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1 **Diet and weight gain characteristics of pregnant women with gestational**
2 **diabetes**

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6

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22

23 Running title: Diet of pregnant women with gestational diabetes

24

25

1 **Abstract**

2 **Objectives:** To determine if women with gestational diabetes (GD) modify their diet and
3 nutrient intake in late pregnancy and gain more weight during pregnancy compared to women
4 without GD.

5 **Subjects and methods:** Food and nutrient intake of 3 613 pregnant women was studied using
6 food frequency questionnaires from the Type 1 Diabetes Prediction and Prevention Nutrition
7 Study.

8 **Results:** GD was reported in 4.8% of the participating women (n=174). Women with GD
9 gained less weight during pregnancy than those unaffected by GD (mean 9.4 kg vs. 12.6 kg,
10 p<0.001). Women with GD consumed more milk products (84 vs. 76 g/MJ, p=0.002), cereal
11 products (21 vs. 18 g/MJ, p<0.001), vegetables (32 vs. 22 g/MJ, p<0.001) and meat (16 vs. 14
12 g/MJ, p<0.001) than unaffected women. The intake of protein (18 vs. 16 E%, p<0.001) and
13 dietary fibre (3.1 vs. 2.4 g/MJ, p<0.001) was higher, while the intake of sugars (13.3 g/MJ vs.
14 15.0 g/MJ, p<0.001) and saturated fatty acids (3.49 g/MJ vs. 3.98 g/MJ, p<0.001) was lower,
15 among women with GD. The nutrient density of the diet was higher in women with GD with
16 higher intakes of vitamin A and D, folate and iron.

17 **Conclusions:** The late pregnancy diet of women with GD differed considerably from that of
18 unaffected women. Women with GD had a higher body weight at the beginning of the
19 pregnancy, but they gained less weight during pregnancy. These findings indicate that
20 abnormal glucose tolerance during pregnancy encourages women to modify their dietary
21 habits towards healthier food choices.

22

23 **Keywords:** gestational diabetes, diet, weight gain

24

25

1 **Introduction**

2 Gestational diabetes (GD) represents the onset or first recognition of glucose intolerance
3 during pregnancy (Metzger and Coustan, 1998). It has been associated with adverse foetal
4 outcomes such as macrosomia and birth trauma (Blank et al., 1995; Crowther et al., 2005).
5 Women with GD may face other pregnancy complications such as pre-eclampsia and have
6 also increased risk of developing glucose intolerance in subsequent pregnancies (Dornhorst
7 and Rossi, 1998; Metzger and Coustan, 1998). In addition, those with a history of GD are also
8 at increased risk of developing type 2 diabetes. Although glucose tolerance is impaired in all
9 women during pregnancy, only a small percentage go on to develop GD. In 2006, 8.4% of
10 pregnant Finnish women were found to have an abnormal result in an oral glucose tolerance
11 test (National Research and Development Centre for Welfare and Health, 2007). Worldwide,
12 the estimates of GD prevalence vary widely, depending on the diagnostic criteria used.

13

14 Age, parity, smoking, increased body weight and body mass index (BMI), along with
15 previous GD are factors known to increase the risk of GD in pregnant women (Langer et al.,
16 2005; Rudra et al., 2007; Solomon et al., 1997; Wang et al., 2000). Generally GD is more
17 common among overweight and obese women than among lean women (American College of
18 Obstetricians and Gynecologists, 2005; Chu et al., 2007; Solomon et al., 1997). It has been
19 indicated that women with GD gain less weight during pregnancy than those without GD
20 (Catalano et al., 1993; Couch et al., 1998; Teramo et al., 2007). This is a likely reflection of
21 the effectiveness of lifestyle interventions available for women with GD at maternity welfare
22 clinics when the condition is first detected.

23

1 The cornerstone of the management of GD is nutrition therapy (Gunderson, 2004; Metzger
2 and Coustan 1998). The goal of dietary intervention is to attain normoglycemia and to
3 maintain a moderate weight gain (around 6-8 kg) through pregnancy (Gunderson, 2004;
4 Hasunen et al., 2004). However, those who fail to respond to the glycemic targets through diet
5 receive insulin in conjunction with nutrition therapy. At Finnish maternity welfare clinics,
6 women with GD are advised to follow a diet that favours vegetables, fruits, berries and whole
7 grain cereal over high energy content food (Hasunen et al., 2004). They are also
8 recommended to increase their intake of fibre, and to moderate their consumption of fats,
9 while ensuring an adequate intake of unsaturated fats. The intake of protein is recommended
10 to not exceed 20-25%, total fat 30-40% and carbohydrates 40-50% of the total daily energy
11 intake (Virtanen et al., 2008). Furthermore, women with GD are advised to increase their
12 level of physical activity (American Diabetes Association, 2004; Hasunen et al., 2004).

13

14 Pregnancy is an ideal time for behavioral and lifestyle modifications pertaining to diet and
15 physical exercise (Artal et al., 2007). Although pregnant women with GD are generally
16 advised to improve the quality of their diet, it is not well known whether women adhere to the
17 given instructions. In the present study, we firstly wanted to **determine if women with GD**
18 **modify their diet and nutrient intake in late pregnancy compared to women without GD.**
19 Secondly, we wanted to **determine if women with GD gain more weight during pregnancy**
20 **compared to women without GD.**

21

22 **Materials and methods**

23 Subjects of the present study are participating in the ongoing Type 1 Diabetes Prediction and
24 Prevention (DIPP) study, a large population-based birth cohort study in Finland which started
25 in 1994 (Kupila et al., 2001). The study was established to predict the development of type 1

1 diabetes and to search for means to prevent or delay progression of increased genetic
2 susceptibility to clinical type 1 diabetes. Infants who carry increased genetic risk represent
3 about 15% of the total population. Infants for the DIPP study were screened for HLA-DQB1-
4 conferred susceptibility to type 1 diabetes using samples of cord blood, and those with a high
5 risk were invited to participate in the DIPP study in the area of their local university hospital
6 (Oulu, Tampere and Turku University Hospitals). The study is approved by the local Ethical
7 Committees. All participating families have given their informed, written consent.

8
9 **The DIPP Nutrition Study falls within the framework of the larger DIPP Study.** The DIPP
10 Nutrition Study aims at investigating maternal nutrition during pregnancy and lactation, and
11 child's nutrition, in relation to the natural progression from increased genetic susceptibility to
12 the development of β -cell autoimmunity and clinical manifestation of type 1 diabetes, allergic
13 diseases and asthma. The subjects of the present study are women whose child was born
14 between October 20, 1997 and December 31, 2002 in Oulu and Tampere University Hospitals
15 (n=5 339) (Figure 1). Baseline dietary data was available from 3 783 women, of which 51
16 were rejected because of incomplete dietary data (for example more than 10 missing food
17 items in the food frequency questionnaire, FFQ). A total of 3 732 women with dietary data
18 were available for this study (70% of the women eligible to the DIPP Study). The research
19 questions were studied between women with and without GD. We excluded those with type 1
20 or type 2 diabetes from the comparison group. The total study population was thereafter 3
21 613. For our analyses on maternal weight and weight gain, we needed to exclude further
22 subjects based on the following criteria: women with twin and triple pregnancies, those with
23 missing information on the number of foetuses and women with incomplete weight gain
24 information. After this exclusion, data on 3 260 were available for weight gain analysis.

25

1 *The food frequency questionnaire*

2 Maternal diet during pregnancy was assessed retrospectively by a self-administered, semi-
3 quantitative FFQ, which has been validated specifically for the present study population
4 (Erkkola et al., 2001). This 181-item questionnaire assesses the mother's usual dietary intake
5 over the last month before maternity leave, usually the 8th month of the pregnancy in Finland.
6 The mothers filled in the questionnaire 1-3 months after the delivery and returned it at their
7 first visit to the study center where a trained study nurse checked the FFQ and if required,
8 completed it in consultation with the mother. All returned FFQs were also double-checked by
9 a trained nutritionist. The FFQ contained questions about the frequency (number of times per
10 day, week or month) and the amount of foods consumed, in units of common serving sizes.
11 The food consumption data was entered into a dietary database and the Finnish Food
12 Composition Database Fineli[®] (National Institute for Health and Welfare Nutrition Unit,
13 2009) was used to calculate daily food and nutrient intakes. Besides food consumption data,
14 the FFQ also enquired about the use of dietary supplements (i.e. brand name and
15 manufacturer, dosage and gestational weeks when used). Supplement intake was divided by
16 the length of the pregnancy (days) and represents the whole time period of the pregnancy.

17

18 *Information on GD, pregnancy and background characteristics*

19 In Finland, free-of-charge health care is offered to all pregnant women in maternity welfare
20 clinics and in practice all pregnant women attend the service. During the present study an oral
21 glucose tolerance test was performed usually at 26-28 week of gestation for those women who
22 fulfilled one or more of the following criteria: glucosuria after fasting, overweight (BMI>25
23 kg/m²), age >40 years, earlier delivery of a baby with birth weight >4 500 g or macrosomic
24 foetus (Berger et al 2002). GD is diagnosed when at least one of the values is pathological in
25 a 75 g (2 hrs) oral glucose tolerance test (American Diabetes Association, 2004). The FFQ

1 required the women to indicate if they followed any special diets during pregnancy by
2 selecting one of the following alternatives: no special diets, food allergy or hypersensitivity,
3 lactose intolerance, type 1 diabetes, type 2 diabetes, gestational diabetes, coeliac disease,
4 vegetarian diet or other special diets. This reported information of the GD is the main
5 outcome of the study.

6

7 The maternal weight and height information at the beginning of the pregnancy, as well as the
8 weight gain during pregnancy, was obtained from the follow-up card kept at the maternity
9 welfare clinic. In Finnish healthcare system, the first antenatal visit is usually between 8th and
10 12th gestational week. The rate of weight gain (kg/week) was calculated as the difference in
11 body weight between the last and the first antenatal visit divided by the number of gestational
12 weeks at the time of the weight measurement. BMI was calculated based on the weight and
13 height information. The women's age and education details were registered by a structured
14 questionnaire completed after the delivery. Professional education was merged into three
15 groups from the seven education groups available in the questionnaire. Information about
16 parity, place of residence and smoking habits during pregnancy was derived from the Medical
17 Birth Registries of the Oulu and Tampere University Hospitals. The same registries contained
18 information on the municipality code, from which the degree of urbanization (urban,
19 population centre, rural) was derived.

20

21 *Statistical analysis*

22 Stepwise logistic regression using forward elimination was used to analyse the association
23 between background factors and GD. The energy densities (g/MJ) of foods and nutrients were
24 calculated to eliminate the effects of differences in total energy intake. Foods and nutrients
25 that were not normally distributed were transformed into logarithmic scale for statistical

1 analyses. The associations between GD and food and nutrient intake were studied using linear
2 regression analyses and were adjusted for maternal age, place of residence, degree of
3 urbanization, vocational education, BMI and parity. T-test was used to investigate the
4 difference in weight gain through pregnancy and the child's birth weight between women
5 with and without GD. The proportions of vitamin and mineral supplement users between the
6 two groups were tested using χ^2 -test. In addition, the differences of the mean supplement
7 intakes between women with and without GD were tested using non-parametric Mann-
8 Whitney test. A p-value of <0.05 was considered statistically significant. SPSS 15.0 for
9 Windows (SPSS Inc., Chicago, IL, USA) was used to analyse the data.

10

11 **Results**

12 In the present study GD was reported in 174 (4.8%) of the participating women (total n=3
13 613). GD was more common among women in the two oldest age categories (30-34 years and
14 ≥ 35 years). Furthermore, women with GD had higher BMI at the first visit (mean 28.1 kg/m²)
15 than women without GD (mean 24.1 kg/m²). The risk of GD was higher among women living
16 in northern Finland (Oulu University Hospital district) and those who had an upper secondary
17 vocational education. (Table 1)

18

19 Women affected by GD gained less weight ($p<0.001$) (mean 9.4 kg, SD 5.1) than the
20 unaffected women (mean 12.6 kg, SD 4.5). The mean rate of weight gain was 0.34 kg/wk in
21 women with GD and 0.43 kg/wk in women without GD ($p<0.001$) (Figure 2). Infant birth
22 weights differed between the two groups of women (mean 3 650 g in women with GD vs. 3
23 560 g in unaffected women; $p=0.036$).

24

1 The diet of the women with GD differed from the diet of the women without GD. The former
2 consumed more milk and cereal products than the latter. Those with GD consumed less fruits
3 and berries but more vegetables. Meat was consumed more frequently by the women with GD
4 than by the unaffected women. Women with GD consumed less chocolate and sweets than
5 those unaffected. (Table 2)

6

7 The dietary intake of most nutrients differed statistically between the women with GD and
8 those without. However, for many nutrients the difference was too small to be of practical
9 importance. If the difference was <10%, we concluded that the difference is not of clinical
10 importance and did not analyse the results further. The intake of sugars was lower while the
11 intake of starch and dietary fibre was higher among women with GD. Their intake of protein
12 was higher than that of the unaffected women. Intake of saturated fatty acids was lower in
13 women with GD. Their intake of vitamins A and D, folate and iron was higher than that of the
14 unaffected women. The intake of iron was also higher in subjects with GD. (Table 3)

15

16 Most of the women (77.2%) complemented their diet with dietary supplements during
17 pregnancy. No difference was found in nutrition intake from supplements between the two
18 groups of women. Subjects with GD took iron supplements less frequently than other
19 subjects. (Table 4)

20

21 **Discussion**

22 The present study was undertaken to explore differences in food and nutrient intakes between
23 pregnant women with GD and those unaffected. Our study revealed that the diet in late
24 pregnancy among women with GD differed considerably from the diet of those without GD.

25 Women with GD consumed more milk and cereal products, vegetables and meat than those

1 unaffected, and consequently their intake of protein, starch and dietary fibre, and that of
2 vitamin A and D, folate and iron, was higher. In addition, women with GD had a lower intake
3 of sugars and saturated fatty acids. **Women affected by GD also gained less weight than the**
4 **unaffected women.** Our findings indicate that when abnormal glucose tolerance is first
5 detected, women tend to modify their dietary habits towards healthier food choices. Since the
6 first line of treatment of GD is through nutrition therapy in maternity welfare clinics, our
7 findings indicate that the dietary advice women receive is in fact effective.

8

9 The main strength of the current study was the large sample size of a population-based cohort.
10 In addition, since virtually all deliveries in Finland take place in public hospitals, our study
11 population is likely to be a close representation of the overall population of pregnant women
12 in the areas of the university hospitals of the study. A further strength is our use of an FFQ
13 which was specifically validated for the purpose of this study population (Erkkola et al.,
14 2001). However, the study involves some limitations, of which most are related to the
15 retrospective study design and its potential for recall bias. Firstly, since the participants
16 needed to recall their food use retrospectively, the influence of their current diet is a possible
17 source of error (Bunin et al., 2001). On the other hand, it could also be argued that women
18 may recall their dietary habits during pregnancy particularly well because of this unique
19 period in their lives. Secondly, as the women without GD mostly had a relatively
20 uncomplicated pregnancy, while those with GD received dietary guidance, it is possible that
21 the latter may have over-reported their consumption of healthy foods. Thirdly, since we used
22 an FFQ to study the maternal intake during pregnancy, there is a possibility that the food
23 consumption and nutrient intake data are overestimates, especially that of vegetables, and
24 energy and energy-yielding nutrients (Erkkola et al., 2001; Nelson and Bingham, 1997). Then
25 again, some studies have reported that the energy intake among certain groups of women,

1 such as those who are overweight, weight-conscious or pregnant, is often too low to meet the
2 physiological energy requirements (Hill and Davies, 2001; Trabulsi and Schoeller, 2001).
3 Hence, the reduced energy intake among the women with GD in our study may in fact to
4 certain extent be down to the tendency of under-reporting by obese women (Hill and Davies,
5 2001). We therefore took steps to minimize the effects of over and underreporting in the
6 present study, and thus estimated the energy densities of food and nutrient intakes in the
7 analyses. Finally, as the GD status in our study was reported by the responding mothers, we
8 could not confirm the status independently.

9

10 Our data showed that women with GD had a lower intake of sugars and saturated fatty acids
11 whilst having a higher intake of protein, starch and dietary fibre, as compared with the
12 unaffected women. A recent study among British women with GD, who also received dietary
13 advice, observed similar differences in the intakes of saturated fats, added sugar, complex
14 carbohydrates and dietary fibre (Thomas et al., 2006). In our study, the women with GD had a
15 total fat intake of 32% of the total energy intake, while the unaffected women had a slightly
16 higher intake of fat at 34%. The mean intake of protein among women with GD was 18% of
17 the total daily energy intake and hence fell below the recommended level of 20-25%
18 (Virtanen et al., 2008). In women without GD the intake of protein was even lower at 16% of
19 the total energy intake. However, the proportion of carbohydrates of the total energy intake
20 was similar in both groups at 49% of the total daily energy intake.

21

22 In line with many previous studies, we observed that the women with GD were generally
23 older and had a higher BMI at the beginning of the pregnancy than women without GD
24 (Hackmon et al., 2007; Radesky et al., 2008; Rudra et al., 2007; Solomon et al., 1997; Wang
25 et al., 2000). In our study, those with GD also had a higher body weight at the beginning of

1 the pregnancy than those not affected, but they gained less weight during the course of the
2 pregnancy. Similar observations have been made previously in a case-control study, which
3 evaluated weight gain during pregnancy in women with GD and those without (Catalano et
4 al., 1993). However, although the study indicated that the weight gain in women with GD was
5 less than in controls, the effect was considered to be attributed to their greater pregravid
6 weight. In contrast to previous studies, parity and cigarette smoking were not associated with
7 GD in the present study (England et al., 2004; Solomon et al., 1997).

8

9 Overall the use of dietary supplements was quite common in our study population; 77% of all
10 women took at least one dietary supplement. Our results are similar to an earlier study among
11 pregnant Finnish women in which 70% of women were reported to take dietary supplements
12 (Erkkola et al., 1998). However, in the present study population women with GD took iron
13 supplementation less frequently than the unaffected women. The high consumption of meat
14 and cereal products, both good sources of iron, among women with GD is a likely explanation
15 to this finding.

16

17 In conclusion, our findings indicate that women diagnosed with GD are capable of modifying
18 their dietary habits when given nutrition guidance at the maternity welfare clinics. This
19 observation is of great importance from the perspective of type 2 diabetes prevention. Thus by
20 means of dietary advice, regular exercise, stabilizing weight and monitoring blood glucose
21 levels, it is possible to delay or prevent the progression of GD to type 2 diabetes and its
22 further complications in women with a history of GD. Since the maternal nutritional status
23 before pregnancy, as reflected by pre-pregnancy BMI, is known to be more important than the
24 diet during pregnancy in the development of GD, efforts to reduce rates of GD should
25 continue to focus on reducing the prevalence of obesity among women in fertile age.

1 Furthermore, any efforts to promote physical activity and healthy eating habits among women
2 at this age should be strengthened.

3

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13

14 **Conflict of interest**

15 There are no conflicts of interest.

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Tables

Table 1 Characteristics of women with and without gestational diabetes (GD) in the DIPP nutrition study, with child born in 20.10.1997-31.12.2002 in Tampere and Oulu University Hospital districts.

	Women with GD (n=174)		Women without GD (n=3 439)		OR ^a (95% CI)
	n	%	n	%	
Age (years) ^b					
<25	18	10.3	678	19.7	1
25-29	48	27.6	1 185	34.5	1.53 (0.83-2.82)
30-34	56	32.2	1 017	29.6	2.02 (1.11-3.68)
≥35	52	29.9	559	16.3	3.20 (1.73-5.93)
Place of residence					
District of Tampere	68	39.1	2 062	60.0	1
District of Oulu	106	60.9	1 377	40.0	2.33 (1.66-3.26)
Degree of urbanization					
Urban	117	67.2	2 642	76.8	NS
Population centre	20	11.5	332	9.7	
Rural	35	20.1	438	12.7	
Missing data	2	1.1	27	0.8	
BMI at the first antenatal visit (kg/m ²)					
1. quarter (<21.4)	12	6.9	847	24.6	1
2. quarter (21.4-23.4)	22	12.6	839	24.4	1.60 (0.76-3.41)
3. quarter (23.4-26.1)	35	20.1	826	24.0	2.77 (1.38-5.54)
4. quarter (>26.1)	100	57.5	760	22.1	8.58 (4.51-16.31)
Missing data	5	2.9	167	4.9	
Smoking during pregnancy					
No	153	87.9	2 962	86.1	NS
Yes	15	8.6	359	10.4	
Missing data	6	3.4	118	3.4	
Professional education					
Academic	28	16.1	748	21.8	1
Upper secondary vocational education	92	52.9	1 377	40.0	1.65 (1.03-2.65)
None or vocational school or course	49	28.2	1 221	35.5	1.01 (0.60-1.70)
Missing data	5	2.9	93	2.7	
Parity					
0	55	31.6	1 581	46.0	NS
1	56	32.2	1 081	31.4	
2	25	14.4	476	13.8	
≥3	36	20.7	277	8.1	
Missing data	2	1.1	24	0.7	

Abbreviations: BMI, body mass index; OR, odds ratio; CI, confidence intervals; NS, not significant

^aLogistic regression stepwise analysis for developing GD. All estimates are simultaneously adjusted for all other characteristics in the table.

^bAt the time of the delivery.

Table 2 Consumption of foods (g/MJ) in women with gestational diabetes (GD) and unaffected women.

	Women with GD (n=174)		Women without GD (n=3 439)		p-value ^a
	mean	SD	mean	SD	
Milk products (g/MJ)	84.3	33.5	75.5	31.6	0.002
Cereal products (g/MJ)	20.7	5.2	17.9	4.4	<0.001
Fruits and berries (g/MJ)	44.3	24.5	52.8	28.3	0.004
Vegetables (g/MJ)	32.3	18.8	21.5	11.6	<0.001
Meat (g/MJ)	16.3	5.1	14.2	5.0	<0.001
Fish (g/MJ)	2.6	2.0	2.2	1.7	0.062
Dietary fats (g/MJ)	4.0	1.4	4.0	1.4	0.344
Chocolate and sweets (g/MJ)	1.1	1.4	2.6	2.2	<0.001

Abbreviations: SD, standard deviation

^aLinear regression analyses adjusted for maternal age, place of residence, degree of urbanization, vocational education, BMI and parity.

Table 3 Intake of energy and nutrients from foods adjusted for energy (per MJ) in women with gestational diabetes (GD) and unaffected women.

	Women with GD (n=174)		Women without GD (n=3 439)		p-value ^a
	mean	SD	mean	SD	
Energy (MJ)	10.8	2.9	11.5	3.4	
(kcal)	2579	699	2759	814	0.009
Protein (E%)	18		16		<0.001
Carbohydrates (E%)	49		49		0.712
Starch (g/MJ)	15.0	3.0	13.2	2.5	<0.001
Sugars (g/MJ)	13.3	3.3	15.0	3.4	<0.001
Dietary fibre (g/MJ)	3.08	0.91	2.40	0.66	<0.001
Total fat (E%)	32		34		<0.001
Saturated fatty acids (g/MJ)	3.49	0.77	3.98	0.76	<0.001
Trans fatty acids (g/MJ)	0.13	0.04	0.14	0.04	0.003
Monounsaturated fatty acids (g/MJ)	3.06	0.53	3.23	0.54	0.001
Polyunsaturated fatty acids (g/MJ)	1.31	0.32	1.26	0.29	0.016
N-3 fatty acids (g/MJ)	0.29	0.08	0.28	0.08	0.408
N-6 fatty acids (g/MJ)	1.00	0.27	0.95	0.23	0.007
Vitamin A (µg/MJ)	189	110	141	72	<0.001
Vitamin D (µg/MJ)	0.50	0.21	0.43	0.19	<0.001
Vitamin E (mg/MJ)	1.38	0.31	1.25	0.25	<0.001
Folate (µg/MJ)	37.4	8.37	32.1	6.40	<0.001
Vitamin C (mg/MJ)	17.5	8.3	17.3	8.7	0.134
Calcium (mg/MJ)	174	41.7	161	41.9	<0.001
Iron (mg/MJ)	1.67	0.32	1.44	0.27	<0.001

Abbreviations: SD, standard deviation

^aLinear regression analyses adjusted for maternal age, place of residence, degree of urbanization, vocational education, BMI and parity.

Table 4 Proportion of vitamin and mineral supplement users and nutrient intake from supplements in women with gestational diabetes (GD) and unaffected women.

	Proportion of users				p value ^a	Intake from supplements				p-value ^b
	Women with GD (n=174)		Women without GD (n=3 439)			Women with GD (n=174)		Women without GD (n=3 439)		
	n	%	n	%		mean	SD	mean	SD	
Vitamin A (µg)	12	6.9	210	6.1	0.673	39.6	204.3	16.9	103.0	0.605
Vitamin D (µg)	46	26.4	1 043	30.3	0.273	1.12	2.57	1.30	2.59	0.248
Vitamin E (mg)	49	28.2	1 199	34.9	0.069	0.84	1.97	1.13	5.04	0.093
Folic acid (µg)	51	29.3	1 254	36.5	0.119	53.0	95.3	57.1	98.4	0.223
Vitamin C (mg)	45	25.9	1 075	31.3	0.132	20.6	66.4	23.2	83.3	0.172
Calcium (mg)	33	19.0	594	17.3	0.343	81.0	178.5	68.2	177.2	0.311
Iron (mg)	105	60.3	2 388	69.4	0.011	25.2	35.1	27.0	33.3	0.067
Any supplement	128	73.6	2 663	77.4	0.235					

Abbreviations: SD, standard deviation

^a χ^2 -test

^bMann-Whitney Test

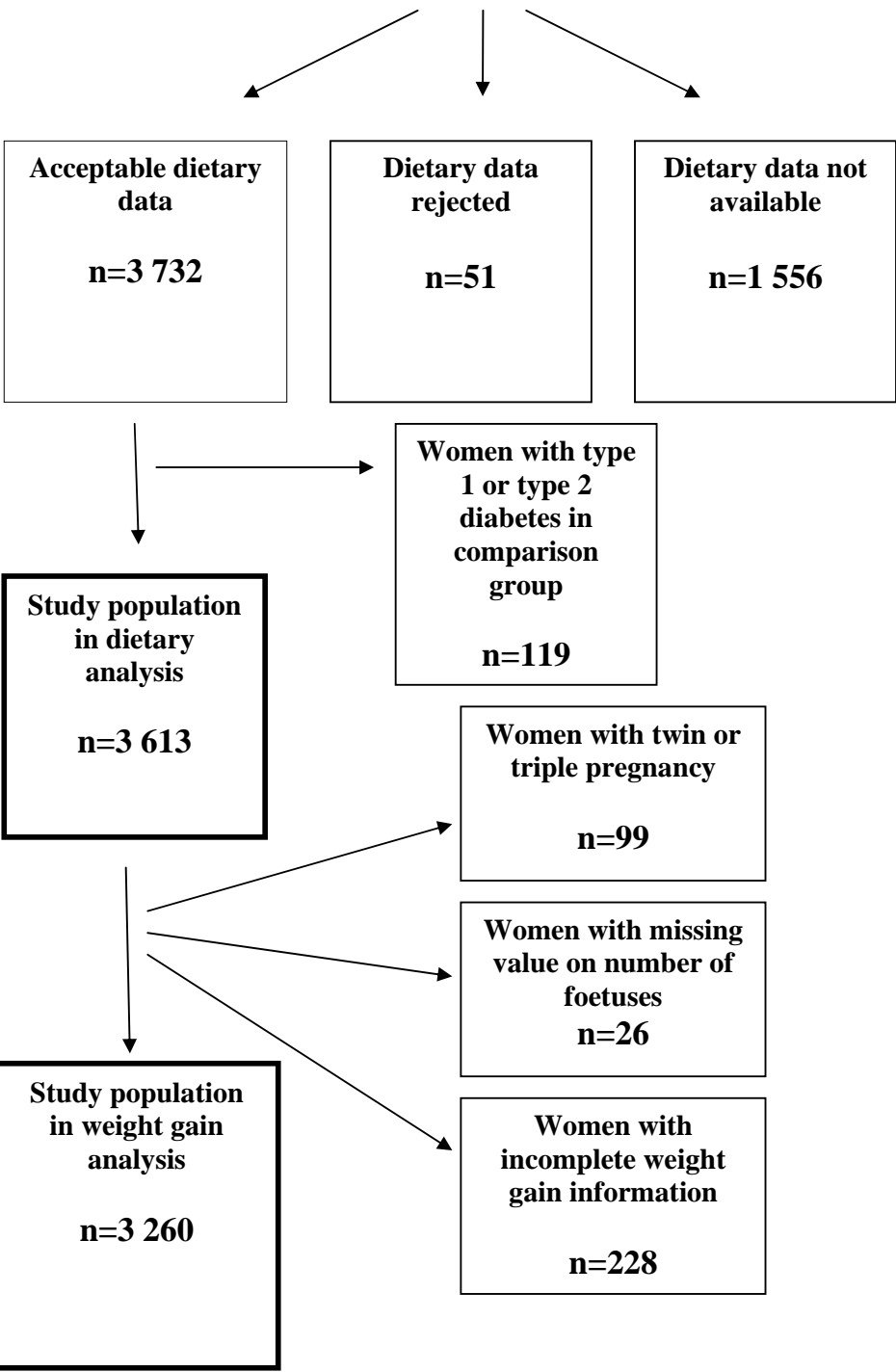
Figure legends

Figure 1 Study population of pregnant women in the DIPP Nutrition Study.

Figure 2 Rate of weight gain during pregnancy (kg/week) in women with gestational diabetes (GD) (n=160) and without gestational diabetes (n=3100).

Women invited to the DIPP Nutrition Study after giving birth to a child at increased genetic risk for type 1 diabetes at the University Hospital of Oulu or Tampere (Oct 20, 1997- Dec 31 2002)

n=5 339



Rate of weight gain during pregnancy, kg/week

1,50
1,00
0,50
0,00
-0,50

Women with GD (n=160)

Women without GD (n=3 100)

