Maternal Quality of Life, Lifestyle, and Interventions after Complicated Pregnancies.

Meeke Hoedjes

Maternal Quality of Life, Lifestyle, and Interventions after Complicated Pregnancies.

Meeke Hoedjes

Voor Roan

Colofon

ISBN 978-94-6191-018-9

Cover design: Meeke Hoedjes
Lay-out: Ontwerpbureau Demeneer
Printing: Ipskamp drukkers

The studies described in this thesis were financially supported by the Netherlands Organisation for Health Research and Development (ZonMW, grant 6120.0024).
This thesis was printed with financial support of the Dutch Heart foundation, the Erasmus University Rotterdam, and the Department of Public Health, Erasmus MC, Rotterdam.

Maternal Quality of Life, Lifestyle, and Interventions after Complicated Pregnancies.

Maternale kwaliteit van leven, leefstijl en interventies na gecompliceerde zwangerschappen.

Proefschrift

ter verkrijging van de graad van doctor aan de
Erasmus Universiteit Rotterdam
op gezag van de
rector magnificus

Prof. dr. H.G. Schmidt

en volgens besluit van het College voor Promoties.

De openbare verdediging zal plaatsvinden op
woensdag 14 december 2011 om 9.30 uur

door

Meeke Hoedjes
geboren te Goirle

Promotiecommissie

Promotoren:

Prof. dr. J.D.F. Habbema

Prof. dr. E.A.P. Steegers

Overige leden:

Prof. dr. E.J.G. Sijbrands

Prof. dr. ir. J. Brug

Prof. dr. J. de Vries

Copromotoren:

Dr. H. Raat

Dr. J.J. Duvekot

CONTENTS

	List of abbreviations	8
Chapter 1	Introduction	11
	Part I: Postpartum mental health and health-related quality of life after preeclampsia.	29
Chapter 2	Poor health-related quality of life after severe preeclampsia *Birth. 2011 Sep;38(3):246-55. PMID:21884233*	31
Chapter 3	Postpartum depression after mild and severe preeclampsia. *J Womens Health (Larchmt). 2011 Oct;20(10):1535-42. PMID:21815820*	49
Chapter 4	Symptoms of post-traumatic stress after preeclampsia. *J Psychosom Obstet Gynecol. 2011; 32(3):126-134. PMID:21824043*	65
	Part II: Postpartum lifestyle and its determinants.	87
Chapter 5	Motivators and barriers to a healthy postpartum lifestyle in women at increased cardiovascular and metabolic risk: a focus group study. *Hypertens Pregnancy. 2011 Jan 20. [Epub ahead of print] PMID: 21250888*	89
Chapter 6	Postpartum physical activity after preeclampsia. *Submitted.*	103
	Part III: Postpartum lifestyle interventions after complicated pregnancies.	121
Chapter 7	Effect of postpartum lifestyle interventions on weight loss, smoking cessation, and prevention of smoking relapse: a systematic review. *Obstet Gynecol Surv. 2010 Oct;65(10):631-52. PMID:21182803*	123
Chapter 8	Preferences for postpartum lifestyle counseling among women sharing an increased cardiovascular and metabolic risk: a focus group study. *Hypertens Pregnancy. 2011;30(1):83-92. PMID:20818968*	151
Chapter 9	Discussion	165
Summary		183
Samenvatting		187
Manuscripts based on this thesis		191
CV		193
PhD Portfolio		195
Dankwoord		199

LIST OF ABBREVIATIONS

ACOG	American College of Obstetricians and Gynecologists
ANOVA	Analysis of variance
B	Beta
BMI	Body Mass Index
C	Control group
CI	Confidence Interval
DSM-IV	Diagnostic and Statistical manual of Mental disorders, 4rd edition
EPDS	Edinburgh Postnatal Depression Scale
ES	Effect Size
ESC	European Society of Cardiology
GEE	Generalized Estimating Equations
GLM	Generalized Linear Models
HELLP syndrome	Hemolytic anemia Elevated Liver and Low Platelet count syndrome
I	Intervention group
IQR	Interquartile range
IPAQ	International Physical Activity Questionnaire
ISSHP	International Society of Hypertension in Pregnancy
MET	Metabolic equivalent
MID	Minimally important difference
NA	Non applicable
NICU	Neonatal Intensive Care Unit
NS	Non significant
OR	Odds ratio
Pro-Active	Postpartum Rotterdam Appraisal of Cardiovascular Health and Tailored Intervention
PTSD	Post-traumatic Stress Disorder
RCT	Randomized Controlled Trial
SD	Standard deviation
SF-36	36-item Short-Form Health Survey
SPSS	Statistical Package for Social Sciences
USA	United States of America
WHO	World Health Organisation
WHR	Waist-hip ratio

CHAPTER 1

Introduction

1. INTRODUCTION

Although most pregnancies elapse uneventful, complications arise in a substantial number. This thesis will focus on preeclampsia, intrauterine growth restriction and gestational diabetes, because women who experience these pregnancy complications share an increased cardiovascular and metabolic risk [1-5]. See Box 1 for the definitions of these pregnancy complications used in this thesis.

Preeclampsia is a placenta-related hypertensive pregnancy complication, which affects 2-8% of all pregnancies [6], and is associated with both maternal complications (such as eclampsia, abruptio placentae, pulmonary edema, acute renal failure) [1,6], and neonatal complications (such as fetal growth restriction, preterm delivery, and perinatal death) [7-9]. Furthermore, preeclamptic women frequently experience an emergency cesaerean section and admission to an intensive care unit. Preeclampsia is usually classified as mild or severe. Severe preeclampsia more frequently has adverse maternal and/or perinatal outcomes compared with mild preeclampsia [9]. Preeclampsia may develop before 34 weeks (early onset), at 34 weeks or later (late onset), during labor, or postpartum. It is suggested that early onset and late onset preeclampsia may be related to different pathophysiological pathways. Early onset disease is associated with higher maternal mortality [6], fetal growth restriction and ischemic lesions on placental examination, whereas late onset disease is not [10,11]. Additionally, maternal hemodynamics may be different [12].

Intrauterine growth restriction is an important placenta-related pregnancy complication with increased perinatal morbidity and mortality [13,14]. It is the single strongest risk factor for stillbirth [15]. In most cases, intrauterine growth restriction is caused by disorders of the placenta.

Diabetes mellitus is common worldwide. Gestational diabetes is characterized by glucose intolerance of variable severity that begins or is first diagnosed during pregnancy and usually resolves after delivery [16]. Diagnosis of gestational diabetes is usually based on the results of oral glucose tolerance tests. An accurate estimation of the prevalence of gestational diabetes does not exist in many countries because of the lack of uniform standards in glucose tolerance testing [17]. The prevalence varies with the testing method and diagnostic criteria used, and differs between ethnic groups. E.g., in the United States, prevalence is higher in African-American, Latino, Native American, and Asian women than in Caucasian women [18]. The prevalence of gestational diabetes has been increasing over time, possibly related to an increase in mean maternal age and weight [19,20]. Pregnant women are at increased risk if they are obese or when they have a family history of type II diabetes mellitus or gestational diabetes. Gestational diabetes significantly increases the risk of a number of adverse consequences for the fetus, such as macrosomia, hyperbillirubinemia, hypoglycemia, respiratory distress syndrome, shoulder dystocia, and brachial plexus injury [21,22]. It can also adversely impact maternal health and is

associated with a significantly higher relative risk of gestational hypertension, preterm labor [23], cesarean delivery [23] and metabolic syndrome [24]. Effective treatment of gestational diabetes consists of dietary therapy, self blood glucose monitoring, and the administration of insulin if target blood glucose values are not met with diet alone. Nutritional counseling by a dietician is recommended for all women diagnosed with gestational diabetes. The goals of nutritional therapy are to achieve normoglycemia, prevent ketosis, provide adequate maternal weight gain and to contribute to fetal well-being. Exercise is being increasingly promoted as part of the therapeutic regimen for diabetes mellitus. In addition to its cardiovascular benefits, exercise can also improve glycemic control, largely resulting from increased tissue sensitivity to insulin.

Box 1. *Definitions of pregnancy complications used in this thesis.*

(Mild) Preeclampsia [25]

- blood pressure of ≥140/90 mmHg
- proteinuria (defined as ≥300 mg/day of urinary protein loss)
- at least 20 weeks of gestation in a previously normotensive woman

Severe preeclampsia [9]

One or more of the following:

- blood pressure of 160 mmHg systolic or higher or 110 mmHg diastolic or higher on two occasions at least 6 hours apart
- proteinuria of 5 gram or higher in a 24 hour urine specimen or 3+ or greater on two random urine samples collected at least 4 hours apart
- oliguria of less than 500 mL in 24 hours
- cerebral or visual disturbances
- pulmonary edema or cyanosis
- epigastric or right upper-quadrant pain
- impaired liver function
- thrombocytopenia
- fetal growth restriction
- Hemolysis Elevated Liver enzymes and Low Platelets (HELLP) syndrome (defined by thrombocyte count less than 100*109/l, and/or ASAT and ALAT enzymes above 30 U/l)

Intrauterine growth restriction [26] due to placental insufficiency

- fetal abdominal circumference below the fifth percentile measured by ultrasound, in combination with
- an increased pulsatility index of the umbilical artery (> p 95), or absent or reversed end diastolic flow

Gestational Diabetes [27,28]

- at least one abnormal result (fasting ≥ 7.0 mmol/l or two hour ≥ 7.8 mmol/l) of a two-hour 75-gram oral glucose tolerance test

1.1 Postpartum health and health-related quality of life after pregnancy complications

The World Health Organization (WHO) defines health as a ‘state of complete physical, mental and social well-being and not merely the absence of disease or infirmity’ [29].

A common way to assess a person's perception of the effects of symptoms, diseases or conditions is by measuring quality of life. According to the WHO, quality of life is defined as an individuals' perceptions of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns [30]. This definition reflects the view that quality of life refers to a subjective evaluation that is embedded in a cultural, social and environmental context. In this thesis we will focus on health-related quality of life, which can be defined as the extent to which one's usual or expected physical, emotional, and social well-being is affected by a medical condition or its treatment [31]. A commonly used questionnaire to measure health-related quality of life is the RAND 36-item Short-Form Health Survey (SF-36) [32,33]. The SF-36 consists of eight subscales, which can be summarised in two summary measures: a physical component (consisting of the subscales physical functioning, role physical, bodily pain, and general health), and a mental component (consisting of the subscales vitality, social functioning, role emotional, and mental health).

Pregnancy complications have been associated with a poor physical and mental postpartum health. Women who have experienced preeclampsia frequently report physical complaints such as headache, right upper quadrant pain, visual disturbances, and fatigue [34]. They also report cognitive complaints such as problems with attention, concentration, and memory [35]. Up to 12 months after delivery, women who have experienced preeclampsia, intrauterine growth restriction, and/ or gestational diabetes show cardiovascular and metabolic risk factors, including high values for circulating concentrations of fasting insulin, blood pressure, lipids, body mass index, and insulin resistance compared with women with uncomplicated pregnancies [36-45].

Besides these physical sequelae, pregnancy complications are also associated with a poor mental postpartum health. Mental health is described by the WHO as a state of well-being in which the individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community [46]. Mental health is increasingly seen as fundamental to physical health and quality of life and thus needs to be addressed as an important component of improving overall health and well-being. The WHO states that there is a need for appropriate care and treatment for those experiencing poor mental health. The WHO also pleads for a greater focus on promotion of mental health and prevention of illness in global, national and local policy and practice [47].

Preeclampsia is considered to have a strong psychological impact, especially when it develops early in pregnancy or when an adverse perinatal outcome occurs [34,48]. Compared with women who have had uncomplicated pregnancies and deliveries, women who have had preeclampsia experience more emotional problems and more posttraumatic stress symptoms such as re-experiencing the delivery, amnesia for the event, sweating, irritability, and sleep disturbances [34,49,50]. Post-traumatic stress disorder (PTSD) may develop after 'stressful situations in which a person has experienced, witnessed, or is confronted with an event that involves actual or threatened death or serious injury, or a threat to the physical integrity of self

or others'[51]. Childbirth has shown to be such a stressful situation in some cases; post-traumatic stress disorder occurs in 3–6% at 6 weeks postpartum [50,52,53]. According to DSM-IV criteria, post-traumatic stress disorder is diagnosed when at least one intrusion symptom (e.g. intrusive memories, nightmares, flashbacks or re-living an event), three avoidance symptoms (e.g., avoiding reminders, amnesia, or numbing) and two hyperarousal symptoms (e.g., irritability, concentration problems, sleeping problems) occur during a period of at least one month [51]. Symptoms of post-traumatic stress disorder may develop as a consequence of traumatic delivery [50] and / or perinatal complications such as stillbirth, preterm birth [54,55], and perinatal loss [56,57]. Post-traumatic stress disorder has also shown to be associated with preeclampsia [49,58].

Obstetric complications are also possible causal factors in postpartum depression [59]. According to DSM-IV criteria, postpartum depression is defined as a non-psychotic depressive episode that begins or extends into the postpartum period [51,60]. The average prevalence of postpartum depression is 13% [61]. Studies found that women who experienced preeclampsia report more postpartum symptoms of depression than women after uneventful pregnancies. However, these differences failed to reach statistical significance [35,49,55]. Postpartum depression also has adverse effects on the behavioral, intellectual and emotional development of the offspring [62-66].

Although knowledge on the sequelae of pregnancy complications is increasing, knowledge on postpartum health-related quality of life, and particulary on mental health, is still lacking. In particular, little is known about the postpartum course of mental health and its determinants, and about differences in mental health between women who had mild and severe preeclampsia.

1.2 Occurrence and prevention of cardiovascular disease and type II diabetes mellitus after pregnancy complications

Women who have experienced placenta-related pregnancy complications like preeclampsia, intrauterine growth restriction and/or gestational diabetes share an increased risk for recurrence of these complications in a subsequent pregnancy [67-70]. Furthermore, epidemiological data indicate that an obstetric history of preeclampsia, intrauterine growth restriction and/ or gestational diabetes is associated with a significantly increased risk for type II diabetes mellitus later in life [71-73], and for remote cardiovascular diseases, such as myocardial infarction, ischemic heart disease, and cerebrovascular accidents [1-5].

Cardiovascular disease and type II diabetes mellitus continue to be major causes of mortality and morbidity. Secondary prevention of cardiovascular disease and type II diabetes mellitus remains challenging, partly due to the lack of an effective strategy to identify individuals at high risk, at a sufficiently young age.

Knowledge from recent years has led to a novel high-risk prevention strategy, aiming at women who have experienced preeclampsia, intrauterine growth restriction, and/ or gestational

diabetes. It is hypothesized that exposure of these women to the additional metabolic and cardiovascular challenges of these pregnancy induced transient clinical diseases are likely to re-emerge later in life as cardiovascular disease and type II diabetes mellitus. Thus, pregnancy is seen as a challenge test to women, with preeclampsia, intrauterine growth restriction, and gestational diabetes as positive test results. It is hypothesized that endothelial or metabolic compromise is already present before it transiently deteriorates during pregnancy as a result of additional cardiovascular and metabolic demands. Endothelial compromise occurs in all pregnancies, but usually within the limits that define normality. In women with pre-existing endothelial and metabolic compromise however, physical (e.g., blood pressure levels) or biochemical (e.g., blood glucose levels) characteristics will exceed the clinical thresholds of abnormality or disease. When the additional demands of pregnancy subside after delivery, blood pressure and blood glucose concentration often decrease again below the clinical threshold. See Figure 1. (Adapted from Sattar & Greer, BMJ 2002) [3]

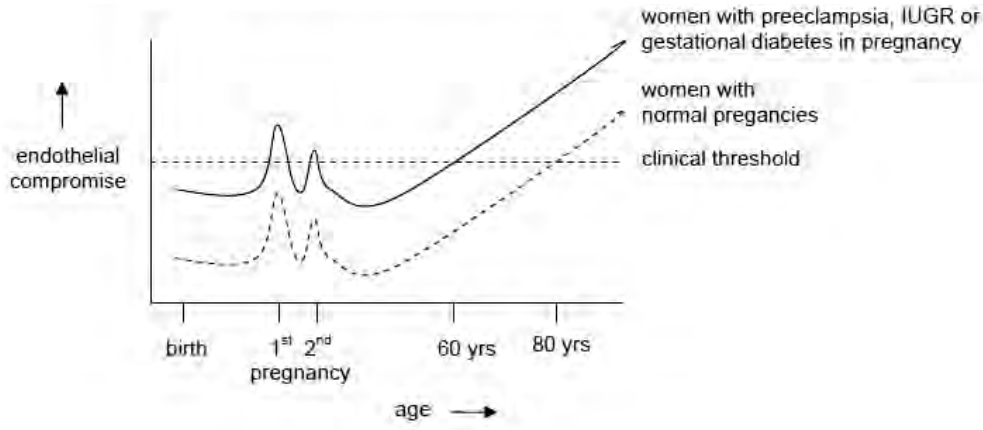


figure 1. *Pregnancy as a cardiovascular and metabolic challange test*

1.3 Opportunities for lifestyle changes after pregnancy complications

This new concept of pregnancy as a cardiovascular and metabolic challenge test offers a window of opportunity for health risk assessment and secondary preventive interventions shortly after pregnancy in women who had preeclampsia, intrauterine growth restriction, and/or gestational diabetes. It is concluded that women with these pregnancy complications should be screened postpartum for cardiovascular risk factors, and should be offered a postpartum lifestyle intervention to reduce future cardiovascular morbidity and mortality [3,4,38,41,71]. There is increased knowledge on postpartum lifestyle behavior and its determinants for gestational diabetes [74-78], but not for preeclampsia and intrauterine growth restriction. Such knowledge is needed for the development of effective lifestyle interventions. Potential motivators and barriers to live a healthy postpartum lifestyle should be examined. For example, poor health-related quality of life might be a barrier to the adoption of a healthy postpartum lifestyle.

1.4 Lifestyle interventions to reduce cardiovascular risk

Risk factors for cardiovascular disease and type II diabetes mellitus, such as dyslipidemia, hypertension and obesity, are related to lifestyle behavior [79,80]. Potentially modifiable lifestyle factors include consumption of saturated fat, fruit, vegetables, alcohol, physical activity, smoking, and psychosocial factors [80]. Interventions on lifestyle behavior have proven to be effective for cardiovascular disease [79,81-84] and type II diabetes mellitus [85,86], for example, in promoting smoking cessation and weight loss [2,87-90]. The European Society of Cardiology (ESC) has issued the following lifestyle recommendations[91]: no smoking; weight reduction if BMI $\geq$ 25; no further weight gain if waist circumference is 80 to 88 centimeters, and weight loss if waist circumference is $\geq$ 88 centimeters; 30 minutes of moderately vigorous exercise on at least 5 days a week; eat a variety of foods; limit energy intake to avoid overweight; encourage intake of fruits, vegetables, wholegrain cereals and bread, fish (especially oily fish), lean meat, and low fat dairy products; replace saturated fat with vegetable or marine unsaturated fats; and hypertensive individuals should reduce salt intake.

1.5 Lifestyle interventions after pregnancy complications

Although the postpartum period is considered to be a window of opportunity for lifestyle interventions, there is little knowledge on how cardiovascular and metabolic risk can be reduced in women after pregnancy complications, particularly after preeclampsia and intrauterine growth restriction. We hypothesize that the experience of these sometimes threatening pregnancy complications may serve as a cue to action enhancing the motivation for behavior change. However, this has not yet been studied.

Considering the individual differences in pregnancy complications and their consequences, physical and mental recovery, and other personal factors (e.g., education and family composition), the use of lifestyle interventions that are specifically tailored for this group of high-risk women seems to be most suitable. To promote participation and adherence, opinions, needs, and ideas of women who have recently experienced pregnancy complications should be taken into account while developing tailored interventions. For example, preferred characteristics of lifestyle interventions should be examined.

1.6 Tailoring lifestyle interventions

Health education approaches and lifestyle interventions can be categorized into three levels: mass media interventions, targeted interventions and tailored interventions. Mass media interventions have been defined as those interventions that reach groups of individuals by using a medium other than personal contact, and offer a means to reach large numbers of people [92]. Targeted interventions are developed for a defined population subgroup [93]. Tailored interventions or health education materials are “intended to reach one specific person, are based on characteristics that are unique to that person, are related to the outcome of interest,

and have been derived from an individual assessment" [94]. Currently, in the healthcare setting, interventions that are tailored to the individual (such as face-to-face counseling) are widely applied. In the last decades, several potentially important new channels for health communication have emerged, such as interactive computer programs and the Internet [95]. With computer-tailoring, individualized health education for relatively large target populations can be realized. It is a promising strategy for various behaviors [96-98]. Computer-tailored lifestyle counseling (e.g., computer-tailored nutrition education) can provide people with both individualized feedback and advice on personal performance levels (e.g., nutritional intake) and awareness of their own performance, as well as personal motivation to change, goals, outcome expectations, subjective norms, self-efficacy, self-regulation processes and other possible behavioral determinants [94,99]. Computer-tailored lifestyle interventions for various behaviors are currently offered on the world-wide web [96,100,101].

1.7 Planned health promotion

The science discipline of health behavior promotion has extensively studied how lifestyle interventions should be developed and recognizes the importance of theory-based intervention planning. The studies presented in this thesis are based on the model for planned health education and promotion [102]. Figure 2 shows this model, elaborated with the operationalisation of this model in this thesis. Each of the steps in the model should be evaluated and should preferably be evidence-based. The first three steps refer to 'needs assessment'. The first step in health education and health promotion planning is the identification of health problems. During this step, the impact and burden of the

health problem is evaluated. The second step concerns the identification of possible behavioral causes or behavioral risk factors for the health problem. Steps 1 and 2 result in a set of priorities for preventive interventions, health change goals and specific target groups for interventions. During step 3 important modifiable behavioral determinants are identified. The relation between determinants of behavior and actual behavior is described in various behavioral models, which are used to explain behavior (e.g., the theory of planned behavior developed by Azjen [103]). The use of behavioral models is well embedded in the field of health behavior promotion. The third step serves to identify the reasons why people in the population at risk engage in risk behavior and what determinants could be targeted for realizing healthy behavior change.

The needs assessment in steps 1 to 3 is followed by intervention development. In this fourth step, the intervention development phase, intervention methods and strategies that induce changes in the behavioral determinants and subsequently reduce risk behaviour should be identified or developed. Intervention strategies, methods and materials need to be selected and/ or developed that address the most important and modifiable determinants identified in the third step. These should then be translated into deliverable intervention strategies and should be evaluated for their efficacy. Then the intervention needs to be implemented and disseminated so that the

target population is reached and exposed to the health education messages. Interventions should be implemented and disseminated after their effectiveness has been established. Step 6 consists of monitoring and evaluation of the intervention. This thesis involves steps 1 to 4 of the model for planned health education and promotion.

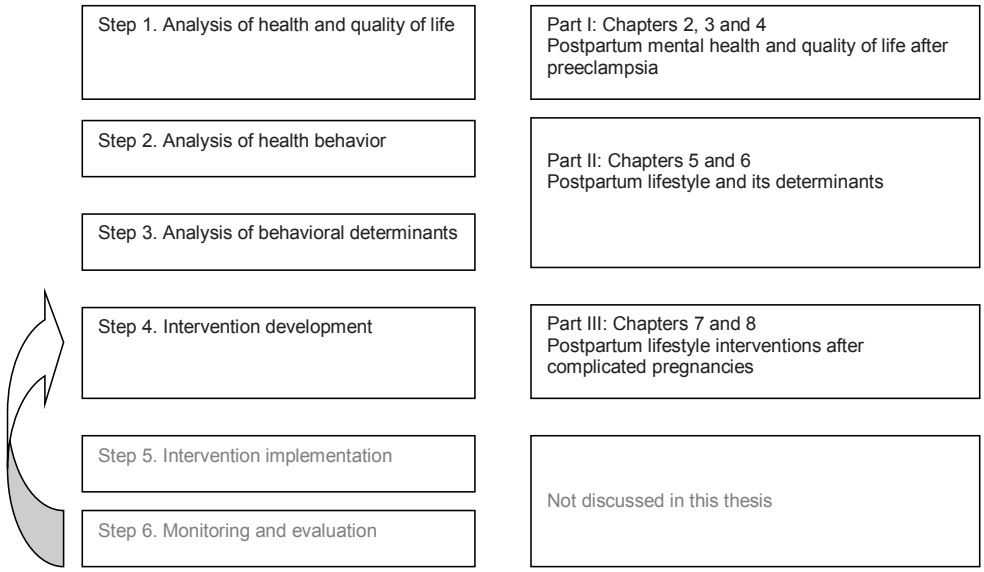


Figure 2. *Model for planned health education and promotion and operationalisation in this thesis.*

1.8 The Pro-Active study

The studies described in this thesis were conducted as part of the Pro-Active (Postpartum Rotterdam Appraisal of Cardiovascular Health and Tailored Intervention) study. The Pro-Active study is a prospective multi-center cohort study coordinated by the Erasmus University Medical Center Rotterdam, the Netherlands. Women whose previous pregnancy had been complicated by preeclampsia, intrauterine growth restriction and/ or gestational diabetes were included in the Pro-Active study postpartum in order to: a) appraise postpartum mental and physical health (in particular cardiovascular and metabolic health), b) to develop a high-risk strategy in order to prevent cardiovascular disease and type II diabetes mellitus, and c) to examine the feasibility of a postpartum lifestyle intervention after complicated pregnancies. See Box 2 for a description of the inclusion and exclusion criteria for the selection of eligible participants for the Pro-Active study. Eligible patients were selected by searching hospital records. All selected patients were invited to participate up to 6 weeks postpartum for follow-up hospital visits at 6 weeks, 3 months and 6 months postpartum. During those hospital visits cardiovascular and metabolic risk factors were assessed, including overweight, latent hypertension, dyslipidemia, hyperhomocysteinemia, insulin resistance, smoking, physical activity and saturated fat intake. Mental health (postpartum depression, and post-traumatic stress disorder) and health-related quality of life was assessed by questionnaires that were administered during all three hospital visits.

The studies described in this thesis focus on the appraisal of postpartum mental health and health-related quality of life, postpartum lifestyle behavior and its determinants, and postpartum lifestyle interventions. The evaluation of the feasibility of the lifestyle intervention developed during the Pro-Active study is not within the scope of this thesis.

Box 2. *Inclusion and exclusion criteria for the selection of eligible Pro-Active participants.*

Inclusion criteria:

- delivery between February 2007 and June 2009
- diagnosis of preeclampsia, intrauterine growth restriction, and/or gestational diabetes during pregnancy
- 18 years of age or older
- able to understand and speak the Dutch language

Exclusion criteria:

- preexisting pathology (e.g., type I or type II diabetes mellitus and ischemic heart disease)
- intrauterine growth restriction not caused by placental insufficiency

1.9 Postpartum mental health and health-related quality of life after preeclampsia

Part I of this thesis refers to the first step of the model for planned health education and promotion: analysis of health and quality of life. Part I aims to gain more insight into the postpartum mental health and health-related quality of life in women after pregnancy complications. It focuses on women who have experienced preeclampsia. In chapter 2, postpartum health-related quality of life among formerly preeclamptic women is assessed. Chapters 3 and 4 focus on postpartum mental health. Chapter 3 describes postpartum depression and chapter 4 describes post-traumatic stress disorder after pregnancies complicated by preeclampsia.

1.10 Postpartum lifestyle and its determinants

Part II of this thesis refers to step 2 and 3 of the model for planned health education and promotion: analysis of behavior and behavioral determinants. Part II aims to gain more insight into postpartum lifestyle behavior and determinants of postpartum lifestyle behavior among women who experienced pregnancy complications. Chapter 5 describes motivators and barriers to postpartum lifestyle behavior in women who previously experienced preeclampsia, intrauterine growth restriction, and/or gestational diabetes. Chapter 6 describes postpartum physical activity and variables associated with physical activity in formerly preeclamptic women.

1.11 Postpartum lifestyle interventions after complicated pregnancies

Part III of this thesis refers to step 4 of the model for planned health education and promotion: intervention development. This part aims to gain more insight into postpartum lifestyle interventions that are suitable for women who have experienced pregnancy complications. Chapter 7 describes postpartum lifestyle interventions and their effectiveness. Chapter 8 describes women's preferences for postpartum lifestyle counseling after pregnancy complications.

1.12 Study questions addressed in this thesis

This thesis aims to describe postpartum mental health, health-related quality of life and lifestyle in women after placenta-related pregnancy complications, and to examine what postpartum lifestyle interventions could be implemented in order to improve modifiable cardiovascular risk factors for prevention of cardiovascular disease and type II diabetes mellitus. The research questions addressed in this thesis can be formulated as follows:

1. To what extent do women who had preeclampsia experience a good postpartum health-related quality of life, and what are its determinants? (Part I: Chapter 2)
2. To what extent do women who had preeclampsia experience a good postpartum mental health, and what are its determinants? (Part I: Chapter 2, 3 and 4)
3. How healthy is the postpartum lifestyle of women who experienced pregnancy complications, and what are its determinants? (Part II: chapter 5 and 6)
4. What postpartum lifestyle interventions are suitable for women who experienced pregnancy complications? (Part III: chapter 7 and 8)

1.13 Overview of this thesis

Table 1. *Overview of the different studies presented in this thesis*

Chapter	Study design	Sample and timing of measurements	Focus of the study
Part I: Postpartum mental health and health-related quality of life after preeclampsia			
2	Prospective cohort study	Women after preeclampsia; 6 and 12 weeks postpartum	Postpartum health-related quality of life and associated variables after a pregnancy complicated with preeclampsia.
3	Prospective cohort study	Women after preeclampsia; 6, 12, and 26 weeks postpartum.	Prevalence and variables associated with postpartum depression after a pregnancy complicated with preeclampsia.
4	Prospective cohort study	Women after preeclampsia; 6 and 12 weeks postpartum.	Prevalence and variables associated with postpartum post-traumatic stress after a pregnancy complicated with preeclampsia.
Part II: Postpartum lifestyle and its determinants			
5	Focus group study	Women after preeclamsia, intrauterine growth restriction, and or/ gestational diabetes; up to 19 months postpartum.	Motivators and barriers to a healthy postpartum lifestyle.
6	Prospective cohort study	Women after preeclampsia, 12 and 26 weeks postpartum.	Postpartum physical activity and associated variables after a pregnancy complicated with preeclampsia.
Part III: Postpartum lifestyle interventions after complicated pregnancies			
7	Review of the literature	Postpartum women; up to 1 year after delivery.	Effectiveness of postpartum lifestyle interventions.
8	Focus group study	Women after preeclamsia, intrauterine growth restriction, and or/ gestational diabetes; up to 19 months postpartum.	Preferences for postpartum lifestyle counseling.

1.14 REFERENCES

1. Bellamy L, Casas JP, Hingorani AD, Williams DJ. Pre-eclampsia and risk of cardiovascular disease and cancer in later life: systematic review and meta-analysis. BMJ (Clinical research ed. 2007 Nov 10;335(7627):974.
2. Ray JG, Vermeulen MJ, Schull MJ, Redelmeier DA. Cardiovascular health after maternal placental syndromes (CHAMPS): population-based retrospective cohort study. Lancet. 2005 Nov 19;366(9499):1797-803.
3. Sattar N, Greer IA. Pregnancy complications and maternal cardiovascular risk: opportunities for intervention and screening? BMJ (Clinical research ed. 2002 Jul 20;325(7356):157-60.
4. Smith GC, Pell JP, Walsh D. Pregnancy complications and maternal risk of ischaemic heart disease: a retrospective cohort study of 129,290 births. Lancet. 2001 Jun 23;357(9273):2002-6.
5. Barker DJ. Adult consequences of fetal growth restriction. Clinical obstetrics and gynecology. 2006 Jun;49(2):270-83.
6. Steegers EA, von Dadelszen P, Duvekot JJ, Pijnenborg R. Pre-eclampsia. Lancet. 2010 Aug 21;376(9741):631-44.
7. Sibai B, Dekker G, Kupferminc M. Pre-eclampsia. Lancet. 2005 Feb 26-Mar 4;365(9461):785-99.
8. Barton JR, Sibai BM. Prediction and prevention of recurrent preeclampsia. Obstetrics and gynecology. 2008 Aug;112(2 Pt 1):359-72.
9. ACOG practice bulletin. Diagnosis and management of preeclampsia and eclampsia. Number 33, January 2002. American College of Obstetricians and Gynecologists. International journal of gynaecology and obstetrics: the official organ of the International Federation of Gynaecology and Obstetrics. 2002 Apr;77(1):67-75.
10. von Dadelszen P, Magee LA, Roberts JM. Subclassification of preeclampsia. Hypertens Pregnancy. 2003;22(2):143-8.
11. Moldenhauer JS, Stanek J, Warshak C, Khoury J, Sibai B. The frequency and severity of placental findings in women with preeclampsia are gestational age dependent. American journal of obstetrics and gynecology. 2003 Oct;189(4):1173-7.
12. Valensise H, Vasapollo B, Gagliardi G, Novelli GP. Early and late preeclampsia: two different maternal hemodynamic states in the latent phase of the disease. Hypertension. 2008 Nov;52(5):873-80.
13. Marsal K. Obstetric management of intrauterine growth restriction. Best practice & research. 2009 Dec;23(6):857-70.
14. Kramer MS, Olivier M, McLean FH, Willis DM, Usher RH. Impact of intrauterine growth retardation and body proportionality on fetal and neonatal outcome. Pediatrics. 1990 Nov;86(5):707-13.
15. Gardosi J. Intrauterine growth restriction: new standards for assessing adverse outcome. Best practice & research. 2009 Dec;23(6):741-9.
16. Reece EA, Homko C, Miodovnik M, Langer O. A consensus report of the Diabetes in Pregnancy Study Group of North America Conference, Little Rock, Arkansas, May 2002. J Matern Fetal Neonatal Med. 2002 Dec;12(6):362-4.
17. Reece EA, Leguizamon G, Wiznitzer A. Gestational diabetes: the need for a common ground. Lancet. 2009 May 23;373(9677):1789-97.
18. Anna V, van der Ploeg HP, Cheung NW, Huxley RR, Bauman AE. Sociodemographic correlates of the increasing trend in prevalence of gestational diabetes mellitus in a large population of women between 1995 and 2005. Diabetes care. 2008 Dec;31(12):2288-93.
19. Dabelea D, Snell-Bergeon JK, Hartsfield CL, Bischoff KJ, Hamman RF, McDuffie RS. Increasing prevalence of gestational diabetes mellitus (GDM) over time and by birth cohort: Kaiser Permanente of Colorado GDM Screening Program. Diabetes care. 2005 Mar;28(3):579-84.
20. Getahun D, Nath C, Ananth CV, Chavez MR, Smulian JC. Gestational diabetes in the United States: temporal trends 1989 through 2004. American journal of obstetrics and gynecology. 2008 May;198(5):525 e1-5.
21. Boulet SL, Alexander GR, Salihu HM, Pass M. Macrosomic births in the united states: determinants, outcomes, and proposed grades of risk. American journal of obstetrics and gynecology. 2003 May;188(5):1372-8.
22. Esakoff TF, Cheng YW, Sparks TN, Caughey AB. The association between birthweight 4000 g or greater and perinatal outcomes in patients with and without gestational diabetes mellitus. American journal of obstetrics and gynecology. 2009 Jun;200(6):672 e1-4.

23. Tan PC, Ling LP, Omar SZ. The 50-g glucose challenge test and pregnancy outcome in a multiethnic Asian population at high risk for gestational diabetes. International journal of gynaecology and obstetrics: the official organ of the International Federation of Gynaecology and Obstetrics. 2009 Apr;105(1):50-5.

24. Gunderson EP, Jacobs DR, Jr., Chiang V, Lewis CE, Tsai A, Quesenberry CP, Jr., et al. Childbearing is associated with higher incidence of the metabolic syndrome among women of reproductive age controlling for measurements before pregnancy: the CARDIA study. American journal of obstetrics and gynecology. 2009 Aug;201(2):177 e1-9.

25. Brown MA, Lindheimer MD, de Swiet M, Van Assche A, Moutquin JM. The classification and diagnosis of the hypertensive disorders of pregnancy: statement from the International Society for the Study of Hypertension in Pregnancy (ISSHP). Hypertens Pregnancy. 2001;20(1):IX-XIV.

26. ACOG Practice Bulletin No. 58. Ultrasonography in pregnancy. Obstetrics and gynecology. 2004 Dec;104(6):1449-58.

27. Metzger BE, Gabbe SG, Persson B, Buchanan TA, Catalano PA, Damm P, et al. International association of diabetes and pregnancy study groups recommendations on the diagnosis and classification of hyperglycemia in pregnancy. Diabetes care. 2010 Mar;33(3):676-82.

28. Weinert LS. International Association of Diabetes and Pregnancy Study Groups recommendations on the diagnosis and classification of hyperglycemia in pregnancy: comment to the International Association of Diabetes and Pregnancy Study Groups Consensus Panel. Diabetes care. 2010 Jul;33(7):e97; author reply e8.

29. WHO. Basic documents. 43rd ed. Geneva: World Health Organisation 2001.

30. WHOQOLGroup. Development of the WHOQOL: Rationale and current status. Int J Mental Health. 1994;23:24-56.

31. Khanna D, Tsevat J. Health-related quality of life--an introduction. The American journal of managed care. 2007 Dec;13 Suppl 9:S218-23.

32. Ware JE, Kosinski M. Interpreting SF-36 summary health measures: a response. Qual Life Res. 2001;10(5):405-13; discussion 15-20.

33. Ware JE, Snow KK, Kosinski M, Gandek BG. SF-36 health survey: manual and interpretation guide. Boston, MA: Health Institute, New England Medical Center 1993.

34. Roes EM, Raijmakers MT, Schoonenberg M, Wanner N, Peters WH, Steegers EA. Physical well-being in women with a history of severe preeclampsia. J Matern Fetal Neonatal Med. 2005 Jul;18(1):39-45.

35. Brusse I, Duvekot J, Jongerling J, Steegers E, De Koning I. Impaired maternal cognitive functioning after pregnancies complicated by severe pre-eclampsia: a pilot case-control study. Acta obstetricia et gynecologica Scandinavica. 2008;87(4):408-12.

36. Elvan-Taspinar A, Bots ML, Franx A, Bruinse HW, Engelbert RH. Stiffness of the arterial wall, joints and skin in women with a history of pre-eclampsia. Journal of hypertension. 2005 Jan;23(1):147-51.

37. Raijmakers MT, Roes EM, Zusterzeel PL, Steegers EA, Peters WH. Thiol status and antioxidant capacity in women with a history of severe pre-eclampsia. Bjog. 2004 Mar;111(3):207-12.

38. Manten GT, Sikkema MJ, Voorbij HA, Visser GH, Bruinse HW, Franx A. Risk factors for cardiovascular disease in women with a history of pregnancy complicated by preeclampsia or intrauterine growth restriction. Hypertens Pregnancy. 2007;26(1):39-50.

39. Agatisa PK, Ness RB, Roberts JM, Costantino JP, Kuller LH, McLaughlin MK. Impairment of endothelial function in women with a history of preeclampsia: an indicator of cardiovascular risk. American journal of physiology. 2004 Apr;286(4):H1389-93.

40. Chambers JC, Fusi L, Malik IS, Haskard DO, De Swiet M, Kooner JS. Association of maternal endothelial dysfunction with preeclampsia. Jama. 2001 Mar 28;285(12):1607-12.

41. Forest JC, Girouard J, Masse J, Moutquin JM, Kharfi A, Ness RB, et al. Early occurrence of metabolic syndrome after hypertension in pregnancy. Obstetrics and gynecology. 2005 Jun;105(6):1373-80.

42. He S, Silveira A, Hamsten A, Blomback M, Bremme K. Haemostatic, endothelial and lipoprotein parameters and blood pressure levels in women with a history of preeclampsia. Thrombosis and haemostasis. 1999 Apr;81(4):538-42.

43. Hu J, Norman M, Wallensteen M, Gennser G. Increased large arterial stiffness and impaired acetylcholine induced skin vasodilatation in women with previous gestational diabetes mellitus. British journal of obstetrics and gynaecology. 1998 Dec;105(12):1279-87.

44. Meyers-Seifer CH, Vohr BR. Lipid levels in former gestational diabetic mothers. Diabetes care. 1996 Dec;19(12):1351-6.

45. Smith GN, Walker MC, Liu A, Wen SW, Swansburg M, Ramshaw H, et al. A history of preeclampsia identifies women who have underlying cardiovascular risk factors. American journal of obstetrics and gynecology. 2009 Jan;200(1):58 e1-8.

46. WHO. Strengthening mental health promotion. World Health Organisation 2001.

47. WHO. Promoting mental health: concepts, emerging evidence, practice. Geneva: Department of Mental Health and Substance Abuse in collaboration with the Victorian Health Promotion Foundation and the University of Melbourne 2005.

48. Rep A, Ganzevoort W, Bonsel GJ, Wolf H, de Vries JI. Psychosocial impact of early-onset hypertensive disorders and related complications in pregnancy. American journal of obstetrics and gynecology. 2007 Aug;197(2):158 e1-6.

49. Engelhard IM, van Rij M, Boullart I, Ekhart TH, Spaanderman ME, van den Hout MA, et al. Posttraumatic stress disorder after pre-eclampsia: an exploratory study. Gen Hosp Psychiatry. 2002 Jul-Aug;24(4):260-4.

50. Olde E, van der Hart O, Kleber R, van Son M. Posttraumatic stress following childbirth: a review. Clinical psychology review. 2006 Jan;26(1):1-16.

51. American Psychiatric Association (APA) Diagnostic and statistical manual of mental disorders IV. Washington, DC 2000.

52. Ayers S, Pickering AD. Do women get posttraumatic stress disorder as a result of childbirth? A prospective study of incidence. Birth (Berkeley, Calif. 2001 Jun;28(2):111-8.

53. Wijma K, Soderquist J, Wijma B. Posttraumatic stress disorder after childbirth: a cross sectional study. Journal of anxiety disorders. 1997 Nov-Dec;11(6):587-97.

54. Kersting A, Dorsch M, Wesselmann U, Ludorff K, Witthaut J, Ohrmann P, et al. Maternal posttraumatic stress response after the birth of a very low-birth-weight infant. Journal of psychosomatic research. 2004 Nov;57(5):473-6.

55. Baecke M, Spaanderman ME, van der Werf SP. Cognitive function after pre-eclampsia: an explorative study. Journal of psychosomatic obstetrics and gynaecology. 2009 Mar;30(1):58-64.

56. Ryding EL, Wijma K, Wijma B. Psychological impact of emergency cesarean section in comparison with elective cesarean section, instrumental and normal vaginal delivery. Journal of psychosomatic obstetrics and gynaecology. 1998 Sep;19(3):135-44.

57. Ryding EL, Wijma K, Wijma B. Predisposing psychological factors for posttraumatic stress reactions after emergency cesarean section. Acta obstetricia et gynecologica Scandinavica. 1998 Mar;77(3):351-2.

58. Poel YH, Swinkels P, de Vries JI. Psychological treatment of women with psychological complaints after pre-eclampsia. Journal of psychosomatic obstetrics and gynaecology. 2009 Mar;30(1):65-72.

59. Cox JL. Postnatal depression: A guide for health professionals. Edinburgh: Churchill Livingstone 1986.

60. Cox JL, Murray D, Chapman G. A controlled study of the onset, duration and prevalence of postnatal depression. Br J Psychiatry. 1993 Jul;163:27-31.

61. O'Hara MW, Swain AM. Rates and risk of postpartum depression-a meta analysis. Int Rev Psychiatry. 1996;8:37-54.

62. Cogill SR, Caplan HL, Alexandra H, Robson KM, Kumar R. Impact of maternal postnatal depression on cognitive development of young children. Br Med J (Clin Res Ed). 1986 May 3;292(6529):1165-7.

63. Wrate RM, Rooney AC, Thomas PF, Cox JL. Postnatal depression and child development. A three-year follow-up study. Br J Psychiatry. 1985 Jun;146:622-7.

64. Murray L, Cooper PJ. Postpartum depression and child development. Psychological medicine. 1997 Mar;27(2):253-60.

65. Beck CT. The effects of postpartum depression on child development: a meta-analysis. Arch Psychiatr Nurs. 1998 Feb;12(1):12-20.

66. Hay DF, Pawlby S, Sharp D, Asten P, Mills A, Kumar R. Intellectual problems shown by 11-year-old children whose mothers had postnatal depression. J Child Psychol Psychiatry. 2001 Oct;42(7):871-89.

67. Bakketeig LS, Hoffman HJ. The tendency to repeat gestational age and birth weight in successive births, related to perinatal survival. Acta obstetricia et gynecologica Scandinavica. 1983;62(5):385-92.

68. Patterson RM, Gibbs CE, Wood RC. Birth weight percentile and perinatal outcome: recurrence of intrauterine growth retardation. Obstetrics and gynecology. 1986 Oct;68(4):464-8.

69. Kinzler WL, Kaminsky L. Fetal growth restriction and subsequent pregnancy risks. Seminars in perinatology. 2007 Jun;31(3):126-34.

70. Holmes HJ, Lo JY, McIntire DD, Casey BM. Prediction of diabetes recurrence in women with class A1 (diet-treated) gestational diabetes. American journal of perinatology. 2010 Jan;27(1):47-52.

71. Di Cianni G, Ghio A, Resi V, Volpe L. Gestational diabetes mellitus: an opportunity to prevent type 2 diabetes and cardiovascular disease in young women. Women's health (London, England). 2010 Jan;6(1):97-105.

72. Shah BR, Retnakaran R, Booth GL. Increased risk of cardiovascular disease in young women following gestational diabetes mellitus. Diabetes care. 2008 Aug;31(8):1668-9.

73. Bellamy L, Casas JP, Hingorani AD, Williams D. Type 2 diabetes mellitus after gestational diabetes: a systematic review and meta-analysis. Lancet. 2009 May 23;373(9677):1773-9.

74. Jones EJ, Roche CC, Appel SJ. A review of the health beliefs and lifestyle behaviors of women with previous gestational diabetes. J Obstet Gynecol Neonatal Nurs. 2009 Sep-Oct;38(5):516-26.

75. Zehle K, Smith BJ, Chey T, McLean M, Bauman AE, Cheung NW. Psychosocial factors related to diet among women with recent gestational diabetes: opportunities for intervention. Diabetes Educ. 2008 Sep-Oct;34(5):807-14.

76. Smith BJ, Cheung NW, Bauman AE, Zehle K, McLean M. Postpartum physical activity and related psychosocial factors among women with recent gestational diabetes mellitus. Diabetes Care. 2005 Nov;28(11):2650-4.

77. Symons Downs D, Ulbrecht JS. Understanding exercise beliefs and behaviors in women with gestational diabetes mellitus. Diabetes Care. 2006 Feb;29(2):236-40.

78. Kieffer EC, Willis SK, Arellano N, Guzman R. Perspectives of pregnant and postpartum latino women on diabetes, physical activity, and health. Health Educ Behav. 2002 Oct;29(5):542-56.

79. Rippe J, Angelopoulos T, Zukley L. Lifestyle Medicine for Risk Factor Reduction, Prevention, and Treatment of Coronary Heart Disease: Part II. Am J lifestyle med. 2007(1):79-90.

80. Yusuf S, Hawken S, Ounpuu S, Dans T, Avezum A, Lanas F, et al. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. Lancet. 2004 Sep 11-17;364(9438):937-52.

81. Rippe C, Erlanson-Albertsson C, Lindqvist A. Consequences of metabolic challenges on hypothalamic colipase and PLRP2 mRNA in rats. Brain Res. 2007 Dec 14;1185:152-7.

82. Ratner R, Goldberg R, Haffner S, Marcovina S, Orchard T, Fowler S, et al. Impact of intensive lifestyle and metformin therapy on cardiovascular disease risk factors in the diabetes prevention program. Diabetes care. 2005 Apr;28(4):888-94.

83. Lisspers J, Sundin O, Hofman-Bang C, Nordlander R, Nygren A, Ryden L, et al. Behavioral effects of a comprehensive, multifactorial program for lifestyle change after percutaneous transluminal coronary angioplasty: a prospective, randomized controlled study. Journal of psychosomatic research. 1999 Feb;46(2):143-54.

84. Lisspers J, Sundin O, Ohman A, Hofman-Bang C, Ryden L, Nygren A. Long-term effects of lifestyle behavior change in coronary artery disease: effects on recurrent coronary events after percutaneous coronary intervention. Health Psychol. 2005 Jan;24(1):41-8.

85. Knowler WC, Barrett-Connor E, Fowler SE, Hamman RF, Lachin JM, Walker EA, et al. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. The New England journal of medicine. 2002 Feb 7;346(6):393-403.

86. Tuomilehto J, Lindstrom J, Eriksson JG, Valle TT, Hamalainen H, Ilanne-Parikka P, et al. Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. The New England journal of medicine. 2001;344(18):1343-50.

87. Mozaffarian D, Wilson PW, Kannel WB. Beyond established and novel risk factors: lifestyle risk factors for cardiovascular disease. Circulation. 2008 Jun 10;117(23):3031-8.

88. Shaw K, Gennat H, O'Rourke P, Del Mar C. Exercise for overweight or obesity. Cochrane Database Syst Rev. 2006(4):CD003817.

89. Mozaffarian D. Promise of improving metabolic and lifestyle risk in practice. Lancet. 2008 Jun 14;371(9629):1973-4.

90. Case J, Willoughby D, Haley-Zitlin V, Maybee P. Preventing type 2 diabetes after gestational diabetes. The Diabetes educator. 2006 Nov-Dec;32(6):877-86.

91. Graham I, Atar D, Borch-Johnsen K, Boysen G, Burell G, Cifkova R, et al. European guidelines on cardiovascular disease prevention in clinical practice: executive summary: Fourth Joint Task Force of the European Society of Cardiology and Other Societies on Cardiovascular Disease Prevention in Clinical Practice (Constituted by representatives of nine societies and by invited experts). European heart journal. 2007 Oct;28(19):2375-414.

92. Marcus BH, Owen N, Forsyth LH, Cavill NA, Fridinger F. Physical activity interventions using mass media, print media, and information technology. American journal of preventive medicine. 1998 Nov;15(4):362-78.

93. Kreuter MW, Skinner CS. Tailoring: what's in a name? Health education research. 2000 Feb;15(1):1-4.

94. Kreuter MW, Strecher VJ, Glassman B. One size does not fit all: the case for tailoring print materials. Ann Behav Med. 1999 Fall;21(4):276-83.

95. Brug J, Oenema A, Kroeze W, Raat H. The internet and nutrition education: challenges and opportunities. European journal of clinical nutrition. 2005 Aug;59 Suppl 1:S130-7; discussion S8-9.

96. Brug J, Oenema A, Campbell M. Past, present, and future of computer-tailored nutrition education. The American journal of clinical nutrition. 2003 Apr;77(4 Suppl):1028S-34S.

97. Kroeze W, Oenema A, Campbell M, Brug J. The efficacy of Web-based and print-delivered computer-tailored interventions to reduce fat intake: results of a randomized, controlled trial. Journal of nutrition education and behavior. 2008 Jul-Aug;40(4):226-36.

98. Noar SM, Benac CN, Harris MS. Does tailoring matter? Meta-analytic review of tailored print health behavior change interventions. Psychological bulletin. 2007 Jul;133(4):673-93.

99. de Vries H, Brug J. Computer-tailored interventions motivating people to adopt health promoting behaviours: introduction to a new approach. Patient education and counseling. 1999 Feb;36(2):99-105.

100. Strecher VJ. Computer-tailored smoking cessation materials: a review and discussion. Patient education and counseling. 1999 Feb;36(2):107-17.

101. Kroeze W, Werkman A, Brug J. A systematic review of randomized trials on the effectiveness of computer-tailored education on physical activity and dietary behaviors. Ann Behav Med. 2006 Jun;31(3):205-23.

102. Brug J, Oenema A, Ferreira I. Theory, evidence and Intervention Mapping to improve behavior nutrition and physical activity interventions. The international journal of behavioral nutrition and physical activity. 2005 Apr 4;2(1):2.

103. Ajzen I. The Theory of Planned Behavior. Organizational Behavior and Human Decision Processes. 1991;50:179-211.

PART I

Postpartum mental health and health-related quality of life after preeclampsia

CHAPTER 2

Poor health-related quality of life after severe preeclampsia.

Based on: M. Hoedjes, D. Berks, I. Vogel, A. Franx, J.J. Duvekot, E.A.P. Steegers, H. Raat. Poor health-related quality of life after severe preeclampsia. *Birth. 2011 Sep;38(3):246-55. PMID:21884233*

ABSTRACT

Background

Preeclampsia is a major complication of pregnancy associated with increased maternal morbidity and mortality, and adverse birth outcomes. The objective of this study was to describe changes in all domains of health-related quality of life between 6 and 12 weeks postpartum after mild and severe preeclampsia; to assess the extent to which it differs after mild and severe preeclampsia; and to assess which factors contribute to such differences.

Methods

We conducted a prospective multicenter cohort study of 174 postpartum women who experienced preeclampsia, and who gave birth between February 2007 and June 2009. Health-related quality of life was measured at 6 and 12 weeks postpartum by the RAND 36-item Short-Form Health Survey (SF-36). The population for analysis comprised women (74%) who obtained scores on the questionnaire at both time points.

Results

Women who experienced severe preeclampsia had a lower postpartum health-related quality of life than those who had mild preeclampsia (all $p<0.05$ at 6 weeks postpartum). Quality of life improved on almost all SF-36 scales from 6 to 12 weeks postpartum ($p<0.05$). Compared with women who had mild preeclampsia, those who experienced severe preeclampsia had a poorer mental quality of life at 12 weeks postpartum ($p<0.05$). Neonatal intensive care unit admission and perinatal death were contributing factors to this poorer mental quality of life.

Conclusion

Obstetric caregivers should be aware of poor health-related quality of life, particularly mental health-related quality of life in women who have experienced severe preeclampsia (especially those confronted with perinatal death or their child's admission to a neonatal intensive care unit), and should consider referral for postpartum psychological care.

INTRODUCTION

Preeclampsia is a major complication of pregnancy associated with increased maternal morbidity and mortality, and with adverse birth outcomes including perinatal death [1]. Preeclamptic women frequently experience complications, such as emergency cesarean section, preterm birth, and admission to an intensive care unit. Women who have experienced preeclampsia frequently report physical complaints in the postpartum period, such as headache, right upper quadrant pain, visual disturbances, and fatigue [2]. They also report cognitive complaints such as problems with attention, concentration, and memory [3]. Furthermore, preeclampsia may also have psychological consequences, especially when it develops early in pregnancy or when adverse infant outcome occurs [2, 4]. For example, compared with women whose pregnancy and delivery was uncomplicated, those who had preeclampsia experienced more emotional problems and more post-traumatic stress symptoms, such as re-experiencing the delivery, amnesia for the event, sweating, trembling, irritability, and sleep disturbances [2, 5, 6].

Health-related quality of life can be defined as the extent to which one's usual or expected physical, emotional, and social well-being is affected by a medical condition or its treatment [7]. We hypothesized that preeclampsia and its physical and psychological consequences were likely to affect postpartum health-related quality of life, particularly in women who had experienced severe preeclampsia. Measurement of health-related quality of life among women who had preeclampsia enabled us to examine the effects of having experienced preeclampsia as perceived by these women.

To date, little is known about the impact of the severity of preeclampsia on postpartum health-related quality of life. Using a self-administered health-related quality of life questionnaire (the RAND 36-item Short-Form Health Survey, SF-36) completed at 6 and 12 weeks postpartum, the objectives of this study were: 1) to describe changes in all domains of health-related quality of life between 6 and 12 weeks postpartum after mild and severe preeclampsia, 2) to assess the extent to which health-related quality of life differed after mild and severe preeclampsia, and 3) to assess which factors contributed to such differences in health-related quality of life.

METHODS

Study population

This study was embedded in the Pro-Active study, a prospective multicenter cohort study coordinated by the Erasmus MC, University Medical Center Rotterdam, in the Netherlands. Women who had preeclampsia, intrauterine growth restriction, and/ or gestational diabetes were included in the Pro-Active study to appraise postpartum physical and psychological health and to examine the feasibility of lifestyle interventions (implemented from 7 to 10 months postpartum) after a pregnancy complicated with preeclampsia, intrauterine growth restriction, and/ or gestational diabetes.

Women were eligible for participation in the Pro-Active study if they had given birth between February 2007 and June 2009; if their pregnancy had been complicated by preeclampsia, intrauterine growth restriction, and/ or gestational diabetes; if they were older than 18 years; and if they understood and spoke the Dutch language. For this study, only women who had preeclampsia were included in the analyses. Eligible women (n=255) were selected by searching the records of four hospitals (one university hospital and three large general teaching hospitals) in the Netherlands, whose medical ethics committee had approved the study. All selected women were invited to participate up to 6 weeks postpartum, and received an information leaflet and an informed consent form. In total, 174 (68%) participants provided written informed consent.

Of the 174 participants, 139 completed the SF-36 at 6 weeks postpartum (response rate: 79%) and 142 participants completed the SF-36 at 12 weeks (response rate: 82%). The population for analysis comprised the 128 women (74%) whose scores on the SF-36 questionnaire were available at both time points.

Data collection and measures

Age and details on the diagnosis and severity of preeclampsia, parity, highest level of care that women received during hospitalization (standard care, high obstetric care or intensive care), mode of delivery (vaginal delivery or cesarean section), perinatal death, admission to a neonatal intensive care unit, gestational age at delivery, and birth weight were retrieved from hospital records.

Mild preeclampsia was defined according to the criteria of the International Society for the Study of Hypertension in Pregnancy (ISSHP): development of a blood pressure of more than or equal to 140/ 90 mmHg in combination with proteinuria (defined as $\geq$ 300 mg/day of urinary protein loss) after 20 weeks of gestation in a previously normotensive woman [8]. Severe preeclampsia was defined according to the American College of Obstetricians and Gynecologists (ACOG) criteria as new onset proteinuric hypertension and at least one of the following: symptoms of central nervous system dysfunction (blurred vision, scotomata, altered mental status, severe headache or headache that persists and progresses despite analgesic therapy);

symptoms of liver capsule distention (right upper quadrant or epigastric pain, nausea, vomiting); hepatocellular injury (serum transaminase concentration at least twice normal); severe blood pressure elevation (systolic blood pressure ≥160 mm Hg or diastolic blood pressure ≥ 110 mm Hg on two occasions at least 6 hours apart); thrombocytopaenia (<100,000 platelets per cubic millimeter); heavy proteinuria (≥5 in a 24 hours urine sample, oliguria less than 500 ml in 24 hours); severe fetal growth restriction; pulmonary edema or cyanosis; cerebrovascular accident [8].

Ethnicity and educational level were obtained from the questionnaire administered at 6 weeks postpartum. A participant was categorized as non-Dutch if she, or at least one of her parents, had not been born in the Netherlands [9]. Educational level was assessed by the highest completed education and divided into three categories: high (university degree), mid (higher vocational training, intermediate vocational training), and low (primary school, lower vocational training, intermediate general school) [10].

Generic health-related quality of life at 6 weeks and 12 weeks postpartum was assessed using the Dutch version of the RAND 36-item Short-Form Health Survey (SF-36) [11, 12]. The SF-36 consists of eight subscales: physical functioning (10 items); role limitations as a result of physical problems (role physical, 4 items); bodily pain (2 items); general health (5 items); vitality (4 items); social functioning (2 items); role limitations as a result of emotional problems (role emotional, 3 items); and mental health (5 items). Using standard scoring procedures, scales are transformed to ranges of 0 to 100; higher scores indicate a better health-related quality of life. The SF-36 provides two summary measures: a physical component scale (consisting of the subscales physical functioning, role physical, bodily pain, and general health), and a mental component scale (consisting of the subscales vitality, social functioning, role emotional, and mental health).

Statistical analyses

Statistical analyses were performed using SPSS for Windows, version 15.0 [13]. Frequency tables were used to explore characteristics of the total study population (*n=128)* and those defined as formerly mild *(n=33)* or severe *(n=95)* preeclamptic women. Mean and frequency differences were examined through univariate analysis of variance (ANOVA), and chi-square statistics, and median differences were examined through a median test. To compare SF-36 scores at 6 weeks and at 12 weeks after mild and severe preeclampsia, paired-sample t tests were performed. To indicate the clinical significance of observed significant differences, Cohen's effect sizes were estimated by dividing the difference in mean scores between subgroups by the largest standard deviation (SD). Following Cohen's suggested guidelines, $0.2 \leq d < 0.5$ indicated a 'small effect'; $0.5 \leq d < 0.8$ a 'medium effect'; and $d \geq 0.8$ a 'large effect' [14]. Norman et al. have suggested that, in general, $d = 0.5$ can be considered as threshold for a 'minimally important difference' (MID) [15]. To provide an informative frame of reference for the SF-36 scores from the study population, the overall mean SF-36 scores from our patient sample were compared with mean scores from

a gender- and age-adjusted, Dutch normative sample and listed in an Appendix [16]. We tested the distribution of SF-36 scores of formerly preeclamptic women with those from the reference population using the theory of sufficient statistics [17]. These statistical tests were performed in R, version 2.7.1 (2008 The R Foundation for Statistical Computing).

To assess the extent to which health-related quality of life differed after mild and severe preeclampsia, and to assess which factors contributed to such differences, univariate and multivariate regression analyses were performed. To determine how many participants were needed to produce reliable results in the multiple regression analyses, we applied the guidelines provided by Stevens et al. [18] and Tabachnick & Fidell [19]. The maximum of independent variables used in our paper is seven (Table 4). Our sample consisted of 128 women. According to guidelines from both Stevens (minimum of 15 subjects per independent variable) and Tabachnick & Fidell ($N > 50 + 8$ x the number of independent variables), our sample size was sufficiently large to be able to detect meaningful clinically relevant differences.

First, for each study population characteristic mentioned in Table 1, univariate regression analyses were performed with each study population characteristic as an independent variable and all individual SF-36 scales (including the physical and the mental components) as dependent variables. Study population characteristics are referred to as 'potential confounder' or 'factor'. Potential confounders and factors that were not significantly related to the SF-36 scales were excluded from further analyses.

Second, regression analyses were used to evaluate the effect of severity of preeclampsia on postpartum health-related quality of life. For each SF-36 scale, both an univariate regression model (model 1) with only level of severity of preeclampsia (mild, severe) as an independent variable was conducted, in addition to a multivariate regression model (model 2) with level of severity of preeclampsia, corrected for potential confounders significantly related to health-related quality of life: 'age' and 'educational level.' Models 1 and model 2 are displayed in Table 3. Potential confounders that were not significantly related to health-related quality of life (i.e., 'ethnicity', 'complication during a previous pregnancy', and 'multiple pregnancies' were excluded from these analyses.

Table 1. *Characteristics of the study population (n=128) and their offspring (n=138)*

	Percentage of study population (unless otherwise specified)			p-value[a]
	Total n=128	Mild Preeclampsia n=33	Severe Preecampsia n=95	
Women (*n*= 128)				
Age in years: mean (SD)	31 (5)	33 (5)	30 (4)	[c]
Age				
18-30	50	39	54	
31-42	50	61	46	
Ethnicity				
Dutch	95	94	96	
Other	5	6	4	
Educational level				
Low	16	15	16	
Mid	65	64	66	
High	19	21	18	
Complication previous pregnancy[b]				
NA - Primiparous	79	72	82	
No complication	10	13	8	
Complication	11	15	10	
Multiple pregnancies				
Singleton pregnancy	92	100	89	
Multiple pregnancy	8	0	11	
Highest Level of Obstetric Care				[d]
Standard care	59	100	45	
High obstetric care	39	0	52	
Intensive Care	2	0	3	
Delivery				[d]
Normal vaginal	28	58	18	
Instrumental vaginal	8	24	2	
Cesarean section	64	18	80	
Gestational age at delivery				[d]
< 34 weeks	52	3	68	
34-37 weeks	14	9	16	
> 37 weeks	34	88	16	
Gestational age at delivery (days): *mean (SD)*	236 (32)	267 (15)	225 (30)	[d]
Offspring (*n*=138)				
Birth weight (g): mean (SD)	2002 (1080)	3212 (735)	1622 (872)	[d]
Admission to NICU	56	3	72	[d]
Days of NICU admission: median (IQR)	7 (0 - 46)	0 (0 – 0)	25 (0 – 54)	[d]
Perinatal death	4	0	6	

SD= standard deviation; IQR= Interquartile range; NA= non applicable; NICU= neonatal intensive care unit

[a] Women with mild preeclampsia compared with women with severe preeclampsia

[b] Complication= preeclampsia or perinatal death

[c] $p < 0.01$

[d] $p < 0.001$

Table 2. *Health-related quality of life measured by the SF-36 at 6 and 12 weeks postpartum after mild and severe preeclampsia.*

SF-36 scales	*6 weeks postpartum*		*12 weeks postpartum*		*12 weeks vs. 6 weeks postpartum*	
	Mean	SD	Mean	SD	ES	p-value
Mild preeclampsia						
Physical functioning	86.4	14.7	90.5	13.0	0.28[a]	0.036
Role physical	56.3	29.0	76.2	23.0	0.69[b]	<0.001
Bodily pain	77.1	22.8	86.9	14.8	0.43[a]	0.004
General health	76.8	16.3	76.4	17.3	-0.02	0.831
Vitality	57.6	14.3	67.4	14.4	0.68[b]	<0.001
Social functioning	78.0	21.9	89.4	15.4	0.52[b]	<0.001
Role emotional	79.8	21.5	87.6	16.1	0.36[a]	0.037
Mental health	81.9	12.5	84.9	9.9	0.23[a]	0.055
Physical component	47.7	7.9	51.1	6.9	0.43[a]	0.001
Mental component	51.3	6.8	53.9	6.2	0.38[a]	0.006
Severe preeclampsia						
Physical functioning	76.9	18.2	86.9	15.8	0.64[b]	<0.001
Role physical	41.9	28.0	68.6	28.1	0.95[c]	<0.001
Bodily pain	63.7	22.1	83.3	19.9	0.99[c]	<0.001
General health	67.8	17.4	67.1	20.3	-0.04	0.543
Vitality	48.4	15.7	60.2	17.2	0.68[b]	<0.001
Social functioning	58.8	25.4	78.0	23.3	0.82[c]	<0.001
Role emotional	63.6	30.8	75.0	27.4	0.42[a]	<0.001
Mental health	69.5	18.5	75.9	17.4	0.37[a]	<0.001
Physical component	43.9	7.1	49.8	8.1	0.72[b]	<0.001
Mental component	44.6	10.1	48.7	9.7	0.42[a]	<0.001

ES= Effect Size

[a] indicates a small effect (0.2≤d<0.5); [b] indicates a moderate effect (0.5≤d<0.8); [c] indicates a large effect (d≥0.8)

The factors 'highest level of maternal care', 'mode of delivery ', 'gestational age at delivery', 'birth weight', 'admission to the neonatal intensive care unit', 'days of neonatal intensive care unit admission', and 'perinatal death' were considered as relevant consequences of preeclampsia and therefore as potential contributing factors of differences in health-related quality of life after mild and severe preeclampsia at 6 and 12 weeks.

Table 3. *Effect of severity of preeclampsia (mild vs. severe) on postpartum health-related quality of life at 6 and 12 weeks postpartum: Unstandardized regression coefficients (B) and 95 percent confidence intervals (CIs).*

Sf-36 scales	6 weeks postpartum				12 weeks postpartum			
	Model 1		*Model 2*		*Model 1*		*Model 2*	
	B	95% CI	B	95% CI	B	95% CI	B	95% CI
Physical functioning	-9.81	(-16.8, -2.87)[b]	-9.29	(-16.3, -2.27)[b]	-3.79	(-9.94, 2.35)	-3.35	(-9.47, 2.76)
Role physical	-14.1	(-25.5, -2.74)[a]	-12.4	(-23.6, -1.17)[a]	-8.14	(-19.0, 2.73)	-7.06	(-17.9, 3.79)
Bodily pain	-13.4	(-22.3, -4.44)[b]	-11.6	(-20.3, -2.96)[b]	-3.58	(-11.1, 3.92)	-3.32	(-10.9, 4.23)
General health	-8.97	(-15.8, -2.14)[a]	-8.47	(-15.2, -1.70)[b]	-9.35	(-17.2, -1.53)[a]	-8.35	(-16.6, -0.64)[a]
Vitality	-9.14	(-15.3, -3.01)[b]	-8.21	(-14.2, -2.19)[b]	-7.25	(-13.8, -0.64)[a]	-5.78	(-12.1, 0.53)
Social functioning	-19.2	(-29.1, -9.38)[c]	-17.4	(-27.0, -7.79)[c]	-11.4	(-19.9, -2.74)[a]	-10.6	(-19.3, -1.91)[a]
Role emotional	-14.8	(-26.5, -3.09)[a]	-14.2	(-25.7, -2.66)[b]	-13.0	(-23.1, -2.95)[a]	-12.1	(-21.9, -2.12)[a]
Mental health	-12.5	(-19.3, 5.61)[c]	-11.5	(-18.3, -4.78)[c]	-8.89	(-15.2, -2.56)[b]	-8.13	(-14.4, -1.87)[a]
Physical component	-3.79	(6.73, -0.84)[a]	-3.33	(-6.26, -0.39)[a]	-1.53	(-4.70, 1.63)	-1.31	(-4.49, 1.88)
Mental component	-6.20	(-10.1, -2.35)[b]	-5.72	(-9.51, -1.93)[b]	-5.44	(-9.06, -1.83)[b]	-4.96	(-8.52, -1.39)[b]

Model 1: Univariate regression model with level of severity of preeclampsia only as an independent variable (model without confounders).

Model 2: Multivariate regression model with level of severity of preeclampsia as an independent variable, controlled for the confounders age and educational level.

B= Beta, which indicates the difference in SF-36 score between formerly mild and severe preeclamptic women. A negative value indicates that formerly severe preeclamptic women had a lower SF-36 score than formerly mild preeclamptic women; 95% CI= 95% Confidence Interval

a $p < 0.05$; b $p < 0.01$; c $p < 0.001$

Table 4. *Contributing factors to differences in postpartum health-related quality of life at 6 and 12 weeks postpartum among women after preeclampsia (n=128): Unstandardized regression coefficients (Beta) and p-values[a].*

SF-36 scales	Model[b]	6 weeks				12 weeks			
		High obstetric /intensive care admission	Cesarean section	NICU admission	Perinatal death	High obstetric /intensive care admission	Cesarean section	NICU admission	Perinatal death
		Beta *p-value*	*Beta* *p-value*	*Beta* *p-value*	*Beta* *p-value*	*Beta* *p-value*	*Beta* *p-value*	*Beta* *p-value*	*Beta* *p-value*
Physical functioning	3	-8.21 0.011	-5.92 0.146	2.18 0.597	3.74 0.642	NA	NA	NA	NA
	4	-8.21 0.011							
Role physical	3	-9.40 0.069	-10.3 0.102	-7.25 0.255	-17.4 0.137	NA	NA	NA	NA
	4								
Bodily pain	3	0.67 0.869	-1.72 0.728	2.58 0.606	-8.43 0.357	NA	NA	NA	NA
	4								
General health	3	-3.96 0.211	-1.55 0.689	-0.84 0.829	-8.99 0.208	-4.89 0.175	-2.39 0.587	-3.77 0.396	-2.57 0.753
	4								
Vitality	3	-2.93 0.297	0.38 0.912	-6.07 0.078	-14.0 0.026	NA	NA	NA	NA
	4				-14.0 0.026				

Social functioning	3	-9.64 0.030	-9.70 0.076	-11.5 0.037	-6.71 0.509	-9.59 0.017	-4.22 0.395	-6.32 0.205	-7.30 0.426
	4	-9.64 0.030				-9.59 0.017			
Role emotional	3	-11.2 0.035	-6.75 0.300	-10.3 0.116	-30.6 0.010	-7.17 0.118	-1.03 0.855	-8.46 0.134	-18.7 0.070
	4				-30.6 0.010				
Mental health	3	-8.11 0.009	-2.88 0.455	-9.58 0.013	-24.7 <0.001	-6.93 0.017	-3.43 0.337	-8.03 0.024	-16.2 0.013
	4	-5.86 0.048		-9.06 0.013	-23.8 <0.001			-8.37 0.017	-16.7 0.009
Physical component	3	-1.25 0.359	-2.19 0.194	1.33 0.433	2.71 0.414	NA	NA	NA	NA
	4								
Mental component	3	-3.86 0.027	-1.89 0.387	-6.35 0.003	-13.6 0.001	-3.62 0.027	-1.77 0.381	-4.98 0.013	-7.88 0.033
	4			-6.12 0.003	-13.2 0.001			-5.15 0.009	-8.23 0.023

[a] Statistically significant p-values are bold printed. [b] 3= model with level of severity of preeclampsia, age, educational level and 1 contributing factor; 4= model with level of severity of preeclampsia, age, educational level and significant contributing factor(s) after backward selection method. NA=Not Applicable, since level of severity of preeclampsia was not shown to be a significant predictor of quality of life, see Table 3 for Confidence Intervals and p-values. Beta's indicate differences in SF-36 scores.

Third, to explore the contribution of these relevant factors, zero-order correlations were calculated for severity of preeclampsia and potential contributing factors to explore associations between potential contributing factors and severity of preeclampsia, and to assess for multicollinearity between the contributing factors. This analysis showed that multicollinearity could be a problem for the variables 'gestational age at delivery,' 'birth weight', 'neonatal intensive care unit admission' and 'days of neonatal intensive care unit admission' because these variables had correlations greater than 0.70 [19]. Therefore, for these variables we decided to include only 'neonatal intensive care unit admission' in the regression analyses because it was expected that a neonatal intensive care unit admission of a child would have a large impact on the quality of life of a mother. Finally, the factors 'highest level of maternal care,' 'mode of delivery,' 'neonatal intensive care unit admission' and 'perinatal death' were considered as potential contributing factors and were included in the regression analyses.

Fourth, we conducted multivariate regression analyses. For each SF-36 scale, we tested regression models (model 3) in which each potential contributing factor was added separately to model 2 (containing 'severity of preeclampsia,' and confounders 'age,' and 'educational level'). We also tested multivariate regression models that consisted of the variables of model 2 and all potential contributing factors that were significant in model 3. To be included in the final model (i.e., model 4) a factor had to remain significant in a stepwise-backward regression analysis. Models 3 and 4 are displayed in Table 4.

RESULTS

Study population

In this study, most of the participants were Dutch (95%), experienced severe preeclampsia (74%), and were primiparous (79%). Their mean age was 31 years (SD: 5). Compared with women who had mild preeclampsia, those who had severe preeclampsia were younger (p<0.01), more often had a cesarean section (p<0.001), had a lower gestational age at delivery (p<0.001), delivered offspring with a lower birth weight (p<0.001), and their offspring were admitted to the neonatal intensive care unit more often (p<0.001) and for a longer period (p<0.001). Women who had severe preeclampsia were admitted to the high obstetric care or intensive care unit (55%), experienced perinatal death (6%), and had multiple pregnancies (11%), whereas those who had mild preeclampsia were not admitted to the high care or intensive care unit, did not experience perinatal death, and did not have multiple pregnancies (Table 1). Women included in the study analyses were more often of Dutch origin (84.8%) compared with those who were not included in the present analyses (95.3%; p=0.045). The two groups did not differ on any of the remaining characteristics.

Postpartum health-related quality of life after mild and severe preeclampsia

Compared with the reference population, overall mean SF-36 scores in our participants were lower at 6 weeks postpartum on all SF-36 scales, especially on the scales role physical, vitality, social functioning, and on the physical component scale (all $p<0.001$ and $d\geq0.8$). At 12 weeks postpartum, our participants had significantly lower scores on most physical scales but not on the mental scales; however, all effect sizes were below the minimally important difference of 0.50 (see Appendix).

After mild preeclampsia, health-related quality of life improved from 6 to 12 weeks postpartum for role physical, vitality, and social functioning (all $p<0.001$ and $d \geq 0.5$). After severe preeclampsia, health-related quality of life improved for role physical, bodily pain and social functioning (all $p<0.001$ and $d \geq 0.8$) (Table 2).

Effect of severity of preeclampsia on postpartum health-related quality of life

At 6 weeks postpartum, compared with women who experienced mild preeclampsia, those with severe preeclampsia reported significantly lower health-related quality of life on all scales and both component scales (Table 3). At 12 weeks postpartum, compared with women after mild preeclampsia, those with severe preeclampsia had significantly lower scores on the general health, social functioning, role emotional, mental health (all $p<0.01$), and the mental component scale ($p<0.05$) (Table 3).

Contributing factors to differences in postpartum health-related quality of life

Table 4 shows that several contributing factors for differences in health-related quality of life after mild and severe preeclampsia were identified at both 6 and 12 weeks postpartum. For both the mental health scale and the mental component at 6 and 12 weeks postpartum, neonatal intensive care unit admission and perinatal death contributed to differences in health-related quality of life (all $p<0.05$). For the mental health scale at 6 weeks also, high or intensive care admission of the mother was identified as a contributing factor ($p<0.05$).

DISCUSSION

This prospective cohort study showed that postpartum women had a poor health-related quality of life after preeclampsia, especially after severe preeclampsia. Although it improved from 6 to 12 weeks postpartum, compared with women who experienced mild preeclampsia at 12 weeks postpartum, those who experienced severe preeclampsia still had a poor mental health-related quality of life. They evaluated their personal health as poorer, had more interference with normal social activities as a result of physical or emotional problems, had more problems with work and other daily activities as a result of emotional problems, and experienced more feelings of

nervousness and depression. Neonatal intensive care unit admission and perinatal death were found to be contributing factors to this poorer mental health-related quality of life.

To our knowledge, this study is the first to describe details on health-related quality of life from 6 to 12 weeks postpartum after preeclampsia. Our finding that quality of life after childbirth is poor supports the findings of previous studies. Furthermore, the finding that quality of life increased from 6 to 12 weeks postpartum, is also reported in studies measuring postpartum quality of life after uncomplicated pregnancies [20, 21]. Compared with a gender- and age-adjusted reference population, the women in our study population reported a low quality of life at 6 weeks postpartum, particularly in relation to physical functioning and vitality. Similar findings were reported in a study that compared postpartum quality of life of women with pregnancy-induced hypertension with postpartum quality of life of women with uncomplicated pregnancies [22].

Our study clearly showed that women who had severe preeclampsia reported a low health-related quality of life across all domains at 6 weeks postpartum. At 12 weeks postpartum many women seem to have recovered physically, which was reflected in their mean SF-36 scores. After severe preeclampsia women still reported significantly relatively low mental SF-36 scores at 12 weeks postpartum, which was associated with an admission of their child to the neonatal intensive care unit or even death of their child. Although no other studies have explored which factors contribute to differences in postpartum health-related quality of life after mild and severe preeclampsia, some have explored which factors contribute to poor quality of life after childbirth. Preterm delivery and cesarean section were found to be associated with a lower postpartum quality of life [20-23]. In this study neonatal intensive care unit admission, which is related to gestational age at delivery, was a contributing factor to postpartum quality of life, whereas no relationship with cesarean section was found. Although univariate analyses showed that cesarean section was related to SF-36 scores (data not shown), because cesarean section was highly correlated with severity of preeclampsia, it was no longer associated with SF-36 scores when controlling for severity of preeclampsia.

Methodological considerations

This study did not include a control group of postpartum women with an uncomplicated pregnancy. Therefore, we compared quality of life scores with an age-adjusted Dutch female reference population. To confirm these findings, future larger longitudinal prospective cohort studies should preferably measure health-related quality of life in women with and without complicated pregnancies. Our analyses were performed on complete data only. Of the 174 women, 26 percent did not complete questionnaires at both time points and were excluded from the analyses. However, additional analyses showed that these latter women (apart from more often being of non-Dutch origin) did not differ from those who were included in the statistical analyses. As ethnicity was not statistically significantly related to SF-36 scores among our study

participants, we might assume that women who did not complete the questionnaire at both time points did not differ in their health-related quality of life from women who did complete the questionnaire at both time points. Unfortunately, we do not have complete details of the 81 (255 eligible women -174 participants) women who declined participation, so we cannot make any definite conclusions considering biases.

Selection bias might have occurred, because most of the eligible women gave birth in the Erasmus University Medical Center (a tertiary referral hospital). Those who gave birth in this university hospital generally experienced more severe complications compared with other hospitals in the surrounding area. This finding explains the relative high number of women with severe preeclampsia in the Pro-Active cohort, which may have contributed to the low mean health related quality of life scores. If the population had consisted of relatively more women who had experienced mild preeclampsia, the mean SF-36 scores might have been somewhat higher.

Clinical implications

Our findings have important implications for clinical practice. Obstetricians should be aware of the potential impact of severe preeclampsia on health-related quality of life and should be alerted to the potential need for longer postpartum care, especially mental health care. In the Netherlands, postpartum care generally consists of one postpartum hospital visit around 6 weeks postpartum. We recommend that women who experience severe preeclampsia in pregnancy be assessed for their need of intensified, extended or customized postpartum care. Particularly women who have experienced perinatal death and women whose child was admitted to a neonatal intensive care unit may require such care. Customized postnatal care with a potential for extending length of time according to women's needs has shown improved postnatal mental health and psychological well-being in a general postnatal population [24]. Obstetric caregivers can play a major role in detecting formerly preeclamptic patients with poor postpartum mental quality of life and in providing care for these women. In case of potential poor postpartum quality of life, they should inform their patients that a poor physical quality of life may continue up to 6 weeks or more and that a poor mental quality of life may occur and continue up to 12 weeks or more after a pregnancy complicated with severe preeclampsia. It should be common practice for obstetric caregivers to refer the latter to other healthcare specialists (e.g., their general practitioner, psychologist or social worker), especially when mental complaints interfere with daily life. These healthcare specialists should also be aware that women with prolonged poor postpartum health-related quality of life also experience interference with work and family obligations. Therefore, family members and medical officers should also be informed about poor mental quality of life and should be involved in the postpartum care of these women.

Conclusions

This study shows that, after preeclampsia, women have a poor health-related quality of life for up to 6 weeks postpartum. Furthermore, compared with formerly mild preeclamptic women, formerly severe preeclamptic women had a poorer health-related quality of life at 6 weeks postpartum. At 12 weeks postpartum, formerly severe preeclamptic women had a poorer mental quality of life than formerly mild preeclamptic women.

REFERENCES

1. Sibai B, Dekker G, Kupferminc M. Pre-eclampsia. Lancet. 2005; 365(9461):785-99.
2. Roes EM, Raijmakers MT, Schoonenberg M, Wanner N, Peters WH, Steegers EA. Physical well-being in women with a history of severe preeclampsia. J Matern Fetal Neonatal Med. 2005; 18(1):39-45.
3. Brusse I, Duvekot J, Jongerling J, Steegers E, De Koning I. Impaired maternal cognitive functioning after pregnancies complicated by severe pre-eclampsia: a pilot case-control study. Acta obstetricia et gynecologica Scandinavica. 2008; 87(4):408-12.
4. Rep A, Ganzevoort W, Bonsel GJ, Wolf H, de Vries JI. Psychosocial impact of early-onset hypertensive disorders and related complications in pregnancy. American journal of obstetrics and gynecology. 2007; 197(2):158 e1-6.
5. Engelhard IM, van Rij M, Boullart I, Ekhart TH, Spaanderman ME, van den Hout MA, et al. Posttraumatic stress disorder after pre-eclampsia: an exploratory study. Gen Hosp Psychiatry. 2002; 24(4):260-4.
6. Olde E, van der Hart O, Kleber R, van Son M. Posttraumatic stress following childbirth: a review. Clin Psychol Rev. 2006; 26(1):1-16.
7. Khanna D, Tsevat J. Health-related quality of life-an introduction. Am J Manag Care 2007; 13 Suppl 9:S218-23.
8. ACOG practice bulletin. Diagnosis and management of preeclampsia and eclampsia. Number 33, 2002. American College of Obstetricians and Gynecologists. International journal of gynaecology and obstetrics: the official organ of the International Federation of Gynaecology and Obstetrics. 2002; 77(1):67-75.
9. Statistics Netherlands. Migrants in the Netherlands. Heerlen: Statistics Netherlands; 2003.
10. Statistics Netherlands. Standard classification of education. Heerlen: Statistics Netherlands; 2003.
11. Ware JE, Kosinski M. Interpreting SF-36 summary health measures: a response. Qual Life Res. 2001; 10(5):405-13; discussion 15-20.
12. Ware JE, Snow KK, Kosinski M, Gandek BG. SF-36 health survey: manual and interpretation guide. Boston, MA: Health Institute, New England Medical Center 1993.
13. SPSS, Inc. SPSS Statistical Package Version 15.0. Chicago: SPSS, Inc., 2006.
14. Cohen J. Statistical power analysis for the behavioral sciences. New York: Academic Press 1977.
15. Norman GR, Sloan JA, Wyrwich KW. Interpretation of changes in health-related quality of life: the remarkable universality of half a standard deviation. Med Care. 2003; 41(5):582-92.
16. Aaronson NK, Muller M, Cohen PD, Essink-Bot ML, Fekkes M, Sanderman R, et al. Translation, validation, and norming of the Dutch language version of the SF-36 Health Survey in community and chronic disease populations. J Clin Epidemiol. 1998; 51(11):1055-68.
17. Johnson R, Wichern D. Applied Multivariate Statistical Analysis. 3rd ed. Englewood Cliffs, New Yersey: Prentice-Hall Int. Inc. 1992.
18. Stevens JP. Applied multivariate statistics for the social sciences. 4rd ed. Mahway, New Jersey: Lawrence Erlbaum Associates, Inc. 2002.
19. Tabachnick BG, Fidell LS. Using multivariate statistics. 4th ed. Needham Heights, MA: Allyn and Bacon 2001.
20. Hill PD, Aldag JC. Maternal perceived quality of life following childbirth. J Obstet Gynecol Neonatal Nurs. 2007; 36(4):328-34.
21. Torkan B, Parsay S, Lamyian M, Kazemnejad A, Montazeri A. Postnatal quality of life in women after normal vaginal delivery and caesarean section. BMC Pregnancy Childbirth. 2009; 9:4.
22. Kim C, Brawarsky P, Jackson RA, Fuentes-Afflick E, Haas JS. Changes in health status experienced by women with gestational diabetes and pregnancy-induced hypertensive disorders. J Womens Health (Larchmt). 2005; 14(8):729-36.
23. Jansen AJ, Duvekot JJ, Hop WC, Essink-Bot ML, Beckers EA, Karsdorp VH, et al. New insights into fatigue and health-related quality of life after delivery. Acta Obstet Gynecol Scand. 2007; 86(5):579-84.
24. MacArthur C, Winter HR, Bick DE, Knowles H, Lilford R, Henderson C, et al. Effects of redesigned community postnatal care on womens' health 4 months after birth: a cluster randomised controlled trial. Lancet. 2002; 359(9304):378-85.

Appendix. *Short-from health survey (SF-36) scores of women after preeclampsia (n=128) at 6 and 12 weeks postpartum, compared with a gender and age-matched reference population.*

SF-36 Scales	Reference population[d]		Women after preeclampsia				Reference population vs. preeclamptic women at		Reference population vs. preeclamptic women at	
			6 weeks		12 weeks		6 weeks		12 weeks	
	Mean	SD	Mean	SD	Mean	SD	ES	p-value	ES	p-value
Physical functioning	91.9	12.4	79.4	17.8	87.6	15.2	0.70[b]	<0.001	0.28[a]	0.008
Role physical	83.1	32.6	45.5	28.7	70.6	26.9	1.15[c]	<0.001	0.38[a]	<0.001
Bodily pain	78.9	18.3	67.1	22.9	84.2	18.7	0.51[b]	<0.001	-0.28[a]	0.014
General health	78.3	17.2	70.2	17.5	69.5	19.9	0.47[a]	<0.001	0.44[a]	<0.001
Vitality	67.4	16.9	50.8	15.8	62.0	16.8	0.98[c]	<0.001	0.32[a]	0.007
Social functioning	85.9	20.6	63.8	25.9	80.9	22.1	0.85[c]	<0.001	0.22[a]	0.046
Role emotional	81.1	34.3	67.3	29.6	78.3	25.4	0.40[a]	<0.001	0.08	0.435
Mental health	76.4	16.1	72.7	17.9	78.3	16.2	0.21[a]	0.060	-0.11	0.326
Physical component	52.7	6.60	44.9	7.43	50.1	7.82	1.04[c]	<0.001	0.33[a]	0.002
Mental component	50.4	9.90	46.2	9.84	50.0	9.21	0.42[a]	<0.001	0.04	1

SD= Standard Deviation; ES= Effect Size

[a] indicates a small effect (0.2≤d<0.5); [b] indicates a moderate effect (0.5≤d <0.8); [c] indicates a large effect (d≥0.8)

[d] gender and age-adjusted, Dutch normative sample [14]

CHAPTER 3

Postpartum depression after mild and severe preeclampsia.

Based on: M. Hoedjes, D. Berks, I. Vogel, A. Franx, M. Bangma, A.S. Darlington, W. Visser, J.J. Duvekot, J.D.F. Habbema, E.A.P. Steegers, H. Raat. Postpartum depression after mild and severe preeclampsia. *J Womens Health (Larchmt). 2011 Oct;20(10):1535-42. PMID:21815820*

ABSTRACT

Objective

To describe the prevalence of postpartum depressive symptoms after preeclampsia, to assess the extent to which the prevalence of postpartum depressive symptoms differs after mild and severe preeclampsia, and to investigate which factors contribute to such differences.

Methods

Women diagnosed with preeclampsia (n=161) completed the Edinburgh Postnatal Depression Scale at 6, 12 or 26 weeks postpartum. Multiple logistic regression analysis was used to investigate the association between severity of preeclampsia, contributing factors and postpartum depression a) at any time point during the first 26 weeks postpartum and b) accounting for longitudinal observations at three time points.

Results

After mild preeclampsia, 23% reported postpartum depressive symptoms at any time up to 26 weeks postpartum, compared to 44% after severe preeclampsia (unadjusted OR 2.65; 95% CI: 1.16, 6.05) for depression at any time up to 26 weeks postpartum after severe preeclampsia; (unadjusted OR 2.57; 95% CI: 1.14-5.76) while accounting for longitudinal observations). Admission to the Neonatal Intensive Care Unit (NICU) (adjusted OR 3.19; 95% CI 1.15, 8.89) and perinatal death (adjusted OR 2.96; 95% CI 1.09-8.03) contributed to this difference.

Conclusions

It appears that not the severity of preeclampsia itself, but rather the consequences of the severity of the disease (especially admission to the NICU and perinatal death) cause postpartum depressive symptoms. Obstetricians should be aware of the high risk of postpartum depressive symptoms after severe preeclampsia, particularly among women whose infant has been admitted to the NICU and/or has died.

INTRODUCTION

Preeclampsia is a vascular-related pregnancy syndrome of unknown cause, which affects approximately 2-8% of pregnancies [1]. Preeclampsia is associated with both maternal complications (e.g. eclampsia, cerebral hemorrhage, placental abruption, pulmonary adema, acute renal failure, and death), and an increased risk for future maternal vascular and metabolic morbidity (e.g. chronic hypertension, diabetes mellitus, chronic renal failure, coronary artery disease, stroke, and premature death) [1-4]. Moreover, preeclampsia is associated with perinatal complications, such as fetal growth restriction, preterm delivery, and perinatal asphyxia and death [4,5]. Severe preeclampsia is associated with more adverse maternal and child outcomes compared with mild preeclampsia [6].

Preeclampsia is also considered to have a strong psychological impact [7], particularly severe preeclampsia [8,9]. For example, preeclampsia is associated with post-traumatic stress disorder [7]. Moreover, obstetric complications are possible causal factors in postpartum depression [10].

According to the DSM-IV criteria, postpartum depression is defined as a non-psychotic depressive episode that begins or extends into the postpartum period [11,12]. The average prevalence rate of postpartum depression is 13% in unselected populations [13]. Besides the burden of postpartum depression for the mother, postpartum depression has adverse effects on the behavioral, intellectual and emotional development of children [14-18]. Although studies on postpartum depression after preeclampsia show that women with preeclampsia report more symptoms of depression than patients without preeclampsia, these differences did not reach significance [7,19,20].

To date, it is unknown whether women with mild preeclampsia differ from those with severe preeclampsia in the extent to which they experience symptoms of postpartum depression. It is also unknown whether postpartum depression is associated with the severity of preeclampsia itself or with the sequelae of the disease, such as admission to the neonatal intensive care unit (NICU) of the infant, admission to high obstetric care or intensive care of the mother, having a caesarean section, or perinatal death.

To provide better postpartum support for women who experience depressive symptoms after preeclampsia, knowledge on the prevalence of depressive symptoms after mild and severe preeclampsia, and on the factors that contribute to differences in the prevalence of postpartum depression after preeclampsia, is needed.

Therefore, this prospective cohort study describes the prevalence of postpartum depressive symptoms after preeclampsia, the extent to which the prevalence of postpartum depressive symptoms differs after mild and severe preeclampsia, and explores which factors contribute to differences in the prevalence of depressive symptoms.

METHODS

Study population

The present study was embedded in the Pro-Active study, a prospective multicenter cohort study coordinated by the Erasmus MC, University Medical Center Rotterdam. Women who had been diagnosed with preeclampsia were included in the Pro-Active study to appraise their postpartum physical and psychological health, and to examine the feasibility of lifestyle interventions after a pregnancy complicated with preeclampsia.

Patients were eligible for participation in the present study if they had given birth between February 2007 and June 2009, their pregnancy had been complicated by preeclampsia, they were older than 18 years of age, and they understood and spoke the Dutch language. Eligible patients (n=255) were selected by searching the records of four Dutch hospitals (one university hospital and three large general teaching hospitals). The medical ethics committee of all four hospitals approved the study.

All selected patients were invited to participate up to 6 weeks postpartum and received an information leaflet and an informed consent form: 174 participants (68%) provided written informed consent. Participants were asked to complete a questionnaire at 6 weeks, 12 weeks and 26 weeks postpartum.

Data collection and measures

Age and details on the diagnosis of preeclampsia, parity, highest level of obstetric care during admission (standard care, high obstetric care or intensive care), mode of delivery (vaginal delivery or caesarean section), perinatal death, admission to a NICU, gestational age at delivery, and birth weight were retrieved from hospital records.

Preeclampsia was defined according to the criteria of the American College of Obstetricians and Gynecologists, i.e. development of a blood pressure of $\geq$140/90 mmHg plus proteinuria (defined as $\geq$300 mg/day of urinary protein loss) after 20 weeks of gestation in a previous normotensive woman [6]. Severe preeclampsia was also defined according to the criteria of the American College of Obstetricians and Gynecologists, i.e. preeclampsia and at least one of the following: severe blood pressure elevation defined by systolic blood pressure equal to or above 160 mm Hg and/or diastolic blood pressure equal to or above 110 mm Hg, severe proteinuria (5 or more grams in 24 h), HELLP syndrome (defined by thrombocyte count less than $100*10^9$/l, and/or ASAT and ALAT above 30 U/l), convulsion, or fetal growth restriction [6]. Within the participating hospitals, different treatments are used for mild and severe preeclampsia. Compared with mild preeclampsia, severe preeclampsia is generally treated with intravenous antihypertensive drugs and eclampsia prophylaxis is treated with magnesiumsulphate.

Details on ethnicity and educational level were obtained from a questionnaire administered at 6 weeks postpartum. A participant was categorized as non-Dutch if she, or at least one of

her parents, had been born abroad [21]. Educational level was assessed by the highest level of completed education and categorized into three categories: 1) high (university degree), 2) mid (higher vocational training, intermediate vocational training), 3) low (primary school, lower vocational training, intermediate general school) [22].

The Edinburgh Postnatal Depression Scale (EPDS) [23,24], a 10-item self-report scale commonly used to screen for postpartum depression, was used to measure postpartum depressive symptoms at 6, 12 and 26 weeks postpartum. A cut-off score of 10 has been suggested to detect possible depression, is likely to detect almost all cases of depression (with very few false negatives), and is particularly useful when the EPDS is the only measure used or when it is used as a first-stage screening scale to identify possible depression [23,25]. Moreover, a cut-off for probable depression has been suggested at 12/13 [23].

Statistical analysis

Statistical analysis was performed using SPSS for Windows, version 17.0 (SPSS Inc., Chicago, IL). Frequency tables were used to explore characteristics of the total study population and those classified as having experienced mild or severe preeclampsia. Means and frequencies regarding scores on the EPDS were reported for both a cut-off score of 10 and 13. Mean and frequency differences were examined through independent sample t-tests and Chi-square statistics, and median differences were analysed through median tests.

The association between severity of preeclampsia and postpartum depression was investigated in two ways: a) at any time point during the first 26 weeks postpartum, and b) accounting for longitudinal observations at three time points. To investigate the relationship at any time point, multiple logistic regression analysis was used. Women were considered to report postpartum depressive symptoms at any time point when they scored above the cut-off value 10 on the EPDS at one or more measured time points. The first logistic regression analysis (model 0) used level of severity of preeclampsia (mild, severe) as an independent variable. A second, multiple logistic regression analysis (model 1) included level of severity of preeclampsia and potential confounders significantly related to postpartum depressive symptoms: 'age', 'ethnicity' and 'educational level'. Potential confounders that were not significantly related to postpartum depressive symptoms and to severity of preeclampsia, i.e. 'complication during a previous pregnancy' and 'multiple pregnancies,' were excluded from this analysis. Third, a multiple logistic regression model (model 2) was fitted, consisting of the variables in model 1 plus all statistically significantly related potential contributing factors.

Previous research among women without preeclampsia has shown that obstetric factors contribute to the occurrence of postpartum depression [26]. Perinatal complications, such as hospitalization during pregnancy, emergency caesarean section, suspicion of fetal distress, low birth weight, low gestational age at delivery, a medically indicated delivery provided by an obstetrician, admission to the neonatal intensive care unit, and perinatal death have been found

to increase the risk of postpartum depression [27-30]. These perinatal complications are also associated with preeclampsia, particularly severe preeclampsia [4-6]. Therefore, the factors 'highest level of obstetric care' of the mother, 'mode of delivery ', 'gestational age at delivery', 'birth weight', 'admission to the neonatal intensive care unit (NICU admission)', 'days of NICU admission', and 'perinatal death' were considered relevant consequences of preeclampsia and therefore potential contributing factors of differences in depressive symptoms after mild and severe preeclampsia. Before evaluating the contribution of these factors, zero-order correlations and chi-squares were calculated for severity of preeclampsia and potential contributing factors in order to explore associations between potential contributing factors and severity of preeclampsia, and to assess multicollinearity between potential contributing factors. This showed that multicollinearity could be a problem for the variables 'gestational age at delivery,' 'birth weight' 'NICU admission' and 'days of NICU admission' because these variables had correlations of >0.70 [31]. (See appendix.) Therefore, of these variables we only included 'NICU admission' in the regression analyses because it is expected that a NICU admission of a child has a large impact on postpartum depressive symptoms of a mother. Thus, the factors 'highest level of obstetric care,' 'mode of delivery,' 'NICU admission' and 'perinatal death' were considered as potential contributing factors, and the factors 'gestational age at delivery,' 'birth weight', and 'days of NICU admission' were excluded from this analysis.

To evaluate the association between severity of preeclampsia and postpartum depression while accounting for longitudinal observations at three time points, the analyses using the above-mentioned three models were repeated by performing similar logistic regression analysis with the Generalized Estimating Equations (GEE) method [32]. GEE is an extension of the quasi-likelihood approach used in generalized linear models (GLM). GEE is a generalization of GLM that takes into account within-group correlation encountered in longitudinal data [33].

RESULTS

Study population

Of the 174 participants, 137 completed the EPDS at 6 weeks postpartum, 142 completed the EPDS at 12 weeks, and 142 participants completed the EPDS at 26 weeks postpartum. The population for analysis was composed of 161 women who obtained scores on the EPDS at least at one time point.

Most participants were Dutch (94%), had experienced severe preeclampsia (76%), and were primiparous (77%). Mean age was 31 (SD 5) years. Compared with women who experienced mild preeclampsia, women with severe preeclampsia were younger ($p<0.05$), were more often admitted to the high obstetric care or intensive care unit ($p<0.001$), more often had a caesarean section ($p<0.001$), had a lower gestational age at delivery ($p<0.001$), delivered an infant with a lower birth weight ($p<0.001$), and their infant was more often admitted to the NICU ($p<0.001$). Women with severe preeclampsia experienced perinatal death (5%), whereas no woman with mild preeclampsia experienced perinatal death (Table 1). Women included in the study population (n=161) were less often of non-Dutch origin (6%) compared with women (n=13; 31%) who were left out of the study population ($p<0.01$). Both groups did not differ on all other characteristics.

Prevalence of depressive symptoms after mild and severe preeclampsia

Women who had severe preeclampsia more frequently reported postpartum depressive symptoms at 6 and 12 weeks postpartum, compared with women who experienced mild preeclampsia. After mild preeclampsia, 23% reported postpartum depressive symptoms at any time up to 26 weeks postpartum, compared with 44% after severe preeclampsia (OR 2.65; 95% CI: 1.16, 6.05) for depression at any time up to 26 weeks postpartum after severe preeclampsia; (OR 2.57; 95% CI: 1.14-5.76) while accounting for longitudinal observations (Table 1).

After severe preeclampsia, the percentage of women who reported postpartum depressive symptoms decreased over time from 36% at 6 weeks postpartum to 25% at 12 weeks and to 18% at 26 weeks postpartum, whereas this percentage in women who experienced mild preeclampsia decreased over time from 11% at 6 weeks to 9% at 12 weeks, but increased to 21% at 26 weeks postpartum. Although the course of the prevalence of depressive symptoms differed over time after mild and severe preeclampsia the difference was not significant.

Both with and without adjustment for time, and with and without adjustment for the confounders age, ethnicity, and educational level, the women who had severe preeclampsia had an increased risk for developing postpartum depressive symptoms compared with women who had mild preeclampsia (Table 2).

Table 1. *Characteristics of the study population (n=161) and their offspring (n=178)*

	Percentage of study population (unless otherwise specified)			p-value[1]
	Total n=161	Mild Preeclampsia n=39	Severe Preeclampsia n=122	
Women (n=161)				
Age in years: mean (SD)	31.2 (4.5)	32.7 (4.7)	30.7 (4.3)	**0.014**
Age				
18-30	49.1	38.5	52.5	0.181
31-42	50.9	61.5	47.5	
Ethnicity				
Dutch	94.4	89.7	95.9	0.222
Other	5.6	10.3	4.1	
Educational level				0.784
Low	16.3	12.8	17.4	
Mid	67.5	69.2	66.9	
High	16.3	17.9	15.7	
Preeclampsia or perinatal death in previous pregnancy				0.862
NA - Primiparous	76.6	73.7	77.5	
No	10.1	10.5	10.0	
Yes	13.3	15.8	12.5	
Multiple pregnancies				
Singleton pregnancy	90.7	97.4	88.5	0.120
Multiple pregnancy	9.3	2.6	11.5	
Highest level of obstetric care				
Standard care	61.6	97.4	50.4	**<0.001**
High obstetric care	36.5	2.6	47.1	
Intensive care	1.9	0	2.5	
Delivery				
Normal vaginal	26.1	51.3	18.0	**<0.001**
Instrumental vaginal	7.5	23.1	2.5	
Cesarean section	66.5	25.6	79.5	
Gestational age at delivery				
< 34 weeks	51.6	5.1	66.4	**<0.001**
34-37 weeks	14.3	10.3	15.6	
> 37 weeks	34.2	84.6	18.0	
Gestational age at delivery (days): *median (IQR)*	236 (50.5)	268 (16.0)	219.5 (46.7)	**<0.001**

Depressive symptoms: mean (SD)				
6 weeks postpartum	6.9 (5.7)	4.5 (5.0)	7.8 (5.8)	**0.003**
12 weeks postpartum	5.3 (5.1)	3.2 (3.5)	5.9 (5.4)	**0.001**
26 weeks postpartum	5.4 (5.0)	5.6 (5.1)	5.3 (5.0)	0.754
At any time postpartum	5.8 (5.3)	4.4 (4.6)	6.3 (5.5)	**0.001**
Depressive symptoms (cut off ≥ 10 on the EPDS)				
6 weeks postpartum	29.2	11.1	35.6	**0.005**
12 weeks postpartum	21.1	8.8	25.0	**0.044**
26 weeks postpartum	19.0	21.2	18.3	0.713
At any time postpartum	39.1	23.1	44.3	**0.018**
Score of ³ 10 at one time point	23.0	12.8	26.2	0.130
Score of ³ 10 at two time points	11.2	7.7	12.3	
Score of ³ 10 across all three time points	5.0	2.6	5.7	
Depressive symptoms (cut off ≥ 13 on the EPDS)				
6 weeks postpartum	17.5	5.6	21.8	**0.028**
12 weeks postpartum	10.6	2.9	13.0	0.097
26 weeks postpartum	8.5	12.1	7.3	0.387
At any time postpartum	23.6	15.4	26.2	0.165
Score of ³ 13 at one time point	17.4	12.8	18.9	0.492
Score of ³ 13 at two time points	4.3	2.6	4.9	
Score of ³ 13 across all three time points	1.9	0	2.5	
Offspring (n=178)				
Birth weight (g): median (IQR)	1700 (1870)	3075 (989)	1340 (1438)	**<0.001**
Admission to NICU	57.9	14.3	71.3	**<0.001**
Days of NICU admission: median (IQR)	39 (55)	65 (17)	38 (53)	0.198
Perinatal death	3.9	0	5.1	0.201

NA = Non Applicable
SD = Standard Deviation
IQR = Interquartile Range
NICU = neonatal intensive care unit
EPDS = Edinburgh Postnatal Depression Scale
[1] Women with mild preeclampsia compared with women with severe preeclampsia. P-values <0.05 are bold printed.

Table 2. *Odds ratios and 95% confidence intervals for postpartum depressive symptoms[1] among women after preeclampsia (n=161) according to severity of preeclampsia and potential contributing factors*

	Model 0[2]	Model 1[3]	Model 2[4]
A) At any time postpartum			
Severity of preeclampsia			
Mild preeclampsia	1	1	1
Severe preeclampsia	2.65 (1.16-6.05)	2.80 (1.14-6.91)	1.39 (0.44-4.43)
NICU admission			
No			1
Yes			3.19 (1.15-8.89)
Highest level of obstetric care			
Standard care			1
High obstetric or intensive care			0.98 (0.43-2.19)
Delivery			
Vaginal			1
Cesarean section			0.71 (0.26-1.98)
Perinatal death			
No			1
Yes			4.59 (0.62-34.1)
B) Accounting for longitudinal observations at 6, 12, and 26 weeks postpartum			
Severity of preeclampsia			
Mild preeclampsia	1	1	1
Severe preeclampsia	2.57 (1.14-5.76)	2.54 (1.08-6.01)	1.43 (0.51-3.99)
NICU admission			
No			1
Yes			2.09 (0.93-4.72)
Perinatal death			
No			1
Yes			2.96 (1.09-8.03)

NICU = neonatal intensive care unit

[1]Symptoms of postpartum depression are defined as a score ≥10 on the Edinburgh Postnatal Depression Scale at either 6, 12 or 26 weeks postpartum.

[2]Model 0= unadjusted model with severity of preeclampsia as independent variable

[3]Model 1= model with severity of preeclampsia, adjusted for age, ethnicity and educational level

[4]Model 2= model with severity of preeclampsia and statistically significant related potential contributing factors, adjusted for age, ethnicity and educational level

Contributing factors

Both NICU admission and perinatal death were found to be contributing factors (Table 2). NICU admission was found to be a contributing factor to differences in the prevalence of postpartum depressive symptoms after mild and severe preeclampsia at any time point (OR 3.19; 95% CI 1.15, 8.89). With the variables 'NICU admission', 'highest level of obstetric care', 'mode of delivery', and 'perinatal death' added to the variables included in model 1, severity of preeclampsia was no longer a significantly related predictor of postpartum depressive symptoms (Table 2).

While accounting for longitudinal observations, perinatal death was found to be a contributing factor to the differences in the prevalence of postpartum depressive symptoms (OR 2.96; 95% CI 1.09-8.03). With the variables 'NICU admission' and 'perinatal death' added to the variables included in model 1, severity of preeclampsia was no longer a significantly related predictor of postpartum depressive symptoms (Table 2).

DISCUSSION

This first study to examine the impact of severity of preeclampsia on the prevalence of postpartum depressive symptoms shows that women with severe preeclampsia more often report postpartum depressive symptoms than women with mild preeclampsia. However, it seems that not the severity of preeclampsia itself, but rather the consequences of the severity of the disease (especially admission to the NICU and perinatal death) cause postpartum depressive symptoms.

Methodological considerations

The present study did not include a control group of postpartum women with an uncomplicated pregnancy. Moreover, the small sample size of formerly mild preeclamptic women limits the power to detect differences in postpartum depressive symptoms. To confirm our findings, future longitudinal prospective cohort studies should preferably contain larger subgroups of women with complicated pregnancies and should also include a group of women with uncomplicated pregnancies. Preferably, future studies should incorporate a baseline measurement before pregnancy to rule out any potential preexisting differences (such as differences in the prevalence of overweight and history of depression). Previous research has shown that a history of past psychiatric illness [28, 34,35], life events (the death of a loved one, divorce, or losing a job) [35], and anxiety or depression during pregnancy [28, 34, 35] are risk factors for the development of postpartum depression. Receiving social support has been found to be a protective factor against developing postpartum depression [30,35]. We were not able to include these known predictors for postpartum depression in our analyses. The lack of such known predictors in our multivariate analyses, might have led to an overestimation of the association between postpartum depressive symptoms and contributing obstetric factors.

We do not have complete details of the 81 (255 eligible women - 174 participants) women who declined participation, so we cannot make any definite conclusions considering biases. We did find that the 13 women who were left out of the study population were more often of non-Dutch origin. Since the data from our study population has shown that being non-Dutch is associated with reported depressive symptoms at 6 months postpartum (data not shown), our results considering the number of women who reported depressive symptoms might have been underestimated.

Selection bias might have occurred, as the majority of eligible patients gave birth in the Erasmus University Medical Center (a tertiary referral hospital). Patients who gave birth in this university hospital generally experience more severe complications compared with other hospitals in the surrounding area. This explains the relative high number of women with severe preeclampsia in the Pro-Active cohort, and may have contributed to a higher prevalence of depressive symptoms. If the population had consisted of relatively more women who had experienced mild preeclampsia, the prevalence of depressive symptoms in our study population might have been somewhat lower.

It is not known whether the different nature of the different medical treatment for mild and severe preeclampsia influenced the development of depressive symptoms after delivery.

In the present study, the high rate of depressive symptoms after preeclampsia (particularly after severe preeclampsia) confirms other studies reporting a frequent need for psychological support after severe preeclampsia [36]. Our finding that the postpartum psychological condition improves over time confirms previous research on postpartum psychosocial condition after early-onset hypertensive disorders [8]. Our women with severe preeclampsia more frequently reported postpartum depressive symptoms at 6 and 12 weeks postpartum, but women who had mild preeclampsia more frequently reported depressive symptoms at 26 weeks postpartum. However, this might be a chance result in the small group of women in the present study who had mild preeclampsia.

Compared with the analysis at any time point where admission to the NICU was identified as a the most important contributing factor, the analysis accounting for longitudinal observations identified perinatal death as the most important contributing factor to differences in depressive symptoms between formerly mild and severe preeclamptic women. However, when looking at NICU admission and perinatal death separately, both were identified as contributing factors in both analyses. Probably due to limited power and the fact that there was a significant interaction between NICU admission and time, and not between perinatal death and time (data not shown), only one of them remained significant when looking at the combination of these contributing factors in the final models. Therefore, these findings suggest that both NICU admission and perinatal death contribute to differences in the prevalence of postpartum depressive symptoms after mild and severe preeclampsia. This is in line with previous findings. It has been suggested

that admission to the intensive care unit in itself affects psychological distress [37,38]. In addition, perinatal death was found to be a contributing factor to postpartum depression among postpartum women after an uncomplicated delivery [28]. In line with previous findings, the factors 'highest level of obstetric care' and 'mode of delivery' were associated with postpartum depressive symptoms at any time in the univariate analyses (data not shown) [27]. However, in the multivariate analyses, and in the analyses that accounted for longitudinal observations, these factors were not significantly associated with depressive symptoms.

This first study examining whether women with mild preeclampsia differ from those with severe preeclampsia with regard to postpartum depressive symptoms found that women with severe preeclampsia more often experienced postpartum depressive symptoms than women with mild preeclampsia. Our findings suggest that not severe preeclampsia itself, but rather the obstetrical complications frequently experienced by women with severe preeclampsia cause this higher prevalence of postpartum depressive symptoms among women with severe preeclampsia. Obstetrical complications have previously been found to contribute to postpartum depressive symptoms [26-30].

This study has some important implications for clinical practice. Because of the high prevalence of depressive symptoms after preeclampsia, particularly after severe preeclampsia, obstetricians should be aware of depressive symptoms among these women. Particularly among women whose child had been admitted to the NICU or whose child has died. Furthermore, the results of this study seem to suggest that obstetricians should be aware of depressive symptoms among postpartum women who experienced NICU admission or perinatal death, regardless whether they experienced preeclampsia or not. Psychological treatment (e.g., psycho-education or supportive and autonomy-increasing techniques) can increase coping abilities, and is effective in managing postnatal depression [39,40]. Furthermore, rapid recognition and referral seems to be associated with shorter treatment duration [41]. Therefore, it is important that women with postpartum depressive symptoms be detected as early as possible, and receive adequate professional psychological support as soon as possible. Obstetricians and other physicians can play a major role in signaling such postpartum depressive symptoms at an early stage. The EPDS can be used on a regular basis to screen women; when screened positive for depressive symptoms these women can then be referred for appropriate psychological support.

REFERENCES

1. Steegers EA, von Dadelszen P, Duvekot JJ, Pijnenborg R. Pre-eclampsia. Lancet. 2010 Aug 21;376(9741):631-44.
2. Bellamy L, Casas JP, Hingorani AD, Williams DJ. Pre-eclampsia and risk of cardiovascular disease and cancer in later life: systematic review and meta-analysis. Bmj. 2007 Nov 10;335(7627):974.
3. Newstead J, von Dadelszen P, Magee LA. Preeclampsia and future cardiovascular risk. Expert Rev Cardiovasc Ther. 2007 Mar;5(2):283-94.
4. Sibai B, Dekker G, Kupferminc M. Pre-eclampsia. Lancet. 2005 Feb 26-Mar 4;365(9461):785-99.
5. Barton JR, Sibai BM. Prediction and prevention of recurrent preeclampsia. Obstet Gynecol. 2008 Aug;112(2 Pt 1):359-72.
6. ACOG practice bulletin. Diagnosis and management of preeclampsia and eclampsia. Number 33, January 2002. American College of Obstetricians and Gynecologists. International journal of gynaecology and obstetrics: the official organ of the International Federation of Gynaecology and Obstetrics. 2002 Apr;77(1):67-75.
7. Engelhard IM, van Rij M, Boullart I, Ekhart TH, Spaanderman ME, van den Hout MA, et al. Posttraumatic stress disorder after pre-eclampsia: an exploratory study. General hospital psychiatry. 2002 Jul-Aug;24(4):260-4.
8. Rep A, Ganzevoort W, Bonsel GJ, Wolf H, de Vries JI. Psychosocial impact of early-onset hypertensive disorders and related complications in pregnancy. Am J Obstet Gynecol. 2007 Aug;197(2):158 e1-6.
9. Roes EM, Raijmakers MT, Schoonenberg M, Wanner N, Peters WH, Steegers EA. Physical well-being in women with a history of severe preeclampsia. J Matern Fetal Neonatal Med. 2005 Jul;18(1):39-45.
10. Cox JL. Postnatal depression: A guide for health professionals. Edinburgh: Churchill Livingstone 1986.
11. American Psychiatric Association. Diagnostic and Statistical Manual of the Mental Disorders. 3rd ed. Washington, DC 1994.
12. Cox JL, Murray D, Chapman G. A controlled study of the onset, duration and prevalence of postnatal depression. Br J Psychiatry. 1993 Jul;163:27-31.
13. O'Hara M.W., Swain A.M. Rates and risk of postpartum depression-a meta analysis. Int Rev Psychiatry. 1996;8:37-54.
14. Cogill SR, Caplan HL, Alexandra H, Robson KM, Kumar R. Impact of maternal postnatal depression on cognitive development of young children. Br Med J (Clin Res Ed). 1986 May 3;292(6529):1165-7.
15. Wrate RM, Rooney AC, Thomas PF, Cox JL. Postnatal depression and child development. A three-year follow-up study. Br J Psychiatry. 1985 Jun;146:622-7.
16. Murray L, Cooper PJ. Postpartum depression and child development. Psychological medicine. 1997 Mar;27(2):253-60.
17. Beck CT. The effects of postpartum depression on child development: a meta-analysis. Arch Psychiatr Nurs. 1998 Feb;12(1):12-20.
18. Hay DF, Pawlby S, Sharp D, Asten P, Mills A, Kumar R. Intellectual problems shown by 11-year-old children whose mothers had postnatal depression. J Child Psychol Psychiatry. 2001 Oct;42(7):871-89.
19. Baecke M, Spaanderman ME, van der Werf SP. Cognitive function after pre-eclampsia: an explorative study. Journal of psychosomatic obstetrics and gynaecology. 2009 Mar;30(1):58-64.
20. Brusse I, Duvekot J, Jongerling J, Steegers E, De Koning I. Impaired maternal cognitive functioning after pregnancies complicated by severe pre-eclampsia: a pilot case-control study. Acta Obstet Gynecol Scand. 2008;87(4):408-12.
21. Statistics Netherlands. Migrants in the Netherlands. Heerlen: Statistics Netherlands; 2003.
22. Statistics Netherlands. Standard classification of education. Heerlen: Statistics Netherlands; 2003.
23. 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.
24. Pop VJ, Komproe, I.H., van Somm, M.J. Characteristics of the Edinburgh Postnatal Depression Scale in the Netherlands. . Journal of Affective Disorders. 1992;26:105-10.
25. Cox JL, Holden, J. Perinatal mental health. A guide to the Edinburgh Postnatal Depression Scale. 2003.
26. Filippi V, Ganaba R, Baggaley RF, Marshall T, Storeng KT, Sombie I, et al. Health of women after severe obstetric complications in Burkina Faso: a longitudinal study. Lancet. 2007 Oct 13;370(9595):1329-37.

27. Blom EA, Jansen PW, Verhulst FC, Hofman A, Raat H, Jaddoe VW, et al. Perinatal complications increase the risk of postpartum depression. The Generation R Study. Bjog. 2010 Oct;117(11):1390-8.

28. Gausia K, Fisher C, Ali M, Oosthuizen J. Magnitude and contributory factors of postnatal depression: a community-based cohort study from a rural subdistrict of Bangladesh. Psychological medicine. 2009 Jun;39(6):999-1007.

29. Yurdakul Z, Akman I, Kuscu MK, Karabekiroglu A, Yaylali G, Demir F, et al. Maternal Psychological Problems Associated with Neonatal Intensive Care Admission. International journal of pediatrics. 2009;2009:591359.

30. Vigod SN, Villegas L, Dennis CL, Ross LE. Prevalence and risk factors for postpartum depression among women with preterm and low-birth-weight infants: a systematic review. Bjog. 2010 Apr;117(5):540-50.

31. Tabachnick BG, Fidell LS. Using multivariate statistics. 4th ed. Needham Heights, MA: Allyn and Bacon 2001.

32. Zeger SL, Liang KY. Longitudinal data analysis for discrete and continuous outcomes. Biometrics. 1986 Mar;42(1):121-30.

33. Hanley JA, Negassa A, Edwardes MD, Forrester JE. Statistical analysis of correlated data using generalized estimating equations: an orientation. American journal of epidemiology. 2003 Feb 15;157(4):364-75.

34. Leigh B, Milgrom J. Risk factors for antenatal depression, postnatal depression and parenting stress. BMC psychiatry. 2008;8:24.

35. Robertson E, Grace S, Wallington T, Stewart DE. Antenatal risk factors for postpartum depression: a synthesis of recent literature. General hospital psychiatry. 2004 Jul-Aug;26(4):289-95.

36. van Pampus MG, Wolf H, Mayruhu G, Treffers PE, Bleker OP. Long-term follow-up in patients with a history of (H)ELLP syndrome. Hypertens Pregnancy. 2001;20(1):15-23.

37. Meyer EC, Garcia Coll CT, Seifer R, Ramos A, Kilis E, Oh W. Psychological distress in mothers of preterm infants. J Dev Behav Pediatr. 1995 Dec;16(6):412-7.

38. Perrins J, King N, Collings J. Assessment of long-term psychological well-being following intensive care. Intensive Crit Care Nurs. 1998 Jun;14(3):108-16.

39. Dennis CL, Hodnett E. Psychosocial and psychological interventions for treating postpartum depression. Cochrane database of systematic reviews (Online). 2007(4):CD006116.

40. Holden JM, Sagovsky R, Cox JL. Counselling in a general practice setting: controlled study of health visitor intervention in treatment of postnatal depression. Bmj. 1989 Jan 28;298(6668):223-6.

41. Poel YH, Swinkels P, de Vries JI. Psychological treatment of women with psychological complaints after pre-eclampsia. Journal of psychosomatic obstetrics and gynaecology. 2009 Mar;30(1):65-72.

Appendix. *Intercorrelations between predictor variables.*

	Age	Ethnicity	Educational level	Severity of preeclampsia	Highest level of obstetric care	Mode of delivery	Gestational age at delivery	Birth weight	NICU admission	Perinatal death
Age										
Ethnicity	-0.060									
Educational level	0.066	**-0.190**								
Severity of preeclampsia	**-0.193**	-0.115	-0.051							
Highest level of obstetric care	-0.151	0.031	-0.090	**0.412**						
Mode of delivery	**-0.214**	-0.056	-0.139	**0.489**	**0.320**					
Gestational age at delivery	**0.287**	-0.030	0.112	**-0.518**	**-0.483**	**-0.436**				
Birth weight	**0.319**	0.028	0.094	**-0.560**	**-0.404**	**-0.504**	**0.926**			
NICU admission	**-0.278**	-0.056	-0.133	**0.549**	**0.352**	**0.561**	**-0.708**	**-0.757**		
Perinatal death	-0.092	0.081	-0.054	0.121	**0.209**	-0.042	**-0.355**	**-0.280**	0.005	

p-values of <0.05 are bold printed

CHAPTER 4

Symptoms of post-traumatic stress after preeclampsia.

Based on: M. Hoedjes, D. Berks, I. Vogel, A. Franx, W. Visser, J.J. Duvekot, J.D.F. Habbema, E.A.P. Steegers, H. Raat. Symptoms of post-traumatic stress after preeclampsia. *J Psychosom Obstet Gynecol. 2011; 32(3): 126-134. PMID:21824043*

ABSTRACT

This study describes the prevalence of postpartum post-traumatic stress disorder (PTSD) based on the DSM-IV criteria, including its symptoms of intrusion, avoidance and hyperarousal after pregnancies complicated by preeclampsia, and examines which variables are associated with PTSD and its symptoms. Women whose pregnancies were complicated by preeclampsia completed the Self-Rating Inventory for PTSD at 6 and 12 weeks postpartum: 149 women completed this questionnaire on at least one time point. Logistic regression analyses were used to examine associations with PTSD and its symptoms. Results showed that the prevalence of PTSD was 8.6% at 6 weeks, and 5.1% at 12 weeks postpartum; 21.9% of the study sample experienced postpartum symptoms of intrusion at 6 weeks postpartum (11.7% at 12 weeks), 9.4% symptoms of avoidance (8.0% at 12 weeks), and 28.9% symptoms of hyperarousal (20.4% at 12 weeks). Younger age, severe preeclampsia, cesarean section, lower gestational age, lower birth weight, admission to the neonatal intensive care unit, and perinatal death were found to be associated with PTSD and its symptoms. There was a relatively high prevalence of postpartum symptoms of PTSD among women after preeclampsia. The prevalence was highest among younger women who experienced more adverse pregnancy outcomes.

INTRODUCTION

Post-traumatic stress disorder (PTSD) may develop after '*stressful situations in which a person has experienced, witnessed, or is confronted with an event that involves actual or threatened death or serious injury, or a threat to the physical integrity of self or others*' [1]. In the DSM-IV, symptoms of PTSD are categorized into three symptom clusters [1]: intrusion (e.g., intrusive memories, nightmares, flashbacks or re-living an event), avoidance (e.g., avoiding reminders, amnesia, or numbing) and hyperarousal (e.g., irritability, concentration problems, sleeping problems). PTSD is reported to occur after childbirth in 2.8-5.6% of women at 6 weeks postpartum [2-4]. It may develop as a consequence of traumatic delivery [4], obstetric procedures (such as emergency cesarean section), and perinatal complications (such as stillbirth, preterm birth and perinatal loss) [5,6]. Nulliparity and low level of social support have also been associated with the occurrence of PTSD after childbirth [3-7].

PTSD is also associated with preeclampsia [8,9]. Preeclampsia is a hypertensive pregnancy disorder that complicates 2-8% of pregnancies [10]. Common symptoms of PTSD after preeclampsia are: intrusive memories, nightmares, psychological distress at exposure to internal or external cues that symbolise or resemble an aspect of the event; avoiding reminders, avoidance of subsequent pregnancies, amnesia, feeling detachment or estrangement from others, diminished interest or participation in significant activities; concentration problems, and sleeping problems [8,9,11]. Preeclampsia is associated with both maternal complications (e.g. eclampsia, abruptio placentae, pulmonary edema, acute renal failure, and increased risk for cardiovascular disease in later life) [10,12], and perinatal complications (e.g. fetal growth restriction, preterm delivery, and perinatal death) [13-15]. Moreover, preeclampsia is considered to have a strong psychological impact, particularly after severe preeclampsia [11,16]. Compared with women after mild preeclampsia, women after severe preeclampsia experience more adverse pregnancy outcomes, such as (an emergency) cesarean section, admission to the obstetric high care unit or intensive care unit of the mother, pre-term birth, low birth weight, admission to the neonatal intensive care unit, and perinatal death [15]. These adverse pregnancy outcomes are known to be associated with PTSD [8,17-22]. Furthermore, multiple pregnancies and nulliparity are known risk factors for preeclampsia [10]. Multiple pregnancies are also associated with an increased risk for adverse pregnancy outcomes.

To our knowledge, of the three earlier studies that reported on the prevalence of PTSD after preeclampsia in the late postpartum period [8,9,23], only one reported on variables associated with PTSD [8]. All three studies measured the prevalence of PTSD after preeclampsia cross-sectionally, of which two studied the prevalence retrospectively [8,9]. Engelhard et al. (2002) found a prevalence of PTSD of 28% after pre-term (< 36 weeks of gestation) preeclampsia, 28% after pre-term delivery, 17% after term preeclampsia (≥37 weeks of gestation), and 0% after an uncomplicated pregnancy at 13-15 months postpartum [8]. The prevalence of PTSD in the

term preeclampsia group was not significantly lower than that of the pre-term groups; however, it was substantially higher compared with the control group [8]. The authors also found that PTSD symptom severity was significantly associated with gestational age, peritraumatic distress, peritraumatic dissociation (dissociative symptoms, such as alterations in the experience of time, place and person, which lead to a sense of unreality during or shortly after exposure to a traumatic event), negative interpretations of symptoms (taking initial psychological symptoms as signs of going crazy or losing control), and suppression of condition-related thoughts (avoidant coping); their data suggest that preeclampsia predisposes to PTSD, primarily but not exclusively resulting from concomitant pre-term birth [8]. Poel et al. (2009) reported a prevalence of PTSD of 20% among women with a history of preeclampsia and/or HELLP syndrome around 18.7 months postpartum [9]. Beacke et al. (2009) reported a prevalence of PTSD of 44% at 6-18 months postpartum after pre-term (delivery < 32 weeks of gestation) preeclampsia, and of 11% after term (delivery ≥37 weeks of gestation) preeclampsia [23].

The scarce literature on PTSD after preeclampsia lacks both prospective and longitudinal studies examining the prevalence and variables associated with PTSD after preeclampsia in the early postpartum period. Until now, no studies have described the prevalence and variables associated with the DSM-IV PTSD symptoms intrusion, avoidance, and hyperarousal after preeclampsia. To provide appropriate postpartum psychological care for women who experience PTSD symptoms after preeclampsia, it is important to specify which women are at increased risk to develop these symptoms. We hypothesize that obstetrical characteristics (such as severity of preeclampsia and adverse pregnancy outcomes) are associated with symptoms of PTSD after preeclampsia. Preeclampsia and its adverse pregnancy outcomes may be experienced as traumatic events that involve actual or threatened death, serious injury, or a threat to the physical integrity of self or others, which may lead to symptoms of PTSD. In addition to the only other study that examined whether obstetrical characteristics are associated with PTSD after preeclampsia [8], we also evaluated whether admission to the neonatal intensive care unit, perinatal death, admission of the mother to the obstetric high care unit or intensive care unit, parity and multiple pregnancies were associated with PTSD after preeclampsia.

This longitudinal prospective cohort study describes the prevalence of postpartum PTSD and its symptoms based on the DSM-IV criteria at 6 and 12 weeks postpartum, and examines which variables are associated with PTSD and its symptoms after preeclampsia.

METHODS

Study sample

The present study was embedded in the Pro-Active study, a prospective multicenter cohort study coordinated by the Erasmus MC, University Medical Center Rotterdam. Women who had preeclampsia were included in the Pro-Active study to evaluate postpartum physical and psychological health, and to examine the feasibility of postpartum lifestyle interventions.

Patients were eligible for participation in the present study if they had given birth between February 2007 and June 2009, their pregnancy had been complicated by preeclampsia, they were older than 18 years, and they understood and spoke the Dutch language. Eligible patients (n=255) were selected by searching the birth records of four Dutch hospitals (one university hospital and three large general teaching hospitals), whose medical ethics committee had approved the study. All selected patients were invited to participate up to 6 weeks postpartum, and received an information leaflet. Of the 255 eligible patients, 174 (68%) provided written informed consent. During outpatient hospital visits at 6 weeks and 12 weeks postpartum, participants were asked to complete a questionnaire. For the statistical analyses, our study sample was composed of 149 women who completed the questionnaire at least once.

Non-response

Relative to women with missing information on post-traumatic stress symptoms, more women with information on post-traumatic stress symptoms were native Dutch (94.6% versus 80.0%; p=0.024).

Data collection and measures

Maternal age, details on the diagnosis of preeclampsia, parity, level of care: standard care (women receiving standard obstetrical care), high obstetric care (admission to the obstetric high care unit) or intensive care (admission to the obstetric intensive care unit), mode of delivery (either spontaneous or instrumental vaginal delivery, or cesarean section), perinatal death, admission to the neonatal intensive care unit, gestational age at delivery, and birth weight were retrieved from the hospital records.

Mild preeclampsia was defined according to the criteria of the International Society for the Study of Hypertension in Pregnancy (ISSHP): development of a blood pressure of $\geq$140/90 mmHg plus proteinuria (defined as $\geq$300 mg/day of urinary protein loss) after 20 weeks of gestation in a previously normotensive woman [15].

Severe preeclampsia was defined according to the ACOG criteria, i.e. preeclampsia and at least one of the following: severe blood pressure elevation defined by systolic blood pressure ≥160 mm Hg and/or diastolic blood pressure ≥110 mm Hg, severe proteinuria (5 or more g in 24 h), HELLP syndrome defined by a thrombocyte count ≤ $100*10^9$/l, and/or ASAT and ALAT above 30 U/l, eclamptic convulsions, or fetal growth restriction [15].

Details on ethnicity and educational level were obtained from the questionnaire administered at 6 weeks postpartum. A participant was categorized as non-Dutch if she, or at least one of her parents, had been born abroad [24]. Educational level was assessed by the highest completed education and categorized into three categories: 1) high (university degree), 2) mid (higher vocational training, intermediate vocational training), and 3) low (primary school, lower vocational training, intermediate general school) [25].

PTSD symptoms were measured using the Dutch version of the Self-rating Inventory for PTSD. This questionnaire has shown good internal consistency, test-retest reliability, concurrent and discriminant validity, and high sensitivity and specificity [26,27]. The 22 items of the Self-rating Inventory for PTSD are based on the DSM-IV PTSD criteria, and scored on a 4-point Likert scale, ranging from 1 (not at all) to 4 (a lot) [26,28,29]. The questionnaire consists of 3 subscales representing the 3 DSM-IV symptom clusters: intrusion (6 items), avoidance (9 items), and hyperarousal (7 items). According to the scoring protocol of the Self-rating Inventory for PTSD, a symptom was considered present when a woman scored $\geq$ 3 on the 4-point scale [30]. PTSD and its symptoms were considered present according to the DSM-IV criteria. According to the DSM-IV criteria, PTSD is diagnosed when at least one intrusion symptom (e.g. intrusive memories, nightmares, flashbacks or re-living an event), three avoidance symptoms (e.g., avoiding reminders, amnesia, or numbing) and two hyperarousal symptoms (e.g., irritability, concentration problems, sleeping problems) occur during a period of at least one month [1]. For the statistical analyses, we dichotomised women into symptoms and no symptoms according to the DSM-IV criteria. For each type of symptom (intrusion, avoidance, hyperarousal) and for PTSD, a dichotomous outcome measure was composed. All available data were used in the statistical analyses. When women completed the questionnaire at both time points, data from those two time points were included in the analyses. When data from only one time point were available, data from that time point only were included in the analyses.

Statistical analyses

Statistical analyses were performed using SPSS for Windows, version 17.0 (SPSS Inc., Chicago, IL). Mean, median, and frequency tables were used to explore characteristics of the total study sample for analyses (n=149), and of those who experienced mild (n= 35) and severe (n=114) preeclampsia. Mean and frequency differences were examined through independent sample t-tests, Mann-Whitney U tests, and Chi-square statistics. Median differences were analysed through median tests.

GEE (Generalized Estimating Equations) [31,32] was used to analyse changes in the percentage of women who reported PTSD and its symptoms between 6 and 12 weeks postpartum among the total study sample, and those who experienced mild and severe preeclampsia. GEE is a generalization of generalized linear models that takes into account within-group correlation encountered in longitudinal data [32].

GEE was also used to conduct logistic regression analysis in order to examine which study sample characteristics were associated with PTSD and its symptoms of intrusion, avoidance and hyperarousal, while accounting for longitudinal observations at the two time points. Demographic and obstetrical characteristics (such as severity of preeclampsia, parity, multiple pregnancies, and adverse pregnancy outcomes) were included in the analyses, since these variables are associated with preeclampsia and/or PTSD [8,17-22].

The characteristics 'age', 'ethnicity', 'educational level', 'severity of preeclampsia', 'parity', 'multiple pregnancies', 'highest level of obstetric care', 'mode of delivery', 'gestational age at delivery', 'birth weight', 'admission to the neonatal intensive care unit', and 'perinatal death' were considered to be variables that could potentially be associated with PTSD. Logistic regression analyses were performed for each variable potentially associated with PTSD or its symptoms. Each logistic regression model contained one variable potentially associated with PTSD or its symptoms, controlled for time points.

Additionally, Mann-Whitney U tests were performed to examine age differences of variables that were significantly related to symptoms of PTSD, intrusion, avoidance and hyperarousal in the logistic regression analyses. These tests were conducted for both the total group and for nulliparous and multiparous women separately, since parity is associated with adverse pregnancy outcomes among women who experience preeclampsia [13,33,34]. Furthermore, in addition to the analyses with a continuous age variable, we conducted ANOVAs with a categorized age variable [< 30 years (n=65); 30-35 years (n=58); 36 years and older (n=26)] as independent variable, and with all four outcome variables (PTSD, symptoms of intrusion, avoidance and hyperarousal) as dependent variables.

Table I. *Characteristics of the study sample (N=149)*

	Percentage of study sample (unless otherwise specified)			p-value[1]
		Severity of Preeclampsia		
	Total	Mild	Severe	
	N=149	N=35	N=114	
Age in years: mean (SD)	31.0 (4.4)	32.5 (4.8)	30.6 (4.2)	**0.045**
Age in categories				
< 30 years	43.6	34.3	46.5	0.123
30-35 years	38.9	37.1	39.5	
≥ 36 years	17.4	28.6	14.0	
Ethnicity				
Dutch	94.6	91.4	95.6	0.337
Other	5.4	8.6	4.4	
Educational level				
Low	16.9	14.3	17.7	0.844
Mid	65.5	65.7	65.5	
High	17.6	20.0	16.8	
Parity				
Primiparous	76.5	71.4	78.1	0.418
Multiparous	23.5	28.6	21.9	
Multiple pregnancies				
Singleton pregnancy	91.3	97.1	89.5	0.301
Multiple pregnancy	8.7	2.9	10.5	
Highest level of obstetric care				
Standard care	61.2	97.1	50.4	**<0.001**
High obstetric care or intensive care	38.8	2.9	49.6	
Delivery				
Vaginal	34.2	80.0	20.2	**<0.001**
Caesarean section	65.8	20.0	79.8	
Gestational age at delivery				
< 34 weeks	52.3	5.7	66.7	**<0.001**
34-37 weeks	14.1	8.6	15.8	
> 37 weeks	33.6	85.7	17.5	
Gestational age at delivery (weeks): Mean(SD)	33.6 (4.6)	37.9 (2.6)	32.3 (4.2)	**<0.001**
Birth weight (kg): mean (SD)	2.01 (1.11)	3.14 (0.79)	1.67 (0.96)	**<0.001**
NICU admission	57.0	5.7[2]	72.8	**<0.001**
Days of NICU admission: median (IQR)	39 (51)	70.5 (-)[2]	38.0 (47)	0.443
Perinatal death	4.0	0	5.3	0.336

SD= Standard Deviation; IQR=Interquartile range; NICU= Neonatal Intensive Care Unit

[1] Women with mild preeclampsia compared with severe preeclampsia

[2] There were only 2 women with mild preeclampsia whose neonate was admitted to the NICU

Statistically significant p-values (p<0.05) are bold printed.

RESULTS

Study sample

Of the 174 participants, 128 (74%) completed the Self-rating Inventory for PTSD at 6 weeks postpartum, 137 (79%) completed this questionnaire at 12 weeks postpartum, and 116 (67%) women completed the questionnaire at both time points. The sample for the statistical analyses was composed of 149 (86%) women who completed the PTSD questionnaire on at least at one time point.

Most participants were Dutch (95%), had experienced severe preeclampsia (77%), were primiparous (77%), had had singleton pregnancies (91%), and were delivered by cesarean section (66%). Mean age was 31.0 (SD 4.4) years (Table I). Compared with women who had mild preeclampsia, women who experienced severe preeclampsia were younger (p=0.045), were more often admitted to the obstetric high care unit or intensive care unit (p<0.001), more often had a cesarean section (p<0.001), had a lower gestational age at delivery (p<0.001), their children had a lower birth weight (p<0.001), and were more often admitted to the neonatal intensive care unit (p<0.001).

Table II. *PTSD and its symptoms at 6 and 12 weeks postpartum among the total study sample (n=149), women with mild preeclampsia (n=35), and women with severe preeclampsia (n=114)*

	6 weeks postpartum	12 weeks postpartum	
	Percentage of the study population[1]		p-value[2]
Total study sample (n=149)			
PTSD	8.6	5.1	0.083
Intrusion	21.9	11.7	**0.012**
Avoidance	9.4	8.0	0.512
Hyperarousal	28.9	20.4	**0.007**
Mild preeclampsia (n=35)			
PTSD	3.0	0	[3]
Intrusion	6.1	3.2	0.597
Avoidance	3.0	0	[3]
Hyperarousal	15.2	9.7	0.446
Severe preeclampsia (n=114)			
PTSD	10.5	6.6	0.106
Intrusion	27.4	14.2	**0.009**
Avoidance	11.6	10.4	0.580
Hyperarousal	33.7	23.6	**0.008**

PTSD= Post-traumatic stress disorder

[1]Observed percentages

[2] PTSD and its symptoms at 6 weeks postpartum compared with 12 weeks postpartum. P-values <0.05 are printed bold.

[3] P-value could not be calculated because of an empty cell.

Prevalence of symptoms of PTSD, intrusion, avoidance and hyperarousal

In the total study sample (n=149), 8.6% experienced postpartum PTSD, 21.9% experienced postpartum symptoms of intrusion, 9.4% experienced symptoms of avoidance, and 28.9% experienced symptoms of hyperarousal at 6 weeks postpartum. From 6-12 weeks postpartum, the prevalence of symptoms of intrusion (p=0.012) and hyperarousal (p=0.007) decreased significantly (Table II). Compared with women who had mild preeclampsia, the prevalence of women with PTSD and its symptoms was higher among women who had severe preeclampsia, both at 6 and 12 weeks postpartum.

The mean PTSD score decreased from 31.8 (SD 8.9) at 6 weeks postpartum to 29.4 (SD 8.1) at 12 weeks postpartum (p<0.001).

Variables associated with PTSD symptoms

Age, cesarean section, and gestational age at delivery were shown to be associated with PTSD (all p<0.05). Age, severe preeclampsia, cesarean section, gestational age at delivery, birth weight, admission to the neonatal intensive care unit, and perinatal death were found to be associated with postpartum symptoms of intrusion (all p<0.05). Age, cesarean section, gestational age at delivery, birth weight, and admission to the neonatal intensive care unit were significantly associated with postpartum symptoms of avoidance. Postpartum symptoms of hyperarousal were associated with age, severe preeclampsia, cesarean section, gestational age at delivery, birth weight, admission to the neonatal intensive care unit, and perinatal death (all p<0.05) (Table III).

Women younger than 30 years reported symptoms of PTSD (19.3%) at 6 weeks postpartum (and 12.5% at 12 weeks), whereas women in the age categories 30-35 years and 36 years and older did not (both p<0.01). Furthermore, women younger than 30 years more often reported symptoms of intrusion (35.1% at 6 and 21.4% at 12 weeks) compared with women aged 30-35 years (12.2% at 6 and 3.6% at 12 weeks) and 36 years and older (9.1% at 6 and 8.0% at 12 weeks; both p<0.05). Also, women younger than 30 years more often reported symptoms of avoidance (19.3% at 6 and 17.9% at 12 weeks) than women aged 30-35 years (2.0% at 6 and 1.8% at 12 weeks) and women aged 36 years and older (both 0%; both p=0.002). Finally, women younger than 30 years more often reported symptoms of hyperarousal (40.4% at 6 and 26.8% at 12 weeks) than women aged 30-35 years (22.4% at 6 and 17.9% at 12 weeks) and women aged 36 years and older (6 weeks=13.6%; p=0.028 and 12 weeks=12.0%; p=0.262).

Table III. *Odds ratios (OR) and 95% confidence intervals (CI)[1] for symptoms of PTSD, intrusion, avoidance and hyperarousal according to characteristics of the study sample (N=149)*

	PTSD	Intrusion	Avoidance	Hyperarousal
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Age in years	**0.6 (0.4-0.7)**	**0.8 (0.7-0.9)**	**0.7 (0.6-0.8)**	**0.9 (0.8-1.0)**
< 30 years		1		1
30-35 years	[2]	**0.2 (0.1-0.5)**	[2]	0.5 (0.3-1.1)
≥ 36 years	[2]	**0.2 (0.1-0.7)**	[2]	**0.3 (0.1-1.0)**[3]
Ethnicity				
Dutch	1	1	1	1
Other	2.4 (0.5-12.2)	1.4 (0.4-4.8)	2.1 (0.4-10.5)	2.9 (0.7-12.7)
Educational level				
Low	1	1	1	1
Mid	0.5 (0.1-1.8)	1.0 (0.4-2.5)	0.6 (0.2-2.2)	0.7 (0.3-1.7)
High	0.2 (0.0-1.9)	**0.2 (0.0-0.9)** [3]	0.3 (0.1-2.0)	0.3(0.1-1.1)
Severity of preeclampsia				
Mild	1	1	1	1
Severe	5.0 (0.6-38.8)	**5.5 (1.6-18.7)**	5.9 (0.8-45.8)	**3.0 (1.2-7.9)**
Parity				
Primiparous	1	1	1	1
Multiparous	1.2 (0.4-4.1)	1.1 (0.5-2.3)	1.1 (0.3-3.8)	1.4 (0.6-3.0)
Multiple pregnancies				
Singleton pregnancy		1	1	1
Multiple pregnancy	[2]	0.2 (0.0-1.3)	0.4 (0.1-2.8)	0.3 (0.1-1.1)
Highest level of obstetric care				
Standard	1	1	1	1
High obstetric or intensive	2.7 (0.9-8.3)	1.8 (0.9-3.6)	2.2 (0.8-6.1)	1.2 (0.6-2.3)
Delivery				
Vaginal	1	1	1	1
Caesarean section	**8.4 (1.1-65.5)**	**4.3 (1.7-10.6)**	**3.9 (1.1-13.9)**	**2.6 (1.2-5.7)**
Gestational age at delivery	**0.8 (0.7-1.0)**	**0.9 (0.8-0.9)**	**0.9 (0.8-0.9)**	**0.9 (0.8-1.0)**
Birth weight	0.4 (0.2-1.1)	**0.5 (0.3-0.8)**	**0.4 (0.2-1.0)**	**0.6 (0.4-0.8)**
Admission to NICU				
No	1	1	1	1
Yes	3.3 (0.9-12.6)	**5.9 (2.4-15.0)**	**4.3 (1.2-15.6)**	**2.8 (1.3-5.8)**
Perinatal death				
No	1	1	1	1
Yes	5.7 (1.0-32.3)	**7.1 (1.8-27.8)**	4.0 (0.7-22.2)	**6.6 (1.1-39.6)**

PTSD= Post-traumatic stress disorder; OR=odds ratio; CI=confidence interval; NICU=Neonatal Intensive Care Unit

[1] Odds ratios and 95% confidence intervals obtained from logistic regression models with one study sample characteristic as a predictor, controlled for time points. Odds ratios with a p-value of <0.05 are printed bold.

[2] Odds ratios and 95% confidence intervals could not be calculated since there was a cell in the frequency table with a count of zero.

[3] Overall p-value was not significant (p>0.05)

Table IV. *Mean age and standard deviation (SD) of nulliparous and multiparous women per study sample characteristic significantly related to symptoms of PTSD (N=149)*

	Total			Nulliparous			Multiparous		
	N=149			N=114			N=35		
	N	Mean (SD)	p-value	N	Mean (SD)	p-value	N	Mean (SD)	p-value
Severity of preeclampsia									
Mild	35	32.5 (4.8)	**0.045**	25	32.2 (4.4)	**0.024**	10	33.4 (5.9)	0.928
Severe	114	30.6 (4.2)		89	29.9 (4.0)		25	32.8 (4.4)	
Delivery									
Vaginal	51	32.3 (4.3)	**0.006**	35	31.8 (3.7)	**0.010**	16	33.5 (5.3)	0.502
Cesarean section	98	30.4 (4.4)		79	29.9 (4.3)		19	32.5 (4.4)	
Gestational age at delivery									
≤34 weeks	78	29.6 (4.0)	**<0.001**	51	32.0 (4.0)	**0.000**	20	34.3 (4.8)	0.086
>34 weeks	71	32.7 (4.4)		63	29.2 (3.9)		15	31.1 (4.3)	
Birth weight									
< 2000 grams	80	29.7 (4.0)	**<0.001**	65	29.3 (3.9)	**0.001**	15	31.1 (4.3)	0.085
≥ 2000 grams	69	32.6 (4.4)		49	31.9 (4.1)		20	34.3 (4.8)	
Admission to NICU									
No	64	32.5 (4.4)	**0.001**	47	31.7 (4.1)	**0.007**	17	34.5 (4.8)	0.143
Yes	85	30.0 (4.2)		67	29.6 (4.1)		18	31.4 (4.4)	
Perinatal death									
No	143	31.2 (4.3)	0.225	109	30.6 (4.0)	0.252	34	33.0 (4.8)	0.743
Yes	6	28.2 (6.5)		5	27.6 (7.1)		1	31.0 (-)	

PTSD= Post-traumatic stress disorder; SD= Standard Deviation; NICU=Neonatal Intensive Care Unit

Additional analyses (Table IV) showed that women diagnosed with severe preeclampsia were younger than women who had mild preeclampsia (p=0.045). Also, women who had a cesarean section had a lower mean age than women who had a vaginal delivery (p=0.006). Moreover, mothers of children with a lower gestational age at delivery, and with a lower birth weight were younger than women with a higher gestational age at delivery and a higher birth weight (both p<0.001). Also, women with a child admitted to the neonatal intensive care unit were younger than women whose child had not been admitted (p=0.001). When controlling for parity, mean age was lower in nulliparous women who experienced adverse pregnancy outcomes, whereas in multiparous women no significant difference in age was found between those who did and did not experience adverse pregnancy outcomes.

DISCUSSION

This investigation into the prevalence and variables associated with postpartum symptoms of post-traumatic stress after preeclampsia shows that the prevalence of PTSD was relatively high among women after preeclampsia, compared with the general population of women, after giving birth. The prevalence of PTSD and its symptoms decreased between 6 and 12 weeks postpartum. Symptoms of PTSD, intrusion, avoidance and hyperarousal were relatively more frequent among younger women (particularly women below 30 years of age), women who had severe preeclampsia, who were delivered by cesarean section, who had a lower gestational age at delivery, a lower birth weight, and among women whose child had been admitted to the neonatal intensive care unit or had died. Younger women more often experienced adverse pregnancy outcomes.

Methodological considerations

Our non-response analyses showed that non-native Dutch women were underrepresented. It is difficult to ascertain whether the association between ethnicity and post-traumatic stress symptoms would be different in the non-responders. Non-response is associated with adverse health outcomes. If the non-participating women had indeed reported more post-traumatic stress symptoms, the association between ethnicity and post-traumatic stress symptoms might be somewhat underestimated. Given the relatively low numbers of women with PTSD and related symptoms, the study had a relatively low power to detect clinically meaningful differences. Because of the number of regression analyses that were conducted to test which variables were associated with PTSD and its symptoms, a correction for the inflation in type I error rate (such as Holm's sequential Bonferroni correction [35]) might have been appropriate. However, the application of a correction for type I error when testing multiple hypotheses is under debate and has received substantial criticism [36,37]. For example, correction for type I error increases the likelihood of type II errors and thus lowers the power of a study to detect clinically meaningful differences [37]. Therefore, it is preferred that data of exploratory studies such as ours are analyzed without multiplicity adjustment. Future larger confirmatory studies should be conducted to confirm our results [38]. Such studies should preferably include a control group of postpartum women after an uncomplicated pregnancy, which the present study lacks. Ideally, future studies should incorporate a pre-conception baseline measurement to rule out any potential pre-existing differences. Known psychological risk factors (such as avoidant coping, peritraumatic distress and dissociation) should also be included as potential associated variables.

In the present study, the prevalence of PTSD after preeclampsia (8.6% at 6 and 5.1% at 12 weeks postpartum) was relatively high compared with that in a general sample of women with an uncomplicated pregnancy and childbirth at 6 weeks postpartum (2.8-5.6%) [4]. This prevalence

was particularly higher after severe preeclampsia (10.5% at 6 and 6.6% at 12 weeks postpartum). However, in the present study the prevalence of PTSD after preeclampsia is relatively low compared to the prevalence (ranging from 11-44%) reported by others [8,9,23]. In these latter studies, the higher prevalence compared with our study might be due to different (sub) samples. For example, in contrast to these latter studies, we did not stratify for gestational age at delivery. Furthermore, Engelhard et al. [8] and Beacke et al. [23] retrospectively studied symptoms of postpartum PTSD, whereas we studied the prevalence of PTSD prospectively. Data from Engelhard et al. suggest that it is the preterm delivery that provokes PTSD, rather than the preeclampsia itself [8]. Our findings tend to support this assumption. To our knowledge, ours is the first study to report on the prevalence of postpartum symptoms of intrusion, avoidance and hyperarousal after preeclampsia. According to previous research, the prevalence of these symptoms after childbirth in general is 12-15% for symptoms of intrusion, 2-7% for avoidance, and 25-27% for hyperarousal [7,39-41]. In our study sample, at 6 weeks postpartum, the prevalence of symptoms of intrusion (21.9%) avoidance (9.4%) and hyperarousal (28.9%) was higher compared with the prevalence of these symptoms after childbirth. At 12 weeks postpartum, in our study sample only the prevalence of symptoms of avoidance (8.0%) was relatively higher than the prevalence of these symptoms after childbirth. This may suggest that particularly symptoms of avoidance are relatively more frequent after preeclampsia than after childbirth in general; however, this needs further investigation. It is important to provide an overview of the prevalence of all types of post-traumatic stress symptoms after preeclampsia and not to report only the prevalence in women who fulfil the diagnostic criteria of PTSD. Insight into this pattern of post-traumatic stress symptoms after preeclampsia can provide a starting point for better postpartum treatment for women after preeclampsia. Research on symptoms of post-traumatic stress after childbirth indicates that each type of post-traumatic stress symptom seems to be related to different variables (such as depression or physical problems) and thus may require different treatment [39,40].

To our knowledge, the current study is the first longitudinal prospective cohort study to report on PTSD symptoms after preeclampsia in the early postpartum period. Our finding that PTSD symptoms decreased from 6 weeks to 12 weeks postpartum, confirms previous research on the prevalence of PTSD after childbirth [2-4]. However, an increase in PTSD after childbirth from 6% at six weeks postpartum to 14.9% at six months postpartum has also been reported [42].

The results of the present study confirm previous reports on variables associated with PTSD after preeclampsia which suggested that gestational age at delivery is negatively associated with postpartum PTSD symptoms after preeclampsia [8,23]. In contrast to Engelhard et al. [8], we found that cesarean section and birth weight were associated with symptoms of PTSD. In addition, we found that admission to the neonatal intensive care unit and perinatal death were associated with PTSD and its symptoms. This is in line with research among women after childbirth in general [4,17,19,22].

Our finding that younger preeclamptic women, in particular women below 30 years of age, more often experience symptoms of PTSD confirms previous reports on higher levels of post-traumatic stress among younger pregnant women [43]. The phenomenon that relatively young age may be associated with the development of PTSD, was also reported among survivors of cardiac arrest [44], patients following ICU admission [45] and among patients after major physical trauma [46]. Relatively younger women may have less life experience and might lack sufficient coping skills to deal with the stressful life events associated with preeclampsia and its consequences [47]. However, findings regarding the role of age in terms of coping with daily stress have been mixed [48]. Nevertheless, younger women might perceive less social support, which was found to be related to the development of posttraumatic stress symptoms after childbirth [3,41]. Social support satisfaction, self-efficacy, and perceived stress may mediate the effect of age on coping [49]. Another explanation is that younger women might be more 'shocked' by their complicated pregnancy, since an increased risk for complications in pregnancies is generally expected to be found at older age. On the other hand, we found that younger women with preeclampsia suffered from more adverse pregnancy outcomes than their older counterparts. This finding seems to confirm research that preeclampsia occurs relatively more often during the first pregnancy [13], and that outcomes of subsequent pregnancies after a first pregnancy with preeclampsia are generally favorable [34]. However, we also found that nulliparous women who experienced adverse pregnancy outcomes were younger than nulliparous women who did not, whereas for multiparous women no difference in mean age was found between those who did and did not experience adverse pregnancy outcomes. This suggests that even after correction for parity, younger age is still associated with the occurrence of adverse pregnancy outcomes among nulliparous women.

The results of the current study suggest the need for physicians to be aware of possible PTSD symptoms after preeclampsia. Our findings imply that systematic postpartum screening for PTSD symptoms should be considered as routine care for women who have experienced preeclampsia. Obstetric caregivers could play an active role in signalling these symptoms by using a questionnaire to screen for symptoms of post-traumatic stress. Screen positives should be referred for further psychological assessment and treatment. Psychological treatment is reported to increase coping possibilities in women who have experienced preeclampsia [9]. Women with PTSD symptoms should be detected as early as possible (e.g., during the 6-week postpartum follow-up visit), since early recognition has been shown to reduce treatment duration [9,50,51].

Additional research is needed to confirm and strengthen our findings. To gain more insight into the course of post-traumatic stress symptoms after preeclampsia, larger longitudinal prospective cohort studies are needed to measure post-traumatic stress symptoms from the early postpartum period up to the later postpartum period (e.g., at 6 and 12 months postpartum). In addition to the use of a PTSD questionnaire, a full interview should preferably be used to measure symptoms of post-traumatic stress.

In conclusion, compared with women who experienced an uncomplicated pregnancy and childbirth, we found that women who experienced preeclampsia reported a relatively high prevalence of PTSD and its symptoms of intrusion, avoidance and hyperarousal. Women below 30 years of age, women who had severe preeclampsia, had a cesarean section, had a lower gestational age at delivery, had a lower birth weight, and women whose child had been admitted to the neonatal intensive care unit or had died, more often reported symptoms of PTSD. In particular, obstetric caregivers should be aware of possible symptoms of PTSD among these women. These findings imply that systematic postpartum screening for PTSD symptoms after preeclampsia should be considered as routine care, and that screen positives should be referred for further psychological assessment and treatment.

REFERENCES

1. American Psychiatric Association (APA) Diagnostic and statistical manual of mental disorders IV. Washington, DC 2000.
2. Ayers S, Pickering AD. Do women get posttraumatic stress disorder as a result of childbirth? A prospective study of incidence. Birth 2001;28:111-8.
3. Wijma K, Soderquist J, Wijma B. Posttraumatic stress disorder after childbirth: a cross sectional study. Journal of anxiety disorders 1997;11:587-97.
4. Olde E, van der Hart O, Kleber R, van Son M. Posttraumatic stress following childbirth: a review. Clinical psychology review 2006;26:1-16.
5. Ryding EL, Wijma K, Wijma B. Psychological impact of emergency cesarean section in comparison with elective cesarean section, instrumental and normal vaginal delivery. Journal of psychosomatic obstetrics and gynaecology 1998;19:135-44.
6. Ryding EL, Wijma K, Wijma B. Predisposing psychological factors for posttraumatic stress reactions after emergency cesarean section. Acta obstetricia et gynecologica Scandinavica. 1998;77:351-2.
7. Cigoli V, Gilli G, Saita E. Relational factors in psychopathological responses to childbirth. Journal of psychosomatic obstetrics and gynaecology. 2006;27:91-7.
8. Engelhard IM, van Rij M, Boullart I, Ekhart TH, Spaanderman ME, van den Hout MA, et al. Posttraumatic stress disorder after pre-eclampsia: an exploratory study. General hospital psychiatry. 2002;24:260-4.
9. Poel YH, Swinkels P, de Vries JI. Psychological treatment of women with psychological complaints after pre-eclampsia. Journal of psychosomatic obstetrics and gynaecology. 2009;30:65-72.
10. Steegers EA, von Dadelszen P, Duvekot JJ, Pijnenborg R. Pre-eclampsia. Lancet. 2010;376:631-44.
11. Rep A, Ganzevoort W, Bonsel GJ, Wolf H, de Vries JI. Psychosocial impact of early-onset hypertensive disorders and related complications in pregnancy. American journal of obstetrics and gynecology. 2007;197:158 e1-6.
12. Bellamy L, Casas JP, Hingorani AD, Williams DJ. Pre-eclampsia and risk of cardiovascular disease and cancer in later life: systematic review and meta-analysis. BMJ 2007;335:974.
13. Sibai B, Dekker G, Kupferminc M. Pre-eclampsia. Lancet. 2005;365:785-99.
14. Barton JR, Sibai BM. Prediction and prevention of recurrent preeclampsia. Obstet Gynecol. 2008;112:359-72.
15. ACOG practice bulletin. Diagnosis and management of preeclampsia and eclampsia. Number 33, January 2002. American College of Obstetricians and Gynecologists. International journal of gynaecology and obstetrics: the official organ of the International Federation of Gynaecology and Obstetrics. 2002;77:67-75.
16. Roes EM, Raijmakers MT, Schoonenberg M, Wanner N, Peters WH, Steegers EA. Physical well-being in women with a history of severe preeclampsia. J Matern Fetal Neonatal Med. 2005;18:39-45.
17. Badenhorst W, Hughes P. Psychological aspects of perinatal loss. Best practice & research. 2007;21:249-59.
18. Kersting A, Dorsch M, Wesselmann U, Ludorff K, Witthaut J, Ohrmann P, et al. Maternal posttraumatic stress response after the birth of a very low-birth-weight infant. Journal of psychosomatic research. 2004;57:473-6.
19. Lefkowitz DS, Baxt C, Evans JR. Prevalence and correlates of posttraumatic stress and postpartum depression in parents of infants in the Neonatal Intensive Care Unit (NICU). Journal of clinical psychology in medical settings. 2010;17:230-7.
20. Ryding EL, Wijma B, Wijma K. Posttraumatic stress reactions after emergency cesarean section. Acta obstetricia et gynecologica Scandinavica. 1997;76:856-61.
21. Shaw RJ, Bernard RS, Deblois T, Ikuta LM, Ginzburg K, Koopman C. The relationship between acute stress disorder and posttraumatic stress disorder in the neonatal intensive care unit. Psychosomatics. 2009;50:131-7.
22. Vanderbilt D, Bushley T, Young R, Frank DA. Acute posttraumatic stress symptoms among urban mothers with newborns in the neonatal intensive care unit: a preliminary study. J Dev Behav Pediatr. 2009;30:50-6.
23. Baecke M, Spaanderman ME, van der Werf SP. Cognitive function after pre-eclampsia: an explorative study. Journal of psychosomatic obstetrics and gynaecology. 2009;30:58-64.
24. Statistics Netherlands. Migrants in the Netherlands. Heerlen: Statistics Netherlands; 2003.

25. Statistics Netherlands. Standard classification of education. Heerlen: Statistics Netherlands; 2003.

26. Hovens JE, van der Ploeg HM, Bramsen I, Reuling IE. Test-retest reliability of the self-rating inventory for posttraumatic stress disorder. Psychological reports. 2000;87:735-7.

27. Hovens JE, Bramsen I, van der Ploeg HM. Self-rating inventory for posttraumatic stress disorder: review of the psychometric properties of a new brief Dutch screening instrument. Perceptual and motor skills. 2002;94:996-1008.

28. Hovens JE, van der Ploeg HM, Bramsen I, Klaarenbeek MT, Schreuder JN, Rivero VV. The development of the Self-Rating Inventory for Posttraumatic Stress Disorder. Acta psychiatrica Scandinavica. 1994;90:172-83.

29. Hovens JE, van der Ploeg HM, Klaarenbeek MT, Bramsen I, Schreuder JN, Rivero VV. The assessment of posttraumatic stress disorder: with the Clinician Administered PTSD Scale: Dutch results. Journal of clinical psychology. 1994;50:325-40.

30. Hovens JE, Bramsen I, van der Ploeg HM. Handleiding bij de Zelfinventarisatielijst Posttraumatische Stressstoornis: ZIL. Lisse: Swets & Zeitlinger 2000.

31. Zeger SL, Liang KY. Longitudinal data analysis for discrete and continuous outcomes. Biometrics. 1986;42:121-30.

32. Hanley JA, Negassa A, Edwardes MD, Forrester JE. Statistical analysis of correlated data using generalized estimating equations: an orientation. American journal of epidemiology. 2003;157:364-75.

33. Hnat MD, Sibai BM, Caritis S, Hauth J, Lindheimer MD, MacPherson C, et al. Perinatal outcome in women with recurrent preeclampsia compared with women who develop preeclampsia as nulliparas. American journal of obstetrics and gynecology. 2002;186:422-6.

34. van Rijn BB, Hoeks LB, Bots ML, Franx A, Bruinse HW. Outcomes of subsequent pregnancy after first pregnancy with early-onset preeclampsia. American journal of obstetrics and gynecology. 2006;195:723-8.

35. Holm S. A simple sequential rejective multiple test procedure. Scandinavian Journal of Statistics 1979;6:65-70.

36. Rothman KJ. No adjustments are needed for multiple comparisons. Epidemiology Cambridge, Mass. 1990;1(1):43-6.

37. Perneger TV. What's wrong with Bonferroni adjustments. BMJ 1998;316:1236-8.

38. Bender R, Lange S. Multiple test procedures other than Bonferroni's deserve wider use. BMJ 1999;318:600-1.

39. Ayers S, Harris R, Sawyer A, Parfitt Y, Ford E. Posttraumatic stress disorder after childbirth: analysis of symptom presentation and sampling. Journal of affective disorders. 2009;119:200-4.

40. Maggioni C, Margola D, Filippi F. PTSD, risk factors, and expectations among women having a baby: a two-wave longitudinal study. Journal of psychosomatic obstetrics and gynaecology. 2006;27:81-90.

41. Soet JE, Brack GA, DiIorio C. Prevalence and predictors of women's experience of psychological trauma during childbirth. Birth 2003;30:36-46.

42. Zaers S, Waschke M, Ehlert U. Depressive symptoms and symptoms of post-traumatic stress disorder in women after childbirth. Journal of psychosomatic obstetrics and gynaecology. 2008;29:61-71.

43. Lau Y, Yin L. Maternal, obstetric variables, perceived stress and health-related quality of life among pregnant women in Macao, China. Midwifery. 2010 May 11 [Epub ahead of print.]

44. Gamper G, Willeit M, Sterz F, Herkner H, Zoufaly A, Hornik K, et al. Life after death: posttraumatic stress disorder in survivors of cardiac arrest--prevalence, associated factors, and the influence of sedation and analgesia. Critical care medicine. 2004;32:378-83.

45. Scragg P, Jones A, Fauvel N. Psychological problems following ICU treatment. Anaesthesia. 2001;56:9-14.

46. Harris IA, Young JM, Rae H, Jalaludin BB, Solomon MJ. Predictors of post-traumatic stress disorder following major trauma. ANZ journal of surgery. 2008;78:583-7.

47. Labouvie-Vief G, DeVoe M, Bulka D. Speaking about feelings: conceptions of emotion across the life span. Psychology and aging. 1989;4:425-37.

48. Diehl M, Hay EL. Risk and resilience factors in coping with daily stress in adulthood: the role of age, self-concept incoherence, and personal control. Developmental psychology. 2010;46:1132-46.

49. Trouillet R, Gana K, Lourel M, Fort I. Predictive value of age for coping: the role of self-efficacy, social support satisfaction and perceived stress. Aging & mental health. 2009;13:357-66.

50. WHO. Strengthening mental health promotion. World Health Organisation 2001.

51. WHO. Promoting mental health: concepts, emerging evidence, practice. Geneva: Department of Mental Health and Substance Abuse in collaboration with the Victorian Health Promotion Foundation and the University of Melbourne 2005.

Current knowledge on this subject:

- PTSD is known to be associated with preeclampsia.
- The reported prevalence of PTSD after preeclampsia in retrospective and cross-sectional studies ranged from 11 to 44% in the late postpartum period.
- The only study examining variables that are associated with PTSD after preeclampsia, found that gestational age, peritraumatic distress, peritraumatic dissociation, negative interpretations of symptoms and suppression of condition-related thoughts were significantly associated with PTSD.

What this study adds:

- In the early postpartum period, the prevalence of PTSD is relatively high among women after preeclampsia, as compared with a general sample of women after giving birth.
- This first prospective longitudinal cohort study has shown that the prevalence of PTSD after preeclampsia in the early postpartum period decreases from 6 weeks to 12 weeks postpartum.
- This is the first study to report on the prevalence of postpartum symptoms of intrusion, avoidance, and hyperarousal after preeclampsia.
- After preeclampsia, symptoms of PTSD are relatively more frequent among younger women (below 30 years of age), women who had severe preeclampsia, had a cesarean section, a low birth weight, a low gestational age at delivery, and among women whose child had been admitted to the neonatal intensive care unit or had died.
- After preeclampsia, younger women more often experienced adverse pregnancy outcomes, including severe preeclampsia, caesarean section, neonatal intensive care unit admission of their child, low gestational age at birth, low birth weight, and perinatal death.

PART II

Postpartum lifestyle and its determinants

CHAPTER 5

Motivators and barriers to a healthy postpartum lifestyle in women at increased cardiovascular and metabolic risk: a focus group study.

Based on: M. Hoedjes, D. Berks, I. Vogel, A. Franx, J.J. Duvekot, A. Oenema, E.A.P. Steegers, H. Raat. Motivators and barriers to a healthy postpartum lifestyle in women at increased cardiovascular and metabolic risk: a focus group study. *Hypertens Pregnancy. 2011 Jan 20. [Epub ahead of print] PMID: 21250888*

ABSTRACT

Objective

To describe the motivators and barriers to the adoption of a healthy postpartum lifestyle after a pregnancy complicated by preeclampsia, intrauterine growth restriction, and/or gestational diabetes.

Methods

Thirty-six women with complicated pregnancies participated in six focus- group interviews that aimed to explore perceptions of modifiable determinants of postpartum lifestyle.

Results

Although women expressed that they intended to live a healthy postpartum lifestyle, it was generally not achieved. The motivators included improving their own current health condition as well as modeling a healthy lifestyle for their children. Important barriers were reported to be lack of knowledge, poor recovery and lack of professional support after delivery.

Conclusions

The reported motivators and barriers can be used to develop a postpartum lifestyle intervention.

INTRODUCTION

Cardiovascular disease and diabetes mellitus type II continue to be major causes of mortality and morbidity. Women who have experienced pregnancy complications like preeclampsia, intrauterine growth restriction and/or gestational diabetes are not only at an increased risk for recurrence of these complications in a subsequent pregnancy [1-3] but share an increased risk to develop cardiovascular disease or diabetes mellitus type II later in life [4-7]. Furthermore, maternal placental syndromes, such as preeclampsia and intrauterine growth restriction, occur more often in women with metabolic risk factors for cardiovascular disease, such as obesity, hypertension, and diabetes mellitus [4,5].

Risk factors for cardiovascular disease and diabetes mellitus type II, such as dyslipidemia, hypertension and obesity, are significantly related to lifestyle behaviors [8,9]. Lifestyle interventions have proven to be effective in reducing these risk factors for cardiovascular disease [8] and diabetes mellitus type II [10,11]. For example, improving poor nutrition, smoking cessation, and increasing physical activity can delay or prevent the onset of diabetes mellitus type II [5,12].

Guidelines recommend lifestyle interventions to reduce cardiovascular risk [13]. More specifically, current literature suggests adoption of a healthy postpartum lifestyle to ameliorate cardiovascular and metabolic risk in women who have experienced these pregnancy complications [14]. However, it remains unclear how postpartum lifestyle can best be promoted in these women. To understand how a healthy postpartum lifestyle can best be promoted, women's perceptions of modifiable determinants of postpartum lifestyle need to be explored. Therefore, in these high-risk groups, focus-group interviews were held to describe motivators and barriers to the adoption of a healthy postpartum lifestyle.

METHODS

Participants

Patients with pregnancies complicated by preeclampsia, intrauterine growth restriction and/or gestational diabetes, who delivered in the Erasmus Medical Center in Rotterdam between November 2004 and October 2006, were invited to participate in the focus-group interviews. After searching hospital records, 182 patients were selected and invited by mail.

Preeclampsia was defined according to the criteria of the International Society for the Study of Hypertension in Pregnancy (ISSHP) as the development of systolic blood pressure $\geq$ 140 mmHg and/or diastolic blood pressure $\geq$ 90 mmHg after 20 weeks of gestation in a previous normotensive woman plus proteinuria. Proteinuria was defined as a 24-hour urine collection containing at least 300 mg of protein [15,16].

Intrauterine growth restriction due to placental insufficiency was defined as an ultrasonic fetal abdominal circumference below the fifth percentile in combination with a pulsatility index of the umbilical artery > p 95th percentile or absent or reversed end-diastolic flow [17]. Gestational diabetes was diagnosed in case of at least one abnormal result (fasting $\geq$ 7.0 mmol/l or two hour $\geq$ 7.8 mmol/l) of a two-hour 75-gram oral glucose tolerance test [18,19].

A pregnancy complication was defined as severe if the gestational age at delivery was less than 32 weeks, the newborn was admitted to the Neonatal Intensive Care Unit, or resulted in perinatal death.

Procedure

Six focus-group interviews were held at the Erasmus University Medical Center, Rotterdam, the Netherlands, between December 2006 and February 2007. Four of the group interviews consisted of patients with either mild or severe preeclampsia or isolated intrauterine growth restriction. One group interview consisted of women diagnosed with severe preeclampsia. Another group interview consisted of women diagnosed with gestational diabetes. Before the interviews, participants provided informed consent and completed a questionnaire regarding ethnicity, level of education, smoking habits, and self-reported weight and height. A moderator (M. Hoedjes), assisted by a facilitator (D. Berks/W. Brouwer), led the focus-group interviews. Interviews were held in line with the focus-group principles provided by Morgan et al. [20]. A semi-structured focus-group discussion guide was used to structure the discussion topics (see Appendix). Motivators and barriers to adoption of a healthy postpartum lifestyle were the topics addressed in the semi-structured discussion guide. Additionally, components of the Theory of Planned Behavior, namely, attitude, subjective norm, perceived behavioral control, and intention were addressed (see Theoretical Framework). Interviews were audiotaped and each lasted about 60 minutes. The study was approved by the Medical Ethical Committee of the Erasmus Medical Center.

Theoretical Framework

Interpretation of results was theoretically framed within the Theory of Planned Behavior. The topics in the semistructured interview guide were derived from the components of the Theory of Planned Behavior, according to which attitude, subjective norm, and perceived behavioral control determine the intention to behavior. Attitude is defined as the degree to which performance of the behavior is positively or negatively valued. Subjective norm is the perceived social pressure to engage or not to engage in a behavior. In addition, perceived behavioral control refers to people's perceptions of their ability to perform a given behavior. Intention to behavior is a person's readiness to perform a given behavior [21,22]. Behavior is a function of compatible intentions and perceptions of behavioral control. Perceived behavioral control moderates the effect of intention on behavior, such that a favorable intention produces the behavior only when perceived behavioral control is strong.

Analysis

Ethnicity was classified according to the Heart and Stroke Foundation criteria [23]. Educational level was assessed by the highest completed education and reclassified into three categories: primary school, secondary school, and higher education [24]. Self-reported weight and height was used to calculate body mass index (BMI); a BMI of 25 or higher was defined as overweight, and 30 or higher as obesity. Birth weight and gestational age at delivery were retrieved from the hospital records.

Focus groups were audiotaped, transcribed verbatim, and checked for accuracy. After transcripts were made, a qualitative data analysis program (the software package QSR Nvivo, version 7) was used to analyze the transcripts in accordance with content analysis principles [25,26]. Content analyses is a methodology to systematically analyze the content of communication. It is commonly used to analyze the recorded transcripts of interviews. Discussion topics were identified, sorted and labeled according to the technique of content analysis. Discussion topics were examined across groups and for all groups combined.

RESULTS

Participants

Recruitment rate was 19.8%. Of the 36 women who participated in the focus-group interviews, 21 had preeclampsia, 4 had intrauterine growth restriction, 5 had gestational diabetes, and 6 women had both preeclampsia and intrauterine growth restriction. The number of participants per group ranged from 4 to 10 (average 6). Women were 5.8-19.0 months postpartum at the time of the focus groups. Demographic data and clinical characteristics of the participants are shown in Table 1.

Attitude and Intention

Women considered the main components of a healthy lifestyle to be a healthy diet, sufficient physical activity, no smoking, limited alcohol use, little stress, and a healthy environment to live in. All participants expressed their desire for living a healthy postpartum lifestyle, and most stated that they had the intention to adopt a healthy lifestyle shortly after delivery.

Motivators and Subjective norm

After their complicated pregnancy, women felt that they were more aware of the vulnerability of their health condition, the importance of being in good health, and of the importance of a healthy lifestyle: *I've never been so conscious of my health as after my pregnancy*. A healthy lifestyle after delivery was perceived as important, desirable, and a way of taking good care of themselves and their children. By adopting a healthy lifestyle, women expected to promote both their physical and psychological health conditions and to feel more energetic. The desire to be a good role model for their children also motivated them to adopt a healthy lifestyle. Women who were breastfeeding stated that a healthy diet was considered important because of the direct influence of their diet on the nutrition of their newborn.

Promotion of a future health condition was also reported to be a motivator for adopting a healthy postpartum lifestyle. Women stated that they wanted to live a healthy lifestyle to prevent recurrence of the old complication: *If I want to have another baby in two years, I believe I have to improve my weight and physical condition - just in case it all goes wrong again, and I have another too small baby.* Furthermore, the majority said that their increased cardiovascular and metabolic risk was an important reason for wanting to adopt a healthy postpartum lifestyle: *Because of the increased risk, I don't eat too much fat, I avoid smoky places, and I have enough exercise. I'm aware of it - it's not that I think: I'll see what will happen in 10 years.* Furthermore, women perceived that a healthy lifestyle was also considered important and desirable by their partner, family, friends, and their healthcare specialists.

Table 1. *Demographic data and clinical characteristics of the study participants.*

	n	(%)	Mean (SD)	Range
Women				
Age (years)			32.7 (4.5)	22-41
Ethnicity				
Caucasian	22	(61.1%)		
African	8	(22.2%)		
Asian	6	(16.7%)		
Educational level				
Primary school	5	(14.7%)		
Secondary school	15	(44.1%)		
Higher education	14	(41.2%)		
Smoking				
Yes	3	(8.3%)		
BMI			24.8 (4.9)	17.1-39.3
25-30	12	(36.4%)		
≥ 30	4	(12.1%)		
Parity				
Nulliparous	18	(50.0%)		
Multiparous	18	(50.0%)		
Pregnancy complication				
Preeclampsia	21	(16.7%)		
Intrauterine growth restriction	4	(58.3%)		
Gestational diabetes	5	(11.1%)		
Preeclampsia and intrauterine growth restriction	6	(13.9%)		
Time since delivery (months)	36		11.8 (3.6)	5.8-19.0
Offspring				
Birth weight (grams)	36		2352 (1155)	690-4360
Gestational age at delivery (days)	36		246 (4.9)	184-290

Barriers and Perceived Behavioral Control

The vast majority did not feel confident in their ability to be able to adopt a healthy lifestyle and perceived it as difficult to achieve. Most women reported that they did not succeed in adopting a healthy postpartum lifestyle; this also applied to those who were living a healthy lifestyle before their pregnancy.

All women characterized their postpartum physical and psychological health condition as being worse than that before their pregnancy. This was more pronounced in women who had experienced a severe complication: *After delivery, I've never had the feeling of being my old self again*. Frequently reported complaints were fatigue, forgetfulness, low mood, sleep disturbance, emotional lability, and reliving events surrounding their complicated pregnancy. Women felt they were not yet recovered from their pregnancy, both physically and psychologically. This was reflected in the complaints they reported, even up to 19 months after delivery. This reported lack of recovery from their complicated pregnancy was mentioned to be the main barrier to adopt and maintain a healthy lifestyle. This was more often the case among women who had experienced preeclampsia compared with women who experienced gestational diabetes, because women who had experienced preeclampsia more often reported postpartum complaints and lack of recovery form their pregnancy: *It was a battle to get out of bed, let alone thinking about eating two pieces of fruit and two ounces of vegetables a day.* The pregnancy complications and their consequences were experienced as stressful life events, and the processing of and coping with these life events contributed to lack of recovery. In particular, the burden of emotional damage and the importance of psychological recovery were mentioned. Women also reported feelings of loss of control over their own body, and feelings of loss of confidence in their own body. Women reported that the recovery process as well as the adoption of a healthy postpartum lifestyle was hindered by a lack of postpartum support from health care providers, lack of knowledge, and lack of understanding about the pregnancy complication and its consequences: *That's something I've missed, women who have been through the same thing to share experiences with, to be able to process my experiences. Nobody around me indicated what had happened to me, what I could expect to happen after delivery, and what kind of help could be offered to me when needed.*

Compared with women who experienced preeclampsia and intrauterine growth restriction, women with gestational diabetes struggled with a healthy postpartum diet for different reasons. Whereas maintaining the diet prescribed by a dietician was associated with feelings of solitude, dullness, and isolation from their family or friends among women who had gestational diabetes, women who had preeclampsia and intrauterine growth restriction generally struggled with a healthy diet because of lack of recovery.

Other perceived barriers included lack of time and energy caused by daily demands such as taking care of their offspring, housekeeping, working, and frequent hospital visits. *I was already very pleased that I could run my household and to go to work.* And that was all I could cope with at the time. For nine months I was worn out just by doing that. Frequent hospital visits were a

particular challenge for women who had had intrauterine growth restriction, since their offspring had more frequently been admitted to a neonatal care facility.

DISCUSSION

Our results show that even though most women reported that they had the intention, the majority did not succeed in adopting a healthy lifestyle. Barriers included poor postpartum physical and psychological recovery and lack of postpartum medical and psychological support from their healthcare specialists. This suggests that there is a need for professional support in the adoption of a healthy lifestyle after pregnancies complicated by preeclampsia, intrauterine growth restriction and/or gestational diabetes. Professional support should focus on the provision of knowledge about the pregnancy complications, their consequences, and what to expect after delivery.

The finding that poor postpartum recovery is a barrier to live a healthy lifestyle confirms previous research [27,28]. According to the participants in this study, after delivery more information is needed about the complication and its consequences, about what to expect regarding its course, and how to deal with the complication and postpartum recovery. This is especially the case in severe complications. Women also prefer to receive more psychological and physical guidance to support their recovery and would like to be guided in adopting a healthy lifestyle. They expect such information and guidance from their healthcare specialists. Healthcare specialists could be assisted and exonerated in the application of a lifestyle intervention directly after delivery, as previously proposed by Sattar and Greer [29].

It has been suggested that pregnancies complicated by preeclampsia, intrauterine growth restriction, and/or gestational diabetes may provide a window of opportunity to apply a lifestyle intervention shortly after delivery [29]. Our study provides a list of motivators and barriers of postpartum lifestyle. This list can be used to develop a lifestyle intervention aimed at women who have experienced these pregnancy complications. However, the reported findings are descriptive and provide information that should be further evaluated in quantitative research in representative samples. Further quantitative research is needed to be able to determine the prevalence and the relative importance of the reported benefits and barriers. In addition, research should be focused on the determinants of participation in health promotion programs and preferred program characteristics to develop an effective evidence-based lifestyle intervention for implementation in this high-risk group.

Study Limitations and Strengths

Selection bias might have occurred, as only patients who gave birth in the Erasmus University Medical Center (a tertiary referral hospital) were invited to participate. Patients who are

admitted to this university hospital generally experience more severe complications compared with other hospitals in the surrounding area. Despite efforts to prevent bias (e.g., by having random, consecutive participant selection), a volunteer bias could have occurred. There was a low recruitment rate. Reasons for nonparticipation included insufficient understanding of the Dutch language and inability to be present at the time of the focus-group interviews.

In addition, an investigator bias may have arisen. Although using more than one analyst might have improved the consistency or reliability of the analyses, the appropriateness of the inter-rater reliability concept in qualitative research is still debated [26,30].

Despite their positive attitude, their motivation to comply to the beliefs of important referents, and their favorable intention, our finding that women did not succeed in living a healthy lifestyle can be explained by applying the Theory of Planned Behavior. According to this theory, these women did not achieve a healthy postpartum lifestyle because of their low perceived behavioral control. This suggests that a healthy lifestyle can be promoted in these women by improving their perceived behavioral control. Perceived behavioral control might be increased by lowering or removing perceived barriers, such as lack of postpartum guidance and poor physical and psychological recovery. Thus, a healthy postpartum lifestyle may be promoted by supporting postpartum recovery and by providing better postpartum guidance.

REFERENCES

1. Bottalico JN. Recurrent gestational diabetes: risk factors, diagnosis, management, and implications. Seminars in perinatology. 2007 Jun;31(3):176-84.
2. Kinzler WL, Kaminsky L. Fetal growth restriction and subsequent pregnancy risks. Seminars in perinatology. 2007 Jun;31(3):126-34.
3. Sibai BM, Mercer B, Sarinoglu C. Severe preeclampsia in the second trimester: recurrence risk and long-term prognosis. American journal of obstetrics and gynecology. 1991 Nov;165(5 Pt 1):1408-12.
4. Bellamy L, Casas JP, Hingorani AD, Williams DJ. Pre-eclampsia and risk of cardiovascular disease and cancer in later life: systematic review and meta-analysis. BMJ (Clinical research ed. 2007 Nov 10;335(7627):974.
5. Ray JG, Vermeulen MJ, Schull MJ, Redelmeier DA. Cardiovascular health after maternal placental syndromes (CHAMPS): population-based retrospective cohort study. Lancet. 2005 Nov 19;366(9499):1797-803.
6. Smith GC, Pell JP, Walsh D. Pregnancy complications and maternal risk of ischaemic heart disease: a retrospective cohort study of 129,290 births. Lancet. 2001 Jun 23;357(9273):2002-6.
7. Smith GN, Walker MC, Liu A, Wen SW, Swansburg M, Ramshaw H, et al. A history of preeclampsia identifies women who have underlying cardiovascular risk factors. American journal of obstetrics and gynecology. 2009 Jan;200(1):58 e1-8.
8. Rippe JM, Angelopoulos TJ, Zukley L. Lifestyle Medicine for Risk Factor Reduction, Prevention, and Treatment of Coronary Heart Disease: Part II. Am J lifestyle med. 2007(1):79-90.
9. Yusuf S, Hawken S, Ounpuu S, Dans T, Avezum A, Lanas F, et al. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. Lancet. 2004 Sep 11-17;364(9438):937-52.
10. Knowler WC, Barrett-Connor E, Fowler SE, Hamman RF, Lachin JM, Walker EA, et al. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. N Engl J Med. 2002 Feb 7;346(6):393-403.
11. Tuomilehto J LJ, Eriksson JG, Valle TT, Hamalainen H, Ilanne-Parikka P, et al. . Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. . N Engl J Med. 2001;344(18):1343-50.
12. Case J, Willoughby D, Haley-Zitlin V, Maybee P. Preventing type 2 diabetes after gestational diabetes. The Diabetes educator. 2006 Nov-Dec;32(6):877-86.
13. Mosca L, Banka CL, Benjamin EJ, Berra K, Bushnell C, Dolor RJ, et al. Evidence-based guidelines for cardiovascular disease prevention in women: 2007 update. Circulation. 2007 Mar 20;115(11):1481-501.
14. Williams D. Pregnancy: a stress test for life. Current opinion in obstetrics & gynecology. 2003 Dec;15(6):465-71.
15. ACOG practice bulletin. Diagnosis and management of preeclampsia and eclampsia. Number 33, January 2002. American College of Obstetricians and Gynecologists. International journal of gynaecology and obstetrics: the official organ of the International Federation of Gynaecology and Obstetrics. 2002 Apr;77(1):67-75.
16. Brown MA, Lindheimer MD, de Swiet M, Van Assche A, Moutquin JM. The classification and diagnosis of the hypertensive disorders of pregnancy: statement from the International Society for the Study of Hypertension in Pregnancy (ISSHP). Hypertens Pregnancy. 2001;20(1):IX-XIV.
17. ACOG Practice Bulletin No. 58. Ultrasonography in pregnancy. Obstetrics and gynecology. 2004 Dec;104(6):1449-58.
18. Metzger BE, Gabbe SG, Persson B, Buchanan TA, Catalano PA, Damm P, et al. International association of diabetes and pregnancy study groups recommendations on the diagnosis and classification of hyperglycemia in pregnancy. Diabetes care. 2010 Mar;33(3):676-82.
19. Weinert LS. International Association of Diabetes and Pregnancy Study Groups recommendations on the diagnosis and classification of hyperglycemia in pregnancy: comment to the International Association of Diabetes and Pregnancy Study Groups Consensus Panel. Diabetes care. 2010 Jul;33(7):e97; author reply e8.
20. Morgan DL, Krueger RA, King JA. The focus group kit.: Sage publications. 1998.

21. Ajzen I. The Theory of Planned Behavior. Organizational Behavior and Human Decision Processes. 1991;50:179-211.

22. Godin G, Kok G. The theory of planned behavior: a review of its applications to health-related behaviors. Am J Health Promot. 1996 Nov-Dec;11(2):87-98.

23. www.heartandstroke.ca. [cited 2010 02-09-2010]; Available from: www.heartandstroke.ca

24. CBS. Standaard onderwijsindeling (SOI): CBS; 2003.

25. Downe-Wamboldt B. Content analysis: method, applications, and issues. Health care for women international. 1992 Jul-Sep;13(3):313-21.

26. Pope C, Ziebland S, Mays N. Qualitative research in health care. Analysing qualitative data. BMJ (Clinical research ed. 2000 Jan 8;320(7227):114-6.

27. Engelhard IM, van Rij M, Boullart I, Ekhart TH, Spaanderman ME, van den Hout MA, et al. Posttraumatic stress disorder after pre-eclampsia: an exploratory study. General hospital psychiatry. 2002 Jul-Aug;24(4):260-4.

28. Roes EM, Raijmakers MT, Schoonenberg M, Wanner N, Peters WH, Steegers EA. Physical well-being in women with a history of severe preeclampsia. J Matern Fetal Neonatal Med. 2005 Jul;18(1):39-45.

29. Sattar N, Greer IA. Pregnancy complications and maternal cardiovascular risk: opportunities for intervention and screening? BMJ (Clinical research ed. 2002 Jul 20;325(7356):157-60.

30. Armstrong D, Gosling A, Weinman J, Marteau T. The place of inter-rater reliability in qualitative research: an empirical study. Sociology. 1997;31(3):597-606.

Appendix. *Discussion guide to explore women's perceptions of postpartum lifestyle after a pregnancy complicated by preeclampsia, gestational diabetes, and/or intrauterine growth restriction.*

Opening questions
- What comes to mind when you think of a healthy lifestyle?
- What do you consider to be a healthy lifestyle?

Attitude
- To what extent is the adoption of a healthy lifestyle important to you?
- What makes a healthy lifestyle important to you?
- To what extent do you want to adopt a healthy lifestyle?

Intention
- To what extent do you intend to adopt a healthy lifestyle?

Motivators
- What motivates you to adopt a healthy lifestyle?
- What would be the reasons for you to adopt a healthy lifestyle?
- To what extent does your social environment motivate you to adopt a healthy lifestyle (subjective norm)?

Barriers
- To what extent do you think you are able to live a healthy lifestyle (perceived behavioral control)?
- Why do you think you may not be able to adopt a healthy lifestyle?
- To what extent does your social environment not allow you to adopt a healthy lifestyle (subjective norm)?

CHAPTER 6

Postpartum physical activity after preeclampsia.

Based on: M. Hoedjes, D. Berks, I. Vogel, A. Franx, A. Oenema, J.J. Duvekot, J.D.F. Habbema, E.A.P. Steegers, H. Raat. Postpartum physical activity after preeclampsia. *Submitted.*

ABSTRACT

Background

Women who experienced preeclampsia have an increased risk to develop cardiovascular disease and diabetes mellitus type II in later life. Physical activity (moderate physical activity for at least 30 minutes a day on at least 5 days a week) is recommended to lower this risk. It is unknown whether women after preeclampsia meet the physical activity recommendation.

Objective

To assess whether women after mild and severe preeclampsia meet the physical activity recommendation at 3 and 6 months postpartum, and to assess whether demographic characteristics, obstetric characteristics, anthropometrics, mental health, and health-related quality of life are associated with less physical activity than recommended.

Methods

Women who were diagnosed with preeclampsia were invited to participate in this prospective cohort study. 174 (68%) provided informed consent. The analyses were restricted to 141 participants who completed the short form of the International Physical Activity Questionnaire (IPAQ) at 3 and/ or 6 months postpartum. Logistic regression analyses were used to evaluate changes in physical activity level over time and to evaluate which variables were associated with failure to meet the postpartum physical activity recommendation.

Results

Both at 3 and 6 months postpartum, 38% failed to meet the physical activity recommendation. Failure was associated with severe preeclampsia, cesarean section, admission to the neonatal intensive care unit, low gestational age at delivery, and low birth weight (all $p<0.05$).

Conclusions

Our results suggest a need to stimulate physical activity in at least one third of women after a pregnancy complicated by preeclampsia, particularly when they experienced severe preeclampsia and other adverse pregnancy outcomes. Additional research is needed to develop tailored lifestyle interventions for those who fail to meet the recommendation.

INTRODUCTION

Women who have experienced preeclampsia in pregnancy are at increased risk to develop cardiovascular disease and diabetes mellitus type II later in life [1-3]. The postpartum period after preeclampsia is considered to be a window of opportunity for preventive lifestyle interventions to lower cardiovascular and metabolic risk [4,5], since formerly preeclamptic women are relatively young and motivated to make lifestyle changes [6,7]. Details on the prevalence of modifiable lifestyle risk behaviors, such as physical inactivity, are needed to evaluate the need for postpartum lifestyle interventions.

Physical inactivity is a modifiable cardiovascular and metabolic risk factor. Physical activity is defined as any bodily movement produced by skeletal muscles that requires energy expenditure [8]. According to physical activity recommendations adults (18-55 years) should be moderately physically active (e.g., by means of walking or bicycling) for at least 30 minutes a day on at least 5 days a week. However, more physical activity has additional health benefits, and may be required for weight control [8]. The beneficial effects of physical activity in the prevention of cardiovascular disease and diabetes mellitus type II are widely recognized and are supported by a large amount of evidence [9-14]. These beneficial effects are already observed at a moderate level of physical activity [14-16].

To date, there is no knowledge on physical activity after preeclampsia during the first year postpartum. In a cross-sectional study, Kvehaugen et al.[17] evaluated physical activity at 5 to 8 years postpartum in women who experienced preeclampsia in pregnancy and compared these levels to those of women who had uncomplicated pregnancies. Women who experienced preeclampsia were less physically active 5 to 8 years postpartum compared with women after an uncomplicated pregnancy. Their findings confirm that lifestyle interventions should preferably be offered from the early postpartum period onwards and that adherence to the physical activity recommendation should be assessed longitudinally [4,5].

Insight into the determinants of not meeting the physical activity recommendation is needed to be able to develop lifestyle interventions tailored for women who have experienced preeclampsia [18]. To our knowledge, these determinants are not known. Research in general populations has shown an association between physical activity and anthropometric indicators related to overweight and obesity such as BMI [19], mental health status such as the presence of depression [20], and health-related quality of life [21]. We hypothesize that in addition obstetric characteristics (e.g., severity of preeclampsia, caesarean section) will influence postpartum physical activity after preeclampsia.

In this study we assess whether women after mild and severe preeclampsia meet the physical activity recommendation at 3 and 6 months postpartum, and whether demographic characteristics, obstetric characteristics, anthropometric characteristics, mental health status, and health-related quality of life are associated with less postpartum physical activity than recommended.

METHODS

Population for analysis

The present study was embedded in the Pro-Active study (Postpartum Rotterdam Appraisal of Cardiovascular Health and Tailored Intervention), a prospective multi-center cohort study coordinated by the Erasmus MC, University Medical Center Rotterdam, the Netherlands. Women who had been diagnosed with preeclampsia, intrauterine growth restriction, or gestational diabetes were included in the Pro-Active study to appraise postpartum physical and psychological health and to examine the feasibility of lifestyle interventions after these pregnancy complications.

Patients were eligible for participation in the present study if they had given birth between February 2007 and June 2009; their pregnancy had been complicated by preeclampsia; they were older than 18 years; and they understood and spoke the Dutch language. Eligible patients (n=255) were selected by searching the records of four hospitals, whose medical ethics committee had approved the Pro-Active study. They received an information leaflet and an informed consent form. Of the eligible patients, 174 (68%) provided written informed consent. During outpatient hospital visits at 3 and 6 months postpartum, anthropometrics were obtained and participants were asked to complete a questionnaire. Of the 174 participants, 118 (68%) completed the questionnaire at 3 months postpartum, 131 (75%) completed this questionnaire at 6 months postpartum, and 108 (62%) women completed the questionnaire at both time points. The population for analysis was composed of the 141 women who completed the questionnaire at least once. Relative to women excluded from the population for analysis, more women in the population for analysis were native Dutch (96% versus 79%; $p<0.01$), nulliparous (77% versus 58%; $p=0.02$), and less often had a caesarean section (65% versus 85%; $p=0.02$).

Data collection and measures

Age and details on the diagnosis of preeclampsia, parity, multiple pregnancies, highest level of obstetric care (standard care, high obstetric care or intensive care), mode of delivery (vaginal delivery or caesarean section), perinatal death, admission to the Neonatal Intensive Care Unit (NICU), gestational age at delivery, and birth weight were retrieved from hospital records.

Mild preeclampsia was defined according to the research criteria of the International Society for the Study of Hypertension in Pregnancy (ISSHP): development of a blood pressure of $\geq$ 140/90 mmHg plus proteinuria (defined as $\geq$ 300 mg/day of urinary protein loss) after 20 weeks of gestation in a previous normotensive woman [22]. Severe preeclampsia was defined according to the research criteria of the American College of Obstetricians and Gynecologists (ACOG): preeclampsia and at least one of the following: severe blood pressure elevation defined by systolic blood pressure equal or above 160 mm Hg and/ or diastolic blood pressure equal or above 110 mm Hg, severe proteinuria (5 or more grams in 24 hours), Hemolytic anemia Elevated Liver enzymes and Low Platelet count (HELLP) syndrome (defined by thrombocyte count less

then 100*10^9/l, and/or ASAT and ALAT above 30 U/l), convulsions or fetal growth restriction [23].

Details on ethnicity and educational level were obtained from a questionnaire administered at 6 weeks postpartum. A participant was categorized as non-Dutch if she, or at least one of her parents, had been born abroad [24]. Educational level was assessed by the highest completed education and categorized into three categories: 1) high (university degree), 2) mid (higher vocational training, intermediate vocational training), 3) low (primary school, lower vocational training, intermediate general school) [25].

Physical Activity

The short form of the International Physical Activity Questionnaire (IPAQ) was used to measure self-reported physical activity at 3 and 6 months postpartum [26]. The IPAQ has shown to have acceptable measurement properties [27]. Participants were asked to recall the frequency (days per week), duration (minutes), and level of intensity (vigorous, moderate, or walking) of physical activity undertaken during the previous 7 days. Self-reported physical activity was transformed into MET-minutes according to the IPAQ scoring protocol (www.ipaq.ki.se)[26]. Scoring of the IPAQ results in a categorization of self-reported physical activity, based upon the MET minutes per week expenditure, into high, moderate or low for level of physical activity. The high category represents at least an hour of moderate-intensity activity over and above the basal level of activity, or half an hour of vigorous-intensity activity over and above basal levels daily. The moderate category corresponds to the physical activity recommendation (half an hour of at least moderate intensity physical activity on at least 5 days a week). The low category includes all women whose activity levels fail to meet the criteria for the above categories. For the statistical analyses, these categories were dichotomized into a group of women who met the physical activity recommendation (including the categories moderate and high), and a group of women who did not meet the physical activity recommendation (category low).

Anthropometrics

During the outpatient hospital visits at 3 and 6 months the following anthropometrical details were obtained: length, weight, waist and hip circumference. Body Mass Index (BMI) was calculated as body weight (in kilo's) divided by the square of the length (in meters). Waist-hip ratio (WHR) was calculated from the waist and hip circumference. The WHR equals the waist circumference divided by the hip circumference. The waist was measured at the smallest circumference of the waist, and the hip circumference was measured at its widest part of the buttocks or hip.

Mental health and health-related quality of life

The Edinburgh Postnatal Depression Scale (EPDS) [28,29], a 10-item self-report scale commonly used to screen for postpartum depression, was used to measure postpartum depressive symptoms at 3 and 6 months postpartum. Both the total score and a dichotomisation (with

depression =1; no depression =0) of the total score (based on a cut-off value of 10) are reported as outcome measures.

Post-traumatic stress disorder (PTSD) and its symptoms intrusion, avoidance and hyperarousal were measured at 3 months postpartum using the Dutch version of the Self-rating Inventory for PTSD [30-33]. PTSD and its symptoms were considered present according to DSM-IV criteria [34]. For PTSD and each type of symptom, a dichotomous outcome measure was composed (with PTSD or PTSD-symptom present=1; PTSD or PTSD-symptom not present=0). The total score was also reported as an indicator of the level of post-traumatic stress.

Generic health-related quality of life (HRQoL) at 3 months postpartum was assessed using the Dutch version of the RAND 36-item Short-Form Health Survey (SF-36) [35,36]. The SF-36 provides two summary measures: a physical component scale and a mental component scale. Scores range from 0 to 100, with higher scores indicating a better health-related quality of life.

Statistical analyses

Statistical analyses were performed using SPSS for Windows, version 17.0 (SPSS Inc., Chicago, IL). Frequency tables were used to explore characteristics of the total study population (*n*=141), and those diagnosed with mild (*n*=36) or severe (*n*=105) preeclampsia. Mean and frequency differences were examined through independent sample t-tests, ANOVA's, and Chi-square statistics. Median differences were analysed through median tests. (Table 1)

Differences in physical activity level at 3 and 6 months postpartum were examined for the total study population, and for women who had mild and severe preeclampsia. Outcome measures were: total MET-minutes per week, walking MET-minutes per week, moderate MET-minutes per week, vigorous MET-minutes per week, and the percentage of women who did or did not meet the physical activity recommendation. Generalized Estimating Equations (GEE) was used to examine these differences between 3 and 6 months postpartum [37]. (Table 2) GEE is an extension of the quasi-likelihood approach used in generalized linear models (GLM). It is a generalization of GLM that takes into account within-group correlation encountered in longitudinal data [38].

Table 1. *Characteristics of the population for analysis (N=141)*

	Percentage of study population (unless otherwise specified)			
		Severity of Preeclampsia		
	Total N=141	Mild N=36	Severe N=105	p-value[1]
Demographic characteristics				
Age in years: mean (SD)	31 (5)	33 (5)	31 (4)	**0.01**
Ethnicity				
Dutch	96	94	96	0.65
Other	4	6	4	
Educational level				
Low	14	14	14	0.90
Mid	69	67	70	
High	17	19	16	
Obstetric characteristics				
Parity				
Primiparous	77	69	80	0.28
Multiparous	23	31	20	
Multiple pregnancies				
Singleton pregnancy	91	100	88	**0.04**
Multiple pregnancy	9	0	12	
Highest level of obstetric care				
Standard care	62	100	50	**<0.01**
High obstetric care or intensive care	38	0	50	
Mode of delivery				
Vaginal	35	78	21	**<0.01**
Caesarean section	65	22	79	
Gestational age at delivery				
< 34 weeks	51	3	68	**<0.01**
34-37 weeks	15	8	17	
> 37 weeks	34	89	15	
Gestational age at delivery (weeks): Mean (SD)	34 (5)	38 (2)	32 (4)	**<0.01**
Birth weight (g): mean (SD)	2015 (1103)	3188 (712)	1613 (910)	**<0.01**
NICU admission	55	3	73	**<0.01**
Days of NICU admission: median (IQR)	38 (51)	76 (-)[2]	38 (48)	
Perinatal death	4	0	6	0.34
Anthropometrics				
3months postpartum				
Weight (kg): mean (SD)	79 (18)	86 (21)	77 (17)	**0.02**
Body Mass Index (BMI): mean (SD)	27 (6)	30 (7)	27 (5)	**0.02**
Waist circumference (cm): mean (SD)	91 (13)	94 (14)	90 (13)	0.15
Waist-hip ratio: mean (SD)	0.8 (0.1)	0.8 (0.1)	0.8 (0.1)	0.59
6 months postpartum				
Weight (kg): mean (SD)	80 (20)	86 (23)	77 (18)	**0.03**
Body Mass Index (BMI): mean (SD)	27 (6)	30 (8)	27 (6)	**0.04**
Waist circumference: mean (SD)	91 (15)	95 (18)	89 (14)	0.06
Waist-hip ratio: mean (SD)	0.8 (0.1)	0.8 (0.1)	0.8 (0.1)	0.47

SD= Standard Deviation; IQR=Interquartile range; NICU= Neonatal Intensive Care Unit

[1] Women with mild preeclampsia compared with severe preeclampsia

[2] There was only 1 woman with mild preeclampsia whose neonate was admitted to the NICU

Statistically significant p-values (p<0.05) are bold printed.

Table 2. *Physical activity as measured in MET-minutes per week at 3 and 6 months postpartum among women after preeclampsia (n=141), after mild preeclampsia (n=36), and after severe preeclampsia (n=105).*

	3 months postpartum			6 months postpartum			
	Mean	95% CI	%	Mean	95% CI	%	p-value[1]
Total study population (n=141)							
Total MET-minutes per week	2210	(1881-2540)		2410	(2076-2745)		0.35
Walking MET-minutes per week	1295	(1120-1470)		1195	(1016-1373)		0.36
Moderate MET-minutes per week	580	(429-732)		632	(489-774)		0.58
Vigorous MET-minutes per week	271	(146-396)		585	(411-760)		**0.01**
Met physical activity recommendation			62			62	0.97
Mild preeclampsia (n=36)							
Total MET-minutes per week	2571	(1968-3173)		2622	(1939-3306)		0.90
Walking MET-minutes per week	1637	(1321-1953)		1224	(867-1582)		**0.05**
Moderate MET-minutes per week	547	(273-821)		634	(393-875)		0.54
Vigorous MET-minutes per week	298	(94-503)		789	(402-1176)		**0.02**
Met physical activity recommendation			83			69	0.22
Severe preeclampsia (n=105)							
Total MET-minutes per week	2091	(1704-2478)		2337	(1955-2719)		0.32
Walking MET-minutes per week	1181	(979- 1383)		1183	(977- 1389)		0.99
Moderate MET-minutes per week	592	(412- 772)		634	(463- 806)		0.71
Vigorous MET-minutes per week	264	(111- 417)		520	(327-712)		**0.04**
Met physical activity recommendation			56			60	0.53

%= percentage ; 95% CI= 95% Confidence Interval. Statistically significant p-values (p<0.05) are bold printed.

[1] Physical activity at 3 months postpartum compared with 6 months postpartum

MET= metabolic equivalent

To evaluate the association between meeting (or not meeting) the physical activity recommendation and relevant study population characteristics while accounting for longitudinal observations at the two time points, logistic regression analyses were conducted with the GEE method. Relevant characteristics were: demographic background, obstetric characteristics (severity of preeclampsia, parity, multiple pregnancies, highest level of obstetric care, mode of delivery, gestational age at delivery, birth weight, admission to the neonatal intensive care unit, and perinatal death), mental health status, and health-related quality of life. Per characteristic, a logistic regression analysis was performed with the characteristic and time as independent variables, and adherence to the physical activity recommendation as dependent variable. (Table 3)

Table 3. *Odds Ratio's (OR) and 95%-confidence intervals (CI) for recommended physical activity obtained from logistic regression analyses conducted with GEE (n=141).*

	OR[1]	95% CI
Demographic characteristics		
Age (years)	1.05	(0.99- 1.12)
Ethnicity		
Dutch	2.25	(0.51- 9.91)
Other	1	
Educational level		
Low	1	
Mid	1.61	(0.67- 3.85)
High	1.87	(0.65- 5.43)
Obstetric characteristics		
Parity		
Primiparous	1	
Multiparous	1.70	(0.84- 3.44)
Multiple pregnancies		
Singleton pregnancy	1	
Multiple pregnancy	0.83	(0.32- 2.14)
Highest level of obstetric care		
Standard care	1	
High obstetric care or intensive care	0.57	(0.32- 1.03)
Delivery		
Vaginal	1	
Caesarean section	**0.38**	**(0.20- 0.74)**
Gestational age at delivery		
< 34 weeks	1	
34-37 weeks	1.20	(0.52- 2.78)
> 37 weeks	**2.73**	**(1.41- 5.29)**
Gestational age at delivery (weeks)	**1.09**	**(1.03- 1.16)**
Birth weight (kg)	**1.47**	**(1.14- 1.89)**
NICU admission		
No	1	
Yes	**0.52**	**(0.29- 0.94)**
Perinatal death		
No	1	
Yes	0.52	(0.12- 2.30)
Severity of preeclampsia		
Mild	1	
Severe	**0.47**	**(0.23- 0.95)**

Table 3 continued.

	OR[1]	95% CI
Mental health		
Depression		
Total score on the EPDS	0.96	(0.91- 1.01)
Depression		
No	1	
Yes	0.73	(0.37- 1.45)
Post-traumatic stress disorder		
Total score	0.99	(0.96- 1.04)
Intrusion		
No	1	
Yes	1.25	(0.49- 3.18)
Avoidance		
No	1	
Yes	1.63	(0.50- 5.30)
Hyperarousal		
No	1	
Yes	1.88	(0.83- 4.29)
PTSD		
No	1	
Yes	0.83	(0.18- 3.84)
Anthropometrics		
Weight (kg)	0.99	(0.98- 1.01)
Body Mass Index (BMI)	0.98	(0.93- 1.03)
Waist circumference (cm)	0.99	(0.97- 1.01)
Waist-hip ratio (x 10)	0.93	(0.58- 1.49)
Health-related quality of life		
Physical component	1.02	(0.98- 1.06)
Mental component	1.00	(0.97- 1.04)

95% CI= 95% Confidence Interval; OR= Odds Ratio. OR's and 95% CI's of statistically significant variables ($p<0.05$) are bold printed.

[1]Odds ratio's were obtained from GEE. Each logistic regression analysis contained a characteristic and time as independent variables, and adherence to the physical activity recommendation as dependent variable.

NICU= Neonatal Intensive Care Unit; PTSD= Post-traumatic Stress Disorder;

EPDS= Edinburgh Postnatal Depression Scale

RESULTS

Population for analysis

As depicted in Table 1, most participants were Dutch (96%), had experienced severe preeclampsia (74%), were primiparous (77%), and had had singleton pregnancies (91%). Mean age was 31 (SD 4.5) years. Mean length was 170 cm (SD 6.5). At 3 months postpartum, 30% was overweight (BMI $\geq$ 25) and 27% was obese (BMI $\geq$ 30). At 6 months postpartum, 30% was overweight (BMI $\geq$ 25) and 26% was obese (BMI $\geq$ 30).

Compared with women who experienced mild preeclampsia, women with severe preeclampsia were younger (p=0.01), were more often nulliparous (p=0.04), were more often admitted to the high obstetric care or intensive care unit (p<0.01), more often delivered by a caesarean section (p<0.01), had a lower gestational age at delivery (p<0.01), delivered an infant with a lower birth weight (p<0.01), and their infant was more often admitted to the NICU (p<0.01). Women with mild preeclampsia had a higher mean weight, and a higher BMI both at 3 (26% overweight, 40% obese) and at 6 months postpartum (28% overweight, 38% obese) than women with severe preeclampsia (31% overweight, 23% obese at 3 months, and 30% overweight, 23% obese at 6 months postpartum; all p<0.05).

Postpartum physical activity

Although total physical activity did not differ between 3 and 6 months postpartum (p=0.35), vigorous intensive physical activity increased from 3 months to 6 months postpartum (p=0.01). The percentage of women that met the physical activity recommendation did not differ between 3 months and 6 months postpartum (both 62%) (Table 2).

Among women with mild preeclampsia, walking MET-minutes decreased (p=0.05), and vigorous MET-minutes increased (p=0.02) from 3 to 6 months postpartum. Among women with severe preeclampsia, vigorous intensive physical activity increased from 3 to 6 months postpartum (p=0.04). In general, MET-minutes per week tend to be lower for women with severe preeclampsia compared with women with mild preeclampsia. Also, compared with women with severe preeclampsia, the percentage of women that met the physical activity recommendation was higher among women with mild preeclampsia, both at 3 months (83% versus 56%) and at 6 months postpartum (69% versus 60%).

Variables associated with failure to meet the physical activity recommendation

Women who experienced severe preeclampsia, who had a cesarean section, premature delivery, had offspring with a low birth weight and whose offspring was admitted to the NICU were less likely to meet the physical activity recommendation (all p<0.05) (Table 3).

DISCUSSION

This prospective cohort study which analyses postpartum physical activity among women who had preeclampsia showed that 38% did not meet the physical activity recommendation at 3 and 6 months postpartum. Women were less likely to meet the physical activity recommendation if they experienced severe preeclampsia, delivered by a cesarean section, delivered prematurely, had a small for gestational age infant, and if their offspring was admitted to the NICU.

To our knowledge, our study was the first longitudinal prospective cohort study that examined physical activity after preeclampsia in the early postpartum period. Contrary to Kvehaugen et al. [17], and also contrary to our clinical experience, we found that women who experienced preeclampsia more often reported to meet the physical activity recommendation than women in a reference population. According to a Dutch age- and gender matched reference population, 52% reported to meet the physical activity recommendation [39]. This is not in line with prior expectations based on our experience in clinical practice. Based on our clinical experience we would have expected to find that women after preeclampsia less often met the physical activity recommendation compared with women in a reference population. This finding may be explained by the use of a different questionnaire to measure physical activity and/ or by an overestimation of self-reported physical activity in our study population. Since we did not have access to further details on the reference population, we could not discover whether our sample differs from the reference population with regard to demographic characteristics.

Our findings are not fully comparable with the findings of Kvehaugen et al. [17], since they studied physical activity 5 to 8 years postpartum, and they only reported on total physical activity. They did not report on the percentage of women who met the physical activity recommendation nor did they report on variables that are associated with postpartum physical activity after preeclampsia. Previous research among women who had gestational diabetes, who also are at increased cardiovascular and metabolic risk, showed that physical activity levels were suboptimal [40]. Only 31 to 50% of these women met physical activity recommendations [41-45].

In contrast with our hypothesis, the percentage of women who met the physical activity recommendation did not increase over time. This suggests a sustained need for interventions aimed at increasing physical activity among women who had preeclampsia.

Also contrary to our hypothesis, anthropometrics, mental health, and health-related quality of life were not found to be associated with meeting the recommendation after preeclampsia. However, we expected the result that obstetric complications were associated with failure to meet the physical activity recommendation. Previous research on postpartum physical activity after gestational diabetes found that postpartum physical activity was associated with high social support and high self-efficacy among women with previous gestational diabetes [44,45]. Future research among women with previous preeclampsia should focus on the behavioral determinants of postpartum physical activity. E.g., it could be assessed whether the theory of planned behavior

predicts postpartum physical activity after preeclampsia [46], since earlier qualitative research has suggested that the theory of planned behavior could be used to explain postpartum lifestyle behavior among women with previous preeclampsia [7].

Methodological considerations

Our study did not include a control group of postpartum women who experienced an uncomplicated pregnancy. To evaluate differences in postpartum physical activity between women who had preeclampsia and women who had uncomplicated pregnancies, future prospective cohort studies should preferably measure postpartum physical activity in women with and without a history of preeclampsia. To further assess adherence to the physical activity recommendation in women after preeclamptic or uncomplicated pregnancies as compared with a same-age female population, future studies should also include new population data on physical activity.

Although a validated questionnaire like the IPAQ is suitable for everyday practice [27], such a self-report might overestimate physical activity [47].

Non-response analyses showed that compared with women who were excluded from the population for analysis, non-native Dutch women, multiparous women, and women who had a cesarean section were underrepresented in our population for analysis. Since women with a cesarean section are less likely to meet the physical activity recommendation, the reported proportion of women who met the physical activity recommendation might have been overestimated. Furthermore, our conclusions are limited to women of Dutch origin, since these constituted 96% of our study population. Future studies assessing postpartum physical activity among women from foreign ethnicities, with or without pregnancy complications, seem to be worthwhile.

To date, it remains unknown whether preeclampsia causes a low level of physical activity or whether a low physical activity level increases the risk of preeclampsia. Previous research has found that physical inactivity is an independent risk factor for the development of preeclampsia [48-51]. However, a number of studies do not support this finding [52-55]. Future research is needed to elucidate the causal relationship between preeclampsia and physical activity.

Our results suggest that for at least one third of women after preeclampsia, lifestyle interventions aimed at increasing physical activity could be appropriate. We recommend that women who experienced preeclampsia should be informed about the importance of adoption of a healthy lifestyle, and that women who do not meet physical activity recommendations should be encouraged to increase their physical activity level. Our findings also suggest that, in the early postpartum period, particularly women who have experienced severe preeclampsia, a caesarean section, NICU admission, premature delivery, and low birth weight, are at risk for a physical activity level below recommended levels. Although further research is needed to be able to confirm our

findings, our study provides a first indication of how many women after preeclampsia fail to meet the physical activity recommendation and which variables are associated with physical activity levels below the recommendation. These data provide a starting point for the development of lifestyle interventions aimed at women after preeclampsia. The next step is to determine which modifiable psychosocial risk factors are related to physical activity behaviour in this specific group of women. Awaiting the development of lifestyle interventions tailored for women who have experienced preeclampsia, existing effective postpartum lifestyle interventions could be used to promote physical activity [56]. For example, self-supervised exercise sessions, an aerobic exercise program, an individualized activity plan, correspondence materials, telephone contact, activity diaries, and counseling sessions could be used to promote postpartum physical activity [56].

REFERENCES

1. Bellamy L, Casas JP, Hingorani AD, Williams DJ. Pre-eclampsia and risk of cardiovascular disease and cancer in later life: systematic review and meta-analysis. BMJ (Clinical research ed. 2007 Nov 10;335(7627):974.
2. Smith GC, Pell JP, Walsh D. Pregnancy complications and maternal risk of ischaemic heart disease: a retrospective cohort study of 129,290 births. Lancet. 2001 Jun 23;357(9273):2002-6.
3. Smith GN, Walker MC, Liu A, Wen SW, Swansburg M, Ramshaw H, et al. A history of preeclampsia identifies women who have underlying cardiovascular risk factors. American journal of obstetrics and gynecology. 2009 Jan;200(1):58 e1-8.
4. Williams D. Pregnancy: a stress test for life. Current opinion in obstetrics & gynecology. 2003 Dec;15(6):465-71.
5. Sattar N, Greer IA. Pregnancy complications and maternal cardiovascular risk: opportunities for intervention and screening? BMJ (Clinical research ed. 2002 Jul 20;325(7356):157-60.
6. Hoedjes M, Berks D, Vogel I, Duvekot JJ, Oenema A, Franx A, et al. Preferences for postpartum lifestyle counseling among women sharing an increased cardiovascular and metabolic risk: a focus group study. Hypertens Pregnancy. 2011;30(1):83-92.
7. Hoedjes M, Berks D, Vogel I, Franx A, Duvekot JJ, Oenema A, et al. Motivators and Barriers to a Healthy Postpartum Lifestyle in Women at Increased Cardiovascular and Metabolic Risk: A Focus-Group Study. Hypertens Pregnancy. 2011 Jan 20.
8. WHO. Global recommendations on physical activity for health; 2010.
9. Berlin JA, Colditz GA. A meta-analysis of physical activity in the prevention of coronary heart disease. American journal of epidemiology. 1990 Oct;132(4):612-28.
10. Paffenbarger RS, Jr., Hyde RT, Hsieh CC, Wing AL. Physical activity, other life-style patterns, cardiovascular disease and longevity. Acta medica Scandinavica. 1986;711:85-91.
11. Paffenbarger RS, Jr., Hyde RT, Wing AL, Hsieh CC. Physical activity, all-cause mortality, and longevity of college alumni. The New England journal of medicine. 1986 Mar 6;314(10):605-13.
12. Helmrich SP, Ragland DR, Leung RW, Paffenbarger RS, Jr. Physical activity and reduced occurrence of non-insulin-dependent diabetes mellitus. The New England journal of medicine. 1991 Jul 18;325(3):147-52.
13. Schnohr P, Scharling H, Jensen JS. Changes in leisure-time physical activity and risk of death: an observational study of 7,000 men and women. American journal of epidemiology. 2003 Oct 1;158(7):639-44.
14. Hu FB, Stampfer MJ, Colditz GA, Ascherio A, Rexrode KM, Willett WC, et al. Physical activity and risk of stroke in women. Jama. 2000 Jun 14;283(22):2961-7.
15. Tanasescu M, Leitzmann MF, Rimm EB, Willett WC, Stampfer MJ, Hu FB. Exercise type and intensity in relation to coronary heart disease in men. Jama. 2002 Oct 23-30;288(16):1994-2000.
16. Franco OH, de Laet C, Peeters A, Jonker J, Mackenbach J, Nusselder W. Effects of physical activity on life expectancy with cardiovascular disease. Archives of internal medicine. 2005 Nov 14;165(20):2355-60.
17. Kvehaugen AS, Andersen LF, Staff AC. Dietary intake and physical activity in women and offspring after pregnancies complicated by preeclampsia or diabetes mellitus. Acta obstetricia et gynecologica Scandinavica. 2010 Nov;89(11):1486-90.
18. Brug J, Oenema A, Ferreira I. Theory, evidence and Intervention Mapping to improve behavior nutrition and physical activity interventions. The international journal of behavioral nutrition and physical activity. 2005 Apr 4;2(1):2.
19. Gaston A, Cramp A. Exercise during pregnancy: A review of patterns and determinants. Journal of science and medicine in sport / Sports Medicine Australia. 2011 Mar 21.
20. Goodwin RD. Association between physical activity and mental disorders among adults in the United States. Preventive medicine. 2003 Jun;36(6):698-703.
21. Bize R, Johnson JA, Plotnikoff RC. Physical activity level and health-related quality of life in the general adult population: a systematic review. Preventive medicine. 2007 Dec;45(6):401-15.
22. Brown MA, Lindheimer MD, de Swiet M, Van Assche A, Moutquin JM. The classification and diagnosis of the hypertensive disorders of pregnancy: statement from the International Society for the Study of Hypertension in Pregnancy (ISSHP). Hypertens Pregnancy. 2001;20(1):IX-XIV.

23. ACOG practice bulletin. Diagnosis and management of preeclampsia and eclampsia. Number 33, January 2002. American College of Obstetricians and Gynecologists. Int J Gynaecol Obstet. 2002 Apr;77(1):67-75.

24. Statistics Netherlands. Migrants in the Netherlands. Heerlen: Statistics Netherlands; 2003.

25. Statistics Netherlands. Standard classification of education. Heerlen: Statistics Netherlands; 2003.

26. Guidelines for Data Processing and Analysis of the International Physical Activity Questionnaire (IPAQ) - Short and Long Forms. 2005 [cited; Available from: http://www.ipaq.ki.se

27. Craig CL, Marshall AL, Sjostrom M, Bauman AE, Booth ML, Ainsworth BE, et al. International physical activity questionnaire: 12-country reliability and validity. Medicine and science in sports and exercise. 2003 Aug;35(8):1381-95.

28. 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.

29. Pop VJ, Komproe, I.H., van Somm, M.J. Characteristics of the Edinburgh Postnatal Depression Scale in the Netherlands. . Journal of Affective Disorders. 1992;26:105-10.

30. Hovens JE, van der Ploeg HM, Bramsen I, Reuling IE. Test-retest reliability of the self-rating inventory for posttraumatic stress disorder. Psychological reports. 2000 Dec;87(3 Pt 1):735-7.

31. Hovens JE, Bramsen I, van der Ploeg HM. Self-rating inventory for posttraumatic stress disorder: review of the psychometric properties of a new brief Dutch screening instrument. Perceptual and motor skills. 2002 Jun;94(3 Pt 1):996-1008.

32. Hovens JE, van der Ploeg HM, Bramsen I, Klaarenbeek MT, Schreuder JN, Rivero VV. The development of the Self-Rating Inventory for Posttraumatic Stress Disorder. Acta psychiatrica Scandinavica. 1994 Sep;90(3):172-83.

33. Hovens JE, van der Ploeg HM, Klaarenbeek MT, Bramsen I, Schreuder JN, Rivero VV. The assessment of posttraumatic stress disorder: with the Clinician Administered PTSD Scale: Dutch results. Journal of clinical psychology. 1994 May;50(3):325-40.

34. Diagnostic and statistical manual of mental disorders. 4th ed. Washington, DC: American Psychiatric Association 1994.

35. Ware JE, Kosinski M. Interpreting SF-36 summary health measures: a response. Qual Life Res. 2001;10(5):405-13; discussion 15-20.

36. Ware JE, Snow KK, Kosinski M, Gandek BG. SF-36 health survey: manual and interpretation guide. Boston, MA: Health Institute, New England Medical Center 1993.

37. Zeger SL, Liang KY. Longitudinal data analysis for discrete and continuous outcomes. Biometrics. 1986 Mar;42(1):121-30.

38. Hanley JA, Negassa A, Edwardes MD, Forrester JE. Statistical analysis of correlated data using generalized estimating equations: an orientation. American journal of epidemiology. 2003 Feb 15;157(4):364-75.

39. CBS. Gezondheid, leefstijl, gebruik van zorg 2010 [cited 2011 25 february 2011]; Available from: http://statline.cbs.nl/StatWeb/publication/?DM=SLNL&PA=03799&D1=152-153,183-189,227-241&D2=0-17&D3=0&D4=a&VW=T

40. Jones EJ, Roche CC, Appel SJ. A review of the health beliefs and lifestyle behaviors of women with previous gestational diabetes. J Obstet Gynecol Neonatal Nurs. 2009 Sep-Oct;38(5):516-26.

41. Kieffer EC, Sinco B, Kim C. Health behaviors among women of reproductive age with and without a history of gestational diabetes mellitus. Diabetes care. 2006 Aug;29(8):1788-93.

42. Kim C, McEwen LN, Kerr EA, Piette JD, Chames MC, Ferrara A, et al. Preventive counseling among women with histories of gestational diabetes mellitus. Diabetes care. 2007 Oct;30(10):2489-95.

43. Symons Downs D, Ulbrecht JS. Understanding exercise beliefs and behaviors in women with gestational diabetes mellitus. Diabetes care. 2006 Feb;29(2):236-40.

44. Koh D, Miller YD, Marshall AL, Brown WJ, McIntyre D. Health-enhancing physical activity behaviour and related factors in postpartum women with recent gestational diabetes mellitus. Journal of science and medicine in sport / Sports Medicine Australia. 2010 Jan;13(1):42-5.

45. Smith BJ, Cheung NW, Bauman AE, Zehle K, McLean M. Postpartum physical activity and related psychosocial factors among women with recent gestational diabetes mellitus. Diabetes care. 2005 Nov;28(11):2650-4.

46. Ajzen I. The Theory of Planned Behavior. Organizational Behavior and Human Decision Processes. 1991;50:179-211.

47. Boon RM, Hamlin MJ, Steel GD, Ross JJ. Validation of the New Zealand Physical Activity Questionnaire (NZPAQ-LF) and the International Physical Activity Questionnaire (IPAQ-LF) with accelerometry. British journal of sports medicine. 2010 Aug;44(10):741-6.

48. Rudra CB, Williams MA, Lee IM, Miller RS, Sorensen TK. Perceived exertion during prepregnancy physical activity and preeclampsia risk. Medicine and science in sports and exercise. 2005 Nov;37(11):1836-41.

49. Saftlas AF, Logsden-Sackett N, Wang W, Woolson R, Bracken MB. Work, leisure-time physical activity, and risk of preeclampsia and gestational hypertension. American journal of epidemiology. 2004 Oct 15;160(8):758-65.

50. Marcoux S, Brisson J, Fabia J. The effect of leisure time physical activity on the risk of pre-eclampsia and gestational hypertension. Journal of epidemiology and community health. 1989 Jun;43(2):147-52.

51. Sorensen TK, Williams MA, Lee IM, Dashow EE, Thompson ML, Luthy DA. Recreational physical activity during pregnancy and risk of preeclampsia. Hypertension. 2003 Jun;41(6):1273-80.

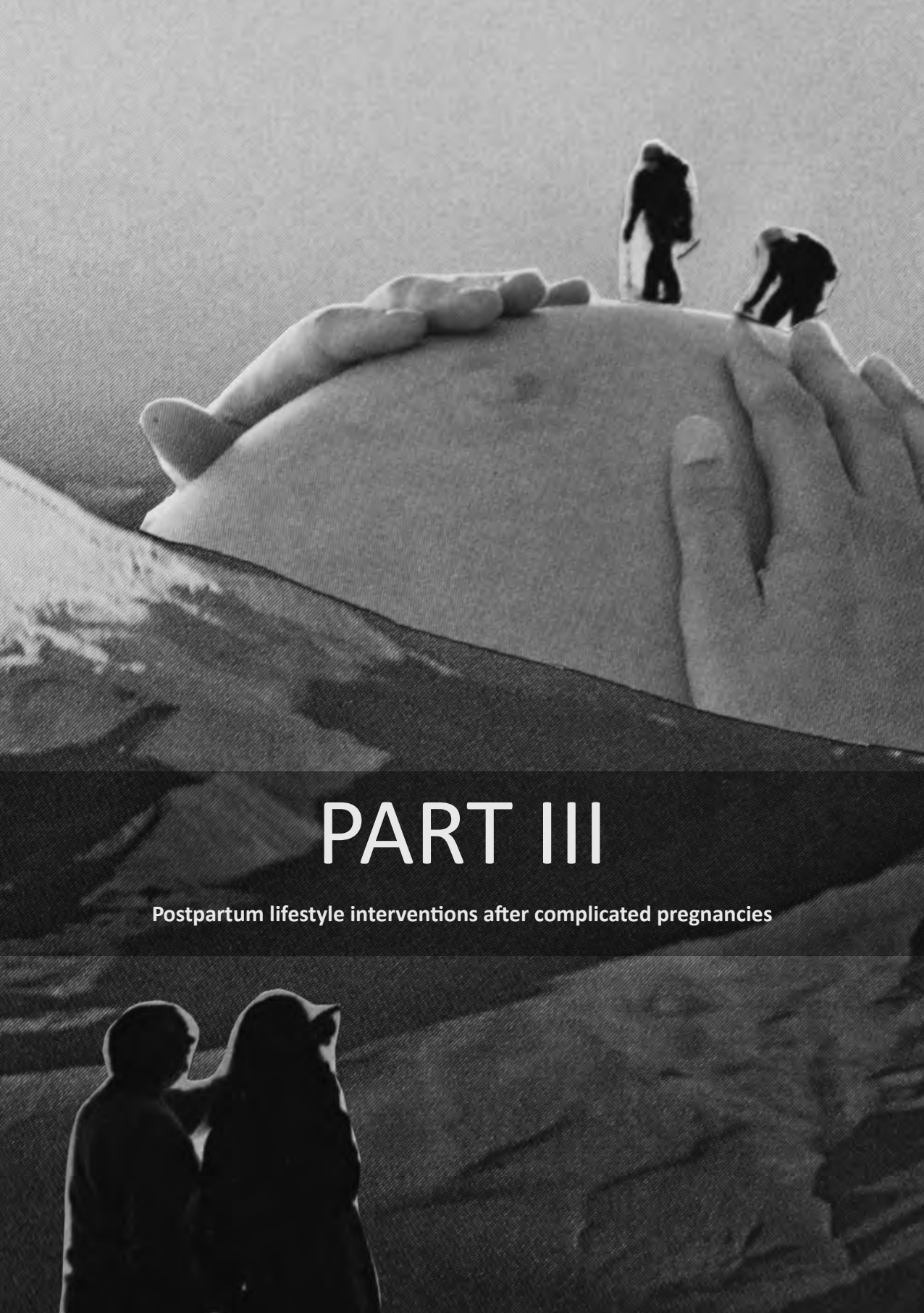
52. Osterdal ML, Strom M, Klemmensen AK, Knudsen VK, Juhl M, Halldorsson TI, et al. Does leisure time physical activity in early pregnancy protect against pre-eclampsia? Prospective cohort in Danish women. Bjog. 2009 Jan;116(1):98-107.

53. Tyldum EV, Romundstad PR, Slordahl SA. Pre-pregnancy physical activity and preeclampsia risk: a prospective population-based cohort study. Acta obstetricia et gynecologica Scandinavica. 2010 Mar;89(3):315-20.

54. Hegaard HK, Ottesen B, Hedegaard M, Petersson K, Henriksen TB, Damm P, et al. The association between leisure time physical activity in the year before pregnancy and pre-eclampsia. J Obstet Gynaecol. 2010 Jan;30(1):21-4.

55. Vollebregt KC, Wolf H, Boer K, van der Wal MF, Vrijkotte TG, Bonsel GJ. Does physical activity in leisure time early in pregnancy reduce the incidence of preeclampsia or gestational hypertension? Acta obstetricia et gynecologica Scandinavica. 2010;89(2):261-7.

56. Hoedjes M, Berks D, Vogel I, Franx A, Visser W, Duvekot JJ, et al. Effect of postpartum lifestyle interventions on weight loss, smoking cessation, and prevention of smoking relapse: a systematic review. Obstetrical & gynecological survey. 2010 Oct;65(10):631-52.



PART III

Postpartum lifestyle interventions after complicated pregnancies

CHAPTER 7

Effect of postpartum lifestyle interventions on weight loss, smoking cessation, and prevention of smoking relapse: a systematic review

Based on: M. Hoedjes, D. Berks, I.Vogel, A. Franx, W.Visser, J. J. Duvekot, J.D.F. Habbema, E.A.P. Steegers, H. Raat. Effect of postpartum lifestyle interventions on weight loss, smoking cessation, and prevention of smoking relapse: a systematic review. *Obstet Gynecol Surv. 2010 Oct;65(10):631-52. PMID: 21182803*

ABSTRACT

Postpartum lifestyle interventions are recommended for women after pregnancies complicated by preeclampsia, intrauterine growth restriction and/or gestational diabetes, since they are at increased cardiovascular risk. To identify potential intervention strategies to reduce this risk, a systematic review of the literature is presented on the effectiveness of postpartum lifestyle interventions aimed at weight loss, smoking cessation, and smoking relapse prevention. The main characteristics of these postpartum lifestyle interventions are briefly described. The PubMed, Embase, Web of Science, PsychInfo, and Cinahl databases were searched for studies on the effects of postpartum lifestyle interventions on weight loss, and smoking cessation or prevention of smoking relapse, initiated for up to 1 year postpartum. No studies on the effectiveness of postpartum lifestyle interventions after the aforementioned specific pregnancy complications were found. However, 21 studies are included that describe existing postpartum lifestyle interventions, which were applied to unselected (on the basis of pregnancy complications) postpartum women. Six of 8 weight loss interventions, 4 of 5 smoking cessation interventions, and 4 of 8 smoking relapse prevention interventions were effective. Individually tailored counseling, group counseling sessions, and use of diaries or other correspondence materials were shown to be effective. Currently, postpartum lifestyle interventions tailored specifically for women who experienced the pregnancy complications are lacking. While awaiting their development, it seems reasonable to utilize existing lifestyle interventions shown to be effective in unselected postpartum women.

INTRODUCTION

Women who have experienced preeclampsia, intrauterine growth restriction and/or gestational diabetes are at increased risk to develop cardiovascular disease later in life compared with women who did not experience these complications [1-4]. Women with such complications more often exhibit cardiovascular risk factors, including higher circulating concentrations of fasting insulin, increased blood pressure, increased lipids, increased body mass index, and increased insulin resistance [5-11]. It has been suggested that women who have experienced these pregnancy complications during pregnancy should be screened for postpartum cardiovascular risk factors, and should be offered a postpartum lifestyle intervention to reduce future cardiovascular morbidity and mortality [4,6,9]. Moreover, after a pregnancy complicated by preeclampsia, intrauterine growth restriction and/or gestational diabetes, the immediate postpartum period is considered to be a window of opportunity for preventive interventions [3]. Lifestyle interventions have been effective in ameliorating risk factors for cardiovascular disease, by promoting smoking cessation and weight loss [12,13], with substantial effects on cardiovascular risk reduction [14].

To date, however, few data are available to inform the choice of which specific lifestyle interventions for promoting a healthy postpartum lifestyle after complicated pregnancy. Considering the specific challenges that women who have experienced complications face, such lifestyle interventions would ideally be tailored to the specific needs, characteristics and preferences of these high-risk women in order to promote participation and adherence to the intervention. For example, compared with women with an uncomplicated pregnancy, women who experienced pregnancy complications more frequently experience emergency caesarean section, preterm birth, and admission to an intensive care unit. Furthermore, in the postpartum period, women who have experienced pregnancy complications more frequently report physical symptoms (e.g., headache and fatigue) [15], cognitive difficulties (e.g., problems with concentration and memory) [16], and emotional duress [17,18]. These postpartum problems can be important barriers to the adoption of a healthy lifestyle.

In order to select an effective intervention strategy, an overview of the effects of existing postpartum lifestyle interventions is needed. Therefore, we present a systematic review of the literature on the effects of postpartum lifestyle interventions targeted at weight loss, smoking cessation, and smoking relapse prevention. The characteristics of these postpartum lifestyle interventions are also briefly described.

METHODS

Literature Search

A systematic review of the literature up to May 2010 was conducted using the following computerized databases: PubMed, Embase, Web of Science, PsychInfo, and Cinahl. First, these databases were searched for literature on the effects of postpartum lifestyle interventions on weight loss, smoking cessation, and the prevention of smoking relapse, with specific regard to women who experienced preeclampsia, intrauterine growth restriction, and/or gestational diabetes.

Since no articles on the effects of lifestyle interventions after these pregnancy complications were found, a broader search, focusing on the effects of postpartum lifestyle interventions on weight loss, smoking cessation, and smoking relapse in unselected women was conducted using the following terms: puerperium or postpartum period or postpartum or post-partum and lifestyle or life style or risk reduction behavior or risk reduction behaviour or health promotion or smoking cessation or weight loss or weight reduction or smoking relapse prevention. Articles retrieved from this search were copied to a reference library (EndNote) and duplicates, if any, were deleted.

Selection Procedure

First, the titles and abstracts of the retrieved articles were screened and labeled in EndNote. Papers were excluded when they were not written in the English language, when non-human research was described, when the study was not an original research article (e.g., a review article), when the study did not deal with the postpartum period, and when the study did not describe the effect of a lifestyle intervention.

Second, the full texts of the remaining articles were examined. Additionally, a manual search of the reference lists of these articles was conducted. We included original research articles describing effects of postpartum lifestyle interventions that were initiated up to 1 year after delivery. Only articles that described the effects of postpartum lifestyle interventions for weight loss, smoking cessation, and smoking relapse prevention were included, since they address the established cardiovascular risk factors of overweight/obesity and smoking. Articles on the effects of lifestyle interventions on other outcome measures (e.g., fruit and vegetable intake or physical activity) were excluded, since our focus was on the effect of lifestyle interventions for established modifiable cardiovascular risk factors only. Furthermore, studies without a control group, studies that did not describe the effect of a behavioral lifestyle intervention (e.g., that described the effect of reduced nicotine cigarettes), and studies on the effect of lifestyle interventions initiated during pregnancy were also excluded.

Data Extraction

For the articles included in the present review, the following characteristics were recorded: first author and year of publication, country, study design, interventions, participant demographics, sample sizes, measurements, and the effects of the interventions in terms of weight loss, smoking cessation, and smoking relapse prevention. With regard to weight loss, reported outcome measures were mean weight loss or weight retention in kilograms (kg) at follow-up, mean weight loss per time unit, and percentage of women who returned to their prepregnancy weight at follow-up. With regard to smoking cessation, reported outcome measures were number of cigarettes smoked (self-reported or biochemically validated), salivary cotinine levels, self-reported and biochemically validated 7-day abstinence, 4-week point prevalence abstinence rates, quit rates, daily smoking rates, and percentages of women who reported sustained or continuous cessation. With regard to smoking relapse prevention, the following outcome measures were reported: relapse rates, percentage of nonsmokers, and percentage of women who reported sustained or continuous cessation.

All reported outcome measures in the intervention group were compared to a control group. An intervention was considered to be effective when a significant difference ($p<0.05$) was found between the intervention and control group for the outcome measure at follow-up. Study results were also interpreted in the context of the study design. A randomized controlled trial (RCT) was considered to be the preferred study design with regard to interpretation of the effectiveness of the study.

Additionally, when available, the following intervention characteristics were described: type of intervention, duration of the intervention, participant contact during the intervention (such as the number/type of contacts, e.g., face-to-face, or telephone contact), by whom the intervention was delivered, type of counselling, the materials and methods used during counseling, and (when applicable) the theoretical background of the counseling.

RESULTS

Study Selection

After removal of duplicates, the searches in PubMed, Embase, Web of Science, PsychInfo, and Cinahl resulted in a total of 2590 articles. Of these, 33 full texts were examined. The manual search provided an additional 2 full texts. From the 35 full texts screened, 21 articles were suitable for inclusion in this review (Figure 1).

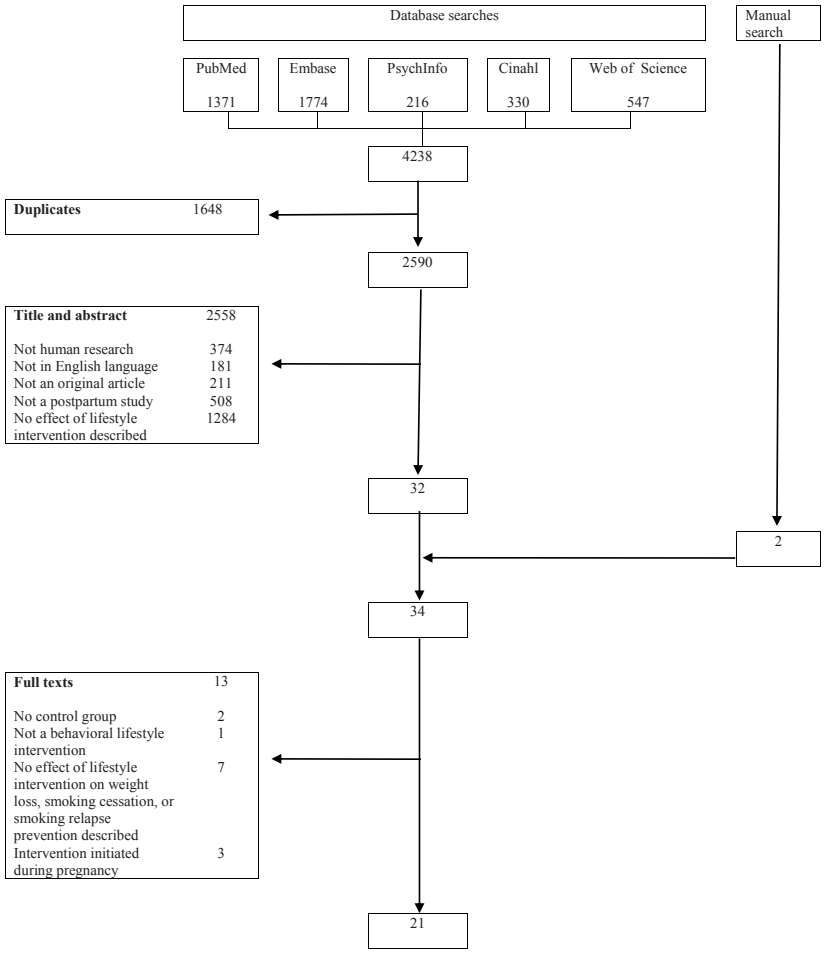


figure 1. *Diagram showing the reasons for exclusion from the review and the number of excluded articles.*

Data Extraction

Table 1 gives an overview of the effectiveness of the included intervention studies. Details on the effects and characteristics of interventions aimed at weight loss are given in Table 2, and those aimed at smoking cessation or smoking relapse prevention in Table 3.

Postpartum Lifestyle Interventions

Weight Loss

Tables 1 and 2 give an overview of 10 articles describing the effect of 8 lifestyle interventions on postpartum weight loss [19-28]. Of these interventions, 6 were diet and exercise interventions [20-22,24-26,28], of which 5 described statistically significant effects on weight loss [20-22,24,26,28]. In these latter studies, mean weight loss ranged from 1.9 kg [24] to 7.8 kg [21]. One study reported no significant effect on weight loss [25]; however, a positive relation was found between the number of visits attended and weight loss (p=0.01).

Of the 2 other studies, 1 described the effect of an exercise intervention only, which had no significant effect on weight loss [19,23], and 1 study described the effect of a diet intervention only, which did have a significant effect on weight loss [27].

Smoking Cessation and Smoking Relapse Prevention

Tables 1 and 3 give an overview of 11 articles describing the effect of 9 interventions on smoking cessation and smoking relapse prevention. One article described the effect of a postpartum smoking cessation intervention only [29]. Results of this study were contradictory. Although salivary cotinine levels indicated an effect of the smoking cessation intervention, the self-reported cessation rate indicated an opposite effect [29].

Table 1. *Summary of the effectiveness of the included intervention studies.*

First Author	Country	p-value[1]
1A *Weight loss*		
Diet intervention		
De Castro (2009) [27]	Brazil	***
Exercise intervention		
Lovelady (1995) [23] & Dewey (1994) [19]	USA	NS
Combined Diet and Exercise intervention		
McCrory (1999) [24]	USA	***
Lovelady (2000) [22] & Lovelady (2006) [28]	USA	***
Leermakers (1998) [21]	USA	*
O'Toole (2003) [26]	USA	*
Kinnunen (2007) [20]	Finland	*
Ostbye (2009) [25]	USA	NS
1B *Smoking*		
Smoking cessation		
Fossum (2004) [29]	Sweden	*[3]
Smoking relapse prevention		
Van t Hof (2000) [34]	USA	NS
Johnson (2000) [31] & Ratner (2000) [32]	Canada	*[2]
Suplee (2005) [33]	USA	NS
French (2007) [30]	USA	*
Combined smoking cessation and smoking relapse prevention interventions		
Wall (1995) [36] & Severson (1997) [37]	USA	
Smoking cessation		*[2]
Smoking relapse prevention		**[2]
Roske (2008) [38]	Germany	
Smoking cessation		*
Smoking relapse prevention		*
Hannover (2009) [37]	Germany	
Smoking cessation		*
Smoking relapse prevention		NS
Winickoff (2010) [39]	USA	
Smoking cessation		NS
Smoking relapse prevention		NS

[1] Indicates level of significance of the intervention effect *p<0.05, **p<0.01, ***p<0.001

[2] These interventions showed a significant intervention effect at 6 months postpartum. However, this effect was no longer significant at 12 months postpartum [31,32,35,36].

[3] This study reported conflicting results: while salivary cotinine levels indicated an effect of the smoking cessation intervention, the self-reported cessation rate indicated no intervention effect.

NS indicates non-significant

Five articles described the effect of 4 postpartum smoking relapse prevention interventions [30-34]. Of the 4 smoking relapse interventions, 2 showed no significant effect on smoking relapse prevention [33,34]. One smoking relapse prevention intervention was shown to be effective in preventing smoking relapse at 3 and 6 months postpartum [30]. Smoking abstinence at both 3 and 6 months postpartum was 18.2% in the intervention group compared with 5.2% in the control group. In this study, a prospective 2-group design (not an RCT) was used to evaluate intervention efficacy [30]. The other smoking relapse prevention intervention was shown to have a significant intervention effect at 6 months postpartum. Daily smoking was reported in 34% of the intervention group, compared with 48% in the control group [31,32]. However, this intervention effect was not sustained at 12 months postpartum [31,32].

Five other articles described 4 interventions aimed at both smoking cessation and smoking relapse prevention [35-39]. An intervention aimed at both smoking cessation and the prevention of smoking relapse evaluated in 2 studies was shown to be effective in promoting smoking cessation and preventing smoking relapse at 6 months postpartum ($p<0.01$) [36]. A 7-day abstinence rate was reported by 5.9% in the intervention group, compared with 2.7% in the control group; 45% of the intervention group reported smoking relapse compared with 55% of the control group. At 12 months postpartum, this effect was not sustained [35]. While 1 intervention demonstrated a significant effect on both smoking cessation and smoking relapse prevention at 6 months postpartum [38], another failed to show significant effects at 3 months postpartum on either outcome measures [39]. The fourth intervention reported a small effect on smoking cessation (sustained abstinence rate of 3% in the intervention group compared with 0% in the control group) and no effect on smoking relapse [37].

Characteristics of the Interventions

Of the 21 included articles, 14 were conducted in the United States [19,21-26,28,30,33-36,39] and the remaining 7 were conducted in Finland [20], Sweden [29], Canada [31,32], Brazil [27], and Germany [37,38]. Apart from 1 study that used a prospective 2-group design [30] and one that used a prospective cohort design [27], the studies were RCTs. The number of participants per study ranged from 33 [19,23] to 1875 [35].

Weight Loss

Of the 6 effective weight loss interventions, 5 were individually tailored [20-22,24,26,28]. The duration of these 6 effective interventions ranged from 11 days [24] to 9 months [26]. Only 1 study reported the use of a lifestyle intervention that was based on a theoretical background [20]. This latter study used the theoretical models of Laitakari and Asikainen [44], PRECEDE-PROCEED [45] and Stages of Change [46].

Participants were recruited as early as 1 day after delivery [27] and up to 12 months postpartum [21]. Of the 6 effective intervention studies, 5 had specific participant inclusion

criteria: 1 intervention included exclusively breastfeeding women [24], 2 interventions recruited breast-feeding, overweight women [22,28], 1 intervention included non-breast-feeding, overweight women [21], and another intervention included overweight women irrespective of breastfeeding [26].

Effective diet interventions consisted of a high-protein diet [27], group sessions [21,26], correspondence materials (e.g., homework assignments) [21], telephone contact [21], food diaries [21,26], and individual counselling sessions [20,28]. In some interventions, food was provided in preweighed amounts [22,24,28]. Diet interventions were delivered by a dietician [26], a public health nurse [20], or a trained graduate research assistant [28].

Effective physical activity interventions consisted of self-supervised exercise sessions [24], an aerobic exercise program [21], an individualized activity plan [26], correspondence materials [21], telephone contact [21], physical activity diaries [21,26], individual counseling sessions [20], and individualized exercise sessions [28]. Physical activity interventions were delivered by an exercise physiologist [26], a public health nurse [20], or a research assistant [28].

Smoking Cessation and Smoking Relapse Prevention

A smoking cessation and smoking relapse prevention intervention that was found effective was office-based, delivered by a pediatrician, and implemented during 4 routine 'well baby' office visits (from 2 weeks to 6 months postpartum) [35,36]. This intervention consisted of a hospital packet (containing written information about passive smoking and a letter advising women to quit), a videotape, and a brief discussion. Another effective intervention consisted of a home counseling session and 2 telephone counseling sessions, and was based on the principles of motivational interviewing and motivational stages of change [38]. A third smoking cessation and smoking relapse prevention intervention that was shown to be effective in smoking cessation, but not in preventing smoking relapse, consisted of face-to-face and telephone counseling sessions based on the principles of motivational interviewing and relapse prevention [37].

One effective smoking relapse prevention intervention consisted of 9 contacts during 3 months: one face-to face counseling session at birth followed by 8 telephone counseling sessions or home visits delivered by a nurse [31,32]. This intervention was based on Marlatt's relapse model [50]. Another effective smoking relapse prevention intervention was also delivered by a nurse, and consisted of 4 home visits or telephone contacts over 2 months [30]. This intervention was based on the principles of motivational interviewing, and the '5As' [51,52]. Motivational interviewing is a directive patient-centered counseling technique that aims to promote intrinsic motivation for behavior change [55]. The '5As' refer to asking if the women smoked, advising her to quit, assessing her willingness to quit, assisting her in quitting, and arranging a follow-up.

The smoking cessation intervention that reported conflicting results was based on a client-centered approach and aimed at increasing self-efficacy [29]. It was delivered by a child health nurse.

Table 2. *Description of postpartum lifestyle interventions and their effect on weight loss: type of study, groups and sample sizes, participants, follow-up, description of the intervention, baseline weight, and the effect of the intervention on weight loss.*

First author (year), [reference] country	Study design	Groups and sample sizes (n)	Participants	Follow-up	Intervention description	Mean baseline weight in kg (SD)	Weight loss
Diet							
De Castro (2009) [27] Brazil	Prospective cohort	High-protein (HP) diet n=261 Low-protein (LP) diet n=160	Postpartum women, recruited 1 to 3 days after delivery Mean age (SD) years: HP: 25.5 (6.0) LP: 26.7 (5.9)	Follow-up at 2, 6 and 9 months postpartum	High-protein (HP) diet: protein intake above or equal to 1.2 g per kg per day of body weight. Low-protein (LP) diet: protein intake below 1.2 g per kg per day of body weight.	HP: 59.4 (10.4) LP: 67.9 (11.6)	At **6 months** postpartum, women with an HP diet lost more body weight than women with an LP diet 1.69(3.7) vs. 0.77(4.3) kg, **p= 0.08**. Mean difference in body weight loss form baseline to **9 months** postpartum between the HP and LP groups was 0.84 kg **(p= 0.17)**. Women with an HP diet lost more (324 (0.06 grams)) **per month** than women with an LP diet **(p<0.0001)**.
Exercise							
Lovelady (1995)[23] USA & Dewey (1994)[19] USA	RCT	Intervention (I): Regular supervised exercise, n=18 Control (C): Exercise restricted to once a week, n=15	Exclusively breast-feeding women, recruited 6-8 weeks postpartum Mean age in years: I: 31.1 C: 29.7	Follow-up at 12-14 wks postpartum & at 18-20 wks postpartum	Regular supervised aerobic exercise (at a level of 60-70% of the heart-rate reserve) for 45 min per day, 5 days per week for 12 weeks. Individually tailored exercise sessions. The program began with 20-min sessions, with 5-min increments every 3 days until the woman could complete 45 min of continuous exercise at the target heart rate.	I: 67.3 C: 67.0	At **12-14 wks** postpartum, women in the intervention group lost 0.60 kg, while women in the control group lost 1.00 kg. At **18-20 wks** postpartum both women in the intervention group and women in the control group had lost 1.60 kg. Differences between the intervention group and the control group at both time points were not significant **(NS)**.

pp=postpartum
BMI= Body Mass Index
I=intervention group
C=control group
SD=Standard Deviation
NS=not significant
RCT=randomized controlled trial
min=minutes

Table 2 continued.

First author (year), [reference] country	Study design	Groups and sample sizes (n)	Participants	Follow-up	Intervention description	Mean baseline weight in kg (SD)	Weight loss
Diet & Exercise							
McCrory (1999)[24] USA	RCT	Diet intervention (D): n=22 Diet & exercise intervention (D +E): n=22 Control (C): n= 23	Exclusively breast-feeding women, recruited at 12 (4) weeks postpartum Mean age (SD): 32 (5)	Follow-up at 12 (4) weeks postpartum + 11 days	Diet intervention: aimed a 35% energy deficit. Diets were individually tailored and food was provided in preweighed amounts. Diet plus exercise intervention: aimed a 35% net energy deficit, 60% by dietary restriction and 40% by additional exercise. Exercise was prescribed in terms of a target heart rate range (50-70% of maximal heart rate) and total time. Exercise sessions were self-supervised. Energy expended in exercise (based on heart rate monitoring) was checked every 1-3 days during the intervention period, and the prescription was adjusted as necessary. Control group: asked to maintain their weight during the intervention by maintaining their usual diet and activity patterns.	D: 68.3 (10.2) D+E: 69.0 (12.8) C: 68.5 (8.5)	Women in the diet group had lost 1.9 kg, and women in the diet and exercise group lost 1.6 kg at follow-up, while women in the control group lost 0.2 kg **(P < 0.0001).**
Lovelady (2000)[22] USA	RCT	Intervention (I): diet & exercise n=21 Control (c): no intervention n=19	Breast-feeding women, overweight (BMI 25-30) recruited at 4 wks postpartum. Mean age (SD) years: I: 31 (4) C: 33 (4)	Follow-up at 14 weeks postpartum	Diet: 500 kcal fewer than daily energy requirements. Diet prescription: 25% of energy from fat, 20% from protein, and 55% from carbohydrate, with no diet less than 1,800 kcal (7,531 kJ) total per day. Trained graduate research assistants used the Food Guide Pyramid [40] to meet dietary recommendations. Food models were used to demonstrate portion sizes. Cognitive and behavioral strategies were discussed at individual weekly sessions. Six low-fat, low-calorie frozen dinners were provided each week. Exercise: brisk walking, jogging, or aerobic dancing at 65-80% of maximum heart rate 4 times per week during 10 weeks. Initial exercise session: 15 min. The following sessions: increased by 2 min per day until women were exercising within their target heart rate range for 45 min. Control: control group was instructed not to change their dietary intake or physical activity during the study.	I: 75.9 (9.3) C: 76.8 (7.8)	Women in the intervention group (4.8 (1.7) kg) lost significantly more weight than women in the control group (0.8 (2.3) kg). **(p<0.001)**

Lovelady (2006) [28] USA	RCT	Intervention (I): diet & exercise n=19 Control (c): no intervention n=16	Breast-feeding women, overweight (BMI 25-30) recruited at 4 wks postpartum.	Follow-up at 14 weeks postpartum	Same intervention as Lovelady et al. (2000)	I: 75.9 (9.8) C: 77.2 (8.3)	Women in the diet and exercise group (4.8 (1.6) kg) lost significantly more weight than women in the control group (0.8 (1.8) kg **(p<0.001)).**
Leermakers (1998)[21] USA	RCT	Intervention (I): Behavioral weight loss intervention, n= 47 Control group (C): no treatment, n=43	3-12 months postpartum non-lactating women, exceeded pre-pregnancy weight by at least 6.8 kg; BMI>=22 Mean age (SD) years: I: 32.4 (4.5) Range: 24- 43 C: 30.3 (5.6) Range: 18- 40	Follow-up directly after end of intervention	Behavioural weight loss intervention. Duration: 6 months Diet: consisting of 1000-1500 kcal/d, with fat restricted to 20% of caloric intake. Physical activity: Aerobic exercise program: gradually increasing the frequency and duration of walking, until 2 miles per day on at least 5 days per week was reached. Consistent with guidelines for all adults, American College of Sports Medicine (ACSM)[41]. Included three components: 1. Two group sessions (at beginning & at 2 months) Discussion of eating and exercise progress and problem solving. 2. Correspondence materials. Consisted of 16 written lessons about nutrition, exercise, and behavior change strategies. These lessons were sent weekly for the first 12 weeks, biweekly for the next four weeks, and monthly for the last 8 weeks. Women were asked to monitor their calorie and fat intake and their exercise on a daily basis throughout the 6-month program and return their record by mail. Behavioral lessons, which focused on strategies to modify diet and exercise behaviors, were tailored to the special needs of new mothers. Each lesson included a 1-2 page homework assignment, which was to be completed and returned with the self-monitoring diaries. 3. Brief telephone contacts. (5-15 min), weekly or biweekly, depending on participants desires and needs. The discussions focused on eating and exercise progress, goal setting and problem solving.	I: 78.7 (11.2) C: 82.9 (15.2)	Weight loss among women in the intervention group (7.8 kg), differed significantly from weight loss in the control group (4.9 kg) at follow-up **(p=0.03)**. Significantly more women in the intervention group (33%) returned to their pre-pregnancy weight at follow-up, than women in the control group (11.5%), **p<0.05**.

pp=postpartum
BMI= Body Mass Index
I=intervention group
C=control group
SD=Standard Deviation
NS=not significant
RCT=randomized controlled trial
min=minutes

Table 2 continued.

First author (year), [reference] country	Study design	Groups and sample sizes (n)	Participants	Follow-up	Intervention description	Mean baseline weight in kg (SD)	Weight loss
O'Toole (2003)[26] USA	RCT	Intervention (I): Structured diet & physical activity intervention Control (C): Self-directed diet & physical activity intervention (n=40)	6 wks-6 months postpartum overweight women Mean age (SD) years: I: 30.8 (4.2) C: 32.2 (4.9) Mean time since delivery (weeks) (SD): I: 12 (5) C: 14 (4)	Follow-up at 1 year postpartum	Individualised structured diet and physical activity intervention delivered by a dietician and an exercise physiologist. Duration: 9 months. Consisted of: individualised diet (deficit of at least 350 kcal/d) and physical activity prescriptions (individualised activity plan to increase energy expenditure from physical activity by at least 150 kcal a day) derived from baseline measurements, kept daily food and activity diaries, and met for group educational sessions dealing with nutrition and physical activity strategies. Group sessions: weekly for the first 12 weeks, biweekly for the following 2 months and monthly thereafter up to 1 year postpartum. Self-directed intervention: met individually with a dietician and exercise physiologist for a single 1-hour educational session about diet and physical activity. Received copies of the American Dietetic Association brochure, Nutrition & health for women[42], and the food pyramid[40]. Also received copies of the ACOG brochure, Exercise and fitness: A guide for women[43].	I: 78.6 (1.6) C: 85.4 (3.5)	After **12 weeks** of intervention, women in the intervention group had lost 5.6 kg, and women in the control group had lost 0.6 kg **(p<0.05).** At **1 year postpartum**, women in the intervention group had lost 7.3 kg, while women in the control group had lost 1.3 kg **(p<0.05)**.
Kinnunen (2007)[20] Finland	RCT	Intervention (I): individual diet and physical activity intervention (n= 53) Control (C): usual care (n=39)	Primiparas; recruited through public child health clinics at 2 months postpartum Mean age (SD) years: I: 29.5 (3.9) C: 28.3 (4.4)	Follow-up at 10 months postpartum	Individual counseling on diet and physical activity delivered by a public health nurse (PHN). Duration 8 months. Five visits; at 2, 3, 5, 6 and 10 months. Counseling was based on the theoretical models of Laitakari and Asikainen[44] , PRECEDE-PROCEED [45] and Stages of Change [46]. Individual physical activity counseling consisted of one primary counseling session (allocated time 20-30 min) at the 2-month visit and four booster sessions (allocated time 10-15 min) at the 3, 5, 6 and 10-month visits. An individual weekly physical activity plan was composed, adherence to this plan was assessed, and the plan was revised, if needed. Also: option to attend supervised group exercise sessions, developed specifically for postpartum women, held once a week for 45-60 min.	I: 67.1 (11.1) C: 64.7 (7.8) Weight retention (kg): I: 4.3 (4.0) C: 4.2 (3.9)	Of the women in the intervention group, 50% (n= 23) returned to their pre-pregnancy weight at follow-up (weight retention ≤ 0 kg), while 30% (n=11) of the women in the control group did **(p = 0.06).** (OR: 3.89 (95% CI 1.16–13.04, **p = 0.028**) Mean weight retention in the intervention group (1.8 (4.3) kg) was not significantly different from weight retention in the control group (1.0 (4.4) kg). **(NS)**

					The dietary counseling consisted of one primary counseling session (allocated time 20-30 min) at the 3-month visit and three booster sessions (allocated time 10 min, in addition to the physical activity boosters) at the 5, 6 and 10-month visits. After comparing the personal habits to the recommendations, the PHN and the participant discussed the participant's need for dietary changes, as well as her opportunities for and barriers to making the changes. Also received two take home leaflets on healthy diet. Weekly record of compliance with the individual objectives was kept.		
Ostbye (2009)[25] USA	RCT	Intervention group (I) n=225 Control group (c) n=225	Overweight or obese women BMI ≥25. Recruited at 6 weeks postpartum. Mean age (SD) years: I: 30.6 (5.8) C: 31.2 (5.3)	Follow-up at 1-month post-intervention (at 12 months postpartum)	Duration: 9 months. Diet: Eight healthy-eating classes (Mom's Time Out [MTO] classes) to reduce total caloric intake, increase in fruit and vegetable consumption. In the MTO classes, women were taught practical skills shown to facilitate weight loss, including making choices that decrease consumption of high-fat, high-sugar foods and beverages; learning appropriate portion sizes; cooking easy, low-fat meals; making appropriate choices at fast-food restaurants; and avoiding overeating in stressful situations. Participants were provided with a study notebook with exercises and recipes. Ten physical activity (ACTIVMOMS) classes: increasing physical activity to the recommended 30 min a day, 5 times a week. Counseling sessions by a trained counselor: every 6 weeks, lasting 20 min each, delivered primarily over the phone, but occasionally in person. Consistent with motivational interviewing, the counselor utilized reflective listening techniques, self-motivational statements, and change talk to elicit participants' personal behavioral goals and troubleshoot barriers to achieving them. Participants received a pedometer, and a sport stroller. Control: biweekly newsletters with general tips for postpartum mothers.	I: 88.7 (18.8) C: 88.4 (18.5)	Mean weight at follow-up in intervention group was 87.8 (20.7) kg, and in the control group 88.1 (20.2) kg. Mean weight loss was 0.90 kg (SD5.1 kg) in the intervention group and 0.36 kg (SD4.9 kg) in the control group; this difference was not significant **(NS).** There was a positive relationship between classes attended and weight loss (**p=0.01**). There were no significant differences between the two groups in other measures of weight change, including return to pre-pregnancy weight, and percent weight loss **(NS)**.

pp=postpartum
BMI= Body Mass Index
I=intervention group
C=control group
SD=Standard Deviation
NS=not significant
RCT=randomized controlled trial
min=minutes

Table 3. *Description of postpartum lifestyle interventions and their effect on smoking cessation and smoking relapse: type of study, groups and sample sizes, participants, follow-up, description of the intervention, baseline values, and the effect of the intervention on smoking cessation and smoking relapse prevention.*

First author (year), [reference] country	Study design	Groups and sample size (n)	Follow-up	Participants	Intervention description	Baseline values	Findings
Smoking cessation							
Fossum (2004)[29] Sweden	RCT	Intervention (I): ''Smoke-free children'' counseling, n=26 Control (c): Usual care, n=15	Follow-up at 3 months postpartum	Smoking mothers, recruited 0-4 weeks after delivery at child health center.	Counseling method ''Smoke-free children'' developed by Swedish child health centers [47]. Based upon a client-centered approach. Based on the principles developed by Greenberg et al. [48]. Delivered by a Child health nurse (CHN). Contacts at Child health centers (CHC). Aimed at increasing self-efficacy. Five key elements: (1) asking what the mothers themselves know about the effects of smoking on children, (2) suggesting to the mothers that they register how much tobacco smoke there is in the child's proximity, (3) discussing the results of the mothers' survey and asking what they think about present smoking habits and whether they have suggestions about possible changes, (4) supporting any attempts they might carry out to change smoking habits and discussing problems that may emerge, and (5) supporting women who have stopped smoking during pregnancy to continue to refrain from smoking.	Self-reported number of cigarettes: I: 13.1 (6.5) C: 10.8 (5.7) Biochemicaly validated number of cigarettes: I: 12.7 (6.6), n=22 C: 8.4 (3.9), n=8 Mean cotinine level: I: 185 ng/mL C: 245 ng/mL	In the intervention group, the number of self-reported cigarettes smoked was reduced with 0.3 at follow-up, compared to 2.6 in the control group **(p<.05)**. Mothers reported more smoking in the intervention group than in the control group. When biochemically validated, the number of cigarettes smoked in the intervention group increased with 0.2, while the number of cigarettes smoked in the control group decreased with 1.3 cigarettes. However, salivary cotinine levels indicated a decrease of 20 ng/mL cotinine in the intervention group, and an increase of 101 ng/mL cotinine in the control group **(p= 0.027)**. Weak correlations between self-reported smoking and cotinine-levels were found.

Smoking cessation & smoking relapse interventions							
Wall (1995) [36] USA	RCT MOMS-study (Modification of Maternal Smoking)	Intervention (I): extended intervention, smokers: n=842 quitters: n=514 Control (C): Minimal intervention, smokers: n=636 quitters: n=344	Follow-up at 6 months postpartum	Enrolment at 10-14 days pp. Smoking 1 month prior to becoming pregnant.	Pediatric office-based brief smoking intervention, delivered by a pediatrician. Duration 6 months. Implemented during usual 'well baby' office visits: at 2 weeks, 2, 4, and 6 months postpartum. Duration counselling 1-2 min. Hospital packet containing written information about passive smoking and a letter advising them to quit + oral and written advice. Content of advice: adverse health effects of passive smoking, hints for quit strategies, role modelling, and a letter to the fathers. Videotape: potential health effects of passive smoking, benefits of quitting. Brief discussion about amount smoked, barriers to quitting, and results of past quit attempts. Smokers were asked whether they were willing to set a quit date. If mothers expressed a willingness to set a quit date, they were given the Freedom From Smoking materials developed by the American Lung Association and a list of local resources for assistance in quitting. They were encouraged to follow through and a project quit kit was distributed. Quitters were encouraged to stay quit.	Smokers: n=1478 Quitters: n=858	Smokers At 6 months postpartum, 5.9% of the women in the intervention group reported a 7-day abstinence compared to 2.7% of the women in the control group (p<.01). OR: 1.82, 95% CI (1.02-3.25) **p<.05.** Quitters At 6 months postpartum, 45% of the intervention group reported smoking relapse, compared to 55% in the control group OR: 1.56, 95% CI (1.16-2.10) **p<.01.**

pp=postpartum
I=intervention group
C=control group
SD=Standard Deviation
NS=not significant
RCT=randomized controlled trial

Table 3 continued.

First author (year), [reference] country	Study design	Groups and sample size (n)	Follow-up	Participants	Intervention description	Baseline values	Findings
Severson (1997)[35] USA	RCT MOMS-study (Modification of Maternal Smoking)	Smokers: I: n=1073 C: n=802 Quitters: I: n=609 C: n=417	Follow-up at 12 months postpartum	Enrolment at 10-14 days pp. Smoking one month prior to becoming pregnant.	Same intervention as Wall et al.., 1995.	Smokers: n=1875 Quitters: n=1026	Smokers At 12 months postpartum, 5.5% of the women in the smokers in the intervention group reported to have quit smoking, compared to 4.7% in the control group **(NS)**. Continuous quit at both 6 and 12 months postpartum was 2.3%of the smokers in the intervention group, and 1.2% of the smokers in the control group (**p<.05**). However, no intervention effect was found on sustained quitting (OR 1.78, 95% CI 0.84, 3.74). Quitters At 12 months postpartum, 42.9% of the quitters in the intervention group reported to have still quitted, compared to 39.1% of the quitters in the control group **(NS)**. Continuous quit at both 6 and 12 moths among quitters was 32.8% in the intervention group, and 26.1% in the control group (**p<.05**). No intervention effect was found on sustained quitting (OR 1.25, 95% CI 0.93, 1.68). The effect of the intervention at 6 months postpartum was reduced at 12 months postpartum.

Roske (2008) [38] Germany	RCT	I: postpartum smoking cessation and relapse prevention intervention n=239 C: control n=272	Follow-up at 4 weeks, 6 and 12 months postpartum	Postpartum women who had smoked before pregnancy. Recruited at the time of giving birth. Mean age (SD) years: I: 26.7 (2.7) C: 26.0 (5.4)	Intervention group: home counseling session 4-6 weeks after giving birth and 2 telephone counseling sessions 4 and 12 weeks later. The counseling was conducted by four trained study co-workers. It was based on the principles of Motivational Interviewing [49] and tailored to the motivational stage of change. Both the intervention and control condition received: a self-help manual addressing maternal smoking, smoking cessation, and relapse prevention; and a manual addressing the partner of the participating women.	Non-smokers: I: n=134 (56.1%) C: n=145 (53.3%)	Women in the intervention group were significantly more likely to be non-smokers six months after the intervention **(p<0.05).** Membership in the intervention group significantly predicted non-smoking at six months, but not 1 year postpartum, after controlling for demographic, smoking, and postpartum risk variables.
Hannover (2009) [37] Germany	RCT	Intervention (I): smoking cessation & smoking relapse intervention. n=299 Control (C): usual care n=345	Follow-up at 6, 12, 18, and 24 months postpartum	Postpartum women who smoked prior to or in pregnancy, and who had quit no longer than 4 weeks prior to pregnancy. Recruited directly after birth in maternity wards. Mean age (SD) years: I: 26.2 (5.7) C: (26.0 (5.4)	Intervention: face-to-face counseling 40 days postpartum plus telephone counseling calls 4 and 12 weeks later. Motivational Interviewing (MI) [49] and relapse prevention [50] served as principles for the intervention. Counseling incorporated: information on the health effects of smoking and environmental tobacco smoke, balancing of the pros and cons of smoking, self-efficacy for behavior change, reflecting previous, observed, or imagined behaviour changes, exploring high-risk situations and relapse prevention strategies, and the abstinence violation effect. Control: usual care plus self-help material for each parent.	Median=35 days after delivery Smokers: I: n=151 (51%) C: n=187 (54%) Mean number of cigarettes per day (SD): I: 11.6 (6.9) C: 11.8 (7.5)	With regard to smoking cessation, 4 week point prevalence abstinent rates were higher in the treatment group at 6, 12, and 18 months (7% vs. 1%, 7% vs. 2%, and 9% vs. 1%, respectively). **p<0.05** Sustained abstinence was higher in the treatment group at 6 months follow-up (3% vs. 0%). **p<0.05** Small effect with regard to smoking cessation. No effect with regard to relapse prevention.

pp=postpartum
I=intervention group
C=control group
SD=Standard Deviation
NS=not significant
RCT=randomized controlled trial

Table 3 continued.

First author (year), [reference] country	Study design	Groups and sample size (n)	Follow-up	Participants	Intervention description	Baseline values	Findings
Winickoff (2010) [39] USA	RCT	Intervention (I): n=48 (32 women) Control (C): usual care n=53 (35 women)	Follow-up at 3 months	Parents (both fathers and mothers) who were current smokers (1 cigarette, even a puff, in past 30 days) or recent quitters (smoked since 1 month before conception). Recruited directly after birth. Median age (years): I: 28 C: 30	Intervention: one 15-min in-person counseling session delivered by trained study staff working from adapted materials and messages specifically tailored for parental smokers (www.ceasetobacco.org); offer of enrolment in a proactive state-of-the-art telephone counseling intervention (QuitWorks, the Massachusetts statewide quitline); and letters faxed to the newborn's pediatrician, parents' primary care provider, and mother's obstetrician indicating the parent's tobacco use status and readiness to quit and recommending useful strategies to facilitate parental cessation, the need for ongoing support, and medication prescription when appropriate. The overall strategy was based on the 5A model [50,53] and tailored to the circumstances of the parental smoker in the hospital setting when their child is hospitalized.	Smokers: I: 69% (63% female) C: 62% (54% female) Median number of cigarettes per day: I: 4.4 C: 5.0	At 3 months post-partum self-reported 7-day point abstinence decreased from 31-25% among intervention parents versus 38-23% among control subjects (effect size 9.4%; **NS**). Among current smokers at baseline who were reached at follow-up (n=36), self-reported cotinine-confirmed 7-day abstinence rates at follow-up were 9% in the intervention group and 3% in the control group **(NS)**. Among mothers who were smokers at baseline, 10% in the intervention group and 5% in the control group self-reported 7-day abstinence at the 3-month follow-up **(NS)**.

Smoking relapse interventions							
Van t Hof (2000)[34] USA	RCT	Intervention (I): relapse prevention intervention n=141 Control (C): usual care n=146	Follow-up at 6 months postpartum	Smoking during the 30 days before pregnancy, and quit during pregnancy.	Counseling delivered by VNA (Visiting Nurse Association) nurse and the pediatric provider: during the hospital stay (15-30 min), during the period soon after delivery (2 wk) and at 2 'well-baby' visits (2 months and 4 months). The VNA nurse delivered counseling during the first visit; the pediatric provider delivered counseling during the other 3 visits. Duration 4 months. Counseling about reasons for maintaining cessation and help in developing a plan for doing so. Reinforcement if they quit and if not, given encouragement and a plan to try to quit again.	287 quitters	41% of the women in the intervention group relapsed to smoking (any smoking during the last 7 days), compared to 37% of the women in the control group **(NS)**. (Biochemically validated with cotinine)
Johnson (2000)[31] Canada	RCT	Intervention (I): brief in-hospital intervention Control (C): Usual care n=254	Follow-up at 3 and at 6 months postpartum	Recruited while admitted to hospital for delivery. Stopped smoking at least 6 weeks before delivery. Age: 15-40 years.	Face-to-face, in-hospital counseling sessions at birth, followed by 8 telephone follow-up sessions, home-visits, or face-to face visits outside the home during the first 3 months postpartum. Delivered by a nurse. Sessions were weekly during the first month postpartum and biweekly during the second and third months. Counselling based on principles derived from Marlatt's relapse model [50,53]. Aim counselling: teaching women to identify high-risk situations for smoking relapse and determining strategies to manage those situations, thereby strengthening their smoking cessation self-efficacy. The nurse supported efforts to maintain smoking abstinence, reviewed high-risk situations encountered and reviewed the lessons learned from any lapses. Supplemented with written materials.	All women had stopped smoking during pregnancy. 100% abstinence.	Continuous abstinence rate at 3 and 6 months postpartum was 38% in the intervention group, compared to 27% in the control group **(NS)**. OR = 1.63, 95% CI:0.96 - 2.78). At 6 months postpartum, daily smoking was reported in 34% of the intervention group, compared with 48% of the control group. **p = 0.03** OR = 1.80, 95% CI = 1.08 - 2.99. (Validated with CO in expired air.)

pp=postpartum
I=intervention group
C=control group
SD=Standard Deviation
NS=not significant
RCT=randomized controlled trial

Table 3 continued.

First author (year), [reference] country	Study design	Groups and sample size (n)	Follow-up	Participants	Intervention description	Baseline values	Findings
Ratner (2000)[32] Canada		n=251	Follow-up at 12 months postpartum				At 12 months, daily smoking was 41.2% in the intervention group, and 50.4% in the control group **(NS)**. OR: 1.45, 95% CI: 0.87-2.43 Continuous abstinence rate at 6 and 12 months was 21% in the intervention group, and 18.5% in the control group. OR: 1.17 95% CI: 0.62-2.22 **(NS)** Significant intervention effect at 6 months was not sustained at 12 months postpartum.
French (2007)[30] USA	Pro-spective 2-group design	Interven-tion (I): brief inter-vention, n=122 Control (C): routine care, n=97	Follow-up at 3 and 6 months post- enrolment.	Women who had quit smoking during their pregnancy, and at least 7 days before delivery. Recruited during postpartum hospitalisa-tion.	Home visiting program during postpartum hospitalisation (5 min), home visit at 1 week postpartum (15 min), and two follow-up phone calls or home visits (15 min). Deliv-ered by a nurse. Duration 2 months. Based on the principles of motivational interview-ing [49]. Use of the US public Health Service clinical practice guideline: 5A's [51,52]. Use of the 5A's of *asking* if the women smoked, *advising* her to quit, *assessing* her willing-ness to quit, *assisting* her in quitting and *ar-ranging* a follow-up: Topics included: relapse prevention, stress management, skills build-ing, trigger avoidance, relapse rehearsal, postpartum depression. 4-part intervention: -postpartum hospitalisation: brief interven-tion (congratulations and encouragement) -home visit at 1 week postpartum: (smok-ers: 5A's, non-smokers: encouragement and further problem solving) -Two follow-up phone calls or home visits (same status-dependent content).	All women had quit smoking during preg-nancy: 100% abstinence.	Smoking abstinence at 3 months was 26.4% in the intervention group, compared to 12.4% in the control group (OR= 2.4, 95% CI= 1.16-4.98). Smoking abstinence at 6 months was 21.5% in the intervention group, and 10.2% in the control group (OR= 2.5, 95% CI= 1.13-5.71). Smoking abstinence at both 3& 6 months was 18.2% in the inter-vention, and 5.2% in the control group (OR= 2.4, 95%, CI= 1.16-4.93). Biochemically verified (salivary cotinine level < 14 ng/ml).

Suplee (2005)[33] USA	RCT	Intervention (I): Counseling intervention Control (C): No intervention n=62	Follow-up 4-8 weeks postpartum	Enrolment during pregnancy. Smoking cessation during pregnancy. Mean age (years): 22.6 Range: 14-45	One brief (10-20-min) counseling session provided during the immediate postpartum hospitalization in the participant's hospital room, delivered by a researcher. Using empowerment techniques, motivational interviewing [49], identification of stressors and individual coping strategies, and educational materials. Personal Rulers Worksheet [54] Marlatt and Gordon's [50,53] relapse prevention model. The participant received 4 different educational brochures developed by the American Lung Association and Agency for Health Care Policy and Research.	All non-smoking.	Relapse rate in the intervention group was 63%, compared with 75% in the control group **(NS).** Quit rate in the intervention group was 37%, compared with 25% in the control group **(NS).**

pp=postpartum
I=intervention group
C=control group
SD=Standard Deviation
NS=not significant
RCT=randomized controlled trial

DISCUSSION

This extensive literature search identified existing postpartum lifestyle interventions that were shown to be effective in lowering cardiovascular risk factors in general populations of postpartum women. Although the immediate postpartum period after a pregnancy complicated with preeclampsia, intrauterine growth restriction and/or gestational diabetes is considered to be a window of opportunity for preventive interventions shortly after delivery [3], no studies were identified which have specifically examined the effects of postpartum lifestyle interventions among women with such complications. Whether the interventions aimed at general populations of postpartum women identified in our present study will also be effective in women who have experienced complicated pregnancies should be the subject of further research. Awaiting the results of such future studies, utilization of lifestyle interventions that have been shown to be effective in postpartum women in general should be considered for use in women who have experienced complicated pregnancies.

Specifically, the current review suggests that individually tailored postpartum weight loss interventions with both a diet and an exercise component might be used, since 5 out of the 6 interventions included in this review were effective. Group sessions, correspondence materials, telephone contact, food diaries, or individual counseling sessions may be effective in improving postpartum diet. Self-supervised exercise sessions, an aerobic exercise program, an individualized activity plan, correspondence materials, telephone contact, activity diaries, and counseling sessions could be used to promote postpartum physical activity. Home visits, face-to-face counseling, and telephone counseling, might be used to promote postpartum smoking cessation and prevent smoking relapse.

Furthermore, the results of this literature study suggest that a theoretical background can be used to develop postpartum lifestyle interventions. For example, the theoretical models of Laitakari and Asikainen [44], PRECEDE-PROCEED [45] and Stages of Change [46] might be used in the development of weight loss interventions. Smoking cessation and smoking relapse prevention interventions could be based on the principles of motivational interviewing [49], the '5As' [51,52], and Marlatt's relapse model [50,53]. However, a theoretical framework that takes into account the context of the lives of women after pregnancies complicated by preeclampsia, intrauterine growth restriction, and/or gestational diabetes may more specifically contribute to the development of effective interventions to reduce cardiovascular risk in these women [56]. To our knowledge, such a theoretical framework has not yet been described.

Besides the interventions identified in this study, the results of other research, such as research on lifestyle and related factors among women with a recent pregnancy complicated by gestational diabetes, could also provide useful information to be taken into account when developing effective interventions for women who experienced a complicated pregnancy [56-60]. For example, lack of time and childcare duties have been identified as barriers to physical

activity, suggesting that interventions should preferably be delivered at variable hours and should entail minimal travel time. Also, involvement of family (e.g., to provide child care) is suggested to enhance participation.

To our knowledge, only 1 study has explored the needs, ideas and opinions of women who have experienced preeclampsia, intrauterine growth restriction, and/or gestational diabetes as they relate to postpartum lifestyle counseling [61]. This study showed that these women do perceive a need for postpartum lifestyle counseling and prefer to receive a combination of face-to-face personal counseling, supported by computer-tailored lifestyle advice offered on the internet [61].

Methodological Considerations/Limitations

Although the most relevant articles on the effectiveness of postpartum lifestyle interventions are probably in the English language, relevant non-English literature might have been missed for inclusion in the present review. Additionally, although studies reporting nonsignificant results were retrieved in the literature search, due to publication bias ineffective interventions might have been underreported. Another limitation is that we did not assess the quality of the included studies. However, all included studies incorporated a control group in their design, and most of them were RCTs. Since the participants of the included studies were diverse (e.g., they differed with regard to breastfeeding and baseline weight) and the interventions used were mostly unique across the included studies, we could not estimate overall mean effects in a meta-analysis.

CONCLUSION

In conclusion, existing postpartum lifestyle interventions might be used to achieve weight loss, smoking cessation, or to prevent smoking relapse in women who have experienced preeclampsia, intrauterine growth restriction, and/or gestational diabetes. Ideally, lifestyle interventions tailored for these high-risk women will be developed and tested. The interventions identified in this study could provide a solid starting point for the development of such tailored interventions. Future research should also focus on the long-term effectiveness of such interventions.

REFERENCES

1. Bellamy L, Casas JP, Hingorani AD, Williams DJ. Pre-eclampsia and risk of cardiovascular disease and cancer in later life: systematic review and meta-analysis. Bmj. 2007 Nov 10;335(7627):974.
2. Ray JG, Vermeulen MJ, Schull MJ, Redelmeier DA. Cardiovascular health after maternal placental syndromes (CHAMPS): population-based retrospective cohort study. Lancet. 2005 Nov 19;366(9499):1797-803.
3. Sattar N, Greer IA. Pregnancy complications and maternal cardiovascular risk: opportunities for intervention and screening? Bmj. 2002 Jul 20;325(7356):157-60.
4. Smith GC, Pell JP, Walsh D. Pregnancy complications and maternal risk of ischaemic heart disease: a retrospective cohort study of 129,290 births. Lancet. 2001 Jun 23;357(9273):2002-6.
5. Chambers JC, Fusi L, Malik IS, Haskard DO, De Swiet M, Kooner JS. Association of maternal endothelial dysfunction with preeclampsia. Jama. 2001 Mar 28;285(12):1607-12.
6. Forest JC, Girouard J, Masse J, Moutquin JM, Kharfi A, Ness RB, et al. Early occurrence of metabolic syndrome after hypertension in pregnancy. Obstet Gynecol. 2005 Jun;105(6):1373-80.
7. He S, Silveira A, Hamsten A, Blomback M, Bremme K. Haemostatic, endothelial and lipoprotein parameters and blood pressure levels in women with a history of preeclampsia. Thromb Haemost. 1999 Apr;81(4):538-42.
8. Hu J, Norman M, Wallensteen M, Gennser G. Increased large arterial stiffness and impaired acetylcholine induced skin vasodilatation in women with previous gestational diabetes mellitus. Br J Obstet Gynaecol. 1998 Dec;105(12):1279-87.
9. Manten GT, Sikkema MJ, Voorbij HA, Visser GH, Bruinse HW, Franx A. Risk factors for cardiovascular disease in women with a history of pregnancy complicated by preeclampsia or intrauterine growth restriction. Hypertens Pregnancy. 2007;26(1):39-50.
10. Meyers-Seifer CH, Vohr BR. Lipid levels in former gestational diabetic mothers. Diabetes Care. 1996 Dec;19(12):1351-6.
11. Smith GN, Walker MC, Liu A, Wen SW, Swansburg M, Ramshaw H, et al. A history of preeclampsia identifies women who have underlying cardiovascular risk factors. Am J Obstet Gynecol. 2009 Jan;200(1):58 e1-8.
12. Mozaffarian D, Wilson PW, Kannel WB. Beyond established and novel risk factors: lifestyle risk factors for cardiovascular disease. Circulation. 2008 Jun 10;117(23):3031-8.
13. Shaw K, Gennat H, O'Rourke P, Del Mar C. Exercise for overweight or obesity. Cochrane Database Syst Rev. 2006(4):CD003817.
14. Mozaffarian D. Promise of improving metabolic and lifestyle risk in practice. Lancet. 2008 Jun 14;371(9629):1973-4.
15. Roes EM, Raijmakers MT, Schoonenberg M, Wanner N, Peters WH, Steegers EA. Physical well-being in women with a history of severe preeclampsia. J Matern Fetal Neonatal Med. 2005 Jul;18(1):39-45.
16. Brusse I, Duvekot J, Jongerling J, Steegers E, De Koning I. Impaired maternal cognitive functioning after pregnancies complicated by severe pre-eclampsia: a pilot case-control study. Acta Obstet Gynecol Scand. 2008;87(4):408-12.
17. Engelhard IM, van Rij M, Boullart I, Ekhart TH, Spaanderman ME, van den Hout MA, et al. Posttraumatic stress disorder after pre-eclampsia: an exploratory study. Gen Hosp Psychiatry. 2002 Jul-Aug;24(4):260-4.
18. Rep A, Ganzevoort W, Bonsel GJ, Wolf H, de Vries JI. Psychosocial impact of early-onset hypertensive disorders and related complications in pregnancy. Am J Obstet Gynecol. 2007 Aug;197(2):158 e1-6.
19. Dewey KG, Lovelady CA, Nommsen-Rivers LA, McCrory MA, Lonnerdal B. A randomized study of the effects of aerobic exercise by lactating women on breast-milk volume and composition. N Engl J Med. 1994 Feb 17;330(7):449-53.
20. Kinnunen TI, Pasanen M, Aittasalo M, Fogelholm M, Weiderpass E, Luoto R. Reducing postpartum weight retention - A pilot trial in primary health care. Nutrition Journal. 2007;6.
21. Leermakers EA, Anglin K, Wing RR. Reducing postpartum weight retention through a correspondence intervention. Int J Obes Relat Metab Disord. 1998 Nov;22(11):1103-9.
22. Lovelady CA, Garner KE, Moreno KL, Williams JP. The effect of weight loss in overweight, lactating women on the growth of their infants. N Engl J Med. 2000 Feb 17;342(7):449-53.
23. Lovelady CA, Nommsen-Rivers LA, McCrory MA, Dewey KG. Effects of exercise on plasma lipids and metabolism of lactating women. Med Sci Sports Exerc. 1995 Jan;27(1):22-8.

24. McCrory MA, Nommsen-Rivers LA, Mole PA, Lonnerdal B, Dewey KG. Randomized trial of the short-term effects of dieting compared with dieting plus aerobic exercise on lactation performance. Am J Clin Nutr. 1999 May;69(5):959-67.

25. Ostbye T, Krause KM, Lovelady CA, Morey MC, Bastian LA, Peterson BL, et al. Active Mothers Postpartum. A Randomized Controlled Weight-Loss Intervention Trial. American Journal of Preventive Medicine. 2009;37(3):173-80.

26. O'Toole ML, Sawicki MA, Artal R. Structured diet and physical activity prevent postpartum weight retention. J Womens Health (Larchmt). 2003 Dec;12(10):991-8.

27. de Castro MB, Kac G, de Leon AP, Sichieri R. High-protein diet promotes a moderate postpartum weight loss in a prospective cohort of Brazilian women. Nutrition. 2009 Nov-Dec;25(11-12):1120-8.

28. Lovelady CA, Stephenson KG, Kuppler KM, Williams JP. The Effects of Dieting on Food and Nutrient Intake of Lactating Women. Journal of the American Dietetic Association. 2006;106(6):908-12.

29. Fossum B, Arborelius E, Bremberg S. Evaluation of a counseling method for the prevention of child exposure to tobacco smoke: an example of client-centered communication. Prev Med. 2004 Mar;38(3):295-301.

30. French GM, Groner JA, Wewers ME, Ahijevych K. Staying smoke free: an intervention to prevent postpartum relapse. Nicotine Tob Res. 2007 Jun;9(6):663-70.

31. Johnson JL, Ratner PA, Bottorff JL, Hall W, Dahinten S. Preventing smoking relapse in postpartum women. Nurs Res. 2000 Jan-Feb;49(1):44-52.

32. Ratner PA, Johnson JL, Bottorff JL, Dahinten S, Hall W. Twelve-month follow-up of a smoking relapse prevention intervention for postpartum women. Addictive Behaviors. 2000;25(1):81-92.

33. Suplee PD. The importance of providing smoking relapse counseling during the postpartum hospitalization. J Obstet Gynecol Neonatal Nurs. 2005 Nov-Dec;34(6):703-12.

34. Van't Hof SM, Wall MA, Dowler DW, Stark MJ. Randomised controlled trial of a postpartum relapse prevention intervention. Tob Control. 2000;9 Suppl 3:III64-6.

35. Severson HH, Andrews JA, Lichtenstein E, Wall M, Akers L. Reducing maternal smoking and relapse: long-term evaluation of a pediatric intervention. Prev Med. 1997 Jan-Feb;26(1):120-30.

36. Wall MA, Severson HH, Andrews JA, Lichtenstein E, Zoref L. Pediatric office-based smoking intervention: impact on maternal smoking and relapse. Pediatrics. 1995 Oct;96(4 Pt 1):622-8.

37. Hannover W, Thyrian JR, Roske K, Grempler J, Rumpf HJ, John U, et al. Smoking cessation and relapse prevention for postpartum women: Results from a randomized controlled trial at 6, 12, 18 and 24 months. Addictive Behaviors. 2009;34(1):1-8.

38. Roske K, Schumann A, Hannover W, Grempler J, Thyrian JR, Rumpf HJ, et al. Postpartum smoking cessation and relapse prevention intervention: A structural equation modeling application to behavioral and non-behavioral outcomes of a randomized controlled trial. Journal of Health Psychology. 2008;13(4):556-68.

39. Winickoff JP, Healey EA, Regan S, Park ER, Cole C, Friebely J, et al. Using the postpartum hospital stay to address mothers' and fathers' smoking: The NEWS study. Pediatrics. 2010;125(3):518-25.

40. Food Guide Pyramid. Home and Garden Bulletin Number 252. USDoAHNI. 1992. http://www.cnpp.usda.gov/FGP.htm.

41. 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.

42. American Dietetic Association. Available at: http://www.eatright.org. Accessed February 15, 2010.

43. ACOG. Patient Education Pamphlet. Exercise and Fitness: A guide for women. Washington, DC: ACOG, 1998.

44. Laitakari J, Asikainen TM. How to promote physical activity through individual counseling--a proposal for a practical model of counseling on health-related physical activity. Patient Educ Couns. 1998 Apr;33(1 Suppl):S13-24.

45. Green L, Kreuter M, Deeds S, Partridge K. Health education planning. A diagnostic approach. Palo Alto: Mayfield Publishing Company 1980.

46. Prochaska JO, Velicer WF. The transtheoretical model of health behavior change. Am J Health Promot. 1997 Sep-Oct;12(1):38-48.

47. Arborelius E, Bremberg S. Child health-centre-based promotion of a tobacco-free environment--a Swedish case study. Health Promot Int. 2001 Sep;16(3):245-54.

48. Greenberg RA, Strecher VJ, Bauman KE, Boat BW, Fowler MG, Keyes LL, et al. Evaluation of a home-based intervention program to reduce infant passive smoking and lower respiratory illness. J Behav Med. 1994 Jun;17(3):273-90.

49. Miller WR, Rollnick S. Motivational Interviewing: preparing people to change addictive behaviour. New York: Guilford 1991.

50. Marlatt GA. Relapse prevention: Theoretcial rationale and overview of the model. In: Marlatt GA, Gordon JR, eds. Relapse prevention: maintainance strategies in the treatment of addictive behaviors. New York: Guilford Press 1985:3-70.

51. Smoking cessation. TheAgency for Health Care Policy and Research: Smoking Cessation Guideline. JAMA. 1996;275(16):1270-1280

52. Fiore MC, Bailey WC, Cohen SJ, Goldstein MG, Gritz ER, al. E. Treating tobacco use and dependence. Clinical practice guideline. In: Service. USDoHaHSPH, ed. Rockville, MD 2000.

53. Marlatt GA. Taxonomy of high-risk situations for alcohol relapse: evolution and development of a cognitive-behavioral model. Addiction. 1996 Dec;91 Suppl:S37-49.

54. Rollnick S, Butler CC, Stott N. Helping smokers make decisions: the enhancement of brief intervention for general medical practice. Patient Educ Couns. 1997 Jul;31(3):191-203.

55. Miller WR. Motivational interviewing: research, practice, and puzzles. Addict Behav. 1996 Nov-Dec;21(6):835-42.

56. Jones EJ, Roche CC, Appel SJ. A review of the health beliefs and lifestyle behaviors of women with previous gestational diabetes. J Obstet Gynecol Neonatal Nurs. 2009 Sep-Oct;38(5):516-26.

57. Zehle K, Smith BJ, Chey T, McLean M, Bauman AE, Cheung NW. Psychosocial factors related to diet among women with recent gestational diabetes: opportunities for intervention. Diabetes Educ. 2008 Sep-Oct;34(5):807-14.

58. Smith BJ, Cheung NW, Bauman AE, Zehle K, McLean M. Postpartum physical activity and related psychosocial factors among women with recent gestational diabetes mellitus. Diabetes Care. 2005 Nov;28(11):2650-4.

59. Kieffer EC, Willis SK, Arellano N, Guzman R. Perspectives of pregnant and postpartum latino women on diabetes, physical activity, and health. Health Educ Behav. 2002 Oct;29(5):542-56.

60. Symons Downs D, Ulbrecht JS. Understanding exercise beliefs and behaviors in women with gestational diabetes mellitus. Diabetes Care. 2006 Feb;29(2):236-40.

61. Hoedjes M, Berks D, Vogel I, Duvekot JJ, Oenema A, Franx A, et al. Preferences for Postpartum Lifestyle Counseling Among Women Sharing an Increased Cardiovascular and Metabolic Risk: A Focus Group Study. Hypertens Pregnancy. 2011;30(1):83-92. Epub 2010 Sep 6.

CHAPTER 8

Preferences for postpartum lifestyle counseling among women sharing an increased cardiovascular and metabolic risk: a focus group study

Based on: M. Hoedjes, D. Berks, I. Vogel, J. J. Duvekot, A. Oenema, A. Franx, E.A.P. Steegers, H. Raat. Preferences for postpartum lifestyle counseling among women sharing an increased cardiovascular and metabolic risk: a focus group study. *Hypertens Pregnancy. 2011;30(1):83-92. Epub 2010 Sep 6. PMID: 20818968*

ABSTRACT

Objective

To describe women's preferences for postpartum lifestyle counseling after a pregnancy complicated by preeclampsia, intrauterine growth restriction and/or gestational diabetes.

Methods

Thirty-six women who had experienced these pregnancy complications participated in six focus group interviews.

Results

All women expressed a need for participation in postpartum lifestyle counseling. They preferred participation to be tailored to individual preferences. A combination of face-to-face counseling supported by computer-tailored lifestyle advice appealed to them.

Conclusion

Postpartum lifestyle counseling aimed at these women should be tailored to individual needs and preferences.

INTRODUCTION

Epidemiological data indicate that an obstetric history of preeclampsia, intrauterine growth restriction and/ or gestational diabetes is associated with a significantly increased risk for remote cardiovascular diseases, such as hypertension, myocardial infarction, ischemic heart disease, and cerebrovascular accidents [1]. Women who have experienced these pregnancy complications share cardiovascular and metabolic risk factors, such as abdominal obesity, insulin resistance, atherogenic dyslipidemia, and elevated blood pressure [2].

It is suggested that lifestyle-related risk factors should primarily be targeted to reduce cardiovascular and metabolic risk in women who have experienced these pregnancy complications [2]. Research in other high-risk groups has shown that lifestyle interventions have been effective in lowering risk factors for cardiovascular disease [3-6] and diabetes mellitus type II [7,8]. Potentially modifiable lifestyle-related risk factors associated with cardiovascular disease are consumption of saturated fat, fruit, vegetables, and alcohol, physical activity, smoking, and psychosocial factors [9].

Currently, in the health care setting, tailored interventions (such as face-to-face counseling) are widely applied. Such interventions are intended to reach one specific person, are based on characteristics that are unique to that person, are related to the outcome of interest, and have been derived from an individual assessment [10,11].

However, in the last decades, potentially important new channels for health communication have emerged, such as computers and the Internet [12]. Computer-tailored lifestyle counseling (e.g., computer-tailored nutrition education) can provide people with both individualized feedback and advice on personal performance levels (e.g., nutritional intake) and awareness of their own performance, as well as personal motivation to change, goals, outcome expectations, subjective norms, self-efficacy, self-regulation processes and other possible behavioral determinants [11,13]. Now that computer-tailored health education is recognized as a promising health education strategy, computer-tailored lifestyle interventions for various behaviors are currently offered on the World Wide Web [14-16].

Considering the individual differences in pregnancy complications and their consequences, physical and psychological recovery, and other personal factors (e.g., education and family composition), the use of tailored lifestyle interventions seems to be highly suitable. For example, face-to-face lifestyle counseling or computer-tailored lifestyle advice might be offered. Moreover, tailoring a lifestyle intervention to the specific characteristics and preferences of these high-risk women is expected to promote participation and adherence to the intervention. In the process of developing such a tailored intervention, opinions, needs, and ideas of women who have recently experienced such pregnancy complications should be taken into account.

Although the postpartum period after a pregnancy complicated with preeclampsia, intrauterine growth restriction and/or gestational diabetes, is considered to be a window of

opportunity for preventive interventions shortly after delivery [1,17], little is known about what the lifestyle interventions aimed at these high-risk women should consist of. Up to now, little information is available about women's preferences regarding postpartum lifestyle counseling. Therefore, we conducted focus group interviews among women after a pregnancy complicated with preeclampsia, intrauterine growth restriction and/or gestational diabetes in order to document their needs, opinions, and ideas regarding postpartum lifestyle counseling. Two different types of lifestyle interventions were discussed: face-to-face counseling by a health care specialist and computer-tailored lifestyle counseling.

METHODS

Participants

Patients with pregnancies complicated by preeclampsia, intrauterine growth restriction and/or gestational diabetes who had given birth in the Erasmus University Medical Center (MC) in Rotterdam between November 2004 and October 2006, were eligible for participation in the focus group interviews. By searching hospital records, 182 eligible patients were selected and invited by mail to participate in the focus groups.

Preeclampsia was diagnosed according to ISSHP criteria [18]. Intrauterine growth restriction due to placental insufficiency was defined when the ultrasonic fetal abdominal circumference was below the 5th percentile in combination with abnormal Doppler patterns of the umbilical artery (pulsatility index above the 95th percentile and/or in case of absent or reversed end diastolic flow) [19]. Patients were diagnosed with gestational diabetes when 1-hour postprandial glucose level was above 7.0 mmol/l [20].

A complication was defined as severe when delivery occurred at a gestational age of 32 weeks or less, when the newborn was admitted to the neonatal intensive care unit, or in case of perinatal mortality [18].

Procedure

The study was approved by the Medical Ethical Committee of the Erasmus MC. Focus group interviews were held at the Erasmus MC in December 2006 and February 2007, and lasted about 60 minutes each. Prior to the interviews, participants provided informed consent and completed a questionnaire assessing ethnicity (Dutch, non-Dutch), level of education (primary school, secondary school, and higher education) smoking (yes, no), and self-reported weight and height. A moderator (M.H.), assisted by a facilitator (D.B/ W.B), led the focus group interviews. Interviews were audiotaped, and were held in line with focus group principles provided by Morgan et al. [21]. A semistructured focus group discussion guide was used to structure discussion topics.

Analysis

Questionnaire

Self-reported weight and height were used to calculate the body mass index (BMI). A BMI of 25 or higher was defined as overweight and 30 or higher as obesity. Birth weight and gestational age at delivery were retrieved from hospital records. A participant was designated to be of non-Dutch ethnic origin if one of her parents was born abroad [22]. Educational level was assessed by the highest completed education and reclassified into three categories: 1) primary school, 2) secondary school and 3) higher education [23].

Interviews

Focus groups were audiotaped, transcribed verbatim, and checked for accuracy. After transcripts were made, a qualitative data analysis program (the software package QSR Nvivo, version 7) was used to analyze the transcripts in accordance with content analysis principles [21]. Discussion topics were identified, sorted, and labeled according to the technique of content analysis. A systematic summary of what each group said about a topic was made. Discussion topics were examined across groups and for all groups combined. Discussion topics addressed in the interview guide were preferred characteristics of the postpartum lifestyle counseling, face-to-face lifestyle counseling, and computer-tailored lifestyle counseling. To illustrate some findings, quotations are reported.

RESULTS

Participants

Of the 36 women participating in the focus group interviews, 21 had experienced preeclampsia, 4 intrauterine growth restriction, 5 gestational diabetes, and 6 women had experienced both preeclampsia and intrauterine growth restriction. The number of participants per group ranged from 4 to 10 (average 6). See Table 1 for demographic data and clinical characteristics of the study participants.

Postpartum Lifestyle Counseling

All women expressed a need for postpartum lifestyle counseling. *"Every piece of advice, guidance and information after delivery is very valuable."* Generally, women said that they would like to receive personal feedback on their current health status and their future risk. *"It would help if someone would say: You are too heavy, these are the consequences of being too heavy, and this is what you can do to lose weight".* However, all stated that postpartum lifestyle counseling should preferably not be too time consuming and should not cost too much effort.

Table 1. *Demographic data and clinical characteristics of the study participants.*

	n	(%)	Mean (SD)	Range
Women				
Age (years)	36		32.7 (4.5)	22 -41
Ethnicity				
Dutch	20	(55.6%)		
Educational level				
Primary school	5	(14.7%)		
Secondary school	15	(44.1%)		
Higher education	14	(41.2%)		
Smoking				
Yes	3	(8.3%)		
Body mass index			24.8 (4.9)	17.1-39.3
25-30	12			
≥ 30	4			
Pregnancy complication				
Preeclampsia	21	(16.7%)		
Intrauterine growth restriction	4	(58.3%)		
Gestational diabetes	5	(11.1%)		
Preeclampsia and intrauterine growth restriction	6	(13.9%)		
Offspring				
Birth weight (g)	36		2352 (1155)	(690-4360)
Gestational age at delivery (days)	36		246 (4.9)	(184- 290)

All preferred to receive tailored postpartum lifestyle advice. In addition, women mentioned that participation in postpartum lifestyle counseling should preferably be tailored to personal preferences regarding the frequency, onset, duration, and the length of personal guidance. For example, some reported that they would like to be able to decrease the frequency of counseling visits after a certain time after delivery. Also, women who had experienced a prolonged period of recovery, preferred to postpone participation in a lifestyle counseling program until completely recovered from their pregnancy. The idea that prolonged guidance might decrease a woman's fear

of recurrence of the condition and hence their threshold for a next pregnancy, was mentioned as a reason for the desire for lifestyle support until the next pregnancy.

Particularly women who experienced a severe complication expressed a need for more and longer physical and psychological guidance after their complicated pregnancy as part of postpartum counseling: *"Such counseling is a step in the right direction towards better follow-up care".*

Face-to-Face Counseling

All women indicated that they would like to receive postpartum lifestyle counseling from a health care specialist. Face-to-face counseling from a health care specialist was perceived as effective and motivating. Women said that they would feel motivated to show the counselor what progress they had made. They would like to receive support from the counselor and they would like to receive reminders of why it is important to improve their lifestyle. *"Regularly being reminded of what you are doing it for would help".* Furthermore, they would like the idea of their lifestyle being monitored by a health care specialist; they would prefer regular moments of evaluation; and they would like to be able to observe progress from participating in lifestyle counseling.

A preferred counselor was reported to be someone who had sufficient and extensive knowledge about lifestyle, and about the pregnancy complications and their consequences. Women mentioned that the counselor must be experienced, and should be familiar with experiences of other women who had the same complications during pregnancy. *"It must be someone who knows how to put our experiences into perspective."*

Several health care specialists were mentioned as potential counselors: specialized nurses, general practitioners, gynecologists, and midwives. A gynecologist was perceived as sufficiently specialized, but overqualified to apply lifestyle counseling. The general practitioner was perceived as easily accessible, but not sufficiently specialized. Women generally stated that a nurse might be easier to talk to than a physician. Additionally, they would like the counselor to be able to provide information, and both medical and psychological support, when needed. When the counselor cannot provide this support, he or she should preferably be able to transfer the patient to other health care specialists (e.g., a psychologist or a dietician).

Most women said that they would rather receive counseling from the same person so that they can build a relationship on mutual trust. Others indicated they would not mind if they would receive counseling from multiple counselors, because they might profit from the variance in both the level and the nature of knowledge between counselors. For most women, the gender of the counselor was irrelevant.

Women generally preferred the location of the counseling to be close to home. *"As a young mother, you're not very flexible in making appointments."* Suggested locations for the counseling included: the general practitioner's premises, the infant welfare center, and a nearby hospital. Additionally, women suggested that lifestyle counseling might also be administered at home,

or that counseling might take place by telephone. Others suggested that counseling could take place at a location where they could meet fellow sufferers.

Finally, they said that it would be practical to combine a counseling visit with one of the standard postpartum visits to a healthcare specialist (e.g., gynecologist or pediatrician) that they have already planned. This was particularly the case for women who had experienced a severe complication, since they generally had more postpartum hospital visits. However, some women preferred a separate visit so that they could pay full attention to counseling (and could choose whether or not to bring their child). All stated that they were willing to pay a separate visit (or extra visits) for lifestyle counseling.

Computer-Tailored Counseling: Alternative or Supplement?

The use of computer-tailored lifestyle counseling was perceived as appealing. Women reported that a computer-tailored lifestyle promotion program should be readable, comprehensible and accurate. It would be appreciated if the progress of their lifestyle behaviors could be registered on the computer-tailored lifestyle promotion program. It was suggested that lifestyle behavior could be monitored and displayed in a graph, so that progress could be made "visible". Women said this would stimulate them to (re)gain control and responsibility over their own lifestyle behavior.

The majority preferred a computer-tailored advice to be accessible on the Internet, so that they could complete the intervention wherever and whenever convenient. "*Internet is widespread and universally accessible; when you're not able to complete the intervention at home, there are lots of places where you can."* Moreover, it was suggested that a computer-tailored lifestyle program on the Internet could provide a forum. Such a forum was mentioned as an easy way to get in contact with other women who had experienced the same pregnancy complication. Others, however, perceived making contact with fellow suffers by means of a forum on the Internet as too impersonal.

Although the Internet was generally thought to be a suitable medium to offer computer-tailored lifestyle advice, it was mentioned that caution should be paid to safety on the Internet. The Internet connection has to be secure, and privacy has to be guaranteed. "*It has to be a personal, protected space on the Internet, not everyone should be able to read what's on it."* With regard to lifestyle questionnaires, a minority preferred the use of paper and pencil to the use of a computer, or keeping a "lifestyle" diary. They thought the Internet would be too impersonal and not motivating enough. "*Internet could be too undisciplined.* " Moreover, women mentioned that lack of access to the Internet and lack of skills to adequately surf on the Internet could be barriers towards computer-tailored counseling on the Internet. They also mentioned that, although the Internet is widespread, not everyone has a computer at home or a fast connection on the Internet.

Thus, although a computer was seen as an attractive medium to provide tailored lifestyle counseling, the use of a computer-tailored advice alone was considered to be too minimal, perhaps less effective and not suited for longer-term purposes, because *"the computer doesn't answer back".* Computer-tailored advice was seen as a way to support face-to-face counseling. A combination of face-to-face personal counseling supported by computer-tailored lifestyle advice offered on the Internet appealed to women. This combination was perceived as desirable, effective, and motivating.

DISCUSSION

This first study exploring the needs, ideas and opinions on postpartum lifestyle counseling of women who had experienced preeclampsia, intrauterine growth restriction, and/or gestational diabetes shows that these women have a need for postpartum lifestyle counseling. They preferred to receive tailored lifestyle advice. According to these women, participation in postpartum lifestyle counseling should preferably be tailored to individual preferences regarding the location, onset, duration, length, and the frequency of personal guidance. A combination of face-to-face personal counseling, supported by computer-tailored lifestyle advice offered on the Internet, appealed to these women.

Our results show that women, who are at increased cardiovascular and metabolic risk after they have experienced a pregnancy complication, are motivated to participate in postpartum lifestyle interventions. Women reported that they would like to be guided in adopting a healthy lifestyle, and that they would like their lifestyle to be monitored by a health care specialist. This is in line with the window of opportunity for preventive interventions in women after a pregnancy complicated with preeclampsia, intrauterine growth restriction and/or gestational diabetes, as demonstrated earlier [17].

To our knowledge, our study is the first to describe preferences for postpartum lifestyle support among women who have experienced preeclampsia, intrauterine growth restriction and/or gestational diabetes. However, we found one other study that investigated preferred types of lifestyle support among women with recent gestational diabetes in order to improve the development of diabetes prevention strategies. The results of this study by Zehle et al. [24] show that advice from a dietician and telephone support from a health educator were the most preferred forms of health assistance to improve dietary and physical activity habits. The results of our study confirm the conclusion of Zehle et al. that dietary change programs, informed by the beliefs and circumstances of this high-risk population, need to be developed [24].

The finding that the Internet might be a suitable medium to offer lifestyle counseling supports previous research. It was earlier concluded that the Internet can be a valuable tool to support physicians and nurses in the field of adolescent preventive care [25]. The use of a combination of

face-to-face counseling and computer-tailored counseling is also supported by previous research. In the field of child preventive health care, Internet-tailored fruit and vegetable education was combined with brief counseling [26]; this integrated two-component intervention induced positive changes in knowledge and awareness of intake levels of fruit and vegetables among schoolchildren.

In addition to individual counseling, our results seem to indicate that group counseling might be suitable for these women as well. However, this needs to be further examined. During the focus group meetings, women reported that they would like to share their experiences with fellow sufferers. Their preference for a location where they could meet fellow sufferers, and their preference for a forum to get in touch with fellow sufferers, reflects this desire. This is also demonstrated by the fact that, after the focus group interviews, participants exchanged their e-mail addresses. In their social environment, women generally seem to lack the company of women who have experienced the same pregnancy complication(s), probably because of lack of knowledge and lack of understanding about the complication and its consequences. Due to this lack of social support, during participation in lifestyle counseling they would like contact with other women who have experienced the same pregnancy complication(s).

Some methodological considerations of the present study need to be addressed. Some selection bias may have occurred since only patients who gave birth in the Erasmus MC (a tertiary referral hospital) were invited to participate; despite efforts to prevent bias (e.g., by having random, consecutive participant selection), a volunteer bias might have occurred. In addition, an investigator bias may have arisen; although using more than one analyst might have improved the consistency or reliability of the analyses, the appropriateness of the interrater reliability concept in qualitative research is still debated [27].

Conclusion

The results of our study suggest that postpartum lifestyle counseling aimed at women who had experienced preeclampsia, intrauterine growth restriction, and/or gestational diabetes should be tailored to individual needs and preferences. However, further quantitative studies should be conducted to determine the relative importance of the reported preferences.

Postpartum lifestyle counseling aimed at these women should preferably be developed in collaboration with a multidisciplinary team of health care specialists and in close collaboration with potential users, should address important behavioral determinants, and should be both theory and evidence based. Further research is needed to establish whether women who have experienced different pregnancy complications also differ in their preferences for postpartum lifestyle counseling.

Based on our results, we conclude that postpartum lifestyle promotion among women who have experienced these pregnancy complications deserves more attention in clinical practice. Gynecologists should play a central role in informing women of their increased cardiovascular

and metabolic risk. Before evidence-based interventions are developed specifically for this high-risk group, they could already emphasize the importance of adopting a healthy postpartum lifestyle.

Practice Implications

The efficacy of a developed lifestyle counseling strategy should eventually be tested in a randomized controlled trial. Meanwhile, the preferences reported in the present study provide a basis for desired health promotion support. These preferences can be implemented in the process of developing and implementing a lifestyle promotion program for use in this high-risk group. Addressing these preferred lifestyle-counseling characteristics might promote participation in and adherence to postpartum lifestyle counseling aimed at women who have experienced these pregnancy complications.

REFERENCES

1. Harskamp RE, Zeeman GG. Preeclampsia: at risk for remote cardiovascular disease. *Am J Med Sci* 2007; 334:291-5.
2. Grundy SM, Cleeman JI, Daniels SR, Donato KA, Eckel RH, Franklin BA, et al. Diagnosis and management of the metabolic syndrome: an American Heart Association/National Heart, Lung, and Blood Institute Scientific Statement. *Circulation* 2005;112:2735-52.
3. Rippe C, Erlanson-Albertsson C, Lindqvist A. Consequences of metabolic challenges on hypothalamic colipase and PLRP2 mRNA in rats. *Brain Res* 2007;1185:152-7.
4. Ratner R, Goldberg R, Haffner S, Marcovina S, Orchard T, Fowler S, et al. Impact of intensive lifestyle and metformin therapy on cardiovascular disease risk factors in the diabetes prevention program. *Diabetes Care* 2005;4:888-94.
5. Lisspers J, Sundin O, Hofman-Bang C, Nordlander R, Nygren A, Ryden L, et al. Behavioral effects of a comprehensive, multifactorial program for lifestyle change after percutaneous transluminal coronary angioplasty: a prospective, randomized controlled study. *J Psychosom Res* 1999;46:143-54.
6. Lisspers J, Sundin O, Ohman A, Hofman-Bang C, Ryden L, Nygren A. Long-term effects of lifestyle behavior change in coronary artery disease: effects on recurrent coronary events after percutaneous coronary intervention. *Health Psychol* 2005; 24:41-8.
7. Knowler WC, Barrett-Connor E, Fowler SE, Hamman RF, Lachin JM, Walker EA, et al. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med* 2002;346:393-403.
8. Tuomilehto J, Lindstrom J, Eriksson JG, Valle TT, Hamalainen H, Ilanne-Parikka P, et al. Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. *N Engl J Med* 2001;344:1343-50.
9. Yusuf S, Hawken S, Ounpuu S, Dans T, Avezum A, Lanas F, et al. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. *Lancet* 2004;364:937-52.
10. Rakowski W. The potential variances of tailoring in health behavior interventions. *Ann Behav Med* 1999; 21:284-9.
11. Kreuter MW, Strecher VJ, Glassman B. One size does not fit all: the case for tailoring print materials. *Ann Behav Med* 1999;21:276-83.
12. Brug J, Oenema A, Kroeze W, Raat H. The internet and nutrition education: challenges and opportunities. *Eur J Clin Nutr* 2005; 59 Suppl 1:S130-7; discussion S8-9.
13. de Vries H, Brug J. Computer-tailored interventions motivating people to adopt health promoting behaviours: introduction to a new approach. *Patient educ couns* 1999;36:99-105.
14. Brug J, Oenema A, Campbell M. Past, present, and future of computer-tailored nutrition education. *Am J Clin Nutr* 2003;77(4 Suppl):1028S-34S.
15. Strecher VJ. Computer-tailored smoking cessation materials: a review and discussion. *Patient educ couns* 1999;36:107-17.
16. Kroeze W, Werkman A, Brug J. A systematic review of randomized trials on the effectiveness of computer-tailored education on physical activity and dietary behaviors. *Ann Behav Med* 2006; 31:205-23.
17. Sattar N, Greer IA. Pregnancy complications and maternal cardiovascular risk: opportunities for intervention and screening? *BMJ* 2002;325:157-60.
18. ACOG practice bulletin. Diagnosis and management of preeclampsia and eclampsia. Number 33, January 2002. American College of Obstetricians and Gynecologists. *Int J Gynaecol Obstet* 2002; 77:67-75.
19. ACOG Practice Bulletin No. 58. Ultrasonography in pregnancy. *Obstet Gynecol* 2004; 104:1449-58.
20. ACOG Practice Bulletin. Clinical management guidelines for obstetrician-gynecologists. Number 30, September 2001 (replaces Technical Bulletin Number 200, December 1994). Gestational diabetes. *Obstet Gynaecol* 200; 98:525-38.
21. Morgan DL, Krueger RA, King JA. The focus group kit: Sage publications, 1998.
22. CSB. Migrants in the Netherlands. 2003 [cited 2003 14 november 2003]; Available from: www.cbs.nl
23. CBS. Standaard onderwijsindeling (SOI): CBS; 2003.
24. Zehle K, Smith BJ, Chey T, McLean M, Bauman AE, Cheung NW. Psychosocial factors related to diet among women with recent gestational diabetes: opportunities for intervention. The *Diabetes educ* 2008;34:807-14.

25. Mangunkusumo R, Brug J, Duisterhout J, de Koning H, Raat H. Feasibility, acceptability, and quality of Internet-administered adolescent health promotion in a preventive-care setting. *Health Educ Res* 2007; 22:1-13.

26. Mangunkusumo RT, Brug J, de Koning HJ, van der Lei J, Raat H. School-based internet-tailored fruit and vegetable education combined with brief counselling increases children's awareness of intake levels. *Public Health Nutr* 2007;10:273-9.

27. Pope C, Ziebland S, Mays N. Qualitative research in health care. Analysing qualitative data. *BMJ* 2000; 320:114-6.

Appendix. *Prompts to explore women's preferences for postpartum lifestyle counseling after a pregnancy complicated with preeclampsia, intrauterine growth restriction and/or gestational diabetes.*

To what extent do you need postpartum lifestyle counseling?

What would be your preferred characteristics of a lifestyle promotion program?

Face-to-face counseling

- By whom would you prefer the lifestyle counseling to be offered?
- Would you prefer your counselor to be a man or a woman?
- What profession would you prefer the counselor to have?
- Would you prefer seeing the same counselor across visits? Would you prefer multiple counselors?
- Where would you prefer the lifestyle counseling to take place?
- When would you prefer the lifestyle counseling to be offered?
- Would you prefer a separate visit for counseling or would you prefer to combine visits?
- What would you prefer with regard to the frequency of counseling visits?

Computer-tailored counseling

- What do you think about offering computer-tailored counseling on the Internet?
- What do you think of combining lifestyle counseling with a computer-tailored lifestyle promotion program?

CHAPTER 9

Discussion

9. DISCUSSION

Women with an obstetric history of preeclampsia, intrauterine growth restriction and/ or gestational diabetes share an increased risk for future cardiovascular disease [1-5] and type II diabetes mellitus [6-8]. For these women, the postpartum period can be used for preventive lifestyle interventions [3]. To date, little is known on what lifestyle interventions should be recommended. In the context of the model of planned health education and promotion [9], this thesis aimed to describe postpartum mental health, health-related quality of life (part I) and lifestyle (part II) in women after pregnancy complications, and to examine which postpartum lifestyle interventions seem promising for preventing cardiovascular disease and type II diabetes mellitus in these women (part III).

9.1 Main findings

The main findings are presented per study question and discussed in relation to relevant current literature.

Part I: Postpartum mental health and health-related quality of life after preeclampsia

Health-related quality of life after preeclampsia was assessed at 6 weeks and 12 weeks postpartum by the RAND 36-item Short-Form Health Survey (SF-36) [10,11]. Additionally, mental health was examined by the assessment of postpartum depression and post-traumatic stress disorder. Postpartum depression was assessed by administration of the Edinburgh Postnatal Depression Scale (EPDS) [12,13] at 6 weeks, 12 weeks, and 26 weeks postpartum. Post-traumatic stress disorder was assessed by administration of the Self-Rating Inventory for Posttraumatic Stress Disorder [14,15] at 6 and 12 weeks postpartum.

To what extent do women who had preeclampsia experience a good postpartum health-related quality of life, and what are its determinants?

After preeclampsia, women have a relatively poor health-related quality of life, especially when preeclampsia was severe. Neonatal intensive care unit admission and perinatal death were found to be associated with this poorer mental health-related quality of life among women with severe preeclampsia.

Although health-related quality of life improved from 6 to 12 weeks postpartum, women who experienced severe preeclampsia still had a poorer mental health-related quality of life at 12 weeks postpartum than women who had mild preeclampsia. They evaluated their personal health as poorer, they had more interference with normal social activities due to physical or emotional problems and more problems with work and other daily activities as a result of emotional problems, and they experienced more feelings of nervousness and depression.

Our finding that health-related quality of life increased from 6 to 12 weeks postpartum, is consistent with results of studies assessing the postpartum trajectory of health-related quality of life after uncomplicated pregnancies [16,17]. Compared with a gender and age-adjusted reference population, the women in our study population reported a low health-related quality of life at 6 weeks postpartum, particularly with regard to physical functioning and vitality. Similar findings were reported in a study that compared postpartum health-related quality of life between women with pregnancy-induced hypertension and women with uncomplicated pregnancies [18]. Additionally, preterm delivery and caesarean section have previously been found to be associated with relatively low health-related quality of life after childbirth in general [16-19].

To what extent do women who had preeclampsia experience a good postpartum mental health, and what are its determinants?

After mild preeclampsia, 23% of women experienced postpartum depressive symptoms up to 6 months postpartum, compared to 44% after severe preeclampsia. Admission to the neonatal intensive care unit and perinatal death appeared to be associated with symptoms of postpartum depression (see below).

The relatively high rate of depressive symptoms after preeclampsia is in line with other studies reporting a frequent need for psychological support after severe preeclampsia [20]. Our finding that the postpartum psychological condition improves over time confirms results on postpartum psychosocial condition after early-onset hypertensive disorders [21]. Surprisingly, we found that women who had mild preeclampsia more frequently experienced depressive symptoms at 26 weeks postpartum than women with severe preeclampsia. This might be a chance result due to the relatively small numbers involved.

Further analysis showed that not the severity of preeclampsia itself, but rather the consequences were associated with postpartum depressive symptoms, especially admission to the neonatal intensive care unit and perinatal death. This is in line with previous findings [22-24]. It has been suggested that admission to the intensive care unit in itself affects psychological distress [22,23]. In addition, perinatal death was previously found to be associated with postpartum depression among women after an uncomplicated delivery [24].

The prevalence of post-traumatic stress disorder after preeclampsia was 9% at 6 weeks, and 5% at 12 weeks postpartum. The prevalence was highest among young women with multiple adverse pregnancy outcomes. 22% experienced postpartum symptoms of intrusion at 6 weeks postpartum (12% at 12 weeks), 9% symptoms of avoidance (8% at 12 weeks), and 29% symptoms of hyperarousal (20% at 12 weeks). Young age (< 30 years), severe preeclampsia, caesarean section, low gestational age, low birth weight, admission to the neonatal intensive care unit, and perinatal death were found to be associated with the presence of symptoms of post-traumatic stress disorder.

The prevalence of post-traumatic stress disorder was relatively high among women after preeclampsia, in comparison with general populations of women after giving birth. [25]. However, the prevalence of post-traumatic stress syndrome of 5 to 9% found in our population women is relatively low compared with the prevalence of 11 to 44% reported in other studies [26-28]. However, others studied the prevalence retrospectively and used different, more severe, subgroups.

According to previous research, the prevalence of symptoms of intrusion is 12–15%, the prevalence of avoidance is 2–7%, and the prevalence of hyperarousal is 25–27% after childbirth in general [29-32]. At 6 weeks postpartum, the prevalence of symptoms of intrusion (22%) avoidance (9%) and hyperarousal (29%) in our study sample was higher compared with the prevalence of these symptoms after childbirth. At 12 weeks postpartum, only the prevalence of symptoms of avoidance in our study sample (8%) was relatively higher than the prevalence of these symptoms after childbirth. This may suggest that particularly symptoms of avoidance are relatively more frequent after preeclampsia than after childbirth in general. However, this needs to be studied further.

Our finding that PTSD symptoms decreased from 6 weeks to 12 weeks postpartum, is in line with previous research regarding the prevalence of PTSD after childbirth [25,33,34]. However, an increase in PTSD after childbirth from 6% at six weeks postpartum to 15% at six months postpartum has also been found [35].

The results reported in chapter 4 confirm previous reports which suggested that gestational age at delivery is negatively associated with postpartum post-traumatic stress disorder symptoms after preeclampsia [26,28]. Contrary to the only other study that examined variables associated with post-traumatic stress after preeclampsia [26], we did find that caesarean section and birth weight were associated with symptoms of post-traumatic stress disorder. In addition, we found that admission to the neonatal intensive care unit and perinatal death were associated with post-traumatic stress disorder and its symptoms. This is in line with previous research among women after childbirth in general [25,36-38].

Our finding that younger preeclamptic women relatively more often experience symptoms of post-traumatic stress disorder confirms previous reports on higher levels of post-traumatic stress among younger pregnant women [39]. The phenomenon that relatively young age may be associated with the development of post-traumatic stress disorder, was also reported among survivors of cardiac arrest [40] and patients following intensive care unit admission [41]. Our finding may be explained by a lack of life experience or a lack of sufficient coping skills to deal with the stressful life events associated with preeclampsia and its consequences [42]. Furthermore, relatively younger women might perceive less social support, which has been found to be related to the development of posttraumatic stress symptoms after childbirth [32,34]. Another explanation could be that younger women might be more ‘shocked’ by their complicated pregnancy, since risk for complications in pregnancy is generally associated with

older age. On the other hand, we found that younger women with preeclampsia suffered from more adverse pregnancy outcomes than their older counterparts with preeclampsia. This finding confirms previous research showing that a younger maternal age was associated with adverse pregnancy outcomes, irrespective of confounding sociodemographic variables [43]. It also seems to confirm research that preeclampsia relatively more often occurs during the first pregnancy [44], and that outcomes of subsequent pregnancies after a first pregnancy with preeclampsia are generally favourable [45]. However, we also found that nulliparous preeclamptic women who experienced adverse pregnancy outcomes were younger than nulliparous preeclamptic women who did not, whereas for multiparous preeclamptic women, no difference in mean age was found between those who did and did not experience adverse pregnancy outcomes. This suggests that even after correction for parity, younger age is still associated with the occurrence of adverse pregnancy outcomes among nulliparous preeclamptic women.

Part II: Postpartum lifestyle and its determinants

Chapter 5 reports qualitative results with regard to motivators and barriers to postpartum lifestyle from focus group interviews with women who had experienced preeclampsia, intrauterine growth restriction and/ or gestational diabetes. Chapter 6 reports quantitative results from the Pro-Active study regarding physical activity at 12 and 26 weeks postpartum, as measured by the short form of the International Physical Activity Questionnaire (IPAQ) [46]).

How healthy is the postpartum lifestyle of women who experienced pregnancy complications, and what are its determinants?

Many women reported that they did not succeed in adopting a healthy lifestyle. E.g., 38% reported not to meet the physical activity recommendation at 3 and 6 months postpartum after preeclampsia. Particularly women with severe preeclampsia and adverse pregnancy outcomes did not meet the physical activity recommendation. For example, limited recovery from their complications was reported to be an important barrier to adopting a healthy postpartum lifestyle.

Chapter 5 showed that even though most women reported that they had the intention to adopt a healthy lifestyle, the majority did not succeed. This chapter provides a list of motivators and barriers to adoption of a healthy postpartum lifestyle after preeclampsia, intrauterine growth restriction and/ or gestational diabetes. (See Box 1). This information can be used to develop a lifestyle intervention aimed at women who have experienced these pregnancy complications.

The finding that poor postpartum recovery is a barrier to live a healthy lifestyle confirms previous research [26,47]. According to the participants, after delivery more information is needed about the experienced complication and its consequences, about what to expect regarding its course, and how to deal with it. This is especially the case after severe complications. Women prefer to receive more psychological and physical guidance to support their recovery, and would like to be guided in adopting a healthy lifestyle. They expect such information and

guidance from their healthcare specialists (e.g., their gynaecologist or midwife, and their general practitioner). Healthcare specialists could be assisted and exonerated in the application of a lifestyle intervention directly after delivery, as previously proposed by Sattar et al. (2002) [3]. The finding that women did not succeed in living a healthy lifestyle, despite their positive attitude, could be explained by the Theory of Planned Behavior [48]. In line with this theory, these women may not have achieved a healthy postpartum lifestyle because of their low perceived behavioral control. Lowering or removing perceived barriers, such as lack of postpartum guidance, and poor physical and psychological recovery, might increase this perceived behavioral control.

Box 1. *Motivators and barriers to the adoption of a healthy postpartum lifestyle as reported in chapter 5.*

Motivators

- improvement of current physical and psychological health condition
- improvement of future health condition (by decreasing the risk for developing cardiovascular disease or type II diabetes mellitus)
- the desire to be a good role model for their children
- breastfeeding

Barriers

- lack of physical and psychological recovery
- lack of postpartum medical and psychological support from health care providers
- lack of knowledge and lack of understanding about the pregnancy complication and its consequences
- lack of time and energy caused by daily demands such as taking care of offspring, housekeeping, working, and frequent hospital visits

Chapter 6 showed that 38% of women who had experienced preeclampsia reported not to meet the physical activity recommendation at 12 and 26 weeks postpartum. Not meeting the recommendation was associated with severe preeclampsia, cesarean section, low gestational age at birth, low birth weight and admission to the neonatal intensive care unit.

Contrary to the only other study that examined physical activity after preeclampsia conducted by Kvehaugen et al. [49], and also contrary to our clinical experience, we found that women who experienced preeclampsia more often reported to meet the physical activity recommendation than women in a reference population [50]. Based on our clinical experience we would have expected to find the opposite. This finding may be explained by the use of a different questionnaire to measure physical activity and/ or by an overestimation of self-reported physical activity in our study population. Since we did not have access to further details on the reference population, we could not discover whether our sample differs from the reference population with regard to demographic characteristics.

Our findings are not fully comparable with the findings of Kvehaugen et al. [49], since they studied physical activity 5 to 8 years postpartum, and they only reported on total physical activity. They did not report on the percentage of women who met the physical activity recommendation

nor did they report on variables that are associated with postpartum physical activity after preeclampsia. Previous research on physical activity levels among women who had gestational diabetes, who also are at increased cardiovascular and metabolic risk, showed that physical activity levels after gestational diabetes were suboptimal [51]. 31 to 50% met physical activity recommendations [52-56].

Contrary to our hypothesis, the percentage of women who met the physical activity recommendation did not increase over time. This suggests a sustained need for interventions aimed at increasing physical activity among women who had preeclampsia.

Also contrary to our hypothesis, anthropometrics, mental health, and health-related quality of life were not found to be associated with meeting the recommendation after preeclampsia. However, we expected the result that obstetric complications were associated with failure to meet the physical activity recommendation. Previous research on postpartum physical activity after gestational diabetes found that postpartum physical activity was associated with high social support and high self-efficacy among women with previous gestational diabetes [55,56].

The findings in chapter 6 suggest that for at least one third of women after preeclampsia, lifestyle interventions aimed at increasing physical activity could be appropriate, particularly for women who experienced severe preeclampsia and adverse pregnancy outcomes.

Part III: Postpartum lifestyle interventions after complicated pregnancies

Chapter 7 reports the results of a systematic review of the literature of lifestyle interventions aimed at women who had experienced preeclampsia, intrauterine growth restriction and/ or gestational diabetes, and to provide an overview of the effectiveness and characteristics of postpartum lifestyle interventions aimed at postpartum women in general. In chapter 8, the results of focus group interviews are presented concerning women's preferred characteristics of postpartum lifestyle interventions after pregnancy complications.

What postpartum lifestyle interventions are suitable for women who experienced pregnancy complications?

The review of the literature presented in chapter 7 did not identify any studies describing postpartum lifestyle interventions tailored to women with a history of a pregnancy complicated with preeclampsia, intrauterine growth restriction and/or gestational diabetes. However, the review did identify tailored weight loss and smoking interventions that were effective in postpartum women in general.

The review suggests that individually tailored postpartum weight loss interventions with both a diet and an exercise component might be used to achieve weight loss among postpartum women. Group sessions, correspondence materials, telephone contact, food diaries, or individual counseling sessions may be effective in improving postpartum diet. Furthermore, self-supervised exercise sessions, an aerobic exercise program, an individualised activity plan, correspondence

materials, telephone contact, activity diaries, and counselling sessions could be used to promote postpartum physical activity. Home visits, face-to-face counselling, and telephone counselling, might be used to promote postpartum smoking cessation and to prevent smoking relapse.

Postpartum lifestyle interventions that were based on a theoretical model were found to be effective. Therefore, it may be beneficial to apply a theoretical background to guide the development of postpartum lifestyle interventions. For example, the theoretical models of Laitakari and Asikainen [57], PRECEDE-PROCEED [58] and Stages of Change [59] might be used in the development of weight loss interventions. Smoking cessation and smoking relapse prevention interventions could be based on the principles of motivational interviewing [60], the '5As' [61,62], and Marlatt's relapse model [63,64]. However, a theoretical framework that takes into account the context of the lives of women after pregnancies complicated by preeclampsia, intrauterine growth restriction, and/or gestational diabetes may more specifically contribute to the development of effective interventions to reduce cardiovascular risk in these women [51]. To our knowledge, such a theoretical framework has not yet been described. Results from this thesis (in particular chapter 5 and 8) could provide a starting point.

Results of studies assessing the determinants of lifestyle-related behaviours among women that suffered from gestational diabetes, could also provide useful information to be taken into account when developing effective interventions for women who experienced a complicated pregnancy [51,54,56,65,66]. For example, lack of time and absence of childcare facilities have been identified as barriers to physical activity, suggesting that interventions should preferably be delivered at variable hours and should entail minimal travel time. Also, involvement of family (e.g., to provide child care) is suggested to enhance participation.

Chapter 8 reports on a qualitative study exploring the needs, ideas and opinions on postpartum lifestyle counseling of women who had experienced preeclampsia, intrauterine growth restriction, and/or gestational diabetes. The findings of this study showed that these women have a need for postpartum lifestyle counseling and that this counseling should be tailored to individual needs and preferences. According to the women in the study, participation in postpartum lifestyle counseling should preferably be tailored to individual preferences regarding the location, onset, duration, length, and frequency of personal guidance. A combination of face-to-face personal counselling and computer-tailored lifestyle advice offered on the Internet, appealed to these women. Women were motivated to participate in postpartum lifestyle interventions. They reported that they would like to be guided in adopting a healthy lifestyle, and that they would like their lifestyle to be monitored by a healthcare specialist.

In an earlier study, Zehle et al. (2008) showed that advice from a dietician, and telephone support from a health educator, were the most preferred forms of health assistance to improve dietary and physical activity habits, among women who had experienced gestational diabetes. Our results confirm the conclusion of Zehle et al. (2008) that lifestyle interventions, informed by

the beliefs and circumstances of this high-risk population, need to be developed [65].

The finding that the Internet might be a suitable medium to offer lifestyle counseling supports previous findings that the Internet can be a valuable tool to support physicians and nurses in the field of adolescent preventive care [67]. The use of a combination of face-to-face counseling and computer-tailored counseling is also supported by previous research. In the field of child preventive health care, Internet-tailored fruit and vegetable education was combined with brief counseling [68]; this integrated two-component intervention induced positive changes in knowledge and awareness of intake levels of fruit and vegetables among schoolchildren. In addition to individual counseling, our results indicate that group counseling might be suitable for women who experienced complicated pregnancies as well. However, this needs to be further examined. During the focus group meetings, women reported that they would like to share their experiences with fellow sufferers. Their preference for a location where they could meet fellow sufferers, and for a forum to get in touch with them, reflects this desire. This was also demonstrated by the spontaneous exchange of email addresses after the focus group interviews. Women generally seem to lack the company of other women who experienced the same pregnancy complication(s), probably because of limited understanding of the complication and its consequences.

9.2 Methodological considerations

While interpreting the results of this thesis, methodological considerations should be taken into account. They are listed per type of study: prospective cohort study (chapters 2, 3, 4, and 6), focus group study (chapters 5 and 8), and systematic review of the literature (chapter 7). Finally, a general consideration regarding the relatively low absolute cardiovascular and metabolic risk among women who experienced preeclampsia, intrauterine growth restriction and/ or gestational diabetes is discussed.

Prospective cohort study

The studies described in chapters 2, 3, 4 and 6 all make use of data from the Pro-Active study, a multi-center prospective cohort study. Women were only included in the Pro-Active study if they could understand and speak the Dutch language. The majority of the study population was Caucasian (predominantly Dutch). This could possibly have affected our findings. For example, ethnic minorities who are known to have an increased risk for diabetes mellitus (e.g., south and central Asian women [69,70]) were excluded. Results with regard to postpartum mental health, health-related quality of life, and lifestyle could have been different for these women. In other words, the generalizability of our findings is limited, and mostly restricted to women of Dutch origin.

In our analyses (in chapter 2, 4 and 6) ethnicity was found not to be related to the outcome measures (health-related quality of life, post-traumatic stress disorder, and postpartum physical

activity), suggesting that exclusion of these women did not substantially affect our results. However, in chapter 3, additional analyses showed that being non-Dutch was associated with reported depressive symptoms at 6 months postpartum. Therefore, our results considering the number of women with depressive symptoms might have been underestimated. Furthermore, in chapter 6 non-response analyses showed that non-native Dutch women, multiparous women, and women who had a caesarean section were underrepresented in our population for analyses. Since the results of this chapter have shown that women with a caesarean section were less likely to meet the physical activity recommendation, our data might have overestimated the proportion of women who met the physical activity recommendation.

Selection bias might have occurred, as only patients who gave birth in the Erasmus University Medical Center were included in the Pro-Active study. Patients who are admitted to this university hospital with a tertiary referral function will experience more severe complications compared to general hospitals. This explains the relatively high number of women with severe preeclampsia in the Pro-Active cohort.

There are some limitations with regard to the design of the Pro-Active study. The Pro-Active study is a prospective cohort study, and not an experimental study. Therefore, no causal inferences can be made. Since the Pro-Active study did not include a control group of women with an uncomplicated pregnancy, we compared our health-related quality of life and lifestyle scores to those of gender and age-matched reference populations. We recommend for future studies to include an appropriate control group. Furthermore, future studies should try to incorporate a baseline assessment before pregnancy to rule out any potential pre-existing differences (such as differences in the prevalence of overweight and history of depression). Such a preconceptional baseline assessment could be done retrospectively, since prospective measurement would require very large groups of women.

The samples of the studies described in part I, and chapter 6 were relatively small. This may have led to a lack of power to detect clinically meaningful differences. For example, in chapter 4 the number of women with post-traumatic stress disorder was probably too small to be able to detect differences with women without post-traumatic stress disorder.

Focus group study

Representativeness is not a prime requirement in qualitative research [71]. Nevertheless, a volunteer bias could have occurred. Although a diverse group of women were present during the focus group interviews (chapters 5 and 8), women who poorly recovered from their pregnancy complication might have volunteered to participate, whereas women who did feel recovered might have declined. However, the reverse could also be true. Women with poor health condition and lifestyle, or women whose child had died might have declined participation.

There was a low recruitment rate for the focus group studies. Reasons for non-participation included insufficient understanding of the Dutch language and not being able to attend.

The remarks on selection bias as discussed under the heading “prospective cohort study” are equally valid here, as only patients who gave birth in the Erasmus University Medical Center were included in the focus group studies.

An investigator bias may have arisen in the focus group studies. Although using more than one analyst might have improved the consistency or reliability of the analyses, the inter-rater reliability concept in qualitative research is still under debate [72,73].

Review

In the systematic review of the literature (chapter 7), non-English literature was not included, assuming that the majority of relevant papers on the effectiveness of postpartum lifestyle interventions have been published in the English language. The literature was systematically searched for relevant papers in five different databases and an additional hand search was conducted. We assume that in this way all relevant English language literature was retrieved.

Although studies reporting non-significant results were retrieved in the literature search, negative results might have been underreported due to publication bias.

We did not systematically assess the quality of the included studies. However, all included studies incorporated a control group in their design, and most of them were randomized controlled trials.

Since the participants of the included studies were diverse (e.g., they differed with regard to breastfeeding rates and baseline weight) and the interventions used were unique across the majority of the included studies, we could not estimate overall mean effects in a meta-analysis.

The relative risk to develop cardiovascular disease and diabetes mellitus type II later in life is increased in women who have experienced preeclampsia, intrauterine growth restriction and/ or gestational diabetes compared with women who experienced an uncomplicated pregnancy. E.g., preeclampsia is associated with an increased risk for (non) fatal ischemic heart disease (odds-ratio 2.2, 95%-CI 1.9-2.5) and (non) fatal stroke (odds-ratio 1.8, 95%-CI 1.4-2.3) [1]. However, the absolute risk to develop cardiovascular disease and diabetes mellitus type II in the next decades is rather low (2-8 %) since women are of relatively young age in their postpartum period [74]. Because the absolute risk to develop cardiovascular disease increases over time, it remains important for these high-risk women to monitor and lower cardiovascular and metabolic risk factors. Moreover, lowering cardiovascular risk factors at young age increases the benefit from these preventive interventions.

9.3 Recommendations for future research

1) Large longitudinal prospective cohort studies are needed to confirm and strengthen our findings. Such studies should preferably include a control cohort of postpartum women after an uncomplicated pregnancy. Ideally, they should incorporate a preconceptional baseline assessment (e.g., anthropometrics, psychiatric history) to take pre-existing differences into account. Postpartum mental health, health-related quality of life and lifestyle should also be measured later (e.g. at 12 months postpartum), not only in women after preeclampsia, but also after gestational diabetes or intrauterine growth restriction. Several components of a healthy lifestyle should be examined, including physicl activity, saturated fat intake and smoking.

2) Future studies should assess the availability and quality of current postpartum care, in order to have a baseline to improve upon.

3) The findings of the focus group studies in chapter 5 and 8 should be confirmed in representative samples. The prevalence and relative importance of the reported motivators and barriers to adoption of a healthy postpartum lifestyle should be determined in quantitative studies. E.g., we recommend to further study whether postpartum mental health problems are a barrier for living a healthy postpartum lifestyle, and if so, how such problems may be best dealt with.

4) Postpartum lifestyle interventions tailored for women who have experienced preeclampsia, intrauterine growth restriction, and/ or gestational diabetes should be developed. This thesis provides a starting point for developing such interventions. Eventually, the (long-term) efficacy of these interventions should be tested.

9.4 Recommendations for practice

1) Women who experience preeclampsia should be screened for their need of intensified, extended or customized postpartum care. Screen positives should be referred for further assessment and treatment.

2) Obstetric caregivers should routinely inform women who have experienced preeclampsia, intrauterine growth restriction and/ or gestational diabetes about their risks for recurrence of the complication in a subsequent pregnancy, their increased cardiovascular and metabolic risk, and the importance of the adoption of a healthy lifestyle. Women with an unhealthy lifestyle should be identified and encouraged to improve their lifestyle. If needed, they should be referred to a specialised health care professional, such as a dietician.

3) Awaiting the development of tailored interventions, lifestyle interventions that are effective in postpartum women in general should be considered for use in women who have experienced

preeclampsia, intrauterine growth restriction, and/or gestational diabetes. Interventions addressing weight loss, smoking cessation, or prevention of smoking relapse have proven to be effective.

9.5 General conclusion

This thesis has increased our knowledge and insights regarding postpartum mental health, health-related quality of life, lifestyle, and promotion of a healthy lifestyle after pregnancies complicated by preeclampsia, intrauterine growth restriction, and/ or gestational diabetes. There is a need for improvement of postpartum mental health, health-related quality of life, and postpartum lifestyle, particularly after severe preeclampsia. Women should be assessed for their need of intensified, extended or customized postpartum care after pregnancy complications. This thesis provides a starting point for developing postpartum lifestyle interventions tailored for women who have experienced preeclampsia, intrauterine growth restriction, and/ or gestational diabetes. Awaiting the results of research on the effectiveness of tailored postpartum lifestyle interventions, existing effective postpartum lifestyle interventions should be considered for use in women who have experienced complicated pregnancies.

REFERENCES

1. Bellamy L, Casas JP, Hingorani AD, Williams DJ. Pre-eclampsia and risk of cardiovascular disease and cancer in later life: systematic review and meta-analysis. Bmj. 2007 Nov 10;335(7627):974.

2. Ray JG, Vermeulen MJ, Schull MJ, Redelmeier DA. Cardiovascular health after maternal placental syndromes (CHAMPS): population-based retrospective cohort study. Lancet. 2005 Nov 19;366(9499):1797-803.

3. Sattar N, Greer IA. Pregnancy complications and maternal cardiovascular risk: opportunities for intervention and screening? Bmj. 2002 Jul 20;325(7356):157-60.

4. Smith GC, Pell JP, Walsh D. Pregnancy complications and maternal risk of ischaemic heart disease: a retrospective cohort study of 129,290 births. Lancet. 2001 Jun 23;357(9273):2002-6.

5. Barker DJ. Adult consequences of fetal growth restriction. Clinical obstetrics and gynecology. 2006 Jun;49(2):270-83.

6. Di Cianni G, Ghio A, Resi V, Volpe L. Gestational diabetes mellitus: an opportunity to prevent type 2 diabetes and cardiovascular disease in young women. Women's health (London, England). 2010 Jan;6(1):97-105.

7. Shah BR, Retnakaran R, Booth GL. Increased risk of cardiovascular disease in young women following gestational diabetes mellitus. Diabetes care. 2008 Aug;31(8):1668-9.

8. Bellamy L, Casas JP, Hingorani AD, Williams D. Type 2 diabetes mellitus after gestational diabetes: a systematic review and meta-analysis. Lancet. 2009 May 23;373(9677):1773-9.

9. Brug J, Oenema A, Ferreira I. Theory, evidence and Intervention Mapping to improve behavior nutrition and physical activity interventions. The international journal of behavioral nutrition and physical activity. 2005 Apr 4;2(1):2.

10. Ware JE, Kosinski M. Interpreting SF-36 summary health measures: a response. Qual Life Res. 2001;10(5):405-13; discussion 15-20.

11. Ware JE, Snow KK, Kosinski M, Gandek BG. SF-36 health survey: manual and interpretation guide. Boston, MA: Health Institute, New England Medical Center 1993.

12. Cox JL, Holden, J. Perinatal mental health. A guide to the Edinburgh Postnatal Depression Scale. 2003.

13. 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.

14. Hovens JE, van der Ploeg HM, Bramsen I, Klaarenbeek MT, Schreuder JN, Rivero VV. The development of the Self-Rating Inventory for Posttraumatic Stress Disorder. Acta psychiatrica Scandinavica. 1994 Sep;90(3):172-83.

15. Hovens JE, van der Ploeg HM, Bramsen I, Reuling IE. Test-retest reliability of the self-rating inventory for posttraumatic stress disorder. Psychological reports. 2000 Dec;87(3 Pt 1):735-7.

16. Hill PD, Aldag JC. Maternal perceived quality of life following childbirth. J Obstet Gynecol Neonatal Nurs. 2007 Jul-Aug;36(4):328-34.

17. Torkan B, Parsay S, Lamyian M, Kazemnejad A, Montazeri A. Postnatal quality of life in women after normal vaginal delivery and caesarean section. BMC Pregnancy Childbirth. 2009;9:4.

18. Kim C, Brawarsky P, Jackson RA, Fuentes-Afflick E, Haas JS. Changes in health status experienced by women with gestational diabetes and pregnancy-induced hypertensive disorders. J Womens Health (Larchmt). 2005 Oct;14(8):729-36.

19. Jansen AJ, Duvekot JJ, Hop WC, Essink-Bot ML, Beckers EA, Karsdorp VH, et al. New insights into fatigue and health-related quality of life after delivery. Acta Obstet Gynecol Scand. 2007;86(5):579-84.

20. van Pampus MG, Wolf H, Mayruhu G, Treffers PE, Bleker OP. Long-term follow-up in patients with a history of (H)ELLP syndrome. Hypertens Pregnancy. 2001;20(1):15-23.

21. Rep A, Ganzevoort W, Bonsel GJ, Wolf H, de Vries JI. Psychosocial impact of early-onset hypertensive disorders and related complications in pregnancy. American journal of obstetrics and gynecology. 2007 Aug;197(2):158 e1-6.

22. Meyer EC, Garcia Coll CT, Seifer R, Ramos A, Kilis E, Oh W. Psychological distress in mothers of preterm infants. J Dev Behav Pediatr. 1995 Dec;16(6):412-7.

23. Perrins J, King N, Collings J. Assessment of long-term psychological well-being following intensive care. Intensive Crit Care Nurs. 1998 Jun;14(3):108-16.

24. Gausia K, Fisher C, Ali M, Oosthuizen J. Magnitude and contributory factors of postnatal depression: a community-based cohort study from a rural subdistrict of Bangladesh. Psychological medicine. 2009 Jun;39(6):999-1007.

25. Olde E, van der Hart O, Kleber R, van Son M. Posttraumatic stress following childbirth: a review. Clinical psychology review. 2006 Jan;26(1):1-16.

26. Engelhard IM, van Rij M, Boullart I, Ekhart TH, Spaanderman ME, van den Hout MA, et al. Posttraumatic stress disorder after pre-eclampsia: an exploratory study. Gen Hosp Psychiatry. 2002 Jul-Aug;24(4):260-4.

27. Poel YH, Swinkels P, de Vries JI. Psychological treatment of women with psychological complaints after pre-eclampsia. Journal of psychosomatic obstetrics and gynaecology. 2009 Mar;30(1):65-72.

28. Baecke M, Spaanderman ME, van der Werf SP. Cognitive function after pre-eclampsia: an explorative study. Journal of psychosomatic obstetrics and gynaecology. 2009 Mar;30(1):58-64.

29. Ayers S, Harris R, Sawyer A, Parfitt Y, Ford E. Posttraumatic stress disorder after childbirth: analysis of symptom presentation and sampling. Journal of affective disorders. 2009 Dec;119(1-3):200-4.

30. Cigoli V, Gilli G, Saita E. Relational factors in psychopathological responses to childbirth. Journal of psychosomatic obstetrics and gynaecology. 2006 Jun;27(2):91-7.

31. Maggioni C, Margola D, Filippi F. PTSD, risk factors, and expectations among women having a baby: a two-wave longitudinal study. Journal of psychosomatic obstetrics and gynaecology. 2006 Jun;27(2):81-90.

32. Soet JE, Brack GA, DiIorio C. Prevalence and predictors of women's experience of psychological trauma during childbirth. Birth (Berkeley, Calif. 2003 Mar;30(1):36-46.

33. Ayers S, Pickering AD. Do women get posttraumatic stress disorder as a result of childbirth? A prospective study of incidence. Birth (Berkeley, Calif. 2001 Jun;28(2):111-8.

34. Wijma K, Soderquist J, Wijma B. Posttraumatic stress disorder after childbirth: a cross sectional study. Journal of anxiety disorders. 1997 Nov-Dec;11(6):587-97.

35. Zaers S, Waschke M, Ehlert U. Depressive symptoms and symptoms of post-traumatic stress disorder in women after childbirth. Journal of psychosomatic obstetrics and gynaecology. 2008 Mar;29(1):61-71.

36. Badenhorst W, Hughes P. Psychological aspects of perinatal loss. Best practice & research. 2007 Apr;21(2):249-59.

37. Lefkowitz DS, Baxt C, Evans JR. Prevalence and correlates of posttraumatic stress and postpartum depression in parents of infants in the Neonatal Intensive Care Unit (NICU). Journal of clinical psychology in medical settings. 2010 Sep;17(3):230-7.

38. Vanderbilt D, Bushley T, Young R, Frank DA. Acute posttraumatic stress symptoms among urban mothers with newborns in the neonatal intensive care unit: a preliminary study. J Dev Behav Pediatr. 2009 Feb;30(1):50-6.

39. Lau Y, Yin L. Maternal, obstetric variables, perceived stress and health-related quality of life among pregnant women in Macao, China. Midwifery. May 11.

40. Gamper G, Willeit M, Sterz F, Herkner H, Zoufaly A, Hornik K, et al. Life after death: posttraumatic stress disorder in survivors of cardiac arrest--prevalence, associated factors, and the influence of sedation and analgesia. Critical care medicine. 2004 Feb;32(2):378-83.

41. Scragg P, Jones A, Fauvel N. Psychological problems following ICU treatment. Anaesthesia. 2001 Jan;56(1):9-14.

42. Labouvie-Vief G, DeVoe M, Bulka D. Speaking about feelings: conceptions of emotion across the life span. Psychology and aging. 1989 Dec;4(4):425-37.

43. Fraser AM, Brockert JE, Ward RH. Association of young maternal age with adverse reproductive outcomes. The New England journal of medicine. 1995 Apr 27;332(17):1113-7.

44. Sibai B, Dekker G, Kupferminc M. Pre-eclampsia. Lancet. 2005 Feb 26-Mar 4;365(9461):785-99.

45. van Rijn BB, Hoeks LB, Bots ML, Franx A, Bruinse HW. Outcomes of subsequent pregnancy after first pregnancy with early-onset preeclampsia. American journal of obstetrics and gynecology. 2006 Sep;195(3):723-8.

46. Craig CL, Marshall AL, Sjostrom M, Bauman AE, Booth ML, Ainsworth BE, et al. International physical activity questionnaire: 12-country reliability and validity. Medicine and science in sports and exercise. 2003 Aug;35(8):1381-95.

47. Roes EM, Raijmakers MT, Schoonenberg M, Wanner N, Peters WH, Steegers EA. Physical well-being in women with a history of severe preeclampsia. J Matern Fetal Neonatal Med. 2005 Jul;18(1):39-45.

48. Ajzen I. The Theory of Planned Behavior. Organizational Behavior and Human Decision Processes. 1991;50:179-211.

49. Kvehaugen AS, Andersen LF, Staff AC. Dietary intake and physical activity in women and offspring after pregnancies complicated by preeclampsia or diabetes mellitus. Acta obstetricia et gynecologica Scandinavica. 2010 Nov;89(11):1486-90.

50. CBS. Gezondheid, leefstijl, gebruik van zorg 2010 [cited 2011 25 february 2011]; Available from: http://statline.cbs.nl/StatWeb/publication/?DM=SLNL&PA=03799&D1=152-153,183-189,227-241&D2=0-17&D3=0&D4=a&VW=T

51. Jones EJ, Roche CC, Appel SJ. A review of the health beliefs and lifestyle behaviors of women with previous gestational diabetes. J Obstet Gynecol Neonatal Nurs. 2009 Sep-Oct;38(5):516-26.

52. Kieffer EC, Sinco B, Kim C. Health behaviors among women of reproductive age with and without a history of gestational diabetes mellitus. Diabetes care. 2006 Aug;29(8):1788-93.

53. Kim C, McEwen LN, Kerr EA, Piette JD, Chames MC, Ferrara A, et al. Preventive counseling among women with histories of gestational diabetes mellitus. Diabetes care. 2007 Oct;30(10):2489-95.

54. Symons Downs D, Ulbrecht JS. Understanding exercise beliefs and behaviors in women with gestational diabetes mellitus. Diabetes care. 2006 Feb;29(2):236-40.

55. Koh D, Miller YD, Marshall AL, Brown WJ, McIntyre D. Health-enhancing physical activity behaviour and related factors in postpartum women with recent gestational diabetes mellitus. Journal of science and medicine in sport / Sports Medicine Australia. 2010 Jan;13(1):42-5.

56. Smith BJ, Cheung NW, Bauman AE, Zehle K, McLean M. Postpartum physical activity and related psychosocial factors among women with recent gestational diabetes mellitus. Diabetes care. 2005 Nov;28(11):2650-4.

57. Laitakari J, Asikainen TM. How to promote physical activity through individual counseling--a proposal for a practical model of counseling on health-related physical activity. Patient Educ Couns. 1998 Apr;33(1 Suppl):S13-24.

58. Green L, Kreuter M, Deeds S, Partridge K. Health education planning. A diagnostic approach. Palo Alto: Mayfield Publishing Company 1980.

59. Prochaska JO, Velicer WF. The transtheoretical model of health behavior change. Am J Health Promot. 1997 Sep-Oct;12(1):38-48.

60. Miller WR, Rollnick S. Motivational Interviewing: preparing people to change addictive behaviour. New York: Guilford 1991.

61. Smoking cessation. Washington D.C.: Agency for health care policy and research: smoking cessation guideline panel; 1996.

62. Fiore MC, Bailey WC, Cohen SJ, Goldstein MG, Gritz ER, al. E. Treating tobacco use and dependence. Clinical practice guideline. U.S. Department of Health and Human Services. Public Health Service. Rockville, MD 2000.

63. Marlatt GA. Relapse prevention: Theoretical rationale and overview of the model. In: Marlatt GA, Gordon JR, eds. *Relapse prevention: maintenance strategies in the treatment of addictive behaviors*. New York: Guilford Press 1985:3-70.

64. Marlatt GA. Taxonomy of high-risk situations for alcohol relapse: evolution and development of a cognitive-behavioral model. Addiction (Abingdon, England). 1996 Dec;91 Suppl:S37-49.

65. Zehle K, Smith BJ, Chey T, McLean M, Bauman AE, Cheung NW. Psychosocial factors related to diet among women with recent gestational diabetes: opportunities for intervention. Diabetes Educ. 2008 Sep-Oct;34(5):807-14.

66. Kieffer EC, Willis SK, Arellano N, Guzman R. Perspectives of pregnant and postpartum latino women on diabetes, physical activity, and health. Health Educ Behav. 2002 Oct;29(5):542-56.

67. Mangunkusumo R, Brug J, Duisterhout J, de Koning H, Raat H. Feasibility, acceptability, and quality of Internet-administered adolescent health promotion in a preventive-care setting. Health Educ Res. 2007 Feb;22(1):1-13.

68. Mangunkusumo RT, Brug J, de Koning HJ, van der Lei J, Raat H. School-based internet-tailored fruit and vegetable education combined with brief counselling increases children's awareness of intake levels. Public Health Nutr. 2007 Mar;10(3):273-9.

69. Savitz DA, Janevic TM, Engel SM, Kaufman JS, Herring AH. Ethnicity and gestational diabetes in New York City, 1995-2003. Bjog. 2008 Jul;115(8):969-78.

70. Thorpe LE, Berger D, Ellis JA, Bettegowda VR, Brown G, Matte T, et al. Trends and racial/ethnic disparities in gestational diabetes among pregnant women in New York City, 1990-2001. American journal of public health. 2005 Sep;95(9):1536-9.

71. Mays N, Pope C. Rigour and qualitative research. BMJ (Clinical research ed. 1995 Jul 8;311(6997):109-12.

72. Armstrong D, Gosling A, Weinman J, Marteau T. The place of inter-rater reliability in qualitative research: an empirical study. Sociology. 1997;31(3):597-606.

73. Pope C, Ziebland S, Mays N. Qualitative research in health care. Analysing qualitative data. BMJ (Clinical research ed. 2000 Jan 8;320(7227):114-6.

74. Steegers EA, von Dadelszen P, Duvekot JJ, Pijnenborg R. Pre-eclampsia. Lancet. 2010 Aug 21;376(9741):631-44.

SUMMARY

Women with an obstetric history of preeclampsia, intrauterine growth restriction and/ or gestational diabetes share an increased risk for future cardiovascular disease and type II diabetes mellitus. For these women, the postpartum period offers opportunities for preventive lifestyle interventions. To date, little is known on what lifestyle interventions should be recommended. In the context of the model of planned health education and promotion, this thesis aimed to describe postpartum mental health, health-related quality of life (part I) and lifestyle (part II) in women after such placenta-related pregnancy complications, and to examine which postpartum lifestyle interventions seem promising for preventing cardiovascular disease and type II diabetes mellitus in these women (part III). The studies described in this thesis were conducted as part of the Pro-Active (Postpartum Rotterdam Appraisal of Cardiovascular Health and Tailored Intervention) study, a prospective multi-center cohort study coordinated by the Erasmus University Medical Center Rotterdam, the Netherlands. The research questions addressed in this thesis can be formulated as follows:

Part I: Postpartum mental health and health-related quality of life after preeclampsia.
1) To what extent do women who had preeclampsia experience a good postpartum health-related quality of life, and what are its determinants? (Chapter 2)
2) To what extent do women who had preeclampsia experience a good postpartum mental health, and what are its determinants? (Chapter 2, 3 and 4)

Part II: Postpartum lifestyle and its determinants
3) How healthy is the postpartum lifestyle of women who experienced pregnancy complications, and what are its determinants? (Chapter 5 and 6)

Part III: Postpartum lifestyle interventions after complicated pregnancies
4) What postpartum lifestyle interventions are suitable for women who experienced pregnancy complications? (Chapter 7 and 8)

Postpartum mental health and health-related quality of life after preeclampsia.
Part I of this thesis aimed to gain more insight into the postpartum mental health and health-related quality of life in women after pregnancy complications. This part focuses on women who have experienced preeclampsia. In chapter 2, postpartum health-related quality of life among formerly preeclamptic women was assessed. We found that women had a poor health-related quality of life after preeclampsia, especially after severe preeclampsia. Neonatal intensive care unit admission and perinatal death were found to be associated with this poorer mental health-related quality of life among women with severe preeclampsia. Chapters 3 and 4 focus on postpartum mental health. Chapter 3 describes postpartum depression after a pregnancy complicated with preeclampsia. We found that 23% of women experienced postpartum

depressive symptoms up to 6 months postpartum after mild preeclampsia, compared with 44% after severe preeclampsia. Admission to the neonatal intensive care unit and perinatal death appeared to be associated with postpartum depression after severe preeclampsia. Chapter 4 describes post-traumatic stress disorder after a pregnancy complicated with preeclampsia. The prevalence of post-traumatic stress disorder after preeclampsia was 9% at 6 weeks, and 5% at 12 weeks postpartum. Young age (< 30 years), severe preeclampsia, caesarean section, premature birth, low birth weight, admission to the neonatal intensive care unit, and perinatal death were found to be associated with the presence of symptoms of post-traumatic stress disorder.

Postpartum lifestyle and its determinants

Part II of this thesis aimed to gain more insight into postpartum lifestyle behavior and determinants of postpartum lifestyle behavior among women who experienced pregnancy complications. Chapter 5 describes motivators and barriers to postpartum lifestyle behavior in women who previously experienced preeclampsia, intrauterine growth restriction, and/or gestational diabetes. Improvement of current and future health condition was reported to be a motivator for adoption of a healthy lifestyle. However, many women reported not to succeed in adopting a healthy lifestyle. Limited recovery from their complications was reported to be an important determinant. Chapter 6 describes postpartum physical activity in formerly preeclamptic women. We found that about 38% reported not to meet the physical activity recommendation at 3 and 6 months postpartum after preeclampsia. Severe preeclampsia and adverse pregnancy outcomes were found to be associated with not meeting the physical activity recommendation.

Postpartum lifestyle interventions after complicated pregnancies

Part III aimed to gain more insight into postpartum lifestyle interventions that are suitable for women who have experienced pregnancy complications. Chapter 7 describes postpartum lifestyle interventions and their effectiveness. No studies describing postpartum lifestyle interventions tailored for women with a history of a pregnancy complicated with preeclampsia, intrauterine growth restriction and/or gestational diabetes were found. However, tailored weight loss and smoking interventions that have been proven to be effective in postpartum women in general were identified. Chapter 8 describes women's preferences for postpartum lifestyle counseling after pregnancy complications. We found that women prefer a combination of face-to-face and Internet counseling, tailored to their preferences regarding the location, onset, duration, length, and frequency of personal guidance.

Chapter 9 provides a general discussion of the main findings. Furthermore, methodological issues, recommendations for future research and recommendations for clinical practice are discussed. This thesis has shown that there is a need for improvement of postpartum mental health, health-related quality of life, and lifestyle, particularly after severe preeclampsia. Therefore, women

should be assessed for their need of intensified, extended or customized postpartum care after pregnancy complications. This thesis provides a starting point for developing postpartum lifestyle interventions tailored for women who have experienced preeclampsia, intrauterine growth restriction, and/ or gestational diabetes. Awaiting the results of research on the effectiveness of tailored postpartum lifestyle interventions, existing effective postpartum lifestyle interventions should be considered for use in women who have experienced these complicated pregnancies.

SAMENVATTING

Vrouwen met preeclampsie, intra-uteriene groei restrictie en/ of diabetes gravidarum in de obstetrische voorgeschiedenis hebben een verhoogd risico om hart- en vaatziekten en diabetes mellitus type II te ontwikkelen op latere leeftijd. Voor deze vrouwen biedt de postpartum periode mogelijkheden voor preventieve leefstijlinterventies. Tot op heden is er weinig bekend over welke leefstijlinterventies gebruikt zouden kunnen worden. In het kader van het model voor planmatige gezondheidsvoorlichting en gezondheidsbevordering, heeft dit proefschrift tot doel gehad de mentale postpartum gezondheid, gezondheidsgerelateerde kwaliteit van leven (deel I) en leefstijl (deel II) te beschrijven van vrouwen die dergelijke zwangerschapscomplicaties hebben gehad, alsmede te onderzoeken welke postpartum leefstijlinterventies veelbelovend lijken voor de preventie van hart- en vaatziekten en diabetes mellitus type II (deel III). De studies die in dit proefschrift worden beschreven zijn uitgevoerd in het kader van de Pro-Active (Postpartum Rotterdam Appraisal of Cardiovascular Health and Tailored Intervention) studie, een multi-center prospectieve cohort studie gecoördineerd door het Erasmus MC Rotterdam. De onderzoeksvragen kunnen als volgt worden geformuleerd:

Deel I: Postpartum mentale gezondheid en gezondheidsgerelateerde kwaliteit van leven na preeclampsie.

1) In hoeverre ervaren vrouwen die preeclampsie hebben gehad een goede postpartum gezondheidsgerelateerde kwaliteit van leven en wat zijn de determinanten daarvan? (Hoofdstuk 2) In hoeverre ervaren vrouwen die preeclampsie hebben gehad een goede postpartum mentale gezondheid en wat zijn de determinanten daarvan? (Hoofdstuk 2, 3 en 4)

Deel II: Postpartum leefstijl en determinanten daarvan

3) Hoe gezond is de postpartum leefstijl van vrouwen die zwangerschapscomplicaties hebben gehad en wat zijn de determinanten daarvan? (Hoofdstuk 5 en 6)

Deel III: Postpartum leefstijlinterventies na gecompliceerde zwangerschappen

4) Welke postpartum leefstijlinterventies zijn geschikt voor toepassing bij vrouwen die zwangerschapscomplicaties hebben gehad? (Hoofdstuk 7 en 8)

Postpartum mentale gezondheid en gezondheidsgerelateerde kwaliteit van leven na preeclampsie.

Deel I van dit proefschrift had tot doel meer inzicht te verkrijgen in de postpartum mentale gezondheid en gezondheidsgerelateerde kwaliteit van leven van vrouwen na gecompliceerde zwangerschappen. Dit deel is gericht op vrouwen die preeclampsie hebben gehad. In hoofdstuk 2 werd de postpartum gezondheidsgerelateerde kwaliteit van leven getoetst. We vonden dat vrouwen na preeclampsie een slechte gezondheidsgerelateerde kwaliteit van leven hadden, met name na ernstige preeclampsie. Opname op de neonatale intensive care unit en perinatale sterfte waren geassocieerd met deze slechtere gezondheidsgerelateerde kwaliteit van leven bij

vrouwen na ernstige preeclampsie. Hoofdstukken 3 en 4 beschrijven de postpartum mentale gezondheid. Hoofdstuk 3 geeft een beschrijving van postpartum depressie na een zwangerschap die gecompliceerd werd door preeclampsie. Na milde preeclampsie had 23% van de vrouwen depressieve symptomen tot 6 maanden na de bevalling, terwijl 44% depressieve symptomen had na ernstige preeclampsie. Opname op de neonatale intensive care unit en perinatale sterfte waren geassocieerd met postpartum depressie na ernstige preeclampsie. Hoofdstuk 4 beschrijft posttraumatische stress na preeclampsie. De prevalentie van posttraumatische stress stoornis na preeclampsie was 9% op 6 weken postpartum en 5% op 12 weken postpartum. Jongere leeftijd (< 30 jaar), ernstige preeclampsie, sectio, premature bevalling, laag geboortegewicht, opname op de neonatale intensive care unit en perinatale sterfte waren geassocieerd met de aanwezigheid van posttraumatische stress symptomen.

Postpartum leefstijl en determinanten daarvan

Deel II van dit proefschrift had tot doel meer inzicht te verkrijgen in postpartum leefstijlgedragingen en de determinanten daarvan bij vrouwen die zwangerschapscomplicaties hebben gehad. Hoofdstuk 5 beschrijft motiverende en beperkende factoren met betrekking tot postpartum leefstijlgedrag bij vrouwen die preeclampsie, intra-uteriene groei restrictie en/ of diabetes gravidarum hebben gehad. Verbetering van de huidige en de toekomstige gezondheid werden gerapporteerd als motiverende factoren voor het aannemen van een gezonde leefstijl. Echter, veel vrouwen rapporteerden dat zij er niet in slaagden om een gezonde postpartum leefstijl aan te nemen. Een beperkt herstel van de zwangerschapscomplicatie werd als belangrijke beperkende factor voor het aannemen van een gezonde leefstijl genoemd. Hoofdstuk 6 beschrijft de postpartum fysieke activiteit bij vrouwen die preeclampsie hebben gehad. Achtendertig procent van de vrouwen rapporteerden dat zij niet voldeden aan de beweegnorm tot 6 maanden na de bevalling. Ernstige preeclampsie en andere ongunstige zwangerschapsuitkomsten waren geassocieerd met fysieke activiteit onder de beweegnorm.

Postpartum leefstijlinterventies na gecompliceerde zwangerschappen

Deel III had tot doel meer inzicht te verkrijgen in welke postpartum leefstijlinterventies geschikt zijn voor vrouwen die zwangerschapscomplicaties hebben gehad. Hoofdstuk 7 geeft een beschrijving van postpartum leefstijlinterventies en de effectiviteit van deze interventies. Er werden geen leefstijlinterventies aangetroffen die specifiek waren gericht op vrouwen die preeclampsie, intra-uteriene groei restrictie en/ of diabetes gravidarum hebben gehad. Er werden wel effectieve leefstijlinterventies gericht op postpartum vrouwen in het algemeen aangetroffen. Hoofdstuk 8 beschrijft de voorkeuren van vrouwen die zwangerschapscomplicaties hebben gehad met betrekking tot postpartum leefstijl counseling. Vrouwen hadden een voorkeur voor een combinatie van face-to-face en internet counseling op maat, aangeboden naar persoonlijke voorkeur voor de locatie, start, duur, lengte en frequentie van de persoonlijke begeleiding.

In hoofdstuk 9 wordt een algemene discussie van de bevindingen in dit proefschrift beschreven. Tevens worden in dit hoofdstuk methodologische zaken, aanbevelingen voor toekomstig onderzoek en aanbevelingen voor de klinische praktijk besproken. Dit proefschrift heeft laten zien dat er behoefte is aan verbetering van de postpartum mentale gezondheid, gezondheidsgerelateerde kwaliteit van leven en leefstijl na zwangerschapscomplicaties, met name na ernstige preeclampsie. De behoefte voor geïntensiveerde, verlengde of gebruikersspecifieke postpartum zorg zou in kaart moeten worden gebracht bij vrouwen die dergelijke zwangerschapscomplicaties hebben gehad. Dit proefschrift kan gezien worden als startpunt voor het ontwikkelen van postpartum leefstijlinterventies op maat voor vrouwen die preeclampsie, intra-uteriene groei restrictie en/of diabetes gravidarum hebben gehad. Terwijl de resultaten van onderzoek naar de effectiviteit van dergelijke postpartum leefstijlinterventies op maat worden afgewacht, zou het gebruik van bestaande effectieve postpartum leefstijlinterventies in deze groep vrouwen moeten worden overwogen.

Manuscripts

Manuscripts based on this thesis

Chapter 2	M. Hoedjes, D. Berks, I. Vogel, A. Franx, J.J. Duvekot, E.A.P. Steegers, H. Raat. **Poor health-related quality of life after severe preeclampsia.** *Birth. 2011 Sep;38(3):246-55. PMID:21884233*
Chapter 3	M. Hoedjes, D. Berks, I. Vogel, A. Franx, M. Bangma, A.S. Darlington, W. Visser, J.J. Duvekot, J.D.F. Habbema, E.A.P. Steegers, H. Raat. **Postpartum depression after mild and severe preeclampsia.** *J Womens Health (Larchmt). 2011 Oct;20(10):1535-42. PMID:21815820*
Chapter 4	M. Hoedjes, D. Berks, I. Vogel, A. Franx, W. Visser, J.J. Duvekot, J.D.F. Habbema, E.A.P. Steegers, H. Raat. **Symptoms of post-traumatic stress after preeclampsia.** *J Psychosom Obstet Gynecol. 2011; 32(3): 126-134. PMID:21824043*
Chapter 5	M. Hoedjes, D. Berks, I. Vogel, A. Franx, J.J. Duvekot, A. Oenema, E.A.P. Steegers, H. Raat. **Motivators and barriers to a healthy postpartum lifestyle in women at increased cardiovascular and metabolic risk: a focus group study.** *Hypertens Pregnancy. 2011 Jan 20. [Epub ahead of print] PMID: 21250888*
Chapter 6	M. Hoedjes, D. Berks, I. Vogel, A. Franx, A. Oenema, J.J. Duvekot, J.D.F. Habbema, E.A.P. Steegers, H. Raat. **Postpartum physical activity after preeclampsia.** *Submitted.*
Chapter 7	M. Hoedjes, D. Berks, I. Vogel, A. Franx, W. Visser, J.J. Duvekot, J.D.F. Habbema, E.A.P. Steegers, H. Raat. **Effect of postpartum lifestyle interventions on weight loss, smoking cessation, and prevention of smoking relapse: a systematic review.** *Obstet Gynecol Surv. 2010 Oct;65(10):631-52. PMID: 21182803*
Chapter 8	M. Hoedjes, D. Berks, I. Vogel, J.J. Duvekot, A. Oenema, A. Franx, E.A.P. Steegers, H. Raat. **Preferences for postpartum lifestyle counseling among women sharing an increased cardiovascular and metabolic risk: a focus group study.** *Hypertens Pregnancy. 2011;30(1):83-92. PMID: 20818968*

Curriculum Vitae

Curriculum Vitae

Meeke Hoedjes was born in Goirle, the Netherlands, on the 5th of October 1979. In 1999 she finished her pre-university education (VWO) at the Koning Willem II college in Tilburg. From 2000-2002, she studied psychology at the Free University, Amsterdam. From 2003-2006 she studied psychology at Tilburg University. She obtained her master's degree in 2006, and graduated with a major in clinical health psychology and a minor in clinical neuropsychology. During graduation, she chose to write two master's theses instead of a master's thesis and an internship because of her interest in scientific research. Both master's theses dealt with informed choice and knowledge about prenatal screening and diagnostic tests. The research for both theses was conducted at the department of Obstetrics and Gynecology at the St. Elisabeth hospital in Tilburg. From 2006-2010 she was appointed as junior researcher and PhD-student at the Department of Public Health, Erasmus University Medical Center Rotterdam. During her PhD, she worked on the Pro-Active (Postpartum Rotterdam Appraisal of Cardiovascular health and Tailored Intervention) study, a multi-center prospective cohort study conducted in close collaboration with the department of Obstetrics and Gynecology of the Erasmus University Medical Center.

PhD portfolio

PhD Portfolio

Summary of PhD training and teaching

Name PhD student: M. Hoedjes	PhD period: 2006-2010
Erasmus MC Department: Public Health	Promotors: Prof. dr. J.D.F. Habbema
	Prof. dr. E.A.P. Steegers
	Co-promotors: Dr. H. Raat
	Dr. J.J. Duvekot

	Year	Workload (ECTS)
1. PhD training		
Research Skills		
Netherlands Institute for Health Sciences (NIHES), Erasmus University Rotterdam, the Netherlands:		
Quality of life measurement	2010	0.9
Social epidemiology	2010	0.7
Primary and secondary prevention research	2010	0.7
Cohort studies	2010	0.7
Causal inference	2010	0.7
Clinical decision analysis	2010	0.7
Topics in meta-analysis	2010	0.7
General Academic skills		
Biomedical English writing and communication	2009	4.0
MS Access cursus, Zorgacademie Erasmus MC	2008	0.6
Presentatiecursus ”Eigenwijs presenteren- Een training in het geven van wetenschappelijke presentaties”.	2008	0.3
Seminars and workshops		
-Workshop “Theorie en praktijk van motivational interviewing”. Centre for Motivation and Change, Hilversum, the Netherlands.	2007	1.0
-Attending seminars of the department of Public Health, Erasmus MC Rotterdam, the Netherlands.	2006-2010	3.6
Presentations		
-Presentation research meeting at the Department of Public Health, Erasmus MC, Rotterdam, the Netherlands.	2007	0.6
-Presentatie research meeting Verloskunde &Vrouwenziekten, Erasmus MC, Rotterdam, The Netherlands.	2007	0.6
-DSM, Delft, the Netherlands.	2007	0.6
-Twee presentaties Pro-Active studie, St. Elisabeth ziekenhuis Tilburg, the Netherlands.	2007/2008	1.2

-Presentatie gemeenschappelijke researchbespreking Moeder en Kind Centrum, Erasmus MC Sophia kinderziekenhuis.	2008	0.6
-Presentatie research meeting afdeling Maatschappelijke gezondheidszorg, sectie Determinanten van Gezond Gedrag, Erasmus MC, Rotterdam, the Netherlands.	2008	0.6
-Patiënten informatieavond Pro-active studie, Erasmus MC, Rotterdam, the Netherlands.	2008	0.6
-Drie presentaties begeleidingscommissie Pro-Active studie, Erasmus MC, Rotterdam, the Netherlands.	2007-2009	1.8
-Researchmeeting Afdeling Verloskunde & Vrouwenziekten Erasmus MC, Rotterdam, the Netherlands.	2010	0.6
(Inter)national conferences- participation and presentations		
-ISSHP 2010, XVII World Congress of the International Society for the study of Hypertension in Pregnancy, Melbourne, Australia. "Poor Health-Related Quality of Life after severe preeclampsia". Oral presentation. *Young Investigator award.*	2010	1.3
-ISOM 2010, Congress of the International society of Obstetric Medicine, Melbourne, Australia. "Post-traumatic stress disorder after preeclampsia". Oral presentation.	2010	1.3
-ISOM 2010, Congress of the International society of Obstetric Medicine, Melbourne, Australia. "The effect of postpartum lifestyle interventions on weight loss, smoking cessation, and prevention of smoking relapse: a systematic review". Poster presentation.	2010	1.3
-ISSHP 2008, XVI World Congress of the International Society for the study of Hypertension in Pregnancy, Washington, United States of America. "Postpartum depression after mild and severe preeclampsia." Poster presentation.	2008	1.3
-Nederlanse Werkgroep Preeclampsie (NedWep), Utrecht, the Netherlands.	2008	0.3
-Congres Infertiliteit, gynaecologie en obstetrie. "Risicofactoren leefstijl en mogelijkheden tot interventie". De doelen, Rotterdam, the Netherlands.	2007	0.3
-Exchange meeting Cambridge, Amsterdam, Ghent, Gent, Belgium.	2007	0.5
-Conferentie Migratie, gezondheid & ethniciteit- de Doelen, Rotterdam, the Netherlands.	2007	0.2
-Symposium perinatologie 'Circle of life', Rotterdam, the Netherlands.	2006	0.3
2. Teaching		
Supervision of four research assistants, Department of Public Health, Erasmus MC	2009/2010	11.4

Dankwoord

DANKWOORD

Dit proefschrift had ik niet kunnen schrijven zonder de medewerking, inzet, en steun van velen. Er zijn dan ook veel mensen die ik graag zou willen bedanken voor hun bijdrage aan de totstandkoming van mijn proefschrift.

Allereerst wil ik graag alle vrouwen die hebben deelgenomen aan de Pro-Active studie heel erg bedanken! Ik weet dat we erg veel van jullie hebben gevraagd: vele ziekenhuisbezoeken, waarbij telkens 24-uurs urine verzameld moest worden, nuchter (veel) bloed geprikt moest worden, lange vragenlijsten ingevuld moesten worden en vieze suikerdrankjes gedronken moesten worden. Des te meer ben ik dankbaar dat zoveel van jullie het hebben volgehouden tot het einde van de studie. Doordat ik de meeste van jullie een aantal keer heb teruggezien op de poli heb ik jullie (en vaak jullie kindjes) beter leren kennen. Ik heb erg genoten van deze contacten. Ik hoop dat dit proefschrift zal bijdragen aan de erkenning voor jullie klachten en aan een verbetering van de nazorg.

Daarnaast wil ik mijn promotoren (Prof. Dr. J.D.F. Habbema & Prof dr. E.A.P. Steegers) en co-promotoren (dr. H. Raat & dr. J.J. Duvekot) bedanken. Prof. Habbema, Dik, heel erg bedankt voor de prettige samenwerking. U bent wat later bij het project betrokken geraakt als mijn promotor. Ik heb met veel plezier met u samengewerkt en heb heel veel gehad aan uw doeltreffende begeleiding en uw analytische blik. Ook heb ik uw hartelijkheid en uw voortvarendheid zeer gewaardeerd. Prof. Steegers, Eric, ik heb heel veel bewondering voor de manier waarop u de Pro-Active studie heeft geleid. Ik wil u hartelijk danken voor uw begeleiding en uw snelle, accurate reacties. Ik kijk met plezier terug naar de ontelbare bijeenkomsten, waarbij ik meestal kwam aanzetten met een hele stapel papieren. Beste Hein, vanaf het begin van het project ben je mijn directe begeleider geweest. Ook zijn we zelfs lange tijd buren geweest, wat voor mij vaak erg praktisch was. Ik wil je hartelijk danken voor de samenwerking, je belangstelling, en je vertrouwen in mij. Beste Hans, heel erg bedankt voor de fijne samenwerking! Het was erg fijn om wekelijks overleg met je hebben en samen dingen ‘echt aan te pakken’ (zoals bijvoorbeeld het organiseren van informatiebijeenkomsten, begeleidingsbijeenkomsten, en het runnen van het Pro-Active spreekuur). Ik heb heel erg veel aan deze wekelijkse gesprekken gehad. Daardoor ging ik vaak weer helemaal gemotiveerd aan de slag.

Graag zou ik Prof. dr. E.J.G. Sijbrands, Prof. dr. ir. J. Brug en Prof. dr. J. de Vries willen bedanken voor het beoordelen van mijn proefschrift. Ook wil ik Prof. dr. A. Franx en Prof. dr. P.J.E. Bindels hartelijk danken voor het plaatsnemen in de grote commissie.

Ineke, mijn officieuze 3de co-promotor, wat heb ik veel aan je te danken! Zonder jouw bijdrage had dit proefschift er zo niet uitgezien! Het was ontzettend fijn dat ik altijd bij je binnen kon komen lopen om iets te bespreken waar ik tegenaan liep, of om gewoon even bij te kletsen. Dat ik even langsliep ging meestal niet onopgemerkt, aangezien je meestal al aan mijn voetstappen kon horen dat ik eraan kwam. Dank je wel dat je altijd de tijd hebt genomen om “even” te overleggen, dat was voor mij erg leerzaam en motiverend! Ik heb veel bewondering voor je research-skills en ik vind het een fijne en geruststellende gedachte dat jij naast me zult staan als paranimf.

Durk, we hebben van begin tot eind samengewerkt aan de Pro-Active studie. Het was voor mij erg leerzaam om met je samen te werken. Ik heb veel gehad aan je “medische blik”. We kunnen terugkijken op veel onvergetelijke momenten: bijvoorbeeld de talloze overleggen over onder andere het “never-ending review”, het runnen van de Pro-Active poli, het eindeloos pipetteren van buisjes uit Breda, het organiseren van de begeleidingscommissiebijeenkomsten, de focusgroepen en talloze voortgangsbijeenkomsten en niet te vergeten je ‘verjaardagsfeestje’ in Melbourne. Bedankt!

Inge, we zijn bijna van begin tot eind kamergenoten geweest. Ik vond het altijd erg gezellig op onze Brabantse kamer. Wat hebben we aan totaal verschillende projecten gewerkt. Bij mij was het vaak chaotisch en druk en jij was vaak juist erg relaxed aan het werk. Het was voor mij erg leerzaam om bij jou te zien ‘hoe het ook kon zijn’. Je hebt letterlijk en figuurlijk kunnen meegenieten van alles wat er bij de uitvoering van mijn studie kwam kijken: studieparticipanten die je aan de telefoon kreeg om te melden dat ze ongesteld waren en wat ze nu met hun plasje moesten doen, “boze mevrouwen” waar je eigenlijk niets mee kon, en al die vragen die je hebt beantwoord over wachtwoorden die niet leken te werken. Gelukkig kun je er achteraf om lachen. We hebben in die vier jaar lief en leed gedeeld. Bedankt daarvoor! Ik vond een hele mooie ervaring dat ik naast je mocht staan als paranimf tijdens jouw promotie. En ik vind het super dat je naast me zult staan tijdens mijn promotie.

Arie, bedankt voor de fijne samenwerking! Als aanvrager ben je vanaf het begin betrokken bij de Pro-Active studie (voorheen CHANCES). Bedankt voor het opzetten van de dataverzameling en voor je begeleiding op de poli in Tilburg. Ik heb de Pro-Active poli in Tilburg met veel plezier “gerund”. Hartelijk dank voor je constructieve feedback op mijn artikelen, daar heb ik erg veel aan gehad!

Dr. D.N.M. Papatsonis, Dimitri, hartelijk dank voor het opzetten van de Pro-Active studie in Breda. Mirjam van Oostwaard en Meike Bangma, dank jullie wel voor het runnen van de poli in Breda! Ik weet dat het een hele opgave voor jullie is geweest om de poli te runnen. Ik zal de “stappenteller”-taferelen en de tochtjes van Breda naar Rotterdam met een veel te grote

piepschuimen box vol met ingevroren bloedbuisjes niet snel vergeten. Meike, ik denk met plezier terug aan de keer dat ik samen met je een dagje poli heb gedraaid in Breda. Bedankt ook voor je bijdrage aan het depressie-artikel. Mirjam, bedankt voor de gezelligheid in Melbourne!

Robbert van Oppenraaij en Sarah Timmermans, heel erg bedankt voor het runnen van de Pro-Active poli in afwezigheid van Durk. Ik heb fijn met jullie samengewerkt. Robbert, bedankt voor het helpen organiseren van de eerste informatieavond. Sarah, bedankt voor de fijne samenwerking en de gezelligheid!

Dr. W. Visser, Willy, hartelijk dank voor de fijne samenwerking! Fijn dat je steeds aanwezig was bij de Pro-Active voortgangsbijeenkomsten. Bedankt voor je bijdrage aan mijn artikelen!

Alle leden van de Pro-Active begeleidingscommissie: dr. Carla van der Wijden, Robert Rozenberg, Prof. Wim Saris, Dr. A.H. van den Meiracker, Conni de Groot, ir. Joke Hammink, Anne-Sophie Darlington en Mw. L.J.M. Spijkers-Mertens. Hartelijk dank voor jullie inbreng en voor jullie inzet.

Anne-Sophie, dank je wel voor je bijdrage aan het depressie-artikel.

Ook wil ik de research nurses Wilma Keller en Joke van Rhee heel erg bedanken voor hun inzet! Wat hebben jullie veel werk verricht voor de Pro-Active studie! Ik zal niet snel vergeten dat we samen de bloedbuisjes gingen invriezen. Ik heb heel wat gehad aan jullie kennis over de -80 vriezer en de bijbehorende logistiek. En bedankt voor jullie “koffie en thee- reddingsactie” tijdens de eerste informatiebijeenkomst!

Alle medewerksters van de poli verloskunde en vrouwenziekten in Rotterdam, Breda en Tilburg: Hartelijk dank voor jullie inzet! In het bijzonder wil ik graag Marij van Wijk bedanken voor het managen en ondersteunen van de Pro-Actove poli in het St. Elisabeth ziekenhuis. Ook wil ik graag Karin Boel hartelijk danken voor haar inzet en de organisatie van de labafnames in het St. Elisabeth ziekenhuis.

Verder wil ik graag alle secretaresses heel erg bedanken voor alle praktische ondersteuning. Yvonne, Sanne, Anja, bedankt! Wat kon het een klus zijn om een afspraak in te plannen met de hele Pro-Active onderzoeksgroep. Jolanda wil ik nog in het bijzonder bedanken. Vanaf het begin van mijn aanstelling tot aan het einde (en daarna) heb ik regelmatig een beroep op je gedaan. Eerst bij MGZ en later bij verloskunde. Je hebt me erg geholpen bij onder andere het indienen van de voortgangsverslagen, het organiseren van bijeenkomsten en het inplannen van nieuwe afspraken. Bedankt voor je hulp en je gezelligheid!

Gerard Borsboom en Caspar Looman, hartelijk dank voor de statistische ondersteuning! Ik heb heel erg veel aan jullie adviezen gehad!

Mirjam Struijk, heel erg bedankt! Het was erg fijn dat ik bij je aan kon kloppen en dat de deur altijd open stond voor een gezellig praatje en voor het regelen en onder de aandacht brengen van dringende praktische zaken.

Ook wil ik alle onderzoeksassistenten die betrokken zijn geweest bij de Pro-Active studie heel erg bedanken! Amely en Janine, het was me nooit gelukt om zelf al die data in te voeren, al die brieven te versturen en al die vrouwen na te bellen. Sabah en Rukiye, heel erg bedankt voor jullie hulp bij het nabellen van de Turkse en Marokkaanse participanten.

Laraine Visser, heel erg bedankt voor het nakijken van mijn artikelen op het juist gebruik van de Engelse taal. Geweldig dat ik altijd zo snel antwoord kreeg!

Medewerkers van de ICT-helpdesk van MGZ, heel erg bedankt voor jullie ondersteuning! Met name de toegang tot de gezamenlijke schijf met verloskunde (de v-schijf, die meer dan eens van naam heeft gewisseld en daardoor bijna alle letters van het alfabet heeft gehad) bleek een uitdaging. In het bijzonder wil ik Kees bedanken: bedankt voor je hartelijkheid en dat je altijd voor me klaar stond!

Ook wil ik Frank Santegoets, datamanager bij MGZ, heel erg bedanken! Frank, bedankt voor je pogingen specifieke data uit de Pro-Active database te halen! Dat bleek nogal een uitdaging, waar je volgens mij nog wel enkele grijze haren aan over hebt gehouden!

Verder wil ik alle MGZ-(oud)collega's bedanken: Wendy (Bedankt voor je steun! Fijn dat ik bij altijd je binnen kon komen lopen om van alles en nog wat te bespreken.), Vicki (Ik heb altijd het gevoel gehad dat ik altijd bij je terecht kon, heel erg bedankt daarvoor), Leatitia (We zijn maar heel kort kamergenoten geweest, maar wat hebben we een hoop nieuwe aparte smaken thee bedacht in die korte tijd. Ik vond het erg leuk om je "3de paranimf" te zijn!), Tinneke (Bedankt voor je steun en voor de gezelligheid!), Eefje (Collega-paranimf, het was gezellig om samen dingen te regelen voor de promotie van Inge. Dank je wel voor het "regelen" van mijn afscheid op MGZ! Het was fijn om geregeld even binnen te komen lopen en bij te kletsen.) Henrike (Bedankt voor de gezelligheid!), Lidy (Fijn om zo nu en dan bij te kletsen en onderzoeksperikelen te delen onder het genot van een kopje koffie), Lenneke (Ieder jaar weer een uitdaging om een geschikt verjaardagscadeau voor je te kopen.), Nicole (Het was altijd gezellig om in de trein even bij te kletsen.), Else- Mariëtte (Bedankt voor het "delen van je onderzoeksassistente"), Noortje (Bedankt voor de gezelligheid en het bijkletsen op de gang.), Ilse, Willemieke, Rick en alle andere

DGG/ Jeugd MGZ collega's voor de praatjes op de gang bij het koffieautomaat, bij de printer (die vaak weer eens vastliep), bij de kopieermachine die ook regelmatig bleef hangen of "enige tijd bezig was" (gewoonlijk op het moment dat je haast had). En alle "nieuwe" MGZ-collega's die ik wat minder lang heb meegemaakt, maar waarvan ik een aantal wel wat beter heb leren kennen tijdens de NIHES summercourse.

En natuurlijk ook alle Generation R collega's: Lenie (Bedankt voor de gezelligheid en het delen van onderzoeksperikelen!), Lindsay (Bedankt voor de gezelligheid op MGZ en in Washington!), Nienke (Ik vond het erg gezellig in Melbourne).

Ook wil ik mijn vriendinnen bedanken voor hun luisterende oor en voor de broodnodige afleiding! Ik ben erg druk geweest de afgelopen 4 jaar, waardoor ik minder tijd met jullie heb kunnen doorbrengen dan ik had gewild. Dat hoop ik de komende tijd ruimschoots goed te gaan maken!

Ook mijn schoonfamilie mag natuurlijk niet in dit rijtje ontbreken! Dank jullie wel voor jullie belangstelling, steun en voor alle gezelligheid!

Lieve oma, ik vind het heel erg fijn dat u bij mijn promotie zult zijn! Na al die verhalen kunt u eindelijk zelf zien wat ik precies allemaal gedaan heb in Rotterdam. Na mijn promotie heb ik eindelijk meer tijd om u te kunnen inmaken met kaarten. (Nou ja, eigenlijk heeft u meer tijd om mij te kunnen inmaken..)

Zonder de steun van mijn ouders was het me nooit gelukt! Pap en mam, heel erg bedankt voor jullie steun! Fijn dat jullie altijd voor me klaar staan. Bedankt dat jullie al die keren dat ik weer eens gestrand was op een station ergens in Nederland hebben bijgesprongen door Roan op te vangen. Bedankt ook dat ik altijd mijn verhaal bij jullie kwijt kon!

Lieve Jeroen, liefde van mijn leven, je bent van onschatbare waarde geweest tijdens mijn promotietraject! Bedankt dat je altijd voor me klaar staat. Het is heerlijk om alles met je te kunnen delen. Ik kijk er erg naar uit om na mijn promotie meer tijd met je door te brengen.

Lieve Roan, dit boekje heb ik voor jou geschreven. Om je te laten zien dat je alles kan bereiken wat je maar wilt zolang je maar volhoudt en je je voor 100% blijft inzetten. Daar is dit boekje het bewijs van. Ik hoop dat je later zult snappen dat ik vanwege dit boekje vaak weg ben geweest. Doordat ik het zo druk had met het schrijven van dit boekje heb veel gemist en dat vind ik erg jammer. Lieve Roan, bedankt dat je bent wie je bent! Ik ben er heel erg trots op jouw mama te zijn!

Hoewel dit al een behoorlijke lijst is, vergeet ik vast nog een hoop mensen bij naam te noemen. Bij deze wil ik diegenen ook allemaal bedanken!

Ik kijk met een goed gevoel terug op de afgelopen 4 jaar. Wat is er veel gebeurd in die tijd en wat heb ik veel geleerd. Ik heb een hoop mensen leren kennen. En ik kijk terug op heel veel mooie (en natuurlijk ook wat minder mooie, maar die vallen in het niet bij de mooie) herinneringen. Zo zal ik nooit vergeten hoe ik een ondergeplaste vragenlijst op de verwarming heb gedroogd, om deze daarna in de database te kunnen invoeren. Hoe ik bevroren buisjes in een veel te grote piepschuimen box van Breda of Tilburg naar Rotterdam in auto, bus en trein vervoerd heb. En hoe ik deze buisjes vervolgens “even” met behulp van Joke en Wilma een plekje heb gegeven in de -80. Ik heb me echt verbaasd over hoe veel tijd dingen die je “even” wilt gaan doen in werkelijkheid kosten. Zo ook bijvoorbeeld het “even” nasturen van vragenlijsten of stappentellers nog net “even” voordat ik mijn trein moest halen. Of het versturen van een mailing, waarbij doorgaans de printer “niet echt meewerkte” en ik daardoor alsnog in tijdnood kwam. Dit soort momenten zorgde ervoor dat mijn tempo op de gang steeds hoger werd (voor velen op de eerste verdieping herkenbaar) en dat ik nog nèt (of nèt niet) mijn trein haalde. Het was een ontzettende organisatie om alle deelneemsters op de juiste momenten terug te zien en te zorgen dat alles keurig volgens het studieprotocol werd uitgevoerd. Zo heb ik vele uren besteed aan het versturen van brieven en (na)bellen van vrouwen. Wat was ik blij dat ik daarvoor hulp kreeg van onderzoeksassistenten! Ook heb ik vele uren besteed aan de leefstijlbegeleidingsgesprekken. Erg leuk om te doen, maar wat ging daar veel tijd in zitten! Verder heb ik zoveel meer verschillende dingen gedaan: focusgroepen gevoerd, uitgewerkt (slaapverwekkend, maar werkt ontzettend op je lachspieren), geanalyseerd en beschreven, vragenlijsten samengesteld, talloze bijeenkomsten georganiseerd, de poli gerund, presentaties gegeven en nog veel meer. Wat een werk is het geweest, maar ik had het niet willen missen!

Meeke

Maternal Quality of Life, Lifestyle, and Interventions after Complicated Pregnancies.

Women with an obstetric history of preeclampsia, intrauterine growth restriction and/ or gestational diabetes share an increased risk for future cardiovascular disease and type II diabetes mellitus. For these women, the postpartum period offers opportunities for preventive lifestyle interventions. To date, little is known on what lifestyle interventions should be recommended. In the context of the model of planned health education and promotion, this thesis aims to describe postpartum mental health, health-related quality of life and lifestyle in women after such placenta-related pregnancy complications, and to examine which postpartum lifestyle interventions seem promising for preventing cardiovascular disease and type II diabetes mellitus in these women.

ISBN: 978-94-6191-018-9

STELLINGEN

behorende bij het proefschrift

Maternal quality of life, lifestyle, and interventions after complicated pregnancies

Meeke Hoedjes

1. Vrouwen met ernstige preeclampsie hebben in de vroege postpartum periode een slechtere gezondheidsgerelateerde kwaliteit van leven dan vrouwen met milde preeclampsie.
   (dit proefschrift)
2. Onvoldoende herstel na een gecompliceerde zwangerschap is een barrière voor het aannemen van een gezonde leefstijl. (dit proefschrift)
3. Er is met name bij vrouwen die ernstige preeclampsie en ongunstige zwangerschaps-uitkomsten hebben doorgemaakt ruimte voor verbetering van de fysieke activiteit in de vroege postpartum periode. (dit proefschrift)
4. Er is behoefte aan begeleiding op maat bij het verbeteren van de leefstijl van vrouwen die preeclampsie, intra-uteriene groei restrictie en/ of diabetes gravidarum hebben gehad. (dit proefschrift)
5. Leefstijlinterventies bij vrouwen na een ongecompliceerde zwangerschap blijken tot verlaging van cardiovasculaire risicofactoren te leiden. (dit proefschrift)
6. The largest reduction in all-cause mortality from physical activity is obtained when changing from a sedentary lifestyle to low levels of physical activity.
   (Woodcock et al. International Journal of Epidemiology 2011; 40:121–138)
7. A directive, client-centered counseling style for eliciting behavior change by helping clients explore and resolve ambivalence has been found to effectively promote a healthy lifestyle. (Miller, 1996)
8. Implementation intentions are way of bridging the intention-behavior gap. (Ogden, 2000)
9. The trajectory by which individuals enter the metabolic syndrome has a significant impact on subsequent risk of developing cardiovascular disease.
   (Franco et al. Circulation. 2009; 120:1943-1950)
10. Although there is consensus that health professionals providing prenatal testing services should give women and their partners the information they need to make autonomous informed decisions, this does not always happen in practice.
    (Marteau & Dormandy. American Journal of Medical Genetics. 2001; 106(3):185-90)
11. PROACTIVE decision-making is a way of life. (Hunink & Glasziou, 2001)