Maternal characteristics, physical activity and quality of life in women with normal and impaired glucose tolerance and type 2 diabetes five years after gestational diabetes

Master Thesis in Medicine

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Abstract

Background

Gestational diabetes (GDM) is a risk factor for developing type 2 diabetes (T2D). Within five years postpartum, 30% of women with history of GDM develop T2D. Despite this well-known correlation we lack appropriate studies on markers that can identify women with history of GDM at risk for T2D.

Aims

The aim of this thesis is to study the differences in maternal characteristics, physical activity and quality of life between women with normal glucose tolerance (NGT), impaired glucose regulation (IGR) and T2D five years after diagnosed with GDM.

Methods

507 women diagnosed with GDM during 2005-2009 were recruited from Sahlgrenska University Hospital and were invited to participate in a 5-year follow-up visit. Totally 163 women participated. An oral glucose tolerance test (OGTT) was performed, blood samples, physical measurements and questionnaires were filled in and collected during the visit.

Results

Higher BMI, insulin treatment during pregnancy, non-Nordic origin, heredity for diabetes, low socioeconomics, low gestational age at diagnosis and delivery, were more common among women who develop T2D five years after diagnosed with GDM. NGT women had highest scores in self-estimated quality of life, followed by

the IGR and T2D women respectively, but only the GH scale was statistical significant. No significant results on physical activity levels were found.

Conclusions

Certain maternal characteristics are more common among the women who develop T2D and that can be used when designing proper follow-up programs for these women. Our non-significant results on physical activity levels might be due to the low physical activity levels within the whole GDM-population in our study, or that other factors such as eating behavior have stronger impact. It is possible that the diagnosis of T2D change the woman's view of her health, which results in reduced quality of life.

Key-Words

Gestational diabetes, glucose tolerance, physical activity

Introduction

Gestational diabetes mellitus (GDM) is defined as any degree of glucose intolerance with onset or first recognition during pregnancy according to the World Health Organization (WHO)[1].

With obesity becoming more prevalent in pregnant women, GDM is a growing health concern[2]. Traditionally deemed less dangerous for the fetus than pregestational diabetes, GDM may have serious long-term consequences for both mother and fetus/child[3].

The metabolic demands of pregnancy can reveal a predisposition for type 2 diabetes (T2D), especially within 5 years postpartum. About 30% of the women with previously diagnosed GDM develop T2D within five years and the 10 year risk of T2D is almost 40%[3,4]. Women with history of GDM are at substantially increased risk of developing T2D but today no appropriate follow-up programs or biomarkers exist to identify women at high risk for developing T2D[4,5,10].

Due to the lack of national and international screening methods, it is difficult to compare frequencies of GDM in various populations. About 7% of all pregnancies are complicated by GDM in the US and the prevalence of GDM is expected to rise, partly explained by the increasing obesity rate in fertile women[6]. In Europe, the prevalence is reported as 2-6%, with lower prevalence towards the Northern Europe and higher in the Southern/Mediterranean regions of Europe[7]. In Sweden, 0.8-4.3% of all pregnant women develop GDM and the incidence varies depending on what screening methods

that are used[5,7,8]. On average, 1.7% of all pregnancies in Sweden are complicated by GDM[9].

To diagnose GDM in pregnant women a non-fasting P-glucose or a standard oral glucose tolerance test (OGTT) is commonly used, but there are no worldwide or national unified guidelines in Sweden for diagnosing, screening or treating GDM. In Västra Götaland, the pregnant women are diagnosed GDM with fasting p-glucose >7.0mmol/l, non-fasting p-glucose value > 12.2mmol/l or a 2h p-glucose >10.0mmol/l at the OGTT[5,10]. A majority of the maternal health care units in Västra Götaland, including Gothenburg, offer an OGTT only if the woman has a capillary non-fasting p-glucose value > 8.0mmol/l taken during routine visits at the antenatal care units. Certain risk factors such as overweight or obesity and family history of diabetes are indications for performing an OGTT but this is not done on all pregnant women as a routine at the antenatal care units[10].

There is an inverse correlation between women with GDM and socioeconomic-status as women with low education displays more risk factors for GDM such as higher BMI and multiparity[11].

Physical activity is well known to improve the glucose homeostasis through its direct and indirect effects on the insulin sensitivity[12]. In addition, a meta-analysis found a strong association between greater physical activity level before and during early pregnancy in GDM women and lower risk of later T2D[13]. Women with GDM might therefore reduce their risk of developing T2D by increasing their physical activity[14].

The fact that there might be risk-factors that are potentially possible to reduce makes it desirable to early identify women at high risk and to prevent T2D.

Women with previously diagnosed GDM might also feel anxious about the knowledge of belonging to a high-risk population for progression to T2D. The onset of T2D after a GDM might also reduce quality of life.

Studies that examine quality of life in relation to glucose tolerance among women with previously diagnosed GDM are very limited. In a recent study, women with GDM reported lower sense of well-being, a less positive experience of their pregnancy, more concern about their health and more physical problems than women without GDM[15]. Others have shown that women diagnosed with GDM do not differ from a healthy pregnant population or that the difference in quality of life is due to obesity rather than GDM[16]. A Finish study found no significant differences between GDM women and non-GDM women's health related quality of life on usual activities, mental function, depression, distress, vitality and sexual activity[17].

Thus, it is important to find out how women with previously GDM view their health, especially when those studies that examine self-rated health among these women during pregnancy differ[15-18]. To our knowledge, no other study has examined differences in self- estimated quality of life within a postpartum GDM population in relation to their glucose metabolism.

More knowledge about women with GDM might enable early identification of women at risk for progression to T2D. Early identification and mapping of potential

risk-factors, protective factors and biomarkers that influence the onset of T2D could be used to create unified behavioral interventions and recommendations for these women, and thereby reduce the incidence of T2D after previously diagnosed GDM in the future.

Aim

The aim of this master thesis is to compare women with previously diagnosed GDM according to their glucose tolerance; those who have developed IGR or T2D and those who remained normal glucose tolerance (NGT), on differences in maternal characteristics, physical activity levels and quality of life five years postpartum.

Hypothesis

We hypothesize that characteristics such as low physical activity level, low education, and overweight/obesity will be found in women with IGR and T2D, and that they have lower quality of life compared with women with NGT.

Materials and Methods

Study population and study design

542 pregnancies were diagnosed with GDM based on WHO guidelines during 2005-2009 and referred to the same special maternity ward at Östra Sjukhuset[1]. Due to multiple pregnancies during the selected time interval, 35 women were excluded. Totally 507 women were set as baseline population for this study.

By the time for this study, 327 women had passed five years postpartum and 258 of these women was contacted by telephone and asked to participate in a follow-up visit five years postpartum. The women also answered a short interview during the phone call. The questions for the short telephone interview are shown in Appendix 1. Totally 183 women agreed to participate in the follow-up visit.

The main reasons for not participating in the follow-up visit were refusal (n=69), moving out from the area (n=6), and death (n=2). Women who agreed to participate in follow-up visit but had developed Type I diabetes (T1D) (n=13) or Latent Autoimmune Diabetes in Adults (LADA) (n=1) or those who had underwent gastric-bypass surgery (n=6) during the selected time interval were excluded, giving a population of 163 women participating in this cross-sectional study.

At the five-year postpartum follow-up visit, the women went through a 75g OGTT after at least eight hours of fasting overnight. Women were previously diagnosed T2D (n=25) did not perform an OGTT. Fasting venous blood samples for analysis of P-glucose and s-insulin were drawn at 0, 30, 60, 90 and 120 minutes.

At time 0, fasting venous blood samples for analysis of lipids; cholesterol, HDL, triglycerides and LDL were drawn. At time 0 and at time 120, capillary blood samples

were also drawn and were analyzed directly for p-glucose and HbA1c at the special maternal ward. P-glucose was analyzed by using a HemoCue devices (HemoCue, Ängelholm, Sweden) and HbA1c was analyzed with an AfinionAS100 (Axis-Shield, Oslo, Norway).

To calculate insulin resistance (HOMA insulin resistance index) and beta-cell function (HOMA beta-cell index), homeostatic model assessment (HOMA) was used. β-cell function was estimated by the insulinogenic index (insulin 30 min- insulin 0 min)/(glucose 30 min – glucose 0 min)[19,20]. Samples were analyzed at Biochemistry laboratory at Sahlgrenska University Hospital, Gothenburg, Sweden.

Anthropometrical measurements including height, weight, waist and hip circumference were measured including blood pressure, and BMI was calculated.

Based on the values from fasting venous blood samples drawn at 0 and 120 min post 75g glucose load and WHO's guidelines and classification 1999[1] (Table 1), the women (n=163) were divided into three groups; women with normal glucose tolerance (NGT) (n=81) women with impaired glucose regulation (IGR) (n=49) and type 2 diabetes (T2D) (n=33). Women with previously diagnosed T2D (n=25) did not perform an OGTT but were included in the T2D group. In this study, we also merged the IGR and T2D women into one group to analyze women with impaired glucose metabolism (IGM) (n=82). A flowchart of the study population is shown in Figure 1.

At the follow-up visit, we handed out questionnaires about diet, health and physical activity to the women to fill in (Appendix 2-4). To asses information about estimated physical activity at spare-time and occupational time, the *SOS-questionnaire* (Appendix 2) was used. The *SF-36 questionnaire* (Appendix 3) was used to assess

information about self-estimated quality of life and the self -formulated questionnaire *"Kost och hälsa under graviditeten vid typ 2 diabetes och graviditetsdiabetes"* questionnaire (Appendix 4) was used to assess records on occupation, education and smoking habits. Further information about the questionnaires are presented in the sub-chapter *study instruments*.

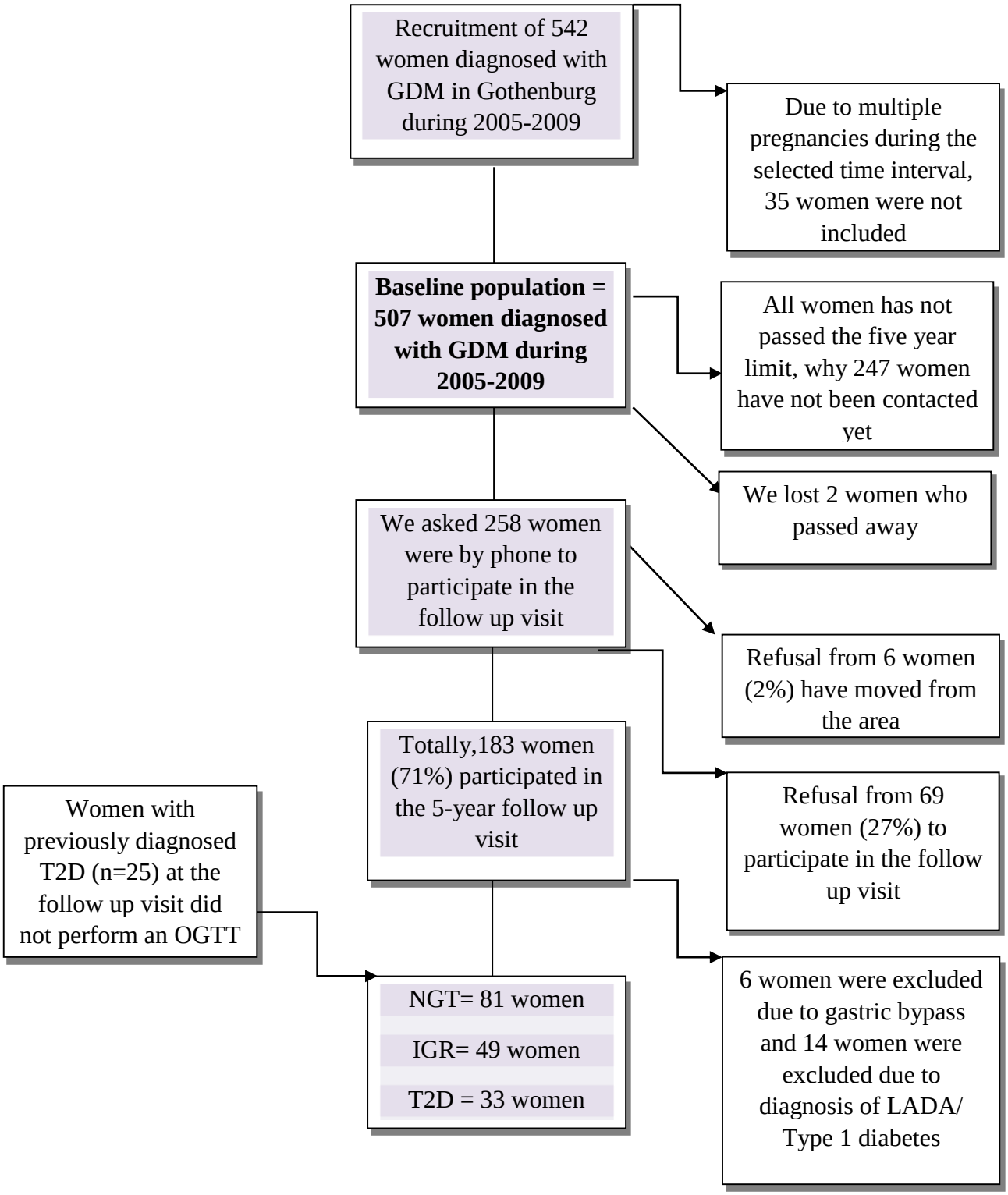

Figure 1 A flow chart of the study population.

GDM = gestational diabetes mellitus, NGT= normal glucose tolerance, IGR=impaired glucose regulation, T2D = type 2 diabetes mellitus, IGM=impaired glucose metabolism (IGR + T2D)

Diagnostic criteria

The OGTT results were evaluated according to WHO guidelines[1]. The cut off values according to WHO guidelines are presented in Table 1.

Table 1. OGTT Cut of value for NGT, IFG, IGT and T2D

Group	Time 0, fasting p-glucose (mmol/l)	120 min post glucose load (mmol/l)
NGT	< 6.1	< 7.8
IFG	≥ 6.1 and ≤ 7.0	< 7.8
IGT	< 7.0 and ≥ 7.8	≥ 7.8 and < 11.1
T2D	≥ 7.0	> 11.1

Table 1 displays cut off values for NGT, IFG, IGT and T2D according to the WHO classification 1999[1]. IGR includes impaired fasting glucose (IFG) and impaired glucose tolerance (IGT).

Diagnosis require that both fasting-p-glucose value and the 120 min post glucose load values are met[1].

In this study, early diagnosis of GDM is defined as diagnosis before 140 days of gestation. This definition is based on a normal pregnancy length of approximately 280 days or 40 weeks.

Study instruments

The self-administrated *SOS-questionnaire* endures of two questions about physical activity levels. The first question examines physical activity levels at leisure-time. The second question examines physical activity levels at occupational time. The physical activity questionnaire were coded 0-4 for work (0 = unemployed) and 1-4 for leisure. Since grade 4 included very few women in both questions in our study, grade 3 and 4 were merged into one grade (grade 3 + 4). Unemployed women were not included in the analyze on activity level at occupational time[21]. The questionnaire is found in Appendix 2.

The SF-36 questionnaire contains 36 items divided into eight scales: physical functioning (PF), bodily pain (BP), social functioning (SF), general health (GH), role-physical (RP), role-emotional (RE), vitality (VT), and mental health (MH). Answers from the 36 questions but the second question about self-reported health transition, are used to score the eight SF-36 scales as well as the two health summary measures Physical Component Summary (PCS) and Mental Component Summary (MCS). There is a hierarchy of SF-36 which can be explained by that PCS is based on the scores on PF, RP, BP and GH scale, whereas MCS is based on the scores on MH, RE, SF, and VT. The scores in each scale constitute of a number on a scale ranging from 0 which is the worst thinkable quality of life, to 100, which is the best thinkable quality of life[22].

The half-scoring rule was used to handle missing data, which means that a scale is considered to be scorable if half or more of the items were present. The main indexes was considered scorabale if the eight scales were present[23]. The SF-36 questionnaire is found in Appendix 3.

The survey *"Kost och hälsa under graviditeten vid typ 2 diabetes och graviditetsdiabetes"* is a self-formulated questionnaire that is used to answer questions on civil status, occupation, education and smoking. The questionnaire is found in Appendix 4.

Statistical methods

For all data analyzes, IBM SPSS Statistic Version 21 (SPSS, Chicago, IL, USA) was used. ANOVA with post hoc test Tukey HSD, has been used to compare group means. Crosstabulation, and X^2tests (Pearson) was used to compare group frequencies.

SF-36 item records were recorded on excel database and then translated in the Health Outcomes Scoring Software 4.0 into ranking scores between 0-100. The Health Outcomes Scoring Software 4.0 also calculated the scale scores and the summary index scores of SF-36. Kruskal Wallis and Mann-Whitney U were performed for comparison of the scores in SF-36[24].

A Spearman's rank-order correlation was run to determine the relationship between physical activity level and level of education, BMI at the first antenatal visit and at the follow-up visit. This method was also used to determinate correlation between each scale and each main index of the SF-36 and BMI, smoking and physical activity at the follow-up visit.

Results are presented as *n* (%) for categorical variables and for continuous variables using mean ± SD. P-values ≤ 0.05 were considered statistical significant. Correlations are presented as Rho (r_s).

Ethics

Informed consent was obtained from the study participants and the study protocol has been approved by the regional ethical review in Gothenburg, the 16th of December 2008, nr 402-08.

Results

Maternal characteristics

Totally 163 women are included in the follow-up population. To ensure that the follow-up population is representative it was compared to the whole baseline population and no statistical differences were found (Table 2).

Table 2. Baseline Maternal Characteristics in women with GDM 2005-2009

Characteristics	**Baseline population**		**Follow-up population**	
n total	*n*	**507**	*n*	**163**
Women's age at delivery (years)	491	33±14	161	34±5
BMI at first antenatal visit (kg/m^2)	506	28.1±5.8	163	27.3±4.9
Non-Nordic origin, n (%)	275	54	84	52
Family history of diabetes, n (%)	235	46	72	44
Insulin treatment during pregnancy, n (%)	137	27	36	22
Gestational age at delivery (days)	491	275±14	162	274±15
Gestational age at diagnosis (days)	498	179 ±57	163	177±58
Early GDM diagnosis (<140 days of gestation) n (%)	114	22	35	22
Parity (n)	507	1±1	163	1±1

Data are % (n) or mean ± SD. Illustrates comparison of data between the baseline population and the follow-up population. Statistical analyses were performed by ANOVA (Tukey HSD) to compare mean differences and X^2 tests (Pearson) have been used to compare group frequencies. *n* = numbers of participants for each of the parameters.

Based on the OGTT results performed five years postpartum, the women were divided into three groups; NGT, IGR and T2D. Records from the first antenatal visit are shown in Table 3.

Table 3. Maternal characteristics in women with GDM at the first antenatal visit 2005-2009 in relation to glucose tolerance measured 5 years later at the follow-up visit

Characteristics	Values per group at first antenatal visit							
	NGT		IGR		T2D		IGM (IGR + T2D)	
	n		*n*		*n*		*n*	
Total women (n= 163) (%)	**81**	**50**	**49**	**30**	**33**	**20**	**82**	**50**
BMI at first antenatal visit (kg/m^2)	81	26.2±4.8	49	27.6±4.6	33	29.7±4.8**	82	28.5±4.8$^{££}$
Weight first antenatal visit (kg)	81	70±14	49	74±15	33	78±13**	82	76±14$^{££}$
Non-Nordic origin (%)	33	41	27	55	24	73**	51	62$^{£}$
Family history of diabetes (%)	30	37	23	47	19	58*	42	51$^{£}$
Parity (n)	81	1±1	49	1±1	33	2±2*	82	1±1
GDM in previous pregnancies (%)	19	23	9	18	12	36	21	26
GDM diagnosis by fasting P-glucose (%)	6	7	2	4	6	18	8	10
GDM diagnosis by non-fasting P-glucose (%)	6	7	5	10	5	15	10	12
GDM diagnosis by OGTT (%)	68	84	42	86	22	67	64	78
Insulin treatment during pregnancy (%)	9	11	13	27	14	42**	27	33$^{£££}$
Women's age at delivery (years)	80	34±5	48	34±6	34	32±5	82	33±6
Gestational age at delivery (days)	80	187±56	49	184±55	33	148±85**	82	169±60$^{£}$
Early GDM diagnosis (<140 days of gestation) (%)	13	16	8	16	14	42*	22	27

Tables 3 illustrates baseline data and mean differences comparisons for the NGT vs. IGR and T2D women, and NGT women vs. IGM women. Data are % (n) or mean ± SD. Statistical analysis was performed by ANOVA (Tukey HSD) to compare mean differences and X^2 tests (Pearson) have been used to compare group frequencies. *n* = numbers of participants for each of the parameters.

NGT vs. T2D * p-value $\leq$ 0.05, ** p-value$\leq$ 0.01,

NGT vs. IGM £ p-value $\leq$ 0.05 ££ p-value $\leq$ 0.01 £££ p-value $\leq$0.001

Table 3 shows that women with T2D had significant higher BMI at first antenatal visit. The BMI ranges were; NGT = 16.9-41.5 kg/m^2, IGR = 19.1-40.4 kg/m^2, T2D = 19.1-41.6 kg/m^2 and IGM = 19.1-41.6 kg/m^2.

Women with T2D were more often of a non-Nordic origin and were more often having a first or a second-degree family history of diabetes. This table also illustrates that women with T2D were more often multiparous and required insulin treatment during pregnancy more frequently than women with NGT. They were also more often having an early GDM diagnosis (<140days of gestation) and were at lower gestational age at delivery compared to the NGT women. Maternal age at delivery did not differ significantly between the groups (Table 2).

No statistical significant differences were found between women with NGT and IGR. As IGR is a pre-diabetic condition and no significant differences were shown in BMI between IGR and T2D at the first antenatal visit, we merged these two groups into one, referred to as women with impaired glucose metabolism (IGM). No significant differences were found in maternal characteristics between the different groups except for that the IGM women have the same parity as the NGT group.

The results from the measurements and the OGTT performed at the follow-up visit five years postpartum are displayed in table 4.

Table 4. Baseline maternal characteristics in relation to glucose tolerance at five year follow-up visit

Characteristics	Values per group at five year follow-up visit							
		NGT		IGR		T2D		IGM (IGR + T2D)
	n		*n*		*n*		*n*	
Total women (n=163) (%)	**81**	**50**	**49**	**30**	**33**	**20**	**82**	**50**
Weight 5 years postpartum (kg)	81	70±13	49	77±15$^{\#}$	33	78±16**	82	78±15
5 year weight development (kg)	81	– 0.6±6	49	2.5±6$^{\#}$	33	– 0.2±9	82	1.5±7
BMI five years postpartum (kg/m^2)	81	26.0±4.4	49	28.3±5.0$^{\#}$	33	29.8±56***	82	29.0±5.3$^{£}$
BMI development 5 years PP (kg/m^2)	81	– 0.2±2.4	49	0.7±2.7	33	0.06±3.2	82	0.5±2.9
Waist/hip-ratio (cm)	81	0.8±0.1	49	0.9±0.1	33	0.9±0.2	82	0.86+0.2
P-glucose venous 0 min at OGTT (mmol/l)	79	5.3±0.4	37	6.0±0.5$^{\#\#\#}$	31	8.0±3.1$^{***,¤¤}$	68	6.9±2.3$^{££}$
P-glucose venous 120 min at OGTT (mmol/l)	75	5.3±1.1	35	7.0±2. $^{\#\#\#}$	6	12.2±0.8$^{***,¤¤}$	41	7.8±2.6$^{££}$
S-insulin venous 0 min at OGTT (mmol/l)	79	7.9±4.79	36	10.1±5.0	31	13.9±7.3***	67	12.0±6.4$^{£}$
S-insulin venous 120 min at OGTT (mmol/l)	74	35.5±27.1	34	59.9±44.7$^{\#\#}$	6	104.9±67.6$^{***¤}$	40	69.8±52.3$^{££}$
HOMA-IR	80	1.9±1.2	48	2.7±1.4$^{\#}$	33	4.9±3.1$^{***,¤¤}$	81	3.6±2.5$^{££}$
HOMA-β-cell	80	90.0±56.8	48	82.5±37.0	33	74.7±46.8	81	79.3±41.2
Insulinogenic index	75	12.5±67.4	46	11.1±11.5	8	11.3±6.8	54	11.1±10.9
HbA1c%	81	37.5±3.5	38	38.8±4.0	31	51.9±17.4$^{***,¤¤}$	59	44.8±14$^{££}$
Development of other chronical diseases (%)	27	33	10	20	10	31	17	21

Table 4 illustrates baseline data and mean differences (mean ± SD) comparisons for the NGT vs IGR and T2D women, and NGT women vs IGM women. Statistical analyses were performed by ANOVA (Tukey HSD) to compare mean differences and X^2 tests (Pearson) were used to compare group frequencies. *n* = numbers of participants for each of the parameters.

NGT vs T2D ** p-value≤ 0.01, *** p-value ≤0.001

NGT vs IGR # p-value ≤ 0.05, ## p-value≤ 0.01, ### p-value ≤0.001

IGR vs T2D ¤ p-value ≤ 0.05, ¤¤ p-value ≤0.001

NGT vs IGM £ p-value ≤ 0.05, ££ p-value ≤0.001

Five years postpartum, women with T2D did still have significant higher BMI than the NGT women. The BMI ranges at the follow-up visit were; NGT = 18.7-36.4 kg/m^2, IGR = 19.0-38.9 kg/m^2, T2D = 18.7-45.2 kg/m^2 and IGM = 18.7-45.2 kg/m^2.

The IGR women gained significantly in weight and BMI between the first antenatal visit and follow-up visit compared with the NGT women who reduced their mean weight during this time interval. The T2D women had higher HOMA-IR values than both IGR and T2D women but no significant differences in HOMA-beta-cell or insulinogenic index were found.

No significant differences were found in waist/hip-ratio or frequency of other chronically diseases were between the groups. The most common chronically diseases were hypertension/cardiovascular diseases (n=11), hypo/hyperthyroidism (n=10) and asthma/allergy (n=4).

We also compared IGR + T2D referred to as the IGM group, with the NGT women. The differences in BMI between women with NGT and IGM were found statistical significant.

Socioeconomics

The *Kost och hälsa under graviditeten vid typ 2 diabetes och graviditetsdiabetes* questionnaire was used to examine socioeconomic status among the women. The questionnaire is shown in Appendix 4 and the results are shown in table 5.

Table 5. Differences in socioeconomics in relation to glucose tolerance at five year follow-up visit

Characteristics	Frequencies per group at five year follow-up visit							
	NGT		IGR		T2D		IGM (IGR + T2D)	
	n	%	*n*	%	*n*	%	*n*	%
Total women (n=125) (%)	**61**	**49**	**37**	**30**	**27**	**21**	**64**	**51**
Unemployed	10	16	8	22	10	37**	18	28
Elementary school as highest education	6	10	5	14	10	37**,¤	15	23
Education > 3 years at University	13	21	8	22	7	26	15	23

Table 5 illustrates differences in socioeconomics between women with NGT, IGR and T2D. It also compares NGT and IGM. To compare group frequencies, X^2 tests (Pearson) were used. *n* = numbers of participants for each of the parameters.

NGT vs T2D ** p-value$\leq$ 0.01

IGR vs T2D ¤ p-value $\leq$ 0.05

We found a significant difference in frequency of unemployment between NGT and T2D. Differences in frequency of women that had elementary school as highest education also differed significantly between NGT and T2D, but also between IGR and T2D.

We examined marital status among the women by asking the question whether the woman was living as married/cohabiting or as a single mother. We also examined working hours per week and frequency of shift workers, night workers and regularly workers between the women with jobs in the different groups, but no significant differences were found (results not shown).

No significant differences were found in frequency of women who had >3 years of education at university between the women or in smoking frequency (results not shown).

Differences in education and unemployment were no longer significant when IGM (IGR + T2D) were compared to the NGT women.

Physical activity

At the follow-up visit, the women answered the SOS-questionnaire about physical activity at leisure time and at work. The SOS-questionnaire is found in Appendix 2 and the results are displayed in Table 6.

Table 6. Physical activity level

	Values per group at five year follow-up visit							
	NGT		**IGR**		**T2D**		**IGM** (IGR + T2D)	
	n	**%**	*n*	**%**	*n*	**%**	*n*	%
Total women (n=115), at leisure time	**58**	**50**	**34**	**30**	**23**	**20**	**57**	**50**
Low (grade 1) activity level	8	14	9	26	6	26	15	26
Moderate (grade 2) activity level	34	59	19	56	11	48	30	53
High (grade 3 + 4) activity level	16	28	6	18	6	26	12	21
Total women (n=100), at occupational time	**55**	**55**	**28**	**28**	**17**	**17**	**45**	**45**
Low (grade 1) activity level	18	33	9	32	4	24	13	29
Moderate (grade 2) activity level	21	38	15	54	8	47	23	51
High (grade 3 + 4) activity level	16	29	4	14	5	29	9	20

Table 6 illustrates comparison of physical activity levels for the NGT vs IGR and T2D women, and NGT women vs IGM women. Values are representing results per group at five year follow-up visit. X^2 tests (Pearson) were used to compare group frequencies. *n* = numbers of participants.

Totally 115 women answered the question about physical activity at leisure time and 109 women about physical activity level at occupational time. As the question that examined physical activity level at occupational time was not adjusted to unemployment, 9 of the 109 women who answered this question were excluded from the statistical calculations due to unemployment.

We did not find any significant differences in physical activity level at occupational time. We examined the correlation between self-reported physical activity and BMI or educational level, but no significant correlations were found.

SF-36, quality of life

At the follow-up visit, the women answered the SF-36 questionnaire. We found that NGT women had felt significant more vigorous (question 9.a), calm and peaceful (question 9.d) compared to women with IGR and T2D for the past four weeks. Comparison of the SF-36 scales and main indexes were also made and the results are displayed in Table 7.

Only the GH scale differed statistically significant between NGT women and T2D women.

We also examined the correlation between the scales in SF-36 and potential confounders such as BMI, physical activity level and smoking[22,30]. We found significant, inverse correlations between BMI and the scales Body Pain (BP) r_s = -0.299, p = 0.008 and General Health (GH) r_s = -0.439, p < 0.001 and the main index PCS r_s = - 0.309, p =0.006 in all three groups.

Significant positive correlation between SF-36 and physical activity level at leisure time was found: Role Physical (RP) r_s= 0.247, p = 0.04, General Health (GH) r_s = 0.322, p = 0.007 and Vitality (VT) r_s =0.311, p =0.009. The main indexes PCS r_s = 0.293 p = 0.015 and MCS r_s = 0.271, p = 0.025 also displayed a positive correlation in all three groups.

Significant correlations between SF-36 and physical activity level at occupational time in all three groups of women were also found: Physical functioning (PF) r_s =- 0.284, p = 0.021, Role Emotional (RE) r_s = -0.300, p = 0.008 and the main index PCS r_s =- 0.396 p = 0.01.

No correlation was found between SF-36 and smoking (results not shown).

Table 7. SF-36 results

		NGT		IGR		T2D		IGM (IGR + T2D)	
SF-36 health survey scales	Scales interval	n	Mean ± SD	n	Mean ± SD	N	Mean± SD	n	Mean± SD
PF	*0 - 100*	43	85.8±22.0	24	84.0±21.0	11	82.7±31.6	35	81.7±24.6
RP	*0 - 100*	42	82.3±30.1	24	81.3±33.2	11	75.0±14.0	35	77.1±37.6
BP	*0 - 100*	43	74.7±25.6	24	67.3±24.6	11	71.0±35.9	35	65.6±28.2
RE	*0 - 100*	41	83.7±32.6	24	73.7±35.4	10	74.0±38.5	34	71.6±35.9
VT	*0 - 100*	43	61.1±20.1	24	51.9±22.6	11	52.3±28.6	35	50.6±24.4
MH	*0 - 100*	43	74.2±19.5	24	69.5±20.5	11	59.6±29.7	35	66.4±23.8
SF	*0 - 100*	43	87.0±18.5	24	85.5±21.0	11	80.0±32.5	35	81.4±25.4
GH	*0 - 100*	43	73.0±19.6	24	67.4±21.0	11	51.1±24.8*	35	62.3±23.2
PCS	*0-100*	43	52.0±8.2	24	51.0±8.4	10	49.8±12.1	34	50.6±9.5
MCS	*0-100*	43	49.6±10.1	24	46.7±11.1	10	45.3±11.2	34	46.3±11.0

Table 7 illustrates results of the 8 scales of the SF-36 questionnaire, comparing the NGT, IGR and T2D women. **PF**= physical functioning, **RP**= Role-physical, **BP**= body pain, **RE**=Role-Emotional, **VT**= vitality, **MH**= Mental Health, **SF**= social functioning, **GH**= general Health. Table also illustrates results of the two main indexes **PCS =** Physical Component Summary and **MCS** = Mental Component Summary. Statistical Analysis was performed with Kruskal Wallis and Mann-Whitney U was used for pairwise comparison. Higher score = better self-estimated health

NGT vs T2D * p-value$\leq$ 0.01

Discussion

Maternal characteristics

In our study, we found that certain characteristics such as higher BMI, insulin treatment during pregnancy and non-Nordic origin were more common in women who develop T2D compared to women that keep NGT after diagnosed with gestational diabetes.

Most of our findings on maternal characteristics are in concordance with results from several other studies in the same field[4,25,26]. According to H.E. Fadl and M.Östlunds study including 10 525 Swedish women diagnosed with GDM during 1991-2003, women with GDM were more often multiparous, of higher BMI and of non-Nordic origin than the non-GDM women. They also suggest that several pregnancy-related factors such as early diagnosis of GDM, insulin treatment during pregnancy, preterm delivery and overweight (BMI>25) seems to be contributing factors of developing T2D among women with history of GDM, which are findings equivalent to ours[9].

In contrast to our findings Ekelund et al found that T2D women and IGR women had higher waist-hip ratio than women with NGT[4]. The wide range of BMI values among the T2D women compared to the NGT women at the follow-up visit might explain this non-significant value in our study.

Some women in the T2D group were overweight, which is a well-known risk factor for developing T2D after GDM. The wide BMI ranges illustrates that we also have women in the T2D and IGR group with a very low BMI, some of them even in the range of underweight (BMI<20). It would be interesting to, not only compare these women according to their glucose metabolism, but also according to their BMI as the study continues. A woman with the minimum BMI at 19.1 in the T2D group might need different interventions and recommendations than a woman with a BMI value at 45.2, which was the maximum BMI value in the T2D group.

Ekelund *et al*. who compared 174 women with previously diagnosed GDM did not find any differences in HOMA- β –cell index, but they did find differences in insulinogenic index between the groups which are findings in contrast with ours[4]. The lack of significant differences in insulinogenic index between the groups in our study

might be due to the wide distribution of our values in the NGT group. In the future, we need to include more women to obtain more reliable results.

Fadl *et al* found that GDM women have higher frequency of chronic hypertensive disease than women without GDM. In contrast to this, we did not find any differences in the prevalence of other chronically diseases among the women in our study[9]. An explanation to our non-significant result could be that all women in our study had GDM five years ago and that GDM mothers are characterized by higher rates of chronic hypertensive disease than women without GDM. We did not compare our women with women with normal glucose tolerance during their pregnancies[25].

Socioeconomics

The GDM women in our study had a high rate of unemployment compared to the general Swedish population. Approximately 8% of the population in Sweden is unemployed according to Statistiska Centralbyrån[27]. We found that women with T2D had highest frequency of unemployment and the highest proportion of women with elementary school as highest educational level compared to the other groups. We did not examine the women's and/or the households' income or geographical differences.

Our findings suggest that women with GDM have a low socioeconomic position compared to the general Swedish population and that the T2D women seem to have the lowest position within the GDM population. Just like Bo *et al* suggests, it seems like women with T2D displays more risk factors, such as high BMI and family history of diabetes, compared to the other groups and this might partly be explained by their low socioeconomic position[11]. Low educational levels probably lead to reduced ability to gain knowledge about the disease, its impact on health and possible

protective actions that can be taken to prevent progression into T2D after previously diagnosed GDM.

No statistical significant differences were found in the percentage of women with educational level at university or marital status between the groups. Even if our findings suggest that T2D women are of lower socioeconomic status than the other groups, there are some women within the T2D group that do not have a low socioeconomic position that still develop the disease.

Physical activity

In our study, levels of physical activity did not differ significantly between the groups. Most other studies has shown that increased physical activity is associated with lower risk of T2D[13,14,28].

We did not answer the question on how our GDM women relate to women with normal glucose tolerance during their pregnancies in this study, which might explain our non-significant results. To better be able to interpret our findings, we compared our results of physical activity level with the female reference group in the SOS (Swedish Obese Subjects) study used in Larsson's study[21].

The reference population in Larsson´s study endures of 139 non-GDM women with mean BMI 24.7± 3.7kg/m^2, aged 47.8± 6.1 (37 – 60) recruited from Gothenburg and Örebro between 1994-1998. Of these 139 healthy women, 16% (n = 31) reported sedentary physical activity level (grade 1) at leisure time. This comparison revealed that all three groups of women in our study have a much higher report of a total lack of physical activity (grade 1) at leisure-time and at occupational time than what is found among the women in Larsson's study[21]. The total lack of physical activity

might be one contributing factor to the development of T2D in women with previously diagnosed GDM.

In Västra Götaland, patients with T2D are recommended 20-60 minutes of moderate to intensive physical activity at least 3 times per week combined with strength training at least 2-3 times a week[29]. Women who self-estimated their physical activity level as sedentary/low at leisure time and at occupational time does not accomplish these recommendations. Therefore, it might be the women that self-estimated their physical activity level as sedentary who needs extra support with physical activity interventions.

The majority of women in all three groups reported at least a physical activity level at grade 2, suggesting that the majority of women actually did perform some kind of physical activity. Again, it seems like some women that have healthy lifestyle habits also can progress into T2D. The multifactorial causation of GDM and the onset of T2D later in life suggest that more than just physical activity is needed to help these women. Although, physical activity might be an important part of an intervention program, especially for the women who report a total lack of physical activity.

Even though the differences were not statistically significant, we found that NGT women had highest level of physical activity at leisure time, followed by the women T2D and IGR respectively. One could imagine that the NGT women who have higher educational level reduced the risk of developing T2D by having more easy to gain knowledge of prevention strategies including higher level of physical activity at leisure time. Although, the non-significant correlation between physical activity level and level of education found in our study does not support this assumption. Neither the correlation between BMI and physical activity level was found significant. An

important issue, not studied in this thesis, is the diet and eating behavior of these women, which has an important role in the development of disease than physical activity levels.

The IGR women have not received the recommendations about a healthier lifestyle to prevent disease development like the T2D women have and they are unaware of heir reduced glucose regulation. Even if not statistically significant, the IGR women have the lowest scores on self-estimated physical activity and gained most weight during the time interval between the first and second visit compared to the other groups. This might suggest that also the IGR women are in need of appropriate follow-up programs to prevent progression to T2D.

The results from this study point the need of a more evidence-based method to examine the impact of physical activity levels to the onset of T2D after previously diagnosed GDM. It would be interesting to perform a prospective randomized intervention study to better be able to answer this question in the future.

SF-36

NGT women had highest scores in self-estimated quality of life, followed by the IGR and T2D women respectively. Even though the differences in the SF-36 were not statistically significant except for the GH scale between NGT and T2D women, our study suggests that women with IGR and T2D have lower quality of life than the NGT women.

According to the interpreting manual of SF-36, the values of the GH scale found in our study indicates that almost twice as many women with T2D consider their general health as fair/poor compared to the NGT and IGR women There is also a strong

inverse correlation between the value of the GH scale and health care utilization. A GH value of 56.7 as the scoring from the T2D women, corresponds to twice as many doctor visits and hospitalizations than GH values found in among the NGT and IGR women. The items that the GH scale is based on suggest that women with T2D get sick easier and do not feel as healthy as anybody else they know, compared to NGT women. The items also imply that T2D women are more likely to believe that their health is going to get worse compared to the NGT women[22].

These findings might indicate that the experience of GDM and the progression to T2D might result in new worries about health, which may have impact on their self-estimated quality of life. It is likely to expect some emotional reactions in a patient being diagnosed with a chronically disease like T2D. The emotional reactions might change the way the woman look at her future, how she estimates her quality of life and the way she looks at herself.

The mean score of all eight scales of SF-36 in all three groups was lower compared to a reference population of 896 Swedish non-GDM women aged 25-34[22]. These findings suggest that women with previously diagnosed GDM estimate lower quality of life compared to non-GDM women.

Women with previously diagnosed GDM might feel anxious about being affected by T2D in the future and the knowledge of belonging to a high-risk population[4,25,26]. Anxiousness about developing T2D in the future could be used to promote lifestyle changes among these women. Findings in Sjögren *et al* suggests that women with GDM are more concerned about their health and are therefore more likely to follow lifestyle interventions compared to a non-GDM population[15]. The question whether motivation for lifestyle changes increases when the women receive knowledge of

belonging to a high-risk population was not asked in this master thesis but it might be addressed as the study continues and could also be of importance to increase compliance in future intervention programs.

Conclusions and implications

Certain characteristics and behaviors are more common in women who develop IGR and T2D compared to the women who keep NGT five years after diagnosed with GDM. Some women with previously diagnosed GDM do not expose risk-factors such as high BMI and low socioeconomics, but still progress to T2D five years postpartum, which suggest that we still need more research on risk-factors, protective factors and biomarkes that might influence the onset.

Our non-significant results on physical activity levels might be due to the low physical activity levels within the whole GDM-population compared to a non-GDM population. Physical activity might be an important part of an intervention program, especially for the women who report a total lack of physical activity. Our non-significant results also raises the question if the women's eating behavior have larger impact on disease development than physical activity levels.

So far only a few studies have been undertaken and little attention has been given to the benefits of behavioral intervention for GDM women with risk of developing T2D, and more research is needed to be able to help these women in the future.

Methodical considerations

A strength with this study is that all women were recruited from the same special maternity ward Östra sjukhuset and that the follow-up population seems to be

representative for the whole population. It is also a strength that most women agreed to participate in the follow-up visit and that we used a very well valid questionnaire to estimate the quality of life among the women.

A limitation is that the study is a cross sectional study where some of the data have been collected retrospectively from records five years ago, which means that the study can only be as comprehensive as the data in the medical records permit.

Eight women in the T2D group got the diagnosis at the follow-up visit, but they were not informed about the results until shortly after the visit. They were apparently unaware of their disease and had not been informed about lifestyle interventions such as diet recommendations and physical activity. In this way, these women are very similar to the IGR women but their glucose values are comparable to the T2D women. One can discuss whether these women should be included in the IGR or the T2D group and what impact it might have on our results. As this study is based on glucose values, we included these women in the T2D group.

It would be interesting to analyze women diagnosed with T2D at the follow-up visit as a separate group when more women are included as the study continues. Although, it did not matter if these women ended up in the IGR or T2D group when these two groups were merged into one group referred to as IGM, and compared to the NGT women.

We did not adjust our statistical calculations for time spent at work/at leisure time when we examined physical activity levels, which make the interpreting of the results more difficult. In the future, we also need to include more women to obtain reliable

results and we need to use another questionnaire or method to study the impact of physical activity on women with previously diagnosed GDM.

It is also important to remember that our data on physical activity level is based on self-estimation, which means that it is difficult to know what has been reported correctly and what is over or under reported. This must be taken into account when interpreting the results. It's possible that daily registration of physical activity over a number of days without letting the women value the amount of activity would provide a more accurate and objective description of the women's physical activity level.

We found significant correlations with several confounders of SF-36, such as BMI and physical activity level. The inverse correlation that was found between BMI and the outcome of SF-36 in our study is a well-known correlation confirmed by several other studies and the interpreting manual of SF-36[22,30]. With the methods used in this study we cannot make sure weather our results in SF-36 are explained by women's glucose metabolism or if the results reflects the T2D women's life situation with high BMI, low education, non-Nordic origin and high frequency of unemployment. We could have performed a multivariate regression analysis and make adjustments for well-known confounders of SF-36 such as BMI and education in the analysis of SF-36 to better answer what affects the women's glucose metabolism has on their quality of life. Unfortunately, this was not done in our study but should be addressed in the near future.

Almost 20% (n=16) of the women included in the statistical calculations were missing some values in the SF-36 survey, but were still included in the statistical calculations[23]. Of the total number of women answering the SF-36 survey, 8% of the

women (n=8) were excluded due to missing values. The fact that no one went through the questionnaires with the patients before they were handed in might be a reason for missing values.

My contributions

My contributions to this master thesis has been to spend a considerable amount of time to go through several literature researches, entering the answers from the questionnaires used in the study into the Excel database and to perform the statistical calculations. I have also been on a follow-up visit and met some of the women who participate in this study.

The writing process of this master thesis has given me an insight in how professional research is performed. It has improved my own skills to critically analyze research, results and suggestions found in other studies.

I am very grateful for the privilege to study Medicine and also for having the opportunity to do so at a University were serious research is performed. My ambition is to continue to improve my own skills and to get more experience of medical research. Hopefully, I will be able to combine clinical medical practice with medical research in the future.

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Populärvetenskaplig sammanfattning

Graviditetsdiabetes drabbar 1.7 % av gravida kvinnor i Sverige. Ungefär 30% av kvinnorna som drabbas av graviditetsdiabetes utvecklar typ 2 diabetes inom en femårsperiod efter förlossningen. Trots det finns det inga nationella uppföljningsrutiner i Sverige för kvinnor som drabbas av graviditetsdiabetes.

I vår studie har vi undersökt om kvinnor som uppskattar att de har en hög fysisk aktivitetsnivå löper mindre risk att insjukna i typ 2 diabetes än de som anger att de har en väldigt låg fysisk aktivitetsnivå, fem år efter förlossning. Vi har också undersökt om det är någon skillnad i hur kvinnornas livskvalitet mellan dem som förblir friska eller de som utvecklar typ 2 diabetes fem år efter en graviditetsdiabetes.

Totalt har 507 kvinnor som fick diagnosen graviditetsdiabetes i Göteborg studerats. Fem år efter förlossningen har dessa kvinnor fått erbjudande om ett uppföljningsbesök där de fått genomgå en glukosbelastning. Resultatet från glukosbelastningen har använts för att bestämma vilka kvinnor som utvecklat typ 2 diabetes, nedsatt glukostolerans och vilka som behöll normal glukostolerans fem år efter förlossningen. På besöket lämnade kvinnorna blodprover samt mätte vikt, höft- och midjeomfång. De fyllde också i enkäter angående fysisk aktivitet och livskvalitet.

Hittills har 163 av de 258 kontaktade kvinnorna har kommit till uppföljningsbesöket och blivit medräknade i studien. Av dessa hade 20 % utvecklat typ 2 diabetes, 30 % nedsatt glukostolerans och 50 % hade normal glukostolerans fem år efter förlossningen. Våra resultat visade att kvinnor som utvecklade typ 2 diabetes bland annat hade ett högre BMI, lägre utbildning, var oftare av icke nordiskt ursprung och hade högre frekvens av arbetslöshet jämfört med de kvinnor som återfick normal

glukostolerans. Vi fann ingen skillnad i självskattad fysisk aktivitetsnivå mellan grupperna. Kvinnor med typ 2 diabetes hade lägst självskattad livskvalitet följt av kvinnorna med nedsatt glukostolerans. Högst poäng hade kvinnor med normala sockervärden. Anmärkningsvärt är att vissa kvinnor som utvecklade typ 2 diabetes helt saknade kända riskfaktorer såsom förhöjt BMI.

Vissa egenskaper är vanligare hos kvinnor som utvecklar typ 2 diabetes efter en graviditetsdiabetes men alla riskfaktorer ännu inte är kända och mer forskning behövs. Att vi inte fann någon skillnad i fysisk aktivitetsnivå mellan de som utvecklade typ 2 diabetes och de som förblev friska kan bero på att kvinnorna i vår studie som helhet hade en låg fysisk aktivitetsnivå jämfört med kvinnor som inte haft graviditetsdiabetes. Våra resultat har också väckt tanken på att kvinnornas kostintag skulle kunna spela större roll än fysisk aktivitetsnivå för utvecklandet av sjukdom.

Våra resultat tyder på att kvinnor som utvecklar typ 2 diabetes har lägre livskvalitet än de som förblir friska eller utvecklar nedsatt glukostolerans. Vi tänker att detta kan bero på att kvinnor som drabbas av en livslång sjukdom såsom typ 2 diabetes ändrar sitt sätt att se på sig själv och sin hälsa vilket skulle kunna leda till lägre självuppskattad livskvalitet.

Fler studier behövs för att kunna skapa bra, nationella uppföljningsrutiner för dessa kvinnor. Rekommendationer om fysisk aktivitet tillsammans med kostråd skulle kunna vara en del i uppföljningen för att förhindra utvecklandet av typ 2 diabetes, speciellt för de kvinnor som inte rör på sig alls. I utvecklandet av gemensamma uppföljningsrutiner för dessa kvinnor är det viktigt att komma ihåg att sjukdomsutvecklingen tycks orsakas av flera olika faktorer och att det också finns en psykisk del i att drabbas av en livslång sjukdom såsom typ 2 diabetes.

Appendices

Appendix 1 – Enkät/telefonfrågor för uppföljning postpartum till kvinnor med DWA.

Enkät/telefonfrågor för uppföljning postpartum till kvinnor med DWA. KODNR:

1. **Har du varit på årlig kontroll på VC eller någon annanstans sedan 2005?**

- JA varje år? 1 gång?
- NEJ
- Blivit gravid på nytt inom 1 år
- Inget alternativ stämmer

2. **Har du utvecklat diabetes sedan 2005?**

- JA debutår…… vilken typ av diabetes ……

Nuvarande behandling:

Kost + motion

Kost + tablett + motion

Kost + tablett + insulin + motion

Kost + insulin + motion

- NEJ

3. **Har du utvecklat någon annan sjukdom?**

- JA debutår…….. Vilken sjukdom……
- NEJ

4. **Har du varit gravid efter 2005**

- JA, fick missfall. År…….
- JA. År…….. Utvecklade du DWA? Vilken gravv?.....

Kostbehandling

Kost och insulinbehandling

- NEJ

5. **Din nuvarande vikt?.....**
6. **Skulle du vilja göra en glukosbelastning om du blev erbjuden?**

- JA
- NEJ

7. **Skulle du vilja göra en hälsoundersökning med hjälp av blodprovskontroll om du blev erbjuden?**

- JA
- NEJ

8. **Kan du tänka dig att göra båda två?**

- JA
- NEJ

Appendix 2 – SOS-questionnaire

Table 1. Physical activity questionnaire

(a) These questions refer to your physical activity during *your* ***leisure time*** *during the last 12 months*. If your activity varies a lot between, for instance, summer and winter, please try to average.

Please choose the group that best describes your own physical activity.

a	**(one cross)**
Group 1: Sedentary leisure You spend most of your leisure time reading, knitting and watching TV or film or the like	☐
Group 2: Moderate exercise You walk, cycle or are active in other ways, for at least 4 hours a week; for instance walking or cycling to and from your job, Sunday walks, gardening, fishing or bowling	☐
Group 3: Regular exercise or training You are, for instance, engaged in running, swimming, tennis, badminton or heavy gardening for at least 3 hours a week	☐
Group 4: Strenuous exercise or competition You are engaged in strenuous exercise or competition in, for instance, running, skiing, skating, swimming, soccer or handball regularly, at least 4 times a week	☐

(b) These questions refer to your degree of physical activity ***at work*** *during the last 12 months*. We want to know how much you walk, run, climb and lift when you are at work. Below we have mentioned a few jobs as examples.

Please choose the group that best describes your own physical activity at work

b	**(one cross)**
Group 0: No paid job Retired, pensioner or without a job for other reasons	☐
Group 1: Sedentary work Most of your time you are sitting and you don't walk much at work. For instance, desk workers and assembly-line workers	☐
Group 2: Rather sedentary but not sitting At work you walk around but you don't have to carry around heavy things. For instance, housewife, shopkeeper, teacher	☐
Group 3: Moderately heavy work At work you walk a lot and also carry weight burdens or often walk upstairs or up hills. For instance, postman, heavy industrial worker	☐
Group 4: Heavy work At work you carry heavy loads and in other ways have a very heavy physical job. For instance, forest work, heavy farming, fishing, carrying heavy tools, house builder	☐

Appendix 3 – SF-36

SF-36® Health Survey Scoring Demonstration

This survey asks for your views about your health. This information will help you keep track of how you feel and how well you are able to do your usual activities.

Answer every question by selecting the answer as indicated. If you are unsure about how to answer a question, please give the best answer you can.

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1. In general, would you say your health is:

Excellent	Very good	Good	Fair	Poor
○	○	○	○	○

---

2. Compared to one year ago, how would you rate your health in general now?

Much better now than one year ago	Somewhat better now than one year ago	About the same as one year ago	Somewhat worse now than one year ago	Much worse now than one year ago
○	○	○	○	○

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3. The following questions are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

	Yes, limited a lot	Yes, limited a little	No, not limited at all
a Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports	○	○	○
b Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	○	○	○
c Lifting or carrying groceries	○	○	○
d Climbing several flights of stairs	○	○	○
e Climbing one flight of stairs	○	○	○

f	Bending, kneeling, or stooping	○	○	○
g	Walking more than a mile	○	○	○
h	Walking several blocks	○	○	○
i	Walking one block	○	○	○
j	Bathing or dressing yourself	○	○	○

4. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

		Yes	No
a	Cut down on the amount of time you spent on work or other activities	○	○
b	Accomplished less than you would like	○	○
c	Were limited in the kind of work or other activities	○	○
d	Had difficulty performing the work or other activities (for example, it took extra effort)	○	○

5. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

		Yes	No
a	Cut down on the amount of time you spent on work or other activities	○	○
b	Accomplished less than you would like	○	○
c	Did work or other activities less carefully than usual	○	○

6. During the past 4 weeks, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?

Not at all	Slightly	Moderately	Quite a bit	Extremely
○	○	○	○	○

7. How much bodily pain have you had during the past 4 weeks?

None	Very mild	Mild	Moderate	Severe	Very severe
○	○	○	○	○	○

8. During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?

Not at all	A little bit	Moderately	Quite a bit	Extremely
○	○	○	○	○

9. These questions are about how you feel and how things have been with you during the past 4 weeks. For each question, please give the one answer that comes closest to the way you have been feeling.

How much of the time during the past 4 weeks...

	All of the time	Most of the time	A good bit of the time	Some of the time	A little of the time	None of the time
a Did you feel full of pep?	○	○	○	○	○	○
b Have you been a very nervous person?	○	○	○	○	○	○
c Have you felt so down in the dumps that nothing could cheer you up?	○	○	○	○	○	○
d Have you felt calm and peaceful?	○	○	○	○	○	○
e Did you have a lot of energy?	○	○	○	○	○	○
f Have you felt downhearted and blue?	○	○	○	○	○	○
g Did you feel worn out?	○	○	○	○	○	○
h Have you been a happy person?	○	○	○	○	○	○
i Did you feel tired?	○	○	○	○	○	○

10. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting friends, relatives, etc.)?

All of the time	Most of the time	Some of the time	A little of the time	None of the time

○ ○ ○ ○ ○

11. How TRUE or FALSE is <u>each</u> of the following statements for you?

		Definitely true	Mostly true	Don't know	Mostly false	Definitely false
a	I seem to get sick a little easier than other people	○	○	○	○	○
b	I am as healthy as anybody I know	○	○	○	○	○
c	I expect my health to get worse	○	○	○	○	○
d	My health is excellent	○	○	○	○	○

Thank you for completing these questions!

Appendix 4 - Kost och hälsa under graviditeten vid typ 2 diabetes och graviditetsdiabetes

Kost och hälsa

Uppföljande studie för kvinnor som haft graviditetesdiabetes

mellan år 2005-2009

Sahlgrenska akademin

GÖTEBORGS UNIVERSITET

Datum du fyller i frågorna:.....

Bakgrundsfrågor

Vilken är din huvudsakliga sysselsättning/ yrke?

.....

Nuvarande arbetstid? Timmar/v:.....

Ringa in det som stämmer bäst in på din arbetstid

Dagtid Oregelbundet Natt Skift

Vilken är din högsta avslutade utbildning?

- O Grundskola
- O Gymnasium mindre än eller lika med 2 år
- O Gymnasium mer än eller lika med 3 år
- O Högskola/Universitet mindre än 3 år
- O Högskola/Universitet lika med eller mer än 3 år
- O Annat.....

Är du ensamstående eller gift/sambo?

O Gift/Sambo O Ensamstående

Hälsa

Har du några kroniska sjukdomar? O Ja O Nej

Om ja, vilka?

1. …… Sedan när?……..
2. …… Sedan när?……..
3. …… Sedan när?……..
4. …… Sedan när?……..

Medicinering

Har du tagit några mediciner det senaste året? O Ja O Nej

Vilka?	Hur länge har du tagit dem
1. ……	……
2. ……...	……
3. ……...	……
4. ……...	.....……
5. ……...	……..……

Rökning och snusning

1. Röker du nu? O Ja O Nej

Om ja, hur mycket?

.....cigaretter per dag

.....cigaretter per vecka

2. Om nej på föregående fråga, har du någonsin rökt varje dag? O Ja O Nej

När? Hur länge? .....

Hur mycket?

.....cigaretter per dag

.....cigaretter per vecka

3. Rökte du de senaste 6 månaderna före du blev gravid? O Ja O Nej

Om ja, hur mycket?

.....cigaretter per dag

.....cigaretter per vecka

4. Snusar du nu? O Ja O Nej

5. Om nej på föregående fråga, har du någonsin snusat varje dag? O Ja O Nej

6. Har du snusat de senaste 6 månaderna före du blev gravid? O Ja O Nej

7. Använder du någon annan form av nikotin än rök och snus? O Ja O Nej

(Ex. nikotintuggummi, nikotinplåster etc.)

8. Bor du tillsammans med någon som röker inomhus? O Ja O Nej

Tack för att du tog dig tid att fylla i enkäterna!