Rate was calculated for each participant. A threshold of 0.9 was used in accordance with previous studies involving pregnant women (21,22).

Atwater figures were used to determine the contributions of carbohydrates, proteins and fats to total energy. Food and drink items were classified into 14 food groups, in accordance with the NDNS (23) as follows: cereals and cereal products; milk and milk products; eggs and egg dishes; vegetables and potatoes; fruit; meat and meat products; fish and fish dishes; fat spreads; sugars, preserves and confectionery;

savoury snacks; nuts and seeds; non-alcoholic beverages; alcoholic beverages and miscellaneous food items.

When assessing fruit and vegetable consumption, one serve was defined as 80g of fresh fruit; beans and lentils; vegetables or vegetable dishes. One serve of fruit juice was defined as 150mL of all fruit and vegetable juices. For the calculation of "5 A Day" intakes, the number of fruit and vegetable portions were added to the number of portions of fruit juice (to a maximum of one serve/150mL per day), following the methodology of the NDNS (24).

The Medical Nutrition Therapy guidelines from the ADA (25) were used to assess carbohydrate intake from recommended and non-recommended sources. These guidelines, which promote eating patterns for overall health (including adequate fibre and sufficient micronutrient intakes) recommend preferential carbohydrate intake from vegetables, fruits, whole grains, legumes and dairy products. Food-reference codes for the following foods were therefore classified as ADA recommended carbohydrate sources: cereal grains, brans and germs; pasta, noodles and couscous; breads; milk and yogurt products; vegetables and vegetable dishes (including potatoes steamed, baked and boiled but excluding chipped potatoes and fries); fruit and fresh fruit juice. The remaining food-reference codes were classified as ADA non-recommended carbohydrate sources.

Referenced UK dietary recommended values (DRVs) are from the Department of Health's "Dietary Reference Values for Food Energy and Nutrients" (26). Micronutrient intakes were compared to Reference Nutrient Intakes (RNIs), the amount required to ensure the needs of 97.5% of the population studied are being met. If the average intake of a group is at RNI, the risk of deficiency is small (26). The percentage of the groups whose mean intake achieved the RNI using the population compliance method (27) is also reported. Nutritional adequacy was assessed by determining the proportion of individuals with intakes below the Lower Reference Nutrient Intakes (LRNI), the amount sufficient for the few people in a group who have low needs (26). UK average values are taken from NDNS data for non-pregnant women aged between 19-64 years, referred to as the UK background population (23).

Statistical Analysis

Data analysis was performed using Microsoft Excel v14.7.3 (Microsoft USA) and SPSS v21.0 (IBM, USA). Macronutrient and micronutrient intakes are described as Mean (SD). Independent t-tests were used to assess differences in macronutrient intakes between the planning pregnancy and pregnant groups. Data was normally distributed and the significance threshold was set at 0.05.

<u>Results</u>

Study population

63 women planning pregnancy and 93 pregnant women provided 104 and 142 3-day food diaries respectively. Food diaries were collected from CONCEPTT participants at 11 National Health Service (NHS) hospitals in England, two in Scotland (Edinburgh, Glasgow) and one Health Service Executive (HSE) hospital (Galway) in Ireland from March 2013 to August 2016. Nine diaries (3.6%) were incomplete with data provided for less than three days. For these diaries, only data from completed

days were used. This provided a total of 307 participant-days in women planning pregnancy and 421 participant-days in pregnant women.

27 food diaries from the planning pregnancy group (26%) and 33 from the pregnant group (23%) were identified as being from under-reporters. Macronutrient intakes of carbohydrate, protein and total fat were analysed with and without exclusion of known under-reporters. With the exclusion of under-reporters, total energy and saturated fat intakes were high during pregnancy compared to pre-pregnancy (Supplemental Table 2). However, to avoid misclassification of true low energy intakes and to allow comparison with the UK National Dietary Nutritional Survey (NDNS), which does not adjust for underreporting (28), food diaries from all participants, including under-reporters are included in the main analyses.

Maternal age, BMI, duration of diabetes, education level, baseline HbA1c and insulin pump use did not differ between those who did and did not consent to participate in the CONCEPTT-Diet study (5). There were more women of European origin, and more women with microvascular complications, especially retinopathy, in the CONCEPTT-Diet study compared to the full randomised controlled trial (data not shown).

Baseline characteristics of the participants are detailed in Table 1. The majority of participants were recruited from English sites. Gestational age in the pregnancy group at randomisation was mean (SD) 10.3 weeks (2.8). Baseline BMI was in the overweight category in both groups.

Total Energy Intake

Mean (SD) energy intakes were 1588 kcal/day (346) in women planning pregnancy and 1673 kcal/day (384) in pregnant women (Table 2). The major sources of energy were similar between groups, consisting of cereals and cereal products (30-33%), meat and meat products (15-18%), vegetables and potatoes (12%) and milk and milk products (10%). The energy intake derived from alcoholic beverages was negligible in both groups (1.5% of mean daily energy intake in women planning pregnancy and <0.1% in pregnant women).

Fibre, Fruit and Vegetables

Daily fibre intakes were below dietary recommendations of 28g per day in both groups; mean (SD) 15.5 g/day (5.3) in women planning pregnancy and 15.4 g/day (5.1) in pregnant women. Fibre intakes were mainly derived from bread, vegetables, fruit and breakfast cereals.

The average consumption of fruit and vegetables was mean (SD) 3.5 serves per day (2.2) in women planning pregnancy and 3.1 serves per day (1.8) in pregnant women. 30 food diaries (29%) from women planning pregnancy included fruit juice and in these participants, mean (SD) consumption was 82 mL/0.54 serves (0.51). Amongst pregnant women, 51 food diaries (36%) included fruit juice and mean daily consumption in these women was 133 mL or 0.89 serve (1.12). Only 25 food diaries (24%) from women planning pregnancy and 29 food diaries (20%) from pregnant women met the "5 A Day" UK fruit and vegetables recommendation. Approximately 10% of food diaries from both groups reported an average daily intake of less than one serve of fruit and vegetables.

Macronutrients

Mean daily carbohydrate intake was higher in the pregnancy group compared to the planning pregnancy group (p=0.008, Table 2). Women consumed nearly 80% of carbohydrates at meal times (Table 3). Carbohydrates were similarly spread across the day in both groups, with women consuming ~20% (35g) of daily carbohydrates at breakfast, ~30% (50g) at lunch and ~30% (60g) at dinnertime. Sources of carbohydrates differed by meals and snack times (Table 3, Supplemental Tables 3 and 4).

Recommended sources of carbohydrates contributed to 54% of mean daily carbohydrate intake in the planing pregnancy group and to 56% of mean daily carbohydrate intake in the pregnancy group. Major sources of non-recommended carbohydrates were sugars, preserves and confectionery; biscuits and cakes and sweet buns; non-alcoholic beverages (including soft drink, lucozade) and savoury snacks. Of the non-recommended carbohydrates, approximately two-thirds were consumed at main meals (~56g) and one-third (~30g) at snack times.

Mean (SD) daily protein intake was 65g (16) in women planning pregnancy and 69g (16g) in pregnant women (Table 2). The three most significant sources of protein were meat and meat products, cereal and cereal products; and milk and milk products. Protein consumption occurred almost exclusively (90%) at meal times.

Total fat and saturated fat intakes were similarly high between groups (p=0.43, Table 2). Consumption of fat occurred mainly at mealtimes (85% in the planning pregnancy group and 80% in the pregnant group), with major sources being meat and meat products; cereal and cereal products; milk and milk products and vegetables and potatoes (Table 4). At snack times, cereal and milk products; savoury snacks; and sugars, preserves and confectionery were the main sources of fat.

Micronutrients

Mean daily consumption of most minerals (sodium, calcium, phosphorous, chloride and zinc) and vitamins (C,D, E, thiamine, retinol and B6) met RNIs (Supplemental Table 5). Mean sodium intake was higher than the RNI of 1600mg/day, both before and during pregnancy (2389 and 2570mg/day respectively). Mean daily intakes of potassium, magnesium, iron, selenium and iodine were below RNIs, similar to the background population. 12 women planning pregnancy (19%) and 24 pregnant women (26%) did not meet nutritional requirements, ie. their intakes were below LRNIs, the most commonly affected vitamins being riboflavin and folate.

Discussion

This is the first multicentre study to describe the dietary habits of women with type 1 diabetes before and during pregnancy. Overall, participants' intakes are characterised by being high in fat and low in fibre, fruit and vegetables compared to current nutritional guidelines. Less than a quarter of participants met the UK "5 A Day" fruit and vegetable target (29) and nearly one in four women were at risk of micronutrient deficiencies.

The total carbohydrate intakes of 180-200g per day met recommendations (14) and carbohydrates were evenly distributed throughout the day at meals and snacktimes. However, nearly half of these daily carbohydrates were derived from non-recommended sources. Protein consumption was sufficient and similar to the UK background population. Energy intake derived from fat appeared higher than the UK background population (~40% in CONCEPTT-Diet compared to 34% in the background population). Micronutrient intakes in our study participants appear comparable to the background population for most vitamins and minerals.

The dietary patterns observed in our participants have been previously reported in other type 1 diabetes cohorts outside of pregancy (30–32). These studies reported high fat diets; low fibre, fruit and vegetable consumption; and suboptimal micronutrient intakes in children, adolescents and adults living with type 1 diabetes. The goals of optimising glycaemic control and minimising postprandial excursions may have resulted in the habitual substitution of carbohydrates for fat. Additionally in our study, high intakes of confectionery and sugars were observed, possibly consumed to treat and/or prevent hypoglycaemia. We were unable to distinguish between these rapidly-absorbed carbohydrates eaten as snacks versus those used for management of hypoglycaemia due to limitations of the dietary software.

There are only two prior studies evaluating maternal dietary intake during type 1 diabetes pregnancy. The first, conducted during 1983-91, focused on dietary fibre, describing 16-18% lower total daily insulin doses in women with higher fibre intakes (33). A more recent Danish study examined total carbohydrate consumption, demonstrating a positive association between carbohydrate intake and maternal HbA1c level in early pregnancy (34). Neither study reported total energy or micronutrient intakes.

The impact of a high fat diet in type 1 diabetes pregnancy is unknown. Data from studies in women with gestational diabetes suggest that high dietary fat intake (45% fat) is associated with increased maternal insulin resistance and newborn adiposity compared to a low fat, high carbohydrate diet (35). We speculate that dietary fat intake may also be relevant for women with type 1 diabetes, for whom the risk of a large for gestational age infant persists despite good glycaemic control (36).

The strengths of this study include the large sample sizes, the inclusion of women from across 14 sites in England, Scotland and Ireland and the choice of methodology for dietary assessment. Compared to alternative methods, the food diary has been found to be more repeatable and accurate (37). The total energy intake and macronutrient consumption in our study are very close to those in the background UK population. Sufficient detail was provided for descriptions of whole foods rather than single nutrients.

There are a number of limitations to consider when interpreting the results of our study. As with all dietary studies, under-reporting is an important issue and verification of actual consumption with a structured interview or photographs did not occur. Where portion sizes were not provided in the food diaries, "medium" portions were selected and the dietary software used does not allow us to audit the frequency of this occurrence. Food diaries from under-reporters were retained for analysis, which is likely to have resulted in total energy intakes being lower than expected. Additionally, food diaries from pregnant women in both early and late gestations were combined for analysis and we are therefore unable to describe dietary differences across trimesters. The study could have been strengthened by the collection of food data during the second trimester.

The generalisability of this study is affected by several factors. Participation in CONCEPTT-Diet was offered only at sites within the UK and Ireland and the majority of women were from England. Additionally, the women in our study had relatively long durations of diabetes (mean 17 years) and a high proportion (>75%) had achieved post-secondary school education.

Conclusion

The CONCEPTT-Diet study provides a comprehensive analysis of the current dietary habits of women with type 1 diabetes before and during pregnancy in the UK and Ireland. Overall, nutritional guidelines are not being met. Of particular concern, are the high fat and low fibre dietary intakes, with nearly half of mean daily carbohydrate intake being from non-recommended sources (eg. confectionery, biscuits and cakes). Fruit and vegetable intake is inadequate, with between one in four to one in five women at risk of micronutrient deficiencies. The emphasis on achieving tight glycaemic targets in pregnancy may have resulted in the substitution of carbohydrates for fat and the consumption of sweets and confectionery to prevent and/or treat hypoglycaemia. It is difficult to maintain healthy nutritional choices while at the same time aiming for strict glycaemic control.

This study demonstrates that there is significant scope for dietary improvement but further research is required to determine whether, and to what extent, dietary behaviour is modifiable. Further studies are also required to understand the impact of maternal diet on glycaemic control and infant health outcomes. Optimising maternal nutrition should be considered alongside intensive insulin therapy, in the clinical management of women with type 1 diabetes.

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Contribution Statements: HRM and SLN designed the CONCEPTT-Diet study. SLN and JAG collected the data and coded the food diaries. SLN and HRM wrote the first draft of the manuscript and all authors (SLN, JAG, DSF, HRM) contributed to data interpretation, reviewing and editing of the manuscript.

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Participating investigators from UK CONCEPTT sites: see Supplemental Data

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Tables

Table 1. Baseline characteristics of CONCEPTT-Diet study participants.

	Planning Pregnancy (n=63)	**Pregnant (n=93)**
Age (years)	33.3 (3.5)	31.8 (4.9)
European origin	59 (94%)	86 (92%)
Recruitment from: England Scotland Ireland	 62 (98%) 1 (2%) 0 (0%)	 73 (78%) 16 (17%) 4 (4%)
Primiparous	N/A	36 (38.7%)
Body-mass index (kg/m2)	27.0 (4.9)	26.2 (4.6)
Duration of diabetes (years)	17.8 (7.9)	17.0 (7.7)
HbA1c (mmol/mol)	58 (7.2)	52 (5.9)
HbA1c (%)	7.5 (0.7)[a]	6.9 (0.5)[b]
Smoking prior to pregnancy	6 (9.5%)	17 (18.3%)
Post-secondary school education	52 (83%)	71 (76%)
Folic acid (prior to pregnancy)	36 (57%)	54 (58%)
Insulin pump therapy	47 (75%)	38 (41%)
Multiple Daily Insulin injections	16 (25%)	55 (59%)
Total insulin dose (U/kg/day)	0.60 (0.17)	0.72 (0.21)
Diabetes complications Retinopathy Nephropathy Neuropathy	29 (46%) 27 3 2	41 (44%) 41 4 1
Chronic Hypertension	14 (22.2%)	7 (7.5%)
Systolic blood pressure (mmHg) Diastolic blood pressure (mmHg)	122.1 (12.9) 74.2 (8.6)	121.5 (13.0) 71.3 (8.6)
History of severe hypoglycaemia (requiring third party assistance) in past 12 months	4 (6.3%)	5 (5.4%)

Data are Mean (SD) or Number (%). N/A = Data not applicable.
13 women in the planning pregnancy group conceived and food diaries during their pregnancies were included in the pregnant group.
[a]8 missing central laboratory HbA1c values, data for n=55 (87.3%), [b]7 missing values, data for n= 86 (92.5%)

Table 2. Macronutrient intakes of CONCEPTT-Diet study participants

	CONCEPTT Planning Pregnancy	CONCEPTT Pregnant	Mean difference (95% CI) p-value	UK average for women aged 19-64 years	UK DRV for women aged 19-50 years
Energy (kcal/day)	1588 (346)	1673 (384)	85 (-9, +178) p=0.08	1632 (503)	1940 2140 (pregnant)
Protein (g/day)	65.5 (15.8)	69.3 (15.7)	3.9 (-0.1, +7.9) p=0.06	66.6 (20.8)	45 51 (pregnant)
Carbohydrate (g/day)	180 (51.6) 42.5% food energy	198 (54.3) 44.4% food energy	18 (+5, +32) p=0.008	199 (66)	50% of food energy
Total Fat (g/day)	69.9 (21.3) 39.6% food energy	72.1 (21.5) 38.8% food energy	2.2 (-3.2, +7.6) p=0.43	62.4 (25.1)	<35% of food energy
Saturated Fat	25.7 (8.4)	27.4 (8.5)	1.1 (-0.4, +3.9), p=0.12	NA	<11%
Monounsaturated Fat	23.6 (8.1)	23.8 (7.6)	0.2 (-1.8, +2.2) p=0.81	NA	12%
Polyunsaturated Fat	12.2 (6.0)	12.2 (4.9)	0 (-1.4, +1.3) p=0.96	NA	6%
Trans-Fat	1.5 (0.8)	1.7 (0.9)	0.2 (-0.02, +0.4) p=0.07	0.9 (0.5)	< 2%

Data are mean (SD). NA = data not available. P-value calculated using independent t-tests. Macronutrient consumption in the background UK population and UK Dietary Recommended Values (DRV) are provided for reference.

Table 3. Contribution of food groups to carbohydrate intake at mealtimes and snack times in CONCEPTT-Diet study participants

	Planning Pregnancy		Pregnant	
	Main Meals	**Snack times**	**Main Meals**	**Snack times**
Cereals and cereal products (%)	41.48	7.41	39.07	8.87
Vegetables and potatoes (%)	12.92	0.42	14.09	0.17
Milk and milk products (%)	4.40	1.24	3.68	2.16
Meat and meat products (%)	4.34	0.14	5.23	0.36
Fruit (%)	4.08	2.79	3.22	3.91
Sugars, preserves and confectionery (%)	3.59	5.09	2.20	4.84
Savoury snacks (%)	2.64	1.19	2.04	1.63
Beverages (non-alcoholic) (%)	2.03	2.49	2.98	2.33
Miscellaneous (%)	1.94	0.09	1.76	0.05
Fish and fish dishes (%)	0.79	0.01	0.57	0.00
Alcoholic Beverages (%)	0.31	0.15	0.01	0.01
Nuts and seeds (%)	0.18	0.14	0.41	0.19
Eggs and egg dishes (%)	0.10	0.00	0.19	0.02
Fat spreads (%)	0.03	0.00	0.02	0.00
Total (%)	**78.82**	**21.19**	**74.47**	**24.54**

Table 4. Contribution of food groups to average daily total fat intake at mealtimes and snack times in CONCEPTT-Diet study participants

	Planning Pregnancy		**Pregnant**	
	Main Meals	**Snack times**	**Main Meals**	**Snack times**
Meat and meat products (%)	18.62	0.56	20.65	0.98
Cereals and cereal products (%)	13.55	4.68	13.68	5.40
Milk and milk products (%)	11.71	2.03	11.67	4.16
Vegetables and potatoes (%)	11.21	0.31	10.80	0.12
Fat spreads (%)	6.40	0.76	6.06	0.96
Eggs and egg dishes (%)	4.86	0.09	2.78	0.37
Miscellaneous (%)	4.67	0.13	4.73	0.07
Savoury snacks (%)	3.97	1.87	3.18	2.67
Fish and fish dishes (%)	3.73	0.05	2.17	0.00
Sugars, preserves and confectionery (%)	2.26	2.88	1.11	3.11
Fruit (%)	1.59	0.09	0.84	0.15
Nuts and seeds (%)	0.97	1.82	1.62	1.97
Beverages (non-alcoholic)(%)	0.52	0.67	0.32	0.40
Alcoholic Beverages (%)	0.00	0.00	0.00	0.00
Total (%)	**84.06**	**15.94**	**79.61**	**20.39**