FEASIBILITY OF THE OI-FI TO MEASURE THE PROCESS AND OUTCOME OF THE FINNISH MATERNITY CARE: A COMPARISON BETWEEN FINNS AND MIGRANT WOMEN OF RUSSIAN, KURDISH, AND SOMALI ORIGIN

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Background: Pregnancy and labor are a natural continuum for life. However, over the past decades different procedures affecting the natural process of pregnancy and labor have become common. Although in many situations these procedures are beneficial to the health of the mother and the fetus, yet they are applied without a medical indication. In today's maternity care, adverse events in pregnancy and labor are rare in countries with high quality health care. At the same time, research detecting these adverse events has become expensive. In the beginning of the new millennium, started a development process of the Optimality Index-US (OI-US), a measurement tool that assesses the process and outcome of maternity care in low risk population. The OI-US offers a new way of measuring perinatal outcomes with a framework of optimality, shifting the perspective from illness to health. The OI-US consists of two indexes, Perinatal Background Index (PBI), and Optimality Index (OI). The PBI describes the social, medical, and obstetric status of the woman. It is detecting the equivalence or difference between the compared groups. The OI measures the particular practice as it concentrates on present pregnancy and labor. The total score of the OI-US is reported with describing the similarity or difference between the groups by the PBI score. The current OI-US contains 56 items.
Objective: The aim of this master's thesis is to apply the OI-US to measure the process and outcome of the Finnish maternity care. A new instrument, Optimality Index Finland (OI-FI) is constructed by referring the OI-US. Furthermore, the Medical Birth Register (MBR), a database that is maintained by THL, guides the item selection for the OI-FI. Additionally, a study comparing pregnancy and labor outcomes between Finns and migrant women of Russian, Kurdish, and Somali origin is conducted to assess if the OI-FI demonstrates applicability on measuring the process and outcome of the Finnish maternity care.
Data and methods: The work started by adapting the items proposed in the OI-US that were collected in the Finnish MBR, a national register on births. Every item that was included in the OI-FI was referred by Finnish national guidelines or high quality research. The limits for the optimality for each of the item were justified primarily by national guidelines. In the absence of national guidelines, high quality research and evidence-based practice was cited. In total, 40 items were included in the OI-FI. The study sample contained 1,495 women with singleton deliveries in Finland between the years 2004-2014. For each of the woman the latest birth between the study years was under investigation. The study sample was divided by parity to primiparous (n=358) and multiparous (n=1,137) women, and further by ethnicity

to four groups: Finns, Russian, Kurdish and Somali. The PBI, OI, and OI-FI scores were calculated for each group and the scores were compared within parity. Finns were used as the reference group. Kruskall-Wallis H test was used to detect statistically significant difference in OI-FI, PBI and OI scores between the study groups. To identify the groups that differ, a pairwise comparison was performed by Mann-Whitney U test. Additionally, optimal responses to each of the items in the OI-FI were calculated. Chi Square test or Exact test was used to detect the items that differed between the study groups. To identify which groups had a statistically significant difference a z-test with adjusted p-values by Bonferroni method was executed. IBM SPSS Statistics 23.0 was used as the analyzing software and the level of statistical significance was set to $p \leq 0.05$.

Results: The PBI scores were statistically significantly higher both in primiparous and multiparous Finns compared with the other ethnicities ($p \leq 0.001$ in all). Both the OI and the OI-FI scores were statistically significantly lower for prmiparous Somali women compared to primiparous Finns ($p \leq 0.001$ in both). Additionally, in multiparous the OI-FI scores were statistically significantly higher in Finns compared to Kurdish ($p\leq 0.001$) and Somali ($p\leq 0.001$). When analyzing the optimality of each of the OI-FI item between the study groups, the results showed that primiparous Somali women had lower percentages for optimality for experiencing other serious antepartum conditions or complications ($p \leq 0.05$), having optimal prenatal care ($p \leq 0.05$), experiencing episiotomy ($p \leq 0.05$), having a neonate with optimal one-minute Apgar scores ($p \leq 0.05$), and transfer of the neonate to neonatal care ($p \leq 0.05$). Multiparous Somali women had lower percentages for optimality for pre-pregnancy BMI ($p \leq 0.05$), experiencing other serious antepartum conditions or complications ($p \leq 0.05$), and for optimal prenatal care ($p \leq 0.05$) compared with Finns. Additionally, multiparous Kurdish had less often an optimal BMI ($p \leq 0.05$), and had other serious antepartum conditions or complication ($p \leq 0.05$) more often than multiparous Finns did. In addition, the results showed that smoking during pregnancy was more common for Finns than for Kurdish and Somali both in primiparous and multiparous ($p \leq 0.05$ in all). Additionally, multiparous Russians had lower percentages of CS and previous CS compared with Finns ($p \leq 0.05$ in both), and multiparous Somali women had amniocentesis less often and had lower usage of epidural, spinal or combined spinal-epidural analgesia for labor pain compared with Finns ($p \leq 0.05$ in both).

Conclusions: This study repeated the unfavorable trend of Somali women having poorer pregnancy and labor outcomes compared to Finns, and the results are in accordance with previous research conducted in Finland comparing the pregnancy and labor outcomes of Finnish and migrant origin women. Somali women had lower PBI, OI, and OI-FI scores in all the comparisons with Finns, except for OI scores for multiparous. Additionally, Somali women had lower percentages for single item optimality for several items compared with Finns. In addition, multiparous Kurdish had poorer PBI and OI-FI scores compared to Finns. Based on the study results, it seems that the OI-FI has a potential to detect differences in the process and outcome of the Finnish maternity care between Finns and ethnic minority women. This encourages to continue the development of the OI-FI and to use it in future research to evaluate the Finnish maternity care.

Keywords: optimality index, OI-FI, maternity care, pregnancy, childbirth, ethnic minority, migrant woman

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Abbreviations:

BMI	Body Mass Index
CS	Cesarean section
GDM	Gestational Diabetes Mellitus
ICD-10	10th Revision of the International Classification of Diseases
LBW	Low Birth Weight
Maamu Study	Migrant Health and Wellbeing Study
MBR	Medical Birth Register
OI	Optimality Index
OI-FI	Optimality Index-Finland
OI-US	Optimality Index-United States
PBI	Perinatal Background Index
PTB	Preterm Birth
SPSS	The IBM Statistical Program for Social Sciences
THL	The National Institute for Health and Welfare
WHO	World Health Organization

1 INTRODUCTION

The World Health Organization (WHO) has stated that every human being should have the right to health. This includes access to timely, acceptable, and affordable health care of appropriate quality. The governments are responsible for ensuring conditions in which everyone can be as healthy as possible. (WHO The right to health, 2013) Despite the WHO statement, annually around 250 million people are suffering financially due to health care expenditures (WHO The right to health, 2013), and more than 400 million people worldwide lack the access to primary health care services (WHO News release, 2015).

The United Nations released Sustainable Development Goals in September 2015 to guide the allocation of scarce resources to tackle the existing inequalities in the world by 2030 (Sustainable Development Goals, 2015). The Sustainable Development Goals are a continuum for the United Nations' Millennium Development Goals that were launched in 2002 to tackle the contemporary issues related to health, education, poverty, and environment around the world (The Millennium Development Compact, 2003). In total, there are nineteen Sustainable Development Goals to guide the governments work towards sustainable development economically, environmentally, and socially. The third goal covers various aspects of health and health care, and aims to ensure healthy lives and promote well-being for all at all ages. Three targets of the third goal relates to reproductive and women's health, including reduction of global maternal mortality ratio (target 3.1), ending of preventable deaths and reduction of mortality rates of newborns and children (target 3.2), and ensuring universal access to sexual and reproductive health-care services to all (target 3.7). (Sustainable Development Goals, 2015)

In Finland these targets may have been achieved a long time ago, however inequalities in health still exists. Although the average health status of Finnish population has improved remarkably in the past decades, the socio-economic inequalities have remained the same or even grown. This means that people in lower social positions have poorer health and shorter life expectancy. When comparing Finland to other West-European countries, differences in mortality rates between population groups are high. (Lahelma, Rahkonen, Koskinen, Martelin & Palosuo, 2009) Socio-economic inequalities between the local population and the ethnic minority populations exists in Finland. Whereas the total unemployment rate for Finns was 9%, it was 22% for all foreigners in Finland in 2011. There are major differences also in education between Finns and the ethnic minority populations. (Foreigners and migration, 2013) These socio-economic differences affect the health and therefore the ethnic minorities are more prone to health inequalities. In addition, the lack of language skills may influence the behavior related to seek health care services. Additionally, talking about sensitive topics such as reproductive health issues may be restricted, and the knowledge of the basic anatomy and physiology related to reproductive health may be almost nonexistent due to lack of education or restrictions in the culture. (Apter, Eskola, Säävälä & Kettu, 2009; Degni, Suominen, El Ansari, Vehviläinen-Julkunen & Essen, 2013; Malin & Gissler, 2009)

The WHO outlines the importance of good health care management of expectant mothers and newborns. The recommendation is to provide a minimum of four antenatal visits under the supervision of a skilled attendant for every pregnant woman. These visits should be divided evenly throughout the pregnancy and the first visit should occur as soon as possible in the early pregnancy but at least prior to sixteen weeks of gestation. (WHO Guide for practice, 2015; WHO Standards for Maternal and Neonatal Care, 2007.) In addition, demedicalization of normal pregnancy and labor is the aim of present maternity care. This means that pregnancy and labor are allowed to occur naturally and medical interventions are applied only if there is an indication. (Chalmers, Mangiaterra & Porter, 2001)

Finland is known for its high quality maternity care services. The utilization of these services is high and it has been estimated that only 0.2% of migrant women and 0.3% of Finnish women have no prenatal care (Malin & Gissler, 2009). Although the utilization is similar, differences in the reproductive and perinatal health exist between Finns and the migrant women in Finland (Castaneda et al. 2012; Malin & Gissler, 2009; Malin, 2011). As the share of the migrant population in Finland continues to grow, the health care providers will face more clients with foreign background. The inequalities in reproductive and perinatal health need to be addressed to provide quality maternity care to all regardless of ethnicity.

The purpose of this Master's thesis is to introduce a new measurement tool Optimality Index-FI and to evaluate its feasibility to measure the process and outcome of the Finnish maternity care. Furthermore, a study comparing the Optimality Index-Finland scores between Finns and migrant women of Russian, Kurdish, and Somali origin living in Finland is conducted. For these purposes, the process of pregnancy and labor, and common complications will be discussed in the literature review. Additionally, presentations of Finnish maternity care and the instrument itself are included in the literature review. In addition, ethnic differences in reproductive health are to be discussed.

2 LITERATURE REVIEW

2.1 Pregnancy and labor

2.1.1 The process of pregnancy

Pregnancy and childbirth are a natural continuum for life. The duration of normal pregnancy is 280 days that equals to 40 weeks (Pietiläinen & Väyrynen, 2015; Sariola & Tikkanen, 2011a; Tiitinen, 2014b). The duration of the pregnancy is calculated from the first day of the latest menstruation period if the menstruation cycle is regular. Thereafter the duration is reported by using full weeks and days, for example, 37+5 equals to 37 weeks and five days. Pregnancy is divided into three trimesters. The first trimester ends at 12 weeks of gestation, the second trimester starts at 12+1 weeks of gestations and ends at 26 weeks, and the third trimester starts from 26+1 weeks of gestation and ends the day the baby is born. (Ahonen et al., 2012) The definition of the weeks of gestation related to the trimesters may vary between different practices but they remain close to these introduced here. The first eight weeks the developing individual is called as embryo and after that until the onset of birth, the individual is called a fetus (Litmanen, 2015). The pregnancy is called full term when the baby is born between the weeks 37 and 42. If the pregnancy proceeds over 42 weeks it is considered post term and if the baby is born before week 37 the pregnancy is considered preterm. (Ahonen et al., 2012; Pietiläinen & Väyrynen, 2015; Sariola & Tikkanen, 2011a; Tiitinen, 2014a) Also the weight of the newborn has commonly been referred as a marker of maturity. A term newborn weighting less than 2,500 grams at birth is defined as having a low birth weight and a newborn weighting more than 4,000 grams at term is referred as heavy for gestational age. (WHO ICD-10 P05-P08, 2016)

In medicine two terms are used to describe a pregnant woman: gravida and parity. A pregnant woman is called gravida, thus a woman that is pregnant for the first time is called primigravida. Nulligravida refers to a woman that has never been pregnant, and multigravida refers to a woman that has been pregnant more than once. Parity refers to a pregnancy that has resulted in a viable birth to an infant weighting more than 500 grams or pregnancy that has lasted more than 20 weeks. A primipara is therefore a woman that has had one pregnancy that resulted in a viable birth. A multipara refers to a woman that has had more than one pregnancy resulting in a viable birth. A nullipara is a woman that may have been pregnant before (primigravida or multigravida) but the pregnancy has never resulted in a viable birth. (Erling, Wayne & Friedman, 2011)

2.1.2 The process of labor

In the clinical practice the process of labor is usually divided into three stages. In the first stage the contractions of the uterus becomes reoccurring, the cervix fully dilates, and the fetus begins to descent. The second stage continues from the first stage and results in the delivery of the baby. During the third stage the placenta and membranes are delivered. (Erling, Wayne & Friedman, 2011; Fishkel & Lequizamón, 2010; Sariola & Tikkanen, 2011b; Tiitinen, 2014a)

The process of labor can be described as an orchestration of hormones in the woman's body. A hormone called oxytocin is released in the woman's blood circulation during the labor. As the concentration of oxytocin in the circulation increases the contractions of the uterus increases in frequency and intensity. At the same time the pain level the woman is experiencing intensifies. If the woman can tolerate the pain, the contractions become more effective and frequent and endorphins are released in the circulation making perception of the pain to fade. The release of endorphins requires high enough concentration of oxytocin in the circulation. If the woman receives pain relief such as epidural analgesia, the oxytocin level drops, endorphins are not released, and sometimes augmentation may be needed for the labor to progress. (Lothian, 2014) Augmentation of the labor refers to a stimulation of the uterus to increase the frequency, duration and intensity of the contractions after the onset of spontaneous labor that is not progressing (WHO Augmentation of labor, 2014). When the labor is allowed to start naturally, the optimal oxytocin level enhances the probability of the labor and birth to progress successfully, and provides the best possible start for breastfeeding and maternal-newborn attachment (Amis, 2014).

If the pregnancy has progressed normally and without any concerns and complications, vaginal delivery has been showed to be the safest way of delivery (Farchi, Polo, Franco, Di Lallo & Guasticchi, 2010; Liu et al. 2007; Pallasmaa, 2014). In low-risk pregnancies unnecessary Cesarean section (CS) increases the risk for maternal and neonatal morbidity and mortality (Brown, Paranjothy, Dowswell, & Thomas, 2013; Villar et al., 2007). In the study of Pallasmaa (2014) comparing two Finnish birth cohorts (1997 and 2002) and comparing different delivery modes (spontaneous vaginal delivery, instrumental vaginal delivery, elective CS, and emergency CS) the incidence of severe maternal complications was lowest in vaginal delivery group compared to the other three delivery modes. Additionally, Pallasmaa studied the purpose of planned delivery and compared the incidence of maternal complications between attempted vaginal delivery (including all vaginal deliveries and non-elective CS) and an elective CS. The results showed that elective CS was associated with nearly 2-fold risk of severe maternal complications compared with attempted vaginal delivery. (Pallasmaa, 2014) In another Finnish study, a register-based cohort study, different delivery modes were compared in women with a high-risk pregnancy. The study population consisted of 292,253 singleton deliveries in Finland between the years 2007-2011. The purpose of the study was to evaluate if maternal obesity, maternal age 35 years or more, insulin dependent diabetes, and preeclampsia have an impact on severe maternal morbidity by the mode of delivery. The occurrence of complications was lowest in the vaginal delivery group compared to the other groups. Only in mothers with preeclampsia the risk for complications was similar in vaginal delivery, attempted vaginal delivery, and elective CS. This study showed that even in high-risk pregnancies vaginal delivery seems to be the safest mode of delivery. (Pallasmaa, Ekblad, Gissler & Alanen, 2015)

The presentation of the fetus at the onset of labor influences the planning of the delivery mode. Cephalic presentation (head first), more precisely occiput anterior presentation (face of the fetus facing the spine of the mother), provides the most favorable delivery of the fetus through the birth canal (Caughey, Sharshiner & Cheng, 2015. Klemetti & Hakulinen-Viitanen, 2013). Even occiput posterior (face of the fetus facing the abdominal wall of the mother) and occiput transverse position (face of the fetus facing the left or right side of the mother) poses the delivery for greater risk for CS and prolonged labor, and increases the risk for perinatal morbidity (Caughey, Sharshiner & Cheng, 2015). Breech presentation (buttocks or feet first) of the fetus occurs in 4% of the pregnancies in Finland. This is an abnormal presentation at birth and increases the risk for birth trauma, especially of the head, since it is the last part of the baby to be delivered. Therefore, a baby in a breech presentation is often delivered by CS. (Klemetti & Hakulinen-Viitanen, 2013; Uotila & Tuimala, 2011a) In a transverse position of the fetus (fetus is sideways in the uterus), CS is chosen for the mode for delivery (Tiitinen, 2015a).

In Finland a device called a cardiotocography is used to monitor the wellbeing of the fetus during the labor. It measures the heart rate of the fetus and the contractions of the uterus. The cardiotocography registration may be taken through the abdominal wall or from the presented part of the fetus. The registration is usually taken when the women arrives at the hospital and then occasionally when the labor progresses. During the second stage and especially in the end of the second stage of the labor the cardiotocography monitoring may be continuous to detect fetal distress. (Sariola & Tikkanen, 2011b) In addition to cardiotocography, ST analysis is commonly used for women in labor to detect fetal distress. The ST analysis is inserted on the presented part of the fetus and it documents fetal electrocardiography, therefore it can only be used after the rupture of the membranes. The ST analysis complements the information from the cardiotocography. The ST refers to ST-segment that is a part of the electronic presentation of the function of the heart. (Aittomäki et al. 2016)

Presence of a support person and allowance of mobilization during the delivery may affect positively to the course of the labor. In a Cochrane review of 25 trials maternal positions and mobility during the labor were reviewed to determine whether up-right positions or recumbent positions during the first stage of labor offer better maternal and neonatal outcomes. The results showed that walking and up-right positions (sitting, kneeling, and standing) at the first stage of labor reduced the duration of labor, the risk for CS, and the need for epidural analgesia. In addition, no increase in interventions or negative effects on the health and wellbeing of the mother and the baby were detected. (Lawrence, Lewis, Hofmeyr & Styles, 2013) The role of a support person in labor was evaluated in a large Cochrane review in 2013. The review consisted of 22 trials including 15,288 women undergoing labor. Women accompanied with continuous support during labor experienced more often spontaneous vaginal delivery without obstetric interventions (instrumental vaginal delivery or CS), and intrapartum analgesia. In addition, their labors were shorter and their infants were less likely to have low Apgar scores at 5 minutes of age. The presence of a support person have significant benefits for the progression of labor and according to the most recent evidence do not harm the event of childbirth. (Hodnett, Gates, Hofmeyer & Sakala, 2013) Therefore, all women should be encouraged to bring their support person (partner, family member, friend, or doula) to their birth (Green & Hotelling, 2014). Around 80% of labors in Finland are accompanied with the father to support the mother throughout the labor (Sariola & Tikkanen, 2011b).

WHO’s ten Principles of Perinatal Care (2001) outlines the importance of comprehensive perinatal care during and after pregnancy and childbirth. The first principle introduces the need for demedicalization of pregnancy and birth when it is appropriate:

> *“Care for normal pregnancy and birth should be demedicalized, meaning that essential care should be provided with the minimum set of interventions necessary and that less rather than more technology be applied whenever possible.” (Chalmers, Mangiaterra and Porter, 2001: 203.)*

This statement underlines the normalcy of pregnancy and birth providing a strong ideology for current practice of midwifery care worldwide. Optimal care of birth allows the process of physiologic childbirth without interrupting it with unnecessary interventions. In a healthy birth practice the birth occurs naturally on its own, the mother is allowed to move around to help to cope with the pain, and the mother is supported by decreasing fear, enhancing relaxation and providing privacy. In addition, spontaneous pushing is allowed and up-right position is encouraged. Most importantly the birthplace setting should provide enough time the birth to occur naturally on its own pace. (Lothian, 2014)

2.1.3 Postpartum monitoring of the mother and the newborn

After the birth, the baby is monitored closely to detect any complications related to adaptation after birth. The clinical status of the newborn is commonly assessed by giving the newborn Apgar scores. These Apgar scores are based on five items that are appearance (skin color), pulse, grimace response (reflexes), activity (muscle tone), and respiration. Each item is scored from 0 to 2 and the maximum score is 10. The Apgar scores are given to the newborn first at one minute of age. (Luukkainen, 2011; The Apgar Score, 2015). In Finland the vast majority of newborns receive 8 to 9 points out of the total ten points at one minute of age. One point is deducted usually for bluish skin color, especially after vaginal delivery. It is recommended that if the score is below nine at one minute of age the scoring should be renewed at 5 minutes and then every five minutes if the score remains below seven. (Jalanko, 2009.) Apgar scores below seven at 5 minutes of age are considered to be low and increasing the risk for several adverse outcomes in the neonate (The Apgar Score, 2015; Boulkedid et al. 2013; Kesmodel & Jolving, 2011; Gissler, Manninen, Tapper & Volmanen 2015). The Apgar score is a convenient method to assess the status of the newborn immediately after birth (The Apgar Score, 2015). Monitoring of the newborn continues during the first hours of life. Oxygen saturation (the percentage or hemoglobin carrying the oxygen) is recommended to measure from all newborns from the lower limb to detect serious heart conditions. The adaptation after birth takes usually from days to weeks to fully complete but the adaptation of vital organs such as respiratory and circulatory systems should occur within minutes after birth. Before discharge, a pediatrician or neonatologist examines the newborn to ensure the baby is healthy and ready for discharge. (Luukkainen, 2011)

The immediate postpartum assessment of the mother includes observing the amount of postpartum bleeding, assessing the involution of the uterus by palpating from the abdominal wall, and supporting to breastfeed. Additionally, in Finland the mother is having a postpartum assessment at the maternity care clinical from five to twelve weeks after the birth. This visit includes vaginal examination, weight and blood pressure control, bloodwork (hemoglobin), and urine sample (protein and glucose) control. In addition, the health care provider observes the attachment of the mother with the baby and supports breastfeeding. (Nuutila & Ylikorkala, 2011)

2.1.4 Major pre-existing chronic diseases affecting the pregnancy and birth outcomes

Chronic medical conditions of the mother are associated with poorer pregnancy and birth outcomes (Graham, Zhang & Schwalberg, 2007). The best results for the mother and the fetus are achieved when the pregnancy is planned and best possible control of the chronic disease is gained before conception. Counseling on possible complications should be given to the mother, and changes in the medication should be done prior to pregnancy. Timely and good quality follow-up is provided for the mother throughout and after the pregnancy and labor. When chronic diseases are treated beforehand, more optimal pregnancy and labor outcomes can be expected. (Kaaja & Teramo, 2011)

Hypertension is one of the leading global burden of disease worldwide. It is an important challenge for public-health policies and actions. (Kearney et al. 2005). Hypertension becomes more common as the age increases (Mustajoki, 2015). It has been estimated that in western countries 1-5% of pregnant women suffer from chronic hypertension. However, as the mean age of parturients increases, it is predicted that the prevalence of chronic hypertension among parturients increases. (Klemetti & Hakulinen-Viitanen, 2013). Hypertension can be chronic and pre-existing or caused by pregnancy. If hypertension is detected during the first trimester it is usually pre-existing but if it occurs later in pregnancy it may indicate a pregnancy complication such as preeclampsia. It is important to distinguish between the two conditions since the treatment and follow-up is different in both cases. (Kaaja & Teramo, 2011) In a Danish National Birth Cohort (n=81,008), a longitudinal study of pregnant women and their offspring, an association between pre-existing conditions and risk for both preterm and term small for gestational age newborns (a newborn whose weight is lower than average for its gestational age) was studied. Pre-existing conditions included chronic hypertension, pre-existing diabetes, body mass index, age, smoking, and reproductive history (e.g. parity, miscarriages, and time to pregnancy). Out of the study sample 975 (1.2%) of the women reported chronic hypertension. After adjusting chronic hypertension with the other considered risk factors it was found to increase the risk for preterm and small for gestational age newborn 5.5-fold. (Catov, Nohr, Olsen & Ness, 2008) The association between pre-existing hypertension and preterm birth (PTB) is well known (Chappell et al. 2008; Koutrolou-Sotiropoulou et al., 2015), and therefore detecting pre-existing hypertension before conception is important to provide better pregnancy and birth outcomes. Pregnancy related hypertension is usually a sign of pregnancy complication such as preeclampsia (Vaillancourt & Lafond, 2012).

Diabetes mellitus (type 1 and type 2) is one of the most common chronic diseases and one of the major issues of public health professionals worldwide. The WHO estimates that in 2014 nine percentage of adults (18 years and over) had diabetes (WHO Diabetes, 2016). Diabetes mellitus is a condition that needs to be taken care off when a woman is planning a pregnancy. If the treatment of diabetes mellitus is in good balance prior to pregnancy many complications associated with it can be overcome. (Teramo & Kaaja, 2011) In a large retrospective study of 175,249 women evaluating the prevalence of preexisting diabetes mellitus and gestational diabetes mellitus (GDM) a significant increase was observed in the former and a constant prevalence in the latter between the study years 1999-2005 ($p < 0.001$, $p < 0.07$). Preexisting diabetes mellitus was discovered to affect 1.3% of all the pregnancies and GDM was diagnosed in 7.6% pregnancies after excluding the preexisting diabetes mellitus cases. The results were adjusted by age and ethnic/racial groups. (Lawrence, Contreras, Chen & Sacks, 2008) Both preexisting and gestational diabetes mellitus poses the pregnancy at increased risk for miscarriages and congenital anomalies. However, most of the severe malformations occur during the first eight weeks of gestation when the development of GDM has not usually triggered yet. For mothers with preexisting diabetes mellitus treating the condition and maintaining appropriate blood glucose level throughout the pregnancy predicts best pregnancy and labor outcomes. This is true also if the diabetes mellitus is detected during the pregnancy. If untreated, the high levels of glucose transferring from the mother to the fetus hyperstimulates the fetal insulin production to compensate the increased fetal blood glucose level. Insulin promotes the growth of the fetus and increases the risk of macrosomia (excess growth of the fetus). Macrosomia can lead to maternal complications during delivery, including higher risk for CS, vaginal laceration, and postpartum hemorrhage, and the neonate is at increased risk for shoulder dystocia. In addition, the neonate may suffer from hypoglycemia, hyperbilirubinemia, hypocalcemia, and respiratory distress syndrome. All these conditions require observation and may require intensive care of the newborn. (Murphy, Janzen, Strehlow, Greenspoon & Palmer, 2013a.)

Major psychiatric disorders and diseases should be closely monitored during pregnancy. One of the most common mental disorders worldwide is depression. WHO's estimation is that globally 350 million people suffer from depression. (WHO Depression, 2016) In Finland the prevalence of depression is 7% in women (Suvisaari et al. 2012). In an international systematic review of 28 articles the prevalence of depression during pregnancy varied from 6.5% to 12.9% (Gavin et al. 2005). It is important to listen and support those mothers that suffer from depression during pregnancy. Recent research shows that the benefits from depression medications are greater than the possible harms to the fetus. Also other serious psychiatric diseases of the mother may lead to situation where the health of the mother and the fetus are jeopardized. Therefore, it is important that the pregnancy is planned and best possible balance of the psychiatric disease is achieved before conception. (Klemetti & Hakulinen-Viitanen, 2013)

Most importantly all fertile women with one or more chronic diseases should be informed on the changes that the possible pregnancy causes for their disease and vice versa. Although not all chronic diseases increase the risk of adverse pregnancy and birth outcomes, they may effect on the condition of the mother if medication needs to be ceased. Pre-pregnancy counseling and careful follow-up of the pregnancy should be priority.

2.1.5 Complications in previous pregnancies affecting present pregnancy and birth outcomes

Some complications, such as intrauterine fetal death, preterm delivery, preeclampsia, and GDM that have occurred in the past pregnancies are more likely to occur again in the following pregnancies. During the following pregnancies these issues are important to discuss with the family and pregnancy follow-ups need to be well planned and offered in timely manner. (Klemetti & Hakulinen-Viitanen, 2013)

Preeclampsia is a condition characterized by high blood pressure and protein in the urine. It is a severe condition and as its worst threatens the lives of both the mother and the fetus. It is one of the most common pregnancy complications worldwide and by current knowledge the only treatment for it is to deliver the baby and the placenta. (Vaillancourt & Lafond, 2012) Preeclampsia may progress to eclampsia, which is a life threatening condition accompanied with seizures (Ekholm & Laivuori, 2011). In a large prospective cohort study (n=2,637) the risk factors for developing a preeclampsia in pregnancy were evaluated. Out of the study sample, 237 (9%) woman developed preeclampsia. Risk factors for developing preeclampsia were chronic hypertension, pre-pregnancy diabetes mellitus, multiple gestation, African American race, prior preeclampsia, nulliparity, assisted reproductive techniques, or overweight/obesity. The findings were similar to severe preeclampsia. Overweight and obesity were the greatest risk factors for both preeclampsia and severe preeclampsia. (Paré et al. 2014) In another study of 822 women with chronic hypertension in pregnancy the occurrence of preeclampsia was increased if the woman's body mass index was elevated, she was of black ethnic origin, smoked, had history of previous preeclampsia or eclampsia, had chronic renal disease, or had pre-conception blood pressure of 130-139/80-89 mmHg or greater. (Chappell et al. 2008) Although preeclampsia is a severe condition, it is also a condition that can be detected if the blood pressure of the mother elevates and protein appears in the urine. If the blood pressure is measured and the urine is tested at every prenatal visit both of these can be detected and appropriate interventions can be applied.

There is a risk for developing Rh sensitization in pregnancies where the mother is Rh-negative and the developing fetus carries Rh-positive protein on the surface of his red blood cells. If some of the fetus's blood leaks to the mother's blood stream either during the pregnancy or childbirth, the mother may start to produce antibodies against the Rh-positive blood of the fetus. The produced antibodies can cross the placenta and start attack the Rh-positive red blood cells of the fetus. In the first pregnancy the fetus usually stays healthy since the production of the antibodies is quite slow and mild but is poses next pregnancies to a higher risk for complications if not treated properly. In next pregnancies the sensitization may lead to severe anemia of the fetus and if not detected and treated can cause severe hemolytic disease and even death of the fetus. A vaccination called anti-D-immunoglobulin is given to the mother if sensitization is noted. This vaccination prevents severe complications in most of the pregnancies. (Sainio & Kuosmanen, 2014)

2.1.6 Complications of the fetus

Preterm birth is causing complications that are affecting the health of babies and children worldwide. It has been estimated that globally 15 million babies a year are born prematurely. (WHO Preterm Birth, 2016) The complications are the greater the more preterm the baby is delivered. In extremely preterm births single days may increase the survival and decrease the number of complications. (Saarikoski, 2011) WHO's classification of the prematurity is presented in Table 2.1. Some risk factors increasing the risk for PTB are previous preterm birth or small for gestational age baby, previous intrauterine fetal death, chronic disease of the mother, multiple pregnancy, placenta previa, hypertension or preeclampsia, infection of the mother, late initiation to prenatal care, smoking, single life, and age younger than 18 years or older than 35 years. The most common complications associated with prematurity are immaturity of the respiratory system, greater susceptibility for infections, and immaturity related to temperature regulation, circulation and metabolism. (Saarikoski, 2011) Most of the prematurely born babies in countries with high quality hospital system can be saved with long and intensive hospital care. However, in countries with poor health care system and lack of high quality hospital care premature birth accounts for majority of the perinatal mortality.

Perinatal mortality is defined as stillbirths and deaths that occur prior to 7 days after birth (Ahonen et al. 2012).

Table 2.1 WHO's classification of prematurity

Prematurity status	**Weeks of gestation**
Extremely preterm	< 28
Very preterm	28 to < 32
Moderate to late preterm	32 to < 37

Reference: WHO Preterm Birth, 2016.

Fetal death refers to the death of the fetus while still in the uterus. Intrauterine fetal death occurs after 22 weeks of gestation and is confirmed by an ultrasound scan to detect the absence of the fetal heart rate. Usually the mother seeks maternity care services after noticing the absence or decrease in the fetal movements. Risk factors for intrauterine fetal death are previous intrauterine fetal death, DM, advantaged age of the mother, overweight, and Afro-American ethnic background. However, these risk factors explain only a small proportion of the intrauterine fetal death cases. (Tiitinen, 2015b)

2.1.7 Procedures and complications during pregnancy and labor

Sometimes medical procedures are indicated during pregnancy and labor if the condition of the mother or the fetus requires them. Procedures may be justified to save the life of the mother and the fetus or to prevent further complications. However, in today's maternity care some procedures have become as a part of the daily practice and may be performed as a routine base without underlying medical indication. In these cases the occurrence of normal pregnancy and labor may be disrupted and adding one procedure may require further procedures and possibly do more harm for the mother or for the fetus than was first indicated.

Induction of labor refers to artificially initiated labor in a case where spontaneous labor has not started naturally and there is an indication for the baby to be born (e.g. post-term pregnancy or preeclampsia). It is recommended that induction of labor is justified only when there is a medical indication for it and the expected benefits are greater than the potential harms. The woman needs to be fully informed of the procedure and the decision should be made with one accord (Nuutila, 2006; Vogel, Gülmezoglu, Hofmeyr & Temmerman, 2014; WHO Induction of labor, 2017). Additionally, comprehensive emergency obstetric care should be available, and the condition of the mother and the fetus should be monitored (Vogel et al. 2014). Induction can be caused by artificial rupture of membranes (amniotomy), or administering intravenous hormonal agents, or combining these two. The rates for induced labors have been rising during the past decades in the Western Countries. (Nuutila, 2006; WHO Induction of labor, 2017) A retrospective cohort study conducted in the General Hospital of Vienna in 2003-2008 evaluated the maternal outcomes between induced labors and spontaneous labors at 38-42 weeks of gestation. The main finding suggested an increased risk for secondary CS (15.2% vs 8.6%, $p < 0.001$) in women undergoing an induction. (Kiesewetter & Lehner, 2012) In another study conducted in the University Hospital of Vienna (2002-2004) comparing the neonatal, maternal, and delivery outcomes between induced and spontaneous labors in prolonged pregnancies (41+ weeks) similar findings in CS rates were witnessed ($p < 0.0001$). In addition, the results showed that women undergoing the induction had increased risk for vacuum extraction (a vacuum device inserted on the presenting part of the fetus to assist during the second stage of labor) ($p < 0.0001$), amniotomy ($p < 0.02$), administration of oxytocin during labor ($p < 0.006$), and need for epidural anesthesia ($p < 0.001$). (Bodner-Adler et al. 2005) In a Finnish review, the indications, methods, and possible complications related to induction of labor were introduced with their prevalence in Finland. In Finland, the most common indications for labor induction are post term pregnancy, and breaking of the amniotic fluid without constructions within 24 hours. The major risks related to labor inductions are failure in induction, prolonged labor, and increased risk for CS. In 2012-2013 in the Helsinki University Central Hospital the percentage of CS in nulliparous women undergoing an induction was 37% compared to 10% in nulliparous women with spontaneous onset of labor. However, an induction with medical indication may save from adverse birth outcomes, such stillbirth, infection of the mother or fetus, and macrosomia of the fetus. (Kruit, Nuutila & Rahkonen, 2016)

Augmentation is used to stimulate the contractions of the uterus if spontaneous labor is not progressing (WHO Augmentation of labor, 2014). Two standard interventions are typically used for augmentation: amniotomy and/or intravenous oxytocin (Lothian, 2014). A Cochrane review of 15 studies assessed the use of amniotomy as an intervention for shortening labor time. Women having an amniotomy were compared to women without amniotomy. No significance difference was found in the length of the first stage of labor between the two groups. (Smyth, Markham & Dowswell, 2013) Another Cochrane review assessed the use of oxytocin to progress prolonged labor at the first stage. A total of eight studies were included in the review involving 1,338 low-risk women at the first stage of spontaneous labor. The administration of oxytocin reduced the delivery time by two hours compared to women not receiving oxytocin or receiving it delayed. However, no reduction in CS rates was detected, suggesting that oxytocin treatment should not be used as an intervention to prevent CS in prolonged labor. (Bugg, Siddiqui & Thornton, 2011) A study comparing laboring in water and standard augmentation of labor suggested that laboring in water could be used as an alternative in slowly progressing labor decreasing the incidence of obstetric intervention such as augmentation (Cluett et al. 2004). Non-medical methods during labor should be offered to the laboring women since these methods appear to be safe to the mother and the baby (Jones et al. 2012).

Vaginal tears are common and may occur spontaneously during childbirth. To prevent tears it is optimal that the baby descents slowly giving time to the vaginal opening to dilate and the vaginal tissues to stretch steadily. (Carroli & Mignini, 2009) Sometimes the health care practitioner performs an episiotomy, an incision of the perineum to enlarge the vaginal orifice, to ease the birth of the baby and prevent potential perineal tear (Carroli & Mignini, 2009; Robinson, 2015). The optimal outcome of vaginal delivery is intact perineum, however, episiotomy may prevent severe perineal tear and potential anal sphincter involvement (Robinson, 2015). In a large systematic review of 26 studies the maternal outcomes of routine versus restrictive use of episiotomy was evaluated. The findings from the review supported that episiotomy should only be performed if there is a medical indication for it and never routinely. As a conclusion a routine episiotomy was claimed to do more harm since some proportion of the women would have passed the unnecessary surgical incision. (Hartmann et al. 2005) A systematic review of eight studies assessed the effects of restrictive use of episiotomy and routine episiotomy during vaginal birth. The study population included over 5000 women. The results showed similar findings as the review by Hartmann et al (2005). Policies of restrictive episiotomies show more benefits compared to routine intervention of episiotomy. These benefits include less suturing and fewer complications, less posterior perineal trauma, and no difference in experiencing pain and severe vaginal or perineal trauma (Carroli & Mignini, 2009)

Unfortunately, routine episiotomies are performed in the daily practice of obstetric care. In 2010 the rates for episiotomy among women with vaginal delivery varied between 5% and 70% in Europe (European perinatal health report, 2010). The objective of a Finnish cross-sectional survey was to describe and explain the short-term effects of lateral episiotomy, and determine the factors associated with the use of episiotomy. The survey was concluded in 2006 using a postal questionnaire sent to 1,000 midwives or student midwives in three large hospitals located in different parts of the country. The response rate was 88%. Episiotomies were more commonly performed to primiparous women than to multiparous women. Predictors for episiotomy in primiparous women were induction of labor, vacuum assistance, prolonged active second stage of labor, and coached pushing. For multiparous the risk for episiotomy was increased if the pushing was coached and if they received epidural analgesia. Episiotomies were less frequent in all women if births were spontaneous, a bath or shower was used to relief the pain during the first stage of labor, sitting position was used at the first stage or labor, and the women were pushing spontaneously. In primiparous women up-right (squatting, kneeling, and sitting) and lateral positions were associated with fewer episiotomies. Logistic regression showed a strong association between vacuum assistance and episiotomy. In addition, third degree perineal tears were more common if an episiotomy was performed. In conclusion, the study suggests that standardizing recommendations on policies for episiotomy is urgently needed. (Räisänen, Vehviläinen-Julkunen & Heinonen, 2010.)

Since 1985 the WHO has stated that the ideal rate for CS is 10-15% (WHO Statement on Caesarean Section Rates, 2015). The newest evidence suggests that a CS rate across a population close to 10% provides the smallest maternal and neonatal mortality rates. When the CS rate increases above 10% no evidence suggests improvements in maternal or neonatal survival. (WHO Caesarean sections, 2015.) In WHO's report (2010) of CS rates in 137 countries, 54 countries showed underuse of CS (<10%), 69 showed overuse of CS (>15%), and the rest 14 countries showed optimal use of CS (10-15%) (Gibbons et al. 2010). Although Cesarean section is relatively safe to perform, it poses the mother for increased risk for infections and hemorrhage compared to vaginal delivery (Uotila & Tuimala, 2011b). In recent years there has been a lot of debate whether a primary CS is as safe as vaginal delivery in low-risk pregnancies (Ben-Meir, Schenker & Ezra, 2005; Grisaru & Samueloff, 2004). The current trend of women in Western countries requesting a CS with no medical indication sets the physicians on difficult situation balancing between the autonomy of the patients and ethical principles of beneficence and nonmalficence (Grisaru & Samueloff, 2004). However, in many studies vaginal delivery have been showed to be the safer option for delivery compared to CS (Farchi et al. 2010; Liu et al. 2007; Pallasmaa, 2014; Pallasmaa et al. 2015) and it should be explained to the women requesting a CS without a medical indication.

Other complications in labor are excessive maternal hemorrhage (more than 500 ml), and prolonged (over 30 minutes) delivery of the placenta. Bleeding more than 500 ml during labor and in 24 hours postpartum is considered abnormal. If bleeding continues the cause for it needs to be examined. Common causes for bleeding are damage of the birth canal, or retention of the placenta or the amniotic membranes. To ease the bleeding massage of the uterus or oxytocin infusion may be beneficial, however, sometimes surgical removal of the placenta or membranes is indicated. Placental retention of more than 30 minutes is considered prolonged since the uterine orifice starts to contract and therefore complicates the delivery of the placenta. At 30 minutes after birth, if the placenta has not delivered spontaneously, manual extraction is indicated. Oxytocin may be given to the mother to fasten the delivery of the placenta. (Uotila & Tuimala, 2011a)

Placental complications occur sometimes during pregnancy and labor. Some complications may be detected already during pregnancy from the ultrasound scan such as placenta previa but some may occur during pregnancy or labor, including placental abruption or cord prolapse. Placenta previa is a complication where the placenta covers the internal cervical orifice either partially or entirely. Typical symptom is hemorrhage that may start as early as at 28 weeks of gestation being usually more modest than in placental abruption. If the hemorrhage is excessive the fetus may be delivered prematurely otherwise the mother is treated with blood transfusion and the delivery is delayed until 36 weeks of gestation is achieved. Excessive hemorrhage may threaten the life of the mother and the fetus. Usually the baby is delivered by CS to control the hemorrhage. (Heinonen, 2011; Neilson, 2003a.) Risk factors for placenta previa are age over 30 years, multiparous, and previous operation of the uterus, including CS (Heinonen, 2011).

In placental abruption the placenta separates prematurely from the uterine wall. This can lead to severe hemorrhage that can threaten the life of the fetus. (Heinonen, 2011; Neilson, 2003b) Fortunately, in countries with well-functioning hospital system most of the placental abruptions can be detected early enough to treat the condition. However, in developing countries placental abruption remains one of the leading causes of maternal and perinatal death (Neilson, 2003b). Risk factors associated with placental abruption are diabetes mellitus (Heinonen, 2011), smoking, preeclampsia, trauma on the abdomen (Heinonen, 2011; Neilson, 2003b), advantaged maternal age, and twin pregnancy (Neilson, 2003b). Cord prolapse is a situation where the umbilical cord is the presented part in the labor and the cord slips out first. If the cord stays compressed it affects the circulation of the fetus and as its worst threatens the life of the fetus. (Uotila & Tuimala, 2011a) Vaginal delivery may be possible with cord prolapse if it is detected soon enough and the health care provider can release the compressed cord. However, sometimes emergency CS is required. Cord prolapse may be detected only if the health care provider regularly checks the progress of the labor.

2.1.8 Pain management during labor and delivery

Perception of pain is individual. Labor pain can be described as transient, meaning it appears in the beginning of labor, and is usually self-limited and lasts until the placenta is delivered (Long, 2009). A qualitative study using a phenomenological approach was carried out in Sweden to gain understanding on the women's perception of pain during labor. Nine women, four primiparous and five multiparous, who had experienced a normal delivery and did not receive medical pain relief were interviewed for the study. One of the main findings was that the pain in labor is hard to describe and is contradictory by its nature. The women described that the pain is the worst pain they had ever experienced but at the same time it was described to be positive and empowering. (Lundgren & Dahlberg, 1998)

A Cochrane review of systematic reviews of randomized controlled trials of labor pain and its management was conducted in 2012. This review included 15 Cochrane reviews (255 randomized controlled trials) and 3 non-Cochrane reviews (55 randomized controlled trials). Interventions to manage the labor pain were categorized in three groups: "What works", "What may work", and "Insufficient evidence to make a judgment". Epidural, combined spinal epidural, and inhaled analgesia were supported by the evidence to be effective in pain management but were also associated with adverse effects. Women receiving epidural analgesia experienced more often instrumental vaginal births and CS for fetal distress (overall CS rate was equal) compared to women receiving placebo or opioids. Epidural analgesia was also associated with hypotension and fever. Common adverse effects associated with inhaled analgesia were nausea and dizziness. Most of the non-pharmacological methods to relieve labor pain appeared to be safe to the mother and the baby. However, more evidence to support their effectiveness is needed. (Jones et al. 2012) The authors reported that the quality of the trials varied and especially evidence to support the effectiveness of non-pharmacological methods to relieve labor pain was insufficient and low quality. High quality trials are needed. More high quality evidence of pharmacological interventions such as epidural analgesia is available to support their effectiveness. However, the adverse effects are also well known. Non-pharmacological interventions seem to be safe to use and women should be encouraged to try them.

2.1.9 Maternal characteristics and health habits affecting pregnancy and birth outcomes

The health status of the woman prior to conception may predict the pregnancy and birth outcome. While health habits (nutrition, smoking, drinking, physical activity) and characteristics (weight) may be influenced by guidance and counseling, some characteristics such as age and marital status are beyond the reach of health counseling. Additionally, medication use during pregnancy affects the pregnancy and labor outcomes, thus some medications may need to be ceased while pregnant.

Marital status

The marital status of the mother has been associated with some adverse outcomes in pregnancy. A systematic review and meta-analysis of 21 studies was conducted to determine the association between mother's marital status and adverse perinatal outcomes, including low birth weight (LBW), PTB, and small for gestational age offspring. Both unadjusted and adjusted odds ratios of LBW, PTB, and small for gestational age offspring were increased among unmarried (cohabiting, and single women) compared to married women. Some limitations of this systematic review were discussed related to the studies used for the analysis. The limitation included maternal self-reporting of the marital status, socio-demographic differences between married and unmarried women, the lengths of the relationship were unreported in all of the studies, perceptions in different demographic locations may differ, and the status of the cohabiting partner (father of the child or not) was reported only in some of the studies. (Shah, Zao, Ali et al. 2011) A study conducted in Texas evaluated the contribution of marital and cohabitation status to racial, ethnic, and nativity differentials in birth outcomes. The study included 369,839 births to Texas women aged 18 and older. The birth outcomes included were LBW and PTB. As indicated the highest prevalence of LBW newborn and PTB was in single mothers without fathers listed in the birth certificate. Lowest prevalence of these adverse outcomes was experienced among married women. Cohabiting women had significantly higher risk for LBW and PTB compared to married women but in addition significantly lower risk for the same adverse outcomes compared to single women. In this study the ethnic, racial, and native background was also investigated and analyzed together with the marital status of the mother. The findings of this analysis suggest that marital status is a weak predictor in accounting for the disparities in birth outcomes across the ethnic, racial, and native groups. (Sullivan, Raley, Hummer & Schiefelbein, 2011)

Age

The age of the mother is one of the most important single factor affecting the process of pregnancy and labor, and the birth outcome of the newborn. Both teenage and over 35 years old parturients have greater risk for certain complications compared to parturients in between. It has been evaluated that around 90% of teenage pregnancies are unplanned and reproductive health education is instrumental to prevent unplanned pregnancies. (Klemetti & Hakulinen-Viitanen, 2013) A retrospective cohort study of 3,886,364 nulliparous pregnant women under 25 years of age with singleton pregnancy was carried out in the United States in 1995-2000. The purpose of the study was to evaluate pregnancy and birth outcomes in teenagers. Compared to the women aged 20-24 the teenage pregnancies were at higher risk for PTB, LBW, small for gestational age and neonatal mortality. The incidence of these adverse outcomes increased as the age of the mother decreased and was highest in the age group of 10-15 years. (Chen et al. 2007) In contrary, a Finnish study showed that poor pregnancy outcomes of teenage mothers could be overcome by timely, high quality maternity care (Raatikainen, Heiskanen, Verkasalo & Heinonen, 2006).

Common problems and complications related to the high age (35-39 years) of the mother are pre-existing chronic diseases, gestational diabetes and hypertension, higher incidence of labor induction and Cesarean section, increased risk for LBW and PTB, and excess need for neonatal intensive care. When the maternal age reaches 40 years and more the risks include increased risk for preeclampsia and higher perinatal mortality. (Klemetti & Hakulinen-Viitanen, 2013) In 1996 in a retrospective cohort study singleton pregnant women age of 40 years or over (n=1,404) and controls pregnant women age of 20-29 (n=6978) were compared and risk factors for different pregnancy and birth outcomes were evaluated. Further on the women were divided in groups based on parity (nulliparous and multiparous). The results showed increased risk for adverse pregnancy outcomes in the age group of 40+ compared to the controls. GDM, preeclampsia, and occurrence of placenta previa were more common in the older women regardless of parity. In multiparous older women antepartum vaginal bleeding was more common than in the younger women. Intrapartum complications, such as induction of labor, CS, and operational vaginal delivery were also more common among the older women. Among multiparous older women the risk for fetal distress and incidence of vaginal postpartum bleeding were higher compared to controls. (Bianco et al. 1996)

A recent Finnish study investigated the threshold-ages for different adverse maternal and neonatal outcomes using the Finnish Medical Birth Register. The study sample consisted of all nulliparous women over 20 years of age with singleton pregnancy between 2005 and 2014 (n= 228,348). Typically the cut-off age for high-risk pregnancy have been set at 35 or 40 years. However, in the Finnish study most adverse events occurred earlier. The risk for CS and for GDM increased from 25 years of age, the risk for placenta previa increased from 27 years of age, and the risk for PTB increased from 28 years of age. Additionally, age over 33 years increased the risk for gestational hypertension; age over 36 years increased the risk for perinatal mortality, and age over 38 years increased the risk for preeclampsia. (Klemetti, Gissler, Sainio & Hemminki, 2016) The findings support that in research the threshold-age for pregnancy and labor complications should been set based on the complications under interest.

Weight

During the past decades maternal obesity has been an increasing public health issue especially in the Western Countries, however, developing countries are facing the same phenomenon as obesity among women is rising worldwide (Nelson, Matthews & Poston, 2010). Body mass index (BMI) is commonly used as the measurement for the weight status of an individual. It is calculated by dividing weight in kilograms by the square of the height in meters (kg/m^2). (WHO BMI classification, 2017). The classification of different weight statuses of an individual and their corresponding BMI values are presented in Table 2.2. In the US a 70% increase in maternal obesity has been reported in the past decade (Kim, Dietz, England, Morrow & Callaghan, 2007). Maternal obesity is one of the major determinant of pregnancy outcome (Nelson et al. 2010). Both overweight and obesity increase the risk for several complications throughout the pregnancy and labor, and also increases risk for adverse outcomes in the neonate. Maternal overweight and obesity increase the risk for miscarriage, GDM, gestational hypertension, preeclampsia, preterm and prolonged labor, and CS (Klemetti & Hakulinen-Viitanen, 2013; Kriebs, 2009). In addition, shoulder dystocia and macrosomia of the fetus are more frequent than in mothers with normal weight. Association between maternal obesity and increased rates of stillbirth, birth defects, and neonatal death has been reported. (Kriebs, 2009)

Table 2.2 WHO's BMI classification

Weight status	**BMI** (kg/m^2)
Underweight	< 18.50
Normal weight	= 18.50-24.99
Overweight	= 25.00-29.99
Obese	> 30.00

Reference: WHO BMI classification, 2017.

Nelson, Matthews and Poston (2010) conducted a review of nine studies to evaluate several factors related to maternal obesity and gestational weight gain, and their impact on pregnancy outcomes. Some major complications increased by maternal obesity were, miscarriage and recurrent miscarriage, GDM, preeclampsia, stillbirth, labor induction, failure to progress in labor, CS (elective and emergency), and maternal infection. (Nelson et al. 2010) In a large retrospective study of 436,414 singleton births in California the association between increasing pre-pregnancy BMI and adverse pregnancy outcomes were evaluated. The results showed that increasing maternal BMI was associated with increased risk for adverse pregnancy outcomes such as developing GDM, gestational hypertension and preeclampsia, as well as undergoing a CS. (Chung et al., 2012) Overweight and obesity have also been associated with increased risk for multiple anomalies and birth defects in the neonate (Nelson et al. 2010; Watkins, Rasmussen, Honein, Botto & Moore, 2003). Similarly, in a Finnish register-based study (n= 199,485) in 2006-2010 the results supported the association of increasing maternal pre-pregnancy BMI, and increased risk of GDM, preeclampsia, and gestational hypertension in primiparous women with singleton pregnancy. Additionally, the results suggested that even normal weight increases the risk for the proposed outcomes compared to underweight women. Therefore, efforts to identify those normal weight women should be implemented in the public health programs. (Metsälä, Stach-Lempinen, Gissler, Eriksson & Koivusalo, 2016)

Pre-pregnancy underweight of the mother and low weight gain during pregnancy have been associated with LBW infants (Catov et al. 2008). In a retrospective cohort study in Northern Germany similar findings were reported supporting the association between pre-pregnancy underweight and neonatal adverse outcomes. In underweight nulliparous women (n=243, BMI $\leq$ 18.5 kg/m^2) the risk for PTB and neonatal LBW were significantly higher than in normal weight nulliparous women (n=3611, BMI 18.5-24.9 kg/m^2). (Hoellen et al., 2014) Another study also suggested the association of maternal pre-pregnancy underweight and fetal growth restriction (Doherty, Magann, Francis, Morrison & Newnham, 2006). Additionally, maternal pre-pregnancy underweight has been associated with increased risk for preterm delivery (Hauger, Gibbons, Vik & Belizán, 2008).

A well working and high quality maternity care can influence positively on the outcomes of pregnancy and labor by paying special attention to those mothers with pre-pregnancy BMI below 18.5 kg/m^2 and over 30 kg/m^2. Quality and timely counselling on healthy nutritious diet and adequate exercise in pregnancy are instrumental in these groups to gain more optimal pregnancy and labor outcomes. Further assistance of dietitian may be needed, especially if any eating disorders are detected or if the BMI is over 35 kg/m^2. (Klemetti & Hakulinen-Viitanen, 2013)

Smoking

Complications in pregnancy may be triggered by the behavior of the mother. Smoking is one of the preventable risk factors in pregnancy that can be decreased by early intervention and support for the mother (Chamberlain et al. 2013). Smoking is a risk factor for several pregnancy complications, including placental abruption and placenta previa (Cnattingius, 2004; Salihu & Wilson, 2007), intrauterine growth restriction (Cnattingius, 2004; Erickson & Arbour, 2012; Salihu & Wilson, 2007), PTB and LBW (Cnattingius, 2004; Erickson & Arbour, 2012; Ekblad, Gissler, Korkeila & Lehtonen, 2015), and increased risk for perinatal and neonatal mortality (Cnattingius, 2004; Salihu & Wilson, 2007). A longitudinal Birth Cohort study by Catov et al. (2008) associated smoking as a risk factor for both preterm and term small for gestational age newborn (Catov et al. 2008). A study of 907 pregnant women in Dublin assessed smoking behavior during pregnancy and adverse perinatal outcomes in three groups of women, non-smokers, ex-smokers (ceased smoking before third trimester), and smokers. The main findings suggested a strong association between smoking and reduction in birth weight and increased incidence of intrauterine growth restriction. The group of ex-smokers had similar perinatal outcomes compared to non-smokers supporting the advantage of smoking cessation even during the pregnancy. (Murphy, Dunney, Mullally, Adnan & Deane, 2013b) Results from several studies have suggested that smoking cessation even during pregnancy improves the pregnancy and birth outcomes (Cnattingius, 2004; Ekblad et al. 2015; Salihu & Wilson, 2007; Seybold, Broce, Siegel, Findley & Calhoun, 2012). Although the rate of smoking has decreased in many countries smoking still remains as an important public health issue due to its impact on many aspects in health and wellbeing. Disparities remain in tobacco use by ethnicity, educational level, socioeconomic status, and region. (Helakorpi, Raisamo, Holstila & Heloma, 2012; Helldán & Helakorpi, 2015; USDHHS, 2014; WHO Tobacco smoking, 2015)

Interpregnancy interval

There is a lack of recommendations on the interval between index pregnancy and previous viable birth in Finland. International evidence supports an interpregnancy interval of 18 to 59 months. In a systematic review of 67 articles, the association between the interval in birth spacing and perinatal adverse outcomes was studied. The findings supported a significant association between both short (< 17months) and long (> 59months) intervals, and PTB, LBW, and small for gestational age offspring. The reasons for these associations remain unclear. Different researchers have offered some explanations but the underlying causes have remained unsolved by high quality research. (Conde-Agudelo, Rosas-Bermúdez & Kafury-Goeta, 2006) In a recent Finnish study, the length of the interpregnancy interval after termination of pregnancy and the association to adverse pregnancy outcomes including, PTB, LBW, and small-for-gestational-age newborns was assessed. This register-based study involved all terminated pregnancies in Finland between 2000 and 2009 with following pregnancy resulting on a viable, singleton delivery (n=19,894). Five groups were formulated based on the interpregnancy interval (less than 6 moths, 6 to less than 12 months, 12 to less than 18 months, 18 to less than 24 months, and 24 months and more). The group of interpregnancy interval of 18 to less than 24 months was used as the reference group. The risk for PTB was increased in the group of interpregnancy interval less than 6 months compared with the reference group. Statistically significant difference were not found between other groups. (Männistö et al. 2017) The finding from the Finnish study supports that after termination of pregnancy a short interpregnancy interval increases the risk for PTB. However, more research is needed on the topic before national recommendations can be given.

Medicine use

A high quality Finnish research evaluated the pattern of medicine use during pregnancy and the association of medication use and adverse pregnancy and labor outcomes, including perinatal death and congenital anomalies. The data for the study was based on three health registers: the Medical Birth Register, Register on Induced Abortions, and Malformation Register, maintained by the National Institute for Health and Welfare (THL), and on two registers: the Register on Reimbursed Drug Purchases, and the Register on Medical Special Reimbursements, maintained by Social Insurance Institution of Finland. All births and induced abortions in Finland between 1996 and 2010 (n = 1 018 227) were included in the study. The results of the study suggested that medicine use increased several perinatal health risks. In those with medicine use, the risk for PTB was 20 percent greater, the risk for LGA baby was 27 percent greater, and the risk for SGA was 13 percent greater compared to those without medicine use. An association between medication use and increased perinatal death was not observed. Congenital malformations were slightly more common in women that had medicine purchases during the first trimester of pregnancy and/or one month before conception compared to those who had not. By this association with increased risk for congenital malformation the research confirmed the already known connection. While interpreting the results from this study it is important to understand that the study population included also women with chronic diseases and they were using medicine as a treatment. Therefore, also the underlying chronic disease has an impact on the adverse perinatal outcomes. (Lahesmaa-Korpinen et al., 2014)

2.2 Maternity care in Finland

2.2.1 Maternity care

In Finland, the responsible authority for the guidance and development of maternity health care and services is the Ministry of Social Affairs and Health. Together with THL the Ministry of Social Affairs and Health provides recommendations and guidelines for executing the maternity clinic services. Municipalities are responsible for the practical execution of these services. (Ministry of Social Affairs and Health, 2017)

According to the Health Care Act 1326/2010 section 15 every municipality in Finland is required to organize free-of-charge maternity and child health clinic services to its residents. The maternity clinic services include regular check-ups to ensure the healthy growth, development, and wellbeing of the fetus or fetuses, and monitoring the health of expectant women and new mothers according to individual needs. (Health Care Act 1326/2010) The prenatal care in Finland is organized by maternity clinics that are situated in the municipalities more precisely in the neighborhoods. The main responsibilities of the maternity clinics are to follow-up the pregnancy, contribute to health education, and prepare the parents for the upcoming labor and parenthood. In addition to these, one major responsibility is to detect any risks or complications during the pregnancy and instruct the woman to seek further help if indicated. It has been reported that annually only 0.2-0.3% of the parturients in Finland do not seek maternity clinic services. (Klemetti & Hakulinen-Viitanen, 2013; Tiitinen, 2014c; Uotila & Raudaskoski, 2014)

THL provides for the recommendations for the minimum number of visits in a maternity clinic. The actual number, however, varies between the municipalities and depends on the need of the woman. Currently there is a change in the ideology of providing prenatal care in Finland. In the newest guidelines for organizing maternity health care services, the recommendation is to provide a minimum of nine visits for nulliparous women and eight visits for multiparous women. Thereafter, the additional prenatal visits are based on the needs of the woman and the family. Additionally, two visits are offered after delivery. After prenatal care, the family will be followed-up in the child health clinic until the child starts the first grade in the elementary school. (Klemetti & Hakulinen-Viitanen, 2013)

The new recommendation is based on the evidence from a Cochrane review of seven trials that showed that decreasing visits in low-risk pregnancies in high-income countries does not impact negatively on pregnancy and birth outcomes. However, the satisfaction of the women receiving less visits was lower compared to women receiving the traditional number of visits. (Dowswell et al., 2010) The definition of low risk pregnancy is based on the medical and social background of the woman and the information of previous pregnancies (Klemetti & Hakulinen-Viitanen, 2013; Uotila & Raudaskoski, 2014). The new ideology enables more visits for those in need without wasting the scarce resources of the social security and health care systems. In 2015 the mean number of visits to maternity care was 14.2, including visits to maternity clinic, private physician's office, hospital policlinic, and prenatal screening (Vuori & Gissler, 2016).

In addition to the minimum number of visits, there is a recommendation on the initiation of the prenatal care. The recommendation is to plan the first visit between 8-10 weeks of gestation. To be eligible for a maternity grant from The Social Insurance Institution of Finland, the first visit should occur by the end of 16 weeks of gestation. (Klemetti & Hakulinen-Viitanen, 2013) The grant is either a maternity package of baby clothing and accessories, or a cash benefit of €140 (Maternity grant, 2016).

A routine check-up in the maternity clinic includes weight gain control, blood pressure monitoring, non-invasive assessment of the uterus, and fetal heart rate monitoring. In addition, bloodwork (hemoglobin) and urine sample (protein and glucose detection) is checked on a regular basis. On these regular visits at the maternity clinical the health care worker also evaluates the situation of the family and preparedness of the parents for the coming life changes and parenthood. Guidance on the healthy life choices and healthy pregnancy are given to the parents, including information on healthy diet, prenatal vitamins and exercising during pregnancy, avoiding tobacco and alcohol consumption, and evaluating the support networks of the family. One of the routine check-ups is recommended to organize as a home visit for nulliparous women. In addition, there is usually one home visit after the labor for both nulliparous and multiparous women. In addition, between weeks 24+0 and 28+6 an oral-glucose tolerance test is conducted to all pregnant women to detect GDM. Women under the age of 25 years and with no additional risk factors for gestational diabetes are excluded from the oral glucose tolerance test. (Klemetti & Hakulinen-Viitanen, 2013; Tiitinen, 2014c) Rh sensitization is measured from all the mothers during the first trimester of pregnancy. Additionally, blood work is done to Rh-negative mothers once in the second and third trimester. In the most recent Finnish maternity care guidelines the recommendation is to give the anti-D-immunoglobulin to all Rh-negative women once during pregnancy at 28-30+6 weeks of gestation if antibodies are detected and within 72 hours after delivery to all Rh-negative mothers if the blood type of the newborn is Rh-positive. In addition to this, the anti-D-immunoglobulin should be administered in all procedures during pregnancy where there is a risk of fetomaternal hemorrhage. (Klemetti & Hakulinen-Viitanen, 2013)

Additionally, prenatal screening is organized by the maternity clinics. There is couple of options the expectant parents may choose. Usually, the first option offered is to have blood screening at 9+0-11+6 weeks of gestations and an early pregnancy general ultrasound performed at 11+0-13+6 weeks of gestation. For the blood screening two markers **β** –hCG (Human Chorionic Gonadotropin beta) and PAPP-A (Pregnancy Associated Plasma Protein-A) are measured in the blood. The ultrasound is performed primarily to confirm that the fetus is alive, determine the accurate duration of the pregnancy and to examine the number of the fetuses. In addition, major structural abnormalities can be detected and a nuchal translucency scan can be performed. The nuchal translucency scan measures the amount of fluid behind the neck of the fetus. The results of the blood screening are combined with the nuchal translucency measurement to determine the risk for chromosomal abnormalities. In addition to this first trimester prenatal screening, a structural ultrasound is performed usually at 18-21 weeks of gestation. The purpose of this second trimester ultrasound is to examine the organs and structure of the fetus. (Klemetti & Hakulinen-Viitanen, 2013; Tiitinen, 2014c; Leipälä, Ignatius, Autti-Rämö & Mäkelä, 2009)

Majority of the labors in Finland occur in hospital (Sariola & Tikkanen, 2011b; Vuori & Gissler, 2016). The trend of current maternity care is to discharge the family from the hospital quickly after the birth and the mean duration of hospitalization has been three days or less since 2010 (Vuori & Gissler, 2016). However, some women may be discharged from the hospital as early as in 6-36 hours after the delivery (Klemetti & Hakulinen-Viitanen, 2013; Viisainen, 1999). There is a strict criterion for this early discharge and it should always be determined based on the condition of the mother and the newborn and the willingness of the mother. After early discharge the mother and the newborn are invited to come back to the hospital in 2-5 days for postpartum examination. (Klemetti & Hakulinen-Viitanen, 2013; Sariola & Tikkanen, 2011b; Viisainen, 1999)

2.2.2 Maternity care statistics

THL is the responsible authority for providing health related statistics of the Finnish population. The most recent perinatal statistics are from the year 2015. These include statistics of parturients, deliveries and newborns. There has been quite a change during the past decades in some areas the perinatal statistics are covering but meanwhile other areas has remained quite the same.

The number of births have been decreasing during the last five years (2010-2015). The number of births in 2015 was 3.5% lower than in 2014. In accordance, the mean age of the parturients continues to increase. In 2000, the mean age was below 30 years and in 2015 it was 30.6 years. Whereas in 1987 up to 80% of the parturients were married and 12% cohabiting, in 2015 around half of the parturients were married and one-third cohabiting. The percentage of smoking parturients has been around 15-16% during the last thirty years. Fortunately, the percentage of smokers that are quitting in early pregnancy has increased from 12% in 2000 to nearly 50% in 2015. (Vuori & Gissler, 2016)

In 2015 the mean BMI of the parturients measured before pregnancy was 24.6 kg/m², which is slightly below the boarder for overweight (BMI ≥ 25 kg/m²). There has been a slight increase in the mean BMI and in 2008 it was 24.2 kg/m². (Vuori & Gissler, 2016) What is concerning is that every third parturient is overweight and this trend of overweight and obesity has been increasing during the past two decades (Raatikainen, 2007; Vuori & Gissler, 2016). The increasing prevalence of overweight and obese parturients poses the pregnancy and developing fetus for a greater risk for several complications such as increased risk for GDM and pre-eclampsia as well as increased need for CS (Gissler & Sankilampi, 2015; Raatikainen, Härmä & Randell, 2010; Vuori & Gissler, 2016). Latest perinatal statistics of parturients and deliveries are shown in Table 2.3.

If these trends of increasing maternal age and increase in prevalence of overweight and obese parturients continue to rise, the Finnish maternity care system will face challenges of providing high quality counseling and care for all the expectant mothers. More resources may be needed to offer guidance on healthy life choices and to raise awareness on the risk factors associated with increased maternal age and overweight and obesity, and pregnancy and birth outcomes. In addition, attention should be paid on the ways to decrease the prevalence of smoking in pregnancy since it has remained the same during the last three decades.

Table 2.3 Perinatal statistics of parturients

Perinatal statistics of parturients and deliveries in 2015	
Parturients	
Number of parturients	55,007
Mean age in years	30.6
Mean age for primiparas (years)	28.8
Parturients 35 years and over	20.8%
Married	54.2%
Mean BMI	24.6 kg/m^2
Diagnose of gestational diabetes (ICD O24.4)	11.5%
Smoking in pregnancy	14.7%
Quit smoking in early pregnancy	48.8%
Total number of antenatal visits	14.2
Time of first antenatal visit (weeks of gestation)	9.7
Lenght of stay at the hospital after delivery (days)	2.8
Deliveries	
Number of births	55,759
Number of multiple births	744
Number of stillbirths	171
Deliveries in hospital	99.6%
Caesarean delivery	15.9%
Vacuum extraction	9.2%
Forceps	0.0%
Induced labor	24.8%
Amniotomy	44.2%
Oxytocin	46.2%
Episiotomy (excl. CS)	20.5%
Suturation of 3rd to 4th degree perineal laceration	1.2%
Epidural analgesia (excl. CS)	49.5%

Reference:
Vuori & Gissler, 2016.

In 2014 the mean duration of a pregnancy was 39+4 weeks (Vuori & Gissler, 2014). The mean weight of a newborn has been slightly below 3,500 grams since 2008. The percentage of newborns weighting 4,000 grams or more has declined during the past decades being around 16-17% during the past eight years compared to 19% in early 2000. The percentage of babies weighting less than 2,500 grams has been between 4.3-4.5% the past eight years. (Vuori & Gissler, 2016) Latest perinatal statistics of newborns are presented in Table 2.4.

Table 2.4 Perinatal statistics of newborns in 2014-2015

Perinatal statistics of newborns 2014-2015	
Mean gestational age [2]	39+4
Gestational age < 37 weeks [1]	5.9%
Mean weight at birth (gr) [1]	3,485
Weight < 2,500 gr [1]	4.4%
Weight ≥ 4,000 gr [1]	16.0%
Apgar score at 1 minute ≥ 7 [2]	94.1%
Apgar score at 5 minute ≥ 7 [2]	97.7%
Intensive care or observation unit [1]	11.4%
Congenital anomalies (yearly average 1993-2011) [3]	3.6%
Child at home at the age of one week [1]	94.0%
Perinatal mortality per 1,000 births[1] Stillbirths and deaths before 7 days	4.1

Reference:
[1] Vuori & Gissler, 2016.
[2] Vuori & Gissler, 2014.
[3] Ritvanen & Sirkiä, 2014.

Fortunately during the past decades adverse events associated with pregnancy and labor have dramatically decreased in Finland and in 2015 the perinatal mortality rate was only 4.1 per 1.000 births (Vuori & Gissler, 2016). Additionally, the maternal mortality rate in Finland is one of the lowest in the world, and in 2014 the maternal mortality ratio was 5.2 per 100.000 live births (Statistics Finland, causes of death, 2014).

In 2013, Finland was ranked first out of 176 countries in the Save the Children's Mother's Index Ranking meaning that Finland was the best country to be a mother in 2013. The ranking was based on Finland's excellent performance in all five dimensions of maternal and child health and wellbeing evaluated in the Index. The dimensions include maternal health, children's wellbeing, and maternal educational, economic and political status. (Surviving the First Day, 2013)

2.3 Understanding the concept of optimality

2.3.1 The development of the Optimality Index

The origin of the optimality principle dates back in the late 1960's when a group of infants was identified to have the best possible start for life. The basis for this optimality was to have a healthy mother with a pregnancy and labor without any problems or complications, and no interventions applied during the pregnancy and labor. Wiegers, Keirse, Berghs and van der Zee (1996a) defined optimality as:

> *"... a healthy woman without social, medical, or obstetrical problems giving birth, at the proper time without interventions or complications, to a healthy child."* (Wiegers, Keirse, Berghs and van der Zee, 1996a, p. 320)

The benefit and specialty of the optimality thinking is that it avoids the problem of defining normal and abnormal outcomes. Instead, it defines the most favorable and most optimal outcome for every possible occasion during pregnancy and labor. In addition to the benefit of defining optimal events, the optimality principle provides a new way of thinking since it can be adapted to assess the maternity care of low-risk women. (Wiegers et al. 1996a)

Wiegers et al. (1996a) implemented the optimality principle to measure the quality of midwifery care in low-risk pregnancies in the Netherlands. The aim was to develop a tool to measure maximum outcome with minimal intervention. The research group developed the optimality index by exploiting the list of items provided in the studies of Prechtl (1968 and 1980) and Touwen et al. (1980). Total of 67 items were included in the index and further divided in two separate indexes: Perinatal Background Index PBI (31 items) and Perinatal

Outcome Index (36 items). The PBI provided a comprehensive list of items to reflect the social, medical, and obstetric status of the woman until the onset of labor. For some items in the PBI the adverse effect on pregnancy outcomes have been proven in many studies but for other items the relation is more uncertain and intermediate. However, the expected relation is always negative or have no effect when an item is given the value as nonoptimal. The Perinatal Outcome Index gives an accurate description of the progression of labor until the baby is born. In addition, it combines the interventions and poor outcome measures reflecting the seriousness of the complications. As a conclusion, both of the indexes are potentially useful tools when assessing the quality of midwifery care in low risk pregnancies. (Wiegers et al., 1996a) To test the PBI and Perinatal Outcome Index, Wiegers, Keirse, van der Zee and Berghs (1996b) conducted a study of outcome of planned home and planned hospital births in low risk pregnancies in the Netherlands. Evaluating the outcomes separately for multiparous and primiparous women, the Index proved its usefulness on detecting the differences on the outcomes of hospital and home births. (Wiegers, Keirse, van der Zee and Berghs, 1996b)

2.3.2 Optimality Index-US

Traditionally the tools for measuring perinatal outcomes have focused on adverse events such as neonatal and maternal morbidity and mortality. Fortunately, these events are rare in today's maternity care in countries with high quality maternity care system and low-risk population. At the same time, completing a research to detect adverse events has become expensive due to the need for huge study populations. The development of the Optimality Index-US (OI-US) started from the need to have a tool to measure both the process and outcome of the midwifery care in a low-risk population in the United States. (Murphy & Fullerton, 2001) In addition, the measurement tool was required to reflect the current midwifery philosophy of minimal interference of the natural process of pregnancy and labor (Chalmers et al. 2001; Murphy & Fullerton, 2001). Assessing low-risk pregnancies can give new insights and evidence on current research and practices, and may lead to new evidence and guidelines in the maternity care setting.

The work to construct the OI-US started by adapting the measurement tool created by Wiegers et al. (1996a). All the items were evaluated and various sources of information were used to support both the inclusion of an item and the proposed criteria for optimality. The inclusion of an item was primarily based on randomized clinical trials or systematic reviews. However, if such information was unavailable, clinical consensus was cited as the evidence. A board of professionals in the field of perinatal and midwifery research and/or clinical practice reviewed the constructed instrument and in addition eight experts were proposed to evaluate the instrument. The contemporary instrument consisted of two indexes the Perinatal Background Index (PBI) and the Optimality Index (OI) with a total of 52 items. (Murphy & Fullerton, 2001) The most recent version has 56 items (Murphy & Fullerton, 2012). The full list of the OI-US items and their optimality is presented in Appendix 1.

The Optimality Index opens possibilities to evaluate maternity care by comparing two or more groups with low-risk for complications. For example if two groups of women have essentially similar demographic backgrounds and healthy pregnancies, differences in the optimality scores for labor may still occur. The health care providers or the procedure policies of the hospital may cause these differences. If the optimality measurement tool reveals such differences, evaluation of the process of perinatal care may be needed in the unit with more possibly unnecessary interventions. However, the OI-US cannot detect the change in the need of care and therefore the information it provides must be critically evaluated before judging any practice. (Murphy & Fullerton, 2001) Therefore, for example CS is always defined as 'non-optimal' even though it is indicated to save the life of the mother and/or the newborn. Additionally, the OI-US is not developed to measure individual client satisfaction with the process of care; it cannot be used to evaluate single woman's care as an optimal or non-optimal; it is not a risk assessment tool; and nor it cannot be used as a benchmarking or quality assurance instrument. (The OI-US User Guidelines and Toolkit, 2012)

The main characteristic of the OI-US is to observe pregnancy and labor as a natural event. It evaluates the process and outcome of the maternity care by focusing on the optimal events rather than the adverse outcomes. It offers a new way of measuring perinatal outcomes with a framework of normalcy shifting the focus from the adverse events to the optimal events by looking for the best possible outcome. The OI-US shifts the perspective from illness to health. (Murphy & Fullerton, 2001; Murphy & Fullerton, 2006)

2.3.3 How the OI-US is used to measure the process and outcome of maternity care?

Every item in the Optimality Index is scored separately. Items with optimal events are scored as 1's and items with non-optimal events as 0's. The Optimality Index consists of a numerator and denominator. The numerator is the sum of the optimal and non-optimal events, simply the sum of 1's and 0's. The denominator is the sum of the items. Items that are missing in the entire data are subtracted from the denominator. In low-risk pregnancies, a 100% optimality is expected, and therefore the ideology is that a point is rather deducted from the total score when a non-optimal event occurs. (The OI-US User Guidelines and Toolkit, 2012) In addition to 1's and 0's, the items can be coded as missing or not applicable. Code 7 can be used for data that is not applicable, code 8 is used for data that is not collected in this setting, and code 9 is used for missing data on a particular chart. (Murphy & Fullerton, 2012)

The OI-US is constructed based on five clinical domains that are perinatal background, antepartum component, intrapartum component, postpartum component, and neonatal condition. Each of the domains contains a number of items that are labeled as essentials or non-essentials. (The OI-US User Guidelines and Toolkit, 2012) Whenever the instrument is applied to measure the process and outcome of maternity care two conditions need to be fulfilled. Firstly, at least one item needs to be presented within each clinical domain, and secondly, items that are labeled as essential are generally available for scoring. The latter means that scoring codes not applicable and missing data on a particular chart are allowed, but if the item is not collected in this setting the validity of the instrument is not guaranteed. (Murphy & Fullerton, 2012)

The PBI and the OI are scored separately and the total score is usually given as a percentage. The PBI is detecting the equivalence or difference between the compared groups and the OI reports the process and outcome of care. The PBI and the OI scores can also be combined to give the total score of the OI-US but it is crucial to report the scores based on the similarity or difference by the PBI score. In the PBI, five items concentrate on previous pregnancies. In a study sample containing both nulliparous and multiparous women, the suggestion is to handle these groups of women separately and eliminate these items from the PBI of the nulliparous women. (The OI-US User Guidelines and Toolkit, 2012)

The PBI is developed to focus on lowest risk status of important demographic factors including social, medical, and obstetric status of the woman. The PBI enables the categorization of the maternity care clientele based on to standard epidemiological markers of perinatal risk. Hence it allows comparing demographically similar groups. The PBI is divided into two subgroups social and medical background, and obstetric past history. It can be said that the PBI is more unchangeable between and especially within populations but rather the availability of the data drives the item selection. The OI is more dependent on the particular practice it is used to measure. The tool is always adapted to the specific insights of the maternity care system under evaluation. The OI is always concentrating on the present pregnancy and labor outcomes and a definition of optimal or non-optimal is given to all the items. (Murphy & Fullerton, 2012) In the recent research and literature, the term optimality index seems to be used to refer to the optimality index including or excluding the perinatal background index.

2.3.4 Validity and reliability of the OI-US

The interrater reliability of the OI-US was assessed in 2008 by agreement between pairs of coders assigned to fill out the OI-US sheet based on medical records. The medical records included paper, and electronic documentation. The coders came from different professions varying from nurse-midwifes to student research assistants. Two individual projects were carried out to assess the reliability. The mean percentage agreement for both of the projects was 92.7%, ranging from 89.1% to 97.8% in the first project and from 88.5% to 96.2% in the second project. The number of errors in the coding of the index items did not differ between clinicians and lay abstractors but the sources of errors were different. These two projects indicate excellent interrater reliability. (Seng, Mugisha & Miller, 2008)

The discriminant validity of the OI-US for use in perinatal clinical research was assessed in 2008. The validity was assessed by using pre-existing hospital records of 3,428 women receiving antepartum and hospital care during pregnancy and labor at a tertiary academic medical center between 1987 and 1999. The women were divided into two groups by the need of care, women who were taken care of the nurse-midwifes throughout the pregnancy and labor, and women that required the care of a physician. Two methods of scoring were compared, the OI-US method and the Dutch method. The OI-US scores and Optimality Index Dutch scores were compared between the women that required physician care and the women that were taken care by the nurse-midwifes. A difference of 13% was detected by the OI-US method and a difference of 3.6 points by the Dutch method between the compared groups. Women in the certified nurse-midwife group received an average score of 84% (26.1 points by the Dutch method) and the women in the physician-involvement group received an average score of 71% (22.5 points by the Dutch method). The clinical difference is significant since remaining in midwifery care versus requiring physician involvement is a meaningful and important clinical difference. The OI-US shows promise for use in perinatal clinical research as a tool to evaluate both the process and outcome of care since it was capable of demonstrating this expected difference between the two groups. (Low, Seng & Miller, 2008)

2.3.5 Use of the Optimality Index-US in ethnic minority populations

Studies to evaluate the feasibility of the optimality index to detect health disparities in ethnic minorities was first proposed by Murphy and Fullerton (2001) in their research paper of the development of the OI-US (Murphy & Fullerton, 2001). Maher, Lurie, Trafton and Dozier (2011) conducted a study to compare perinatal outcomes between Hispanic migrant farmworker women (n= 122) and non-Hispanic women (n= 147) by using the OI-US. The study was conducted in a rural community with a large Hispanic migrant farmworker population in Western New York, USA. The sample was divided in four groups by parity leading to four groups (nulliparous and multiparous Hispanic migrant farmworkers, and nulliparous and multiparous local residents). The 2009 version of the OI-US was used to conduct the study. 49 items out of the 54 in the 2009 OI-US were selected for the study according to the availability of the data. The main results showed statistically significant differences in the Perinatal Background Index (PBI) scores by ethnicity and parity. No statistically significant different was found in the OI scores by ethnicity or parity. As a conclusion the PBI scores showed difference in the pre-existing background factors between Hispanic and non-Hispanic women. Despite these differences in PBI scores the OI scores were relatively high in all groups supporting current ideology of maternity care with minimal interventions in low risk pregnancies. (Maher, Lurie, Trafton & Dozier, 2011)

2.3.6 Implementing the Optimality Index-US in the United Kingdom and in Turkey

Sheridan and Sandall (2009) conducted a pilot study to evaluate if the OI-US could be used to assess the maternity care in the United Kingdom. A team of professionals including experts of midwifery and obstetrics reviewed all the items in the OI-US and an inclusion of the items was made based on the availability of the data in the United Kingdom. All the items were analyzed in accordance to the recent literature, evidence and recommendations on the maternity care in the United Kingdom. After that, it was decided if they were applicable for the Optimality Index-United Kingdom. In addition, contemporary recommendations on the maternity care were cited to decide if new items would be necessary to add on the index. From the total of 54 items in the OI-US, 50 were included in the OI-United Kingdom. The four removed items were marital status, child spacing, amniotic fluid or chorionicvillus sample, and stress test. The items were removed since no evidence in the United Kingdom was found to support their effect on the optimality of pregnancy and labor or current policy was nonexistent in the United Kingdom. A suggestion of adding four items was made based on the literature, evidence, and recommendations in the United Kingdom. These items were social deprivation, woman’s ability to speak and understand English in relation to accessing maternity care services, history of domestic violence during pregnancy, and history of mental health issues. (Sheridan & Sandall, 2009)

A pilot study was conducted to evaluate the availability and quality of data from maternity care records. The maternity care records data was collected from a maternity unit of an inner city teaching hospital in England. A sample of 200 maternity care records were used to conduct the study. Two groups of women were separated (n=97 and n=103) receiving different care (case-load care and standard care). No statistically significant difference was found in the PBI or OI scores between these two groups. As a main conclusion the pilot study suggests that there is potential on adapting the OI-US to measure the process and outcome of the maternity care in the United Kingdom especially if used as a prospective tool rather than for conducting a retrospective study. More research is needed to determine the sensitivity and specificity of the tool in the United Kingdom population. (Sheridan & Sandall, 2009.)

In 2015, the OI-US was adapted in Turkey to construct Optimality Index-Turkey and to assess maternity care outcomes. The work started by translating the OI-US in Turkish, and back translating in English to ensure that the content remained unchangeable. Thereafter, the content validity, discriminant validity, and inter-rater reliability of the OI-Turkey was assessed. A panel of experts in obstetrics and gynecology assessed the content validity by reviewing the items and their evidence-base, and then decided if the items were applicable in Turkey. Additionally, the content validity was evaluated by using the content validity ratio and content validity index. Based on these measures and the opinion of the expert panel, sixty items were included in the OI-Turkey. The discriminant validity was assessed by comparing the OI-Turkey scores of healthy pregnant women and high-risk pregnant women. The instrument demonstrated discriminant validity by distinguishing between healthy and high-risk women. To assess the inter-rater reliability the agreement level of two separate raters was analyzed. The results showed that there was comprehensive agreement between the raters. As a conclusion, the OI-Turkey seems a valid and reliable tool to assess the outcomes of Turkish maternity care. Additionally, it can influence the development of the standard of maternity care, and promote evidence-based practice in Turkey. (Yucel, Taskin & Low, 2015)

2.4 Ethnicity and reproductive health

2.4.1 Ethnicity and race

Race and ethnicity are commonly used concepts in many purposes in the society, such as in research, politics, and everyday discourse. They are often used parallel as each other's synonyms. However, they are defined slightly differently. The classification of these two terms is always related to time and place reflecting the social and political circumstances and the practice they are developed. Race has been traditionally classified as the biological inheritance of the individual. However, recently geographical, social, and class division rather than biological concept have characterized it. The word ethnicity comes from a Greek word *ethnos* meaning nation, people, or tribe. Ethnicity refers to a group to which the individual belongs, characterized by cultural traditions and languages. The people in the same ethnic group share the same geographical or ancestral origin. (Bhopal, 2014)

In the past, it was common for the data collector to classify people to racial or ethnic groups based on his own observations. Nowadays it is more common that the individual itself defines his own ethnicity. Therefore, it is important that the given ethnic or racial groups are precise, acceptable, and meaningful, and serve both the individual and the data collector. With the help of the classification, the purpose is usually to describe an ethnic or racial group that is in the scope of interest by its characteristics (e.g. risk factors for certain ethnic groups for certain diseases or conditions). The term minority is often used as a prefix to describe the national or local numerical minority of a group although some people can find it demeaning. Sometimes the term ethnic is used incorrectly to describe only some groups although every group has its ethnic classification. (Bhopal, 2014)

2.4.2 Ethnicity and the use of maternity care services

Belonging to an ethnic minority population and its association to health inequalities have been studied by many researchers and in many countries. In many studies, ethnicity has been linked to health inequalities (Cooper, 2002; Kómár, Nagymajtényi, Nyári & Paulik, 2006; Målqvist, Phuong Hoa, Thanh Liem, Thorson & Thomsen, 2013; Nazroo, 1998). Many factors, such as inadequate use of antenatal care services among ethnic minorities (Choté et al. 2011), are associated with poor pregnancy and birth outcomes such as PTB and LBW (Becker & Stolberg, 2013; Behrman & Butler, 2007). Good and quality antenatal care perceives the aspects of cultural values and believes of different ethnic populations and provides culturally competent care without prejudices (Premkumar, 2008). As stated in the United Nations' Sustainable Development Agenda (target 3.7) the goal by 2030 is to:

> *"… ensure universal access to sexual and reproductive health-care services, including for family planning, information and education,…"*
> *(Sustainable Development Goal 3)*

Globally and nationally inequalities of access to sexual and reproductive healthcare services exists between and within countries, and between population groups in the country.

In a population-based prospective cohort study, conducted in the city of Rotterdam in the Netherlands in 2002-2004 an association of the use of antenatal services and different ethnic groups was assessed. In total 2,093 women enrolled to the study and were divided into seven ethnic groups (Dutch, Turkish, Moroccan, Surinamese-Creole, Surinamese-Hindustani, Cape Verdean, and Dutch Antilles) and thereafter by parity. The main conclusion was that native Dutch women were using the antenatal services more adequately compared to the other ethnicities and especially significant differences were detected in the initiation to the first antenatal visit (prior to 14 weeks of gestation). (Choté et al. 2011) Similar results were reported in a Swedish study conducted in Malmö in 2000-2003 showing differences in the use of planned antenatal care between ethnic groups. This retrospective community-based register study investigated 5,373 low-risk singleton pregnancies of six subgroups based on the country of origin. The main finding was that foreign-born women had lower utilization of planned antenatal care along with increase in unplanned visits to the delivery ward compared to Swedish women. In addition, initiation of the first antenatal visit was later in some foreign-born women compared to Swedish women. (Ny, Dykes, Molin & Dejin-Karlsson, 2007) Lower number of visits in the maternity care clinic does not seem to affect negatively the pregnancy and birth outcomes in low risk pregnancies (Dowswell et al., 2010; Villar & Bergsjø, 1997). However, the initiation of the first visit is important for the woman to receive all the relevant information and guidance early in the pregnancy and to detect any concerns that may affect the pregnancy and birth outcomes (Villar & Bergsjø, 1997).

Late initiation for antenatal care (later than 12 weeks of gestation) and its association to several socio-demographic factors (including ethnicity, country of birth, parity, relationship status, socio-economic status, educational level, and age) was studied in the United Kingdom in 2005. The data was collected by questionnaires that were sent out to 1,490 women with response rate of 63%. After exclusion of non-eligible candidates, the final sample consisted of 839 replies (57%). Late initiation for first antenatal visit was statistically significantly associated with living without a husband/partner, and with country of birth other than the United Kingdom. The odds for booking the first visit after 18 weeks of gestation was six times higher for Black women compared to White women. These findings support that the initiation for antenatal care may be delayed in ethnic minority populations. (Rowe et al. 2008)

Recent research shows that special attention in organizing maternity care services to diverse ethnic communities should be paid as inequalities seems to exist. Targeted information for those ethnic groups that have significantly greater risk for underuse of services should be one of the priority aims of public health policies. With high quality maternity care services, the health of the entire family can be influenced and health education can be given in a broad perspective if the clients are reached in early pregnancy.

2.4.3 Ethnicity and complications occurring during pregnancy

Ethnic differences in the prevalence of preeclampsia exist. Caughey, Stotland, Washington and Escobar (2005) conducted a retrospective cohort study of 127,544 low-risk women evaluating the association between maternal and paternal ethnicity and parental ethnic discordance. The participants were divided into five groups (Asian, African-American, white, Hispanic, and Native American) based on self-reported race or ethnicity. Confounding factors such as maternal age, parity, and education were controlled in the multivariate model. The main results showed highest prevalence of preeclampsia in African-American women and lowest in Asian women. In the same study Asian paternal ethnicity seemed to be a protective factor against preeclampsia with lower prevalence compared to other paternal ethnicities. In addition, different ethnicities of the parents posed the pregnancy for higher risk for preeclampsia, except for Native Americans. (Caughey, Stotland, Washington & Escobar, 2005) It is important to note that in this study the group of Native Americans was the smallest containing only 0.6% (n= 703) of the total study population and the group for white women was the largest containing 45.2% (n= 57,660) of the women in the total study population. Whether or not this has impacted the results remains unsolved. Although the researchers controlled a number of possible confounders there is always a chance that some confounding factors remained in the analysis. Despite these notions, the reliability of this study seems to be high quality. Similar findings were discovered in the study of Khalil, Rezende, Akolekar, Syngelaki and Nicolaides (2013), as higher prevalence of preeclampsia was associated with Afro-Caribbean and South Asian racial origin compared to Caucasian, East Asian and mixed (Khalil, Rezende, Akolekar, Syngelaki & Nicolaides, 2013).

Studies have revealed an association between racial or ethnic origin of the mother and the prevalence of GDM. A population-based survey conducted in Oregon United States assessed racial/ethnic disparities and the prevalence of GDM. The sample size consisted of 3,883 women that gave birth between 2004 and 2005. The women were categorized in five groups based on ethnic/racial background, Hispanic, non-Hispanic White, non-Hispanic Black, non-Hispanic Asian/Pacific Islander, and non-Hispanic American Indian/Alaskan Native. Non-

Hispanic Whites were used as the reference group. Out of the study sample, 357 women were diagnosed with GDM. The results revealed that belonging to an ethnic or racial minority group was associated with higher risk for developing GDM compared to the reference group. (Hunsberger, Rosenberg & Donatelle, 2010) In the study of Khalil et al. (2013) an association between the racial origin and increased risk for GDM was also revealed. The racial origin of Afro-Caribbean, South Asian, and East Asian was associated with increased risk for developing GDM compared to Caucasians. (Khalil et al. 2013.) A study by Hedderson, Darbinian and Ferrara (2010) conducted in the US assessed the association between GDM and the country of birth and race-ethnicity. This cohort study included 216,089 women who delivered an infant between 1995 and 2004 and who underwent a plasma glucose screening to detect GDM. The main conclusion from this study was that a significant variation in the prevalence of GDM exists between the ethnic groups. Non-Hispanic whites (4.2%) and black women (4.4%) had the lowest prevalence of GDM, whereas Asian Indian women (11.1%) had the highest prevalence. In addition, an association between maternal birthplace outside the US and an increased risk of GDM was detected in most of the race-ethnic groups when compared to US born mothers. (Hedderson, Darbinian & Ferrara, 2010) These findings strongly suggest that some ethnic groups are more prone to develop GDM. More research on the causes affecting the risk is needed to develop prevention programs for GDM that specifies on the different characteristics of different ethnic groups.

In a nationwide prospective cohort study using The Netherlands Perinatal Registry, ethnic disparities and the risk of spontaneous PTB was studied. The study was conducted in the Netherlands including all singleton deliveries with a spontaneous onset of labor between the years 1999-2007 (n= 969,491). The ethnic groups included European white women, African women, South-Asian women, Mediterranean women, and East-Asian women. The results showed that African and South-Asian women had an increased risk of PTB compared with European white women. However, the same ethnic groups had a decreased risk of subsequent adverse neonatal outcome compared to European white women. (Schaaf, Mol, Abu-Hanna & Ravelli, 2012) In a large systematic review, the association between maternal ethnic/racial origin and the risk for PTB was studied. The review consisted of 45 studies. The main finding was that Black ethnicity was associated with an increased risk of PTB compared to whites. (Schaaf, Liem, Mol, Abu-Hanna & Ravelli 2013.) These two studies demonstrates the strong association between maternal ethnicity and risk for PTB.

2.4.4 Ethnicity and differences in procedures performed during pregnancy and labor

Differences by ethnicity on labor induction rates have been reported. Two studies by the same research team were conducted in the US at the same time period evaluated the association of race and early-term induction (Murty, Grobman, Lee & Holl, 2011a), and race and late-preterm induction (Murty, Holl, Lee & Grobman, 2011b). In the study on early-term inductions, non-Hispanic white women were more likely to undergo an induction compared to Hispanic white women, Black women, and women from other racial origin (Murty et al. 2011a). In the study on late-preterm induction, Black women had higher rates on induced labors compared to the other three groups (Murty et al. b). Although these studies showed differences in induction rates between different races, the underlying indications for inductions remained unexplained.

The association of ethnic/racial background and rates for CS is well known although the explaining factors behind the phenomena remain undiscovered (Anderson, Sadler, Stewart, Fyfe & McCowan, 2013; Braveman, Egerter, Edmonston & Verdon, 1995; Edmonds, Hawkins & Cohen, 2014; Khalil et al. 2013; Vangen, Stoltenberg, Johansen, Sundby & Stray-Pedersen, 2000). A population based study conducted in Norway used the data of 553,491 live births between the years 1986-1995 to examine the prevalence of CS between different ethnic groups. The Medical Birth Registry of Norway served as the data and it was linked to information from Statistics Norway to determine the country of origin and the maternal educational level. In total of eight groups were formulated based on the ethnic origin of the mother, including Turkey/ Morocco (n=2,758), Pakistan (n=4,929), Sri Lanka/India (n=2,643), Vietnam (n=2,704), Philippines (n=1,985), Chile/Brazil (n=1,466), Somalia/Eritrea/Ethiopia (n=1,406), and Norwegians (n=535,600). The statistical analyses in this study were contingency tables and analysis of excess risk. The crude excess risk of cesarean section is the prevalence of cesarean section in a particular immigrant group minus the prevalence among ethnic Norwegians. Adjusting for several confounding factors was performed. After the analyzing and adjustments, the risk for having a CS was elevated among women from Somalia/Eritrea/Ethiopia (2.7%) and Chile/ Brazil (6.4%) compared to the other ethnic groups. (Vangen et al. 2000) In the study of Khalil et al. (2013) Afro-American and South Asian racial origin was associated with higher risk for emergency CS compared to Caucasian racial origin (Khalil et al. 2013). In a retrospective cohort analysis conducted in New Zealand, the role of ethnicity was assessed as an independent risk factor for elective and emergency CS. The study population consisted of 11,848 singleton, nulliparous women at term. The results showed that ethnicity was independently associated with elective and emergency CS. Compared with European women, Pacific and Chinese women had lower odds of elective CS, and Indian and other ethnic women had higher odds for emergency CS. (Anderson et al. 2013)

2.4.5 Ethnic minority groups in Finland

The share of population using other language than Finnish or Swedish as their native language has increased from 0.2% in 1980 to 5.3% in 2013 (Statistics Finland, 2013a). The largest ethnic minority groups by the native language in 2013 were Russian, Estonian, Somali, English, Arabic and Kurdish (Statistics Finland, 2013b). There were more than 170 different ethnic minorities living in Finland in the end of year 2012. Although the share of ethnic minority populations in Finland has increased, it is still low in international comparison. In 2011, the average of foreigners living in EU-27 countries was 6.9% and the percentage in Finland the same year was sixth lowest. (Foreigners and Migration, 2013)

The characteristics of an individual may vary remarkably due to the reasons for coming to Finland in the first place. Some come as a student or because of a marriage whereas others come as a refugee or as an asylum seeker, or through resettlement program or family unification. Additionally, limited language skills, separation from family, and cultural and religious beliefs challenges the service providers especially in the field of health and social services where people are the most vulnerable. (Malin & Gissler, 2009) As the number of ethnic minority families increases, the maternity care service providers face new challenges providing culturally competent care that corresponds to the needs of the mothers and families with different ethnicity and health beliefs than the native Finnish population.

2.4.6 The use of maternity care services among different ethnic groups in Finland

In a large Finnish study using the data from the Finnish Medical Birth Register between the years 1999-2001 Malin and Gissler (2009) evaluated the access to and use of maternity care services comparing ethnic minority women (n=6,532) and Finnish women (n=158,469) with singleton births. The ethnic minorities formed 14 groups including Nordic (n=475), Western (n=400), former Eastern Europe (n=597), former Soviet Union and Russia (n=1,770), Baltic (n=496), South Asian (n=176), Chinese (n=135), Southeast Asian (n=336), Vietnamese (n=302), Middle Eastern and North African (n=310), African (n=169), Somalian (n=817), Latin American and Caribbean (n=121), and Iranian, Iraqi and Afghan (n=428). The access to maternity care was measured by the timing of the first visit to a maternity clinic and by the total number of the visits. In addition, participation to prenatal screening, the use of contraception, number of births, and number of pregnancy termination was measured. Additionally, maternal and neonatal morbidity and mortality was assessed to decide if difference in pregnancy and birth outcomes exists. (Malin & Gissler, 2009)

In the study of Malin and Gissler (2009) participation for perinatal care was similar between Finns and other ethnic groups. Some variation was detected but it did not reach the level of statistical significance. However, the results in the study showed that women with African and Somali origin had more health problems during pregnancy and childbirth compared to other ethnic groups. In addition, some variation on the number of prenatal visits was detected between Finns and other ethnicities. Finns had on average 1.2-1.5 visits more than the other ethnic groups ($p<0.001$) (Malin & Gissler, 2009) The results from this study may predict the direction of the trends in the access to and use of maternity care services among these 15 ethnic groups, however, the small study sample of some of the study groups ($n<200$) and the ethnic variation within some of the groups (e.g. all African women in the same group excluding Somalian and North African) may leave some uncertainty of the incidence of the studied outcomes. Fortunately, only a few parturients a year do not seek the maternity care services (Klemetti & Hakulinen-Viitanen, 2013; Tiitinen, 2014c; Uotila & Raudaskoski, 2014).

2.4.7 Differences in perinatal background based on ethnicity

Marital status, age, and parity

The study of Malin and Gissler (2009) shows that the share of single mothers varies between different ethnic groups living in Finland. Among South Asian mothers, the share was as low as 5% compared to 12% in ethnic Finns. The highest share of single mothers was among Nordic mothers whereas quarter of the mothers were singles. Additionally, Nordic mothers were the youngest group by mean age (26.8 years). The mean age among primiparous Finns was 29.9 years. The highest mean age was among Chinese (32.3 years) and Western (31.7 years) mothers. The share of parturients aged 35 years or more varied from 2.9% in Baltic to 28.9% in Chinese mothers compared with ethnic Finns (18.4%). (Malin & Gissler, 2009) The proportion of parturients aged 35 years or over has increased during the past decades in Finland. It seems that this trend is typical for all women regardless of ethnicity.

The share of first-time mothers was 41% in Finns and 37.6% in all migrants. However, there was huge variation in parity between different migrant groups. Whereas over half of the Chinese and Nordic mothers gave birth for the first time, nearly one third of Somali mothers had four or more previous births. (Malin & Gissler, 2009)

Smoking

The reported percentage of smoking among parturients in Finland was 14.7% in 2015 (Vuori & Gissler, 2016). Malin and Gissler (2009) evaluated in their study the reproductive health differences in the ethnic groups living in Finland. The findings suggested some variation in the smoking habits between the ethnic groups. The percentage of smoking during pregnancy was 14.8% for Finns. The highest smoking percentage was among Nordic women (22.7%) and lowest among Somalian, Chinese, South Asian, Iranian, Iraqi and Afghan, Vietnamese, and African (0.7-2%). Smoking in the other ethnic groups remained close to the national average or was relatively lower (6.3-14.1%). (Malin & Gissler, 2009)

2.4.8 Maternal ethnicity and pregnancy and labor outcomes in Finland

Preeclampsia, hospital care in pregnancy, and preterm birth

In the study of Malin and Gissler (2009) differences in pregnancy complications among different ethnic groups was reported. Preeclampsia was more common in women with Chinese or Latin American ethnicity compared to the other ethnic groups. African origin women needed hospital care due to bleeding, threatening preterm delivery or hypertension more often than the other groups in the study. Occurrence of PTB was slightly more common in migrant women (5.1%) compared with Finns (4.8%) but the difference remained statistically insignificant. However, when studied by ethnicity, women from Middle East and North Africa (8.1%, $p < 0.01$) and South Asia (8.0%, $p > 0.05$) had an increased risk for PTB compared to the other ethnic groups. (Malin & Gissler, 2009)

Assisted instrumental delivery, Cesarean section, and pain relief during labor

According to Malin and Gissler (2009), need for assisted instrumental delivery (forceps or vacuum extractor) was at the same level with primiparous migrant women and Finnish women. However, when studied by ethnicity Finns experienced assisted instrumental delivery more often than women from former Soviet Union and Russian, and Somalia. Difference in instrumental deliveries between multiparous Finns and the other ethnic groups was statistically insignificant. The CS rates for primiparous women were statistically significantly higher for Finns (19.7%) than for the other ethnicities (18.2%, $p < 0.05$). Women from Africa, Latin America and Caribbean, Southeast Asia, and Somalia had statistically higher rates for CS compared with Finns. Lower rates were reported in women from Nordic countries, East European countries, and Baltic countries. In multiparous women, the difference was statistically insignificant between Finnish (13.1%) and immigrant women

(12.7%). However, when analyzed separately by the ethnicity of the mother, higher CS rates were detected in multiparous Southeast Asian, and Latin American and Caribbean women compared with Finns, and lower rates in women from East Europe and Baltic countries. In addition to procedure in labor, differences in pain relieving patterns were detected between Finns and migrant women. Both in primiparous and multiparous women, migrant women received epidural analgesia more often compared with Finns. Additionally, the direction was similar when analyzed for any pain relief received during labor. (Malin & Gissler, 2009)

Low birth weight, and small for gestational age newborn

The study of Malin and Gissler (2009) showed that migrant women gave more often birth to a newborn with LBW (< 2500g) compared with Finns (respectively, 3.8% and 3.3%, $p < 0.01$). The risk was increased in migrant women of Asian, East European, Middle Eastern and North African, and Somalian origin compared with Finns. As expected, the risk for small for gestational age newborn was higher for migrant women compared with Finns (respectively 2.7% and 2.0%, $p < 0.001$). The risk was increased in migrant women of South Asian, Vietnamese, Somalian, Middle Eastern and North African, and Iranian, Iraqi and Afghan origin compared with Finns. (Malin & Gissler, 2009)

Newborn interventions, and perinatal mortality

Malin and Gissler (2009) found that Finnish origin newborns experienced fewer interventions after birth than migrant origin newborns. Latin American and Caribbean babies (13.2%), South Asian babies (10.2%), and Iranian, Iraqian and Afghan babies (10.0%) needed intensive care more often than Finns (5.5%). Middle Eastern and North African newborns (1.6%), and Latin American and Caribbean newborns (1.7%) needed respiratory support and care more often than Finns (1.0%). Need for intubation was higher in Somalian (2.1%) and Latin American (1.7%) newborns compared with Finns 0.6%. Antibiotics were administered more often to African, South Asian, and Russian origin newborns (respectively, 4.1%, 4.5%, and 4.1%) and phototherapy was given more often to Chinese and Vietnamese newborns (11.9%, and 9.6%) compared with Finns (3.5%, and 5.7%). The risk for perinatal mortality was slightly higher in ethnic minority newborns (5.8/1,000) compared to Finns

(5.1/1,000) but it remained statistically insignificant. When analyzing separately for all the ethnicities, newborns with African origin (29.6/1,000, $p < 0.001$) and newborns with Somalian origin (12.2/1,000, $p < 0.01$) had significantly higher risk for perinatal death than Finnish newborns (5.1/1,000). (Malin & Gissler, 2009)

3 AIM OF THE STUDY

The aim of this study was to evaluate the feasibility of the Medical Birth Register (MBR) data to construct a new measurement tool Optimality Index Finland (OI-FI) to measure the process and outcome of the Finnish maternity care. To construct the OI-FI, the OI-US was cited as a reference to choose the index items. Additionally, the content of the MBR, a register maintained by THL, guided the item selection. The fundamental reason for constructing the OI-FI was to strengthen the ideology of pregnancy and labor as a natural continuum for life since research of pregnancy and labor is relatively often concentrating on medical interventions or adverse outcomes. Additionally, the OI-FI provides a standardized way of measuring the process and outcome of maternity care. After constructing the OI-FI a study comparing four different ethnic groups living in Finland was conducted to evaluate the usefulness and applicability of the OI-FI.

The specific objectives in this study are:

1. Feasibility of the MBR data to construct the OI-FI
2. Evaluate how the OI-FI detects differences or similarities in the process and outcome of maternity care comparing ethnic Finns to migrant women of Russian, Kurdish, and Somali origin

The first objective will be addressed in the methods section and the second objective will be addressed in the results section.

4 METHODOLOGY

4.1 The Medical Birth Register of Finland

The National Institute for Health and Welfare collects data on all the pregnancies and births occurring in Finland. The information is stored in the Finnish Medical Birth Register. The maintenance of the MBR is based on legislation (Act 556/1989, Decree 774/1989, Act 409/2001, and Act 668/2008). All birth hospitals are responsible for reporting the required information to THL by using a specific form designed for the data collection. The register is maintained to statistical, research, and evaluation use of maternity care, birth practices, and neonatal care. As the register is based on legislation, informed consent from the individuals is not needed for the use of the data. (Aittomäki et al. 2016)

The MBR form consists of forty items that are divided in six domains. The domains are personal data of the mother, previous pregnancies and labors, current pregnancy and prenatal care, labor and delivery, neonatal condition, and the health status of the newborn at 7 days or at discharge. The form includes both check-box items and open-ended questions. For some of the items many options may be checked but for some the health care provider chooses only one. (Syntyneiden lasten rekisteri, 2003) In a study to evaluate the quality of the MBR data, the results showed that an important marker for the quality was the question format. Check-boxes improved the quality compared to open-ended questions. (Gissler & Shelley, 2002) A new MBR form was released in use in January 2017. However, in this study the data is based on the previous form that was in use between the years 2004-2016.

4.2 The Migrant Health and Wellbeing Study, and Health 2011 Survey

The Migrant Health and Wellbeing Study (Maamu Study), a large population based study, was conducted in Finland between the years 2010 and 2012 involving six cities (Helsinki, Espoo, Vantaa, Turku, Tampere and Vaasa). The study was administered by THL. The study started from the need to collect reliable data from the health, welfare, and use and need of health services among the migrant populations in Finland. The data was collected on main socio-demographic factors, health status, chronic diseases and many other aspects on health and wellbeing. Three migrant groups were chosen in the study, Russian, Somali, and Kurdish. The inclusion criteria for each of the migrant groups were specified by the country of origin and native language. For Russians the inclusion criteria was a country of origin of Russia (7.2%) or former Soviet Union (92.8%) and a native language of Russian or Finnish. For Somalis the criteria was a country of origin of Somalia. For Kurdish the country of origin had to be either Iraq (61.9%) or Iran (38.1%), and the native language of Kurdish was required. Additionally, the age for the participants was set to 18-64 years and a limitation of at least one-year residency in Finland was applied. From each of the ethnic origins, 1,000 individuals were randomly chosen to be invited for the study. Out of the 1,000 invitees for each of the ethnic groups the share of Russian women was 622, the share of Somali women was 531, and the share of Kurdish women was 426. (Castaneda, Rask, Koponen, Mölsä & Koskinen, 2012) In addition to the invitees, another sample of 1,000 individuals from each of the ethnic groups was randomly chosen but they were not invited to the actual Maamu Study. Out of the total of 3,000 migrants, 1,492 were women aged 18-64 years. The purpose of this additional sample was that it could be linked with the health registers in Finland by using the personal identification number of each individual without participation on the actual Maamu Study. The precise description on the study methods of Maamu Study can be obtained from the report of Castaneda, Rask, Koponen, Mölsä and Koskinen 2012.

Health 2011 Survey was carried out by THL between the years 2011 and 2012 in sixty locations in Finland. The purpose of the survey was to obtain data on determinants of health, functional capacity, and welfare of Finnish working-age and elderly populations. The individuals for the survey were invited based on three groups, persons that had taken part in Health 2000 Survey eleven years earlier (n=8,135), had participated to Mini-Finland Survey in 1978-1980 and had been followed-up in Health 2000 Survey (n=920), or had randomly been drawn to participate to Health 2011 Survey (n=1,994). The Health 2000 Survey sample consisted of adults aged 29 years or more. To obtain information on young adults the new sample consisted of adults aged 18 to 28 years. Thus, the study population covered adults aged 18 years and more. The share of women in the Health 2011 Survey was 5,271. (Lundqvist & Mäki-Opas, 2016) The precise description on the study methods of Health 2011 Survey can be obtained from the report of Lundqvist and Mäki-Opas 2016.

Ethical approval and informed consent

The Ethical Committee of THL first reviewed the application for ethical approval for the Health 2011 Survey. A more detailed project plan was thereafter submitted to the Coordinating Ethics Committee at the Hospital District of Helsinki and Uusimaa (HUS, reference 45/13/03/00/11). All the invitees received a letter that contained general information on the Health 2011 Survey, an appointment for health examination, questionnaire, and two copies of informed consent form. At the health examination, the purpose of the Health 2011 Survey was explained to the participants, the participants had an opportunity to ask questions concerning the survey, and the informed consent forms were signed if the health examination performer thought the participant was aware of the purpose of the study. By signing the informed consent, the participant gave permission to link data from other registers to be used for research purposes. The participants were informed on this. The linkage was done by using the personal identification number. (Lundqvist & Mäki-Opas, 2016.) The Coordinating Ethical Committee of the Hospital District of Helsinki and Uusimaa gave ethical approval to Maamu Study (19.1.2010 325/13/00/2009) (Koukkula, Keskimäki, Koponen, Mölsä & Klemetti, 2016). Similarly to the Health 2011 Survey, an invitation was mailed to all the invitees. The invitation included information on the Maamu Study, and a request to reach the study coordinator by phone. If the invitees did not call to the coordinator, they were followed up with a telephone contact or home visit. Thereafter, an appointment for the health interview was booked. (Castaneda et al. 2012) Additionally, the study participants gave their written informed consent in the health interview (Koukkula et al. 2016) where they had an opportunity to ask questions related to the study (Castaneda et al. 2012).

4.3 The study population

All the female invitees in Maamu Study and Health 2011 Survey, and the additional sample in Maamu Study were linked to MBR by their personal identification number. The data in this study consists of the MBR data. The ethnicity of the participants was defined based on the information from Maamu Study and Health 2011 Survey. The actual study population consists of all viable singleton births between 2004-2014 to mothers that participated in either the Maamu Study or Health 2011 Survey. The primary interest in this study was the latest pregnancy and labor of the study objects that occurred between the study years. Additionally, information on previous births was included for multiparous. The data in this study corresponds to the MBR collection form that was used between 2004-2016. Exclusion of women with their latest pregnancy and labor prior to 2004 was applied to give the data consistency. Additionally, it reduced missing data since different MBR collection form was used before the year 2004 and it lacked some of the items that were included in the OI-FI.

Multiple births were excluded from the study sample since multiple pregnancies are considered as higher risk pregnancies compared to singletons. Since the optimality index has been developed to measure the optimality of labor and birth in a low risk population it is rationale to exclude multiples. Additionally, one individual was excluded since reliable information on parity was absent. The final study sample consisted of 1,495 women, out of which 358 were primiparous and 1,137 were multiparous.

Four ethnic groups Finns, Somali, Kurdish, and Russian were compared by using the OI-FI. Finns were used as the reference group. The four ethnic groups were further divided in two separate groups by parity. The OI-FI comparisons were made between:

1. primiparous Finns, Russians, Kurdish, and Somali, and

2. multiparous Finns, Russians, Kurdish, and Somali.

Some uncertainty of the parity may exist in the study population since births to immigrant mothers in their country of origin are missing in the records since they are unavailable in the Finnish national register data. However, the MBR contains an item "number of previous births", and therefore births to an immigrant mother in the country of origin should be reported although the pregnancy and birth are not actually documented in the register.

4.4 The OI-FI

Development of the OI-FI started by searching for suitable data to conduct the study feasibly. The MBR offered the most suitable option. The items for the study were selected based on the items in the OI-US and according to the data available in the MBR. National guidelines and timely research was used to support the inclusion of an item in the OI-FI and to define the limits for optimality. Primarily Finnish scientific research and national guidelines were used as a reference to include an item. However, if Finnish studies were unavailable high quality international research and surveys were cited. The OI-FI is presented in Table 4.1. Comparison of the items between OI-FI and OI-US is presented in Appendix 1.

The MBR data needed to be processed to form the OI-FI items. For many of the OI-FI items, a combination of two or more MBR items was required. The IBM Statistical Program for Social Sciences (SPSS) was used to process the data. The completeness of the data was really high, reaching 100% for most of the items. The lowest percentage was 89.8 for the item describing the weight of previous babies for multiparous women.

Table 4.1 Review of the OI-FI items with criteria for optimality and inclusion reference

Index item	**Criteria for optimality**	**Reference**
The Perinatal Background Index		
Social and medical background		
1. Marital status	Married and/or living with a partner	Klemetti & Hakulinen-Viitanen, 2013: 26-29, 31, 33
2. Ethnic minority	No	Klemetti & Hakulinen-Viitanen, 2013: 206-209.
3. Smoking	None	Klemetti & Hakulinen-Viitanen, 2013: 66-68.
4. Pre-pregnancy BMI	18.5 – 24.9 kg/m²	Klemetti & Hakulinen-Viitanen, 2013: 119-121.
5. Age at the onset of labor	18 – 40 years	Klemetti & Hakulinen-Viitanen, 2013: 210-213.
6. Preexisting, major, chronic, diseases in current pregnancy*	No	Klemetti & Hakulinen-Viitanen, 2013: 173-175, 180-182, 184-187. Uotila, 2007b: 432-436
7. Inter-pregnancy interval between index pregnancy and previous viable birth	> 18 months and < 60 months	Conde-Agudelo et al. 2006.
8. Previous preterm delivery prior 37 weeks of gestation	No	Klemetti & Hakulinen-Viitanen, 2013: 166.
9. Previous intrauterine fetal death	No	Klemetti & Hakulinen-Viitanen, 2013: 166.
10. Previous Cesarean section	No	Klemetti & Hakulinen-Viitanen, 2013: 166.
11. Previous baby weighting less than 2,500 grams	No	Klemetti & Hakulinen-Viitanen, 2013: 156.
12. History of other serious antepartum complications*	No	Klemetti & Hakulinen-Viitanen, 2013: 116-118, 166.
The Optimality Index		
Present pregnancy, and maternal status		
13. Intrauterine fetal death	No	Klemetti & Hakulinen-Viitanen, 2013: 166.
14. Other serious antepartum conditions or complications*	No	Klemetti & Hakulinen-Viitanen, 2013: 116-118, 152-153, 168.
15. Prenatal care: initiation in first trimester (≤12 weeks) and minimum of 8 (multipara) or 9 (primipara) visits	Yes	Klemetti & Hakulinen-Viitanen, 2013: 100-102
16. Amniocentesis	No	Autti-Rämö et al. 2005:39-40, 54
Parturition		
17. Amniotic fluid*	No ICD-10 diagnose of abnormal amniotic fluid	Raussi-Lehto, 2007a: 212 Raussi-Lehto, 2007b: 238 Väyrynen & Stefanovic, 2007:199
18. Induction or augmentation of labor by prostaglandin or oxytocin, or records on induction	No	Tiitinen, 2016d.

19. Amniotomy	No	Tiitinen, 2016d.
20. Oral or injectable medication during labor (excluding prostaglandin and oxytocin)	No	Sarvela & Volmanen, 2014
21. Epidural, spinal, or combined spinal-epidural analgesia for labor and/or birth	No	Sarvela & Volmanen, 2014
22. Fetal heart rate abnormalities*	No	Raussi-Lehto, 2007b: 240-243 Uotila, 2007c: 510-514
23. Delivery occurred in the place originally intended at the onset of labor	Yes	Klemetti & Hakulinen-Viitanen, 2013: 242 Äimälä & Järvenpää, 2007: 467-471
24. Presentation at birth	No records on abnormal presentations	Klemetti & Hakulinen-Viitanen, 2013: 251
25. Instrumental vaginal delivery (including vacuum extraction and forceps)	No	Pallasmaa, 2014: 4, 52. Uotila, 2007d: 494-500
26. Cesarean section	No	Pallasmaa, 2014: 4, 52, 64. Uotila, 2007d: 490-494
27. Episiotomy	No	Synnyttäjän hoito ponnistusvaiheessa: 27
28. Suturing of 3rd or 4th degree laceration	No	Synnyttäjän hoito ponnistusvaiheessa: 21-28
29. Placental retention*	No ICD-10 diagnose of placental issues	Raussi-Lehto, 2007b: 263 Uotila, 2007a: 500-501
30. Postpartum hemorrhage*	No ICD-10 diagnose of postpartum hemorrhage	Raussi-Lehto, 2007b: 263 Uotila, 2007a: 504-506
31. Blood transfusion	No	Uotila, 2007a: p 504-506
32. Other serious intrapartum complications*	No	Stefanovic, 2007: 408, 411-412 Väyrynen & Stefanovic 2007: 198 Äimälä, 2007: 484-489
Neonatal condition		
33. Estimate of gestational age	37-42 weeks	Ahonen et al. 2012: 87 Uotila, 2007b: 430-432
34. Birth weight	2500-4000 g	Ahonen et al. 2012: 86
35. Apgar score at 1 minute	7, 8, 9 or 10	The Apgar Score, 2015: 1098
36. Transfer to neonatal care setting	No	Järvenpää, 2007: 284
37. Congenital anomalies*	No	Klemetti & Hakulinen-Viitanen, 2013: 267-268.
38. Birth trauma, or other serious medical problem*	No	Klemetti & Hakulinen-Viitanen, 2013: 262-268.
39. Perinatal death (up to 7 days of age)	No	Ahonen et al. 2012: 90
Maternal condition		
40. Provider diagnosis of fever, infection or major complication*	No	Väyrynen, 2007: 299-300

* See Appendix 2 for detailed explanations of the conditions included in the item.

Indexes and clinical domains

The format of the OI-FI adhered to the format of the OI-US. The OI-FI includes two indexes, the Perinatal Background Index and the Optimality Index similarly to the OI-US. Further in this study, OI-FI is used to refer the entire index including the PBI and the OI. Understandably, the PBI refers to the Perinatal Background Index, and the OI refers to the Optimality Index.

Additionally to the indexes, the OI-FI in constructed based on the five clinical domains that were proposed by the developers of the OI-US. The clinical domains are social and medical background of the mother, present pregnancy and maternal status, parturition, neonatal conditions, and maternal condition. Neonatal and maternal condition are documented in the MBR up to discharge or seven days after birth. Table 4.2 is showing the percentages of the items in each of the clinical domain that were included in the OI-FI compared to the OI-US. In the User Guidelines and Toolkit for the OI-US it was stated that at least 50% of the items should be remained in each of the clinical domains or otherwise the measurement tool is invalid. Thus, the same should be required for the OI-FI. The clinical domain of maternal conditions in includes less than 50% of the items that were proposed in the OI-US. This is a certain limitation and should be considered while interpreting the results.

Table 4.2 The percentage of items included in each clinical domain in the OI-FI

Clinical domain	%
Social and medical background	85.7%
Present pregnancy, and maternal status	57.1%
Parturition	66.7%
Neonatal condition	87.5%
Maternal condition	33.3%*

*Not fulfilling the requirement of 50%

ICD-10 codes

In the OI-FI, the data for eleven items were obtained by utilizing the 10th Revision of the International Classification of Diseases (ICD-10) codes. Health care providers use these codes to give diagnoses. These items are presented in Appendix 2 with explaining ICD-10 codes and conditions. The ICD-10 codes are collected as open-ended questions in the MBR form. The electronic form allows the health care provider to submit ten ICD-10 codes per question and for the paper version six ICD-10 codes can be documented. As showed in the study of Gissler and Shelley (2002), open-ended questions decreased the reliability of the MBR data compared to check-boxes (Gissler & Shelley, 2002). Therefore, a specific attention should be paid to these items since underreporting of conditions may be an issue.

Scoring the OI-FI items

The Optimality Index-US coding and scoring guidelines were used as a reference to score the items in the OI-FI. Additionally, for items with differences in the practice between United States of America and Finland, Finnish national guidelines were cited to decide limits for optimality. In the OI-US coding and scoring guidelines, special abstractors notes are given to some of the items. The notes that apply for OI-FI are listed in Appendix 3 with the actions applied in the OI-FI.

Similarly to the OI-US, optimal events are scored as 1's and non-optimal events as 0's in the scoring of the OI-FI. Additionally, items were coded as not applicable when there were an indication for it. Items that were missing were coded as 'missing' in the SPSS. The total score of each woman is based on a simple division. The numerator is the sum of all the items coded as 1's, and the denominator is the sum of the valid items for each of the woman. Items that were coded as not applicable or general missing were reduced from the denominator. First, the OI-FI scores were calculated for each of the woman in the study population. Thereafter, mean or median scores were calculated for each of the study groups.

Missing items

Fifteen items from the OI-US are not included in the OI-FI. (Table 4.3) The reason for not including the items is the lack of data in the MBR. However, most of the items could be accessed through other Finnish National Registers or hospital and maternity care records. For this study to provide feasibility, a decision was made to obtain the information from the MBR. For future application of the OI-FI, the linkage to the other registers would offer wider coverage of the items proposed in the OI-US and better quality to conduct the research.

Table 4.3 Missing items, access to the information, and relation to pregnancy and birth outcomes

Missing items	**Access to the information**	**Relation to pregnancy and birth outcomes**
Social and medical background		
Alcohol use of the mother	Information on maternal alcohol use should be available in the hospital or maternity care records.	There is no scientific evidence on safe alcohol use during pregnancy. Alcohol use during pregnancy exposes to several complications, including LBW, PTB, congenital anomalies, and fetal alcohol spectrum disorders (all the complications the baby experiences due to the maternal alcohol use). (Tiitinen, 2016b)
Drug use of the mother	Information on maternal drug use should be available in the hospital or maternity care records.	A pregnancy affected by maternal drug use is always considered as a high-risk pregnancy. Maternal drug use exposes to several complications, including LBW, PTB, and intrauterine fetal death. (Tiitinen, 2016c)
Present pregnancy, and maternal status		
Domestic violence	Information should be available in the hospital and/or maternity care records.	Pregnant women are a risk group for domestic violence (Perttu, 2015).
Non-stress test/ contraction stress test/ biophysical profile	Information should be available in the hospital and/or maternity care records.	Listed as a non-essential item in the Optimality Index-US scoring and coding guidelines (Murphy & Fullerton, 2012).
Medication use	Social Insurance Institution of Finland maintains the Register on Reimbursed Drug Purchases and the Register on Medical Special Reimbursements that contain information on maternal medication use.	Medicine use during pregnancy increase several perinatal health risks, including increased risk for PTB and LBW, and higher risk for congenital anomalies (Lahesmaa-Korpinen et al., 2014).
Parturition		

Period of time between first digital examination following rupture of membranes and birth	Information should be available in the hospital records.	It is recommended to visit the hospital at the latest of 12 hours after the rupture of membranes to examine the fetal wellbeing (Breaking of water HUS; Lapsivedenmeno PSHP, 2016).
Fetoscope, Doppler or intermittent electronic monitoring used during labor	Information should be available in the hospital records.	Information on fetal wellbeing during labor is crucial to determine any signs of fetal distress and to apply appropriate procedures (Sariola & Tikkanen, 2011b).
Presence of a support person during labor (other than care provider)	Information should be available in the hospital records.	The presence of a support person have significant benefits for the progression of labor, including spontaneous vaginal delivery without obstetric interventions, shorter labor, and better condition of the baby after the birth (Hodnett et al. 2013).
Non-directed pushing	May be documented in the hospital records.	Listed as a non-essential item in the Optimality Index-US scoring and coding guidelines (Murphy & Fullerton, 2012).
Non-supine position at birth	Information should be available in the hospital records.	Listed as a non-essential item in the Optimality Index-US scoring and coding guidelines (Murphy & Fullerton, 2012).
1st or 2nd degree laceration of perineum or perineal tissue requiring sutures	ICD-10-diagnose codes are collected in the MBR, however, information on 1st and 2nd degree lacerations is insufficient.	Perineal lacerations of 1st and 2nd degree that do not require sutures benefits the woman by avoiding discomfort of local anesthesia and suturing (Lundqvist, Olsson, Nissen & Norman, 2000).
Medication (other than oxytocin or local anesthetic for perineal repair) during the third stage of labor	Information should be available in the hospital records.	Medications to treat conditions during labor and delivery indicates that newly identified issues have occurred (Briggs & Wan, 2006).
Skin-to-skin contact	May be documented in the hospital records.	If the item is not collected in the particular purpose, coding it as missing is allowed (Murphy & Fullerton, 2012).
Neonatal condition		
Breastfeeding	Information should be available in the hospital and/or maternity care records.	Breastmilk is optimal nutrition for the baby, and additionally breastfeeding strengthens the relationship between the mother and the baby (Tiitinen, 2016a).
Maternal condition		
Prescription medications for conditions identified in intrapartum or postpartum period	Information should be available in the hospital records.	Prescribed medications indicate a medical problem, and additionally may effect on breastfeeding (Malm, Vähäkangas, Enkovaara & Pelkonen, 2008).
Maternal mortality	Statistics Finland maintains a register on causes of death.	Understandably, maternal mortality is the worst adverse outcome in labor. Fortunately, maternal mortality ratio in Finland is one of the lowest in the world and was only 5.2 per 100.000 live births in 2014 (Statistics Finland, causes of death, 2014).

4.5 Statistical methods

Non-parametric statistical methods were chosen for this study. The reason to choose non-parametric methods was the fact that the frequency distributions of the observed variables in this study were not meeting the required assumptions related to parametric statistical testing. Non-parametric tests make no assumptions about the tested variable in the population the sample is drawn, and they are also referred as distribution-free methods. Non-parametric statistical methods can be applied when the study sample do not meet the requirements for parametric methods. (Malhan & Arona, 2009) With non-parametric statistic methods the medians of the tested variables are reported. In addition to median, lower and upper interquartile is given. The lower quartile (Q1 or 25th percentile) is the value below which are a quarter of the observed values in the dataset. The upper quartile (Q3 or 75th percentile) is therefore the value below which are three-quarters of the observed values in the dataset. The median is therefore the same as 50th percentile sometimes referred as Q2. (Oliveira, 2013)

To evaluate the statistically significant difference of the OI-FI scores between the study groups a Kruskal-Wallis H Test was performed separately for primiparous women and multiparous women. If a statistically significant difference was detected with Kruskal-Wallis H Test, pairwise comparison between the groups was executed by Mann-Whitney U test to identify the groups that had a statistically significant difference in the OI-FI scores compared with ethnic Finns. The p-values from Mann-Whithey U test were multiplied by three, which is the number of the pairs in the comparison, to correct the p-values. Additionally, PBI scores and OI scores were analyzed similarly. Both Kruskal-Wallis H test and Mann-Whitney U test are rank sum tests. They test the equality of medians and the distributions. (Malhan & Arona, 2009)

The number of optimal responses to each of the OI-FI items between the study groups was also evaluated separately for primiparous women and multiparous women. This was done by using cross tabulation and Chi-Square test. Chi-Square test can be applied when each observation in the sample is independent from each other, and when the total number of observations is large enough. The Chi-Square test is only reliable if it meets two assumptions that are 1) maximum of 20% of the expected counts are below 5, and 2) none of the expected count is below 1. (Malhan & Arona, 2009) For the items that are not meeting these assumptions, Fisher's exact test was executed. Fisher's exact test does not have requirements of minimum sample size (Oliveira, 2013). If a statistically significant difference was detected, a z-test with adjusted p-values by Bonferroni method was executed to define those ethnic groups that differed from the Finns. In this study, the z-test is used to compare the percentages of the optimality of each of the item. The Bonferroni method corrects the desired significance level by the number of comparisons made (Oliveira, 2013). The z-test defines those groups that have a statistically significant difference at level $p \leq 0.05$, hence this method does not provide specific p-values for each comparison.

For all of the statistical methods the level of statistical significance was set to $p \leq 0.05$. IBM SPSS Statistics version 23.0 was used to modify the data and to execute all the analyses.

5 RESULTS

5.1 The study sample

After excluding the women with multiple pregnancy (n=22) and one case with missing information on parity, the total number of women included in the study sample was 1,495. Out of the study sample, 358 were primiparous and 1,137 were multiparous. In primiparous, the smallest group in number was Somali women (n=59) and the largest was Russians (n=116). In multiparous, the size of the groups varied from 142 in Finns to 514 in Somali women. (Table 5.1) Within ethnicity, the share of primiparous was highest in Finns (40%) and lowest in Somali (10%). The median age of the primiparous was 27 years and for the multiparous 31 years. Both in primiparous and in multiparous the youngest women were Somali (respectively 24 years, and 31 years), and the oldest were Finns (respectively 30 years, and 33 years). (Tables 5.2 and 5.3)

Most of the Kurdish were married or living with a partner both in primiparous and multiparous. The share of married primiparous in the other three ethnicities varied from nearly half in Finns to two-thirds in Russian and Somali. Around 80% of primiparous Finns and Russian were living with a partner whereas the percentage for Somali women was around 73%. The percentage of multiparous living with a partner was nearly 90% or over for all the ethnic groups. Similarly to primiparous, the share of married multiparous was lowest in Finns (69%), following Russians (around 74%) and Somali (around 83%). Variation in the number of previous births was detected in the study population. Over 60% of Finns and Russians had only one previous birth, whereas over half of Kurdish and nearly 80% of Somali women had two or more previous births. (Tables 5.2 and 5.3)

Table 5.1 Study sample by ethnicity and parity

	Ethnicity	n	%[1]	%[2]
Primipara	Finnish	97	27.1	40.6
	Russian	116	32.4	36.8
	Kurdish	86	24.0	23.4
	Somali	59	16.5	10.3
	Of total	358	24.0	
Multipara	Finnish	142	12.5	59.4
	Russian	199	17.5	63.2
	Kurdish	282	24.8	76.6
	Somali	514	45.2	89.7
	Of total	1137	76.0	
Total study sample		1495	100.0%	

[1] Within parity
[2] Within ethnicity

Both in primiparous and multiparous, the largest shares of women not smoking during pregnancy were in Kurdish and Somali women with over 90% of non-smokers. In Russians, the percentage of women not smoking was around 84% both for primiparous and multiparous. In multiparous Finns, the share was similar to Russians (around 83%), but for primiparous Finns the share of women not smoking during pregnancy was close to 70%. Additionally, when analyzing the percentages of primiparous that continud smoking after the first trimester, the percentages were unfavorable for Finns (13.4%) compared to the other three ethnicities (Russians 7.8%, Somali 7.7%, and Kurdish 2.3%). (Tables 5.2 and 5.3)

The median BMI in all of the primiparous groups was at the normal range (BMI = 18.50-24.99 kg/m²). However, close to half of the Somali women and one-third of Kurdish were overweight. Additionally, nearly 30% of primiparous Finns were overweight, whereas only 10% of Russian women were overweight. In multiparous Kurdish and Somali, the median BMI exceeded the limit for overweigh (BMI ≥ 25 kg/m²), and additionally, the share of overweight was close to two-thirds. For multiparous Finns and Russians, the median BMI remained within normal limits, but one-third of Finns and quarter of Russians were overweight. (Tables 5.2 and 5.3)

Prenatal care

On an average, the initiation of first prenatal visit occurred during the first trimester in all of the ethnic groups. Within primiparous, the timing of the first visit varied from 8+2 weeks of gestation in Finns to 9+0 weeks of gestation in Somali women. Similarly, in multiparous Finns had their first visit earliest at 8+5 weeks of gestation and Somali women latest at 10+2 weeks of gestation. The median number of prenatal visits in primiparous varied from 11.5 visits in Somali women to 13 visits in Russian and Kurdish. In multiparous, Somali women had least visits (10) compared to 12 visits for Finns and Russians. (Tables 5.2 and 5.3)

Table 5.2 Description of primiparous

	Finnish	Russian	Kurdish	Somali
Marital status				
Married	46.4%	66.4%	86.0%	66.1%
Missing data	0.0%	0.0%	0.3%	0.0%
Living with a partner	80.4%	82.8%	95.3%	72.9%
Missing data	9.3%	6.0%	3.5%	6.8%
Age in years, median (q1, q3)	30 (26, 34)	28 (25, 32)	26 (23, 29)	24 (22, 27)
Smoking status				
No smoking	72.2%	84.5%	93.0%	91.5%
Quit smoking during 1st trimester	12.4%	6.0%	2.3%	0.0%
Smoking after 1st trimester	13.4%	7.8%	2.3%	7.7%
Missing data	2.1%	1.7%	2.3%	5.1%
BMI (kg/m²)				
Median (q1, q3)	22.95 (20.36, 25.80)	20.55 (19.25, 22.31)	23.17 (20.47, 26.49)	23.74 (20.83, 27.14)
< 18.50 kg/m²	7.4%	9.3%	3.8%	3.6%
18.50-24.99kg/m²	63.8%	79.6%	62.5%	50.9%
≥ 25 kg/m²	28.7%	11.1%	33.8%	45.5%
Missing data	3.1%	6.0%	7.0%	6.8%
Prenatal care				
Median visits (q1, q3)*	12 (10.25, 15)	13 (11, 14)	13 (10, 15)	11.5 (9, 12.75)
Missing data	5.2%	2.6%	2.3%	5.1%
Hospital visits	2 (1, 4)	2 (1, 4)	3 (1.5, 5)	3 (1.75, 4)
Missing data	1.0%	0.9%	1.2%	1.7%
Initiation of 1st visit (weeks+days)	8+2 (7+4, 9+3)	8+4 (7+4, 9+4)	8+3 (7+4, 9+4)	9+0 (8+1, 11+5)
Missing data	3.1%	0.9%	1.2%	6.8%

*Visits include visits to maternity care clinic, perinatal screening, and private physician's office

Table 5.3 Description of multiparous

	Finnish	Russian	Kurdish	Somali
Marital status				
Married	69.0%	74.4%	91.1%	83.3%
Missing data	0.0%	0.0%	0.4%	0.2%
Living with a partner	93.7%	89.9%	96.5%	89.1%
Missing data	3.5%	4.5%	1.4%	2.5%
Age in years, median (q1, q3)	33 (29, 36)	32 (28, 36)	31 (28, 35)	31 (26, 36)
Smoking status				
No smoking	83.1%	84.4%	93.6%	95.9%
Quit smoking during 1st trimester	3.5%	3.5%	0.7%	0.6%
Smoking after 1st trimester	9.2%	10.1%	4.6%	1.8%
Missing data	4.2%	2.0%	1.1%	1.8%
BMI (kg/m^2)				
Median (q1, q3)	23.71 (21.48, 26.35)	21.97 (20.20, 25.14)	25.96 (23.34, 29.28)	26.81 (23.32, 30.48)
< 18.50 kg/m^2	5.2%	10.3%	0.8%	5.0%
18.50-24.99kg/m^2	63.4%	64.0%	39.5%	30.8%
≥ 25 kg/m^2	31.3%	25.7%	59.8%	64.2%
Missing data	5.6%	11.1%	7.1%	5.6%
Previous births				
Median (q1, q3)	1 (1, 2)	1 (1, 2)	2 (1, 2)	3 (2, 5)
One previous birth	62.7%	67.8%	47.9%	21.2%
Two or more previous births	37.3%	32.2%	52.1%	78.8%
Prenatal care				
Number of visits, median (q1, q3)*	12 (10, 14.75)	12 (9, 14)	11 (9, 14)	10 (8, 12)
Missing data	1.4%	1.5%	1.4%	2.9%
Hospital visits	3 (1, 5)	2 (1, 4)	3 (1, 5)	3 (1, 5)
Missing data	0 %	0.5%	0 %	0.6%
Initiation of 1st visit (weeks+days)	8+5 (7+6, 9+5)	9+0 (8+1, 10+4)	9+2 (8+0, 10+5)	10+2 (8+5, 13+4)
Missing data	3.5%	0.5%	0 %	0.5%

* Visits include visits to maternity care clinic, perinatal screening, and private physician's office

5.2 The OI-FI results by parity and ethnicity

Primiparous

The PBI scores were statistically significantly higher in primiparous Finns compared with the other ethnicities ($p \leq 0.001$ in all). Both the OI scores and OI-FI scores were statistically significantly higher in primiparous Finns compared with Somali women ($p \leq 0.001$ in both). The median OI-FI scores varied from 84.85 in Finns, and Russians, to 84.61 in Kurdish and 78.79 in Somali women. (Table 5.4)

Multiparous

The PBI scores were statistically significantly higher in Finns compared with Russian, Kurdish, and Somali women ($p \leq 0.001$ in all). The OI-FI scores were statistically significantly higher in Finns compared with Kurdish and Somali women ($p \leq 0.001$ in both). Additionally, the comparison between Russian and Finns was nearly at the level of statistical significance ($p = 0.051$). Finns had the highest OI-FI scores of 89.74, following Russians 87.18, Kurdish 86.49, and Somalians 84.62. There were no statistically significant difference in the OI scores between Finns and the other three ethnicities. However, the p-value of the comparison between Somali women and Finns was close to the level of statistical significance ($p = 0.054$). (Table 5.4)

Table 5.4 Perinatal Background Index (PBI), Optimality Index (OI), and Optimality Index-Finland (OI-FI) scores and p-values from Mann-Whitney U test between Finns and the migrant women of Russian, Kurdish, and Somali origin

		PBI median (Q1, Q3)	p-value	OI median (Q1, Q3)	p-value	OI-FI median (Q1, Q3)	p-value
Primiparous	Finnish (97)	83.33 (80.00, 83.33)		85.19 (80.74, 91.81)		84.85 (81.25, 90.91)	
	Russian (116)	83.33 (66.67, 83.33)	**≤0.001**	86.96 (81.48, 92.59)	1.62	84.85 (78.92, 87.88)	0.372
	Kurdish (86)	83.33 (66.67, 83.33)	**≤0.001**	85.19 (81.48, 88.89)	2.379	84.61 (78.79, 87.88)	0.09
	Somalian (59)	66.67 (66.67, 83.33)	**≤0.001**	81.48 (76.00, 85.19)	**≤0.001**	78.79 (74.19, 83.33)	**≤0.001**
Multiparous	Finnish (142)	90.91 (83.33, 91.67)		91.30 (86.51, 92.59)		89.74 (84.62, 92.31)	
	Russian (199)	83.33 (75.00, 88.89)	**≤0.001**	92.59 (85.19, 96.30)	1.728	87.18 (82.35, 92.11)	0.051*
	Kurdish (282)	80.91 (75.00, 83.33)	**≤0.001**	88.89 (85.19, 92.59)	0.261	86.49 (82.05, 89.74)	**≤0.001**
	Somalian (514)	75.00 (66.67, 83.33)	**≤0.001**	88.89 (84.00, 92.59)	0.054*	84.62 (79.49, 89.19)	**≤0.001**

* On the borderline of statistical significance ($p \leq 0.05$)

5.3 Optimality of the OI-FI items by parity and ethnicity

Primiparous

Having an optimal marital status was more common for Kurdish women (98.8%) compared with Finns (88.6%, $p \leq 0.05$). The difference in the percentages of women not smoking during pregnancy was statistically significant between Finns, and Kurdish and Somali women. Out of Kurdish 95.2% and out of Somali women 96.4% did not smoke during pregnancy compared with 73.3% in Finns ($p \leq 0.05$ in both). Finns (80.4%) experienced less other serious antepartum conditions and complications in pregnancy than Somali (61.0%) women ($p \leq 0.05$). Having optimal prenatal care was statistically significantly more common for Finns (87.9%) than for Somali (68.5%) women ($p \leq 0.05$). (Table 5.5)

When analyzing different procedures and complications in labor, only 27.2% of Somali women did not have an episiotomy performed compared with 58.3% of Finns ($p \leq 0.05$). Optimal one minute Apgar scores (7-10) were less likely in Somali (81.0%) newborns compared to Finns (94.8%, $p \leq 0.05$). Additionally, Somali newborns (76.3%) were more likely to be transferred to neonatal care compared to Finnish newborns (92.8%, $p \leq 0.05$). (Table 5.5)

Multiparous

Similarly to primiparous, the difference in the percentages of multiparous women not smoking during pregnancy was statistically significant between Finns, and Kurdish and Somali women. Out of Kurdish 94.6% and out of Somali women 97.6% did not smoke during pregnancy compared with 86.8% in Finns ($p \leq 0.05$ in both). Finns (63.4%) had more often an optimal pre-pregnancy BMI compared with Somali and Kurdish (respectively, 30.8% and 39.5%, and $p \leq 0.05$ in both). Optimal participation for prenatal care was more common for Finns (86.9%) compared with Kurdish (75.2%, $p \leq 0.05$) and Somali women (51.8%, $p \leq 0.05$). Finns were more likely to undergo amniocentesis compared to Somali ($p \leq 0.05$). (Table 5.5)

Experiencing other serious antepartum conditions or complications was less likely for Finns (85.9%) compared with Somali and Kurdish women (respectively, 59.9% and 69.5%, $p \leq 0.05$ in both). Finns had undergone previous CS more often than Russians had ($p \leq 0.05$). In addition to previous CS, statistically significant difference for the need for CS in current pregnancy was detected between Russians and Finns ($p \leq 0.05$), where 93.5% of Russians did not need a CS compared with 83.1% of Finns. The results revealed a statistically significant difference on pain relief during labor between Somali women (74.4%) and Finns (51.2%, $p \leq 0.05$). Somali women used epidural, spinal or combined spinal-epidural analgesia for labor pain less often than Finns did. (Table 5.5)

Table 5.5 Percentages of optimal responses to the OI-FI items

	Primipara				Multipara			
	Finnish	Russian	Kurdish	Somalian	Finnish	Russian	Kurdish	Somalian
Perinatal Background Index								
Social and medical background								
Marital status	88.6%	88.1%	**98.8%**	80.0%	97.1%	95.3%	98.6%	92.6%
No ethnic minority	100 %	**0 %**	**0 %**	**0 %**	100 %	**0 %**	**0 %**	**0 %**
No smoking	73.7%	86.0%	**95.2%**	**96.4%**	86.8%	86.2%	**94.6%**	**97.6%**
BMI 18.5-24.99 kg/m²	63.8%	79.6%	62.5%	50.9%	63.4%	64.0%	**39.5%**	**30.8%**
Age 18-40 years	96.9%	98.3%	97.7%	98.3%	95.1%	92.5%	94.7%	93.0%
No pre-existing chronic disease	99.0%	99.1%	98.8%	98.3%	98.6%	99.5%	98.9%	97.3%
Interpregnancy interval 18-60 months	-	-	-	-	45.0%	41.8%	55.6%	42.4%
No previous preterm delivery	-	-	-	-	91.5%	96.0%	94.0%	88.3%
No previous intrauterine fetal death	-	-	-	-	97.9%	99.5%	96.5%	93.2%
No previous CS	-	-	-	-	75.4%	**88.4%**	81.9%	68.7%
No previous baby weight less than 2500gr	-	-	-	-	91.3%	95.4%	91.3%	89.1%
No history of other serious antepartum complications	-	-	-	-	94.4%	97.0%	94.3%	89.7%
Optimality Index								
Present pregnancy								
No intrauterine fetal death	100 %	100 %	98.8%	100 %	100 %	100 %	100 %	99.2%
No other serious antepartum condition or complication	80.4%	83.6%	70.9%	**61.0%**	85.9%	85.4%	**69.5%**	**59.9%**
Prenatal care	87.9%	85.7%	81.9%	**68.5%**	86.9%	79.4%	**75.2%**	**51.8%**
No amniocentesis	96.9%	95.7%	98.8%	100 %	96.5%	94.5%	96.8%	**99.4%**
Parturition								
Clear amniotic fluid	99.0%	100 %	98.8%	91.5%	100 %	100 %	99.6%	99 %
No induction or augmentation of labor	35.2%	39.8%	32.1%	22.4%	60.8%	60.9%	51.5%	53.6%
No amniotomy	50.5%	48.3%	58.1%	39.0%	42.3%	44.7%	37.6%	44.7%

No oral or injectable medication during labor	92.8%	95.7%	89.5%	96.6%	96.5%	99.0%	95.4%	98.4%
No epidural, spinal or combined spinal-epidural analgesia for labor	30.8%	38.0%	35.7%	46.6%	51.2%	50.0%	56.4%	**74.4%**
No fetal heart rate abnormalities	87.6%	93.1%	89.5%	83.1%	97.2%	97.0%	95.0%	94.2%
Labor occurred in the place originally intended	100 %	100 %	100 %	98.3%	99.3%	100 %	99.6%	99.2%
Cephalic presentation at birth	94.8%	94.0%	95.3%	98.3%	96.5%	97.5%	96.5%	98.8%
No instrumental vaginal delivery	77.8%	82.1%	73.5%	72.7%	97.5%	97.3%	95.2%	97.1%
No Cesarean section*	74.2%	81.9%	79.1%	74.6%	83.1%	**93.5%**	87.9%	81.5%
No episiotomy	58.3%	57.9%	48.5%	**27.2%**	89.8%	91.4%	91.9%	91.2%
No 3rd or 4th degree laceration	100 %	98.3%	98.8%	100 %	100 %	99.5%	99.6%	99.2%
No placental retention	95.8%	97.9%	100 %	100 %	94.9%	96.8%	94.4%	97.4%
No postpartum hemorrhage	93.8%	94.0%	98.8%	91.5%	94.4%	97.5%	94.0%	95.5%
No blood transfusion	95.9%	94.8%	97.7%	89.8%	97.2%	99.0%	97.5%	95.3%
No other serious intrapartum complication	99.0%	95.7%	97.7%	98.3%	99.3%	99.5%	98.6%	97.5%
Neonatal condition								
Estimate of gestational age 37-42 weeks	90.7%	91.4%	93.0%	83.1%	93.0%	95.0%	94.3%	88.3%
Birth weight 2500-4000 grams	81.4%	83.6%	91.9%	86.4%	79.6%	79.4%	85.1%	81.7%
Apgar score at 1 minute (7-10)	94.8%	94.8%	92.9%	**81.0%**	97.2%	97.0%	94.0%	93.1%
No transfer to neonatal care	92.8%	85.3%	87.2%	**76.3%**	88.7%	92.0%	92.6%	90.9%
No congenital anomalies	87.6%	94.0%	95.3%	93.2%	93.7%	92.0%	95.4%	93.4%
No birth trauma or other serious medical problem	93.8%	86.2%	89.5%	81.4%	95.1%	92.0%	93.6%	93.8%
No perinatal death	100 %	100 %	98.8%	100 %	100 %	100 %	100 %	98.8%
Maternal condition								
No fever or provider diagnosis of infection or major complication	100 %	100 %	97.7%	100 %	100 %	100 %	100 %	99.8%

Statistically significant difference ($p \leq 0.05$) compared with Finns as the reference group by z-test with adjusted p-values by Bonferroni method

* Percentages include all women (special notes (Appendix 3) not applied)

6 DISCUSSION

6.1 Main results

The purpose of this Master's thesis was to evaluate the feasibility of the Medical Birth Register (MBR) data to construct a new measurement tool OI-FI to measure the process and outcome of the Finnish maternity care. Additionally, the capability of the OI-FI to detect differences and similarities between the groups under investigation was assessed by calculating PBI, OI and OI-FI scores, and item optimality for each of the study group. Previous literature supported to apply the instrument, especially in countries with high quality maternity care, and low-risk population for adverse pregnancy and labor outcomes. The instrument is developed to be used as an aggregate measure to describe the overall maternity care outcomes of a particular group, institution, or region. Based on the items in the OI-US, availability of data in the MBR, Finnish national guidelines, and high quality evidence-based practice, 40 items were included in the new instrument OI-FI.

The PBI, OI, and OI-FI scores were calculated for primiparous and multiparous, and compared between Finns and migrant women of Russian, Kurdish, and Somali origin. The PBI scores were higher in both primiparous and multiparous Finns compared to the other three ethnicities. The PBI is based on to standard epidemiological markers of perinatal risk and it is used to detect the equivalence or difference between the compared groups (Murphy & Fullerton, 2012). The difference in the PBI scores tells that the migrant women of Russian, Kurdish, and Somali origin had greater perinatal risk compared with ethnic Finns. Although, when analyzed separately the optimality for each of the OI-FI items, the detected statistically significant differences were unfavorable for Finns for marital status and smoking during pregnancy in primiparous women, and for smoking during pregnancy and a history of CS in multiparous women. However, in multiparous women, Finns had more often an optimal pre-pregnancy BMI compared with Somali and Kurdish. These results of single items may seem contradictory to the results from the PBI scores. Scoring ethnicity have influenced on the PBI scores since the percentages from the other PBI items are not excessively favorable for Finns. In this study, the decision to include all possible items from the original OI-US was made, and as previous research has shown, belonging to an ethnic minority group have indeed influence on pregnancy and birth outcomes (Kahlil et al. 2013; Castaneda et al. 2012; Lu & Halfon, 2003; Malin & Gissler, 2009; Malin, 2011; Willis, McManus, Magallanes, Johnson & Majnik, 2014). However, it is important to consider how including ethnicity have influenced the PBI scores.

Whereas the PBI is used to describe the study groups, the OI is dependent on the particular practice and is affected by the policies and practices on the institution or setting it is used to measure (Murphy & Fullerton, 2012). Primiparous Somali women had lower OI scores compared with Finns. The items with statistically significant difference were having other serious antepartum conditions or complications in present pregnancy, having an optimal prenatal care, experiencing episiotomy, having an optimal one-minute Apgar scores, and being transferred to neonatal care. Additionally, in many other OI items primiparous Finns had more optimal outcome compared with primiparous Somali women but the differences were not statistically significant. (Table 5.5) In multiparous, the difference in the OI scores did not reach the level of statistical significance in any of the comparisons. However, the difference in the OI scores between Somali women and Finns was nearly at the level of statistical significance ($p = 0.054$) suggesting that perhaps a significant difference exist between these two groups. Both in primiparous and multiparous, Finns had higher OI-FI scores compared with Somali women. As Finns had higher PBI scores both in primiparous and multiparous, and higher OI scores in primiparous compared with Somali women, it was expected that the OI-FI scores differ similarly. According to the lower PBI scores in Somali women, it seems that Somali women have greater perinatal risk for medical conditions and complications during pregnancy and labor compared with Finns. Additionally, poorer OI scores of primiparous Somali strengthen this assumption. As it has been said that the OI scores are influenced by the care provider and current practice, this could partially explain the difference in the OI and OI-FI scores. However, the data for this study is from several birth facilities in Finland. Therefore, it is highly unlikely that the OI and OI-FI scores of

Somali women would be influenced by different practices and policies in various birth settings. In addition, multiparous Kurdish had lower OI-FI scores than multiparous Finns, and the difference between multiparous Russian and Finns was almost at the level of statistical significance ($p = 0.051$). As for both of these groups, the PBI scores were lower than for Finns, it seems that the risk for adverse pregnancy and birth outcomes is increased in all of the multiparous ethnic minority groups in this study.

As expected according to the literature review, this study revealed differences in the OI-FI scores between the ethnic groups. The unfavorable status of Somali women is not a new, yet an alarming issue. As the OI-FI, OI, and PBI scores were lower in Somali women compared with Finns, improvements in the maternity care of Somali women are in place during the entire pregnancy and rather even before conception.

6.2 Strengths and limitations of the study

Strengths of the study

The OI-FI offers a new way to measure the process and outcome of maternity care shifting the perspective from illness to health. As demedicalization of normal pregnancy and birth is the ideology of current maternity care, the OI-FI provides an interesting and topic way to study pregnancy and birth (Chalmers et al. 2001). As the number of adverse events in maternity care in Finland are rare, conducting studies to detect them has become expensive due to the need for large study samples. The OI-FI is developed to study low-risk population, thus it would be useful in Finland. The OI-FI could be used as the first measurement tool to detect an overall tendency towards lower optimality scores in one institution or part of Finland compared to another with similar patients. If difference in the optimality scores is detected it could mean that there is difference in the process of care. However, judging the process and outcome of care in one institution completely based on the results from the OI-FI is not the purpose of the instrument yet it may reveal significant differences. Additionally, the OI-FI is not detecting a change in the need for care. Therefore, an investigation to examine the indication for procedures or reasons for complications is always essential before making any judgement on one's practice. In addition, the OI-FI offers a standardized way to measure maternity care.

While using the MBR to conduct the study, the content of the MBR related to the items proposed in the OI-US has been under evaluation. The MBR includes majority of the items that were proposed in the OI-US. Out of the five clinical domains, the items in the social and medical background of the mother, and neonatal condition were comprehensively represented in the MBR. Over 85% of the items in these two clinical domains were obtained from the MBR. Additionally, reasonably comprehensive coverage was obtained for present pregnancy and maternal status (57.1%), and parturition (66.7%). However, the clinical domain containing information on the condition of the mother prior to discharge from the birth facility had only one-third of the items in the MBR that were proposed in the OI-US. Overall, the MBR offered a comprehensive data for this study.

In the beginning of 2017 a new MBR form was established. The new form contains items that are included in the OI-US, but were not included in the previous MBR form. The new items are, electronic fetal monitoring, the incidence and the amount of postpartum hemorrhage, and breastfeeding. Additionally, item describing induction has been divided to induction and/or augmentation separately. (Aittomäki et al. 2016) Continuous evaluation of the content of the MBR form is important. The OI-US provides a list of items that have been evaluated by a team of professionals in the field of midwifery and obstetrics hence it could be considered as a reference for the collection form update. Timely and good quality data that is collected nationwide provides a feasible and reliable ground for future research.

The study sample included women who took part in either Maamu Study or Health 2011 Survey. Participation in the Maamu Study varied, and in general, Russian were more active to participate compared to Somali and Kurdish. Additionally, women were more active to participate than men were, married people participated more actively than unmarried, people aged 35 years and more were more active than younger people, and people living in Tampere, Turku, and Vaasa participated more actively than people living in Helsinki. Lot of resources were used to reach the invitees in the Maamu Study, and people representing the three migrant origins were recruited for the data collection to offer culturally competent interviewers that spoke the native language of the participants. The participation to Maamu Study was at the same level with Health 2011 Survey. The study sample in Maamu Study represents relatively well the populations of Russian, Kurdish, and Somali origin living in Finland. (Castaneda et al. 2012) The Health 2011 Survey was based on a representative sample of Finnish population, except related to immigration. The study sample excludes people that immigrated to Finland after the year 2000. However, Maamu Study contains comparable information on immigrants. Similarly, in Health 2011 Survey women were participating more actively than men were, and older people were more active than younger people were. Statistical methods were used to adjust for non-participation. (Lundqvist & Mäkiopas, 2016) By this, it is possible to conclude that the four groups in this study represents relatively comprehensively the populations of Finns and migrant women of Russian, Kurdish and Somali origin.

The data in the MBR is based on the documentation of the health care provider. The MBR is a reliable source of data and especially information that is collected by using check-boxes has been evaluated to be on high quality (Gissler & Shelley, 2002). However, especially information on the MBR that is documented by using open-ended questions may be underrepresenting some conditions or complications occurring in pregnancy and labor. For example, lack of documenting ICD-10 codes certainly have an impact on the results in this study. More accurate information on diseases and complications, and performed medical procedures could be obtained from Care Register for Health Care maintained by THL. On the other hand, using a national register gives the study reliability since the information is consistent. Additionally, differences on documenting the MBR information between the ethnic groups in this study seem highly unlikely. As a conclusion, MBR offers a reliable and comprehensive source of data to conduct scientific research.

The OI-FI includes many items describing the perinatal background of the women. When thinking about confounding factors that might have influenced on the study results, it seems that most of the usual confounders are included in the Optimality Index-FI. However, there is always a possibility of confounding although for this study design it seems quite unlikely. Additionally, the OI-FI is not measuring a causal relationship of certain risk and outcome, but is rather used as an aggregate measure to describe the overall maternity care outcomes.

Limitations of the study

The most important limitation of the OI-FI is the number of missing items compared to the original OI-US. In the User Guidelines and Toolkit for the use of the OI-US two statements on the issue of missing items has been made. Primarily, it is critical that each clinical domain is presented including each of the items that are designated as essential. And secondly, at least 50% of the items should be remained in each clinical domain. However, in particular context items can be declared as general missing (data that will never be found in these records, and will not be collected for this particular purpose) although the item is coded as essential. (The OI-US User Guidelines and Toolkit, 2012.) In the OI-FI essential items are missing but in this case they can be declared as general missing since they are not collected in the MBR. However, the issue of one of the clinical domains including less than 50% of the items is a critical issue that needs to be addressed, and have indeed impact on the validity of the OI-FI. In the OI-US there are three items in the clinical domain “Condition of the mother prior to discharge”. The items are fever while mother remain in the birth setting or provider diagnosis of infectious process or major complications, prescription medications for conditions newly identified in intrapartum or postpartum period, and maternal mortality. By using the MBR, the only item that could be obtained was fever while mother remain in the birth setting or provider diagnosis of infectious process or major complications. Maternal mortality is really rare in Finland. The Statistics Finland maintains a database on the causes of death. The incidence that a maternal death would have occurred in the data used for this study is highly unlikely yet possible. Social Insurance Institution of Finland maintains two registers: The Register on Reimbursed Drug Purchases and the Register on Medical Special Reimbursements that contain information on maternal prescription medicine use and drug reimbursements. Therefore, prescription medications for conditions newly identified in intrapartum or postpartum period could been obtained in these registers, however the feasibility of the information would have been an issue. Additionally, both of these items would have been available in the hospital records, however, a decision was made to use the MBR to construct the OI-FI and to conduct the study as the information in MBR is reliable and feasible. As said, the validity of the OI-FI is questionable and the results cannot be trusted as such, yet they can be used to predict the direction of the optimality scores between the study groups.

Other important limitation of the study is the possible underreporting of certain conditions in the MBR that are reported by using the ICD-10 codes. Eleven items were completely or partially based on the ICD-10 codes. The inclusion of the items that could be obtained from the ICD-10 codes was discussed with a Research Professor at THL. Congenital anomalies are reported as ICD-10 codes in the MBR. However, a separate Register of Congenital Malformations, maintained by THL is used to systematically collect data on congenital anomalies. Some inadequacy of information in the MBR may exist compared to the Register of Congenital Malformations. In the MBR only conditions identified within the first seven days of life are reported. However, this serves well with the OI-FI since it is designed to detect the condition of the newborn during the first days of life. OI-FI items placental retention, postpartum hemorrhage, consistency of the amniotic fluid, and fetal heart rate abnormalities were partially based on the ICD-10 codes and partially on the information in the MBR. It is probable that documenting these conditions is somehow inadequate in the MBR thus the data used for this study included the ICD-10 codes for these conditions. However, variation between practitioners and hospitals exist on the documentation protocols on how these conditions are defined. Therefore, it is quite probable that these issues are actually more frequent in the study sample than they are in the MBR. In addition to these OI-FI items, six more items including information on other serious medical problems, conditions and complications related to pregnancy and delivery, were formed by using the ICD-10 codes. The same issues as for the other items are existent on these as well. Additionally, THL maintains a Care Register for Health Care that include data on the treatment received by the patient or client, including but not restricting reason for seeking care, diagnoses, and procedures and interventions. Combining this register with the MBR would have been beneficial to obtain more reliable information on the diagnosis, however, it would have impacted on the feasibility to conduct the study. Additionally, one purpose of this study was to evaluate how well the MBR would serve as the source of data to conduct the study using the OI-FI. Therefore, one could claim that using the MBR is indeed a limitation to conduct the study.

Sample size

The sample size for this study was determined by the number of women with singleton delivery between the years 2004-2014, and by the woman's participation for either Health 2011 Survey or Maamu Study. One case was excluded since reliable information on parity was absent. The sample size for primiparous women was 358, and for multiparous women 1,137. The sizes of the ethnic groups varied in primiparous from 59 Somali women to 116 Russian women, and in multiparous from 142 Finnish women to 514 Somali women. It seems that the sample size was big enough to detect the equivalence or difference between the compared groups. Statistically significant differences were obtained between Finns and the migrant origin women.

6.3 Comparison to previous research

The main results of this study are in accordance with the results from previous studies comparing the access to and use of maternity care services between Finns and ethnic minority populations living in Finland. As this study shows a statistically significantly lower total OI-FI scores for Somali women (both primiparous and multiparous) and for multiparous Kurdish compared to Finns, similar findings were reported in the study of Malin and Gissler (2009) where migrant women with Somali origin experienced more health problems during pregnancy and labor compared with Finns (Malin & Gissler, 2009). Additionally, the median PBI scores were statistically significantly higher for primiparous and multiparous Finns compared to the other three ethnicities, which speaks up to the adequate utilization of prenatal care of Finns and the better balance in health prior pregnancy. The results of this study reflects the unfortunate trend in the inequality in reproductive health between different ethnicities (Kahlil et al. 2013; Lu & Halfon, 2003; Willis et al. 2014). The results from the comparison of the optimality of each item in the OI-FI between the ethnic groups showed similar direction as the results from the study of Malin and Gissler (2009). When evaluating the feasibility of the OI-FI to measure the process and outcome of the Finnish maternity care this similarity of the results supports the feasibility of the instrument to detect differences between these ethnic groups.

The high percentage of primiparous Finns smoking during pregnancy is quite alarming, as around quarter of the women reported smoking. Additionally, the share of primiparous Finns that continued smoking after 1st trimester was nearly two-fold compared to Russians and Somali, and almost six-fold compared to Kurdish. Although, the latest perinatal statistics of Finland show that smoking during pregnancy is more common in younger mothers compared to older mothers (Vuori & Gissler, 2016), yet the difference to other ethnicities was significant. The percentage of primiparous Finns that continued smoking after 1st trimester was 13.4%, which was similar to the percentage of smoking among Finns (14.8%) in the study of Malin and Gissler (2009). As smoking has adverse impact on pregnancy and birth outcomes (Catov et al. 2008; Cnattingius, 2004; Ekblad et al. 2015; Erickson & Arbour, 2012; Salihu & Wilson, 2007), women should be encouraged to cease smoking most favorable before conception but latest when finding out on pregnancy.

According to the results from this study, being overweight is more common in Somali and Kurdish parturients compared with Finns. Additionally, the percentage of overweight parturients was higher in multiparous women compared to primiparous women in all ethnicities. The latest national statistics show that every third parturient is overweigh in Finland (Raatikainen, 2007; Vuori & Gissler, 2016). What is concerning is that nearly half of primiparous Somali, two-thirds of multiparous Somali, and nearly 60% of multiparous Kurdish were overweight. Overweight and obesity are associated with several adverse outcomes in pregnancy and labor (Klemetti & Hakulinen-Viitanen, 2013; Kriebs, 2009; Metsälä et al. 2016; Nelson et al. 2010; Watkins et al., 2003). Additionally, maternal obesity is one of the major determinant of pregnancy outcome (Nelson et al. 2010). The proportion of underweight women was higher in prmiparous Finns compared with Kurdish and Somali, and higher or similar in multiparous. For Russian women the proportion of underweight parturients was higher both in primiparous and multiparous compared with Finns. Pre-pregnancy underweight of the mother increases the risk of LBW infants (Catov et al. 2008) and PTB (Hauger et al. 2008; Hoellen et al., 2014).

Both smoking and abnormal BMI are factors that can be influenced by public health programs and campaigns. Based on the results from this study, the percentages of smoking is similar as in previous research. The high percentages of overweight Somali and Kurdish women is an alarming public health issue. Especially together with poorer PBI, OI, and OI-FI scores for Somali women and poorer PBI and OI-FI scores for multiparous Kurdish compared with Finns, improvements on health education for Somali and Kurdish women should be implemented on public health programs to reduce overweight in these ethnic populations. In addition to BMI, primiparous and multiparous Somali, and multiparous Kurdish experienced more frequently other serious antepartum complications in pregnancy compared with Finns. The list of complications included anemia, GDM, psychiatric history, placenta previa, preeclampsia, pyelonephritis, Rh sensitization, and vaginal bleeding in 2nd or 3rd trimester. Out of these complications, GDM, and preeclampsia has been associated with maternal overweight (Chung et al. 2012; Klemetti & Hakulinen-Viitanen, 2013; Kriebs, 2009). If the pre-pregnancy weight status of Somali and Kurdish women would be improved, it could have positive impact on the prevalence on the complications associated with overweight and obesity.

This study repeats the undesirable trend of ethnic minority women using the prenatal care less adequately compared to the main population. Especially the lower utilization of prenatal care services in primiparous and multiparous Somali compared with Finns is worrisome together with lower PBI, OI and OI-FI scores. Studies have shown that belonging to an ethnic minority population is connected to inadequate utilization of prenatal care services (Choté et al. 2011; Ny et al. 2007) and additionally, the initiation for antenatal care may be delayed in ethnic minority populations (Rowe et al. 2008). However, lower number of visits in the prenatal care does not seem to increase the risk for adverse pregnancy and birth outcomes in low risk pregnancies (Dowswell et al. 2010; Villar & Bergsjø, 1997) whereas timely initiation of the first visit seems to play a bigger role (Villar & Bergsjø, 1997). In the study of Malin and Gissler (2009), participation in prenatal care was similar to ethnic minority women and for Finns. Whereas in this study the optimal number of visits was 8 for multiparous and 9 for primiparous women with initiation prior to 12 weeks of gestation, the study of Malin and Gissler (2009) compared the average prenatal visits between the ethnic groups. In a qualitative study (2013), the perceptions and experiences of Somali mothers towards the reproductive and maternity health care services in Finland was evaluated by interviewing 70 Somali mothers who had lived in Finland at least for one year and had their medical records in Finland. The main finding was that Somali women were satisfied with the care they received in Finland. With cultural and communication competencies of health care professionals the experiences and perceptions varied more. The main reason for the care being culturally incompetent was the lack of language skills of the Somali women and the lack of knowledge of Somali culture by the health care professionals. Most of the Somali women did not have common language (Finnish or English) with the health care professionals and it affected to the women's perceptions and experiences. (Degni et al., 2013) It is possible that the lack of language skills and the perceptions of other women from the same ethnic community influence the decision of the participation on prenatal care.

The association of ethnicity and differences in the rates for CS is well known (Anderson et al. 2013; Braveman et al. 1995; Edmonds et al. 2014; Khalil et al. 2013; Malin & Gissler, 2009; Vangen et al. 2000). In this study, primiparous Russian had less often a CS and had experienced previous CS less often than women with Finnish origin. In the study of Malin and Gissler (2009) primiparous migrant women had a CS less often than Finns (Malin & Gissler, 2009). Although, in this study the difference was statistically significant only between primiparous Russian and Finns, the direction was similar to previous research in

Finland. Additionally among primiparous, only around one-third of Somali women did not have episiotomy during labor compared with nearly two-thirds of Finns. The explanation for the higher rates of episiotomy in primiparous Somali compared with Finns is out of the reach of this study.

In this study multiparous Somali women were having an epidural, spinal or combined spinal-epidural analgesia for labor pain less frequently than Finns. This differs from the results from the study of Malin and Gissler (2009) where ethnic Finns received epidural analgesia less often than ethnic minority women. This difference may be explained by the decision to include spinal and combined spinal-epidural analgesia in the analysis.

Among primiparous, to receive optimal one-minute Apgar scores (7-10) was more likely for newborns of Finns compared to Somali newborns. Additionally among primiparous, Finnish newborns were less likely to be transferred to neonatal care compared to newborns of Somali women. In the study of Malin and Gissler (2009), African and Somali newborns had the lowest one-minute Apgar scores, and additionally, newborns of migrant origin women needed intensive care more often than Finnish newborns. In addition to lower Apgar scores, Somali newborns had higher rate for perinatal mortality in the study of Malin and Gissler. (Malin & Gissler, 2009) The results of this study did not find a statistically significant difference on the percentages of perinatal death. However, the only cases of perinatal deaths appeared in ethnic minority groups.

The results from this study show that Somali women had poorer pregnancy and labor outcomes compared with Finns. Similar findings were reported in a Norwegian study comparing perinatal complications between Norwegian women and women with Somali origin (Vangen at al. 2002). A results of a Finnish study showed that the prevalence of female genital mutilation was nearly 70% among women with Somali origin and around 30% among women with Kurdish origin living in Finland. Around quarter of the Somali women and nearly 40% of the Kurdish women reported problems related to reproductive health or other health problems due to the female genital mutilation. Female genital mutilation is associated with several adverse outcomes related to childbirth, including prolonged labor, obstruction, perineal tears, and postpartum hemorrhage. (Koukkula et al. 2016) Additionally, adverse neonatal outcomes, including asphyxia, and perinatal death have been associated with female genital mutilation. (WHO Female genital mutilation, 2006; Rushwan, 2000.) In the WHO's study, the findings showed that an estimated of one to two extra perinatal deaths per 100 deliveries occur due to female genital mutilation (WHO Female genital mutilation and obstetric outcome, 2006). The common feature in these studies on female genital mutilation and adverse pregnancy and labor outcomes is that the more serious the female genital mutilation is the greater the risk is for adverse events. Could the female genital mutilation explain some of the difference in the adverse outcomes of Somali women compared to Finns? This question is out of the reach of this study, yet it offers an interesting topic for future research.

When evaluating the clinical significance of these results it is important to remember that Somali women had a median of three previous births compared to one for Finns and Russians, and two for Kurdish. Studies to assess the association between interpregnancy interval and adverse pregnancy outcomes have showed that either a short or a long interpregnancy interval is associated with adverse pregnancy outcomes, including preterm delivery and low birth weight (Conde-Agudelo et al. 2006; Mahande & Obure, 2016). Less than half of the Somali women had an optimal interpregnancy interval, and together with higher number of previous births compared to the other ethnicities, the occurrence of adverse events, such as preterm delivery, may be more common in this group of women. However, the OI-FI cannot claim any associations based on the optimality of the items, and more research is needed to distinguish the reasons for adverse pregnancy and labor outcomes especially in Somali women compared to Finns.

The difference in pregnancy and birth outcomes between ethnic groups is not a new phenomenon in health care (Kahlil et al. 2013; Lu & Halfon, 2003; Willis et al. 2014). The underlying causes of these disparities extends in broader historic and contemporary social and economic inequality and racial and ethnic discrimination (Nelson, 2002). To influence the health disparities, interventions and policies should be implemented to improve not only health and health care but also other aspects of social and economic factors during the entire life-course (Lu & Halfon, 2003). Additionally, early childhood education could offer a way to influence the birth outcomes of ethnic minorities. Many aspects of adult well-being is based on the habits and experiences in the childhood. (Willis et al. 2014) The importance of maintaining a normal body weight, eating healthy food, maintaining adequate physical activity, and keeping up with healthy life choices in the childhood may have positive and far-reaching consequences for health and wellbeing.

6.4 Future implications

After introducing the OI-FI, the next step would be to establish a team of professionals in the field of maternity care and obstetrics, and clinical research to review the OI-FI. The team should evaluate all the items both in the OI-US and OI-FI, and decide if they are relevant to include in the OI-FI. Additionally, other aspects of the Finnish maternity care would be recommended to review and decide if additional items would be included in the OI-FI that are not in the OI-US. Thereafter a study including all the items in the renewed OI-FI should be carried out to test the discriminant validity of the OI-FI. The data for the study should be collected by using the renewed OI-FI to ensure that all items would be available. The OI-FI could offer a standardized tool to evaluate the process and outcome of the maternity care in Finland, and reveal areas of improvement. For example, the OI-FI could be used in all of the five University Hospitals in Finland to investigate the optimality scores among the clientele. The OI-FI could reveal differences related to pregnancy and labor processes and outcomes, and suggest areas for future research. Additionally, if the use of the optimality index spreads around the world, a more reliable comparison of the process and outcome of maternity care systems would be possible worldwide.

In the study of van Olphen Fehr, the benefits of the OI-US as a teaching tool for midwifery students was assessed. Nine soon-graduating midwifery students from the Shenandoah

University Nurse-Midwifery Program were administered a 10-question interview on the usefulness of the OI-FI as a teaching method. The results from the study suggested that the OI-US have a potential to be used as a teaching tool for evidence-based practice, to recognize potential associations between perinatal care processes and outcomes, and to challenge students to question non-evidence-based care. (van Olphen Fehr, 2013) To use the OI-FI in the education of midwifes could be another future implication, if the development process of the instrument continues.

In addition to the continuous development process of the proposed instrument OI-FI, research in the field of health disparities in ethnic minorities, especially in Somali population, is urgently needed. This study repeats the poorer pregnancy and birth outcomes of Somali women compared to Finns. Special attention should be paid to this ethnic group in the Finnish maternity care.

7 CONCLUSIONS

The fundamental reason for constructing the OI-FI was to strengthen the ideology of pregnancy and labor as a natural continuum for life since research of pregnancy and labor is relatively often concentrating on medical interventions or adverse outcomes. Additionally, introducing a standardized way of measuring the process and outcome of maternity care in a low-risk population could offer a new way to measure pregnancy and labor outcomes in Finland.

The results of the study showed that Somali women had lower PBI, OI, and OI-FI scores in all the comparisons with Finns, except for OI scores in multiparous women. Additionally, Somali women had lower percentages for single item optimality for BMI, other serious antepartum complication in pregnancy, prenatal care, episiotomy, optimal one-minute Apgar score, and for transfer to neonatal care compared with Finns. The main results of the study are in accordance with previous research in Finland and additionally, with high quality international studies.

The OI-FI has demonstrated applicability to measure the process and outcome of the Finnish maternity care. As a conclusion, it seems that the OI-FI has a potential to detect differences in the process and outcome of Finnish maternity care between different ethnicities, although it misses a number of the items proposed in the OI-US. This encourages to continue the development process of the OI-FI and to use it in the future research on Finnish maternity care.

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Appendix 1. Optimality Index-US and Optimality Index-FI

OI-US		**OI-FI**	
The Perinatal Background Index	Optimality	The Perinatal Background Index	Criteria for optimality
Social and medical background		*Social and medical background*	
1. Marital status	(as if) married	1. Marital status	Married and/or living with a partner
2. Ethnic minority	No	2. Ethnic minority	No
3. Smoking	None	3. Smoking	None
4. Alcohol	None		
5. Drug use	None		
6. Pre-pregnancy body mass index	BMI 18.5 – 24.9 kg/m²	4. Pre-pregnancy BMI	BMI 18.5 – 24.9 kg/m²
7. Age	18 – 40	5. Age at the onset of labor	18 – 40 years
8. Preexisting, major, chronic, disease	No	6. Preexisting, major, chronic, disease	No
hypertension		hypertension	
chronic renal disease		chronic renal disease	
diabetes (nongestational)		diabetes (nongestational)	
heart disease class II-IV		heart disease class II-IV	
HIV antibody positive		HIV antibody positive	
major psychiatric history (treated with drugs or inpatient therapy)		major psychiatric history	
9. Inter-pregnancy interval between index pregnancy and previous viable birth	> 18 months and < 60 months	7. Inter-pregnancy interval between index pregnancy and previous viable birth	> 18 months and < 60 months
10. Previous preterm delivery < 37 weeks	No	8. Previous preterm delivery < 37 weeks	No
11. Previous intrauterine fetal death	No	9. Previous intrauterine fetal death	No
12. Previous Cesarean section	No	10. Previous Cesarean section	No

13. Previous baby < 5 1/2 pounds at birth	No	11. Previous baby < 2,500 grams at birth	No
14. Other serious antepartum complications (history of) diabetes placenta abruption placenta previa preeclampsia eclampsia pyelonephritis Rh sensitization	No	12. Other serious antepartum complications (history of) diabetes (gestational and pre-existing) placenta abruption placenta previa preeclampsia eclampsia pyelonephritis Rh sensitization	No
The Optimality Index *Present pregnancy, maternal status, diagnostic and therapeutic measures*		The Optimality Index *Present pregnancy and maternal status*	
15. Intrauterine fetal demise	No	13. Intrauterine fetal death	No
16. Domestic violence (includes intimate partner)	No		
17. Other serious antepartum complications (current pregnancy) anemia (Hgb < 10 gm in any trimester) – not improved with treatment diabetes diagnosed in pregnancy major psychiatric history (formally diagnosed or treated with drugs/inpatient therapy) multiple birth (twins or higher number of births anticipated) placenta praevia preeclampsia (diagnosed in antepartum period)	No	14. Other serious antepartum conditions or complications (current pregnancy) anemia (Hgb < 100g/l) diabetes diagnosed in pregnancy major psychiatric history placenta praevia preeclampsia	No

pyelonephritis Rh sensitization vaginal bleeding in 2nd or 3rd trimester, from cause other than placenta praevia		pyelonephritis Rh sensitization vaginal bleeding in 2nd or 3rd trimester	
18. Prenatal care: initiation in first trimester (<14 weeks) and minimum of 5 visits	Yes	15. Prenatal care: initiation in first trimester (≤12 weeks) and minimum of 8 (multipara) or 9 (primipara) visits	Yes
19. Amniocentesis	No	16. Amniocentesis	No
20. Nonstress test/contraction stress test/biophysical profile	No		
21. Medication use	No		
Parturition		*Parturition*	
22. Period of time between first digital examination following rupture of membranes and birth	24 hours		
23. Amniotic fluid	Clear	17. Amniotic fluid	No ICD-10 diagnose of abnormal amniotic fluid
24. Induction/augmentation of labor	No	18. Induction or augmentation of labor by prostaglandin or oxytocin, or records on induction	No
25. Amniotomy	No	19. Amniotomy	No
26. Oral or injectable (IM or IV) medication during first or second stage of labor	None	20. Oral or injectable medication during labor (excluding prostaglandin and oxytocin)	No
27. Epidural analgesia for labor and/or birth	No	21. Epidural, spinal, or combined spinal-epidural analgesia for labor and/or birth	No
28. Fetoscope, Doppler, or intermittent electronic monitoring during labor (rather than continuous electronic fetal monitoring)	Yes		

29. Fetal heart rate abnormalities that altered management of the labor process	No	22. Fetal heart rate abnormalities	No
30. Presence of a support person during labor (other than care provider)	Yes		
31. Nondirected pushing	Yes		
32. Delivery occurred in the place originally intended at the onset of labor	Yes	23. Delivery occurred in the place originally intended at the onset of labor	Yes
33. Nonsupine position at birth	Yes		
34. Presentation at birth	Cephalic	24. Presentation at birth	No records on abnormal presentations
35. Instrumental (vaginal) delivery	No	25. Instrumental vaginal delivery (including vacuum extraction and forceps)	No
36. Cesarean section	No	26. Cesarean section	No
37. Episiotomy	No	27. Episiotomy	No
38. 1st or 2nd degree laceration of perineum or perineal tissue requiring sutures (including sulcus and cervical lacerations)	No		
39. 3rd or 4th degree extension of either an episiotomy or a 1st or 2nd degree laceration	No	28. Suturing of 3rd or 4th degree laceration	No
40. Medication (other than oxytocin or local anesthetic for perineal repair) during the third stage of labor	No		
41. Skin-to-skin contact	Yes		
42. Placental retention (≥ 30 minutes)	No	29. Placental retention	No ICD-10 diagnose of placental issues

43. Postpartum hemorrhage (provider's documentation that this did not occur; actual amount of blood loss not relevant)	No	30. Postpartum hemorrhage	No ICD-10 diagnose of postpartum hemorrhage
44. Blood transfusion	No	31. Blood transfusion	No
45. Other serious intrapartum complications	No	32. Other serious intrapartum complications	No
chorioamnionitis		chorioamnionitis	
cord prolapse		cord prolapse	
eclampsia		eclampsia	
placental abruption		placental abruption	
preeclampsia present during intrapartum period		preeclampsia	
shoulder dystocia		shoulder dystocia	
Neonatal condition		*Neonatal condition*	
46. Estimate of gestational age	37-42 weeks	33. Estimate of gestational age	37-42 weeks
47. Birth weight	2500-4000 grams	32. Birth weight	2500-4000 grams
48. Apgar score at 5 minutes	7, 8, 9 or 10	35. Apgar score at 1 minute	7, 8, 9 or 10
49. Transfer to high risk neonatal care setting	No	36. Transfer to neonatal care	No
50. Congenital anomalies	No	37. Congenital anomalies	No
51. Birth trauma, or other serious medical problem	No	38. Birth trauma, or other serious medical problem	No
bacterial infections other than sepsis		bacterial infections other than sepsis	
bronchopulmonary dysplasia		bronchopulmonary dysplasia	
cardiac failure		cardiac failure	
hypovolemia, hypotension, shock		hypovolemia, hypotension, shock	
intraventricular hemorrhage		intraventricular hemorrhage	
necrotizing enterocolitis		necrotizing enterocolitis	
pneumonia		pneumonia	
persistent pulmonary hypertension		persistent pulmonary hypertension	

renal failure respiratory distress syndrome Rh disease sepsis seizures		renal failure respiratory distress syndrome Rh disease sepsis seizures	
52. Breastfeeding (time period: at time of mother's discharge from birth setting or up to 72 hours postpartum)	Yes		
53. Perinatal death (time period birth: up to 72 hours of age)	No	39. Perinatal death (up to 7 days of age)	No
Condition of the mother prior to discharge		*Maternal condition*	
54. Fever (100.4 degrees F or higher) while mother remains in the birth setting, OR provider diagnosis of infectious process or major complication	No	40. Fever while mother remains in the birth setting, or provider diagnosis of infection or major complication	No
cystitis endometritis hematoma local infection of sutures mastitis		cystitis endometritis hematoma wound infection, local infection of sutures mastitis fever	
55. Prescription medications for conditions newly identified in IP or PP period (exception: iron and vitamins, oral contraceptives, RhoGam©, rubella vaccine)	No		
56. Maternal mortality	No		

Reference: Murphy & Fullerton, 2012.

Appendix 2. Explanations of the OI-FI items that include several conditions and/or complications

Index item	Conditions or complications	ICD-10 codes	ICD-10 code explanations
6. No preexisting, major, chronic, disease:	Hypertension	I10	Essential (primary) hypertension
		O10	Pre-existing hypertension complicating pregnancy, childbirth and the puerperium
	Chronic renal disease	N18	Chronic kidney disease
	Diabetes (nongestational)	E10	Type 1 diabetes mellitus
		E11	Type 2 diabetes mellitus
		E12	Malnutrition-related diabetes mellitus
		E13	Other specified diabetes mellitus
		E14	Unspecified diabetes mellitus
		O24.0	Pre-existing type 1 diabetes mellitus
		O24.1	Pre-existing type 2 diabetes mellitus
	Heart disease class II-IV	I50	Heart failure
	HIV antibody positive	B20	Human immunodeficiency virus [HIV] disease resulting in infectious and parasitic diseases
		B21	Human immunodeficiency virus [HIV] disease resulting in malignant neoplasms
		B22	Human immunodeficiency virus [HIV] disease resulting in other specified diseases
		B23	Human immunodeficiency virus [HIV] disease resulting in other conditions
		B24	Unspecified human immunodeficiency virus [HIV] disease
	Major psychiatric history	F00-F09	Organic, including symptomatic, mental disorders
		F10-F19	Mental and behavioural disorders due to psychoactive substance use
		F20-F29	Schizophrenia, schizotypal and delusional disorders
		F30-F39	Mood [affective] disorders
		F40-F48	Neurotic, stress-related and somatoform disorders
		F50-F59	Behavioural syndromes associated with physiological disturbances and physical factors
		F60-F69	Disorders of adult personality and behaviour
		F70-F79	Mental retardation
		F80-F89	Disorders of psychological development
		F90-F98	Behavioural and emotional disorders with onset usually occurring in childhood and adolescence
		F99-F99	Unspecified mental disorder

12. No history of other serious antepartum complications:	Diabetes (gestational and pre-existing)	E10	Type 1 diabetes mellitus
		E11	Type 2 diabetes mellitus
		E12	Malnutrition-related diabetes mellitus
		E13	Other specified diabetes mellitus
		E14	Unspecified diabetes mellitus
		O24	Diabetes mellitus in pregnancy
		O24.0	Pre-existing type 1 diabetes mellitus
		O24.1	Pre-existing type 2 diabetes mellitus
		O24.2	Pre-existing malnutrition-related diabetes mellitus
		O24.3	Pre-existing diabetes mellitus, unspecified
		O24.4	Diabetes mellitus arising in pregnancy
		O24.9	Diabetes mellitus in pregnancy, unspecified
	Placenta praevia	O44	Placenta praevia
	Placenta abruption	O45	Premature separation of placenta [abruptio placentae]
	Eclampsia	O15	Eclampsia
		O15.0	Eclampsia in pregnancy
		O15.1	Eclampsia in labour
		O15.9	Eclampsia, unspecified as to time period
	Pre-eclampsia	O11	Pre-eclampsia superimposed on chronic hypertension
		O14	Pre-eclampsia
		O14.0	Mild to moderate pre-eclampsia
		O14.1	Severe pre-eclampsia
		O14.9	Pre-eclampsia, unspecified
	Pyelonephritis	N10	Acute tubulo-interstitial nephritis (incl.: pyelonephritis)
		N11	Chronic tubulo-interstitial nephritis (incl.: pyelonephritis)
		N12	Tubulo-interstitial nephritis, not specified as acute or chronic (incl.: pyelonephritis NOS)
	Rh sensitization	O36.0	Maternal care for rhesus isoimmunization
14. Other serious antepartum complications/ conditions in current pregnancy	Anemia	O99.0	Anaemia complicating pregnancy, childbirth and the puerperium MBR item: anemia
	Gestational diabetes	O24.4	Diabetes mellitus arising in pregnancy
		O24.9	Diabetes mellitus in pregnancy, unspecified MBR item: insulin medication started during pregnancy

	Major psychiatric history	F00-F09	Organic, including symptomatic, mental disorders
		F10-F19	Mental and behavioural disorders due to psychoactive substance use
		F20-F29	Schizophrenia, schizotypal and delusional disorders
		F30-F39	Mood [affective] disorders
		F40-F48	Neurotic, stress-related and somatoform disorders
		F50-F59	Behavioural syndromes associated with physiological disturbances and physical factors
		F60-F69	Disorders of adult personality and behaviour
		F70-F79	Mental retardation
		F80-F89	Disorders of psychological development
		F90-F98	Behavioural and emotional disorders with onset usually occurring in childhood and adolescence
		F99-F99	Unspecified mental disorder
	Placenta previa	O44	Placenta praevia
			MBR item: placenta previa
	Preeclampsia	O11	Pre-eclampsia superimposed on chronic hypertension
		O14	Pre-eclampsia
		O14.0	Mild to moderate pre-eclampsia
		O14.1	Severe pre-eclampsia
		O14.9	Pre-eclampsia, unspecified
	Pyelonephritis	N10	Acute tubulo-interstitial nephritis (incl.: pyelonephritis)
		N11	Chronic tubulo-interstitial nephritis (incl.: pyelonephritis)
		N12	Tubulo-interstitial nephritis, not specified as acute or chronic (incl.: pyelonephritis NOS)
	Rh sensitization	O36.0	Maternal care for rhesus isoimmunization
	Vaginal bleeding in 2nd or 3rd trimester	O46	Antepartum haemorrhage, not elsewhere classified (excl.: hemorrhage in early pregnancy, O44, O45)
23. Amniotic fluid		O68.1	Labour and delivery complicated by meconium in amniotic fluid
		O68.2	Labour and delivery complicated by fetal heart rate anomaly with meconium in amniotic fluid
29. Fetal heart rate abnormalities		O68.0	Labour and delivery complicated by fetal heart rate anomaly
		O68.2	Labour and delivery complicated by fetal heart rate anomaly with meconium in amniotic fluid

42. Placental retention		O72.0 O73.0 O73.1	Third-stage hemorrhage Retained placenta without hemorrhage Retained portions of placenta and membranes, without hemorrhage MBR items: manual removal of placenta and curettage
43. Postpartum hemorrhage		O72.0 O72.1 O72.2 O72.3	Third-stage hemorrhage Other immediate postpartum hemorrhage Delayed and secondary postpartum Postpartum coagulation defects
30. no other serious intrapartum complications:	Cord prolapse	O69.0	Labour and delivery complicated by prolapse of cord
	Eclampsia	O15 O15.1 O15.9	Eclampsia Eclampsia in labour Eclampsia, unspecified as to time period MBR item: eclampsia
	Preeclampsia	O11 O14 O14.0 O14.1 O14.9	Pre-eclampsia superimposed on chronic hypertension Pre-eclampsia Mild to moderate pre-eclampsia Severe pre-eclampsia Pre-eclampsia, unspecified
	Placenta abruption	O45	Premature separation of placenta [abruptio placentae] MBR item: placental separation
	Shoulder dystocia	O66.0	Obstructed labour due to shoulder dystocia MBR item: shoulder dystocia
	Chorioamnionitis	O41.1	Infection of amniotic sac and membranes (incl.:chorioamnionitis)
35. Congenital anomalies		Q00-Q07 Q10-Q18 Q20-Q28 Q30-Q34 Q35-Q37 Q38-Q45 Q50-Q56 Q60-Q64 Q65-Q79 Q80-Q89 Q90-Q99	Congenital malformations of the nervous system Congenital malformations of eye, ear, face and neck Congenital malformations of the circulatory system Congenital malformations of the respiratory system Cleft lip and cleft palate Other congenital malformations of the digestive system Congenital malformations of genital organs Congenital malformations of the urinary system Congenital malformations and deformations of the musculoskeletal system Other congenital malformations Chromosomal abnormalities, not elsewhere classified

36. no birth trauma or other serious medical problem	Bacterial infections	P39.0-P39.9	Other infections specific to the perinatal period MBR item: antibiotic administration
	Bronchopulmonary dysplasia	P27.1	Bronchopulmonary dysplasia originating in the perinatal period
	Cardiac failure	P29.0	Neonatal cardiac failure MBR item: resuscitation
	Hypovolemia, hypotension, shock	I95 R57	Hypotension Shock, not elsewhere classified
	Intraventricular hemorrhage	P10.0-P10.9 P52.0-P52.9	Intracranial laceration and haemorrhage due to birth injury Intracranial nontraumatic haemorrhage of fetus and newborn
	Necrotizing enterocolitis	P77	Necrotizing enterocolitis of fetus and newborn
	Pneumonia	P23.0-P23.9	Congenital pneumonia
	Persistent pulmonary hypertension	P29.3	Persistent fetal circulation (incl.: pulmonary hypertension of newborn (persistent))
	Renal failure	N17 P96.0	Acute renal failure Congenital renal failure
	Respiratory distress syndrome	P22.0	Respiratory distress syndrome of newborn
	Rh disease	P55.0	Rh isoimmunization of fetus and newborn
	Seizures	P90	Convulsions of newborn
	Sepsis	P36.0-P36.9	Bacterial sepsis of newborn
38. no fever (100.4 degrees F or higher) while mother remains in the birth setting, OR provider diagnosis of infectious process or major complication:	Fever	O86.4	Pyrexia of unknown origin following delivery
	Cystitis	N30.0-N30.9	Cystitis
	Endometritis	O85	Puerperal sepsis (incl.: puerperal endometritis, fever, peritonitis and sepsis)
	Wound infection, local infection of sutures	O86.0	Infection of obstetric surgical wound (incl.: infected CS wound and perineal repair)
	Mastitis	O91.0-O91.2	Infections of breast associated with childbirth (incl.: purulent and nonpurulent mastitis)
	Hematoma	O90.2	Haematoma of obstetric wound

Reference for ICD-codes and explanations: ICD-10 version 2016.

Appendix 3. OI-FI items with special notes in the OI-US coding and scoring guidelines, and with actions applied in the OI-FI

OI-FI item	OI-US abstractors note	Actions
Other serious antepartum conditions or complications	If other conditions are listed in chart, please check with researcher.	No additional conditions or complications were included in the OI-FI.
Amniocentesis	If chorionic villus sampling is documented, a note should be added to the abstraction record.	Chorionic villus sampling is collected in the MBR but not included in the OI-FI.
Induction or augmentation of labor by prostaglandin or oxytocin, or records of induction	If index patient has an elective primary or repeat C-section, without labor, code this item as N/A.	This was applied in the OI-FI.
Epidural, spinal, or combined spinal-epidural analgesia for labor and/or birth	If index patient has an elective primary or repeat C-section, without labor, code this item as N/A.	This was applied in the OI-FI.
Instrumental vaginal delivery (including vacuum extraction and forceps)	If index patient has a C-section, code this item as N/A.	This was applied in the OI-FI.
Cesarean section	If index patient has a vaginal delivery (either spontaneous or instrumental), code this item as N/A.	This was applied in the OI-FI.
Episiotomy	If index patient has a C-section, code this item as N/A.	This was applied in the OI-FI.
Placental retention	If delivery is by C-section, code N/A.	This was applied in the OI-FI.

N/A refers to not applicable
Reference: Murphy & Fullerton, 2012.