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**Weight gain restriction for obese pregnant women  
An intervention study**

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*Förändringens dörr  
kan bara öppnas inifrån...*



## ABSTRACT

**Introduction:** Obesity is a growing global public health problem and is as prevalent among pregnant women as in the general population. It is well known that obese women have an increased risk for several complications during pregnancy and delivery and this is also true for the neonate. Excessive gestational weight gain among obese women seems to further increase these risks for adverse outcomes. It has not been known up to the time of this study whether a behavioral intervention program designed for obese pregnant women could result in a reduction of gestational weight gain.

**Aim:** The overall aim of the present thesis was to study the effect of an intervention program designed to control weight gain among obese pregnant women during pregnancy and to then observe the outcomes of their pregnancies. In addition we wanted to learn if this behavioral intervention program could result in a weight gain of less than seven kilograms.

**Material and methods:** The intervention group consisted of 155 obese (BMI  $\geq 30$  kg/m<sup>2</sup>) pregnant women at the antenatal care clinic (ANC) in Linköping; the control group consisted of 193 obese pregnant women in two other cities. The women in the intervention group were offered, in addition to regular care at the ANC, motivational interviewing in weekly visits to support them in making this behavioral change. They were also offered aqua aerobic class once or twice a week. The women in the control group attended the routine antenatal program in their respective ANCs. Outcome measures were: weight in kg, pregnancy-, delivery and neonatal outcomes, prevalence of anxiety- and depressive symptoms and attitudes and experiences of participating in an intervention program.

**Results:** The women in the intervention group had a significantly lower gestational weight gain and also had a lower postnatal weight than the women in the control group. The percentage of women in the intervention group who gained <7 kg was greater than the percentage in the control group. There were no differences between the two groups in pregnancy-, delivery- and neonatal outcomes. In addition, there was no difference in prevalence of symptoms of anxiety and depressions between the intervention- and control group and the gestational weight gain did not have any effect on symptoms' of depression or anxiety. The women in the intervention group with gestational weight gain <7 kg, weighed less at the two years follow-up than the women in the control group. Most of the women who participated in the intervention program expressed positive attitudes and were positive towards their experiences with the intervention program and their efforts to manage the gestational weight gain.

**Conclusion:** The intervention program was effective in controlling weight gain during pregnancy and did not change the pregnancy, delivery or neonatal outcomes or the prevalence of anxiety- and depressive symptoms. The group with a gestational weight gain <7 kg showed the same distribution of complications as the group with a higher weight gain. The intervention program seems to influence the development of weight in a positive direction up to two years after child birth. The women were also satisfied with their participation in the intervention program.

**Keywords:** obesity, pregnancy, weight gain, intervention, outcome, anxiety, depression, postnatal/postpartum.



## LIST OF PUBLICATIONS

This thesis is based on the following papers, which will be referred to in the text by their Roman numerals:

- I. Claesson IM, Sydsjö G, Brynhildsen J, Cedergren M, Jeppsson A, Nyström F, Sydsjö A, Josefsson A. *Weight gain restriction for obese pregnant women: a case-control intervention study*. BJOG. 2008 Jan; 115: 44-50.
- II. Claesson IM, Brynhildsen J, Cedergren M, Jeppsson A, Sydsjö A, Josefsson A. *Weight gain restriction during pregnancy is safe for both the mother and neonate*. Acta Obstet Gynecol Scand. 2009; 88(10):1158-62.
- III. Claesson IM, Josefsson A, Sydsjö G. *Prevalence of anxiety and depressive symptoms among obese pregnant and postpartum women in a weight-gain restriction program*. Submitted.
- IV. Claesson IM, Sydsjö G, Brynhildsen J, Blomberg M, Jeppsson A, Sydsjö A, Josefsson A. *Weight development after childbirth: A 2-year follow-up of obese women in a gestational weight-gain restriction program*. Submitted.
- V. Claesson IM, Josefsson A, Cedergren M, Brynhildsen J, Jeppsson A, Nyström F, Sydsjö A, Sydsjö G. *Consumer satisfaction with a weight-gain intervention programme for obese pregnant women*. Midwifery. 2008 Jun; 24:163-7.

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## **ABBREVIATIONS**

ANC	Antenatal Care Clinic
ANCOVA	Analysis of Covariance
BAI	Beck Anxiety Inventory
BMI	Body Mass Index
CS	Cesarean Section
EPDS	Edinburgh Postnatal Depression Scale
GWG	Gestational Weight Gain
IOM	Institute of Medicine
LGA	Large for Gestational Age
MDD	Major Depressive Disorder
MI	Motivational Interviewing
OGTT	Oral Glucose Tolerance Test
PIH	Pregnancy-Induced Hypertension
p.p.	Postpartum
PROM	Prelabor Rupture of Membrane
SD	Standard Deviation
SGA	Small for Gestational Age
WHO	World Health Organization



## **INTRODUCTION**

### **Prevalence of obesity**

Obesity is today a worldwide epidemic posing major public health problems, medical as well as psychological (1-4). The latest projections of the World Health Organization (WHO) indicate that at least 400 million were obese globally in 2005, and a Swedish National Institute of Public Health report in 2009, reports a prevalence of obesity around 12-13 % in men and women in Sweden (5, 6). Among pregnant women obesity is a growing problem as well; in 2007 the prevalence in Sweden was 12.1 % (7).

### **Definition and classification of obesity**

A common and objective way to define under-, normal- and overweight and obesity is through calculating Body Mass Index (BMI) as body weight in kilograms divided by length squared. Obesity is defined as  $BMI \geq 30 \text{ kg/m}^2$  (8). Obesity is subdivided into three classes: class I BMI 30.0–34.9  $\text{kg/m}^2$ , class II BMI 35.0–39.9  $\text{kg/m}^2$  and class III BMI  $\geq 40.0 \text{ kg/m}^2$ . For comparison, normal weight is set at BMI 18.5 to  $<25 \text{ kg/m}^2$  and the intermediate weight range from BMI 25 to  $<30 \text{ kg/m}^2$  for overweight.

### **Weight gain during pregnancy**

Weight gain during pregnancy is and has been a topic of ongoing discussions. In 1990, the Institute of Medicine (IOM) in the United States published recommendations for weight gain depending on pre-pregnancy weight, in an attempt to balance the benefits of increased fetal growth with the risks of complicated labor and delivery and of postpartum maternal weight retention (9). The advice given was broad and the range extends from at least 6.8 kg for women with BMI  $>29 \text{ kg/m}^2$  to an upper limit of 18.0 kg for BMI  $<19.8 \text{ kg/m}^2$ . In 2009 these guidelines were reexamined and the new guidelines highlighted not only the welfare of the infant but also the health of the mother (10). The new recommendations were based on WHO BMI classes and included a specific and relatively narrow range of suggested gestational weight gain (GWG) for obese women (BMI  $\geq 30 \text{ kg/m}^2$ : 5.0–9.1 kg).

In 2007, two years before the reexamination of IOM's guidelines, two studies were published that dealt with establishing optimal GWG for each BMI group (11, 12). The results in these studies are based on risk estimates of adverse maternal and fetal outcomes. Cedergren (11) showed in a large Swedish cohort study that decrease in risks of six adverse obstetric and seven neonatal outcomes was associated with lower

GWG limits than those recommended by the IOM. For women with pre-pregnancy BMI  $\geq 30$  kg/m<sup>2</sup>, weight gain less than 6 kg was associated with a reduced risk for undesirable outcomes (11). Kiel et al. (12) reported, in a large cohort study in the USA, a similar limit for GWG in women with pre-pregnancy BMI 30.0–34.9 kg/m<sup>2</sup> to decrease the risk of unfavorable pregnancy outcome. The authors argued that the risk of these outcomes could be lowered in women with BMI 35.0–39.9 kg/m<sup>2</sup> if they gained 0–4 kg, and in women with BMI  $\geq 40$  kg/m<sup>2</sup> if they lost about 4 kg (12).

Cedergren (13) investigated the distribution in 245,526 Swedish pregnant women of gestational weight gain in relation to BMI class. The women were divided into three GWG categories: <8 kg (low weight gain), 8–16 kg and >16 kg (high weight gain). As shown in Table 1 the mean GWG decreased with increasing BMI and among morbidly obese women there were more women who gained within the low weight gain category compared with the other two.

**Table 1.** Gestational weight gain categories according to maternal Body Mass Index class.

Body Mass Index	Gestational weight gain categories (kg)	%	Mean gestational weight gain (kg)
<20	<8	6.9	13.5
	8-15.9	65.2	
	$\geq 16$	28.0	
20.0-24.9	<8	8.4	13.8
	8-15.9	67.1	
	$\geq 16$	30.4	
25.0-29.9	<8	15.7	13.2
	8-15.9	54.4	
	$\geq 16$	29.9	
30.0-34.9	<8	30.2	11.1
	8-15.9	48.7	
	$\geq 16$	21.1	
$\geq 35$	<8	44.6	8.7
	8-15.9	40.9	
	$\geq 16$	14.5	

Based on Cedergren (13)

An excessive GWG is associated with a high risk for postnatal weight retention (14-17). Women with a high GWG, i.e. more than 15.6 kg, retained more weight both at one year follow-up and at 15 years follow-up than did women with low GWG (less than 12 kg) (15). In addition, there was an increased risk of postpartum weight retention with increasing GWG, irrespective of BMI class and parity (18). The interrelationship between weight development and weight retention in subsequent pregnancies and inter-pregnancy weight gain has also been subject of investigation (19, 20). Linné & Rössner (19) found that high weight gainers had a higher pre-pregnancy weight and gained more weight during pregnancy than lower weight retainers. The weight before the second pregnancy had increased and these women gained also more weight and retained more weight after the second pregnancy (19). Villamor & Cnattingius show that even a modest increase of BMI between the first and the second pregnancy could result in adverse pregnancy outcomes (20).

### **Perinatal outcome of obesity**

Maternal obesity is associated with adverse medical outcomes during pregnancy and delivery for both the mother and the infant. A large number of studies and reviews have presented data indicating an elevated risk for these complications (21-38). Some examples of adverse outcomes are illustrated in Table 2.

Studies have also evaluated the association between GWG and increasing BMI during the pregnancy and obstetric and neonatal outcomes (13, 16, 18, 39-41). Low GWG, i.e. less than 8 kg, among obese women decreases the risk for adverse outcomes like preeclampsia, cesarean section, instrumental delivery and children born large for gestational age (LGA), while a high gestational weight gain, i.e. more than 16 kg, on the other hand, was associated with increased risk for these complications (13). Similar results have been reported in studies of women in different BMI classes in relation to GWG (16, 39, 41).

Concerning children born small for gestational age (SGA) a low GWG –less than 8 kg – increases the risk of an adverse outcome, while a weight gain more than 14–16 kg decreases the risk (13, 41). Nohr et al. (2009) investigated whether within different BMI categories the GWG with the lowest risk to mother and infant varied with parity, and found that the risk of SGA decreased with increasing GWG in both primiparas and multiparas (18). However, the risk of delivering a SGA-child was higher in primiparas than in multiparas within similar weight gain groups, but in obese primiparas, a low GWG did not increase the risk for this adverse outcome.

**Table 2.** Complications associated with obesity in pregnant women

Pregnancy	Intrapartum	Fetus/neonate
✓ Infertility	✓ Cesarean section (elective and emergency)	✓ Congenital anomalies
✓ Spontaneous abortion	✓ Increased frequency of induction and higher incidence of failed induction	✓ Early neonatal death
✓ Gestational diabetes mellitus	✓ Increased incidence of perineal tears	✓ Fetal distress
✓ Pregnancy-induced hypertension	✓ Instrumental delivery	✓ Large for gestational age
✓ Preeclampsia	✓ Postpartum hemorrhage	✓ Low Apgar Score (<7 at 5 minutes)
✓ Thromboembolism	✓ Postpartum infections	✓ Macrosomia
✓ Stillbirth	✓ Pre- and post-term onset of labor	✓ Meconium aspiration
	✓ Premature preterm rupture of the membranes/ Preterm rupture of the membranes	
	✓ Prolonged labor	
	✓ Shoulder dystocia	

### Psychological health in obese pregnant women

The psychological well-being among a general population of pregnant and postnatal women has been closely investigated in a number of studies (42, 43). Symptoms of depression have been investigated to a greater degree than symptoms of anxiety. Ross et al. state in a systematic review that anxiety disorders of various kind are common during the perinatal period and Sutter-Dallay et al. report the prevalence of anxiety disorders (including agoraphobia, generalized anxiety disorder, panic disorder, obsessive-compulsive disorder, social-phobia and post-traumatic stress disorder) during pregnancy to 24 % (43, 44). The prevalence of symptoms of depression during pregnancy and postpartum has been reported in two Swedish studies to vary between 14 % and 17 % during pregnancy and between 11 % and 13 % postpartum (45, 46). Both anxiety and depression during pregnancy are strong predictors for postpartum depression (42, 44). Obese pregnant women may also run a high risk for adverse psychological well-being, but so far this topic has been only poorly described and investigated.

Three American studies that have investigated the association between BMI and depressive symptoms reported divergent results (47-49). LaCoursiere and colleagues (47) reported a prevalence of depressive symptoms of 30.8 % two to six months postpartum in a group of approximately 600 obese women; they suggested that the results indicate a potential association between pre-pregnancy BMI and self-reported postnatal depressive symptoms. In contrast with these results, Krause and co-workers

found a prevalence of depressive symptoms of 9.2 % six weeks post partum among a group of approximately 500 overweight and obese women, but found no relationship between BMI and postpartum depression (48). In a recent prospective cohort study of the relationship between pre-pregnancy BMI and the likelihood of major depressive disorder (MDD) during pregnancy an effort was made to also determine if this association was modified by gestational weight gain (49). The authors found a strong positive dose-response association between pre-pregnancy BMI and the likelihood of MDD and reported a prevalence among obese women of 41.9 % in gestational week 20, 43.8 % in week 30, and 31.7 % in week 36. They showed that gestational weight gain modified the effect of pre-pregnancy BMI on the likelihood of MDD. Obese women ran a higher risk than women with BMI 18 irrespective of whether GWG was below, within or above the values specified in the 1990 IOM recommendations (49).

### **Treatment of obesity**

As obesity is a chronic and progressive condition it requires lifelong treatment just as do other chronic diseases (50). It is known that it is difficult to prevent and to treat obesity. A majority of population-based programs with the aim of preventing obesity have been scientifically assessed and most have found no favorable effects on the prevalence of obesity (51). According to the authors there are new outreach strategies designed to disseminate the latest information about the causes and risks of obesity and to change dietary habits and motivate individuals to become more physically active. These new methods need to be developed and assessed (51). Sharma reviewed reports on 23 behavioral intervention programs for preventing and treating obesity published during the last decade (52). Most of the interventions focused on both physical activity and nutritional behaviors. They ranged in duration from three weeks to nine years but approximately half of them proceeded for less than six months. Interventions shorter than six months were found to have a higher failure rate than longer interventions. This finding is in accordance with a Swedish review of the literature by Asp (51). Sharma (52) found that most of the interventions were not based on any explicit behavioral theory, and he noted that use of a theory helps the researcher to determine which components work and which do not work. Sharma also observed that if behavioral theories are applied adequately, then the length of the intervention can be reduced and more meaningful interventions, shorter than a year, can be designed (52). Treatment through counseling that focuses on providing advice about reduction of energy and fat intake can lead to a weight reduction during the first year, but the long-term effects are uncertain (5, 51).

Following a "Very Low Calorie Diet" is another method of treatment that might in theory result in a greater reduction than a conventional low energy diet, but studies encompassing one to two years have shown that the treatment was often periodic and the retained weight loss was only a few kilograms more than in those whose treatment only consisted of following a balanced diet (51).

Pharmacological and surgical treatments are two other methods that have been employed. Rubio and colleagues reviewed the use of drugs in the treatment of obesity (53). The drugs Orlistat and Sibutramine (because of increased risk of cardiovascular events the medicine Sibutramine was withdrawn in January 2010 after recommendation from European Medicines Agency) have been found to have a greater effect on weight loss than placebo treatment. Pharmacological treatment of obesity must be considered as a tool to be used together with long-term lifestyle change (53).

Surgical treatment is an option in severely obese patients. In a review by Bult et al, currently used operative treatment for obesity and their effectiveness and complications were evaluated (54). The authors concluded that bariatric surgery is the most effective treatment for long-term weight reduction and should be considered for persons with BMI >40 kg/m<sup>2</sup> and for persons with BMI >35 kg/m<sup>2</sup> with obesity-related co-morbid conditions. The mean weight loss is maximal during the first two years after the operation and slowly increases until about ten years after when the weight stabilizes (55). The intervention carries a risk for complications but evidence to date shows that bariatric surgery is associated with decreased overall mortality (54).

### **Expected weight loss goals in relation to achieved goals in obesity treatment**

A common question in treatment of obesity is about the unmet expectations and what that may lead to. The appropriate treatment goal has been discussed and a weight loss of 5–10 %, if it is persistent, might improve medical conditions related to obesity (51). Some studies have investigated the setting of unrealistic weight loss goals (56-61) and the satisfaction with the achieved weight loss (59). Foster and colleagues assessed in a study of obese American women goals their expectations before, during and after 48 weeks treatment (56). The women defined their "dream"-, "happy"-, "acceptable"- and "disappointed" weight and expected after the treatment to attain a reduction of 32 % body weight. A 25-kg weight loss was "acceptable" while a weight loss of 17 kg was defined as a "disappointed" weight. At the end of the treatment none had reached a "dream weight", 9 % had reached a "happy weight", 24 % had reached an "acceptable weight" and 20 % had reached a "disappointed weight". A total of 47 % had not achieved even a "disappointed weight" despite a weight loss of 16 kg (56).

In another study of Foster and co-authors, aiming to increase the understanding about obese persons' perceptions and expectations of treatment outcome, the role of different factors such as physical characteristics and treatment setting was investigated among American men and women seeking obesity treatment (61). The initial body weight was the strongest predictor for what the patient defined as "happy"-, "acceptable"- and "disappointed weight" while sex and height were the strongest determinants of a "dream weight". Patients with the highest pretreatment weight were likely to have the most unrealistic expectations for success (61). In a Swedish study of Linné et al. the weight loss expectations and the weight loss among morbidly obese men and women participating in a combined diet-exercise-behavioral modification program were described (57). Weight loss expectations were generally unrealistic and women wanted to lose more, up to 42 % of their baseline weight compared with men who were satisfied with 29 % of their baseline weight. There were no relationships between achieved weight loss and age for either sex (57).

Fabricatore et al. found in a randomized controlled trial among obese American men and women in four groups seeking behavioral and/or pharmacological treatment, that the expected weight reduction after one year of treatment was greater than the 5–15 % of initial weight they were told was realistic and more than they ever had lost before (59). Additionally, they found that failure to meet weight loss expectations for the first half year of treatment was related to a lower satisfaction rate but not related to more drop outs or weight regain during the next six months. Symptoms of depression were reduced from baseline, regardless of whether participants achieved or failure to achieve their expected weight losses and interestingly the extent to which the participants met their expectations after a half year of treatment was not correlated with their motivation to continue to lose weight (59).

In a study of Wamsteker et al. designed to investigate the frequency of unrealistic personal weight loss goals among obese Dutch women and men, seeking professional dietary treatment, unrealistic goals were observed in 49 % of the patients and the personal weight loss goals exceeded the medically advised goal by more than 50 % (60). Unrealistic goals were associated with age. The younger the patients, the more unrealistic the goals, and patients who attributed their obesity to a physical cause had more unrealistic goals than patients who attributed their obesity to behavioral causes (60). In another study the ideal goals of low-income African American women with an average BMI = 38.8 kg/m<sup>2</sup>, enrolled in a six months weight loss intervention, were examined and a required weight reduction of 29 % was reported, which demonstrates satisfaction with achieving a weight placing them in the overweight range (58). The ideal loss was over five times greater than the average past weight loss. Expected goals

of gestational weight gain among a general population of pregnant women or among obese pregnant women have to our knowledge not been a subject for research.

## **INTERVENTION**

### **Motivation for a change**

Interest in motivation often originates from the question: “Why don’t people change a destructive behavior in spite of knowing that there are better ways to solve problems than engaging in such behavior?” But one can also raise the question: “Why do people change?” According to Miller and Rollnick (62) it is necessary for a person to detect a discrepancy between present behavior or situation and what one wants to be or wants to have. Perceived discrepancy may motivate a change, and the likelihood that a change will occur is strongly influenced by interpersonal relationships in a counseling session. Of particular importance in this relationship between a counselor and a client is accurate empathy, which involves skillful reflective listening by the counselor in order to seek to understand the client’s feelings and perspectives without imposing the counselor’s own personal history and judging, criticizing or blaming. This acceptance is not the same as agreement or approval, but is rather a means of respecting the opinions of the person.

The degree of empathy shown by the counselor can be a significant determinant of the clients’ response to treatment. Motivation for change arises in an atmosphere characterized by acceptance and empowerment and a therapeutic relationship tends to stabilize relatively quickly where the spirit between the counselor and the client in early sessions predicts treatment retention and outcome. People who believe that they are likely to change do so and people whose counselors believe that they are likely to change do change. The statements of the client, during counseling, about the possibility of change reflect motivation for and commitment to a change that will actually occur and it is important that the argument for change is presented by the client and from the client’s perspective. Formal treatment is not a requirement for a positive change, but can also occur without treatment and the processes seem to be the same.

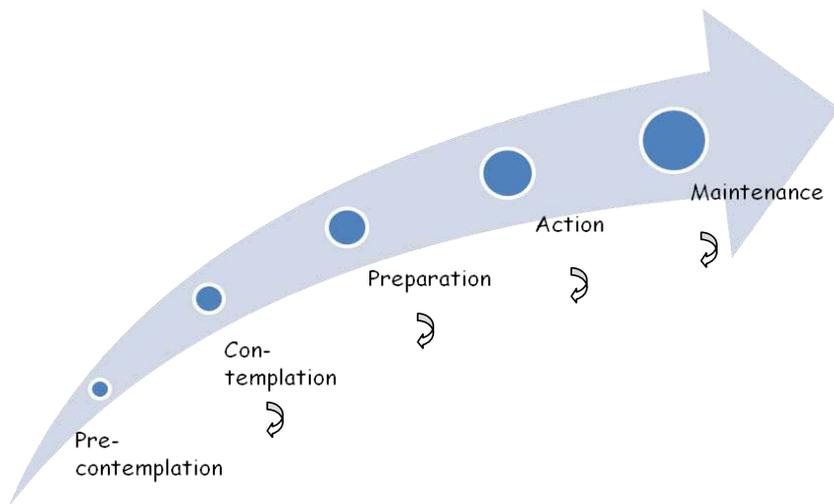
In a process of change, ambivalence can be regarded as a natural phase that the client passes through, but if the client gets stuck in this phase, then problems can persist and intensify. Resolving ambivalence can be a key for change to occur.

In addition, willingness, ability and readiness are key components in motivation for change. Willingness can be described as being able to accept the importance of change and one can look at the measure of willingness as being the degree of discrepancy between what is happening at present and the goal set for the future. When the discrepancy between present state and the desired or expected ideal begins to decrease, then change has begun. A person can feel willing to change but not be able to change because of pessimistic feelings about the chances for change to occur. She has

knowledge of the importance of change but her confidence is low. If she finds a way for change that she can believe will work and that she believes she can implement, she will often pursue the desired change by changing her behavior. The third key component is readiness. A person can be willing and able to change, but not ready to do so because change is not seen as being the most important thing just then. A behavior change seems to arise when a person connects change with something of an inherent value, something important and something appreciated.

### Stages of change

There are a series of stages through which a person must pass when a behavior is being changed. Prochaska et al. and DiClemente et al. identified and viewed these stage as pre-contemplation, contemplation, preparation, action and maintenance (63, 64). The individual goes from being unaware or unwilling to do anything about the problem, to undertaking a serious evaluation of considerations for or against change. Then after planning and becoming prepared to make a change, the individual finally can take action and maintain the change over time. The movement from one step to another can be straightforward and linear, but normally one or more slips occur and one returns to an early stage and then begins progressing through the stages over again (Fig. 1). A change takes time and years of action may pass before a new behavior is completely established.



**Figure 1.** Stages which a person passes through during a process of change.

Moving through the stages requires effort and energy for thinking, planning and doing, and motivation is needed from the beginning to the end of the process of change. Motivational interviewing (MI) can be used to support an individual in transition from one stage to another. In order to give optimal support during this process, it is necessary for the counselor to face the challenge of identifying the stage in which the person is located at the time. If the counselor does not meet the person on the correct level during the deliberation, the client’s confidence can be upset.

### Motivational Interviewing

Motivational Interviewing is a change-oriented conversational methodology described by William Miller and Stephen Rollnick in 1991 in their first book (62). They defined this approach as *a client-centered, directive method for enhancing intrinsic motivation to change by exploring and resolving ambivalence* ; page 25 in (62) an approach that may be seen as “a way to be with people”. Of great importance is the underlying spirit in understanding and experiencing the human nature. The approach of MI is illustrated in Table 3.

**Table 3.** The spirit of motivational interviewing

<b>The Spirit of Motivational Interviewing</b>	
Fundamental approach of motivational interviewing	Mirror-image opposite approach to counseling
<p><i>Collaboration.</i> Counseling involves a partnership that honors the client’s expertise and perspectives. The counselor provides an atmosphere that is conducive rather than coercive to change.</p> <p><i>Evocation.</i> The resources and motivation for change are presumed to reside within the client. Intrinsic motivation for change is enhanced by drawing on the client’s own perceptions, goals and values.</p> <p><i>Autonomy.</i> The counselor affirms the client’s right and capacity for self-direction and facilitates informed choice.</p>	<p><i>Confrontation.</i> Counseling involves overriding the client’s impaired perspectives by imposing awareness and acceptance of “reality” that the client cannot see or will not admit.</p> <p><i>Education.</i> The client is presumed to lack key knowledge, insight, and/or skills that are necessary for change to occur. The counselor seeks to address these deficits by providing the requisite enlightenment.</p> <p><i>Authority.</i> The counselor tells the client what he or she must do.</p>

From Miller & Rollnick “Motivational Interviewing, Preparing People for Change”;page 35 in (62)

In this method for “being with people” during a counseling session there are four general principles that serve as determining factors. The first two, expressing empathy and developing discrepancy are mentioned above. The third principle is to avoid arguing for change. Arguing means resistance and can prevent the client from being able to be active in the process of problem solving. For the counselor this is the signal to shift the approach. The last important principle is to support self-efficacy in enhancing the client’s confidence in her capacity to succeed in making a change. The belief in the possibility of a change is an important motivator and a rather good predictor of outcome. The counselor can support and encourage but the client is responsible for choosing and carrying out change. Counselor sessions normally occur at several occasions but it is important to know that brief intervention sessions under certain conditions can initiate a change and one or two brief counseling sessions can often yield much greater change in behavior than no counseling at all (62).

### **Published intervention studies designed to prevent excessive weight gain during pregnancy**

There are still very few published intervention studies designed to restrict gestational weight gain, even if the number has increased during the last few years (Table 4). The objectives - to evaluate or to investigate whether an intervention prevents excessive weight gain during pregnancy - are the same in all of the studies but one (65). In the study by Thorntorn et al. the primary aim was to compare perinatal outcomes between a study- and control group (65). However, the number of participants, inclusion criteria and study design differ from study to study. The number of subjects in these studies varies from 50 women in the study by Wolff (66) to 560 women in the study by Olson (67). In the studies by Grey-Donald et al., Polley et al. and Kinnunen et al. (68-70) no BMI limitations at the time of recruitment are reported, while the study of Asbee et al. (71) sets an upper limit of BMI higher than 40. Olson et al. (67) recruited women with BMI between 19.8 and 29.0 and Artal et al (72) women with a BMI higher than 25. Three studies included only obese women (65, 66, 73).

Kinnunen et al. (70) recruited only primiparas, while Artal et al. (72) included only women with gestational diabetes mellitus. Five studies (65, 66, 69, 71, 73) were designed as randomized controlled trials, while in the remaining four studies (67, 68, 70, 72) the intervention- and control groups were recruited in different ways. In two studies (68, 70) the intervention was based on a theoretical framework. All the studies (65, 67-73) but one (66) included counseling or instructions on diet and exercise. In the study by Wolff et al. (66) the intervention was based on counseling on healthy eating habits. The number of counseling sessions range from four in the studies by

Grey-Donald et al. (68) and Guelinckx et al. (73) to weekly visits in the study by Artal et al.(72). In four of the studies (67-69, 73) the individual counseling was complemented with mailed/e-mailed newsletter or education program and public activities during the recruiting period.

As concerns the differences between the studies, it is difficult to draw far-reaching conclusions from the results, which differ concerning gestational weight gain. Six studies reporting the effects of the intervention (65-67, 69, 71, 72). Polley et al. (69) found a significant decrease in the percentage of normal-weight women in the intervention group who exceeded the weight set in the IOM recommendations, while the overweight/obese women who got the intervention showed a significant increase. Olson et al. (67) found that low-income women in the intervention group consisting of normal- and overweight women had a significantly reduced risk of excessive gestational weight gain. In the study by Artal et al.(72) of over-weight and obese women with GDM, the weight gain per week was significantly lower in the intervention group than in the control group, while Wolff et al.(66) and Thornton et al. (65), in studies that included only obese women, found that the gestational weight gain was less among the intervention women than among the controls. Finally, Asbee et al. (71) found that the women in the intervention group gained less weight during pregnancy than women in the control group. This study set an upper limit of BMI >40.

**Table 4. Previously published intervention study to prevent excessive weight gain during pregnancy**

Study Authors	Sample/Design	Study Purpose	Intervention and theoretical framework	Outcome Measures	Results
Gray-Donald et al. (68) (2000)	219 pregnant women (Canada): 112 in an intervention group and 107 as their controls. A prospective intervention study. One period with recruiting controls, followed by one period with recruiting women to the intervention group.	Evaluation of an intervention aimed at improving dietary intake during pregnancy, optimizing gestational weight gain, glycemic levels, birth weight and avoiding unnecessary postpartum weight retention.	Regular individual diet counseling (mean 4.03) by nutritionists and health care workers (dietary advice related to improving the intake of dairy products, fruits and vegetables and decreasing the intake of high-energy foods with little nutritional value), Physical activity sessions as exercise /walking groups. During the intervention period was focal radio broadcasts sending messages about healthy eating in pregnancy and there was also pamphlets about nutritional choices an encouraging breast-feeding. Super-market tour and cooking demonstrations were also arranged. The intervention was based on social learning theory.	Dietary intake, weight in kg, plasma glucose level in mmol/L, birth weight in g.	No differences in diet, weight gain or plasma glucose level during pregnancy or mean birth weight of the infant. The maternal weight postpartum (p.p.) was similar in the two groups. Significant differences in reduction in caffeine during pregnancy and increase in folate p.p.
Polley et al. (69) (2002)	110 normal or overweight/obese pregnant women (USA): 57 in an intervention group and 53 as their controls. A randomized controlled trial.	To determine whether a stepped care, behavioral intervention will decrease the percentage of women who gain more than the Institute of Medicine (IOM) recommendation.	Individual counseling in connection with regularly scheduled clinic visits by staff with training in nutrition or clinical psychology. Initially written and oral information about appropriate gestational weight gain (GWG), exercise and healthful eating during pregnancy. Biweekly newsletter concerning the two last-mentioned topics. Review and feed-back of weight gain and progress toward behavioral goals. Assessment of current eating and exercise with computerized nutrition analysis. Problem-solving and goal-setting and instruction in the use of behavioral techniques. A stepped-care approach was used, where the woman was given increasingly structured behavioral goals at each visit if her weight continued to exceed the recommended levels. Telephone-contact between the clinic visits. No theoretical framework.	Weight in kg, GWG in perspective of the IOM guidelines. Pregnancy complications and fetal outcomes. Self-report measures of dietary intake and exercise expenditure.	The intervention significantly decreased the percentage of normal-weight women who exceed the IOM recommendations. Non-significant effect in the opposite direction among overweight/obese women. No differences in infant birth weight or gestational weeks between the groups. The number of obstetric complications was too small for statistical analysis. Further there were no difference between the groups in p.p. weight, but the weight retention was strongly related to weight gain during pregnancy. No differences in dietary or exercise level.

**Table 4. continuation**

Study Authors	Sample/Design	Study Purpose	Intervention and theoretical framework	Outcome Measures	Results
Olson et al. (67) (2004)	560 normal or overweight pregnant women (USA); 179 in an intervention group and 381 as their controls; 517 postpartum women; 158 in the intervention group and 359 as their controls. A prospective cohort design with a historical control group.	Evaluation of the efficacy of an intervention directed at preventing excessive GWG.	The intervention which was designed to encourage reaching a GWG within the recommendations of IOM, had 2 components: a clinical part including guidance by health care providers and a by- mail patient educations component. No theoretical framework.	Biological and demographic data. Weight in kg. GWG in perspective of the IOM guidelines.	Low-income women in the intervention group had a significantly reduced risk of excessive GWG. Overweight low-income women and high-income normal weighted women had a significantly reduce risk of retaining more than 2.27 kg (5lb) one year p.p.
Kinnunen et al. (70) (2007)	105 pregnant primiparas (recruited by 15 public nurses in six maternity clinics) (Finland); 49 in an intervention group and 56 as their controls. A controlled trial.	To investigate whether individual counseling on diet and physical activity during pregnancy can have a positive effect on diet and leisure time physical activity (LTPA) and prevent excessive GWG	Individual counseling on diet and LTPA during 5 routine visits to a public health nurse trained for the study, until 37 weeks' gestation. Information about GWG according to IOM was given at the first visit. The counseling procedure was based on a behaviorally grounded model.	Weight in kg. GWG in perspective of the IOM guidelines. Meal pattern, intake of vegetables, fruit, berries, high-fiber bread and high-sugar snacks and total energy intake. Total multiples of resting metabolic equivalent minutes/week as an outcome for LTPA	No difference between the groups in exceeding the weight gain recommendation. The proportion of high-fiber bread of the total weekly amount of bread decreased more in the control group than in the intervention group. The intake of vegetables, fruit and berries increased more in the intervention group than in the control group. No difference in LTPA. No weight follow-up p.p.
Artal et al. (72) (2007)	96 overweight and obese gestational diabetes mellitus (GDM) (USA); 39 self-enrolled in an intervention group and 57 as their controls. A case-control study.	Evaluation of whether a weight gain restriction regimen, with or without exercise, would impact glycemic control, pregnancy outcome and total GWG in obese women with GDM.	All women were provided a eucaloric or hypocaloric consistent carbohydrate meal plan and instruction in the self-monitoring of blood glucose by a dietitian and a diabetes nurse. Women in the intervention group were also prescribed an exercise routine equivalent to a 60 % symptom-limited $\dot{V}O_{2\max}$ . Weekly or biweekly visits. The instruction for exercise, at least 6 days/week, was based on American College of Obstetrics and Gynecology guidelines for exercise in pregnancy	Weight in kg. birth weight in g. large/small for gestational age.	The weight gain per week was significant lower in the intervention group. Women in both groups who gained weight had a higher but not significant percent of infant with diagnosis large for gestational age, than those women who lost weight or had no weight change during pregnancy. No weight follow-up p.p.

**Table 4. continuation**

<b>Study Authors</b>	<b>Sample/Design</b>	<b>Study Purpose</b>	<b>Intervention and theoretical framework</b>	<b>Outcome Measures</b>	<b>Results</b>
Wolff et al. (66) (2008)	50 obese pregnant (Denmark); 23 in an intervention group and 27 as their controls. Randomized controlled trial.	To investigate whether restriction of GWG (6-7 kg) can be achieved by dietary counseling and whether this restriction could reduce the pregnancy-induced increases in insulin, leptin and glucose.	The women in the intervention group received 10 consultation of one hour with dietitian during pregnancy. The women were instructed to eat healthy diet according to the official Danish dietary recommendations. No theoretic framework.	Weight in kg. Fat-, protein- and carbohydrate intake. Fasting blood samples for measurements of serum insulin, serum leptin and blood glucose.	The women in the intervention group had a lower energy intake and a lower gestational weight gain than their controls. Both serum insulin and serum leptin were significantly reduced in the intervention group at gestational week 27 and in week 36 the serum insulin was further reduced and also the fasting blood glucose. Four weeks p.p. retained the intervention group less weight than the control group.
Asbee et al. (71) (2009)	100 pregnant women (USA); 57 in an intervention group and 43 as their controls. Randomized controlled trial.	To estimate whether an organized consistent program of dietary and lifestyle counseling prevents excessive weight gain in pregnancy.	Dietary and lifestyle counseling according to a standardized protocol by a dietitian at the initial visit. Instruction to engage in moderate-intensity exercise 3-5 times/week. Information about the appropriate GWG according to IOM guidelines. The weight was measured at each routine obstetrical appointment and feed-back and eventually advice was given of the health care provider. No theoretical framework.	Weight in kg. GWG in perspective of the IOM guidelines. Mode of delivery, pregnancy- and delivery complications and birth weight.	The women in the intervention group gained less weight during the pregnancy and there was also less cesarean section (CS) due to "failure to progress" compare with their controls. Women in both groups who were not adherent to the IOM recommendations had heavier infants. Nulliparas gained more weight than multiparas. The most predictive factor of IOM adherence was normal pre-pregnancy body mass index. No differences between the groups in adherence to IOM guidelines, rate of CS, pre-eclampsia, GDM, operative vaginal delivery or vaginal lacerations. No weight follow-up p.p.

Table 4. continuation

Study Authors	Sample/Design	Study Purpose	Intervention and theoretical framework	Outcome Measures	Results
Thornton et al. (65) (2009)	232 pregnant women (USA): 116 in an intervention group and 116 as their controls. Randomized parallel-group trial.	To compare perinatal outcome and weight stabilization between active nutritional and behavioral intervention and conventional dietary prenatal management. To determine perinatal differences in the study group's adherence vs non-adherence to a prescribed nutritional regimen applicable to the general practice of obstetrics. To evaluate outcomes of obese women who gained <math>< 6.8 \text{ kg}</math> or <math>> 4.5 \text{ kg}</math>.	The intervention group was at entry into the study prescribed a balanced nutritional regime based on their weight. All consumed foods and beverages during each day were recorded in a diary. The control group was told to eat to appetite following general prenatal dietary guidelines. Both groups were weighted at each prenatal visit and six weeks p.p., encourage to engage in 30 min walking/day and also counseled at least once by a dietitian but the intervention group was given more detailed information similar to those used in patients with GDM. No theoretical framework.	Perinatal outcome (13 variables), weight in kg.	The women in the intervention group had a lower GWG, weighted less at the last weight before delivery and 6 week p.p. compared with the control group. There were fewer cases of gestational hypertension in the intervention group. No differences in birth weight. Apgar Score or macrosomia between the groups. Regarding adherence vs non-adherence with prescribed nutritional regime there were differences within the study group composed of lower GWG, lower last weight before delivery and 6 weeks p.p., lower birth weight, fewer cases of GDM, preeclampsia, labor induction, CS and macrosomia in the adherent group. A lower GWG were also associated with fewer cases of adverse outcomes.
Guelinckx et al. (73) (2010)	122 obese (BMI >29.0) pregnant women (Belgium): 42 in an active intervention group, 37 in a passive intervention group and 43 in a control group. Randomized controlled trial.	To study which degree of intervention can improve dietary habits according to the National Diet Recommendations, increase physical activity level in obese pregnant women and control GWG	The active group received a brochure, with advice about nutrition, physical activity and tips to limit pregnancy-related weight gain, at the first prenatal consultation. Further actively counseled by a trained nutritionist in three group sessions at gestational week 15, 20 and 32, focusing on a balanced healthy diet. The passive group received the brochure mentioned above. The control group received routine prenatal care. The weight was measured at each antenatal visit. No theoretical framework	Weight and GWG in kg. Nutritional habits were evaluated every trimester through seven-day records. Physical activity was evaluated with the Baecke Questionnaire. Pregnancy- and delivery complications. Birth weight in kg.	No difference in GWG or GWG in accordance with IOM recommendations between the three groups. No differences in pregnancy- or delivery complications, in mean birth weight or infants with birth weight >4000 g, between the groups. The energy intake was comparable in all groups. Fat intake decreased and protein intake increased in the two intervention groups and had the opposite change in the control group. Calcium intake increased while physical activity decreased in all three groups. No weight follow-up p.p.



## **AIMS OF THE PRESENT THESIS**

The overall aim of the present thesis was to study the effect of an intervention program among obese pregnant women on weight gain and pregnancy outcome.

More specifically, we wanted to investigate

... if a behavioral intervention program providing obese women with weekly motivational talks and regular physical activity throughout the pregnancy would result in a reduced weight gain, <7 kg, compared with a control group who received regular antenatal care (Paper I).

... whether pregnancy, delivery and neonatal outcome among obese pregnant women who took part in an intervention study for weight restriction differed from a group of obese pregnant women attending regular antenatal care (Paper II).

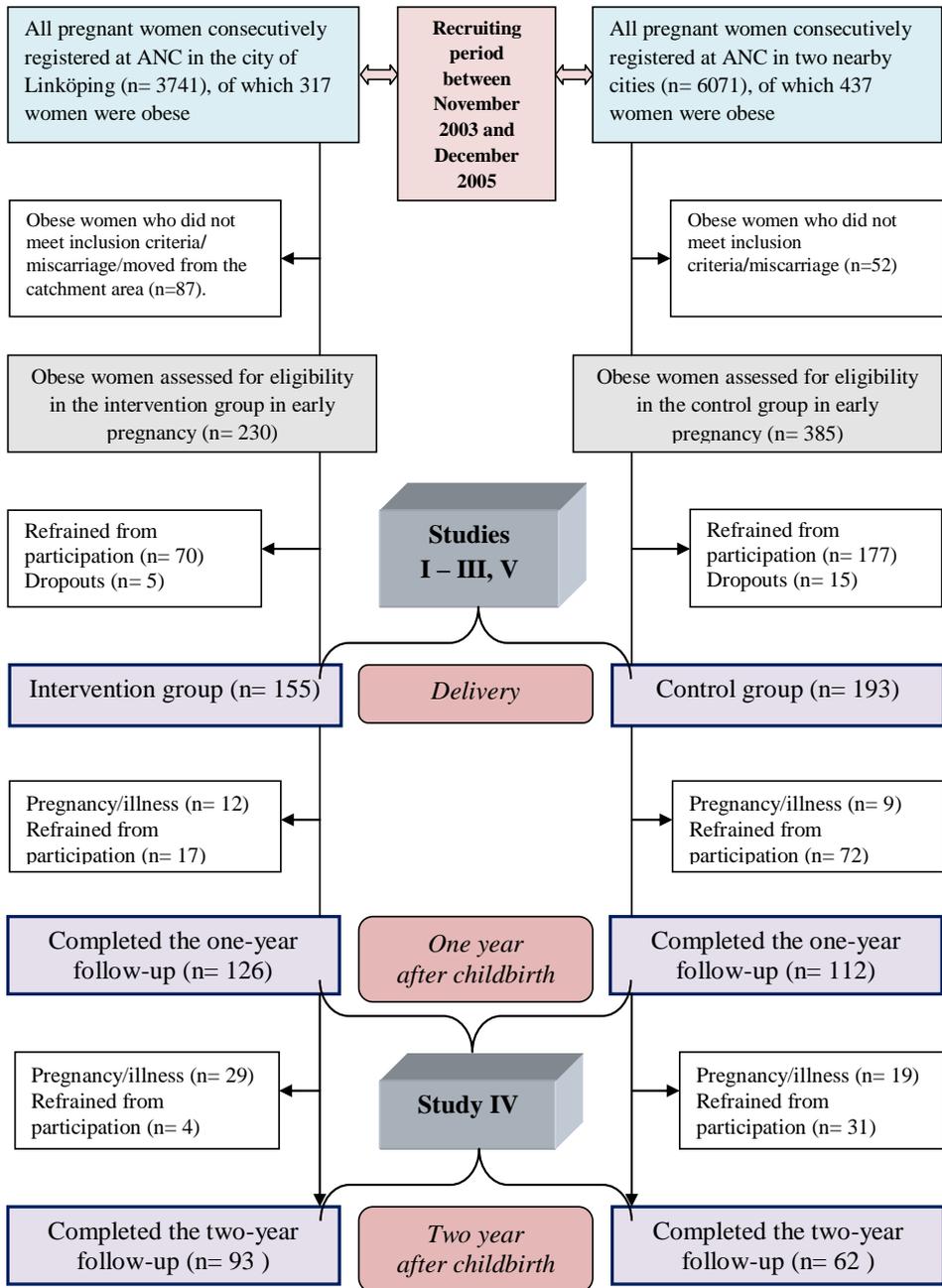
... psychological well-being measured as symptoms of depression and/or anxiety among obese pregnant women attending a weight gain restriction program and to make comparisons of this group with a control-group receiving regular antenatal care (Paper III)

... the effect of the program concerning gestational weight gain restriction on weight gain or weight maintenance for the women in the intervention group and their controls two years after childbirth and furthermore to investigate the course of weight development over time on the basis of pregnancy weight gain of <7 kg (Paper IV).

... the attitudes and satisfaction among women attending a weight-gain intervention program during pregnancy (Paper V).



## SUBJECTS IN THE STUDY



**Figure 2.** Description of the population during the study period



## METHODS IN THE STUDY

### The intervention group in the present study

All women in the intervention group were informed at the time of the first telephone contact with the Antenatal Care Clinic (ANC) or at the first visit at ANC, both verbally and in writing, about the study and were invited to participate in the study. Women who agreed to participate met a specially trained midwife (the author IMC) at all individual visits at the ANC once a week during pregnancy and made on average 22.1 visits during pregnancy: 7-9 check-ups according to the antenatal care program and additionally on average 14.1 (range 10-24) extra visits. The partner of the woman was also invited to take part in these visits.

The first counseling session was one hour long and encompassed besides weight measurement more detailed information about the study. The woman and, in appropriate cases, her partner were asked about their knowledge of the impact of obesity during pregnancy, on the birth process and on the infant. If the woman/couple lacked sufficient knowledge she/they was/were offered the information and given accurate facts. In addition, a conversation was carried out about the woman's current and previous weight situation and her thoughts about the importance of and confidence in the possibility of a change in lifestyle concerning energy intake and energy expenditure. She was encouraged to ask herself, for example: *Is it something that I need to change? Is it something that I can change?* Finally the most important question was: *Is it something that I want to change?* The goal for weight gain, <7 kg during the pregnancy, was also discussed and this was only discussed at the first session.

The counseling sessions that followed once a week at ANC were 30 minutes long and encompassed weight control, pregnancy check-up according to the regular antenatal program and supportive talk according to the methodology of motivational interviewing (62). The deliberation had its starting-point in the woman's current thoughts and views about a lifestyle change. At every visit, the woman was given a chance to discuss her reflections on the preceding week including thoughts that had arisen and suggestions about and possible preparations for taking steps towards changing behavior. The woman frequently assessed verbally the importance of a change and how she assessed her confidence in being able to succeed in making a change. On the current basis of the woman's proposed steps for change (63), we discussed the pros and cons of a change and also the current possibilities and obstacles in the process and how to handle them. Changes that had been performed, small or

large, were identified and the probable next step and the readiness for taking this step were discussed continuously.

All women kept a food diary during four consecutive days (week- and holidays), which constituted a basis for a deliberation about the need for a change in meal contents and the meal standard. The woman's views and reflections about her food intake were requested and she was asked if this was something she was going to change and in that case how. No food advice or instruction was given unless the woman asked for this. In addition, we discussed how to distinguish between feelings of real hunger and feelings of needing a snack or quick pickup and how to handle the different feelings.

All the women also got a diary in which they could register physical activity and all the women were also invited to an aqua aerobic class (once or twice a week) especially designed for obese women and guided by a midwife with education in aqua aerobic. A total of 106 women (68.4 %) participated on average 9.5 times in the aqua aerobic class. The women were advised to set a goal of total daily physical activity from early pregnancy lasting at least 30 minutes and, preferably, 60 minutes of moderate-intensity physical activity such as a quick walk. This advice was based on a recommendation produced by Professional Associations for Physical Activity, a section within the Swedish National Institute of Public Health and accepted by The Swedish Society of Medicine (74). The recommendation is in turn based on an American recommendation from 1995, which was updated in 2007 (75, 76). How the woman performed the activity i.e. type of activity, was not discussed unless a woman asked for advice. If she was not used to exercising at the recommended level, she was told to initially choose a lower level and gradually increase. The diary was followed up during the pregnancy, with the aim of giving support and encouragement to the woman.

During the follow-up period, the first two years after childbirth, the women in the intervention group made a 30 minutes visit to the ANC every six months. These visits encompassed weight control and the woman was asked to take part in a dialogue about her views on how to handle the weight in the light of her new role as mother and in the new family constellation. The deliberations could concern changed routines that the woman was pleased with, but could also concern routines that functioned well during pregnancy but not so well postpartum. If the woman desired supportive motivational talk whether she had met with success or misfortune, this support was given.

For more information about the study schedules for the intervention- and control group, see appendices 1 and 2.

## **Paper I**

The study was designed as a prospective case-control intervention study with control group. Obese (BMI  $\geq 30$  kg/m<sup>2</sup>) pregnant women who had their first early (less than 15 gestational weeks) visit at ANC were asked about participation. Exclusion criteria were inability to understand Swedish, a pre-pregnant diagnosis of diabetes, thyroid dysfunction or a psychiatric disease treated with neuroleptic drugs. The remaining women were objects for consecutive recruitment to an intervention group in Linköping with surrounding area and to control groups in two nearby cities with surrounding areas (Norrköping and Värnamo). The period for enrolment was between November 2003 and December 2005.

### *Intervention group*

During the recruiting period 317 obese pregnant women registered at ANC in Linköping were approached. A total of 45 women were excluded as a result of the previously mentioned exclusion criteria, 13 women who had an early miscarriage or legal abortion were also excluded and 29 women had moved out from the catchment area in early pregnancy. Two hundred and thirty obese women were thus eligible and invited to participate. Out of these, five women dropped out during the intervention and 70 women refrained from participation. The main reason for drop-out was that they felt that the visits were too frequent that they could handle. A total of 155 obese women (67.4%) accepted and completed the intervention. The participants were offered a program based on a number of extra visits with motivational interview/talk with the aim of motivating obese pregnant women to change their behavior and to obtain information relevant to their needs. The women were also offered aqua-aerobic once or twice a week.

### *Control group*

All obese pregnant women (n= 437) consecutively registered during the recruiting period at the ANCs in two nearby cities with surroundings were approached. The exclusion criteria were the same as for the intervention women and 42 women were therefore excluded. Ten women had an early miscarriage or a legal abortion and were also excluded. Three hundred and eighty-five women were invited to participate; 177 women refrained from participation and 15 women dropped out during the study period. The main reason for drop -out in this group was the small number of extra visits and medical check-ups according to the study program. Finally, 193 women accepted and completed the participation (50.1%). The obese women in the control group attended the routine antenatal care program.

## **Statistical method**

All analyses were performed using the SPSS program, version 14.0 (SPSS Inc., Chicago, IL, USA). Statistical significance was defined as (two-sided)  $P \leq 0.05$ . Group differences were estimated by using the chi-square test on categorical variables and the Student's *t* test (both paired and unpaired) on continuous, normally distributed variables. We also used analysis of covariance (ANCOVA) with the two weight gain variables (i.e. weight gain during pregnancy and weight gain between early pregnancy and at the postnatal check-up, respectively) as dependent variables. The covariate in the two models was age, group, parity, marital status, socio-economic group, occupation and smoking were included as independent factors.

## **Paper II**

The participants in this study included all the women in the intervention- and control groups described in study I who completed that study. The intervention group consisted of 155 obese (BMI  $\geq 30$  kg/m<sup>2</sup>) women who took part in an intervention program designed for obese pregnant women. The women were offered weekly visits with a counselor during pregnancy where structured motivational and behavioral talks could take place combined with aqua-aerobics. The control group consisted of 193 obese (BMI  $\geq 30$  kg/m<sup>2</sup>) pregnant women who received routine antenatal care.

All data related to pregnancy, delivery and the perinatal period were registered in standardized Swedish antenatal, delivery and neonatal records and the data were manually extracted from the records by the main author (IMC). The following data were collected: age, parity, marital status, occupation and smoking habits. Pregnancy, delivery and perinatal data were also obtained. Large-for-gestational age was defined as a birth weight at least 2 SD above the mean weight for the gestational length and SGA was defined as a birth weight at least 2 SD below the mean weight for the gestational length.

## **Statistical method**

All analyses were performed using the SPSS program, version 14.0. Statistical significance was defined as (two-sided)  $p \leq 0.05$ . Group differences between the index women and the control women were estimated by using the  $\chi^2$  – test on categorical variables and the Student's *t*-test on continuous, normally distributed variables.

## **Paper III**

The participants in study III were subsamples of the groups described in study I. The study groups consisted of 151 obese (BMI  $\geq 30$  kg/m<sup>2</sup>) pregnant women in the intervention group and 188 obese (BMI  $\geq 30$  kg/m<sup>2</sup>) pregnant women in the control

group. All participants were asked to complete the Beck Anxiety Inventory (BAI) and the Edinburgh Postnatal Depression Scale (EPDS) in connection with visits at the ANC in gestational week 15 and 35 and 11 weeks postpartum. The cut-off level of 10 of both the BAI and the EPDS was used to identify symptoms of anxiety and/or depression.

### **Statistical method**

All analyses were performed using the SPSS program, version 16.0. Statistical significance was defined as (two-sided)  $p \leq 0.05$ . Group differences between the index women and the control women were estimated by using the  $\chi^2$  – test on categorical variables and the Student's *t*-test on continuous, normally distributed variables. Furthermore, to make a more comprehensive assessment of group differences, between as well as within, logistic regression has been performed with the three BAI and EPDS measurements as dependent variables. The grouping variable has been adjusted for socio-demographic variables (age, parity, marital status, socio-economic factors and occupational status), complications during pregnancy (GDM, preeclampsia, premature contractions, lumbar and pelvic pain and hyperemesis), complications during delivery (acute CS, instrumental delivery, induced delivery, bleeding >1000ml, perineal tears) and neonatal complications (SGA, preterm <37 weeks, Apgar Score 5 min <7 and Apgar Score 10 min <7).

### **Paper IV**

Women from the intervention- and control groups from study I participated in this follow-up study during the first two years after childbirth. Women from both groups who got pregnant and/or fell ill during the follow-up period were excluded. Four weight follow-up measurements were scheduled 6, 12, 18 and 24 months after childbirth. This study reports results from the assessment occasions one and two years after childbirth; at 12 months, 126 women in the intervention group and 112 women in the control group were included, and at the 24 months 93 women in the intervention group and 62 women in the control group were included.

The women in the intervention group made a 30 minute visit to the ANC at all postnatal assessments and the weight was measured using the same balance as during the pregnancy and at the postnatal check-up. The woman's views about handling her weight in the light of her new role as mother and in the new family constellation were discussed at the visit. There were also discussions about changes in routines that the woman was pleased with, but could also include discussion of routines that had functioned well during pregnancy but had not functioned as well after birth. If the woman desired being given a supportive motivational talk irrespective of her weight

status, this support was given. The women in the control group were invited to the ANC only for weight measurement. The initial plan for all women in the control group was to objectively measure the weight at the same balance used during the pregnancy, but it was not always possible to do this since some women declined visits at ANC and instead reported their weight by phone. Therefore the weight information among control women consists partly of self-reported data and partly of data from objective measurement at the ANC.

### **Statistical methods**

All analyses were performed using the SPSS program, version 16.0 (SPSS Inc., Chicago, IL). Statistical significance was defined as (two-sided)  $p \leq 0.05$ . Before analyzing the weight changes the assumption of these variables being normally distributed were validated using the Kolmogorov-Smirnov test. Since this assumption was confirmed ordinary Student's t-test was used as method of analysis for detecting weight change differences between index and control women at the 12 and 24 months follow-up. In general, group differences were estimated by using the chi-square test on categorical variables and the Student's t test on continuous, normally distributed variables.

### **Paper V**

From the original sample described in study I, a total of 61 consecutive women were asked to take part in a semi-structured telephone interview concerning their opinions about the intervention program. Fifty-six women were interviewed as two women had experienced intrauterine fetal death and three of the women declined to take part. The interview took place three to four months after delivery.

The interview-guide was study specific (see Appendix 3). During the first three interviews the guide was tested and caused no change. These three interviews were thereafter included in the study. The guide consisted of several questions concerning attitudes and opinions on the intervention program. An *attitude* is defined as “*favorable or unfavorable evaluations of and reactions to objects, people, events or ideas*” (77). Questions were asked about satisfaction with the number of visits, the treatment, the expectations of the goal for the treatment and the weight gain during the pregnancy. Additionally the woman was asked whether she would attend this program during her next pregnancy, if she would recommend this program to a pregnant friend, if she had changed her eating or exercise behavior during pregnancy and, if so, if the behavior had been maintained. The woman was also asked about the support from her family as well as from the midwife, and if she had taken part in the aqua-aerobic sessions. The interviews ranged in length between 15 and 30 minutes.

To minimize bias, a research assistant from another department at the university, with no connection to the treatment or the study, contacted the women and performed the interview. Data related to pregnancy, delivery and the perinatal period were registered in standardized Swedish antenatal, delivery and neonatal records and the data were manually extracted from the records by the main author (IMC). The following data were collected: age, parity, occupation and weight in kilograms.

### **Statistical methods**

The results are presented as frequencies and means.

### **Women who refrained from participation**

A total of 247 women refrained from participation in the study (paper I, II and III). These women in both the intervention group (70 women) and the control group (177 women) were, on average, one year younger than those who participated in the study (29 versus 30 years,  $p = 0.018$ ). Moreover, those who declined to participate had previous children to a higher extent than those participating in the study (70.0% versus 54.9%,  $p < 0.001$ ). Those who declined were also smokers to a greater extent (18.2% versus 7.8%,  $p < 0.001$ ) and were more likely to be unskilled workers or students ( $p = 0.032$ ).

In the follow-up study (paper IV) there were 89 women who refrained from participation at the follow-up occasion one year after childbirth and 35 women at the assessment two year after childbirth. Women in the intervention group (17 and 4 women at one and two years respectively) who refrained from participation in the follow-up had a higher weight at the first visit at the ANC than the women who participated in the follow-up ( $p = .015$  and  $p = .011$  at 12 and 24 months respectively). In the control group (72 and 31 women refrained at one and two years respectively), multiparas refrained from participation at the 12 month follow-up to a significantly greater extent ( $p = .033$ ) but not at the 24 months follow-up

In the exploratory and descriptive study (paper V) a total of 61 women were asked to take part in the follow-up interview. Fifty-six women (92 %) accepted and took part in the study. Two of the women who did not participate had had still births, one woman was abroad and could not be reached and finally two women refrained due to family reasons.

During the research process the question about including the women who refrained from participation as controllers was raised. We refrained from including these women for two reasons of which the main reason was that the application to the ethical review board had not considered any such selection of women who refrained from participating. The other reason was that we had only demographic data, but no outcomes in this group.

### **The Beck Anxiety Inventory**

Beck and colleagues developed the BAI, which was based on three earlier instruments constructed by Beck (78). The BAI is used to measure the severity of anxiety and consists of a 21-item self-report inventory where each item describes a common symptom of anxiety: Numbness or tingling [item1], feeling hot [2], wobbliness in legs [3], unable to relax [4], fear of the worst happening [5], dizzy lightheaded [6], heart pounding or racing [7], unsteady [8], terrified [9], nervous [10], feelings of shocking [11], hand trembling [12], shaky [13], fear of losing control [14], difficulty breathing [15], fear of dying [16], scared [17], indigestion or discomfort in abdomen [18], faint [19], face flushed [20] and sweating (not due to heat) [21]. Symptoms of anxiety and depression are similar and it seems to be a delicate task to distinguish between affective, somatic and behavioral symptoms. Therefore there is a high correlation between scales measuring symptoms like these well-known symptoms (78).

Some studies have investigated and validated the BAI in non-clinical samples composed of women as well as men (79-81). The results support the use of the BAI in a community sample. The inventory was developed to make it possible to distinguish anxiety from depression and has shown high reliability and validity. The respondent was asked to rate each symptom experienced during the preceding week on a four point scale (0-3). Scores of 0-7 reflect minimal anxiety, 8-15 mild anxiety, 16-25 moderate anxiety and score of 26-63 indicate severe anxiety (82). The upper interval limit in each interval may be adjusted depending on the purpose for which the results are to be used. To minimize the rate of false positive results the upper limit may be increased and this is suggested when the researcher wishes to produce a more refined selection of persons with symptoms of anxiety. If the purpose on the other hand is to identify persons experiencing anxiety, the upper limit may be decreased to minimize the rate of false negative results. This approach has been suggested in screening for symptoms of anxiety (82). Because of this reason we used a cut-off level of 10 for the BAI in this study.

## **The Edinburgh Postnatal Depression Scale**

The Edinburgh Postnatal Depression Scale was developed by Cox and colleagues (83). It is a ten item self-report scale assessing common symptoms of depression such as dysphoric mood, anxiety, and feeling of guilt, suicidal ideas and “not coping”. Each item is scored on a four point scale (0-3) and rates the intensity of depressive symptoms during the previous seven days. The scale is specifically designed to screen for postpartum depression but can also be used as a valid measure of dysphoria through the various stages of pregnancy and the puerperium (83). The scale excludes further somatic symptoms which may be expected to occur during pregnancy, e.g. fatigue, changing in appetite. The EPDS has been validated for use during pregnancy (84, 85). The questionnaire has been translated into Swedish (86) and the validity of the Swedish version has been tested (87).

The EPDS cannot by itself confirm a diagnosis of depressive illness, but when using a cut-off level of  $>12$  Cox et al. (83) showed a sensitivity of 86 %, a specificity of 78 % and a positive predictive value of 73 % for major depressive illness. Another validation of the EPDS by Murray & Carothers (88), who also used a cut-off level of  $>12$ , showed a sensitivity of 68 %, a specificity of 96 % and a positive predictive value of 67 % for both major and minor depressive illness. To find all actual major depressions, Cox et al. (83) proposed a cut-off level  $\geq 10$  to reduce detection failure in the postnatal period. By selecting this threshold, the sensitivity for detection of major depression increased to almost 100 % and the specificity to 82 % (89). In this study we used a cut-off level of  $\geq 10$ .

## **Ethical considerations**

Initially, the study was reviewed by the Regional Ethical Review Board at Linköping University (Dnr. 03-231). In connection with preparing the study, ethical questions and dilemmas were taken into consideration. We asked ourselves if an obese woman might feel accused and harassed when questions about obesity and the possibility of changing habits were raised. This could, of course, be a possibility for some of the women but our clinical experience suggested these women rarely got help and support and our intention was to offer a safe and well-known setting, i.e. within the antenatal care, for discussions of this topic. The patients in both groups received oral and written information about the study and participation and gave written informed consent. The information about participation also included information stating that participation was voluntary and that there was a possibility of withdrawing from participation at any time without affecting on-going care or future contact with ANC.

Even if these ethical issues were taken into consideration before and in the beginning of the study, questions and changing attitudes continuously arose during the research process and were a subject of consideration. The midwife (IMC) who met the women each week in the intervention group had vast experience in clinical work with pregnant women which almost certainly increased her ability to handle current issues arising during this research process. An interview study with the objective to describe obese women's experiences of encounters with midwives and physicians during pregnancy conclude that obese pregnant women are a vulnerable group because obesity is highly visible (90). Many obese women have also negative experiences of health care. A respectful and dignified treatment is of the utmost importance for their well-being and quality of life (90). Even if a conversation evokes emotions of discomfort, it can also be a positive and enriching experience for the woman. The deliberations were carried on in the spirit of MI where one important point is that the counseling involves a partnership that honors the client's expertise and perspectives (62). The counselor should provide an atmosphere which is conducive rather than coercive to change.

The counselor is also expected to affirm the client's right and capacity for self-direction rather than telling the client what she must do (62). The fact that someone is interested in the situation faced by an obese person might also have a positive effect.

The women in the intervention group, as well in the control group, were guaranteed confidentiality. Thus each woman was assigned a code number, designed to make it possible to identify her data in the medical record and in the answer sheets to the questionnaires which were put in a prepaid envelope addressed to another person in the research team with no or very little contact with the participants. All results are presented in group level and it is not possible to identify any individual.

## RESULTS AND DISCUSSION

### **Weight gain restriction for obese pregnant women: a case-control intervention study (paper I)**

The aim of this study was to minimize the total weight gain of obese women during pregnancy to less than 7 kg and to investigate some of the delivery and neonatal outcomes. The demographic data at the first antenatal visit showed a significant difference among socio-economic groups ( $p=.044$ ). The women in the intervention group had a higher level of education than the women in the control group. In Table 5 the differences between the intervention- and control group in gestational weight gain, postnatal weight and weight change are shown. In a further analysis, GWG values among the studied women were adjusted for socio-demographic characteristics. After this adjustment, the women in the intervention group still had a lower weight gain during pregnancy ( $p=.001$ ) and had lost more weight at the postnatal check-up ( $p<.001$ ). We also investigated delivery outcomes in the groups as instrumental delivery, acute or elective cesarean section and neonatal outcome, examining birth weight and gestational length in relation to group and we found no differences between the groups irrespective of GWG.

We found that an intervention program with weekly visits at ANC to support the possibility of changing lifestyle factors during pregnancy and then maintaining these changes was effective. The women in the intervention group had a significantly lower GWG than the women in the control group. This is both in line with and in contrast with results from other published intervention studies aiming to prevent excessive GWG (65-73). Polley et al. showed that an intervention with individual counseling, newsletter and telephone contact, was effective in preventing excessive weight gain in normal weight women, but had an opposite or no effect among overweight or obese women (69). The authors speculated about the reason for the low rate of excessive weight gain in the control group of overweight or obese pregnant and suggested that it may be due to recruitment from a lower income area, which may indicate many barriers to participation in the program. Olson et al. observed similar results where the intervention was only effective in preventing excessive weight gain in normal and over-weight low-income women (67).

An intervention study of overweight and obese pregnant women with GDM reported a significantly lower weight gain per week in the intervention group than in the control group (72). Both groups were provided diet counseling, but the intervention group was also prescribed an almost daily exercise routine. A Danish study by Wolff et al. showed that an intervention program encompassing ten one-hour dietary consultations

was effective in preventing excessive weight gain (66). In this study only obese pregnant women participated and the women in the intervention group had a lower GWG compared with the women in the control group. In yet another study of pregnant women in different BMI classes, the researchers reported a significantly lower weight gain in the intervention group, which was given initial dietary and lifestyle counseling by a dietician, than in the control group, which only received routine prenatal care (71). In the study by Thornton et al. obese women in an intervention group were given a prescription about what a balanced nutritional regimen would entail, and they were asked to record in a diary all of the foods eaten during each day (65). The women in the control group received routine care. There was a significantly lower GWG in the intervention group than in the control group.

**Table 5.** Weight during pregnancy and at the postnatal check-up in the intervention- and control group\*

	Intervention group			Control group			<i>p</i> **
	<b>n</b>	<b>Mean</b>	<b>SD</b>	<b>n</b>	<b>Mean</b>	<b>SD</b>	
Weight at the first ANC visit	153	95.5	12.65	190	95.9	15.40	0.781
Weight gain during pregnancy***	143	8.7	5.51	161	11.3	5.80	<0.001
Weight at the postnatal check-up	150	93.2	13.32	163	96.5	14.48	0.037
Weight gain between early check-up and the postnatal check-up†	150	-2.15	5.88	162	0.75	5.34	<0.001
	<b>n</b>	<b>%</b>		<b>n</b>	<b>%</b>		
<u>Gestational weight gain &lt;7 kg</u>	51/143	35.7		33/161	20.5		0.003‡
primiparas	19/59	32.2		12/79	15.2		0.018‡

\*Only women with simplex pregnancies are included.

\*\* Student's *t* -test

\*\*\*That is the weight at the last check-up before delivery (weight in the same week as delivery or if this value was missing, the weight measured 1 or 2 weeks before delivery) minus the weight at the first ANC visit.

† That is the weight at the postnatal check-up minus the weight at the first ANC visit.

‡ Chi<sup>2</sup> -test

Three published studies with different intervention programs showed no effect at all on excessive GWG (68, 70, 73). Grey-Donald et al. designed a program with several intervention components such as individual diet counseling, exercise groups and different public activities during the recruiting period of the intervention group (68). The women studied represented different BMI levels, but the mean BMI was around 30 kg/m<sup>2</sup> in both groups. Kinnunen et al. selected primiparas, mainly normal weight women for intervention- and control groups (70). The women in the control group received standard care while the women in the intervention group were given individual counseling about diet and physical activity during five routine visits. Finally Guelinckx et al. constructed a program with two intervention groups in which different degrees of interference were practiced and a control group, including pregnant women with BMI >29 kg/m<sup>2</sup>. (73). The intervention groups received at the first counseling session a brochure with advice about nutrition, physical activity and tips to limit pregnancy-related weight gain. One of the intervention groups was given in addition three group counseling sessions with a dietician focusing on healthy eating habits. The control group received routine prenatal care.

We also found a significant difference in weight between the studied women at the postnatal check-up. Compared with the weight at the first ANC visit, the women in the intervention group showed a weight loss, while the women in the control group had instead gained weight. In five of eight published studies, postnatal weight was reported (65-69). The studies of Grey-Donald et al, Polley et al. and Olson et al., with follow-up ranging from six weeks to one year p.p., found no difference between the intervention and control groups (67-69). However, there were some other discoveries of interest in these studies. Polley et al found that the postnatal weight retention was strongly related to the gestational weight gain, while Olson et al. observed that overweight low-income women and normal-weight high-income women had a reduced risk of retaining 5 lb (2.27 kg) or more, one year postpartum (67, 69). Wolff et al. and Thornton et al. registered the weight four and six weeks postpartum and reported, in contrast with the other studies described above but in line with our study, a significant difference between the women in the intervention group who retained less weight compared with women in the control group (65, 66).

Not all of these studies describe the number of intervention occasions, but it seems that a high frequency of contact might have a positive effect and this is in line with our results. The professionals in these studies have a variety of professional backgrounds, but this seems not to have affected the outcome.

We investigated delivery and neonatal outcome in relation to mode of delivery (instrumental delivery, acute and elective cesarean section), birth weight and

gestational length and found no differences between the intervention and control groups. Concerning the rate of cesarean section our results are in accordance with other intervention studies where no difference could be detected (65, 66, 68, 69, 71-73). In some studies the sample size was too small for statistical analyses (66, 69). Thornton et al. found fewer cases of cesarean section among those women in the intervention group who were adherent to the prescribed nutritional regimen, compared with the non-adherent group and among those women who had a GWG less than 6,8 kg or 4.5 kg irrespectively group membership (65). Asbee et al. investigated the reasons for cesarean deliveries and found significantly more cesarean sections in the control group due to “failure to progress” compared with the intervention group (71). In contrast with earlier studies, we investigated possible differences in the rates of emergency as well as elective cesarean sections and instrumental deliveries but did not find any differences between the index and control groups. Birth weight and gestational age at delivery have also been evaluated as outcome variables in almost all published studies (65-69, 72, 73). In accordance with our study these studies found no differences between the intervention- and control groups. However, in the study of Thornton et al. there was a lower (but normal) birth weight among the infants of the women in the intervention group who were adherent to the nutritional regimen and among those women who had a GWG less than 6,8 kg irrespectively of group membership (65).

Gestational weight gain among obese women and its association with different modes of delivery have also been investigated in large cohort studies with conflicting results (13, 18, 21, 39, 41). Bianco et al. found that the incidence of cesarean delivery was not correlated with increased weight gain (21). Cedergren found a decreased risk of cesarean and instrumental delivery for obese women with weight gain less than 8 kg, but an increased risk for cesarean section with a weight gain more than 16 kg, which is in accordance with results from Karibu et al. and Nohr et al. (13, 18, 39). However, Tsukamoto et al. could not find any differences in the incidence of cesarean delivery between different weight-gain categories (41). Khashan and Kenny compared two cesarean section outcomes: emergency cesarean section and all cesarean section deliveries among pregnant women in different BMI classes (36). Obese and morbidly obese women ran a higher risk in both these types of surgery compared with normal-weight women. In our study, because of its clinical nature and the relatively smaller sample size, we found no differences in frequencies of emergency or elective cesarean section between the intervention- and control group.

## **Weight gain restriction during pregnancy is safe for both the mother and neonate (paper II)**

The aim of this study was to additionally investigate pregnancy, delivery, and neonatal outcome in obese pregnant women with or without a specific intervention for weight control. The analyses were performed on the gestational weight gain irrespective of number of kilos as well as gestational weight gain less than 7 kg. There was a tendency to experience fewer cases of preeclampsia in the intervention group compared with the control group ( $p = .055$ ), but this tendency was not strengthened in the sub-analysis of women in both groups with gestational weight gain less than 7 kg. We found a significant difference in the frequency of prelabor rupture of membrane (PROM) between the two groups ( $p = .001$ ). There were fewer cases of these complications among the women in the intervention group than among the women in the control group, but this difference was not maintained in the sub-analysis concerning gestational weight gain less than 7 kg.

We also examined complications occurring during pregnancy, delivery and neonatal; these included GDM, lumbar and pelvic pain, premature contractions, hyperemesis, fetal death, shoulder dystocia, bleeding >1000 ml, perineal tears, pre- or post term delivery, respiratory distress, Apgar <7 at 5 minutes, infection postnatal, child born SGA or LGA, and we found no differences between groups in any analyses. The same was true for placental complications, induction of labor, and the use of oxytocin or epidural anesthesia. A low weight gain among obese women did not seem to adversely affect important obstetric and neonatal outcomes.

Pregnancy, delivery and neonatal outcomes among obese pregnant women as well as gestational weight gain in relation to these outcomes are hot topics in studies of epidemiological design or reviews (21, 29, 33-35, 91). In some studies the frequencies of pregnancy-induced hypertension (PIH), preeclampsia and GDM have been subjects of investigation (13, 21, 41). Tsukamoto et al. showed a significantly increased risk of PIH among Japanese women with weight gain over 14 kg, while Bianco et al. reported no increased incidence with increased weight gain (21, 41). Both studies reported no difference in the incidence of GDM in connection with weight gain. Cedergren reported a decreased risk for preeclampsia among obese women with weight gain less than 8 kg, but an increased risk when the weight gain was more than 16 kg (13).

In published intervention studies of pregnancy outcomes among obese women, researchers have not reported any differences in frequencies of preeclampsia and GDM (65, 66, 69, 73). Some of these studies found that the number of individuals was too small for statistical analysis, but the occurrence of these outcomes did not appear to have been affected by the intervention (66, 69). The study of Thornton et al. report

significantly fewer cases of gestational hypertension in the intervention group but no differences in cases of GDM and preeclampsia (65). In our study we found a tendency for fewer cases of preeclampsia in the intervention group compared with the control group but no differences in cases of GDM. The explanation is not straightforward and the results might be caused by the sample size or the care given. Nevertheless, one can speculate that if a rapid lifestyle change can decrease the risk of preeclampsia, then another type of change might be required to decrease the risk of GDM.

Maternal obesity is associated with an increased risk of stillbirth (92). Cnattingius et al. and Nohr et al. found an increased risk of late fetal death with increasing BMI and also an increasing excess risk of fetal death with advancing gestation, while Khashan & Kenny found no significant difference in stillbirths between obese and morbidly obese pregnant women and normal-weight pregnant women (22, 27, 36). In the present study, the total number of stillbirths was 3/348, which is about three times the expected rate in Sweden (The National Board of Health and Welfare) and in accordance with the rates for obese women presented by Kristensen et al (93). We did not detect any differences in the incidence of stillbirth between the index- and control group and this was not expected, as the number of women was rather small.

Intervention with a possibility of attending weekly aqua aerobic classes did not seem to reduce lumbar or pelvic pain. The incidence of hyperemesis was low in both groups of women. This is an interesting finding and in accordance with two recent epidemiological studies, which showed that obese pregnant women were equal or less likely to obtain the diagnose hyperemesis or to use antiemetic drugs and to require hospitalization due to hyperemesis compared with normal-weight women (38, 94).

Several epidemiological studies have shown an increased risk for induction of labor among obese pregnant women compared with non-obese women (24, 28, 29). In our intervention study where we compared two groups of obese women there was no difference in the incidence of labor induction between the two groups which is in line with other intervention studies (65, 73). We found no differences in pre- or post term delivery (<36 respectively >41 completed gestational weeks) between the intervention- and control group and this is also in agreement with another intervention study (65). In studies with larger samples such as the study of Briese et al. there was a significantly elevated risk for both preterm and post term birth among obese primiparas compared with normal-weight mothers and, in contrast with the study of Khashan and Kenny, the only significant difference found was in post-term birth among obese and morbidly obese pregnant women compared with normal-weighted (36, 37).

Weiss et al. investigated PROM but found no significant difference between obese and non-obese pregnant women, while in a recent study of Briese et al. a significantly

elevated risk for PROM was reported among obese primiparas compared with normal-weight primiparas (26, 37). Nohr et al. found similar result in a large Danish cohort study (91). Obese women had an increased risk for preterm PROM. This is in line with the results in the present study where we found significantly fewer cases of PROM in the intervention group compared with the control group, which is an interesting finding. One can speculate over the reason for this. It is known that intrauterine infections play a role in the cause of preterm PROM and obesity may be a low-grade of systemic inflammatory disease (95, 96). Obesity is also associated with various metabolic, inflammatory and vascular abnormalities during pregnancy (97). Is it possible that the immunologic response which is involved in the rupture of membranes, change with decreased adipose tissue which in turn depends on weight loss?

We also investigated the prevalence of SGA and LGA in relation to the mother's weight gain during pregnancy, irrespective of the group to which the mother belonged - index- or control - and no correlation could be demonstrated. A recent systematic review of nine randomized trials for antenatal interventions for overweight or obese pregnant women assessed the benefits and harms of program for these women (98) and found similar results. The primary outcome was LGA infants and no significant differences could be found between women who received antenatal intervention and women who did not. Another recent large Danish study showed a decreased risk of SGA and an increased risk of LGA with increasing gestational weight gain among obese primi- and multiparas, while yet another recent large study in the UK could only demonstrate a significant connection between obese and morbidly obese pregnant women and LGA (18, 36).

The present intervention study could only show limited differences between the intervention- and control group. The antenatal care system is very much standardized in Sweden and regional variations should not therefore influence pregnancy outcomes, while the delivery and neonatal care practices may differ between hospitals and might therefore affect the delivery and neonatal outcomes. The participants in this study were delivered at three different hospitals. Our results as concerns preeclampsia, GDM, pre- or post term delivery, induction of labor, SGA and LGA do not differ from other published intervention studies aiming to prevent excessive gestational weight gain (65, 66, 69, 71-73). On the other hand, the primary scope of these studies, except the study of Thornton et al. (65), was not to investigate outcomes of the complications mentioned above and the data were in some cases too small for statistical analysis.

There is nevertheless an important difference. This study is, to our knowledge, one of few which have thoroughly investigated a large number of frequently occurring pregnancy, delivery and neonatal complications, complications not fully considered in

other published intervention studies (66-73). Interestingly Thornton et al. compared perinatal outcome in the intervention group among women who were adherent to a prescribed nutritional regimen with women who were non-adherent (65). In the group of women who were adherent there were fewer cases of GDM, preeclampsia, labor induction and macrosomia. Additionally, women irrespectively of group membership who had a GWG of less than 6.8 kg had also fewer pregnancy and labor complications as GDM, preeclampsia and labor induction. The same analysis was performed for women who gained more or less than 4.5 kg. In the group of women who gained less than 4.5 kg there were fewer cases of GDM compared to women who gained more. (65).

### **Prevalence of anxiety and depressive symptoms among obese pregnant and postpartum women in a weight-gain restriction program (paper III)**

The aim of this study was to investigate psychological well-being measured as symptoms of anxiety and/or depression among obese pregnant women attending a weight gain restriction program and to make comparisons with a control group receiving traditional antenatal care. There was no difference in prevalence of symptoms of anxiety or depression between the intervention group and the control group (Table 6), either before or after adjustment for socio-demographic variables and pregnancy, delivery and neonatal complications. Neither was there any difference between nor within the two groups concerning fluctuation in symptoms of anxiety or depression between two measurement occasions; in early pregnancy (gestational week 15) and 11 weeks postnatal. Five percent of the women in the intervention group and 4 % of the women in the control group showed symptoms of anxiety during the course of pregnancy and at the postpartum assessment. Six percent of the women in the intervention group and 4 % of the women in the control group had symptoms of depression at the same assessments. Finally a total of six women in the intervention group (4.0 %) and three women in the control group (1.6 %) had symptoms of both anxiety and depression at all three assessment points.

Gestational weight gain had no influence on symptoms of anxiety or depression. Multivariate analyses within the intervention group and within the control group revealed differences in symptoms of anxiety and depression in both groups due to socio-economic factors. Women with a lower education level and who were unemployed showed more symptoms of anxiety and depression than women with a higher education level and who were gainfully employed.

**Table 6.** Prevalence of anxiety and depressive symptoms at three assessments: Gestational week 15 and 35 and 11 weeks postpartum.

	Gestational week 15					Gestational week 35					11 weeks postnatal				
	Inter- vention group		Control group			Inter- vention group		Control group			Inter- vention group		Control group		
	n	%	n	%	p*	n	%	n	%	p*	n	%	n	%	p*
<b>Anxiety symptoms</b>					.719					.648					.557
BAI score $\geq 10$	37	24.5	42	22.8		34	23.9	35	21.6		13	9.1	16	11.2	
<b>Depressive symptoms</b>					.882					.341					.849
EPDS score $\geq 10$	28	18.7	33	18.0		31	22.0	28	17.5		16	11.2	15	10.5	

\* Chi<sup>2</sup> -test

We found a prevalence of symptoms of anxiety of approximately 22 to 25 % among obese pregnant women and 9-11 % postnatal. There was no difference between the intervention- and control groups. To date, no other published study, whether an intervention study or not, has reported data on the prevalence in an obese pregnant population of symptoms of anxiety, and therefore we have been unable to find results with which our findings might be compared. Another difficulty might be that researchers making these studies have investigated different subgroups of anxiety disorder including panic disorder, generalized anxiety, agoraphobia and obsessive-compulsive disorder.

Anxiety disorders occurring in the perinatal period have received less research attention than depression during the same period (43). Leigh and Milgrom investigated risk factors for ante- and postnatal depression in 370 women, probably in different BMI classes (99). They used the BAI as determined in gestational week 28-36, and found a prevalence of 27.7 % of moderate-severe anxiety, as defined by BAI score  $\geq 16$ . In our study, where we used the BAI with cut-off level  $\geq 10$ , the prevalence in gestational week 35 was 22-24 % among obese women. In another study of about 500 pregnant women, assessed through a structured diagnostic interview in the third trimester, it was found that 24 % of the women had at least one anxiety disorder during pregnancy (44). In analyses within the intervention- and control group we found at the two assessments during pregnancy significant differences due to socio-demographic

factors. Women in both groups, at both measurements, with a lower education level showed symptoms of anxiety. There are few published studies which have investigated the relationship between socio-demographic factors and anxiety, but in line with our results Britton found that mothers who were anxious one month postpartum were more likely to be less educated and have lower family income than non-anxious mothers (100). There is, to our knowledge, no study that has investigated the relation between symptoms of anxiety among obese pregnant women and socio-demographic factors and medical outcome for the mother and child.

The prevalence of symptoms of depression in this study was among obese women around 18-19 % in early pregnancy, 18–22 % in late pregnancy and postnatal 11 %. There are to our knowledge still too few other published studies encompassing obese pregnant and postnatal women to allow us to make comparisons, and the three available studies show divergent results (47-49). Bodnar et al. diagnosed MDD with a structured clinical interview for Diagnostic and Statistical Manual of Mental Disorders (4th. Ed.) in gestational week 20, 30 and 36 and found among obese women a prevalence of 42 %, 44 % and 32 % in those gestational weeks (49). Furthermore, there was a strong dose-response association between pre-pregnancy BMI and the likelihood of MDD. Obese pregnant women had a 2.6-fold higher risk for this illness compared with underweight women. LaCoursiere et al. reported a prevalence of 30.8 % of self-reported moderate or greater depressive symptoms among obese women two to six months postpartum, while Krause et al. found a prevalence of 9.2 % of symptoms of depression among overweight and obese women six weeks postpartum (47, 48). The methods chosen in these two studies differ. LaCoursiere asked the women to grade their depressive symptoms in: “not depressed at all”, “little depressed”, “moderately depressed”, “very depressed” and “very depressed and had to get help” while Krause et al. used the EPDS with cut-off point of 13 (47, 48). They categorized women with scores of 13 and above as depressed. In our study, with a cut-off point of 10 on the EPDS, we found a similar prevalence as Krause et al.

Bodnar et al. investigated, according to the 1990 IOM:s recommendation, the GWG in relation to pre-pregnancy BMI and the likelihood of MMD (49). Among women with GWG less than IOM:s guidelines there was no association between pre-pregnancy BMI and the risk for MMD. Compared with underweight women with GWG within IOM:s limits, women with GWG below the recommendations, in all BMI classes, had a 3.5-fold higher likelihood to have antenatal depression. Among women with GWG within these limits there was a strong positive linear relation between pre-pregnancy BMI and MMD and an obese woman with BMI =33 kg/m<sup>2</sup> had more than seven times increased risk. The relation was similar among women with GWG above the guidelines and an obese woman (BMI=33 kg/m<sup>2</sup>) had almost five times increased risk (49).

In our study, of obese women, we found no relation between GWG and symptoms of depression.

It is possible to make comparisons with studies encompassing a general pregnant and postnatal population but the chosen methods differ and for example if the EPDS is used, different cut-off points are presented (45, 46, 101-104). Therefore the prevalence of symptoms of depression in different studies varies from 8 % to 20 % during pregnancy and from 9 % to 13 % postpartum. Josefsson et al. used the same cut-off points as this study and report a prevalence of 17 % in gestational week 35–36 and 13 % 6-8 week postnatally, which is similar to the results as we found at the same assessment points (45).

Depressive symptoms, during and after pregnancy, in relation to demographic characteristics in a general pregnant population have also been investigated (46, 48, 102, 103, 105). Krause et al. found among overweight and obese women a correlation between education, household income, marital status and symptoms of depression at assessment six week post partum (48). Women with a high school education or less were more likely to be depressed than those with a college degree. Furthermore, married women who reported higher income were less likely to be depressed. We found within the both study groups, a relationship postnatally between occupational status and more symptoms of depression for unemployed women. Krause et al. investigated the relationship between mode of delivery and symptoms of depression and report no significant association (48). This is in line with our results where we found no differences between the two investigated groups or within these groups. However, there was a significant difference between symptoms of depression and complications in late pregnancy in the control group.

### **Weight after childbirth: A 2-year follow-up of obese women in a weight-gain restriction program (paper IV)**

The aim of this study was to investigate the effect of a weight gain restriction program on weight development or weight maintenance two years after childbirth. We also wanted to investigate weight development over time for the women who managed to gain less than 7 kg during pregnancy. Socio-demographic data on the women who still remained in this follow-up study showed that significantly more multiparas in the intervention group took part in the assessment at 24 months after childbirth compared with the control group ( $p=.011$ ). There were no significant differences between the two groups in mean weight at the assessment one and two years after childbirth, in spite of the fact that the women in the intervention group weighed 3.0 kg and 4.5 kg less than the women in the control group. Further analysis of the group that reached

the target weight gain during pregnancy, i.e. weight gain less than 7 kg, showed a difference of weight change between the intervention- and control groups at 24 months after childbirth ( $p=.018$ ). The women in the intervention group had a lower mean weight (87.3 kg) than the women in the control group (100.8 kg). The mean weight change from early pregnancy to the follow-up occasion was analyzed and at 12 months after childbirth a difference between the intervention- and control group was found ( $p=.046$ ). The women in the intervention group had a greater mean weight change (-2.2 kg), i.e. weighed less than the women in the control group (0.4 kg). These differences had disappeared 24 months after childbirth. A total of 23 women in the intervention group and 13 women in the control group showed a BMI <30, 24 months after childbirth.

The pattern of weight development, i.e. the weight at the assessment 12 and 24 months after childbirth compared with the weight at the first antenatal care visit and expressed in 5 kg classes, was also analyzed. There was a difference between the intervention- and control group 24 months after childbirth ( $p=.034$ ) with more women in the intervention group who had lost weight, compared with the control group.

In our first study we found that the women in the intervention group had a lower GWG than the women in the intervention group (106). Analysis in the group of women with GWG less than 7 kg also showed a difference with a higher percentage of women in the intervention group reaching the target than in the control group. At the follow-up occasion 12 and 24 months after childbirth both of these differences remained, even if they were smaller, and/or have disappeared. When interpreting the outcomes, the high number of drop-outs, especially in the control group, must be taken in account and further the long term effect of an intervention program during pregnancy for weight development after pregnancy with all confounders and “life events” that can be of importance for behavior changes and maintenances are complex to accurately investigate.

The new role and challenge of being a first-time mother or having both an infant and older children and at the same time also being in a process of behavior change may be hard to handle. It is not very likely that the final stage “maintenance of a new behavior” will be reached during pregnancy. A change takes time and often years of active action/treatment before a new behavior is completely established (62). Finding time and energy for physical activity and healthy choice of foods may not be an easy task and some studies also suggest that postnatal life which involves major changes in lifestyle and behavior such as increased intake of food, greater access to food, change of meal habits and decreased physical activity may be an explanation for postnatal weight retention (107-109). Some investigators have suggested that the influence of

GWG may be greatest during the immediate postpartum period, defined as less than one year after childbirth, and that other factors, as lifestyle alterations, may be important to long-term weight change (109, 110). Questions have also been raised about the optimal amount of time to return to preconception weight and how to value postpartum weight change. The time required may depend on both the amount and composition of the GWG (109).

In a Finnish controlled trial aiming at reducing postpartum weight retention, 48 first-time mothers in an intervention group got individual counseling on diet and physical activity, two to ten months postpartum at five clinic visits at a public child care clinic (111). The counseling consisted of one primary counseling session and four booster sessions. These women were compared with 37 first-time mothers in a control group who received routine care. There was no significant difference between the two groups in weight retention ten months postpartum. The authors speculate over the absence of an effect of the intervention, suggesting that among other things failure might be due to the presence of the infant who interfered with the counseling sessions and therefore reduced their efficacy. It may also be true in our study where the women in the intervention group attended the follow-up visits together with their babies. We offered motivational talks in connection with these assessments, but it is possible that the mother's attention to the infant hampered her ability to reflect over the current situation and necessary changes.

So far, most intervention studies of behavior during pregnancy have not had long follow up designs but there is one study which followed the participants during pregnancy and one year after the delivery. (67). In this study Olson et al. compared a prospective cohort consisting of 179 normal- and overweight pregnant women with 381 women in a historical control group in the same context (67). The GWG was monitored by health care providers and an education program was provided by e-mail. There were no differences between the two groups concerning GWG or postnatal retention one year after childbirth. However, women in a low-income subgroup who received intervention had a significantly reduced risk for excessive gestational weight gain and overweight low-income women and normal-weight high-income women had in addition a reduced risk for weight retention  $\geq 2.27$  kg (5 lb), assessed one year after childbirth. These results correspond partly with our results where the analyses 24 months after childbirth among the women in a subgroup with GWG less than 7 kg showed a significant difference between the intervention- and control group were the women in the intervention group had a lower mean weight compared with the women in the control group.

## **Consumer satisfaction with a weight-gain intervention program for obese pregnant women (paper V)**

The aim of this exploratory, descriptive study was to investigate a group of women's attitudes and opinions towards, and satisfaction with, an intervention program, with the aim of limiting weight gain less than 7 kg during pregnancy. The women answered the question about the most positive experience with participation in the study and 59 % stated the mental coaching, discussion and motivational talk received from the midwife as a positive experience. A total of 36 % of the women confirmed that the weekly weight control was a great help and for 14 % was the opportunity to regular health check-up a positive experience. The women answered also the questions concerning less positive experience with participation in the study and 9 % thought it was too much focus on the weight. A total of 16 % stated that they did not like the amount of medical check-ups (besides the weight control) and experienced the questionnaires about perceived health and psychological well-being burdensome. The opinion of the number of visits was found out and 55 % considered the weekly appointment as sufficient while the remaining participants thought that were too many.

“How satisfied are you with your weight gain during pregnancy?” In these question answered a total of 89 % that they were very or rather satisfied with the GWG and these women had a mean weight gain of 11.3 kg (range 3.2–19.0 kg) and the difference between the first weight in early pregnancy at ANC and the weight at the postnatal check-up 6–12 weeks after childbirth range from -10.2 to +10.1 kg. The remaining women were not satisfied and their gestational weight gain was on average 18.2 kg (range 13.3–21.9 kg). The difference between the first weight and the weight at the postnatal check-up was in this group 1.8–9.7 kg. A total of 41 % gained less than 7 kg and all but two gave birth in gestational week  $\geq 37$ . Eighty six percent of the women stated that they would attend the study if they were pregnant again and all participants would recommend the program to a friend.

In addition, there were a total of 71 % who took part in aqua aerobic class and were satisfied with this form of exercise and they considered it as a good social experience. Slightly more than three fourths of the women said that they had changed diet habits when they joined the program and more than 90 % stated that they had continued the new habits and that they also experienced support from the partner in the change process. More than 90 % of the women stated that they had change exercise habits, continued with them and experienced support from the partner.

This study is, to our knowledge, the first study to examine obese women's experience of attending an intervention program aiming to restrict GWG and to study their

satisfaction with the weight gain during pregnancy. A majority of the women expressed positive experiences with the participation and stated that they got support and coaching. More than half of the women considered weekly visits appropriate and 77 % of women who were satisfied with the GWG stated that the weekly visits were decisive for success in weight maintenance. These results together with the fact that there were few drop outs in the intervention group, indicate satisfaction with the program (106). A considerable percentage of the women stated that they had changed their habits regarding diet and exercise during the pregnancy. There were more women who had changed their exercise habits than eating habits and one can speculate over the reason for that. Was it easier for the women to change their exercise habits than eating habits? Nearly three fourths of the women participated in the aqua aerobic class and it is possible that both this type of exercise and being part of a group inspired the women to alter their habits. The vast majority stated the mental coaching, the motivational talks and discussions as the most positive experience. Concerning change of habits it is likely that these women had encountered difficulties in the past and now were offered coaching and support during ‘the way of change’.

A number of studies have investigated the personal goal of non-pregnant participants in different weight loss program and found a large discrepancy between expected/ideal goal and the outcome or medically advised goal (56-61). Foster and colleagues investigated in two different studies the view of obese women of what is a ‘reasonable weight loss’ and the role of different factors in obese men and women’s evaluation of treatment outcomes (56, 61). There was a great discrepancy between a weight loss that they viewed as being happy, acceptable or disappointed with and the outcome and despite a weight loss of 16 kg, 47 % of the women did not even achieve a “disappointed” weight loss (56). In another study Foster et al. found that initial body weight was the strongest predictor for what the patient defined as happy-, acceptable- and disappointed weight while sex and height were the strongest determinants of dream weight (61). Patients with the highest pretreatment weight were likely to have the most unrealistic expectations for success. Linné and co-authors found that Swedish patients with initial median BMI of 40.7 kg/m<sup>2</sup> expected to be normal-weight (women) or overweight (men) (57). Dutton et al. reported similar result where African American obese women with an average baseline BMI of 38.8 m<sup>2</sup>, expected a weight reduction which would place them in overweight range (58). Also in the study of Fabricatore et al. obese women and men had greater expectations than they were told (59). Failure to meet weight loss expectations after half of the treatment period was related to a lower satisfaction but was not correlated with their motivation to continue to lose weight. Unrealistic goals were also observed among obese Dutch women and men and more frequently in younger patients (60). In this study of Wamsteker et al. patients who

attributed their obesity to a physical cause had more unrealistic goals compared with patients who attributed their obesity to a behavioral cause and those weight loss goals were more realistic (60).

Authors have argued for discussing realistic weight loss goals before treatment or early in the program (56-58, 60). In the present study we discussed the GWG goal for the study once and that was at the first visit. We did not ask the women to propose their own weight gain goals but the interview responses show that 57 % of the women had formulated a goal and of them were 97 % very or rather motivated to reach the goal. A total of 89 % of the women stated that they were very or rather satisfied with their GWG and they gained on average 11.3 kg with a range from 3.2 kg to 19.0 kg. The results of this study indicate that pregnant women in the intervention group did not formulate, in their eyes, an unrealistic weight gain goal. It is possible that there is a difference between primi- and multiparas. During the current pregnancy multiparas often referred to GWG during their previous pregnancies and stated a wish of “a weight gain less than that”.

The study of Fabricatore et al. of obese people in a weight loss program demonstrates that even if the expressed wish and the expectation of a great weight loss and the outcome show discrepancies, the people are satisfied with a modest reduction and are still motivated to continue the loss process (59). One can speculate about the pregnant women's view of GWG. The gestational weight change is due not only to life style factors but to other factors as well. There is also the influence of physiological factors and it is possible that the women take this into account when they grade their satisfaction with GWG, which in the present study had a wide range and they therefore tolerate a discrepancy between a weight goal and the outcome achieved.

## METHODOLOGICAL CONSIDERATIONS

There are both strengths and limitations in the five studies that constitute this thesis. The intervention- and control groups are the same in all studies and report results from early pregnancy to two years after childbirth. Medical outcomes, psychological well-being as well as experiences and attitudes to the intervention are reported. The women in the intervention group met only one midwife during the pregnancy when the main part of the intervention was carried out. This fact supports the statement that all women got the same treatment, a goal we set since in behavioral therapy for obese women it is the continuity that is of great importance (51). However, one can look at it from another point and ask if meeting with the same midwife for a long time might in some way obstruct a progressive change in behavior.

All women in both groups were weighed on the same balance at all assessments during the pregnancy. Therefore the results are not based on self-reported weights, which are not as exactly measured. During the follow-up period this was also valid for the intervention group but unfortunately not for the control group where some women preferred to report their weight by phone.

The calculated power for the main aim in this study i.e. to detect a difference in GWG in the intervention group compared to the control group is 97.96 % on 5 % level of significance. A clinical sample is by definition a much smaller sample than the samples in large epidemiological studies, which make comparisons with epidemiological studies including cohorts of pregnant women difficult. Therefore we may not be able to detect all potential differences. The women in the intervention- and control group were delivered at three different hospitals, which might have influenced the management of the delivery and might therefore be regarded as a disadvantage because of possible differences in obstetric management.

The experiences of attending an intervention program were collected by a semi-structured telephone interview. All women who participated gave their informed consent verbally at the postnatal check-up. We used this study design in order to get a high participation rate and to facilitate the possibility to catch personal comments and reflections. Another possible study design would have been the use of qualitative methods (112).

This study was not randomized which can be seen as an important limitation. Randomization is a powerful tool and a good general rule is to randomize whether possible (113, 114). In all scientific research it is important to control external factors

and to make an effort to minimize situational contaminants. The environment has been found to exert a powerful influence on people's emotion and behavior (114). It requires careful consideration if an intervention- and control group will get treatment and care at the same setting. A continuing intervention program with a new routine might influence the staff to change their behavior and regimens even for those who are supposed to be controls and receive standard care. The antenatal care clinic in Linköping is structured as one large unit. Hence, we were determined to secure that no contamination between the intervention and controls would occur and therefore chose to use ANCs in two nearby cities to serve as controls. The antenatal programs in Sweden are standardized and almost identical concerning the management of the pregnancy, which ensures similar care at different ANCs. We were also able to control for several background characteristics that otherwise could confound the results.

We analyzed the women who refrained from participation in the study (I–III) and found differences in socio-demographic factors. These women were on average one year older, more often multiparas and smokers. They were also more likely to be unskilled workers or students, compared with the women who completed the study. Therefore some caution is advisable when generalizing these results. There was also a difference in the completion rates between the intervention- and control group. A total of five women in the intervention group dropped out compared with 15 women in the control group. We also analyzed the women who refrained from the follow-up occasions one and two years after childbirth (study IV). There were a total of 21 women in the intervention group and 103 women in the control group who refrained from participation and this must be taken in account when interpreting the results. Women in the intervention group who refrained from participation at both assessments had a higher weight at the first visit at the ANC than women who participated. In the control group multiparas refrained from participation at the 12 month follow-up to a greater extent, but not at the 24 months follow-up.

The cut-off level of the EPDS differ in published studies and therefore also the specificity and sensitivity. We used, according to Cox et al. (83), a cut-off level  $\geq 10$  to find all actual major depressions and by selecting this threshold, the sensitivity for detection of this condition supposedly increased to almost 100 % and the specificity to 82 % (89). However, one should still keep in mind that the EPDS cannot by itself confirm a diagnosis of depressive illness unless it is combined with a structured clinical interview.

The BAI is one of several scales which measure anxiety. Studies aiming to validate the BAI against other scales which measure anxiety show that the BAI correlate significantly with e.g. State-Trait Anxiety Inventory (Form Y), Weekly Record of

Anxiety and Depression and Hamilton Rating Scale–Revised (82). Besides the correlation with other scales we chose the BAI because it is developed to distinguish between symptoms of depression and anxiety and has been shown superior ability to separate between these two conditions.

## **GENERAL CONCLUSIONS**

We found that structured motivational and behavior treatment combined with regular physical exercise was effective in controlling weight gain for obese women and especially nulliparas during pregnancy. The program did not affect the pregnancy, delivery and neonatal outcomes. There were neither more nor fewer complications among women with gestational weight gain less than 7 kg. Therefore, gestational weight gain less than 7 kg is assumed to be safe for both the mother and the infant.

A weight gain restriction program during pregnancy or gestational weight gain does not seem to influence the prevalence of symptoms of anxiety or depression. Obese women who participated in this study do not run a higher risk for anxiety and/or depressive symptoms during pregnancy or postpartum, compared with a general pregnant and postnatal population.

The intervention program seems to have an impact on weight gain up to 24 months after childbirth for those women in the intervention group who succeeded in restricting their gestational weight gain to less than 7 kg.

Pregnant women in the intervention group expressed positive experiences with the treatment and would attend the program if they became pregnant again. The women who participated in aqua aerobics classes stated that they were satisfied with this form of exercise and also expressed that this group activity was also a good social experience. Concerning goal setting for preventing excessive gestational weight gain and experience satisfaction with the efforts, it is necessary to acquire the woman's motivation for change and to involve the woman actively in the process.

## **CLINICAL IMPLICATIONS**

The prevalence of obesity is growing in the general population as well as among pregnant women. The staff at ANCs will sooner or later face these women and to treat an obese woman's pregnancy in an optimal way is a challenge. Large studies with an epidemiological approach show that a low GWG among obese women reduces the risk of an adverse outcome (13, 16, 18, 39-41). One method for use in preventive care is MI. This study shows that an intervention based on the use of MI can prevent excessive GWG among obese women. But this program of preventive care and treatment must also be designed for use in the long term and with the recognition that the program does not end at childbirth. Efforts to reverse the obesity trend must be implemented in public health care settings of which the antenatal health care is one.

Motivational interviewing as a method to prevent excessive GWG is not to be reserved only for obese women, but can also be used in preventive care among normal- and overweight pregnant women. There are studies reporting adverse outcomes due to excessive GWG, postnatal weight retention and inter-pregnancy weight gain in these groups as well (13, 18-20). Pregnancy is for some women a trigger for developing overweight and obesity as a result of an excessive gestational weight gain. Failure to lose weight postnatally is a significant predictor for weight gain or retention several years later (115-117).

## **FUTURE RESEARCH**

A large body of information has been collected during the study period. Some of the data is analyzed and its results presented in this thesis. Yet a lot of data remains to be processed:

- During the follow-up period we also collected information from the children of the women in the intervention- and control groups. Data on weight and height of the children will be analyzed in the future.
- All women in the intervention- and control groups underwent oral glucose tolerance test (OGTT); twice during the pregnancy and once postnatally. Blood samples were also collected for future analyses.

In addition, new questions and ideas have arisen during the research process.

- The intervention had a beneficial effect, especially among the primiparas. It would be of interest to design an intervention with a specific aim to reach obese multiparas.
- This intervention offered each individual the opportunity to make extra visits. The interviews in study V found that the women who took part in the aqua aerobic class appreciated this form of exercise as it also entailed a sense of community, which gave them chance to meet with other women who understood the significance of being obese. It is possible that a group meeting like this can further inspire participants to work on weight control. It would be a challenge to create an intervention program, based on MI at group level.
- An excessive GWG is associated with a high risk for postnatal weight retention which can lead to obesity. Is it possible to design and evaluate an intervention with the aim of preventing excessive weight gain regardless of pre-pregnancy BMI?

## SUMMARY IN SWEDISH – SVENSK SAMMANFATTNING

Prevalensen av fetma har under de senaste decennierna ökat snabbt och är i dag världsomfattande. Världshälsoorganisationens (WHO) senaste beräkning från år 2005 visar att omkring 400 miljoner män och kvinnor lider av fetma. Folkhälsoinstitutets folkhälsoenkät från 2009, pekar på en prevalens kring 12–13 % bland den svenska befolkningen. Även bland gravida kvinnor i Sverige finns en ökad förekomst av fetma och år 2007 rapporterades 12,1 % av gravida kvinnor inskrivna vid den svenska mödrahälsovården lida av fetma.

Fetma kan objektivt definieras genom att beräkna Body Mass Index (BMI): kroppsvikten dividerad med längden (uttryckt i meter) i kvadrat. Enligt WHO ska BMI  $\geq 30$  kg/m<sup>2</sup> betraktas som fetma. Ett stigande BMI delas därefter in i tre olika klasser: BMI 30 – 34,9 kg/m<sup>2</sup>, BMI  $\geq 35$  – 39,9 kg/m<sup>2</sup> samt BMI  $\geq 40$  kg/m<sup>2</sup>.

Fetma är associerat med en ökad risk för somatiska och psykologiska sjukdomar. Fetma under graviditet innebär en ytterligare ökad risk för komplikationer under såväl graviditet, förlossning som för fostret/barnet. Jämfört med en normalviktig gravid kvinna löper en gravid kvinna som lider av fetma en ökad risk att drabbas av graviditetsdiabetes, högt blodtryck, havandeskapsförgiftning, fosterdöd, instrumentell förlossning, kejsarsnitt, onormalt stor blödning under eller efter förlossningen, infektioner mm. Fostret/barnet löper bl.a. risk för missbildningar, hög födelsevikt och olika tillstånd av syrebrist i samband med födelsen. En stor viktökning under graviditeten kan ytterligare förvärra hälsoläget.

Frågan kring en normal viktuppgång under graviditet har under flera år varit föremål för diskussioner och forskning. År 1990 publicerade Institute of Medicine, USA, olika viktökningsrekommendationer för gravida kvinnor beroende på BMI vid graviditetens början. Rekommendationerna tog endast hänsyn till barnets hälsa och man ville framför allt förebygga en låg födelsevikt. Kvinnor med BMI  $>29$  kg/m<sup>2</sup> rekommenderades en viktökning under graviditeten omfattande minst 6,8 kg. Man angav ingen övre gräns för denna viktökning. Rekommendationerna reviderades förra året, 2009, och nu vägde man även in mammans hälsa. Med utgångspunkt från WHO:s definition av fetma, rekommenderas nu en gravid kvinna med BMI  $\geq 30$  kg/m<sup>2</sup>, en viktökning mellan 5,0 kg och 9,1 kg.

Flera stora studier, av epidemiologisk art, har under de senaste åren undersökt gränserna för en optimal viktökning. En svensk studie visade att bland gravida kvinnor, med BMI  $\geq 30$  i tidig graviditet, var en viktökning mindre än 6 kg förenat med minskade risker för komplikationer för mor och barn.

Psykologisk hälsa i termer av ångest- och depressionssymptom har också studerats. I en amerikansk studie bland gravida kvinnor beräknades förekomsten av ångestsymptom under graviditet till 24 %. Svenska studier har visat en förekomst av depressionssymptom mellan 14 och 17 % under graviditet och mellan 11 och 14 % under första året efter barnets födelse. Psykisk hälsa bland feta gravida kvinnor är sparsamt undersökt. I två amerikanska studier varierade förekomsten av depressionssymptom mellan 9 % och 31 %, 6 veckor till 6 månader efter barnets födelse. I en annan amerikansk studie bland gravida kvinnor redovisas en förekomst av depressiva symptom mellan 32 % och 44 % under graviditet. Studien visar också att stigande BMI ökar risken för dessa besvär.

Mot bakgrund av dessa fakta genomfördes vid kvinnokliniken i Linköping, år 2003 – 2005, en interventionsstudie med syfte att genom förändrade vanor och beteende, främst gällande kost och fysisk aktivitet begränsa viktuppgång under graviditet hos kvinnor med BMI  $\geq 30$ . Målet var en viktuppgång på mindre än 7 kg. Kvinnorna tillfrågades om deltagande i studien i samband med första kontakten med mödrahälsovården. Utöver den sedvanliga graviditetsövervakningen erbjöds kvinnorna under hela graviditeten extra besök varje vecka för att i möjligaste mån ge det stöd som kan behövas i en förändringsprocess. Vid de veckovisa besöken användes samtalsmetodiken "motiverande samtal". Denna förändringsinriktade metod syftar till att öka personens egen motivation till beteendeförändring. Grundläggande principer är det empatiska och klientcenterade förhållningssättet där rådgivaren söker samarbete med klienten och sätter hennes synsätt i fokus. Kvinnorna funderade och diskuterade ofta över följande frågeställningar: *Är det något jag behöver ändra? Är det något jag kan ändra? Är det något jag vill ändra? Om jag skall ändra på något, hur skall denna förändring gå till?* Kvinnorna erbjöds dessutom vattengymnastik, 1 - 2 gånger per vecka. Aktuell vikt noterades varje vecka.

Kvinnorna i interventionsgruppen (n=155) har jämförts med kvinnor i en kontrollgrupp (n=193) som rekryterats vid mödrahälsovården i Norrköping och Värnamo. Inklusionsvillkoren var de samma som för interventionsgruppen. Dessa kvinnor fick sedvanlig graviditetsvård vid respektive mottagning.

Efter förlossningen följdes kvinnorna och deras barn under 2 år. Kvinnans vikt samt barnets vikt och längd registrerades vid fyra tillfällen; 6, 12, 18 och 24 månader efter barnets födelse.

I den första studien utvärderades viktuppgång under graviditeten samt vikten vid efterkontrollen, ca 11 veckor efter förlossningen. Deltagarna i interventionsgruppen hade en lägre viktuppgång (medelvärde 8,7 kg) jämfört med deltagarna i kontrollgruppen (medelvärde 11,3 kg). Det fanns också en skillnad mellan grupperna

vid efterkontrollen. Vikten vid detta tillfälle jämfördes med vikten vid inskrivningen i tidig graviditet och visade att kvinnorna i interventionsgruppen vägde 2,2 kg under inskrivningsvikten medan kvinnorna i kontrollgruppen vägde 8 hg över inskrivningsvikten. Viktmålet i studien var en viktuppgång <7 kg och detta mål nåddes av 35,7 % i interventionsgruppen och 20,5 % i kontrollgruppen. Det var signifikant fler förstföderskor tillhörande interventionsgruppen som nådde denna lägre viktuppgång jämfört med förstföderskor i kontrollgruppen. I denna delstudie analyserades dessutom förlossningssätt, födelsevikt och graviditetslängd. Ingen skillnad mellan grupperna kunde påvisas.

I den andra studien analyserades olika utfallsmått under graviditet, förlossning och för det nyfödda barnet. Det fanns en skillnad mellan grupperna när det gäller komplikationer som förtidig eller tidig vattenavgång. Färre kvinnor i interventionsgruppen drabbades av detta jämfört med kontrollgruppen. Det fanns också en tendens till färre fall av havandeskapsförgiftning i interventionsgruppen jämfört med kontrollgruppen. Ingen skillnad kunde noteras mellan grupperna när det gäller graviditetsdiabetes, förtidiga sammandragningar, bäckenbensbesvär, graviditetskräkningar, fosterdöd, prematurförlossning, överburenhet, stora blödningar i samband med förlossningen, bristningar, syrebrist och infektioner under nyföddhetsperioden samt för stor eller för liten födelsevikt. Analyser gjordes även bland de kvinnor som gick upp < 7 kg, men ingen skillnad mellan grupperna framkom avseende dessa komplikationer.

Den tredje studien gällde förekomsten av ångest- och depressionssymptom. Kvinnorna besvarade i graviditetsveckorna 15 och 35 samt 11 veckor efter förlossningen enkäter med skattningsskalorna BAI och EPDS. Ingen skillnad mellan grupperna kunde noteras vid något av dessa tillfällen. Förekomsten av ångestsymptom i interventionsgruppen varierade mellan 24 – 25 % under graviditeten samt 9 % vid efterkontrollen. Motsvarande andel i kontrollgruppen var 22 – 23 % samt 11 %. Förekomsten av depressionssymptom i interventionsgruppen uppgick till 18,7 % i tidig graviditet, 22 % i sen graviditet och 11,2 % vid efterkontrollen. I kontrollgruppen var motsvarande andel 18 %, 17,5 % och 10,5 %. Viktuppgång mer eller mindre än 7 kg påverkade inte resultatet.

I den fjärde studien analyserades kvinnans vikt vid uppföljningstillfällena 1 och 2 år efter barnets födelse. Vid ett- och tvåårsuppföljningen deltog 126 respektive 93 kvinnor tillhörande interventionsgruppen samt 112 respektive 62 kvinnor tillhörande kontrollgruppen. Medelvikten analyserades. Ingen skillnad kunde noteras mellan grupperna trots att kvinnorna i interventionsgruppen vägde 3 kg och 4,5 kg mindre än kvinnorna i kontrollgruppen. Medelviktsförändringen dvs. vikten vid inskrivningen jämförd med vikten vid respektive uppföljningstillfälle, analyserades och vid

ettårsuppföljningen fanns en skillnad mellan grupperna bestående av en större medelviktöförändring i interventionsgruppen. Dessa kvinnor vägde mindre (-2,2 kg) än kvinnorna i kontrollgruppen (+0,4 kg). Skillnaden kvarstod inte vid tvåårsuppföljningen. För kvinnorna med viktuppgång <7 kg under graviditeten framkom vid tvåårsuppföljningen en skillnad där kvinnorna i interventionsgruppen uppvisade en lägre vikt (medelvikt 87,3 kg) jämfört med kvinnorna i kontrollgruppen vars medelvikt var 100,8 kg.

I den femte studien intervjuades 56 kvinnor tillhörande interventionsgruppen för att undersöka attityder och uppfattning om interventionen. Intervjuerna ägde rum 4 månader efter förlossningen. Majoriteten av kvinnorna uttryckte positiva erfarenheter av deltagandet i studien och uppskattade särskilt den mentala stöttningen vid samtalen samt möjligheten till vikt- och hälsokontroller. Andra ansåg att det var mycket viktfokus och upplevde de i studien ingående provtagningarna som besvärliga. Det var också betungande att besvara studieenkäterna. Mer än hälften av deltagarna tyckte att det var lagom med de veckovisa besöken och de flesta trodde att de täta besöken var anledningen till att de klarat av att hålla vikten. Frågan *Hur nöjd är du med din viktuppgång under graviditeten* ställdes och 89 % svarade att de var mycket eller ganska nöjda med viktuppgången. Dessa kvinnor gick i genomsnitt upp 11,3 kg och differensen mellan inskrivningsvikten och vikten vid efterkontrollen varierade från -10,2 kg till +10,1 kg. Fyrtioen procent av deltagarna gick upp <7 kg under graviditeten. Kvinnorna fick också frågan om de ändrat kost- och motionsvanor under studien och sedan fortsatt på den inslagna vägen. Majoriteten svarade att så skett.

Studieresultaten kan sammanfattas på följande sätt:

- Interventionen var effektiv. Kvinnorna tillhörande interventionsgruppen hade en lägre viktuppgång under graviditeten jämfört med kvinnorna i kontrollgruppen.
- Interventionen påverkade inte det medicinska utfallet. Det var varken fler eller färre fall av komplikationer i grupperna oavsett viktuppgång. En viktuppgång <7 kg under graviditeten kan betraktas som säker för mor och barn.
- Det var ingen skillnad i förekomsten av ångest- och depressionssymptom mellan interventions- och kontrollgruppen.
- Intervention tycks i viss mån ha effekt upp till 2 år efter barnets födelse. Kvinnor tillhörande interventionsgruppen och med en viktuppgång <7 kg under graviditeten, vägde mindre vid tvåårsuppföljningen jämfört med kvinnorna i kontrollgruppen.
- Kvinnor tillhörande interventionsgruppen uttryckte positiva erfarenheter av deltagandet i studien och skulle delta om de blev gravida igen. Majoriteten av

kvinnorna var nöjda med viktuppgången under graviditeten och de veckovisa besöken. Vattengymnastik ansågs vara en bra motionsform och medförde dessutom tillfälle att dela sina erfarenheter med andra kvinnor i samma situation.

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## REFERENCES

1. Whitlock G, Lewington S, Sherliker P, Clarke R, Emberson J, Halsey J, et al. Body-mass index and cause-specific mortality in 900 000 adults: collaborative analyses of 57 prospective studies. *Lancet*. 2009 Mar 28;373(9669):1083-96.
2. Pickering RP, Grant BF, Chou SP, Compton WM. Are overweight, obesity, and extreme obesity associated with psychopathology? Results from the national epidemiologic survey on alcohol and related conditions. *J Clin Psychiatry*. 2007 Jul;68(7):998-1009.
3. Gariepy G, Nitka D, Schmitz N. The association between obesity and anxiety disorders in the population: a systematic review and meta-analysis. *Int J Obes (Lond)*. 2009 Dec 8.
4. Zhao G, Ford ES, Dhingra S, Li C, Strine TW, Mokdad AH. Depression and anxiety among US adults: associations with body mass index. *Int J Obes (Lond)*. 2009 Feb;33(2):257-66.
5. WHO. Obesity and overweight: Fact sheet 311. 2006 [cited 2010-02-15]; Available from: <http://www.who.int/mediacentre/factsheets/fs311/en/index.html>.
6. Swedish National Institute of Public Health. [National Public Health Survey 2009: Overweight and Obesity]. 2009 [cited 2010-02-15]; Available from: <http://www.fhi.se/sv/Statistik-uppfoljning/Nationella-folkhalsoenkaten/Levnadsvanor/Overvikt-och-fetma/>.
7. The Swedish Society of Obstetrics and Gynecology (SFOG). [National Registry reproductive health: Summary of individual data for 2007]. 2009 [cited 2010-02-17]; Available from: [http://www.sfog.se/PDF/Na\\_arsrapport2007.pdf](http://www.sfog.se/PDF/Na_arsrapport2007.pdf).
8. WHO. Health Topics: Obesity. 2010 [cited 2010-02-17]; Available from: <http://www.who.int/topics/obesity/en/>.
9. Institute of Medicine. Subcommittee on Nutritional S, Weight Gain during P, Institute of Medicine . Subcommittee on Dietary I, Nutrient Supplements during P. Nutrition during pregnancy. Part I, Part II, Weight gain. Nutrient supplements. Washington, D.C.: National Academy Press; 1990.
10. Rasmussen KM, Yaktine AL, Institute of Medicine . Committee to Reexamine IOMPWG. Weight gain during pregnancy : reexamining the guidelines. Washington, DC: National Academies Press; 2009.
11. Cedergren MI. Optimal gestational weight gain for body mass index categories. *Obstet Gynecol*. 2007 Oct;110(4):759-64.
12. Kiel DW, Dodson EA, Artal R, Boehmer TK, Leet TL. Gestational weight gain and pregnancy outcomes in obese women: how much is enough? *Obstet Gynecol*. 2007 Oct;110(4):752-8.
13. Cedergren M. Effects of gestational weight gain and body mass index on obstetric outcome in Sweden. *Int J Gynaecol Obstet*. 2006 Jun;93(3):269-74.
14. Rossner S, Ohlin A. Pregnancy as a risk factor for obesity: lessons from the Stockholm Pregnancy and Weight Development Study. *Obes Res*. 1995 Sep;3 Suppl 2:267s-75s.
15. Linne Y, Dye L, Barkeling B, Rossner S. Long-term weight development in women: a 15-year follow-up of the effects of pregnancy. *Obes Res*. 2004 Jul;12(7):1166-78.
16. Nohr EA, Vaeth M, Baker JL, Sorensen T, Olsen J, Rasmussen KM. Combined associations of prepregnancy body mass index and gestational weight gain with the outcome of pregnancy. *Am J Clin Nutr*. 2008 Jun;87(6):1750-9.
17. Huang TT, Wang HS, Dai FT. Effect of pre-pregnancy body size on postpartum weight retention. *Midwifery*. 2010 Apr;26(2):222-31.
18. Nohr EA, Vaeth M, Baker JL, Sorensen TI, Olsen J, Rasmussen KM. Pregnancy outcomes related to gestational weight gain in women defined by their body mass index, parity, height, and smoking status. *Am J Clin Nutr*. 2009 Nov;90(5):1288-94.
19. Linne Y, Rossner S. Interrelationships between weight development and weight retention in subsequent pregnancies: the SPAWN study. *Acta Obstet Gynecol Scand*. 2003 Apr;82(4):318-25.

20. Villamor E, Cnattingius S. Interpregnancy weight change and risk of adverse pregnancy outcomes: a population-based study. *Lancet*. 2006 Sep 30;368(9542):1164-70.
21. Bianco A, Smilen S, Davis Y, Lopez S, Lapinski R, Lockwood C. Pregnancy outcome and weight gain recommendations for the morbidly obese woman. *Obstet Gynecol*. 1998;91:97-102.
22. Cnattingius S, Bergström R, Bergstrom R, Lipworth L, Kramer M. Prepregnancy weight and the risk of adverse pregnancy outcomes. *N Engl J Med*. 1998;338:147-52.
23. Cedergren MI, Kallen BA. Maternal obesity and infant heart defects. *Obes Res*. 2003 Sep;11(9):1065-71.
24. Cedergren M. Maternal morbid obesity and the risk of adverse pregnancy outcome. *Obstet Gynecol*. 2004;103:219-24.
25. Lashen H, Fear K, Sturdee DW. Obesity is associated with increased risk of first trimester and recurrent miscarriage: matched case-control study. *Hum Reprod*. 2004 Jul;19(7):1644-6.
26. Weiss JL, Malone FD, Emig D, Ball RH, Nyberg DA, Comstock CH, et al. Obesity, obstetric complications and cesarean delivery rate--a population-based screening study. *Am J Obstet Gynecol*. 2004 Apr;190(4):1091-7.
27. Nohr EA, Bech BH, Davies MJ, Frydenberg M, Henriksen TB, Olsen J. Prepregnancy obesity and fetal death: a study within the Danish National Birth Cohort. *Obstet Gynecol*. 2005 Aug;106(2):250-9.
28. Robinson HE, O'Connell CM, Joseph KS, McLeod NL. Maternal outcomes in pregnancies complicated by obesity. *Obstet Gynecol*. 2005 Dec;106(6):1357-64.
29. Usha Kiran TS, Hemmadi S, Bethel J, Evans J. Outcome of pregnancy in a woman with an increased body mass index. *BJOG*. 2005 Jun;112(6):768-72.
30. Vahratian A, Siega-Riz AM, Savitz DA, Zhang J. Maternal pre-pregnancy overweight and obesity and the risk of cesarean delivery in nulliparous women. *Ann Epidemiol*. 2005 Aug;15(7):467-74.
31. Barau G, Robillard PY, Hulseley TC, Dedecker F, Laffite A, Gerardin P, et al. Linear association between maternal pre-pregnancy body mass index and risk of caesarean section in term deliveries. *BJOG*. 2006 Oct;113(10):1173-7.
32. Nohr EA, Bech BH, Vaeth M, Rasmussen KM, Henriksen TB, Olsen J. Obesity, gestational weight gain and preterm birth: a study within the Danish National Birth Cohort. *Paediatr Perinat Epidemiol*. 2007 Jan;21(1):5-14.
33. Arendas K, Qiu Q, Gruslin A. Obesity in pregnancy: pre-conceptional to postpartum consequences. *J Obstet Gynaecol Can*. 2008 Jun;30(6):477-88.
34. Guelinckx I, Devlieger R, Beckers K, Vansant G. Maternal obesity: pregnancy complications, gestational weight gain and nutrition. *Obes Rev*. 2008 Mar;9(2):140-50.
35. Satpathy HK, Fleming A, Frey D, Barsoom M, Satpathy C, Khandalavala J. Maternal obesity and pregnancy. *Postgrad Med*. 2008 Sep;120(3):E01-9.
36. Khashan AS, Kenny LC. The effects of maternal body mass index on pregnancy outcome. *Eur J Epidemiol*. 2009;24(11):697-705.
37. Briese V, Voigt M, Wisser J, Borchardt U, Straube S. Risks of pregnancy and birth in obese primiparous women: an analysis of German perinatal statistics. *Arch Gynecol Obstet*. 2010 Jan 23.
38. Denison FC, Norrie G, Graham B, Lynch J, Harper N, Reynolds RM. Increased maternal BMI is associated with an increased risk of minor complications during pregnancy with consequent cost implications. *BJOG*. 2009 Oct;116(11):1467-72.
39. Kabiru W, Raynor BD. Obstetric outcomes associated with increase in BMI category during pregnancy. *Am J Obstet Gynecol*. 2004 Sep;191(3):928-32.
40. Stotland NE, Cheng YW, Hopkins LM, Caughey AB. Gestational weight gain and adverse neonatal outcome among term infants. *Obstet Gynecol*. 2006 Sep;108(3 Pt 1):635-43.

41. Tsukamoto H, Fukuoka H, Inoue K, Koyasu M, Nagai Y, Takimoto H. Restricting weight gain during pregnancy in Japan: a controversial factor in reducing perinatal complications. *Eur J Obstet Gynecol Reprod Biol.* 2007 Jul;133(1):53-9.
42. Robertson E, Grace S, Wallington T, Stewart DE. Antenatal risk factors for postpartum depression: a synthesis of recent literature. *Gen Hosp Psychiatry.* 2004 Jul-Aug;26(4):289-95.
43. Ross LE, McLean LM. Anxiety disorders during pregnancy and the postpartum period: A systematic review. *J Clin Psychiatry.* 2006 Aug;67(8):1285-98.
44. Sutter-Dallay AL, Giaconne-Marcésche V, Glatigny-Dallay E, Verdoux H. Women with anxiety disorders during pregnancy are at increased risk of intense postnatal depressive symptoms: a prospective survey of the MATQUID cohort. *Eur Psychiatry.* 2004 Dec;19(8):459-63.
45. Josefsson A, Berg G, Nordin C, Sydsjö G. Prevalence of depressive symptoms in late pregnancy and postpartum. *Acta Obstet Gynecol Scand.* 2001 Mar;80(3):251-5.
46. Rubertsson C, Wickberg B, Gustavsson P, Radestad I. Depressive symptoms in early pregnancy, two months and one year postpartum-prevalence and psychosocial risk factors in a national Swedish sample. *Arch Womens Ment Health.* 2005 Jun;8(2):97-104.
47. Lacoursiere DY, Baksh L, Bloebaum L, Varner MW. Maternal body mass index and self-reported postpartum depressive symptoms. *Matern Child Health J.* 2006 Jul;10(4):385-90.
48. Krause KM, Ostbye T, Swamy GK. Occurrence and Correlates of Postpartum Depression in Overweight and Obese Women: Results from the Active Mothers Postpartum (AMP) Study. *Matern Child Health J.* 2008 Oct 4.
49. Bodnar LM, Wisner KL, Moses-Kolko E, Sit DK, Hanusa BH. Prepregnancy body mass index, gestational weight gain, and the likelihood of major depressive disorder during pregnancy. *J Clin Psychiatry.* 2009 Sep;70(9):1290-6.
50. Mauro M, Taylor V, Wharton S, Sharma AM. Barriers to obesity treatment. *Eur J Intern Med.* 2008 May;19(3):173-80.
51. Asp N-G, Statens beredning för medicinsk utvärdering [Swedish Council on Technology Assessment in Health Care]. *Fetma - problem och åtgärder : en systematisk litteraturoversikt [obesity : problems and interventions : a systematic review]*. Stockholm: SBU; 2002.
52. Sharma M. Behavioural interventions for preventing and treating obesity in adults. *Obes Rev.* 2007 Sep;8(5):441-9.
53. Rubio MA, Gargallo M, Isabel Millan A, Moreno B. Drugs in the treatment of obesity: sibutramine, orlistat and rimonabant. *Public Health Nutr.* 2007 Oct;10(10A):1200-5.
54. Bult MJ, van Dalen T, Muller AF. Surgical treatment of obesity. *Eur J Endocrinol.* 2008 Feb;158(2):135-45.
55. Sjöström L, Narbro K, Sjöström CD, Karason K, Larsson B, Wedel H, et al. Effects of bariatric surgery on mortality in Swedish obese subjects. *N Engl J Med.* 2007 Aug 23;357(8):741-52.
56. Foster GD, Wadden TA, Vogt RA, Brewer G. What is a reasonable weight loss? Patients' expectations and evaluations of obesity treatment outcomes. *J Consult Clin Psychol.* 1997 Feb;65(1):79-85.
57. Linne Y, Hemmingsson E, Adolfsson B, Ramsten J, Rossner S. Patient expectations of obesity treatment-the experience from a day-care unit. *Int J Obes Relat Metab Disord.* 2002 May;26(5):739-41.
58. Dutton GR, Martin PD, Brantley PJ. Ideal weight goals of African American women participating in a weight management program. *Body Image.* 2004 Sep;1(3):305-10.
59. Fabricatore AN, Wadden TA, Womble LG, Sarwer DB, Berkowitz RI, Foster GD, et al. The role of patients' expectations and goals in the behavioral and pharmacological treatment of obesity. *Int J Obes (Lond).* 2007 Nov;31(11):1739-45.
60. Wamsteker EW, Geenen R, Zelissen PM, van Furth EF, Iestra J. Unrealistic weight-loss goals among obese patients are associated with age and causal attributions. *J Am Diet Assoc.* 2009 Nov;109(11):1903-8.

61. Foster GD, Wadden TA, Phelan S, Sarwer DB, Sanderson RS. Obese patients' perceptions of treatment outcomes and the factors that influence them. *Arch Intern Med.* 2001 Sep 24;161(17):2133-9.
62. Miller WR, Rollnick S. *Motivational interviewing : preparing people for change.* page 25, 2 ed. New York: Guilford Press; 2002.
63. Prochaska JO, Norcross JC, DiClemente CC. *Changing for good.* New York: Avon Books; 1995.
64. DiClemente CC, Velasquez MM. *Motivational Interviewing and the Stages of Change.* In: Miller WR, Rollnick S, editors. *Motivational interviewing : preparing people for change.* 2 ed. New York: Guilford Press; 2002. p. 201-16.
65. Thornton YS, Smarkola C, Kopacz SM, Ishaof SB. Perinatal outcomes in nutritionally monitored obese pregnant women: a randomized clinical trial. *J Natl Med Assoc.* 2009 Jun;101(6):569-77.
66. Wolff S, Legarth J, Vangsgaard K, Toubro S, Astrup A. A randomized trial of the effects of dietary counseling on gestational weight gain and glucose metabolism in obese pregnant women. *Int J Obes (Lond).* 2008 Mar;32(3):495-501.
67. Olson CM, Strawderman MS, Reed RG. Efficacy of an intervention to prevent excessive gestational weight gain. *Am J Obstet Gynecol.* 2004 Aug;191(2):530-6.
68. Gray-Donald K, Robinson E, Collier A, David K, Renaud L, Rodrigues S. Intervening to reduce weight gain in pregnancy and gestational diabetes mellitus in Cree communities: an evaluation. *CMAJ.* 2000 Nov 14;163(10):1247-51.
69. Polley BA, Wing RR, Sims CJ. Randomized controlled trial to prevent excessive weight gain in pregnant women. *Int J Obes Relat Metab Disord.* 2002 Nov;26(11):1494-502.
70. Kinnunen TI, Pasanen M, Aittasalo M, Fogelholm M, Hilakivi-Clarke L, Weiderpass E, et al. Preventing excessive weight gain during pregnancy - a controlled trial in primary health care. *Eur J Clin Nutr.* 2007 Jul;61(7):884-91.
71. Asbee SM, Jenkins TR, Butler JR, White J, Elliot M, Rutledge A. Preventing excessive weight gain during pregnancy through dietary and lifestyle counseling: a randomized controlled trial. *Obstet Gynecol.* 2009 Feb;113(2 Pt 1):305-12.
72. Artal R, Catanzaro RB, Gavard JA, Mostello DJ, Friganza JC. A lifestyle intervention of weight-gain restriction: diet and exercise in obese women with gestational diabetes mellitus. *Appl Physiol Nutr Metab.* 2007 Jun;32(3):596-601.
73. Guelinckx I, Devlieger R, Mullie P, Vansant G. Effect of lifestyle intervention on dietary habits, physical activity, and gestational weight gain in obese pregnant women: a randomized controlled trial. *Am J Clin Nutr.* 2010 Feb;91(2):373-80.
74. Statens folkhälsoinstitut [The Swedish National Institute of Public Health] Yrkesföreningar för fysisk aktivitet [Professional Associations for Physical Activity]. *FYSS : fysisk aktivitet i sjukdomsprevention och sjukdomsbehandling [Physical Activity in - Prevention and Treatment of Diseases].* Stockholm: Statens folkhälsoinstitut; 2003.
75. Pate RR, Pratt M, Blair SN, Haskell WL, Macera CA, Bouchard C, et al. Physical activity and public health. A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *JAMA.* 1995 Feb 1;273(5):402-7.
76. Haskell WL, Lee IM, Pate RR, Powell KE, Blair SN, Franklin BA, et al. Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation.* 2007 Aug 28;116(9):1081-93.
77. Nolen-Hoeksema S, Fredrickson B, Loftus GR. *Atkinson and Hilgard's introduction to psychology.* Andover: Cengage Learning; 2009. p. 667. .
78. Beck AT, Epstein N, Brown G, Steer RA. An inventory for measuring clinical anxiety: psychometric properties. *J Consult Clin Psychol.* 1988 Dec;56(6):893-7.
79. Dent HR, Salkovskis PM. Clinical measures of depression, anxiety and obsessionality in non-clinical populations. *Behav Res Ther.* 1986;24(6):689-91.

80. Creamer M, Foran J, Bell R. The Beck Anxiety Inventory in a non-clinical sample. *Behav Res Ther.* 1995 May;33(4):477-85.
81. Nordhagen T. Beck Anxiety Inventory: Translation and validation of a Norwegian version. 2001.
82. Beck AT, Steer RA. BAI Beck Anxiety Inventory Manual Swedish Version. Stockholm: Psykologiförlaget 2005.
83. Cox JL, Holden JM, Sagovsky R. Detection of postnatal depression. Development of the 10-item Edinburgh Postnatal Depression Scale. *Br J Psychiatry.* 1987 Jun;150:782-6.
84. Murray DC, J.L. Screening for depression during pregnancy with the Edinburgh Depression Scale (EPDS). *J Reprod Infant psych.* 1990;8:99-107.
85. Gibson J, McKenzie-McHarg K, Shakespeare J, Price J, Gray R. A systematic review of studies validating the Edinburgh Postnatal Depression Scale in antepartum and postpartum women. *Acta Psychiatr Scand.* 2009 May;119(5):350-64.
86. Lundh W, Gyllang C. Use of the Edinburgh Postnatal Depression Scale in some Swedish child health care centres. *Scand J Caring Sci.* 1993;7(3):149-54.
87. Wickberg B, Hwang CP. The Edinburgh Postnatal Depression Scale: validation on a Swedish community sample. *Acta Psychiatr Scand.* 1996 Sep;94(3):181-4.
88. Murray L, Carothers AD. The validation of the Edinburgh Post-natal Depression Scale on a community sample. *Br J Psychiatry.* 1990 Aug;157:288-90.
89. Harris B, Huckle P, Thomas R, Johns S, Fung H. The use of rating scales to identify post-natal depression. *Br J Psychiatry.* 1989 Jun;154:813-7.
90. Nyman VM, Prebensen AK, Flensner GE. Obese women's experiences of encounters with midwives and physicians during pregnancy and childbirth. *Midwifery.* 2008 Dec 17.
91. Nohr EA, Vaeth M, Bech BH, Henriksen TB, Cnattingius S, Olsen J. Maternal obesity and neonatal mortality according to subtypes of preterm birth. *Obstet Gynecol.* 2007 Nov;110(5):1083-90.
92. Chu SY, Kim SY, Lau J, Schmid CH, Dietz PM, Callaghan WM, et al. Maternal obesity and risk of stillbirth: a metaanalysis. *Am J Obstet Gynecol.* 2007 Sep;197(3):223-8.
93. Kristensen J, Vestergaard M, Wisborg K, Kesmodel U, Secher NJ. Pre-pregnancy weight and the risk of stillbirth and neonatal death. *BJOG.* 2005 Apr;112(4):403-8.
94. Cedergren M, Brynhildsen J, Josefsson A, Sydsjo A, Sydsjo G. Hyperemesis gravidarum that requires hospitalization and the use of antiemetic drugs in relation to maternal body composition. *Am J Obstet Gynecol.* 2008 Apr;198(4):412 e1-5.
95. Furman B, Shoham-Vardi I, Bashiri A, Erez O, Mazor M. Clinical significance and outcome of preterm prelabor rupture of membranes: population-based study. *Eur J Obstet Gynecol Reprod Biol.* 2000 Oct;92(2):209-16.
96. Das UN. Is obesity an inflammatory condition? *Nutrition.* 2001 Nov-Dec;17(11-12):953-66.
97. Ramsay JE, Ferrell WR, Crawford L, Wallace AM, Greer IA, Sattar N. Maternal obesity is associated with dysregulation of metabolic, vascular, and inflammatory pathways. *J Clin Endocrinol Metab.* 2002 Sep;87(9):4231-7.
98. Dodd JM, Grivell RM, Crowther CA, Robinson JS. Antenatal interventions for overweight or obese pregnant women: a systematic review of randomised trials. *BJOG.* 2010 Mar 29.
99. Leigh B, Milgrom J. Risk factors for antenatal depression, postnatal depression and parenting stress. *BMC Psychiatry.* 2008;8:24.
100. Britton JR. Maternal anxiety: course and antecedents during the early postpartum period. *Depress Anxiety.* 2007 Mar 30.
101. Evans J, Heron J, Francomb H, Oke S, Golding J. Cohort study of depressed mood during pregnancy and after childbirth. *BMJ.* 2001 Aug 4;323(7307):257-60.
102. Marcus SM, Flynn HA, Blow FC, Barry KL. Depressive symptoms among pregnant women screened in obstetrics settings. *J Womens Health (Larchmt).* 2003 May;12(4):373-80.

103. Pajulo M, Savonlahti E, Sourander A, Helenius H, Piha J. Antenatal depression, substance dependency and social support. *J Affect Disord.* 2001 Jun;65(1):9-17.
104. Milgrom J, Gemmill AW, Bilszta JL, Hayes B, Barnett B, Brooks J, et al. Antenatal risk factors for postnatal depression: a large prospective study. *J Affect Disord.* 2008 May;108(1-2):147-57.
105. Josefsson A, Angelsioo L, Berg G, Ekstrom CM, Gunnervik C, Nordin C, et al. Obstetric, somatic, and demographic risk factors for postpartum depressive symptoms. *Obstet Gynecol.* 2002 Feb;99(2):223-8.
106. Claesson IM, Sydsjo G, Brynhildsen J, Cedergren M, Jeppsson A, Nystrom F, et al. Weight gain restriction for obese pregnant women: a case-control intervention study. *BJOG.* 2008 Jan;115(1):44-50.
107. Ohlin A, Rossner S. Factors related to body weight changes during and after pregnancy: the Stockholm Pregnancy and Weight Development Study. *Obes Res.* 1996 May;4(3):271-6.
108. Harris HE, Ellison GT, Clement S. Do the psychosocial and behavioral changes that accompany motherhood influence the impact of pregnancy on long-term weight gain? *J Psychosom Obstet Gynaecol.* 1999 Jun;20(2):65-79.
109. Gunderson EP, Abrams B. Epidemiology of gestational weight gain and body weight changes after pregnancy. *Epidemiol Rev.* 1999;21(2):261-75.
110. Amorim AR, Linne Y, Kac G, Lourenco PM. Assessment of weight changes during and after pregnancy: practical approaches. *Matern Child Nutr.* 2008 Jan;4(1):1-13.
111. Kinnunen TI, Pasanen M, Aittasalo M, Fogelholm M, Weiderpass E, Luoto R. Reducing postpartum weight retention--a pilot trial in primary health care. *Nutr J.* 2007;6:21.
112. Patton MQ. *Qualitative evaluation and research methods.* Newbury Park, Calif.: Sage Publications; 1990.
113. Graziano AM, Raulin ML. *Research methods : a process of inquiry (with student CD-ROM).* Boston, Mass. [u.a.]: Pearson; 2004.
114. Polit DF, Hungler BP. *Nursing research : principles and methods.* Philadelphia: Lippincott; 1991.
115. Linne Y, Barkeling B, Rossner S. Long-term weight development after pregnancy. *Obes Rev.* 2002 May;3(2):75-83.
116. Rooney BL, Schauburger CW. Excess pregnancy weight gain and long-term obesity: one decade later. *Obstet Gynecol.* 2002 Aug;100(2):245-52.
117. Rooney BL, Schauburger CW, Mathiason MA. Impact of perinatal weight change on long-term obesity and obesity-related illnesses. *Obstet Gynecol.* 2005 Dec;106(6):1349-56.

## **APPENDICES**

Appendix 1. Study schedule for the intervention group

Appendix 2. Study schedule for control group

Appendix 3. Interview-guide (paper V)

**Appendix 1.** Study schedule for the intervention group

Gestational week	11 weeks p.p.*											Months after childbirth				
	8-13	14	15	16-18	19	20-28	29	30-32	33	34	35	36-40	6	12	18	24
First visit at ANC**, information	X															
Weighting	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Motivational talk	X	X	X	X	X	X	X	X	X	X	X	X	X†	X†	X†	X†
Aqua aerobic	X	X	X	X	X	X	X	X	X	X	X	X				
Diary for physical activity	X	X	X	X	X	X	X	X	X	X	X	X				
Diet diary (4 days)		X														
OGTT***			X				X					X				
Sample of blood for lipoproteins and insulin			X				X					X				
Sample of blood for refrigeration			X				X					X				
Questionnaire psychological well-being			X													
Ultrasound (dating, detecting abnormalities, growth respectively)	X			X					X							
Child weight													X	X	X	X

\* postpartum \*\* Antenatal care clinic \*\*\* oral glucose tolerance test

† motivational talk on request red X = the result presents in this dissertation

**Appendix 2.** Study schedule for control group

Gestational week	First visit at ANC* w. 8-13		15	29	32	35	37	11 weeks p.p.**	Months after childbirth				
	X	X							6	12	18	24	
Weighting***	X	X			X		X	X	X				X
OGTT†		X	X***					X					
Sample of blood for lipoproteins and insulin		X	X					X					
Sample of blood for refrigeration		X	X					X					
Questionnaire psychological well-being		X				X		X					
Child weight									X	X	X	X	X

\* Antenatal care clinic

\*\* postpartum

\*\*\* according to the routine program for ANC

† oral glucose tolerance test

red X = the result presents in this dissertation

### Appendix 3. Interview-guide (paper V)

1. Vad var bra med att delta i studien?
2. Vad var mindre bra med att delta i studien?
3. Var antalet kontakttillfällen med barnmorskan:  
Lagom  För många  För få
- 3a. Om besöken var för många/för få. Hur ofta hade du velat komma?
4. Hade du satt ett eget mål för viktuppgång under graviditeten?  
Ja  Nej  Kommentarer:
- 4b. Om Ja, hur motiverad var du att nå detta mål?  
Mycket motiverad  Ganska motiverad  Inte motiverad   
Kommentarer:
5. Hur nöjd är du med din viktuppgång under graviditeten?  
Mycket nöjd  Ganska nöjd  Inte nöjd   
Kommentarer:
- 5a. Om du är nöjd, skulle du klarat av att hålla vikten själv, utan de täta besöken hos barnmorskan?  
Ja  Nej  Kommentarer:
6. Skulle du vilja delta även vid en ev. nästa graviditet om möjlighet finns?  
Ja  Nej  Kommentarer:
7. Skulle du rekommendera någon annan att delta?  
Ja  Nej  Kommentarer:
8. Har du förändrat dina matvanor efter att du gick med i studien?  
Ja  Nej  Kommentarer:
- 8a. Om du har förändrat dina matvanor – fortsätter du på den inslagna vägen?  
Ja  Nej  Kommentarer:
- 8b. Om du har försökt att ändra dina matvanor, har din partner stöttat dig i detta?  
Ja  Nej  Kommentarer:

- 9.** Har övriga familjen ändrat sina matvanor?  
Ja  Nej  Kommentarer:
- 10.** Har du ändrat dina motionsvanor efter att du gick med i studien?  
Ja  Nej  Kommentarer:
- 10a.** Om du har förändrat dina motionsvanor – fortsätter du på den inslagna vägen?  
Ja  Nej  Kommentarer:
- 10b.** Om du har försökt att förändra dina motionsvanor, har din partner stöttat dig i detta?  
Ja  Nej  Kommentarer:
- 11.** Har övriga familjen ändrat sina motionsvanor?  
Ja  Nej  Kommentarer:
- 12.** Upplevde du att stödet från barnmorskan var tillräcklig under graviditeten?  
Ja  Nej  Kommentarer:
- 13.** Hade du behövt stöd från annan profession än barnmorskan?  
Ja, från ..... Nej  Kommentarer:
- 14.** Har du deltagit i vattengympan?  
Ja  Nej  Kommentarer:
- 14a.** Om Ja, vad har varit bra med vattengympan?
- 14b.** Om Ja, vad har varit mindre bra med vattengympan?