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PHYSICAL ACTIVITY AND MODE OF DELIVERY

A prospective cohort on Physical Activity among healthy pregnant women and its relationship to childbirth.

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Preface

To my dear husband Njål, without your backup and positive encouragement I would never have managed to finish this thesis, thank you! To my dear children: mummy's back!

I also want to show my gratitude to Nanna Voldner that has backed me up from the start and who gave me the opportunity to use the data material from STORK2 in this thesis. To my employer OUS/Rikshospitalet that has supported me economically and by allowing me to work part time during the study period, thank you. And finally I would like to give a big thanks to my patient supervisor May-Karin Rognstad. Thank you for your patient and your professional guiding.

Åsa H Waldum

15.09.2014

Abstract

Background and Aim: In many parts of the world there is a tendency toward a more sedentary life style. At the same time instrumental delivery (cesarean section, vacuum extraction and forceps) has increased in Norway, as in many parts of the world. The aim of this study was to investigate the relationship between Physical Activity and mode of delivery. Further the level of Physical Activity performed was analyzed according to parity in order to investigate possible differences between women already having children (multipara) with women expecting their first child (primipara). Finally, mode of delivery was investigated according to parity.

Theoretical framework: As theoretical framework for this study two theories are used. The first is the paradigm of physical activity, fitness and health. The second is health promotion.

Method: A prospective cohort of healthy Scandinavian pregnant women, expecting one child and planning to give birth vaginally at a university hospital in Oslo, Norway. To collect data on the participants' Physical Activity during pregnancy, a questionnaire was handed out. Information about the delivery was collected via the electronical medical record. Binary logistical regression was performed to investigate the relationship between Physical Activity and mode of delivery.

Results: Results did not show a significant relationship between the health determinant Physical Activity and the health outcome mode of delivery in this study. Multiparas were more active than primiparas in total and in the household/care giving domain. Primiparas were more likely to deliver by assisted vaginal delivery than multiparas but there was no significant difference in the rate of cesarean section.

Conclusion: Based on the results of this study, there is no reason to alter the recommendations to pregnant women. No link was found between Physical Activity during pregnancy and mode of delivery. Based on previous research, health promotion to pregnant women about Physical Activity is still important for the health outcome of mothers and infants.

Keywords: Physical Activity, mode of delivery, assisted vaginal delivery, emergency cesarean section, spontaneous vaginal delivery, health promotion.

Abstrakt

Bakgrunn og hensikt: I mange deler av verden ses en tendens mot en mer stillesittende livsstil. Samtidig har bruken av instrumentelle fødsler (keisersnitt, vakuum og tang) økt i Norge og i store deler av verden. Hensikten med denne studien var å undersøke om det er en sammenheng mellom fysisk aktivitet og forløsningsmetode. Videre er mengden av fysisk aktivitet analysert i forhold til paritet for å undersøke eventuelle forskjeller mellom de som har barn fra før (multipara) og de som venter sitt første barn (primipara). Til sist er forløsningsmetode undersøkt i forhold til paritet.

Teoretisk rammeverk: Som teoretisk rammeverk i denne oppgaven, er to teorier brukt. Den første er paradigmet om fysisk aktivitet, form og helse. Den andre omhandler helsefremmende arbeid.

Metode: En prospektiv kohort med friske gravide kvinner med Skandinavisk opprinnelse, som er gravid med ett barn og som planlegger å føde vaginalt på et universitetssykehus i Oslo, Norge. For å samle inn data om deltagernes fysiske aktivitet under graviditeten, ble et spørreskjema delt ut. Informasjon om fødselen ble samlet inn via den elektroniske medisinske journalen. Binær logistisk regresjon ble utført for å undersøke forholdet mellom fysisk aktivitet og forløsningsmetode.

Resultat: Resultatene viste ikke en signifikant sammenheng mellom fysisk aktivitet og forløsningsmetode i denne studien. Multipara var mer aktive enn primipara både totalt sett og i husholdning/omsorg domenet. Primipara hadde større sannsynlighet for å bli forløst med assistert vaginal forløsning enn multipara men det var ingen signifikant forskjell i frekvensen av keisersnitt.

Konklusjon: Basert på resultatene i denne studien, er det ingen grunn til å endre rekommandasjonene som blir gitt i dag til gravide. Ingen sammenheng ble vist mellom Fysisk Aktivitet og forløsningsmetode. Basert på tidligere forskning er rekommandasjoner om Fysisk Aktivitet fortsatt viktig for gravide, både for kvinnens egen helse og for barnets helse.

Emneord: Fysisk Aktivitet, forløsningsmåte, assistert vaginal forløsning, akutt keisersnitt, spontan vaginal fødsel og helse fremmende arbeid.

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ABBREVIATIONS

MFR	Medical Birth Registry
PPAQ	Pregnancy Physical Activity Questionnaire
PPAQ1	First time for completing the questionnaire, 14-16 week of gestation.
PPAQ2	Second time for completing the questionnaire, 30-32 week of gestation.
STORK	STORe barn og Komplikationer (Newborn macrosomia and complications)
WHO	World Health Organization
FIGO	International Federation of Gynecology and Obstetrics
BMI	Body Mass Index
EDA	Epidural analgesia
P	Probability value
OR	Odds ratio
CI	Confidence Interval

1.0 BACKGROUND

In many parts of the world we see a change in the population towards lower Physical Activity (defined in chapter 2.1, p. 9) levels, and women are less physically active than men (Hallal et al., 2012). Physical inactivity is more common in high-income countries than in low-income countries. At the same time, the prevalence of overweight is increasing, also for women in childbearing age. Increased Physical Activity is associated with a reduction in the risk of chronic diseases such as diabetes and cardiovascular diseases (Melzer, Kayser & Pichard, 2004). Reduced Physical Activity may therefore play a part in the development of some chronic diseases. The Norwegian Directorate of Health concludes that if a person goes from being physically inactive to being physically active he/she will benefit through reduced risk for disease, increased quality of life and how long he/she lives (Sælensminde, 2008). For pregnant women, Physical Activity may reduce the prevalence of gestational hypertension and gestational diabetes, and increased Physical Activity has been shown to be accompanied with shorter labor and decreased incidence of operative deliveries (Melzer, Schutz, Boulvain & Kayser, 2010a). Pre gestational inactivity has been shown to be associated with severe perineal lacerations (Voldner, Froslie, Haakstad, Bø & Henriksen, 2009).

Several authors have noted that pregnancy is a unique opportunity to affect maternal and child health, and for behavior modification (Artal & O'Toole, 2003; Gavard & Artal, 2008; Sagedal et al., 2013).

In the research found for this thesis, it seems like there has been a focus on exercise and its effect on pregnancy outcome. The term Physical Activity seems to be treated as synonymous with the term exercise in much of the research found in the literature review for this thesis. Other domains in pregnant women's daily life such as household/care giving, occupation and sedentary activities appear to be used limitedly in analyses of Physical Activity performed during pregnancy. A previous study (Schmidt, Pekow, Freedson, Markenson & Chasan-Taber, 2006) about pregnant women's activity patterns show that household/care giving activities was the largest contributor to energy expenditure during pregnancy. In this thesis, Physical Activity will include all the above mentioned activity domains.

Physical Activity has been shown to have positive effects on the pregnant body, by reducing risk for both mother and child (Melzer et al., 2010a). Several changes occur in the pregnant body that may affect a woman's ability to perform exercise or to be physically active in different settings. Pregnancy affects all systems in the body (Fraser, Myles & Cooper, 2009). Cardiovascular changes consist essentially of an increase in blood volume, cardiac output and heart rate at the same time as a decrease in blood pressure. Changes in activity level or in posture may result in large variations in cardiac output, blood pressure and heart rate. In addition, in the supine position, the growing uterus might compress the inferior vena cava with dizziness or syncope as a result. About 70 % of pregnant women experience back pain due to changes in posture and relaxation of the pelvic ligaments due to hormonal changes (Fraser et al., 2009).

During delivery the presenting part descends through the birth canal and most deliveries progress physiologically (Fraser et al., 2009). It has been shown a large variation in cesarean section rate in the world, from 0.4% to 40%. A low percentage of cesarean section is mainly found in developing countries and a high percentage is found in developed countries (Althabe et al., 2006). The World Health Organization (WHO) has recommended a rate of between 10 and 15%. A cesarean section rate of more than 10% is recommended to prevent maternal or neonatal injury, but a rate of more than 15% is considered unnecessary (Gibbons et al., 2010).

The frequency of caesarean sections and assisted vaginal deliveries (vacuum extraction or forceps) are increasing in Norway as well as in many parts of the world. The Medical Birth Registry (MFR) registers the statistics of all births in Norway since 1967 (MFR, retrieved February 6th, 2014). In 1967, 1.8% of all deliveries in Norway were elective cesarean section; there were no emergency cesarean section. In 2012 the frequency of caesarean sections in Norway had risen to 16.8%, out of which 64 % were emergency cesarean section. At the same time, the number of assisted vaginal births has increased. In 1967, the rate of assisted vaginal births in Norway was 3.1%. In 2012, 9.9% of the women were delivered by assisted vaginal delivery. Increasing frequencies of cesarean section and assisted vaginal deliveries are a public health concern as it is shown that assisted vaginal deliveries and cesarean section

increase the health risks for both the mother and the child (FIGO, 1999; Towner, Castro, Eby-Wilkens & Gilbert, 1999).

Various causes for this increase in instrumental involvement in delivery are possible. For example, increasing maternal age and increased weight in both mother and child are factors that might influence mode of delivery (Tromp, Ravelli, Reitsma, Bonsel & Mol, 2011; Voldner et al., 2009).

There seems to be limited knowledge about the relationship between the amount of Physical Activity, including all activity domains (exercise, household/care giving, occupational and sedentary activities), performed in pregnancy and mode of delivery. Therefore it is important to investigate this subject further, for the development of health promotion programs for pregnant women.

This study is a sub study of data originating from a prospective cohort study of pregnant women. A cohort study is an investigation of a group of persons that share a common experience, for instance are of the same age or have been giving birth the same year, and the study may last over some time (Johannessen, Tufte & Christoffersen, 2010). In this study the common experience is that all participants are pregnant, intending to give birth vaginally, and they are followed from gestational week 14-16 in pregnancy until they have given birth.

The main purpose of the STORK (STORe barn og Komplikationer (Newborn macrosomia and complications)) study was to investigate maternal lifestyle factors as potential predictors of fetal growth (Voldner et al., 2008). Data for the study were collected in two time periods, called STORK1 (2002-2005) and STORK2 (2005-2008). Data used in this sub study are originating from STORK2. Data have been collected by two methods; data on Physical Activity were collected with a questionnaire and data on mode of delivery were collected from the electronic medical records after the delivery. Women who agreed to participate were phoned or mailed to arrange the first appointment with the responsible general physician, who conducted the visits and handed out the questionnaire. The physician was available to help with the interpretation of the questions in the questionnaire.

Inclusion criteria in the sub study

The women included in this sub study are healthy pregnant women of Scandinavian origin expecting one child. The participants were planning to give birth at a selected hospital in Norway and were found on the reservation list for birth. Women with multiple pregnancy, pre-gestational diabetes and severe lung diseases were excluded. Also women giving birth pre- or post-term were excluded. Term pregnancy has been defined as giving birth after 37 gestational weeks and 0 days, and before 41 weeks and 6 days of pregnancy (Spong, 2013). Only women who intended to give birth vaginally were included, elective cesarean sections were therefore excluded.

Issue/aim:

The aim of this thesis was to investigate pregnant women's level of Physical Activity in daily life and its relationship to mode of delivery.

Outcome measures chosen are emergency cesarean section, assisted vaginal delivery (vacuum of forceps) or spontaneous vaginal delivery.

Research questions:

1. Is there an association between Physical Activity and mode of delivery?

2. How physically active are women during pregnancy, as measured in metabolic equivalent (MET) score?

3. Is there a difference between primiparas and multiparas in how physically active they are, as measured in MET score in the different domains (exercise, household/care giving, occupation, and sedentary activities)?

4. Are primiparas more likely to deliver by emergency cesarean section or assisted vaginal delivery than multiparas?

1.1 Structure of the thesis

The structure of the thesis is as follows. After the background presented in chapter 1, the theory and physiology on the subject are presented in chapter 2. Previous research about Physical Activity during pregnancy is presented in chapter 3. The method for the study is described in chapter 4. The results of the study are presented in chapter 5. The study is discussed and concluded in chapter 6. Finally, suggestions for further research are presented in chapter 7.

2.0 THEORY AND PHYSIOLOGY

Two theories are chosen for this thesis. The first theory is the "paradigm of physical activity, fitness and health" by Huskell, Bouchard & Blair (2012). They state that the human being is "designed for activity". It might seem like humans, especially in the industrialized part of the world, have reduced their daily Physical Activity level so much that they have to compensate it by increasing the amount of sports activities.

The second theory is about health promotion, as a mean to enhance health. Both theories are presented below.

In this study Physical Activity is measured as a health determinant. The definition of health used in the thesis is the definition by Hjort (1982): *health is excess of energy in relation to the daily requirements*, as further presented below. The outcome measure, mode of delivery (emergency cesarean section, vacuum, forceps or spontaneous vaginal delivery), may affect the health status in daily life of the women and children concerned.

2.1 The paradigm of physical activity, fitness and health

Throughout history, physicians and scientists, have written and lectured about the importance of exercise for health, among them Herodicus and Hippocrates (Haskell et al., 2012). Huskell et al., (2012) write in their book "Physical activity and health", that the evolution of the human being have demanded our ancestors to be physically active in order to be the ones who survived and reproduced themselves.

Huskell et al., (2012) claim in their book, that the human body is "designed for activity" and that there is a link between Physical Activity, fitness and health. They call it the "paradigm of physical activity, fitness and health" (figure 1, p.7). The three evidences they present to validate this paradigm are:

- *"The human organism can adapt to a wide range of metabolic demands imposed by work or exercise.*
- *A low level of physical activity is associated with risk for common diseases and premature death.*
- *Evolutionary history teaches us that early humans could not have survived without ability to perform very demanding physical work."* (Huskell et al., 2012, p. 5)

Throughout history human beings seems to have been struggling to free themselves from physical work (Haskell et al., 2012). Today it's proposed that the reduction of physically demanding work has gone too far. This point of view is based on the increasing problem of chronic diseases that is related to the level of (or lack of) Physical Activity. Examples of chronic diseases affected by the amount of Physical Activity are cardiovascular diseases and diabetes (Haskell et al., 2012).

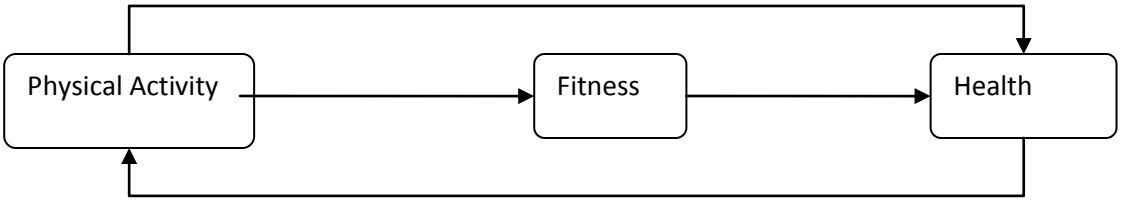


Figure 1. This model shows the positive association between physical activity, fitness and health. It also shows that health is positively associated with Physical Activity (Haskell, et al., 2012).

Physical Activity has been defined as *"any bodily movement produced by skeletal muscles that results in energy expenditure"* (Caspersen, Powell & Christenson, 1985). This energy expenditure varies continuously from low to high and is positively related to physical fitness and health according to Haskell et al., (2012). Further, Physical Activity has been defined into activity categories: *"Physical activity in daily life can be categorized into occupational, sports, conditioning, household, or other activities"* (Caspersen et al., 1985). This definition may be important because of the clarification of the different activities performed. One woman may be less active in one domain but more physically active in another. Therefore it

seems more correct to include all activity domains when analyzing Physical Activity. In all kind of Physical Activity, muscle work results in energy expenditure to some degree. Physical Activity described into categories has also been done by Haskell et al., (2012) into leisure time physical activity, exercise, work and household activities.
Physical fitness has been defined as *"a set of attributes that are either health- or skill-related".* The importance of including all domains in life when addressing Physical Activity in the general population is addressed by Hallal et al., (2012) and has also been a focus in pregnant women (Schmidt et al., 2006).

A person's level of Physical Activity may vary with changes in life conditions. It may be challenging for people to integrate Physical Activity in life in the modern environment that has reduced the need for Physical Activity (Haskell et al., 2012). Different periods in life affect a person's activity level. According to a Norwegian study women tend to exercise less during pregnancy. Why pregnant women stop exercising as the pregnancy progresses has been investigated in a cross-sectional study comparing exercisers and non-exercisers. They found that high gestational weight gain and having no role models as a child were inversely associated with third trimester exercise. The strongest predictor of regular exercise in late pregnancy was pre-pregnancy exercise (Haakstad, Voldner, Henriksen & Bø, 2009).

The link between Physical Activity and health has been shown also during pregnancy. It has been shown that a higher level of Physical Activity during pregnancy reduces the risk of developing gestational (pregnancy related) diabetes and preeclampsia (Melzer et al., 2010a). The studies found in the literature search for this study, have mainly investigated different types of sports activity, for instance aerobics. Since the human being is physically active in different areas of life it may be of importance to investigate the association between the level of Physical Activity that includes all domains, and mode of delivery. The importance of including all activity domains (exercise, household/care giving, occupation and sedentary activities) when addressing Physical Activity in pregnant women, has been discussed by Schmidt et al., (2006).

Lifestyle may affect a person's health and is well known among health professionals. The healthcare system has a responsibility to communicate this knowledge to the public through health promotion programs.

Based on the above definitions and recommendations, Physical Activity in this thesis is understood as bodily movements produced by skeletal muscles that result in energy expenditure, and includes all domains presented above (exercise, household/care giving, occupation and sedentary activities).

2.2 Health promotion

In this chapter health promotion will be presented. Firstly a definition of the concept of health is presented, to show what the aim of health promotion is. In different contexts, health might include different definitions and aspects. The World Health Organization (WHO) first defined health in its constitution in 1946: *"Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity."* (Polit & Beck, 2012)

The fourth international conference on health promotion (WHO,1997), a continuation of a WHO initiative developing international strategies for health, states that health is a basic human right. Therefore health promoting acts needs to be available to the public. The increasing prevalence of chronic diseases in all countries is highlighted as new problems concerning individuals, but it also concerns economic development in the society. In the same document are defined "determinants of health" that includes increased sedentary behavior as health risk behavior. One of the priorities of the Jakarta declaration is to make people aware of the "determinants of health", i.e. health promotion.

The WHO definition of health might seem as a state that is impossible to achieve. Hjort (1982) has stated the WHO definition is a utopia and suggested a definition that is focused on people were they are in their daily life: *health is excess of energy related to the current requirements* (Hjort, 1982). This definition is based on daily life and its requirement and seems more relevant to the pregnant woman and the baby concerned. Pregnant women may have different expectations, from themselves, the family and/or the society that they need to relate to; work, housework, taking care of children and to exercise. Hjort (1982) highlight health as function in relation to the demands put on the specific person. A person that is in a wheelchair might experience good health because that person manages to achieve the expectations put on him or her. A pregnant woman might be physically inhibited by her

growing abdomen, but it is not necessary that she feels her health is influenced by that. It depends on the daily demands she has and how she experience the situation.

According to Naidoo & Wills (2009), modern medicine in the western part of the world, uses a narrow view of health; no disease or no illness. A characteristic is the mechanic view that conceptualizes the body as a machine and that all organs can be treated separately. Another characteristic is the pathogenic view that focuses on why people get ill. As an antithesis to the pathogenic view there is the view of Antonovsky that is called "*salutogenic*" view. The salutogenic point of view is focused on why people remain healthy. Antonovsky suggest the salutogenetic view as a paradigm for health promotion research and practice (Antonovsky, 1991). The salutogenic view is well incorporated in midwifery practice since midwifery is aiming at helping women to stay healthy during pregnancy and childbirth by encouraging healthy behavior.

Naidoo & Wills (2009) claim that measuring health is important in order to plan and evaluate health promotion programs. An alternative to measuring health directly is to measure health indicators such as smoking, exercise or a healthy diet. In this study, health itself is not measured, but one of the identified health determinants is, i.e. the amount of Physical Activity performed during pregnancy. Further, the relationship between the amount of Physical Activity and mode of delivery as health outcome is analyzed. Physical Activity has been shown to reduce maternal and infant health risk (Melzer et al., 2010a).
Promoting a more active lifestyle during pregnancy is understood to be of a more salutogenic than a pathogenic view as it is understood to optimize a person's probability to stay healthy and to not only avoid illness.

The WHO conference on health promotion (Ainsworth et al., 1993) recognizes health promotion as *"a process of enabling people to increase control over, and to improve, their health"*. Several authors have described models of health promotion (Ringdal, 2007; Roberts, Fragala, Pober, Chasan-Taber & Freedson, 2002). There seems to be an agreement of the importance of measuring health, either health itself or health determinants. There seems also to be a common understanding that health promotion is needed in different levels in society. Health promotion might affect the organizational level in the society and thereby optimize the conditions for the people to make healthy choices. Health promotion at the individual level might affect individuals to make healthy choices (Ringdal, 2007).

Hjort (1982) has suggested four methods to affect the health status of the people. The first method is to maintain and approve actions against infectious diseases by means of hygienic actions and vaccination programs. The second is screening, for instance screening of the children in schools and prenatal care. The aim of screening programs is to discover problems early and act on these but it also gives an opportunity to provide information about health promoting behavior, for instance nutrition and Physical Activity. The third method defined is people's lifestyle. This method is aiming at avoiding disease (disease prevention) and promoting health, and includes promoting for instance a healthy diet, not to smoke or drink too much alcohol, to be physically active, and to take responsibility for one's own body. The forth and last area defined by Hjort (1982) is the society. The society gives the foundation for people by political means in education, traffic, working and residential environment.
According to Naidoo & Wills (2009) one of the most influential documents on health promotion is the "Ottawa charter of health promotion" by the WHO (Ainsworth et al., 2000). The "Ottawa charter of health promotion" describes 5 action methods for health promotion. These are much in compliance with the areas defined by Hjort (1982). Both WHO and Hjort focus on that the society plays a part, that the health care system has a job to do and that information to individuals need to be provided by the society.

Naidoo & Wills (2009) highlight five key areas in the "Ottawa charter for health promotion" and label them; building healthy public policy, creating supportive environments, strengthening communities, developing personal skills and reorienting health services.
In Norway the society provides antenatal care for pregnant women. Health care professionals have an arena at the antenatal visits to give pregnant women information about the determinants of health. Pregnant women may be provided with the tools for making healthy choices for themselves.

In this study Physical Activity is measured as a health determinant. Further the relationship between Physical Activity and the health outcome, mode of delivery, is examined.

2.3 Physiology during pregnancy and recommendations of Physical Activity to pregnant women

Physical changes in pregnancy might inhibit women in performing their daily Physical Activity during pregnancy (Wu et al., 2004). The changes may further influence pregnant women's ability to work, perform housework and/or exercise.

Changes in the pregnant body such as weight gain, the growing abdomen and thereby change in posture, increases the force on the joints that can cause discomfort during Physical Activity. An increased laxity in the ligaments due to hormonal changes can also cause discomfort for pregnant women (Artal & O'Toole, 2003). A systematic review (Wu et al., 2004) on "pregnancy-related pelvic girdle pain" and "pregnancy-related low back pain" found an average prevalence of 45% during pregnancy and 25% postpartum, both with large variations. The onset of pain was recorded to start at about 18 weeks of gestation and reaches a peek at about 24-36 week of gestation and is often related to Physical Activity (Wu et al., 2004).

During pregnancy the cardiovascular system undergoes changes that lead to an increase in blood volume, hearth rate and cardiac output. Because of anatomical changes due to the growing uterus, the supine position may result in obstruction of the venous return and decreased cardiac output. Therefore supine position should be avoided during late pregnancy. (Artal & O'Toole, 2003).

It is understood that the physical changes that occur during pregnancy might affect women's ability to perform Physical Activity. It's possible that a part of the decreasing amount of Physical Activity that is documented for pregnant women (Haakstad et al., 2009), might be attributed to the physical changes described above. On the other hand Haakstad et al., (2009) did not find pelvic girdle pain to be a significant factor to stop exercising in the third trimester. But a postal survey in Norway (MacLennan & MacLennan, 1997), aiming to describe characteristics and outcome in women (during pregnancy and/or postpartum) with symptom-giving pelvic girdle relaxation, found negative effects on diverse aspects of the

women's lives. Ranking of most problematic tasks were as follows: housework, exercise, activities with children, employment, leisure/hobbies, and personal relationships/married life (MacLennan & MacLennan, 1997).

Physical Activity affects the human body in short-term and in long-term (Haskell et al, 2012). Exercise, and other Physical Activity, elevates the hearth rate, blood pressure and the ventilation, and increase the oxygen uptake. Exercise also improves a person's glucose tolerance and may prevent or delay the onset of diabetes mellitus (Haskell et al., 2012). Increased Physical Activity is associated with a reduction in the risk of chronic diseases (Melzer et al., 2004).

For this thesis there is not found any recommendations about the total amount of Physical Activity level for women in pregnancy that includes all domains in life (exercise, household/care giving, occupation and sedentary activities).

Recommendations about exercise during pregnancy have been given by American College of Obstetricians and Gynecologists (ACOG): *"In the absence of either medical or obstetric complications, 30 minutes or more of moderate exercise a day on most, if not all, days of the week is recommended for pregnant women."* (ACOG, 2002; Artal & O'Toole, 2003). The same recommendations are given by the Norwegian guidelines for antenatal care (Sosial- og helsedirektoratet, 2005). This is also the same recommendations given to the general population by the American College of Sports Medicine (ACSM) (Pate et al., 1995). In addition, Artal & O'Toole (2003) gives a list of conditions when exercise is not recommended for pregnant women.

2.4 Consequences of mode of delivery

Cesarean sections and assisted vaginal deliveries in childbirth may have negative consequences for mothers and children, on both short and long term and are well known.
Cesarean section (both elective and emergency) is used for both medical reasons, to enhance the outcome for both mother and child and on maternal request. The latter is increasing in

many parts of the world. It has been discussed that secular changes that affect women's life, also affect maternal autonomy and decision-making. Women today want to choose mode of delivery (Klein, 2012). Elective cesarean section in the absence of indications is not supported by International Federation of Gynecology and Obstetrics (FIGO) because of its potential hazards to both mother and child (FIGO, 1999).

A systematic review found that cesarean section increases the risk for complications in subsequent pregnancies, for both mother and child, in particular due to improper placement of the placenta seen in relation to previous cesarean section (Clark & Silver, 2011). The same systematic review also shows an increased incidence of intrauterine fetal death, intrauterine growth retardation and preterm birth in women with previous cesarean section. Another systematic review concluded that cesarean section is a risk factor for the newborn infant to develop respiratory distress syndrome, or tachypnea (rapid breathing) in the neonatal period (Sotiriadis, Makrydimas, Papatheodorou & Ioannidis, 2009). In a prospective multicenter study, conducted in Finland they found that 27% of women who were delivered by cesarean section had complications, 10% severe. Increased risks for complications for women delivered by cesarean section were women with obesity, preeclampsia and increased age (Pallismaa et al., 2010). A large multicentre study analyzing data from 97 095 participants, women that underwent a cesarean section increased health risk in both mother and child when controlled for confounding factors (Villar et al., 2007).

Assisted vaginal delivery is used to expedite birth for the benefit of mother and/or baby. Assisted vaginal delivery is associated with increased risk for complications for both mother and child. In search for relevant literature, most studies investigate different types of assisted vaginal delivery (forceps or vacuum) and its impact on outcome for both mother and infant and do not include spontaneous vaginal birth for comparison. However, one observational study of 583,340 singleton deliveries, investigated the incidence of neonatal intracranial injury according to mode of delivery. They found significantly higher incidence of injury in all operative deliveries (cesarean section, vacuum or forceps) compared to spontaneous vaginal delivery (Towner et al., 1999).

A Cochrane review that investigated consequences of vacuum and forceps in comparison was found. It emphasizes the risk for vaginal trauma and flatus incontinence for the mother and facial injury or cephalhaematoma for the baby (O'Mahony, Hofmeyr & Menon, 2010).

2.5 Factors that may influence mode of delivery

The delivery of a child is a complex process that is influenced by different aspects related to the pregnant women and the childbirth. The delivery may also be influenced by the woman or by the health care professionals.

In order to sort out the important aspects that need to be taken into consideration in the analysis of this study, a literature search was performed on factors that might affect the outcome measure, mode of delivery. The factors investigated were body mass index (weight in kilograms divided by height in meters squared (kg/m2), BMI), birth weight of the child, induction of labour, epidural analgesia (EDA) and parity.

Regarding BMI and mode of delivery, a review of the evidence was conducted in Canada in 2010 (Davies et al., 2010). This review stated that obese women have an increased risk of having a cesarean section. They did not mention the risk of being delivered by assisted vaginal delivery. The result has been confirmed in a resent Norwegian cohort with a sample size of 50 416 participants (Morken, Klungsoyr, Magnus & Skjaerven, 2013). They concluded by a key message in the article: *"obesity and gestational weight gain above 16 kg are independent risk factors for operative delivery with vacuum extraction and cesarean section"*. Obese women are at increased risk of having a cesarean section and this is confirmed in a large population based sample in the USA (Dietz, Callaghan, Morrow & Cogswell, 2005).

The evidence regarding birth weight of the child affecting mode of delivery seems quite clear. An article reviewing 174 articles published between 1980 and 2007 about the challenge that the macrosomic fetus brings into obstetrics that the large fetus increases the risk of operative deliveries and cesarean section (Henriksen, 2008). Delivering infants with macrosomia (≥4000 g) has been shown to increase the risk of having a cesarean section (Weissmann-

Brenner et al., 2012). This is in agreement with another study showing that delivering babies weighing ≥4500 g increases the risk of having both assisted vaginal delivery and cesarean section. This study also showed that the result was more obvious for primipara (women having their first child) when compared to multipara (women that have one or more children) (Mocanu, Greene, Byrne & Turner, 2000).

To evaluate outcome after induction of labour is complex because of the indications to the procedure, the women's parity and the different methods of induction. One retrospective cohort study concluded that multiparas with a cervical dilatation of 3-4 cm had a higher probability of delivering vaginally after induction of labour whilst primiparas with unfavorable cervix had an increased risk of having a cesarean section (Tam, Conte, Schuler, Malang & Roque, 2013). Another study, investigating only primiparas, concluded that primiparas with an unfavorable cervix had a substantially increased risk of cesarean delivery (Vahratian, Zhang, Troendle, Sciscione & Hoffman, 2005). Induction has been shown to result in a higher incidence of cesarean section (Yeast, Jones & Poskin, 1999).

It proved difficult to find articles that investigated the relationship between parity and mode of delivery. This might be due to the obvious differences in giving birth for the first time compared to woman that has given birth before. However, articles about induction showed a clear difference in mode of delivery according to parity (Tam et al., 2013; Yeast et al., 1999). Women who had been giving birth before had more spontaneous deliveries.

Epidural analgesia (EDA) is used in Norway as pain relief during delivery. In 2000 EDA was used in 24% of all births in Norway and in 2012 it was used in 32% of all births (MFR, retrieved February 6th, 2014). EDA has been shown to slow down the progress and increasing the rate of assisted vaginal delivery (Hasegawa et al., 2013).

According to a Cochrane library review, assisted vaginal delivery rate increases in deliveries with EDA but there was no increased risk for cesarean delivery (Anim-Somuah, Smyth & Jones, 2011). Therefore EDA need to be considered for the analyses in this thesis.

3.0 PHYSICAL ACTIVITY IN PREGNANCY – PREVIOUS RESEARCH

3.1 Physical Activity among healthy pregnant women

Literature search for this thesis is conducted in Cochrane library, MEDLINE and Cinahl from April to May 2013.
The PICO-principle (P-population, I-intervention, C-control, O-outcome) was used for all literature searches presented in this chapter about previous research.

The American College of Obstetricians and Gynecologists (ACOG, 2002) recommend Physical Activity on moderate intensity ≥ 30 minutes on most, if not all, days of the week and is consistent with the recommendations given by the Norwegian guidelines for antenatal care (Sosial- og helsedirektoratet, 2005). None of these guidelines mention the total amount of Physical Activity as an issue. Schmidt et al., (2006) has discussed the importance of including all domains of Physical Activity. In the following, research with focus on describing Physical Activity patterns in pregnant women is presented. It seems that research has been focused mainly on exercise and sports. Patterns of Physical Activity including all activity domains (household/care giving, occupation, exercise and sedentary activities) in pregnancy are presented in table 1. Since exercise is one of the activity domains of the total level of Physical Activity performed, it is presented separately below in table 2.

The search strategy used for search for studies of patterns of Physical Activity among pregnant women was as follows: “pregnancy” (MeSH) AND “physical activit*” OR “motor activit*” (MeSH) OR “exercise” AND “lifestyle” (MeSH) OR “demography” (MeSH).
A lot of research on Physical Activity has been done lately; therefore a time limit of the search was set at 2005. This search, with the time limit set to after 2005, resulted in 268 hits in Cochrane library, 224 hits in MEDLINE and 68 hits in Cinahl. Some of the articles were found in more than one database. All titles and abstracts were examined for their relevance for this thesis. The reference lists of the articles found were a source of inspiration to find other relevant articles on the subject. This process ended up with 8 articles on Physical Activity in pregnant women in general, and 5 articles on sport and exercise among pregnant women.

Only main findings are presented.

Level of Physical Activity in pregnancy in current scientific literature.

	Author(s) Journal Year	**Aim Purpose**	**Sample size**	**Methodological approach**	**Main findings**
1	*"Development and validation of a pregnancy physical activity questionnaire"* Medicine & Science in Sports & Exercise (Chasan-Taber, Schmidt, Roberts, Hosmer, Markenson & Freedson, 2004).	Develop and validate a pregnancy Physical Activity questionnaire (PPAQ).	235 pregnant women.	Questionnaire on 24 hour recall about Physical Activity. To validate PPAQ, 54 women wore an actigraph for 7 days. Bivariate analysis.	The Pregnancy Physical Activity Questionnaire (PPAQ) is considered reliable as an instrument to investigate total Physical Activity.
2	*"Activity patterns and time allocation during pregnancy: A longitudinal study of British women."* Annals of Human Biology (Clarke, Rousham, Gross, Halligan & Bosio, 2005).	Investigate pattern of total Physical Activity and changes of Physical Activity during pregnancy.	57 healthy nulliparous women.	Prospective longitudinal study. Modified Baecke questionnaire. Mean total daily activity level, expressed in metabolic equivalent task (MET) score. Linear regression.	Daily activity level declined significantly during pregnancy, both occupational and recreational domains decreased. Nocturnal activity increased while no significant change was seen in domestic activity.
3	*"National trends in self-reported physical activity and*	Describe prevalence, trends and correlates of Physical	1280 pregnant women ≥16 years.	Cross-sectional. Questionnaire. MET hours/week. Multivariable linear and logistic models.	From 1999-2002 to 2003-2006 participation in any moderate

	sedentary behaviors among pregnant women: NHANES 1999-2006." Preventive medicine (Evenson & Wen, 2010).	Activity among pregnant women.			to vigorous household activities and moderate leisure activities increased.
4	*"The impact of pregnancy on physical activity level"* Maternal & Child Health Journal (Fell, Joseph, Armson & Dodds, 2009).	Compare pre-pregnancy Physical Activity with Physical Activity early in pregnancy.	1,737 pregnant women.	Prospective cohort. Logistic regression. Questionnaire: Kaiser Physical Activity Survey. MET score.	The amount of Physical Activity decreased during pregnancy compared to before pregnancy. Largest decrease in sports and exercise.
5	*"Significant changes in physical activity among pregnant women in the UK as assessed by accelerometry and self-reported activity"* European Journal of Clinical Nutrition (Rousham, Clarke & Gross, 2006).	To compare compliance with accelerometer to compliance with self-report. To compare trends in Physical Activity.	57 low-risk pregnant women.	Prospective cohort. Actiwatch. Interview/questionnaire (Modified Baecke). MET-h/day. Longitudinal analysis.	Compliance with self-report: 100%, compliance with accelerometer: 44%. Significant decrease in Physical Activity from second to third trimester in both methods.
6	*"Physical activity patterns during pregnancy in a diverse population of women"*	To describe total Physical Activity.	233 prenatal care patients.	Cross-sectional study. Interviews. PPAQ. MET hours/day. Total energy expenditure. Logistic regression.	MET-hours a day were similar in first and second trimester but slightly lower in third

	Journal of Women's Health (Schmidt, Pekow, Freedson, Markenson & Chasan-Taber, 2006).				trimester, not significant. Household activity was the largest contributor to total Physical Activity.
7	*"Prevalence and correlates of subjectively measured physical activity and sedentary behavior among US pregnant women"*. Preventive medicine (Evenson & Wen, 2011).	Describe prevalence of Physical Activity and sedentary behavior.	359 pregnant women ≥16 years.	Cross-sectional study. Accelerometer for 7 days. Multivariable linear models.	Women were moderately active for 12.0 min/day and vigorously active for 0.3 min/day. Women spent on average 57.1 % of their time in sedentary behaviors. Moderate to vigorous activity was higher in the first and second trimester compared to the third trimester.
8	*"Physical activity level and weight gain in a cohort of pregnant Norwegian women"* Acta Obstetricia et Gynecologica (Haakstad, Voldner, Henriksen & Bø, 2007).	Assess total Physical Activity among healthy pregnant women.	467 healthy pregnant women.	Prospective cohort. STORK1. Questionnaire. Bivariate analyses.	Nineteen percent were defined as non-exercises before pregnancy, 30% in the first, 36% in the second and 53% in the third trimester. Exercisers had lower weight gain then non-exercisers.

In the studies listed in the matrix above, different methods has been used to measure the total amount of Physical Activity performed during pregnancy. There were 5 studies that used Metabolic Equivalent Task (MET) score in their analyses (Clarke et al., 2005; Evenson & Wen, 2010; Fell, Joseph, Armson & Dodds, 2009; Rousham et al., 2006; Schmidt et al., 2006). Out of these 5 studies, 2 included primiparas only (Clarke et al., 2005; Rousham et al., 2006) and 2 adjusted for parity in the analyses (Fell et al., 2009; Schmidt et al., 2006).

Level of sport and exercise in pregnancy in previous scientific literature.

	Author(s) Journal Year	**Aim Purpose**	**Sample size**	**Methodological approach**	**Main findings**
1	*"Leisure-time physical activity among pregnant women in the US"* Paediatric and Perinatal Epidemiology (Evenson, Savitz & Huston, 2004).	To characterize the prevalence of leisure activity during pregnancy.	1 979 pregnant women and 44 657 non-pregnant women, age 18-44.	Cross-sectional. Telephone interview. Logistic regression. MET score on leisure-time activity.	Pregnant women reported less leisure-time activity than non-pregnant women. 15.8% of pregnant women and 26.1% of non-pregnant women followed the recommendations of 30 minutes of activity of moderate intensity at least 5 times per week.
2	*"Sports and leisure time physical activity during pregnancy in nulliparous women"* Maternal & Child Health Journal (Hegaard et al., 2011).	Describe patterns of leisure time Physical Activity during pregnancy.	4 718 nulliparous pregnant women with singleton pregnancy.	Multi-centre cohort. Bivariate analysis.	Decrease in sports activities from prior to pregnancy to the third trimester. Women with light activities were stable. Increase in the proportion of women with sedentary activities.
3	*"Women's behaviour, beliefs and information sources about physical exercise in pregnancy"*	Examine the effect of low-risk pregnancy on recreational activity patterns.	57 nulliparous pregnant women.	Prospective cohort, quantitative and qualitative. Interview: Modified Baecke. Bivariate	Level of exercise may decline during pregnancy. This may be result of physical changes, and of social and psychological factors.

	Midwifery (Clarke & Gross, 2004)			analyses.	
4	*"Trends in Health-Related Behavioral Risk Factors Among Pregnant Women in the United States: 2001-2009"* Journal of Women's Health (Zhao et al., 2012).	Assess trends in behavioral risk factors over time.	22 604 pregnant women.	Cross-sectional. Telephone interview. Logistic regression.	Leisure-time exercise increased from 67.1% in 2001 to 73.0% in 2009.
5	*"Why do pregnant women stop exercising in the third trimester?"* Acta Obstetricia et Gynecologica Scandinavica (Haakstad, Voldner, Henriksen & Bø, 2009).	Compare factors in pregnant women exercising and not exercising in the third trimester.	467 healthy pregnant women.	Cross-sectional design. Bivariate analysis and binary logistic regression.	Fifty women (11%) were defined as regular exercisers in the third trimester. The strongest predictor of exercise was pre-pregnancy exercise.

Research presented in both matrixes above show that the level of Physical Activity decreases during pregnancy. It is also shown that pregnant women have a low Physical Activity level (Haakstad et al., 2007). On the other hand one American study showed that leisure-time exercise had increased in the population from 2001 to 2009 (Zhao et al., 2012).

3.2 Physical Activity/exercise and mode of delivery

In the search for articles investigating the relationship between Physical Activity and mode of delivery, the PICO-principle (P-population, I-intervention, C-control, O-outcome) was used. The search strategy was as follows: "pregnancy" (MeSH) AND "physical activit*" OR "motor activit*" OR "exercise" AND "mode* of delivery" OR "type* of delivery" OR "cesarean section" (MeSH) OR "cesarean" OR caesarean" OR "extraction, obstetrical"

(MeSH) OR "vacuum" OR "obstetrical, forceps" (MeSH) OR "forceps" OR "assisted vaginal delivery" OR "spontaneous vaginal delivery" OR "spontaneous vaginal birth" OR "spontaneous delivery" OR "spontaneous birth". This search resulted in 61 hits in Cochrane library, 140 hits in MEDLINE and 81 hits in Cinahl. Some of the articles were found in more than one database. All titles and abstracts were examined for its relevance for this thesis. The reference lists of the articles found were a source of inspiration to find other relevant articles on the subject. This process ended up with 9 articles.

There seems to be limited evidence of the relationship between the level of total amount of Physical Activity (that includes all the above mentioned domains) on the frequency of operative interventions (cesarean section, vacuum and forceps) during delivery. In the literature search for this study, none was found. Research that investigates the relationship between exercise/sports and mode of delivery has been found and since sport/exercise is one domain of the total level of Physical Activity, it is also presented in this chapter. A lot of work is done in the field the last decennium, therefore the time limit is set to 2005.

Only main findings related to Physical Activity and mode of delivery are presented.

Research about the association between Physical Activity and mode of delivery.

	Author(s) Journal Year	**Aim Purpose**	**Sample size**	**Methodological approach**	**Main findings**
1	*"Effects of recommended levels of physical activity on pregnancy outcomes"* American Journal of Obstetrics & Gynecology (Melzer et al., 2010b).	To examine the relationship between recommended level of Physical Activity and pregnancy outcome, including operative delivery.	44 healthy pregnant women.	Observational study. Bivariate analysis and logistic regression. MET score calculated on measurements by an actiheart.	Active women (n=27) had lower risk for operative delivery (vacuum/ forceps/ cesarean section) than inactive women (n=17).
2	*"Exercise during pregnancy reduces the rate of cesarean and*	To understand the influence of an exercise program during	Exercise group (n=138), control group	Randomized controlled trial. Bivariate analyses.	Lower percentage of cesarean and instrumental

	instrumental deliveries: results of a randomized controlled trial" Journal of Maternal-Fetal & Neonatal Medicine (Barakat, Pelaez, Lopez, Montejo & Coteron, 2012).	pregnancy on type of delivery.	(n=152)		deliveries in the exercise group.
3	*"Exercise in pregnancy: effect on fitness and obstetric outcomes – a randomized trial"* Medicine & Science in Sports & Exercise (Price, Amini & Kappeler, 2012).	Assess the effect of exercise on frequency of cesarean section and assisted vaginal delivery.	Sedentary control group (n=31) and intervention group (n=31).	Randomized controlled trial. Bivariate analysis.	Intervention group had significantly fewer cesarean deliveries (p<0.01). In the intervention group 87% delivered vaginally, 61% in the control group.
4	*"Evaluation of risk factors and effect of physical activity in caesarean section in nulliparous women"* Journal of Maternal-Fetal & Neonatal Medicine (Karabulut, Derbent, Yildirim, Simavli & Turhan, 2012).	Evaluate risk factors for cesarean section and determine the effect of Physical Activity on labor.	282 nulliparous women with singleton pregnancy.	Prospective observational study. Bivariate analysis and multiple logistic regression.	No significant effect of Physical Activity on mode of delivery (p>0.05).
5	*"Physical activity during pregnancy and its association with maternal and child health indicators"* Revista de Saude Publica (Dumith, Domingues, Mendoza-Sassi & Cesar, 2012)	Analyze Physical Activity and its relationship to maternal and child health indicators.	2 557 women who gave birth to a child >20 weeks gestation or >500 g.	Cross-sectional study. Questionnaire. Regression analysis.	Women who had practiced Physical Activity during pregnancy were less likely to have a cesarean delivery.

6	*"Exercise during pregnancy and cesarean delivery: North Carolina PRAMS, 2004-2005"* Birth (Bovbjerg & Siega-Riz, 2009).	Examine the association between exercise during the third trimester and mode of delivery.	1 955 women, postpartum.	Observational. Questionnaire and telephone interview. Bivariate and regression analyses.	No association was found.
7	*"Effect of exercise on pregnancy outcome"* Clinical Obstetrics & Gynecology (Gavard & Artal, 2008).	Evaluate the literature for effect of exercise on pregnancy outcome.	Studies investigating the relationship between Physical Activity and mode of delivery included.	Review.	Lower rate of cesarean section among exercising women or no association.
8	*"Type of delivery is not affected by light resistance and toning exercise training during pregnancy: a randomized controlled trial*" American Journal of Obstetrics and Gynecology (Barakat, Ruiz, Stirling, Zakynthinaki & Lucia, 2009).	Examine the effect of exercise during the second and third trimester on mode of delivery.	Training group (n=80) and control group (n=80)	Randomized controlled trial. Bivariate analysis.	No significant differences among groups.
9	*"Water aerobics in pregnancy: cardiovascular response, labor and neonatal outcome."* Reproductive Health (Baciuk, Pereira, Cecatti, Braga & Cavalcante, 2008).	Investigate the association between water aerobics and delivery and neonatal outcomes.	Pregnant women with singleton pregnancy. Aerobics group (n=34) and control group (n=37).	Randomized controlled trial. Bivariate analysis.	No difference between the groups regarding mode of delivery.

It may seem like previous research has mainly focused on the relationship between exercise activity and mode of delivery. Therefore the research questions in this thesis are focused on

Physical Activity, including other activity domains in daily life; household/care giving, occupational, exercise and sedentary activity.

Only one study examining the relationship between Physical Activity and mode of delivery used MET score in their investigation. Melzer et al., (2010b) calculated MET score out of measurement by an accelerometer. They found that active women had a 7.6 times lower risk of having an operative delivery (vacuum/forceps/cesarean section) when adjusting for parity, maternal weight gain, and birth weight.

The remaining 8 articles examined the relationship between exercise and mode of delivery. Out of these 8 articles, 4 articles concluded that exercise during pregnancy reduced the rate of operative deliveries (vacuum/forceps and/or cesarean section).

4.0 METHOD

In this chapter the study design, study population, the questionnaire and the analysis used in this thesis is described and furthermore validity, reliability and ethical considerations related to the thesis are presented. The method is discussed in chapter 6.

4.1 Research design and method

When designing a study, different approaches can be chosen, depending on the character of the research questions. If the purpose is to gain a deeper understanding of a certain phenomenon or to describe and develop new perspectives, a qualitative approach may be the correct approach. If the purpose is to do a survey to map the prevalence of a concept, to count the numbers, a quantitative approach is appropriate (Johannessen et al., 2010).

In quantitative research, the concepts that are investigated are called variables. The research questions in this thesis are presented in chapter 1.0 and concerns Physical Activity and its relationship to mode of delivery which are the main variables. Data on Physical Activity for this study was collected twice during pregnancy; the responses were then transformed into numbers. The variable mode of delivery had three alternatives, either assisted vaginal delivery, emergency cesarean section or spontaneous vaginal delivery. This means that both Physical Activity and mode of delivery in this thesis can be counted. Consequently a quantitative approach was chosen.

In qualitative research, information can be obtained by conversations with the informants. An alternative for this study could be to perform a qualitative study, for instance by asking women to describe their Physical Activity pattern and related thoughts. A combination of a qualitative and a quantitative approach in order to provide both perspectives on the subject

could be very interesting. It would give a more complete view on the subject by providing the statistical view on level on Physical Activity and its relationship to mode of delivery but also a deeper understanding about the pregnant women's experiences. To include both a qualitative and a quantitative approach in this thesis would have been too comprehensive and therefore not conducted.

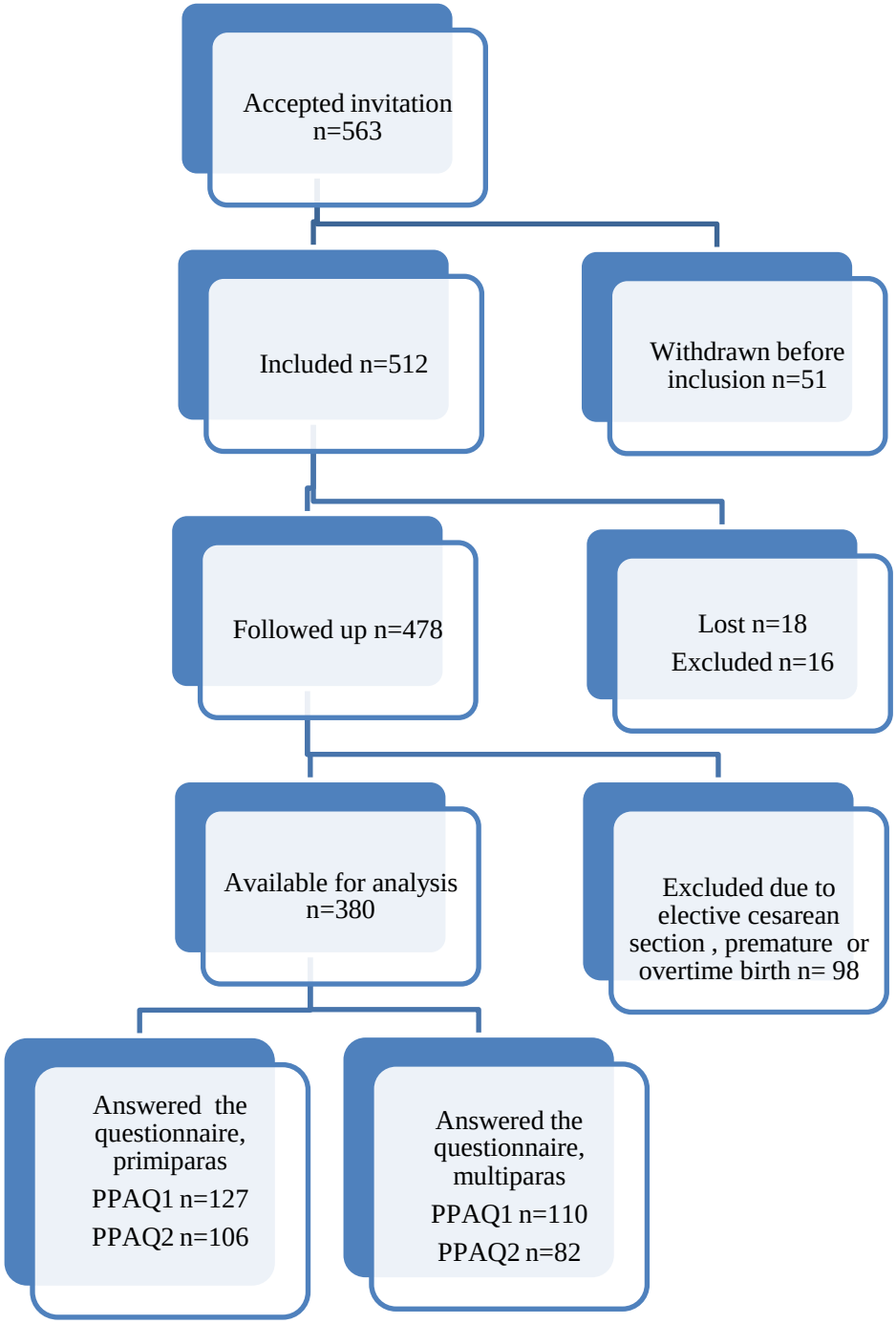
4.2 Study population

According to Johannessen (2009), data in social science is peoples reality transformed into numbers. Data is created by the researchers and is the link between reality and the analyses of the reality. Often it is not possible to examine the whole population so a selection of the population examined is made. It is important that the selection is at random and that the respondents are similar in demographic characteristics in order to draw a conclusion that is valid for the general population (Johannessen, 2009).

The present study is a sub study on data originating from a longitudinal cohort, called STORK. For the STORK cohort, healthy women of Scandinavian origin with singleton pregnancies, planning to give birth at one University Hospital in Norway, were eligible. The women were found in the booking list for birth at the hospital and recruited before 14-16 weeks of gestation.

Inclusion criteria: healthy pregnant women with the intension of delivering vaginally were included and analyzed in this study. The research question in this study (p. 4) on the relationship between Physical Activity and mode of delivery assumes that the women intend to deliver vaginally.
Exclusion criteria: multiple pregnancies (more than one featus), pre-gestational diabetes and severe chronic diseases (lung, cardiac, gastrointestinal or renal).

Figure 2. Flow-chart of inclusion and exclusion of the women in the study.



Some 563 pregnant women accepted the invitation to participate in the study, 51 of them withdrew before inclusion. Another 34 was lost to follow up or excluded. The selection process to the main study therefore resulted in a study sample of 478 healthy pregnant women. For this sub study additional exclusion criteria were set. Women giving birth pre- or

post-term and women having an elective cesarean section were excluded from this study. Term pregnancy has been defined as giving birth after 37 gestational weeks and 0 days, and before 41 weeks and 6 days of pregnancy (Spong, 2013). This process resulted in 380 women as presented in figure 2 below. The women were asked to complete a questionnaire, Pregnancy Physical Activity Questionnaire (PPAQ), explained below in chapter 4.3. Of the 380 women that were available for analysis, 127 women who expected their first child (primiparas) and 110 women who had given birth previously (multiparas) completed the questionnaire early in pregnancy. Later in pregnancy (PPAQ2), 106 primiparas and 82 multiparas completed the questionnaire.

4.2.1 Dropout analysis

The questionnaire on Physical Activity was handed out twice during pregnancy. The inclusion and exclusion flow chart is shown in figure 2 (p. 29). The first 131 participants included in the study did not receive the questionnaire because the data collection was started before the questionnaire was handed out to the participants. The number of participants completing the questionnaire dropped from n=244 at PPAQ1, to n=193 at PPAQ2. Demographic data of the participants that only completed the first questionnaire was compared to the participants that completed both questionnaires.

Participants completing PPAQ the first time had a mean age of 31.1 years (SD 3.8), 97.1% were either married or cohabiting and 53% expected their first child. Participants completing PPAQ the second time had a mean age of 31.2 years (SD 3.7), 96.9% were either married or cohabiting and 56.4% expected their first child.

4.2.2 Representativeness of the data

Table 1. Age and civil status for the study participants and the population in Norway and Oslo.

	STORK2 2005-2008	Norway 2005-2008 (MFR)	Oslo 2005-2008 (MFR)
Age for primipara (in yrs)	29.9*	27.5**	29.6**
Married or cohabiting (%) ***	96.3	92.3	93.1

*Age for primipara at first visit. ** Age for primipara at delivery.

***Both primipara and multipara.

In table 1, the demographic data is compared to data from the Medical Birth Registry (MFR) to investigate the representativeness of the study participants. Age at first child was measured at different times in the STORK study than in the MFR. For participants in the STORK project, age was registered at the first visit, around 14-16 weeks of gestation. In comparison, MFR has registered age at the delivery of the child. But age seems similar for the study participants and the Oslo region.

There was a slight difference in civil status between the study participants and the data from the MFR, both regarding Oslo and Norway as a whole. The data from the MFR is only presented in mean and cannot be analyzed together with the STORK data file in order to look for significant differences. The difference in civil status may perhaps be affected by women in more stable relationships being more likely to accept participation in the study or to having selected the hospital for birth place.

4.3 Pregnancy Physical Activity Questionnaire

A systematic method to obtain information from a selected population with the aim to respond to the research questions in a study is with the use of a questionnaire.

For the collection of the data on Physical Activity analyzed in this thesis, the questionnaire Pregnancy Physical Activity Questionnaire (PPAQ) was used. PPAQ was completed twice during pregnancy by the study participants. The first time was at 14-16 weeks of gestation (hereafter called PPAQ1), the second time at 30-32 weeks of gestation (hereafter called PPAQ2).

The PPAQ covers Physical Activity 24 hours a day and covers the activity domains sports/exercise, household/care giving, occupational and sedentary activities (attachment 1, p. 87).

The questions in the questionnaire are grouped into activity domains as follows:

household/care giving (12 activities), occupational (5 activities), sports/exercise (9 activities), sedentary activity (5 activities). All questions in the questionnaire have 6 alternative answers. Response alternatives were ranged according to time consumption, either per week or per day. Examples of activities in the exercise domain are walking, jogging, swimming and others. Examples of activities in the household/care giving domain are preparing meals, dressing children (while standing or sitting), playing with children (sitting/standing or walking/running), cleaning and shopping. Examples of activities in the occupation domain are sitting at work, "standing or slowly walking at work while carrying things". Examples of activities in the sedentary domain are sitting by a computer, watching TV and sitting and reading. For further detail in the questions, the questionnaire is attached in attachment 1 (p. 87).

PPAQ is a self administered questionnaire. In order to quantify the Physical Activity registered in each activity domain in the questionnaire all activities were transformed into metabolic equivalent task (MET) score. The Compendium of Physical Activities gives a list of physical activities with corresponding estimates of intensity in MET score (Ainsworth et al., 2000). To calculate the score, the duration of each activity is multiplied by its intensity.

The compendium of Physical Activities (Ainsworth et al., 2000), bases its MET intensities on measurements among men and non-pregnant women. The compendium has been updated in 2011 and has included intensities for walking and some household tasks based on measurements on pregnant women (Ainsworth et al., 2011). But this update is done after this study has been performed and therefore, in this study, intensities are based on men and non-pregnant women. A MET score of 1 corresponds with the energy expenditure during quiet sitting, while MET scores 3-6 correspond to walking quickly at 5-7 km/h (Artal & O'Toole, 2003). MET score of activities ranges from 0.9 (sleeping) to 23 (running at 22.5 km/h) (Ainsworth et al., 2011).

Calculation of MET score enables to sum up all Physical Activities (sports/exercise, household/care giving, occupation and sedentary activities) performed and to conduct statistical analysis of the activities.

4.4 Statistical analyzes

When performing statistical analyses in a study the presentation starts by describing the study population (Johannessen et al., 2010).

In the following, a presentation of the analyses performed in the present study will be presented.

Descriptive analyses

In this thesis, descriptive statistics are used to present the study population and is presented as frequencies, percentages and mean with standard deviations. The demographic characteristics are also analyzed according to parity and are presented in table 2 (p. 43).

Bivariate analyses

Bivariate analyze means analyzing two variables at the same time. When analyzing different groups of a selected population for its distribution on one particular variable, it is possible to test the result to investigate if there is a significant difference or not. A significant difference means that it is reasonable to conclude that there is also a difference between groups in the general population. But since a selected population is investigated and not the whole population, there is always a risk of drawing a false conclusion. Therefore a cut off limit of that risk is identified, a so called *p*-level. *P* originates from the word probability and expresses the likelihood for making a false conclusion. If the *p*-level is set to 0.05, this means that there is a 5 % risk that one draw the false conclusion (Johannessen, 2009). A *p*-level of 0.05 is common and recommended in social science and is the *p*-level also in this study.

There are two types of error when testing for significance. Type I error means to conclude that there is a difference between groups when there is not. Type II error means to conclude that there is no difference between groups, when there actually is.

Different tests are performed on different types of variables. It is the level of measurement of the variable that indicate what statistical analyze to perform. To test for significance on continuous variables a t-test are performed. For categorical variables a chi-square test is performed (Johannessen, 2009). In order to describe the study population in this study according to parity, t-test was performed on continuous variables and a chi-square test on categorical variables, as presented in table 2 (p. 43).

The level of Physical Activity, as calculated in MET score (described in chapter 4.3, p. 32), is a continuous variable. To describe the level of Physical Activity among the study population, analysis of both total amount of Physical Activity level, and the activity domains separately, was performed. An independent-sample t-test was performed to analyze all Physical Activity levels according to parity. The results are presented in table 3 (p. 45). Further, changes in activity pattern during pregnancy were analyzed by a paired-sample t-test according to parity, and are presented in table 4 (p. 48).

Mode of delivery and parity are both on a dichotomous level of measurement, therefore a chi-square test for independence was performed to answer one of the research questions (presented in chapter 1.0, p. 4). Results are presented in table 5 (p. 50).

Multivariate analyses

In quantitative research there are usually more than one variable that potentially may affect the results. In order to try to eliminate the influence of other variables, analyses of three or more variables at the same time, a multivariate analysis of the data is performed. A multivariate analysis is regression analyze (Johannessen, 2009).

In this study, when performing analyses with the aim of investigating the relationship between Physical Activity and mode of delivery, it is possible that other aspects are affecting the outcome. It is important that the analyses take possible confounding variables into consideration in order to find out the true relationship.

If, as in this study, the dependent variable is on a dichotomous level of measurement (a variable with 2 values), or has 4 values or less, a logistic regression analysis is performed to examine the relationship between the variables. When the dependent variable is on a dichotomous level of measurement a binary logistic regression analysis is performed (Johannessen, 2009).

In this study the outcome variables are on a dichotomous level of measurement and three logistic regression analyses are performed on the following outcomes: assisted vaginal delivery or not (table 6, p. 52), emergency cesarean section or not (table 7, p. 53) and spontaneous vaginal delivery or not (table 8, p. 55).

The principle of logistic regression analysis is to investigate the likelihood for a specific outcome to occur depending on the values of the independent variables. The higher the odds ratio is, the more likely it is for the outcome to occur. An odds ratio of less than 1.0 means that the outcome is less likely to occur if the independent variable is present (Johannessen,

2009, p 164). And the contrary, an odds ratio of for instance 3.0, gives a three times increased likelihood for the outcome to occur compared with an odds ratio of 1.0. An odds ratio of 1.0 means, it is as likely as unlikely for the outcome to occur. The coding of variables analyzed in this study is presented below in chapter 4.4.1 (below) and 4.4.2 (p.37).

All analyses were conducted using the Statistical Package for Social Sciences (SPSS version 20) for Windows (SPSS Inc., Chicago, IL).

4.4.1 Definition of dependent variables

Health outcome measures in this study are mode of delivery defined as emergency cesarean section, assisted vaginal delivery (vacuum or forceps) or spontaneous vaginal delivery (vaginal delivery without instrumental intervention by cesarean section, vacuum or forceps).

The number of forceps in this study was small (n = 8). In addition, in 4 of these cases both vacuum extraction and forceps were used. Therefore vacuum and forceps variables were recoded and analyzed as one variable, hereafter called assisted vaginal delivery. Assisted vaginal delivery is coded as: 0 = no assisted vaginal delivery (this includes both spontaneous vaginal deliveries and emergency cesarean sections), and 1 = assisted vaginal delivery performed.

Emergency cesarean section is coded as 0 = no emergency cesarean section (this includes both spontaneous vaginal deliveries an assisted vaginal deliveries), and 1 = emergency cesarean section performed.

For analyses on the amount of spontaneous vaginal delivery a new variable was created. Assisted vaginal delivery and emergency cesarean section were computed into one variable with the values: 0 = assisted vaginal delivery or emergency cesarean section and 1 = spontaneous vaginal delivery. This enables analyses with the health measure spontaneous vaginal delivery as dependent variable to be performed.

4.4.2 Definition of independent variables

The independent variable MET score/week is calculated energy expenditure for each activity based on a validated questionnaire (Chasan-Taber et al., 2004), as described in chapter 4.3, p 32). In chapter 5.2 (table 3, p. 45), the level of activity is presented in mean MET score/week. For the logistic regression analyses in chapter 5.4 (p. 51), MET score/week is dichotomized into two groups divided by the median value with 50% of the participants in each group, resulting in one high activity group and one low activity group.

The variable parity was recoded due to a small study sample both in women having given birth twice before the present pregnancy (n = 28) and for women having given birth three times before the present pregnancy (n = 1). Parity was therefore recoded into a dichotomous variable with all women having given birth previously one or more times, clustered into one group, called multipara. Women with no previous birth are called primipara.

The variable "induction of labour" had originally 6 values. The first value is no induction. One value indicates rupture of the membranes. Some women starts labour spontaneously after rupture of membranes and this value does not indicate induction or not. There are only 3 cases with this value and they are coded as missing. One other value in the same variable is induction by cesarean section and there was only one with this value and is also coded as missing. The last tree values are induction by three methods; amniotomia (manual rupture of membranes), prostaglandin (vagitorium) or Oxytocin (intravenous stimulation to induce contractions). The variable induction was dichotomized into 0 = no induction of labour and 1 = induction (including amniotomia, prostaglandin and Oxytocin).

The variable body mass index (BMI, weight in kilograms divided by height in meters squared (kg/m2)) has a continuous level of measurement. It seems as if pre-pregnancy BMI (retrospective BMI based on the women's reporting of weight and height) is widely used in scientific papers. Pre-pregnancy BMI is not influenced by pregnancy itself. On the other hand it is a retrospective measure and might therefore be less accurate than measurements performed at the first visit. In this study the participants were weighed and their height measured at the first visit and BMI calculated based on that measurement.

The variable birth weight has a continuous level of measurement.

4.5 Validity

Validity in research concerns whether or not the data are valid as a representation of reality (Johannessen et al., 2010). Are we measuring what we want to measure? The validity concerns different aspects of the validity of a study. Some aspects of validity are more relevant for this thesis and are presented in the following.

Face validity is an evaluation of the questions, in this study questions about Physical Activity (attachment 1, p. 87), whether the questions capture the concept in question or not. According to Johannessen (2010), face validity is in a way a matter of common sense. Polit & Beck (2012) refers to face validity as whether or not the instrument *looks* like it is measuring the concept in question.

Construct validity concerns if we measure what we meant to measure or not (Ringdal, 2007). In this study, Physical Activity is measured by a questionnaire (attachment 1, p. 87) and construct validity in this case concerns if the instrument really measures Physical Activity. Construct validity concern the operationalization of the research concepts into measurable phenomena (Polit & Beck, 2012). Some variables may be operationalized easily like for instance weight. This study has operationalized the concept Physical Activity in a questionnaire with 31 questions. Subsequently the answers were calculated into MET score as an operationalization of the concept.

To strengthen a study's construct validity, administering the questionnaire to a known group is one approach. If the results are as expected, it strengthens the construct validity.

Internal validity concerns whether it is the independent variable investigated that causes the outcome effect or if there may be other causes involved (Skog, 1998). A possible internal validity problem concerns the causal interpretation of the study.

External validity means that the results are generalizable (Ringdal, 2007). This in turn means that the results can be understood to be valid also in the general population. The results may be generalized to a population with the same traits as the study population.

The PPAQ has been validated on an American population (Chasan-Taber et al., 2004) and has previously been used to study of Physical Activity during pregnancy (Schmidt et al., 2006) . MET score has also been used to calculate and describe the amount of Physical Activity performed during pregnancy based on other questionnaires (Clarke et al., 2005; Rousham et al., 2006; Schmidt et al., 2006).

The questionnaire has not been translated into Norwegian or been validated for a Norwegian population. The questionnaire was handed out to Norwegian participants in its original form and in English to the participants in this study.

4.6 Reliability

Reliability in research concerns whether or not the data are collected and analyzed meticulously, and that the results would be the same if repeated (Johannessen et al., 2010). Are we measuring the same every time?

There are two types of testing of reliability (Pallant, 2010; Polit & Beck, 2012). The first test investigates the stability of the questionnaire. If a test-retest reliability of a scale is performed, the questionnaire is administered to the same people at two different occasions; subsequently the answers are compared with a correlation test to investigate if the same answers were obtained. If there is a high correlation the scale is considered a more reliable scale. A test-retest was performed when the PPAQ questionnaire was validated, the participants completed the questionnaire, then wore an actigraph (a device attached to the body that measures the activity performed) for seven days and then filled out the questionnaire a second time (Chasan-Taber et al., 2004).

A second reliability test investigate the internal consistency, whether the questions in the questionnaire measure the same trait or not (Pallant, 2010; Polit & Beck, 2012). The Cronbach's alfa scale ranges from 0 to1, the higher the statistical size, the more reliable are

the data. To be considered satisfactory the Cronbach's alfa should be over 0.70 (Ringdal, 2007).

Cronbach's alfa has been performed on the data collected on Physical Activity in this study showed quite different levels. At PPAQ1 the Cronbach's alfa of all 33 questions was .487, which is a weak reliability. At PPAQ2 it was .657 which is acceptable. When analyzing the domains separately at PPAQ1, the Cronbach's alfa varied from -.081 (occupational activities) to .697 (household/care giving activities). At PPAQ2 Cronbach's alfa varied from -.037 (occupational activities) to .707 (household/care giving activities).

4.7 Ethical considerations

The study was conducted in accordance with the Declaration of Helsinki (WMA, 2008). The Declaration of Helsinki is a statement of ethical principles for medical research in humans and gives ethical principles on voluntariness. The Declaration of Helsinki is formed to protect individuals in medical research (Ruyter, Solbakk & Førde, 2007).

The regional ethics committee approved the STORK-study (attachment 2, p. 91). The participants were informed through an information document and gave written consent (attachment 3, p. 92). Participation in the study was voluntary and the participants could withdraw from the study at any time without giving reason. All data was treated with confidentiality and is stored de-identified in a fireproof safe at the hospital.

The data file used in this study is de-identified and it is not possible to connect the data to the participants. There is no reason why the participants in this study would be at risk of being identified in a possible publication of this thesis.

4.8 Researcher role

I am currently working as a midwife at a delivery ward in Oslo, Norway. During my 16 years as a midwife I have seen an increase in the use of both assisted vaginal delivery and cesarean section that worries me because of its potential negative effect for mothers and infants. My experience may influence me in my efforts in trying to contribute to inhibit this change towards even more interventions. Furthermore it is my belief that a delivery is a natural event and that it should be treated as such as long as possible. That may also affect me in my interpretation of the results.

In addition, it may seem like there is a growing interest in the positive effects of Physical Activity in the media, but also in research, which may have influenced my choice of research questions in this thesis.

5.0 RESULTS

In this chapter the results from the analyses performed are presented. First the study population is presented. Subsequently, the level of Physical Activity performed at both occasions for completing the questionnaire (PPAQ1 and PPAQ2), as well as mode of delivery, are presented according to parity. Finally the relationship between Physical Activity and mode of delivery is presented.

As described in the chapter about statistical analyzes, chapter 4.4 (p. 34), the significance level in this thesis is $p \leq 0.05$.

5.1 Demographic characteristics of the study population

Table 2. Demographic characteristics of the study population. All participants presented both in total and according to parity.

	N (%)	Mean (SD *)	*p*-value
Participants	**380 (100)**		
Primipara	205 (54)		
Multipara	168 (44)		
Age		**31 (3.7)**	
Primipara		29.9 (3.7)	
Multipara		32.4 (3.4)	.000
Married or cohabiting	**366 (96.3)**		
Primipara	196 (95.6)		
Multipara	163 (97.0)		.659
Higher education	**328 (87.9)**		
Primipara	183 (89.3)		
Multipara	145 (86.3)		
High school	**42 (11.3)**		
Primipara	21 (10.2)		
Multipara	21 (12.5)		
Primary school	**3 (0.8)**		
Primipara	1 (0.5)		
Multipara	2 (1.2)		.584
Not smoking	**377 (99.2)**		
Primipara	204 (99.5)		
Multipara	166 (98.8)		.862
BMI at first visit		**23.9 (3.6)**	
Primipara		23.6 (3.5)	
Multipara		24.2 (3.7)	.150
Birth weight (gram)		**3575 (471)**	
Primipara		3482 (440)	
Multipara		3695 (490)	.000
Epidural analgesia	**154 (40.6)**		
Primipara	108 (52.7)		
Multipara	42 (25.1)		.000
Induction of labour	**58 (15.7)**		
Primipara	29 (14.3)		
Multipara	29 (17.5)		.489

T-test is performed on continuous variables and chi-square test on categorical variables. Significance level, p≤0.05.

- *SD = Standard deviation, show to which degree the units deviate from the mean value.*

As shown in table 2, out of 380 participants, 366 (96.3 %) were either married or cohabiting. Mean age, at first visit, was 31 years. The number of women with higher education was 328 (87.9 %). About half of the study population expected their first child (n=205, 55%).

Only 3 women were smoking, therefore this variable was not included in further analyses.

BMI was not statistically significantly different among primipara and multipara. But birthweight of the baby was, multipara gave birth to babies weighing 213 g more than primipara, *p* .000.

There was a significant difference in the use of epidural analgesia (EDA) between primipara (52.7%) and multipara (25.1%), *p* .000 while induction of labour was not significantly different. The results are shown in table 2 (p. 43).

5.2 Level of Physical Activity in the study population

The amount of Physical Activity performed during pregnancy is collected via questionnaire. The responses have been calculated into MET score in this study and this process is described in chapter 4.4 (p. 32).

The questionnaire was completed twice during pregnancy (as described in chapter 4.4, p. 32). When analyzing the time as measured in gestational weeks, PPAQ1 was (in mean) completed in gestational week 14.7 (SD 4.7). PPAQ2 was completed in gestational week 35.6 (SD 2.1), presented in mean.

Table 3. Level of Physical Activity according to parity, presented as sum of MET score/week. Independent sample t-test.

	All study participants			Primipara			Multipara			
	N	***Mean*** *(min-max)*	***SD***	**N**	**Mean** (min-max)	**SD**	**N**	**Mean** (min-max)	**SD**	***P*-value**
Total sum of MET score, PPAQ1	*244*	*236 (62-626)*	*85*	**127**	**211** (62-505)	**72**	**110**	**266** (104-626)	**92**	***.000***
Exercise	*244*	*16 (0-73)*	*14*	**127**	**19** (0-73)	**16**	**110**	**14** (0-53)	**12**	***.002***
Household/care giving	*244*	*66 (9-279)*	*49*	**127**	**33** (9-122)	**16**	**110**	**103** (27-279)	**47**	***.000***
Occupation	*224*	*98 (0-280)*	*45*	**119**	**100** (0-280)	**48**	**99**	**96** (22-279)	**42**	***.598***
Sedentary activities	*221*	*79 (19-165)*	*26*	**118**	**78** (26-160)	**26**	**98**	**81** (19-165)	**26**	***.549***
Total sum of MET score, PPAQ2	*193*	*193 (70-556)*	*68*	**106**	**172** (70-391)	**56**	**82**	**219** (113-556)	**74**	***.000***
Exercise	*193*	*12 (0-51)*	*10*	**106**	**13** (0-44)	**10**	**82**	**10** (0-51)	**10**	***.011***
Household/care giving	*193*	*62(8-281)*	*46*	**106**	**35** (8-107)	**17**	**82**	**97** (21-280)	**48**	***.000***
Occupation	*149*	*73 (0-192)*	*38*	**85**	**74** (0-192)	**39**	**60**	**72** (0-163)	**37**	***.691***
Sedentary activities	*148*	*77 (23-137)*	*26*	**85**	**79** (27-137)	**25**	**59**	**76** (23-127)	**27**	***.535***

Significance level, $p \leq 0.05$.

In table 3 (p. 45), it is shown that there was a significant association between total sum of MET score and parity both early (PPAQ1) and late (PPAQ2) in pregnancy. Women, who had given birth before the current pregnancy, reported a higher level total sum of Physical Activity when compared to women expecting their first child. At PPAQ1 the mean level of sum score of Physical Activity was 266 MET score/week (SD 92) for multiparas, and 211 MET score/week (SD 72) for primiparas, *p* .000. At PPAQ2, multiparas had a sum score of Physical Activity of 219 MET score/week (SD 74), and for primiparas the score was 172 MET score/week (SD 56), *p* .000.

There was no significant association between parity and the domains occupation and sedentary activities.

The independent-sample t-test showed a significant association between exercise level and parity early in pregnancy. At PPAQ1, primiparas were more physically active (19 MET score/week, SD 16) as measured in MET score/week in the exercise domain than multiparas (14 MET score/week, SD 12), *p* .002. Later in pregnancy the same test was not significant, (primiparas 13 MET score/week, SD 10, multiparas 10 MET score/week, SD 10, *p* .011). But the standard deviation was very wide in relation to the score meaning large differences between the subjects in the study population, making the interpretation imprecise.

Household/care giving activities were significantly associated with parity at both times the study participants completed the questionnaire. Multiparas mean activity level in the household/care giving domain was significantly higher both times. At PPAQ1 the mean level of activity in the household/care giving domain was 33 MET score/week (SD 16) for primiparas, and 103 MET score/week (SD 47) for multiparas, *p* .000. At PPAQ2 the mean level of activity was 35 MET score/week (SD 17) for primiparas, and 97 MET score/week (SD 48) for multiparas, *p* .000 (table 3).

As measured in MET score, primiparas seemed mostly active in the occupation activity domain while multiparas were mostly active in the household/care giving domain. Both

primiparas and multiparas seemed to be least active in the exercise domain, as measured in MET score.

Multicollinearity

For the independent variables parity and household/care giving activity, it turned out that there was a problem. In multiple regression analyses, independent variables are to be controlled for multicollinearity (Johannessen, 2009). Multicollinearity means that the variables measures the same phenomenon and may therefore affect the results of the analyses into an incorrect interpretation of the data. Multicollinearity may be tested with a correlation test. According to Johannessen (2009) a correlation of >0.7 is to be considered a high correlation and both variables should therefore not be brought in to the multiple regression analysis.

The relationship between parity and household/care giving activity at PPAQ1 was further investigated using Spearmans rho. Spearmans rho is a correlation test used when both variables, as in this case, has a dichotomous level of measurement. There was a positive correlation between the two variables, r=.758, p .000. This means that both parity and household/care giving activity at PPAQ1 could not be included in the regression analysis.

If including both parity and household/care giving activity in the multiple logistic regression analyses there is a risk that, when analyzing the impact of household/care giving activity on the outcome mode of delivery, what is actually measured is the effect of parity.

5.2.1 Changes in activity pattern during pregnancy

Physical Activity was also analyzed by paired-sample t-test in order to investigate for eventual changes in activity pattern. Analyses were performed according to parity since

activity pattern showed different pattern for primiparas and multiparas. Results are presented in table 4.

Table 4. Changes in activity pattern from PPAQ1 to PPAQ2, according to parity. Paired-sample t-test.

		PPAQ1		***PPAQ2***		
	*N**	Mean	SD	Mean	SD	p-value
PRIMIPARA						
Total sum of MET score	*106*	212	70	172	56	.000
Exercise	*106*	20	16	13	10	.000
Household/care giving	*106*	33	17	35	17	.338
Occupation	*84*	101	47	75	38	.000
Sedentary activities	*84*	77	25	79	25	.466
MULTIPARA						
Total sum of MET score	*82*	267	92	219	74	.000
Exercise	*82*	14	12	10	10	.000
Household/care giving	*82*	102	49	97	48	.217
Occupation	*58*	89	28	72	37	.001
Sedentary activities	*57*	85	26	76	27	.013

**N=responded to both PPAQ1 and PPAQ2. Significance level, p≤ 0.05.*

In table 4, paired-sample t-test show a significant decrease in total activity level as measured in MET score for both primiparas and multiparas from PPAQ1 to PPAQ2.

At PPAQ1, primiparas had a mean level of total activity of 212 MET score/week (SD 70), which decreased to 172 MET score/week (SD 56) at PPAQ2, *p* .000. For multiparas the level

decreased from 267 MET score/week (SD 91) at PPAQ1 to 219 MET score/week (SD 74) at PPAQ2, *p* .000.

The level of activity in the exercise domain decreased as well for both primiparas (20 Met score/week at PPAQ1, SD 16 and 13 MET score/week at PPAQ2, SD 10, *p* .000) and multiparas (14 MET score/week at PPAQ1, SD 12, and 10 MET score/week at PPAQ2, SD 10, *p* .000).

Primiparas did not change their level of activity in the household/care giving domain (33 MET score/week at PPAQ1, SD 17 and 35 MET score/week at PPAQ2, SD 17, p .338). Neither did multiparas (102 MET score/week at PPAQ1, SD 49 and 97 MET score/week at PPAQ2, SD 48, *p* .217).

Table 4 (p. 48) also show a significant decrease in activity in the occupation domain for primiparas (101 MET score/week at PPAQ1, SD 47 and 75 MET score/week at PPAQ2, SD 38, p .000) and for multiparas (89 MET score/week at PPAQ1, SD 28 and 72 MET score/week at PPAQ2, SD 37, p .001).

Sedentary activity did not change for primiparas (77 MET score/week at PPAQ1, SD 25 and 78 MET score/week at PPAQ2, SD 25, *p* .466) but decreased significantly for multiparas (85 MET score/week at PPAQ1 SD 26 and 76 MET score/week at PPAQ2, SD 27, *p* .013).

5.3 Mode of delivery in the study population

Mode of delivery is in this thesis defined as emergency cesarean section, assisted vaginal delivery or spontaneous vaginal delivery and is analyzed according to parity in the following.

Table 5. Mode of delivery according to parity. Chi-square test for independence.

Mode of delivery	**Primipara n=205**	**Multipara n=167**	***P -value***
	N (%)	N (%)	
Assisted vaginal delivery	46 (22.4)	8 (4.8)	*.000*
Emergency cesarean section	22 (10.7)	12 (7.2)	*.317*
Spontaneous vaginal delivery	138 (67.3)	147 (88.0)	*.000*

One participant had both assisted vaginal delivery and emergency cesarean section.

Significance level, p ≤0.05.

In table 5, chi-square test for independence (With Yates Continuity Correction) showed a significant association between assisted vaginal delivery and parity. The primiparas in the study group had an assisted vaginal delivery rate of 22.4 % and multiparas 4.8 %, *p*.000.

The same test showed no significant association between emergency cesarean section and parity.

There was a significant association between spontaneous vaginal delivery and parity. Multiparas had spontaneous vaginal delivery in 88 % while primiparas had a frequency of 67.3 %, *p* .000.

One study participants had both an assisted vaginal delivery and an emergency cesarean section. A delivery with both an assisted vaginal delivery and an emergency cesarean section is in reality a birth that fails to deliver the child vaginally by assisted vaginal delivery; therefore an emergency cesarean section is performed.

5.4 Analysis of the relationship between level of Physical Activity and mode of delivery

The relationship between Physical Activity and mode of delivery may be investigated from two points of view and the analyses presented below are characterized by that. The first is a pathogenic view and has assisted vaginal delivery and emergency cesarean section as the dependent variable, presented below in chapter 5.4.1 (p. 52) and 5.4.2 (p. 53). The second view is a salutogenic view and has spontaneous vaginal delivery as dependent variable, presented in chapter 5.4.3 (p. 55). The aim of analyzing both perspectives is to cover the subject as comprehensive as possible. When analyzing spontaneous vaginal delivery, cases that were not spontaneous vaginal delivery, were either assisted vaginal delivery or cesarean section. To exclude either the pathogenic or the salutogenic view narrows the investigation and thereby narrows the understanding of the subject.

In order to identify which variables to include in the multiple logistic regression analyses performed and described below, firstly previous research has been studied and presented in chapter 2.5 (p. 15). In the following, unadjusted analysis of relevant independent variables has been conducted. Variables that were significant were to be brought into the multiple logistic regression analyses. This process is presented in tables 6, 7 and 8 below.

Because of the multicollinearity problem, as described in chapter 5.2 (p. 47), only primiparas were included in the regression analyses performed below.

Correlation analyses were performed on the remaining independent variables that were to be brought into the multiple regression analyses. No further multicollinearity was detected.

In the following analyses, the continuous variables on Physical Activity are dichotomized. The study participants (primiparas) were divided into a high activity group (the 50% of the primiparas with higher MET score), and a low activity group (the 50% of the primiparas with lower MET score).

5.4.1 Physical Activity and assisted vaginal delivery

To analyze the relationship between Physical Activity and assisted vaginal delivery, as previously described, a logistic regression analysis was performed on the primiparas in the study.

The number of assisted vaginal deliveries in the study population was 54. It is recommended not to have more than one independent variable for every 10 cases of the value on the dependent variable. Therefore no more than 5 variables can be included in the multiple logistic regression analysis.

Table 6. Risk of having an assisted vaginal delivery among primiparas. Binary logistic regression analysis.

	Unadjusted analysis			**Adjusted logistic regression**
				Not performed
	OR	(95%CI)	*p-value*	
BMI*	1.002	(.912-1.101)	.970	
Birth weight	1.000	(.999-1.000)	.357	
Age	.955	(.872-1.047)	.330	
EDA during delivery	5.095	(2.306-11.258)	.000	
Induction of labour	.503	(.166-1.528)	.225	
Activity PPAQ1				
Total activity	1.252	(.565-2.775)	.580	
Sports/exercise	1.252	(.565_2.775)	.580	
Household/care giving	1.416	(.636-3.152)	.394	
Occupation	1.689	(.746-3.820)	.209	
Sedentary activities	.990	(.443-2.213)	.981	
Activity PPAQ2				
Total activity	.677	(.283-1.616)	.379	
Sports/exercise	1.215	(.511-2.885)	.660	
Household/care giving	1.800	(.738-4.389)	.196	
Occupation	.510	(.197-1.317)	.164	
Sedentary activities				

**BMI as measured at first visit. Significance level, p≤ 0.05.*

In table 6, unadjusted analyses showed no significant association between any of the activity variables and assisted vaginal delivery. Therefore no adjusted analysis is performed.

The unadjusted analysis shows a 5 times increased risk of having an assisted vaginal delivery if using an EDA as pain relief during delivery with a *p*-value of .000. EDA was not the independent variable of interest in this study and therefore variables in the analysis were not selected by possible confounding of the impact of EDA on the outcome.

5.4.2 Physical Activity and emergency cesarean section

Table 7. Risk of having an emergency cesarean section in primiparas. Binary logistic regression analysis.

	Unadjusted analysis			**Adjusted logistic regression** ***Not performed***
	OR	(95%CI)	*p-value*	
BMI*	1.162	(1.040-1.298)	.008	
Birth weight	1.001	(1.000-1.002)	.009	
Age	1.005	(.890-1.134)	.937	
EDA during delivery	3.437	(1.217-9.709)	.020	
Induction of labour	3.636	(1.323-9.992)	.012	
Activity PPAQ1				
Total activity	.583	(.180-1.889)	.368	
Sports/exercise	1.657	(.511-5.372)	.400	
Household/care giving	.799	(.253-2.525)	.702	
Occupation	.511	(.141-1.849)	.306	
Sedentary activities	.596	(.159-2.234)	.443	
Activity PPAQ2				
Total activity	1.226	(.350-4.291)	.750	
Sports/exercise	1.864	(.512-6.790)	.345	
Household/care giving	.162	(.033-.789)	.024	
Occupation	2.500	(.457-13.669)	.290	
Sedentary activities	1.333	(.280-6.354)	.718	

**BMI as measured at first visit. Significance level, p≤ 0.05.*

In table 7, there was one significant relationship between household/care giving activity at PPAQ2 and emergency cesarean section in the unadjusted regression analysis. Results suggest that women in the low activity group were less likely to have an emergency cesarean section than women in the high activity group. Out of the 106 primiparas that had answered PPAQ2, only 11 women had an emergency cesarean section, therefore no adjusted logistic regression was performed. For every independent variable added to the regression analysis, 10 cases of the outcome are needed. Therefore no conclusion can be made from the result.

BMI and birth weight were both significantly associated in the unadjusted logistic regression analysis. With increasing BMI, the odds for having an emergency cesarean section increased (OR 1.16, *p* .008). Birth weight showed significant result but the odds ratio was 1.001 (*p* .009) which is of limited clinical relevance. An odds ratio of 1.0 means equal likelihood for the outcome to occur as not to occur.

Both EDA and induction of labour showed significant relationship with emergency cesarean section in the unadjusted regression analysis. EDA showed an increased risk for the outcome by 3.4 times (*p* .020). Induction of labour showed an increased risk of emergency cesarean section by 3.6 times (*p* .012). But again, no further investigation of the relationship is conducted because possible confounders to EDA and induction of labour are not included in the analyses in this study.

5.4.3 Physical Activity and spontaneous vaginal delivery

Table 8. Odds for having a spontaneous vaginal delivery in primiparas. Binary logistic regression analysis.

	Unadjusted analysis			**Adjusted logistic regression** ***Not performed***
	OR	(95%CI)	*p*-value	
BMI*	.925	(.851-1.005)	.064	
Birth weight	1.000	(.999-1.000)	.468	
Age	1.029	(.949-1.116)	.487	
No EDA in delivery	5.713	(2.893-11.282)	.000	
Induction of labour	1.109	(.484-2.541)	.807	
Activity PPAQ1				
Total activity	.911	(.440-1.885)	.802	
Sports/exercise	1.378	(.664-2.861)	.389	
Household/care giving	1.143	(.552-2.367)	.719	
Occupation	1.331	(.628-2.823)	.455	
Sedentary activities	.900	(.423-1.913)	.784	
Activity PPAQ2				
Total activity	.849	(.383-1.879)	.686	
Sports/exercise	1.390	(.626-3.084)	.419	
Household/care giving	.931	(.420-2.063)	.860	
Occupation	.659	(.271-1.601)	.357	
Sedentary activities	.710	(.292-1.723)	.449	

**BMI as measured at first visit.*

Significance level, $p \leq 0.05$

In table 8, unadjusted regression analyses did not show any relationship between Physical Activity and spontaneous vaginal delivery. Therefore no adjusted regression analysis was performed.

The only significant relationship to the outcome spontaneous vaginal delivery shown in the unadjusted analysis was EDA. Having a delivery without EDA showed an increased likelihood of delivering by spontaneous vaginal delivery by 5.7 times, *p* .000. But this relationship was not investigated further. Possible confounders to EDA were not investigated in this study and investigating EDA was not the aim of this thesis.

6.0 DISCUSSION

In this chapter the main results of the present study will be discussed systematically according to the aim and research questions of the study, as presented in chapter 1.0 (p. 4). Further the understanding of the results will be interpreted in light of previous research and theory of the thesis; the paradigm of physical activity, fitness and health as described by Haskell et al., (2007), and health promotion. Finally, method of the study, strengths and limitations of the study will be discussed.

6.1 Physical Activity as a health determinant for pregnant women

Firstly, the relationship between Physical Activity and mode of delivery will be discussed based on the results in this study, theory and previous research. Further on, Physical Activity and mode of delivery will be discussed separately and according to parity.

6.1.1 Relationship between the health determinant Physical Activity and the health outcome measure mode of delivery

Logistic regression analyses were performed (table 6, p.52, table 7, p. 53 and table 8, p. 55) in order to answer research question nr 1 (p. 4). Results show no significant relationship between Physical Activity and the outcome assisted vaginal delivery (table 6, p. 52) or spontaneous vaginal delivery (table 8, p. 55). When performing the unadjusted analyses, the relationship between Physical Activity and emergency cesarean section (table 7, p. 53), one activity domain showed significant result. Household/care giving activity at PPAQ2 was significantly related to emergency cesarean section suggesting that primiparas with a lower activity level in the household/care giving domain could have less likelihood of having an emergency cesarean section (OR .162, *p* .024). Out of the 106 primiparas that had responded the questionnaire at PPAQ2, only 11 had an emergency cesareans section. Since multiple regression analyses require at least 10 cases for every independent variable in the multiple

regression analysis, no adjusted analysis was performed. Given a larger sample size, an adjusted regression analysis could have been performed and may have contributed additionally to investigate the relationship.

Hypothetically, if the relationship would have been confirmed in an adjusted regression analysis, Physical Activity in the household/care giving domain and health actually may work in the opposite direction than expected. The paradigm of physical Activity and health as presented by Huskell et al., (2007) suggest that a higher level of Physical Activity contributes to improved health. The unadjusted result presented in this study (table 7, p. 53) would suggest the opposite, which would mean that a higher activity level in the household/care giving domain would contribute to a higher rate of emergency cesarean section and thereby increased risk for a decreased health status. It could possibly be due to other reasons than the actual energy expenditure that is investigated in this study, for instance the challenging working positions when vacuum cleaning or other. A previous study has shown that housework is the most problematic task for pregnant women (MacLennan & MacLennan, 1997). To investigate this possible relationship further, an adjusted regression analysis is however required, and for that, a larger study population is required.

Even though this study did not find a relationship between Physical Activity and mode of delivery, there are other researches indicating that such a relationship exists. Physical Activity during pregnancy may enhance health in both mothers and infants by reducing the risk of developing gestational diabetes and gestational hypertension during pregnancy (Melzer et al., 2010a). Physical Activity may also enhance health in both women and infants by reducing the risk of instrumental involvement (cesarean section/assisted vaginal delivery) during childbirth (Melzer et al., 2010a; Melzer et al., 2010b). Both cesarean section and assisted vaginal deliveries may have negative consequences for both maternal and infant health (Clark & Silver, 2011; Towner et al., 1999). Physical Activity may thereby contribute to improved health for mothers and infants directly by reducing risks for pregnancy related complications but also via a reduction of operative deliveries. But a relevant question arises to whether a reduction of operative deliveries always may contribute to improved health.

The World Health Organization (WHO) has recommended a level of cesarean section of 10-15% on the basis that a too low rate may contribute to poor health outcome (Gibbons et al., 2010). Sometimes operative delivery is necessary to assure a good health outcome for mother and/or infant. It should therefore not be an aim to reduce the use of operative deliveries too much. Cesarean section and assisted vaginal delivery should optimally be used on strict

medical indications to assure the health and safety for mother and infant. An optimization of the use of both cesarean section and assisted vaginal delivery is therefore required. It has though been argued that the modern woman want to have a choice of her own, also when it comes to influencing mode of delivery (Klein, 2012). Ideally, this should be an informed choice. Recommendations about mode of delivery and Physical Activity should therefore be given at antenatal visits as a part of health promotion with the aim to improve and/or maintain the health for both mothers and infants.

It has been stated that pregnancy is a unique opportunity for behavior modification (Artal & O'Toole, 2003; Gavard & Artal, 2008; Sagedal et al., 2013) and that health promotion for pregnant women may be effective for behavior modification during pregnancy (Wilkinson & McIntyre, 2012). But behavior change may be challenging to accomplish (Westenhoefer, 2001). A higher level of Physical Activity has been associated with a reduced risk for developing chronic diseases (Melzer et al., 2004). Therefore in a longer perspective, if a behavior change to increase Physical Activity is successful, it may have an impact on the future health of the woman, her children and the family.

In accordance with the discussion above, Melzer et al., (2010b) found a relationship confirming a paradigm of Physical Activity and health for pregnant women. Melzer et al., (2010b) found that inactive pregnant women had an almost 8 times increased risk of having an operative delivery (assisted vaginal delivery/cesarean section) when compared to the active women. This study did not confirm that.

It is possible that differences in the methodological approach contributed to the divergent result. There are both similarities and differences in how this study and the study by Melzer et al., (2010b) were performed. Both studies have measured Physical Activity and calculated MET score. The difference however, is that this study calculated the scores by the women's reporting in a questionnaire, while Melzer et al., (2010b) used an Actiheart (the Actiheart measures heart rate and bodily movements), and calculated MET score out of the results from these recordings. This makes a methodological difference in the measuring of energy expenditure and therefore Physical Activity. However, Melzer et al., (2010b) and this study have both calculated energy expenditure and should therefore be similar in understanding Physical Activity as measured by energy expenditure.

Further, Melzer et al., (2010b) adjusted for maternal weight gain, newborn birth weight and parity. In the present study, no adjusted analyses were performed. But unadjusted analyses (table 8, p. 55) showed that not using an epidural (EDA) as analgesic during delivery increased the likelihood of delivering spontaneously by 5.6 times, *p* .000. Therefore it is understood as a strength for this study that EDA was to be adjusted for in the analyses. Of the primiparas in this study planning a vaginal delivery, 52.7% chose to use EDA during delivery (table 2, p. 43). EDA was not mentioned in the article by Melzer et al., (2010b). On the other hand, it is possible that there are different procedures on EDA and use of different substances in the EDA in different hospitals and countries. Therefore different effects of having an EDA during delivery as measured by mode of delivery may be the result. Perhaps that is the reason for not including EDA in the analyses in the study by Melzer et al., (2010b). To investigate the subject further, a study of the relationship between EDA and mode of delivery needs to be conducted.

Furthermore, the present study included primiparas only when investigating the relationship between Physical Activity and the health outcome measure, mode of delivery (table 6, p. 52, table 7, p. 53 and table 8, p. 55). Melzer et al., (2010b) included both primiparas and multiparas and subsequently adjusted for parity in the analyses. This may have contributed to divergent results. Parity was highly correlated to the household/care giving domain in the present study, as shown in chapter 5.2 (table 3, p. 45). Therefore multiparas were not included in the logistic regression analyses in this study. But on the other hand, parity was not correlated to the total amount of activity. It may have been an acceptable methodological approach to adjust for parity as Melzer et al., (2010b) did, when analyzing the total amount of activity. In the present study, the choice of only including primiparas in the regression analyses instead of adjusting for parity was done because of the multicollinearity described in chapter 5.2 (p. 47) and is a strength in this study.

6.1.1.1 Exercise and the health outcome measure mode of delivery

The link between Physical Activity and health, as described by a paradigm of Physical Activity and health (Haskell et al., 2012), was not confirmed by the results of analyses of total amount of Physical Activity and mode of delivery in this study. Previous research has not

only investigated the total amount of Physical Activity but also exercise. This study did furthermore not show a relationship between exercise and mode of delivery (table 6, p.52, table 7, p. 53 and table 8, p. 55), but some previous studies have found such a relationship.

Several previous researches on Physical Activity pattern during pregnancy have investigated total activity level including different activity domains (Clarke et al., 2005; Evenson & Wen, 2010, 2011; Fell et al., 2009; Haakstad et al., 2007; Rousham et al., 2006; Schmidt et al., 2006). It is therefore interesting that only one study has brought the different activity domains into the analysis on the relationship between Physical Activity and mode of delivery (Melzer et al., 2010b). Other research have only included the exercise domain (Baciuk et al., 2008; Barakat et al., 2012; Barakat et al., 2009; Bovbjerg & Siega-Riz, 2009; Dumith et al., 2012; Gavard & Artal, 2008; Karabulut et al., 2012; Price et al., 2012), possibly because they may have assumed that it is exercise and high intensity activity that may affect the outcome.

Exercise during pregnancy may reduce the rate of cesarean section and assisted vaginal delivery (Barakat et al., 2012; Dumith et al., 2012; Gavard & Artal, 2008; Price et al., 2012). Exercise may thereby contribute to enhance health in mothers and infants. Other studies however do not find such a relationship and thereby confirm the results in this study (table 6, p. 52, table 7, p. 53 and table 8, p.55) (Baciuk et al., 2008; Barakat et al., 2009; Bovbjerg & Siega-Riz, 2009; Karabulut et al., 2012). None of the previous studies of exercise and mode of delivery has used MET score in their analyses as in this study.

There may be methodological differences between studies. The present study shows that including both primiparas and multiparas in the analysis of Physical Activity and health outcome during pregnancy and delivery may cause a multicollinearity problem (chapter 5.2, p. 47). Other researchers have either randomized the study participants, both primiparas and multiparas, to either exercise or no exercise (Baciuk et al., 2008; Barakat et al., 2012; Barakat et al., 2009; Price et al., 2012), or they have adjusted for parity in the analysis (Bovbjerg & Siega-Riz, 2009; Dumith et al., 2012). Only one article presents a study of primiparas (Karabulut et al., 2012) and the study support the results in the present study, no significant relationship between exercise and mode of delivery was shown. To exclude risk of neglecting a multicollinearity problem, it seems correct to include primiparas only in the regression analyses, and therefore strengthens this study.

There are several aspects that are not included, nor investigated, in the analysis of the relationship between Physical Activity and mode of delivery in this study, which also may be difficult to investigate. Psychological aspects and whether women are motivated for vaginal birth or not, are not measured in this study. And further: maybe women that have a higher level of Physical Activity are more used to work with their body, which may influence the course of childbirth. On the other hand it is possible that exercising women have a higher performance anxiety and thereby have a psychological block during delivery. Maybe active women are more willing to give an extra effort in the work that need to be done during the hours the childbirth last. It is also possible that women's deliveries may be affected by anxiety and fear of giving birth. It is possible that these psychological aspects may influence the childbirth.

This study has finally not included the use of medications for enhancing the contractions during delivery. When a delivery is prolonged, as often is the case in deliveries with an EDA (Hasegawa et al., 2013), an intravenous infusion of Oxytocin is used to strengthen the contractions on order to improve the progress of delivery. This study has not analyzed the use of Oxytocin. This may have affected the results. It is possible that the results had been different if also the use of Oxytocin during delivery had been included.

Conclusively, a higher level of Physical Activity was not shown to reduce the rate of instrumental delivery (cesarean section/assisted vaginal delivery). The results were interpreted in relation to previous research that indicates that Physical Activity may or it may not a have an impact on mode of delivery. However, the possible positive aspects by Physical Activity during pregnancy as discussed above, out weight the possible absence of effect. Physical Activity should therefore continue to be recommended to pregnant women in health promotion in the antenatal care visits.

6.1.2 The health determinant Physical Activity and parity

This study has investigated level of Physical Activity among the study participants during pregnancy, total activity level as well as the separate activity domains (exercise, household/care giving, occupation and sedentary activities) were investigated (research

question nr 2 and 3, p. 4). The inclusion of all activity domains is in accordance with the definition of Physical Activity in this study, as presented in chapter 2.1 (p. 9).

Measuring health determinants is an alternative to measure health directly. Both Naidoo & Wills (2009) and WHO (1997) have identified Physical Activity as a health determinant. The health determinant Physical Activity may affect health positively (Haskell et al., 2012). Therefore, measuring Physical Activity during pregnancy is important in order to develop health promotion programs for pregnant women. Measuring health determinants may thereby be important for the health of both mother and infant.

Eventual changes in activity level during pregnancy were also investigated. Analyses were performed according to parity since patterns of Physical Activity during pregnancy are likely to be distinct for primiparas as compared to multiparas. Especially activity in the household/care giving domain is likely to differ since multiparas have children and therefore other demands in the household/care giving domain than primiparas.

Results showed (table 3, p. 45) that multiparas in this study were more active than primiparas both in total activity level and in the household/care giving domain, both early and late during pregnancy (PPAQ1 and PPAQ2). These results were significant and can therefore be generalized to a general population with the same characteristics as the study population. Multiparas are likely to have more demands in the household and less time to practice exercise. This is confirmed by results in this study that showed that primiparas were significantly more active in the exercise domain (table 3, p. 45).
The activity domain showing least amount of MET score in both primiparas and multiparas was the exercise domain, both at PPAQ1 and PPAQ2 (table 3, p. 45).

The health determinant Physical Activity may have positive effects for pregnant women (Barakat et al., 2012; Dumith et al., 2012; Gavard & Artal, 2008; Melzer et al., 2010a; Price et al., 2012; Voldner et al., 2009) as well as for the non pregnant population (Melzer et al., 2004) even though the present study could not confirm this.
A higher activity level during pregnancy is, when seen in relation to the theory the paradigm of physical activity, fitness and health, positive for the individuals. Several health outcome measures have been shown to benefit from Physical Activity during pregnancy, for instance

gestational (pregnancy related) diabetes and gestational hypertension as well as mode of delivery (Melzer et al., 2010a).

Therefore, based on the results showing that multiparas showed a higher level of activity (table 3, p. 45), they should be more likely to stay healthy during pregnancy and childbirth than primiparas. But it may though not be correct to conclude that multiparas have a better health status as a direct result of a higher Physical Activity level. When measured by mode of delivery, multiparas have benefits by having given birth previously. Multiparas have more spontaneous vaginal deliveries as shown in table 5 (p. 50). Outcome measures like gestational diabetes and gestational hypertension are not likely to be affected by parity. Therefore it may still be positive for the health of multiparas that they had a more physically active life style since a higher level of activity is shown to reduce the risk for developing gestational diabetes or hypertension.

On the other hand, some of the research has investigated the relationship between exercise and health outcome measures during pregnancy and delivery (Barakat et al., 2012; Karabulut et al., 2012; Price et al., 2012). If it is actually the exercise activity that has an impact on the health outcome, primiparas should have an advantage since they showed a higher level of activity (MET score) in the exercise domain (table 3, p. 45). But the standard deviation was wide meaning that there was a large variation in the study population making the interpretation imprecise.

A healthy lifestyle may prevent the development of several chronic diseases (Haskell et al., 2012) that may inhibit a person in his or her daily life. In order to cope with daily life, making choices that reduces the risk of developing chronic diseases is important. Physical Activity may contribute to a positive pregnancy health outcome (Melzer et al., 2010a). Physical Activity may therefore affect women's and infants' health and thereby confirms the paradigm of Physical Activity and health.

6.1.2.1 Reduction in Physical Activity level during pregnancy

Analyses showed (table 4, p. 48) that both primiparas and multiparas reduced their activity level throughout pregnancy, as measured by MET score. The reduction was mainly in the occupational activity for both primiparas and multiparas. There was a significant decrease in

activity in the occupation domain for both primiparas and multiparas. There was also a significant decrease in activity in the exercise domain in both primiparas and multiparas. A decrease in exercise activity level during pregnancy has also been shown in previous research (Haakstad et al., 2009).

Neither primiparas nor multiparas changed their household/care giving activity throughout pregnancy (table 4, p. 48). Activities in the household/care giving domain may be difficult to reduce possibly due to external demands in the household.

Previous research on Physical Activity patterns has described how activity patterns change throughout pregnancy according to parity (Rousham et al., 2006) but most studies have included both primiparas and multiparas (Fell et al., 2009; Haakstad et al., 2007; Schmidt et al., 2006). This study showed significant differences in activity pattern between primiparas and multiparas (table 3, p. 45). It is therefore a strength of this study that analyses have been performed according to parity.

Pregnant women tend to reduce their activity level during pregnancy (Clarke et al., 2005; Evenson & Wen, 2011; Fell et al., 2009; Rousham et al., 2006). The level of exercise has also been shown to be reduced during pregnancy (Clarke & Gross, 2004; Hegaard et al., 2011). This is confirmed by the present study (table 4, p. 48).

Schmidt et al., (2006a) investigated Physical Activity during pregnancy using the same questionnaire (and has calculated MET score) as in the present study. It was therefore interesting to investigate if the data in this study would show similar amount of MET scores as Schmidt et al., (2006a). An additional analysis was therefore conducted and is explained in the following.

In the present study MET score/week was calculated. Schmidt et al., (2006a) calculated MET score/day. In order to compare the results from the present study to the results from Schmidt et al., (2006a), MET score/day in the Schmidt study was multiplied by 7. Since Schmidt et al., (2006a) did not divide women by parity; the data in the present study were also analyzed on all participants. In the following, MET score/week in the total study population (not according to parity) was compared between the present study and the Schmidt study.

The present study showed a total amount of MET score at PPAQ1 of 236 MET score/week in mean (SD 85) (table 3, p. 45). Total amount of MET score in the study by Schmidt et al., (2006a) showed 234 MET score/week in the first trimester. Later in pregnancy the present study (at PPAQ2) showed a mean score of 193 MET score/week (SD 68). Schmidt et al., (2006a) showed 228 MET score/week. It seems like the study participants in the present study reduced their activity level more than the study participants in the study by Schmidt et al., (2006a).

The numbers showed similar results, especially early in pregnancy. In both studies the participants reduced the amount of activity performed. The reduction in activity was significant in the Schmidt study. When performing a paired sample t-test on total activity on all women in the present study, it also showed a statistically significant reduction of 25 MET scores in activity during pregnancy from PPAQ1 (mean 236, SD 84) to PPAQ2 (mean 193, SD 68), p .000. The present study showed 35 MET score lower than the American study late in pregnancy. Maybe the difference in MET score was due to the reduction in the occupational domain shown in the present study.

Both studies used the same questionnaire and calculated MET score, the two studies should therefore be comparable and are showing similar results. The studies were conducted in different countries (Norway and America) and still the activity levels seem quite similar. Norwegian women seem to have reduced their total activity level more than American women, possibly due to the reduction shown in activity in the occupation domain (table 4, p. 48). A cultural influence in the activity level is possible but not further investigated in this study.

A possible explanation for a reduction in activity during pregnancy is the physical changes the pregnant body goes through, as previously described in chapter 2.3 (p. 12). However, studies on the subject show different results. Pelvic girdle relaxation may have a negative effect on Physical Activity performed during pregnancy (MacLennan & MacLennan, 1997). But the contrary has also been shown (Haakstad et al., 2009).

MacLennan & MacLennan (1997) has ranked housework as the most problematic task during pregnancy. Paradoxically, household/care giving activity domain in the present study did not show a decrease during pregnancy. This may be because PPAQ1 was completed in gestational week 14.7 (mean); some modifications in activity may therefore already have taken place.

Physical Activity has been shown to be positive for physical health but it may also be positive for psychological health (Haskell et al., 2012). The effect of Physical Activity on depression may be comparable to the effect of antidepressant treatments (Dinas, Koutedakis & Flouris, 2010). There is no reason why this should not be valid for pregnant women. A physically active lifestyle may thereby contribute to strengthen pregnant women psychologically and may contribute to an easier childbirth and possibly also a quicker recovery after delivery.

The direction of effect in the paradigm of Physical Activity and health may go in both directions (figure 1, p. 7). Physical Activity contributes to improve health but a good health also contributes to an increased Physical Activity level (Haskell et al., 2012). Behavior change may be challenging for the individuals (Westenhoefer, 2001). Health promotion and health supportive actions from the health care system are therefore important. The health care system is important in providing necessary information to the people (Hjort, 1982). The population benefits from this information in order to make healthy choices for themselves and their family. In Norway the health care system for pregnant women is easy accessible and antenatal visits are free. The follow up during pregnancy is an easily accessible part of the health care system in which information can be provided for the pregnant women and their families. It has been stated that pregnancy provides a unique possibility for affecting maternal and infant health and for behavior modification (Artal & O'Toole, 2003; Gavard & Artal, 2008; Sagedal et al., 2013). As part of this work, identifying health determinants and their effects on health outcomes is important to provide a necessary foundation for health promotion. Health promotion during pregnancy may have a positive effect not only for the woman and the child she is carrying but for the whole family.

6.1.3 The health outcome mode of delivery and parity

The present study also investigated whether primiparas and multiparas differ in mode of delivery (research question 4, p. 4). Results in this study (table 5, p. 50) show that multiparas had a significantly lower rate of assisted vaginal delivery (4.8%) and were significantly more likely to have a spontaneous vaginal delivery (88%) than primiparas (assisted vaginal delivery in 22.4% and spontaneous vaginal delivery in 67.3%). But there were no significant differences in the rate of emergency cesarean section among the two groups, primipara and

multipara. The difference between the parity groups in spontaneous vaginal deliveries (table 5, p. 50) is likely to be explained by the difference in assisted vaginal delivery and not cesarean section. These results were significant. Instrumental deliveries may affect the health status of both mothers and infants (Clark & Silver, 2011; O'Mahony et al., 2010). Less instrumental deliveries gives multiparas a health advantage when compared to primiparas.

Cesarean section increases the risk for complications, for both mother and infant (Clark & Silver, 2011). The complications are directly correlated to the health of both mother and infant. Health as the ability to cope with the demands of the day (Hjort, 1982) may be affected by the complications to cesarean section. Cesarean section increase the risk of severe hemorrhage (Clark & Silver, 2011). A severe hemorrhage during delivery and the following fatigue may cause difficulty in taking care of the child. Cesarean section may also cause a decreased fertility (Clark & Silver, 2011) which may add extra preoccupation for the couple involved and affect health negatively. Cesarean section may also increase the risk of premature birth and reduced fetal growth in subsequent pregnancies (Clark & Silver, 2011). The health of the child may thereby be affected by being born prematurely or with growth retardation. The infant cannot communicate with care givers or the parents, but the health of the infant should of coarse be considered. In addition, the parents may be inhibited in coping with their daily life by having a prematurely born child or a child with growth retardation due to the extra demands.

On the other hand, cesarean section may reduce the risks of delivery for the infant for instance when there is a breech presentation (Villar et al., 2007). But Villar et al., (2007) also found a five times higher risk for maternal death, a four time’s higher risk for hysterectomy (removal of the uterus) and twice the risk of being admitted to intensive care and longer hospital stay in women with a cesarean section. All understood to affect maternal health negatively. Hysterectomy naturally excludes subsequent pregnancies. It is therefore important to individualize the health care of pregnant women in order to select women into mode of delivery in order to maintain health in both mother and infant.

Cesarean section and assisted vaginal delivery are important tools in order to assure the safety of the mother and infant during childbirth and it is not an aim to reduce the use more than what is beneficial for the mothers and infants. At some point the risk for damages by instrumental deliveries becomes greater than the benefits. And the contrary, not using the

tools may increase the risk for the health of both mother and infant during childbirth (Gibbons et al., 2010).

The World Health Organization (WHO) recommends a level of between 10 and 15% of cesarean sections (Gibbons et al., 2010). In many countries this is not the level of cesarean section and there may be various reasons for this. A low percentage in developing countries may be due to economical shortness and maybe a difficult infrastructure in the country or other circumstances. Reasons for high levels of cesarean section in developed countries may be many and should therefore be a matter for further investigation. In Norway the risk of performing less than 10% of cesarean section seems unrealistic. The challenge is rather to limit the rate of cesarean sections to a level that is beneficial for mothers and infants.

A recommended level for assisted vaginal delivery has not been found in the literature search for this thesis. It may also be difficult to agree to a certain level of assisted vaginal delivery.

6.2 Method discussion – strengths and limitations of the study

In this chapter, the strengths and limitations of the study will be discussed. Further the questionnaire used in the study, and validity and reliability of the study, will be discussed.

6.2.1 Study population - discussion

The study population was compared to the general population of Oslo and Norway (table 1, p. 31). Out of the information that was attainable from the Medical Birth Registry (MFR), it seems that the cohort is fairly representative for an urban population in Norway.

If many study participants drop out from the study it may affect the statistical validity of the study. Out of the 244 study participants that completed the questionnaire the first time, almost 80% completed the questionnaire the second time. The drop-out analysis showed that there were no large differences in age or civil status between the study participants that completed the questionnaire both times (chapter 4.2.1, p. 30). But it seems like more primiparas

completed the questionnaire both at PPAQ1 (53%) and at PPAQ2 (56.4%) than the multiparas did, perhaps due to the time consuming element of the study.
The results may be generalized to a population with the same characteristics as the study population; healthy pregnant women in an urban city in Norway expecting one child and planning to give birth vaginally.

That multiparas has less operative deliveries than primiparas confirms the accuracy of the data set. That is a strength of the study.

6.2.2 Data collection, Pregnancy Physical Activity Questionnaire

In this study a self-reporting Physical Activity questionnaire (Pregnancy Physical Activity Questionnaire, (PPAQ)), designed for pregnant women was used.
It may be a challenge to measure Physical Activity and several methods have previously been used. Both portable activity monitor and questionnaires on activity level have previously been used in research. Several questionnaires are designed in order to facilitate a calculation of MET score (Chasan-Taber et al., 2004; Fell et al., 2009; Rousham et al., 2006) as in this study. People are more likely to complete a questionnaire than to wear a portable activity monitor (Rousham et al., 2006). This support the use of questionnaire to collect data on peoples Physical Activity levels in this study.
The questionnaire used to collect data about pregnant women's level of Physical Activity in this study was not translated into Norwegian language. One criterion for inclusion in this study was Scandinavian origin. The questionnaire has been validated in America on an English speaking population (Chasan-Taber et al., 2004), but not for a Norwegian population. This may have contributed to a language problem and may also have weakened the validity of the study. It may have reduced the response rate and/or influenced the answers. Some women may have rejected to participate or dropped out of the study due to the language challenge.

The physician conducting the visits of the participants was available to help with the interpretation of the questionnaire; this may have contributed to reduce the language problem. Despite this help, distributing a questionnaire in a foreign language is considered a limitation of the study.

Further, it is possible that active and inactive women respond differently to the questionnaire. Perhaps active women exclude responding to questions about walking because they do not consider it relevant when they are much more active. Furthermore, inactive women may wish to appear more active than they really are, affecting the responses they give.

Using a questionnaire may cause methodological difficulties. Questions about study participant's behavior in a specific situation might be of a sensitive character which influence the answers obtained (Ringdal, 2007, p. 183). Another potential problem is a person's memory and possible incorrect recollection. It is also possible that the respondents in this study would like to appear more physically active than they really are and this may have influenced the answers.

Using a portable activity monitor was considered in the initial process of the study. Despite the possible limitations by using a questionnaire, it was considered an acceptable instrument to collect date on Physical Activity.

6.2.3 Analyses

The different domains of Physical Activity (exercise, household/care giving, occupational and sedentary activities) investigated in this study were based on the activities registered by the women via a questionnaire. Subsequently all activities were calculated into MET score. The calculation of MET score has been described in chapter 4.3 (p. 32). MET score is a measure of the energy expenditure in the different activities and multiplied by the time spent in each activity. MET score in this study does not show at which intensity that the study participants have performed Physical Activity or for how long. Some activities may have been performed on a low intensity but lasting for longer and some activities may have been performed on a high intensity for shorter time. The total sum of MET score does not give the details of the activity performed. On the other hand, MET score is a quantification of activities performed and allows for a comparison of different activities. The use of MET score may therefore be a strength of the present study because MET score is a measure that makes it possible to compare the amount of activity performed in the different activity domains in the same study. MET score also allows for a summary of all activities performed and thereby compare

different groups. Analyzes in this study were performed on both the total amount of Physical Activity as measure in MET score/week but also as separated into activity domains.

The MET scores calculated on the exercise domain were much lower than the MET scores in the other domains (table 3, p. 45), both for primiparas and multiparas, and both early and late in pregnancy. Therefore, it may also be a strength of this study to have included not only exercise but also the other activity domains.

Other studies have also used MET score to describe Physical Activity patterns during pregnancy (Rousham et al., 2006; Schmidt et al., 2006).

MET scores in this study were calculated from a list of MET score from a published compendium (Ainsworth et al., 2000; Ainsworth et al., 1993). The list of MET scores is based on research of energy expenditure among men and non pregnant women. After this study, activity intensities of a few activities have been calculated based on measurements on pregnant women (Ainsworth et al., 2011). The results show quite similar energy expenditure as previously measured in men and non pregnant women, only limited differences were identified. It may be a limitation of this study that the calculations of MET score are based on research on men and non-pregnant women. However, the differences were limited and not consistent in tendency and therefore MET score is considered acceptable as a measure of Physical Activity in this study.

It has been shown and discussed above that the analyses in the present study (table 6, p. 52, table 7, p. 53 and table 8, p. 55) did not confirm the theory about Physical Activity and health. Even if this study did not show a relationship between Physical Activity and mode of delivery, it does not necessarily mean that there is no such relationship. It is possible that with a different approach, a different result may have been obtained.

The main study, as described in chapter 1.0 (p. 3), was not designed to answer the research questions in this thesis (chapter 1.0, p. 4). Of a cohort of 380 pregnant women that were available for analyses as shown in figure 2 (p. 29), the PPAQ was responded by 127 primiparas at PPAQ1 and 106 primiparas at PPAQ2. Since there were only 11 cases of cesarean section among the 106 primiparas responding to PPAQ2, an adjusted logistic regression could not be performed. Therefore the only significant unadjusted relationship could not be investigated further. Given a larger cohort or a higher response rate, the results

may have been different and perhaps reduced the risk of making a type II error (described in chapter 4.4, p. 34).

Perhaps the timing of distributing the questionnaire was not optimal. A previous study has shown that pre-pregnancy activity is a determinant of newborn macrosomia (birth weight ≥4.200 g) (Voldner et al., 2008). In addition pre-pregnancy inactivity has been shown to be associated with severe perineal lacerations (Voldner et al., 2009). It is relevant to assume that pre-pregnancy Physical Activity is important. Gavard & Artal (2008) found that women that were more physically active before the pregnancy significantly reduced the risk of developing gestational diabetes. To attain a protective effect of activity against preeclampsia, women need to be physically active in exercise both before and during pregnancy (Gavard & Artal, 2008).
Pregnancy is a limited period in a woman's life. The timing for completing the questionnaire in this study was gestational week 14.7 (SD 4.7) for PPAQ1 and gestational week 35.6 (SD 2.1) for PPAQ2 (chapter 5.2, p. 44). It is possible that the women were already affected by the pregnancy and that they already had reduced their activity level as a consequence of the physical changes induced by the pregnancy when they completed the first questionnaire.

Furthermore, it is possible that there are other aspects than energy expenditure that has a potential to affect the outcome mode of delivery. MET score is a calculation of the energy expenditure but maybe it is other aspects of Physical Activity may have a potential to affect mode of delivery. This could for instance be muscular size and strength or physical endurance which has not been investigated in this study. This study has not examined the participant's motivation for giving birth which probably is important for mode of delivery. It may be a limitation of this study that the elements mentioned above are not investigated in this study.
On the other hand, several studies have calculated MET score as based on women's reporting of activity in different questionnaires (Chasan-Taber et al., 2004; Fell et al., 2009; Rousham et al., 2006) and the MET score seems to be a generally accepted method for collecting data on Physical Activity. The definition of Physical Activity in this thesis (chapter 2.1, p. 9) is the amount of energy expenditure produced by skeletal muscles. Despite the possible limitations, MET is a fairly good measure of Physical Activity in this study.

When investigating the relationship between Physical Activity and mode of delivery in this study, logistic regression analyses were conducted. The first on the outcome assisted vaginal

delivery (table 6, p. 52), the second on the outcome cesarean section (table 7, p. 53) and the final outcome spontaneous vaginal delivery (table 8, p.55). This was done because not only a pathogenic perspective (on the dependent variable assisted vaginal delivery and cesarean section) but also a salutogenic view (on the dependent variable spontaneous vaginal delivery) was intended. The salutogenic view investigated whether or not a higher level of Physical Activity increases the likelihood of delivering by a spontaneous vaginal delivery and thereby enhances health.

Midwifery is aiming at maintaining the healthy state in pregnant women during pregnancy and childbirth. Perhaps it could have been enough to examine the salutogenic perspective only. But then the result showing that there was no significant difference in cesarean section and a significant difference in assisted vaginal delivery according to parity, would not have been shown. Both perspectives were investigated to ensure an as thorough examination of the relationship as possible. However, it may perhaps have contributed to an unclear interpretation of the study.

The study performed in this thesis was a longitudinal prospective cohort. Randomization into various levels of activity including all activity domains that are included in this study would have been close to impossible. The longitudinal prospective approach and that the questionnaire has been completed twice during pregnancy, is a strength of the study.

6.2.4 Validity of the study

When evaluating the validity of the present study, several aspects are relevant to discuss. The study had a longitudinal observational design. A benefit of the design is that it is quite easy to perform.

Face validity

As described in chapter 4.5 (p. 38) face validity is a subjective evaluation of the questions with regards to whether the questions capture the concept or not. The questionnaire (attachment 1, p. 87) includes 31 questions about Physical Activity performed in daily life, including exercise, household/care giving, occupation and sedentary activity. This division

into activity types is in accordance with the definition of Physical Activity in this thesis (chapter 2.1, p. 9). It seems like the questions cover the majority of activities in daily life and also give room for adding activities the study participant wishes to add in blank questions. The face validity of the questions is therefore considered to be good.

Construct validity

When investigating a concept, like Physical Activity in this study, the concept is defined and operationalized in order to measure it. The concept Physical Activity in this study is defined in chapter 2.1 (p. 9). Operationalization of the concept was described in chapter 4.5 (p. 38).

The Physical Activity registered by the study participants are analyzed according to parity, a known groups approach (described in chapter 4.5, p. 38). The questionnaire was administered to pregnant women, both primiparas and multiparas. Results showed (table 3, p. 45) that multiparas were more active in the household/care giving domain (as measured by MET score) than primiparas. This seams logic since multiparas have children and therefore more demands of physical work in the household/care giving domain, which strengthens the construct validity in this study.

Internal validity

Further, a study requires knowledge of which variables to control for (Polit & Beck, 2012). In table 7 (p. 53), there was one significant relationship between one activity domain (household/care giving) at PPAQ2 and the outcome emergency cesarean section. But there were only 11 emergency cesarean sections among the primiparas that had responded to the questionnaire at PPAQ2, which made an adjusted regression analysis impossible to perform. But there were four variables that had a significant relationship to the outcome and should have been included if performing an adjusted regression analysis would have been possible. Given a larger cohort or a higher response rate, an adjusted analysis could have been performed. The results of the study could thereby have been different.

External validity

The study participants were compared to the general population with the purpose of investigating if the study population was valid as a representation of the general population. As presented in table 1 (p. 31) the data about age for primiparas was in this study registered at the first visit and the Medical Birth Registry (MFR) has registered age at delivery. This may have influenced the mean age registered in the study population in comparison to the data from MFR. The mean age of the study participants seamed though fairly similar to the age of primiparas in Oslo. There was a slight difference in civil status between the study participants and the data from MFR, both regarding Oslo and Norway.

Despite the small differences described it seems correct to conclude that the study population was fairly representative for an urban population in Norway. The external validity is therefore understood to be acceptable and results may be carefully generalized to a population of women with the same traits and localization as the study participants. However, a limitation is that the results may only be generalized to a population with the same characteristics as the study population, in this case healthy pregnant women with a Scandinavian origin, in a city in Norway. In addition, the relationship between Physical Activity and mode of delivery may only be generalized to primiparas.

The data of the concept Physical Activity in this study was collected via questionnaire, as discussed above in chapter 6.2.2 (p. 70). The questionnaire used in this study was developed in America and validated on an American population (Chasan-Taber et al., 2004). America is a different culture from Norway in several aspects. For instance different measure systems are used. Questions in the occupation activity domain there are two questions about if you carry "heavier than a 1 gallon of milk jug". Gallon is a measure not used in Norway. This may have contributed to that women rejected to respond to that particular question or to answer the questionnaire at all and therefore contribute to a lower response rate. Further the language is, as discussed in chapter 6.2.2 (p. 70), a challenge.

In order to use a questionnaire written in a foreign language, it is general practice to translate the questionnaire into the native language of the study participants (see above). It is also good practice to perform a study to validate the questionnaire in the language, and in the culture, in which the study is performed. This is not done in this study and is therefore understood as a limitation of the study.

6.2.5 Reliability of the study

As described in chapter 4.6 (p. 39), a test of the reliability of the questionnaire was performed by a Cronbach's alfa test on the answers about Physical Activity in the questionnaire.
At PPAQ1 the Cronbach's alfa of all 31 questions was .487, which is considered week reliability. At PPAQ2 it was .657 which is acceptable. When analyzing the domains separately at PPAQ1, the Cronbach's alfa varied from -.081 (occupational activities) to .697 (household/care giving activities). At PPAQ2 Cronbach's alfa varied from -.037 (occupational activities) to .707 (household/care giving activities). Based on the tests described above, the reliability of the questionnaire was considered weak but acceptable.

The study evaluating the questionnaire PPAQ (Chasan-Taber et al., 2004) analyzed intraclass correlation coefficients (ICC) which is a test-retest measure of the stability of the instrument. The PPAQ was in that study distributed twice to the same group pregnant of women. Results of analyses analyzing the activity domains ranged from 0.83 for exercise activity to 0.93 for occupational activity which is to be considered a high (0.70-0.89) a very high (0.90-1.0) correlation according to Johannessen et al., (2010).

6.3 Summary and conclusion

This study did not find a relationship between the health determinant Physical Activity and the health outcome mode of delivery. The "physical activity-fitness-health paradigm" was therefore not confirmed to be valid for Physical Activity and mode of delivery by this study. There is though a lot of research showing that Physical Activity during pregnancy is important for other health outcome measures. Some previous studies have also shown a relationship between Physical Activity and mode of delivery. The absence of significant results in this study does not change the importance of health promotion about Physical Activity for pregnant women. The positive impact by Physical Activity, as shown in other studies, out weight the possible absence of effect that is shown in this study.

Multiparas were significantly more active than primiparas, as measured by MET score/week, both in total activity level and in the household/care giving domain. Both primiparas and multiparas reduced their activity significantly during the pregnancy.

Multiparas had significantly more spontaneous vaginal deliveries than primiparas and primiparas had more assisted vaginal deliveries. But the emergency cesarean section rate was not significantly different when analyzing according to parity.

Despite the limitations of the study discussed above, it is reasonable to believe that the results of the study can be generalized to the population of healthy pregnant women in a city in Norway, expecting one child and planning to give birth vaginally. The statistical assumption conditions are present. The analyses of patterns of Physical Activity show significant results. Also mode of delivery show significant results. But also the absence of a relationship between Physical Activity and mode of delivery in primiparas may be generalized, because the study population was a fairly representative sample, as presented in chapter 4.2.2 (p. 31). On the other hand, few variables were attainable from the MFR. There is no reason to over-generalize the results to other groups of women in other contexts. Neither is there reason to over-generalize the results of an absence of a relationship between Physical Activity and mode or delivery, to also be valid for multiparas.

The gathered knowledge produced by studies is a basis for the recommendations that is given to pregnant women. The recommendations given to pregnant women in Norway today by the Social- and Health directorate (Sosial- og helsedirektoratet, 2005), should not be changed due to the results of this study.

Considering clinical implications of the study and health promotion to pregnant women at the antenatal visits, there is no reason to alter the recommendations given by midwives and physicians in Norway today. Physical Activity has numerous times been shown to contribute to the positive health outcome for both mothers and infants for other health outcome measures than mode of delivery.

The implications for practice by this study are limited but the study may be a contribution to the overall knowledge on the subject. Previous research has found a relationship between Physical Activity and several health outcomes during pregnancy and child birth that gives implications for health promotion during pregnancy. It has also been highlighted that pregnancy is a good time to introduce life style changes, not only for the woman but also for her family. Therefore, although this study did not find a relationship between Physical

Activity and childbirth, it is important to conduct health promotion about Physical Activity to pregnant women in antenatal counseling.

7.0 FURTHER RESEARCH

To obtain empirical and clinical knowledge about the course of childbirth is complex and challenging. There is no doubt that further research on possible health determinants during pregnancy and childbirth is of clinical value. A focus on differentiated research according to parity may contribute to an individualized health promotion approach in antenatal care. To focus on primiparas may be important since mode of delivery at a woman's first childbirth may influence future childbirths.

There may be methodological reasons for the absence of a relationship between Physical Activity and mode of delivery in this study. For further investigation of the subject, several methodological adjustments may be profitable. Firstly, the questionnaire was in English when distributed to Norwegian study participants. The questionnaire should firstly be translated into Norwegian and subsequently be validated on a Norwegian population. But the questionnaire is covering many activities in a person's daily life and it would be interesting to continue the investigation to see which activities that may have a relationship to mode of delivery. A larger study population could have enabled the possibility to perform complete regression analyses; therefore in future research a larger study population should be included.

When investigating the relationship between Physical Activity and mode of delivery, MET score has been used in this study. MET score is a quantification of activity and express the energy expenditure. Whether or not MET score the correct measure to investigate the relationship to mode of delivery has been discussed in this thesis. Maybe it would be beneficial to examine the relationship between oxygen uptake and/or muscular strength and mode of delivery or the women's motivation for delivery.

Unadjusted analyses showed a relationship between the use of epidural analgesia (EDA) during delivery and mode of delivery. Previous studies have shown that EDA may increase the rate of assisted vaginal delivery (Anim-Somuah et al., 2011). However, this thesis did not investigate such a relationship but future research on the subject may be a valuable contribution to the gathered research. An interesting thought about such a relationship is that it may have an impact on the health of both mothers and infants and should in that extension become a subject for health promotion.

It may be of great clinical interest to investigate other health determinants during pregnancy and delivery. Pregnancy may be a time for health promotion for not only the pregnant women, but also for her family and the child she is carrying.

References

ACOG. (2002). Committee Opinion No. 267: Exercise During Pregnancy and the Postpartum Period. *Obstetrics & Gynecology, 99*(1), 171-173.

Ainsworth, B., Haskell, W., Herrmann, S., Meckes, N., Bassett, D., Tudor-L, C., . . . Leon, A. (2011). 2011 Compendium of Physical Activities: A Second Update of Codes and MET Values. *Medicine & Science in Sports & Exercise, 43*(8), 1575-1581.

Ainsworth, B., Haskell, W., Whitt, M., Irwin, M., Swartz, A., Strath, S., . . . Leon, A. (2000). Compendium of Physical Activities: an update of activity codes and MET intensities. *Medicine & Science in Sports & Exercise, 32(9)*(Supplement), S498-S516.

Ainsworth, B., Haskell, W. L., Leon, A. S., Jacobs, D. R., Montoye, H. J., Sallis, J. F., & Paffenbarger, R. S. (1993). Compendium of physical activities: classification of energy costs of human physical activities. *Medicine & Science in Sports & Exercise, 25*(1), 71-80.

Althabe, F., Sosa, C., Belizán, J. M., Gibbons, L., Jacquerioz, F., & Bergel, E. (2006). Cesarean Section Rates and Maternal and Neonatal Mortality in Low-, Medium-, and High-Income Countries: An Ecological Study. *Birth, 33*(4), 270-277. doi: 10.1111/j.1523-536X.2006.00118.x

Anim-Somuah, M., Smyth, R. M., & Jones, L. (2011). Epidural versus non-epidural or no analgesia in labour. *Cochrane Database of Systematic Reviews*(12), CD000331.

Antonovsky, A. (1991). *Hälsans mysterium*. Stockholm: Natur och Kultur.

Artal, R., & O'Toole, M. (2003). Guidelines of the American College of Obstetricians and Gynecologists for exercise during pregnancy and the postpartum period. *British Journal of Sports Medicine, 37*(1), 6-12; discussion 12.

Baciuk, E., Pereira, R., Cecatti, J., Braga, A., & Cavalcante, S. (2008). Water aerobics in pregnancy: cardiovascular response, labor and neonatal outcomes. *Reproductive Health, 5*(1), 10.

Barakat, R., Pelaez, M., Lopez, C., Montejo, R., & Coteron, J. (2012). Exercise during pregnancy reduces the rate of cesarean and instrumental deliveries: results of a randomized controlled trial. *Journal of Maternal-Fetal & Neonatal Medicine, 25*(11), 2372-2376. doi: 10.3109/14767058.2012.696165

Barakat, R., Ruiz, J. R., Stirling, J. R., Zakynthinaki, M., & Lucia, A. (2009). Type of delivery is not affected by light resistance and toning exercise training during pregnancy: a randomized controlled trial. *American Journal of Obstetrics and Gynecology, 201*(6), 590.e591-590.e596. doi: http://dx.doi.org/10.1016/j.ajog.2009.06.004

Bouchard, C., Blair, S., & Haskell, W. (2007). *Physical activity and health*. Champaign: Human Kinetics.

Bovbjerg, M. L., & Siega-Riz, A. M. (2009). Exercise during pregnancy and cesarean delivery: North Carolina PRAMS, 2004-2005. *Birth, 36*(3), 200-207.

Caspersen, C., Powell, K., & Christenson, G. (1985). Physical Activity, Exercise, and Physical fitness: Definitions and Distinctions for Health-Related Research. *Public Health Reports, 100*(2), 126-131.

Chasan-Taber, L., Schmidt, M. D., Roberts, D. E., Hosmer, D., Markenson, G., & Freedson, P. S. (2004). Development and validation of a Pregnancy Physical Activity Questionnaire. *Medicine & Science in Sports & Exercise, 36*(10), 1750-1760.

Clark, E. A. S., & Silver, R. M. (2011). Long-term maternal morbidity associated with repeat cesarean delivery. *American Journal of Obstetrics & Gynecology, 205*(6, Supplement), S2-S10.

Clarke, P. E., & Gross, H. (2004). Women's behaviour, beliefs and information sources about physical exercise in pregnancy. *Midwifery, 20*(2), 133-141.

Clarke, P. E., Rousham, E. K., Gross, H., Halligan, A. W. F., & Bosio, P. (2005). Activity patterns and time allocation during pregnancy: a longitudinal study of British women. *Annals of Human Biology, 32*(3), 247-258.

Davies, G. A. L., Maxwell, C., McLeod, L., Gagnon, R., Basso, M., Bos, H., . . . Gynaecologists of, C. (2010). Obesity in pregnancy. *Journal of Obstetrics & Gynaecology Canada: JOGC, 32*(2), 165-173.

Dietz, P. M., Callaghan, W. M., Morrow, B., & Cogswell, M. E. (2005). Population-based assessment of the risk of primary cesarean delivery due to excess prepregnancy weight among nulliparous women delivering term infants. *Maternal & Child Health Journal, 9*(3), 237-244.

Dinas, P. C., Koutedakis, Y., & Flouris, A. D. (2010). Effects of exercise and physical activity on depression. *Irish Journal of Medical Science, 180*(2), 319-325.

Dumith, S. C., Domingues, M. R., Mendoza-Sassi, R. A., & Cesar, J. A. (2012). Physical activity during pregnancy and its association with maternal and child health indicators. *Revista de Saude Publica, 46*(2), 327-333.

Evenson, K. R., Savitz, D. A., & Huston, S. L. (2004). Leisure-time physical activity among pregnant women in the US. *Paediatric and Perinatal Epidemiology, 18*(6), 400-407.

Evenson, K. R., & Wen, F. (2010). National trends in self-reported physical activity and sedentary behaviors among pregnant women: NHANES 1999-2006. *Preventive medicine, 50*(3), 123-128.

Evenson, K. R., & Wen, F. (2011). Prevalence and correlates of objectively measured physical activity and sedentary behavior among US pregnant women. *Preventive medicine, 53*(1-2), 39-43.

Fell, D. B., Joseph, K. S., Armson, B. A., & Dodds, L. (2009). The impact of pregnancy on physical activity level. *Maternal & Child Health Journal, 13*(5), 597-603. doi: 10.1007/s10995-008-0404-7

FIGO. (1999). Committee for the Ethical Aspects of Human Reproduction and Women's Health Committee Statement on Ethical Guidelines (Cairo, March 1998). *Journal of Obstetrics & Gynaecology, 19*(4), 444-447.

Fraser, D. M., Myles, M. F., & Cooper, M. A. (2009). *Myles textbook for midwives*. Edinburgh: Churchill Livingstone Elsevier.

Gavard, J. A., & Artal, R. (2008). Effect of exercise on pregnancy outcome. *Clinical Obstetrics & Gynecology, 51*(2), 467-480.

Gibbons, L., Belizan, J., Lauer, J., Betran, A., Merialdi, M., & Althabe, F. (2010). The Global Numbers and Costs of Additionally Needed and Unnecessary Caesarean Sections Performed per Year: Overuse as a Barrier to Universal Coverage. In W. H. R. 2010 (Ed.). Geneva World Health Organization.

Haakstad, L., Voldner, N., Henriksen, T., & Bø, K. (2007). Physical activity level and weight gain in a cohort of pregnant Norwegian women. *Acta Obstetricia et Gynecologica*(886), 559-564.

Haakstad, L., Voldner, N., Henriksen, T., & Bø, K. (2009). Why do pregnant women stop exercising in the third trimester? *Acta Obstetricia et Gynecologica Scandinavica, 88*(11), 1267-1275. doi: 10.3109/00016340903284901

Hallal, P. C., Andersen, L. B., Bull, F. C., Guthold, R., Haskell, W., & Ekelund, U. (2012). Physical Activity 1: Global physical activity levels: surveillance progress, pitfalls, and prospects. *The Lancet, 380*(9838), 247-257.

Hasegawa, J., Farina, A., Turchi, G., Hasegawa, Y., Zanello, M., & Baroncini, S. (2013). Effects of epidural analgesia on labor length, instrumental delivery, and neonatal short-term outcome. *Journal of Anesthesia, 27*(1), 43-47.

Haskell, W. L., Bouchard, C., & Blair, S. N. (2012). *Physical activity and health*. Champaign, Ill.: Human Kinetics.

Hegaard, H. K., Damm, P., Hedegaard, M., Henriksen, T. B., Ottesen, B., Dykes, A.-K., & Kjaergaard, H. (2011). Sports and leisure time physical activity during pregnancy in nulliparous women. *Maternal & Child Health Journal, 15*(6), 806-813.

Henriksen, T. (2008). The macrosomic fetus: a challenge in current obstetrics. [Review]. *Acta Obstetricia et Gynecologica Scandinavica, 87*(2), 134-145.

Hjort, P. (1982). *Helsebegrepet, helseidealet og helsepolitiske mål. In: PE Lorentzen, T Berge & J Åker (Red.), Helsepolitikk og helseadministrasjon (p.11-31)*. Oslo: Tanum-Norli.

Johannessen, A. (2009). *Introduksjon til SPSS: versjon 17*. Oslo: Abstrakt forl.

Johannessen, A., Tufte, P. A., & Christoffersen, L. (2010). *Introduksjon til samfunnsvitenskapelig metode*. Oslo: Abstrakt førlag.

Karabulut, A., Derbent, A. U., Yildirim, M., Simavli, S., & Turhan, N. O. (2012). Evaluation of risk factors and effect of physical activity in caesarean section in nulliparous women. *Journal of Maternal-Fetal & Neonatal Medicine, 25*(8), 1456-1459.

Klein, M. C. (2012). Cesarean Section on Maternal Request: A Societal and Professional Failure and Symptom of a Much Larger Problem. *Birth, 39*(4), 305-310. doi: 10.1111/birt.12006

MacLennan, A. H., & MacLennan, S. C. (1997). Symptom-giving pelvic girdle relaxation of pregnancy, postnatal pelvic joint syndrome and developmental dysplasia of the hip. The Norwegian Association for Women with Pelvic Girdle Relaxation (Landforeningen for Kvinner Med Bekkenlosningsplager). *Acta Obstetricia et Gynecologica Scandinavica, 76*(8), 760-764.

MFR, retrieved February 6th, 2014. Medisinsk fødselsregister, statistikkbank. Nasjonalt folkehelseinstitutt

Melzer, K., Kayser, B., & Pichard, C. (2004). Physical activity: the health benefits outweigh the risks. *Current Opinion in Clinical Nutrition & Metabolic Care, 7*(6), 641-647.

Melzer, K., Schutz, Y., Boulvain, M., & Kayser, B. (2010a). Physical activity and pregnancy: cardiovascular adaptations, recommendations and pregnancy outcomes. *Sports Medicine, 40*(6), 493-507.

Melzer, K., Schutz, Y., Soehnchen, N., Othenin-Girard, V., Martinez de Tejada, B., Irion, O., . . . Kayser, B. (2010b). Effects of recommended levels of physical activity on pregnancy outcomes. *American Journal of Obstetrics & Gynecology, 202*(3), 266.e261-266.

Mocanu, E. V., Greene, R. A., Byrne, B. M., & Turner, M. J. (2000). Obstetric and neonatal outcome of babies weighing more than 4.5 kg: an analysis by parity. *European Journal of Obstetrics, Gynecology, & Reproductive Biology, 92*(2), 229-233.

Morken, N.-H., Klungsoyr, K., Magnus, P., & Skjaerven, R. (2013). Pre-pregnant body mass index, gestational weight gain and the risk of operative delivery. *Acta Obstetricia et Gynecologica Scandinavica, 92*(7), 809-815.

Naidoo, J., & Wills, J. (2009). *Foundations for health promotion.* Edinburgh: Baillière Tindall/Elsevier.

O'Mahony, F., Hofmeyr, G., & Menon, V. (2010). Choice of instruments for assisted vaginal delivery. *Cochrane Database of Systematic Reviews*(11), CD005455.

Pallant, J. (2010). *SPSS survival manual: a step by step guide to data analysis using SPSS*. Maidenhead: McGraw-Hill.

Pallismaa, N., Ekblad, U., Aitokallio-Tallberg, A., Uotila, J., Raudaskoski, T., Ulander, V. M., & Hurme, S. (2010). Cesarean delivery in Finland: maternal complications and obstetric risk factors. *Acta Obstetricia et Gynecologica*(89), 896-902.

Pate, R. R., Pratt, M., Blair, S. N., Haskell, W. L., Macera, C. A., Bouchard, C., & ... Wilmore, J. H. (1995). Physical activity and public health: A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *JAMA, 273*(5), 402-407.

Polit, D. F., & Beck, C. T. (2012). *Nursing research: generating and assessing evidence for nursing practice*. Philadelphia, Pa.: Wolters Kluwer Health.

Price, B. B., Amini, S. B., & Kappeler, K. (2012). Exercise in pregnancy: effect on fitness and obstetric outcomes-a randomized trial. *Medicine & Science in Sports & Exercise, 44*(12), 2263-2269.

Ringdal, K. (2007). *Enhet og mangfold: samfunnsvitenskapelig forskning og kvantitativ metode*. Bergen: Fagbokforl.

Roberts, D. E., Fragala, M. S., Pober, D., Chasan-Taber, L., & Freedson, P. S. F. (2002). Energy Cost of Physical Activities During Pregnancy. *Medicine & Science in Sports & Exercise, 34(5) Supplement*(1), S124.

Rousham, E. K., Clarke, P. E., & Gross, H. (2006). Significant changes in physical activity among pregnant women in the UK as assessed by accelerometry and self-reported activity. *European Journal of Clinical Nutrition, 60*(3), 393-400.

Ruyter, K. W., Solbakk, J. H., & Førde, R. (2007). *Medisinsk og helsefaglig etikk*. Oslo: Gyldendal akademisk.

Sagedal, L. R., Overby, N. C., Lohne-Seiler, H., Bere, E., Torstveit, M. K., Henriksen, T., & Vistad, I. (2013). Study protocol: fit for delivery - can a lifestyle intervention in pregnancy result in measurable health benefits for mothers and newborns? A randomized controlled trial. *BMC Public Health, 13*, 132.

Schmidt, M. D., Pekow, P., Freedson, P., Markenson, G., & Chasan-Taber, L. (2006). Physical activity patterns during pregnancy in a diverse population of women. *Journal of Women's Health, 15*(8), 909-918.

Skog, O. (1998). *Å forklare sosiale fenomener: en regresjonsbasert tilnærming*. Oslo: Ad notam Gyldendal.

Sosial- og helsedirektoratet. (2005). *Nasjonal faglig retningslinje for svangerskapsomsorgen*. (IS-1179/2005). Hentet fra http://helsedirektoratet.no/publikasjoner/nasjonal-faglig-retningslinje-for-svangerskapsomsorgen-fullversjon/Publikasjoner/nasjonal-faglig-retningslinje-for-svangerskapsomsorgen-fullversjon.pdf

Sotiriadis, A., Makrydimas, G., Papatheodorou, S., & Ioannidis, J. (2009). Corticosteroids for preventing neonatal respiratory morbidity after elective caesarean section at term. *The Cochrane Library*(Issue 6). doi: 10.1002/14651858.CD006614.pub2

Spong, C. Y. (2013). Defining “term” pregnancy: Recommendations from the defining “term” pregnancy workgroup. *JAMA, 309*(23), 2445-2446. doi: 10.1001/jama.2013.6235

Sælensminde, K. (2008). Positive helseeffekter av fysisk aktivitet – En konkretisering av veien mot mer fullstendige samfunnsøkonomiske analyser. Oslo: Helsedirektoratet.

Tam, T., Conte, M., Schuler, H., Malang, S., & Roque, M. (2013). Delivery outcomes in women undergoing elective labor induction at term. *Archives of Gynecology & Obstetrics, 287*(3), 407-411.

Towner, D., Castro, M. A., Eby-Wilkens, E., & Gilbert, W. M. (1999). Effect of mode of delivery in nulliparous women on neonatal intracranial injury. *New England Journal of Medicine, 341*(23), 1709-1714.

Tromp, M., Ravelli, A. C. J., Reitsma, J. B., Bonsel, G. J., & Mol, B. W. (2011). Increasing maternal age at first pregnancy planning: health outcomes and associated costs. *Journal of Epidemiology & Community Health, 65*(12), 1083-1090.

Vahratian, A., Zhang, J., Troendle, J. F., Sciscione, A. C., & Hoffman, M. K. (2005). Labor progression and risk of cesarean delivery in electively induced nulliparas. *Obstetrics & Gynecology, 105*(4), 698-704.

Villar, J., Carroli, G., Zavaleta, N., Donner, A., Wojdyla, D., Faundes, A., . . . Perinatal Health Research, G. (2007). Maternal and neonatal individual risks and benefits associated with caesarean delivery: multicentre prospective study. *BMJ, 335*(7628), 1025.

Voldner, N., Froslie, K. F., Haakstad, L. A. H., Bø, K., & Henriksen, T. (2009). Birth complications, overweight, and physical inactivity. *Acta Obstetricia et Gynecologica Scandinavica, 88*(5), 550-555.

Voldner, N., Frøslie, K. F., Bo, K., Haakstad, L., Hoff, C., Godang, K., . . . Henriksen, T. (2008). Modifiable determinants of fetal macrosomia: role of lifestyle-related factors. *Acta Obstet Gynecol Scand, 87*(4), 423-429. doi: 10.1080/00016340801989825

Weissmann-Brenner, A., Simchen, M. J., Zilberberg, E., Kalter, A., Weisz, B., Achiron, R., & Dulitzky, M. (2012). Maternal and neonatal outcomes of macrosomic pregnancies. *Medical Science Monitor, 18*(9), PH77-81.

Westenhoefer, J. (2001). The therapeutic challenge: behavioral changes for long-term weight maintenance. [Review]. *International Journal of Obesity & Related Metabolic Disorders: Journal of the International Association for the Study of Obesity, 25 Suppl 1*, S85-88.

WHO. (1997).*The Jakarta declaration: on leading health promotion into the 21st century*. World Health Organization.

Wilkinson, S. A., & McIntyre, H. D. (2012). Evaluation of the 'healthy start to pregnancy' early antenatal health promotion workshop: a randomized controlled trial. *BMC Pregnancy & Childbirth, 12*, 131.

WMA. (2008). World Medical Association Declaration of Helsinki. [http://www.wma.net/en/30publications/10policies/b3/].

Wu, W. H., Meijer, O. G., Uegaki, K., Mens, J. M. A., van Dieen, J. H., Wuisman, P. I. J. M., & Ostgaard, H. C. (2004). Pregnancy-related pelvic girdle pain (PPP), I: Terminology, clinical presentation, and prevalence. *European Spine Journal, 13*(7), 575-589.

Yeast, J. D., Jones, A., & Poskin, M. (1999). Induction of labor and the relationship to cesarean delivery: A review of 7001 consecutive inductions. [Research Support, Non-U.S. Gov't]. *American Journal of Obstetrics & Gynecology, 180*(3 Pt 1), 628-633.

Zhao, G., Ford, E. S., Tsai, J., Li, C., Ahluwalia, I. B., Pearson, W. S., . . . Croft, J. B. (2012). Trends in Health-Related Behavioral Risk Factors Among Pregnant Women in the United States: 2001-2009. *Journal of Women's Health (15409996), 21*(3), 255-263. doi: 10.1089/jwh.2011.2931

Attachment 1.

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UMASS

Pregnancy Physical Activity Questionnaire

Instructions:
Please use an ordinary No. 2 pencil. *Fill in the circles completely. The Question will be read by a machine so if you need to change your answer, erase the incorrect mark* ***completely****. If you have comments, please write them on the back of the questionnaire.*

Example: During this trimester, when you are NOT at work, how much time do you usually spend:

If you take care of your mom for 2 hours each day, then your answer should look like this... →

E1. **Taking care of an older adult**

- ○ None
- ○ Less than 1/2 hour per day
- ○ 1/2 to almost 1 hour per day
- ○ 1 to almost 2 hours per day
- ● 2 to almost 3 hours per day
- ○ 3 or more hours per day

It is very important you tell us about yourself honestly. There are no right or wrong answers. We just want to know about the things you are doing during this trimester.

1. Today's Date: ☐☐ (Month) / ☐☐ (Day) / ☐☐☐☐ (Year)
2. What was the first day of your last period? ☐☐ (Month) / ☐☐ (Day) / ☐☐☐☐ (Year) ○ I don't know
3. When is your baby due? ☐☐ (Month) / ☐☐ (Day) / ☐☐☐☐ (Year) ○ I don't know

---

During this trimester, when you are NOT at work, how much time do you usually spend:

4. **Preparing meals (cook, set table, wash dishes)**
   - ○ None
   - ○ Less than 1/2 hour per day
   - ○ 1/2 to almost 1 hour per day
   - ○ 1 to almost 2 hours per day
   - ○ 2 to almost 3 hours per day
   - ○ 3 or more hours per day
5. **Dressing, bathing, feeding children while you are sitting**
   - ○ None
   - ○ Less than 1/2 hour per day
   - ○ 1/2 to almost 1 hour per day
   - ○ 1 to almost 2 hours per day
   - ○ 2 to almost 3 hours per day
   - ○ 3 or more hours per day

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During this trimester, when you are NOT at work, how much time do you usually spend:

6. **Dressing, bathing, feeding children while you are standing**
   - O None
   - O Less than 1/2 hour per day
   - O 1/2 to almost 1 hour per day
   - O 1 to almost 2 hours per day
   - O 2 to almost 3 hours per day
   - O 3 or more hours per day

7. **Playing with children while you are sitting or standing**
   - O None
   - O Less than 1/2 hour per day
   - O 1/2 to almost 1 hour per day
   - O 1 to almost 2 hours per day
   - O 2 to almost 3 hours per day
   - O 3 or more hours per day

8. **Playing with children while you are walking or running**
   - O None
   - O Less than 1/2 hour per day
   - O 1/2 to almost 1 hour per day
   - O 1 to almost 2 hours per day
   - O 2 to almost 3 hours per day
   - O 3 or more hours per day

9. **Carrying children**
   - O None
   - O Less than 1/2 hour per day
   - O 1/2 to almost 1 hour per day
   - O 1 to almost 2 hours per day
   - O 2 to almost 3 hours per day
   - O 3 or more hours per day

10. **Taking care of an older adult**
    - O None
    - O Less than 1/2 hour per day
    - O 1/2 to almost 1 hour per day
    - O 1 to almost 2 hours per day
    - O 2 to almost 3 hours per day
    - O 3 or more hours per day

11. **Sitting and using a computer or writing, while not at work**
    - O None
    - O Less than 1/2 hour per day
    - O 1/2 to almost 1 hour per day
    - O 1 to almost 2 hours per day
    - O 2 to almost 3 hours per day
    - O 3 or more hours per day

12. **Watching TV or a video**
    - O None
    - O Less than 1/2 hour per day
    - O 1/2 to almost 2 hours per day
    - O 2 to almost 4 hours per day
    - O 4 to almost 6 hours per day
    - O 6 or more hours per day

13. **Sitting and reading, talking, or on the phone, while not at work**
    - O None
    - O Less than 1/2 hour per day
    - O 1/2 to almost 2 hours per day
    - O 2 to almost 4 hours per day
    - O 4 to almost 6 hours per day
    - O 6 or more hours per day

14. **Playing with pets**
    - O None
    - O Less than 1/2 hour per day
    - O 1/2 to almost 1 hour per day
    - O 1 to almost 2 hours per day
    - O 2 to almost 3 hours per day
    - O 3 or more hours per day

15. **Light cleaning (make beds, laundry, iron, put things away)**
    - O None
    - O Less than 1/2 hour per day
    - O 1/2 to almost 1 hour per day
    - O 1 to almost 2 hours per day
    - O 2 to almost 3 hours per day
    - O 3 or more hours per day

16. **Shopping (for food, clothes, or other items)**
    - O None
    - O Less than 1/2 hour per day
    - O 1/2 to almost 1 hour per day
    - O 1 to almost 2 hours per day
    - O 2 to almost 3 hours per day
    - O 3 or more hours per day

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During this trimester, when you are NOT at work, how much time do you usually spend:

17. **Heavier cleaning (vacuum, mop, sweep, wash windows)**

- O None
- O Less than 1/2 hour per week
- O 1/2 to almost 1 hour per week
- O 1 to almost 2 hours per week
- O 2 to almost 3 hours per week
- O 3 or more hours per week

18. **Mowing lawn while on a riding mower**

- O None
- O Less than 1/2 hour per week
- O 1/2 to almost 1 hour per week
- O 1 to almost 2 hours per week
- O 2 to almost 3 hours per week
- O 3 or more hours per week

19. **Mowing lawn using a walking mower, raking, gardening**

- O None
- O Less than 1/2 hour per week
- O 1/2 to almost 1 hour per week
- O 1 to almost 2 hours per week
- O 2 to almost 3 hours per week
- O 3 or more hours per week

Going Places...

During this trimester, how much time do you usually spend:

20. **Walking slowly to go places (such as to the bus, work, visiting)** ***Not for fun or exercise***

- O None
- O Less than 1/2 hour per day
- O 1/2 to almost 1 hour per day
- O 1 to almost 2 hours per day
- O 2 to almost 3 hours per day
- O 3 or more hours per day

21. **Walking quickly to go places (such as to the bus, work, or school)** ***Not for fun or exercise***

- O None
- O Less than 1/2 hour per day
- O 1/2 to almost 1 hour per day
- O 1 to almost 2 hours per day
- O 2 to almost 3 hours per day
- O 3 or more hours per day

22. **Driving or riding in a car or bus**

- O None
- O Less than 1/2 hour per day
- O 1/2 to almost 1 hour per day
- O 1 to almost 2 hours per day
- O 2 to almost 3 hours per day
- O 3 or more hours per day

For Fun or Exercise...

During this trimester, how much time do you usually spend:

23. **Walking slowly for fun or exercise**

- O None
- O Less than 1/2 hour per week
- O 1/2 to almost 1 hour per week
- O 1 to almost 2 hours per week
- O 2 to almost 3 hours per week
- O 3 or more hours per week

24. **Walking more quickly for fun or exercise**

- O None
- O Less than 1/2 hour per week
- O 1/2 to almost 1 hour per week
- O 1 to almost 2 hours per week
- O 2 to almost 3 hours per week
- O 3 or more hours per week

25. **Walking quickly up hills for fun or exercise**

- O None
- O Less than 1/2 hour per week
- O 1/2 to almost 1 hour per week
- O 1 to almost 2 hours per week
- O 2 to almost 3 hours per week
- O 3 or more hours per week

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During this trimester, how much time do you usually spend:

26. **Jogging**
- O None
- O Less than 1/2 hour per week
- O 1/2 to almost 1 hour per week
- O 1 to almost 2 hours per week
- O 2 to almost 3 hours per week
- O 3 or more hours per week

27. **Prenatal exercise class**
- O None
- O Less than 1/2 hour per week
- O 1/2 to almost 1 hour per week
- O 1 to almost 2 hours per week
- O 2 to almost 3 hours per week
- O 3 or more hours per week

28. **Swimming**
- O None
- O Less than 1/2 hour per week
- O 1/2 to almost 1 hour per week
- O 1 to almost 2 hours per week
- O 2 to almost 3 hours per week
- O 3 or more hours per week

29. **Dancing**
- O None
- O Less than 1/2 hour per week
- O 1/2 to almost 1 hour per week
- O 1 to almost 2 hours per week
- O 2 to almost 3 hours per week
- O 3 or more hours per week

Doing other things for fun or exercise? Please tell us what they are.

30. _____ Name of Activity
- O None
- O Less than 1/2 hour per week
- O 1/2 to almost 1 hour per week
- O 1 to almost 2 hours per week
- O 2 to almost 3 hours per week
- O 3 or more hours per week

31. _____ Name of Activity
- O None
- O Less than 1/2 hour per week
- O 1/2 to almost 1 hour per week
- O 1 to almost 2 hours per week
- O 2 to almost 3 hours per week
- O 3 or more hours per week

Please fill out the next section if you work for wages, as a volunteer, or if you are a student. If you are a homemaker, out of work, or unable to work, you do not need to complete this last section.

At Work...

During this trimester, how much time do you usually spend:

32. **Sitting at working or in class**

- O None
- O Less than 1/2 hours per day
- O 1/2 to almost 2 hours per day
- O 2 to almost 4 hours per day
- O 4 to almost 6 hours per day
- O 6 or more hours per day

33. **Standing or slowly walking at work while carrying things (heavier than a 1 gallon milk jug)**
- O None
- O Less than 1/2 hour per day
- O 1/2 to almost 2 hours per day
- O 2 to almost 4 hours per day
- O 4 to almost 6 hours per day
- O 6 or more hours per day

34. **Standing or <u>slowly</u> walking at work <u>not</u> carrying anything**
- O None
- O Less than 1/2 hours per day
- O 1/2 to almost 2 hours per day
- O 2 to almost 4 hours per day
- O 4 to almost 6 hours per day
- O 6 or more hours per day

35. **Walking <u>quickly</u> at work while <u>carrying</u> things (heavier than a 1 gallon milk jug)**
- O None
- O Less than 1/2 hour per day
- O 1/2 to almost 2 hours per day
- O 2 to almost 4 hours per day
- O 4 to almost 6 hours per day
- O 6 or more hours per day

36. **Walking <u>quickly</u> at work <u>not</u> carrying anything**
- O None
- O Less than 1/2 hour per day
- O 1/2 to almost 2 hours per day
- O 2 to almost 4 hours per day
- O 4 to almost 6 hours per day
- O 6 or more hours per day

Thank You

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Attachment 2.

UNIVERSITETET I OSLO
DET MEDISINSKE FAKULTET

To whom it may concern

Regional komité for medisinsk forskningsetikk
Sør- Norge (REK Sør)
Postboks 1130 Blindern
NO-0318 Oslo

Telefon: 228 44 666
Telefaks: 228 44 661
E-post: rek-2@medisin.uio.no
Nettadresse: www.etikkom.no

Dato: 14.12.06
Deres ref.:
Vår ref.: S-01191 – approval

Title of protocol:

S-01191 Maternal metabolic syndrome, macrosomic newborn and pregnancy complications

Principal investigator: Chief physician dr.med. Tore Henriksen, Rikshospitalet.

The protocol was reviewed and approved by The Regional Committee for Medical Research Ethics, Southern Norway, Oslo, Norway, on 30 August 2001.

Sincerely yours

Kristian Hagestad
Fylkeslege cand.med., spes. i samf.med
Chairman

Jørgen Hardang
Secretary

Attachment 3.

Rikshospitalet

Kvinneklinikken

STORK

Postadresse:
0027 OSLO

Besøksadresse
Sognsvannsv. 20
Sentralbord:
23 07 00 00

Til deg som er gravid og har fødeplass på Rikshospitalet

Forespørsel om å delta i STORK-prosjektet

(store barn og svangerskapskomplikasjoner)

Stork-prosjektet søker å finne svar på hvorfor forekomsten av store barn er økende. Fra 1990 til 2000 har andelen av barn med fødselsvekt over 4kg økt fra 16% til 22%. Dette er en uheldig utvikling. Store barn kan medføre økt risiko for mor og barn både under graviditet, fødsel og muligens også på lengre sikt.

Hos noen er det genetisk bestemt at de skal få store barn. Andre faktorer som også trolig påvirker fosterets vekst, er kvinnens fysiske aktivitet, type og mengde mat hun spiser og omsetningen av sukker i blodet.

Undersøkelsen vil gi mulighet til å utvikle metoder for å identifisere kvinner som har økt risiko for å føde stort barn tidlig i svangerskapet, og utvikle støttetiltak for å motvirke denne utviklingen.

Studien er åpen for alle som skal føde på Rikshospitalet, med enkelte unntak (diabetes etc.)

Hvis du har vært med på prosjektet tidligere, kan du også se bort fra denne forespørselen.

Undersøkelsen er kun ute etter å samle informasjon og vil *ikke ha noen påvirkning på svangerskapet eller barnet ditt.*

Det er frivillig å bli med i undersøkelsen. Selv om du har begynt, kan du når som helst og uten å oppgi grunn trekke deg. Dine data vil da bli slettet og ikke brukt i undersøkelsen. Opplysninger om svangerskap og fødsel innhentes også fra fødejournalen. Alle data registreres avidentifisert og lagres til konsesjonstiden utgår i 2025. Personopplysningene er kun tilgjengelige for prosjektlederne, som er bundet av tausetsplikten for helsepersonell.

Prosjektet finansieres hovedsaklig av Universitetet i Oslo, Helse sør og Freia-fondet. Prosjektleder har ingen personlig økomisk interesse.

Ved å delta i undersøkelsen vil du bli fulgt opp av en av to prosjektleger her på Kvinneklinikken. Alle undersøkelsene er gratis, og du er forsikret på vanlig måte gjennom pasientskadeordningen.

Undersøkelsene:

Hvis du velger å delta, vil det bety fire kontroller hos lege på Rikshospitalet i løpet av svangerskapet. Noen av disse vil kunne være i stedet for kontroller hos egen lege / jordmor.

Hver gang møter du fastende, det betyr at du ikke skal spise eller drikke etter klokka 24.00. Du får litt vann når du kommer.

1. gang ved ca. 14-16 ukers svangerskapsvarighet

- Kostholdsskjema og fysisk aktivitetsskjema som du har fått i posten skal leveres i forbindelse med legetimen.
- Fastende blodsukkerbelastning. Du får drikke 75 g. druesukker. Deretter tas det blodprøve fire ganger (hver ½-time). Vi setter inn en vanlig veneflon (et tynt plastrør) i en blodåre på armen, slik at det bare blir ett stikk. Prøven tar litt over to timer. Vi anbefaler matpakke til å spise etterpå. Du vil få vite resultatet med en gang.
- Din kroppssammensetning vil bli målt ved BIA(spesialvekt) og en enkel ytre målemetode.

2. gang ved 22-24 uker
   - Det blir tatt blodprøve til nedfrysing. Det tar ca. 15 minutter.
   - Ultralyd av barnet for å måle vekst og trivsel. Ultralydundersøkelsen vil også måle blodgjennomstrømningen i navlesnor, til livmoren og i hjernen. Dette gir oss kunnskap om fosterets trivsel. Mors kroppsammensetning måles.

3. gang ved 30-32 uker
   - Sukkerbelastning som første gang
   - Ultralyd og mors kroppssammensetning
   - Nytt kostholdsskjema

4. gang ved 36-38 uker
   - Blodprøver som andre gang, pluss
   - Ultralyd og mors kroppssammensetning
   - Fysisk aktivitetsskjemaer leveres

Det vil hver gang tas blodprøver som skal fryses ned. Disse prøvene vil bli analysert først etter at hele prosjektet er gjennomført om tre til fem år. Ansvarlig for dette er professor/seksjonsoverlege Tore Henriksen.

Etter fødsel tas det prøver fra navlestreng. Barnets vekt, lengde og underhudsfett måles mens dere er på barsel.

Resultatene av undersøkelsen vil bli offentliggjort i vitenskapelige tidsskrifter.

Studien er vurdert av datatilsynet og regional etisk komite.

Med vennlig hilsen

……..

Camilla M. Hoff Marie Cecilie Paasche Roland

lege / stipendiat lege / stipendiat

Hvis du ønsker å være med i prosjektet er det fint hvis du så raskt som mulig gir en tilbakemelding til Kvinneklinikken.

Du kan ringe til sekretær Esther Baumann 23 07 29 27 eller mobil 94833485 og si at du ønsker å være med i STORK-prosjektet og få time over telefon.

Du kan også sende en e-post til esther.baumann@rikshospitalet.no eller stork@rikshospitalet.no *og få time tilbake på mail.*

Spørsmål kan rettes til Camilla Hoff tlf: 23 07 26 31, calling 22926

eller på mail Camilla.Hoff@rikshospitalet.no

og til Marie Cecilie Paasche Roland på tlf: 23 07 26 65

eller på mail marie.cecilie.paasche@rikshospitalet.no

Jeg har mottatt skriftlig informasjon om denne undersøkelsen og samtykker i å delta.

_____

_____

Dato Underskrift

Legens erklæring:

Jeg bekrefter at kvinnen har fått skriftlig informasjon om hva det innebærer å delta i prosjektet.

_____

_____

Dato Underskrift (lege Camilla Hoff/ lege Marie Cecilie P. Roland)