Adverse neonatal outcomes in migrant women in Norway

Eline Skirnisdottir Vik

Thesis for the degree of Philosophiae Doctor (PhD)
University of Bergen, Norway
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UNIVERSITY OF BERGEN

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Scientific environment

This thesis was carried out between 2016 and 2020 at the Department of Global Public Health and Primary Care, University of Bergen (UiB). The research group Genetic Epidemiology at UiB played an important role in the research.

The research was initiated by my principal supervisor Professor Erica Schytt (Western Norway University of Applied Sciences (HVL), Karolinska Institutet and Centre for Clinical Research - Uppsala University) and co-supervisor Dr Vigdis Aasheim (HVL). Other co-supervisors are Professor Roy Miodini Nilsen (HVL), Professor Dag Moster (UiB) and Professor Rhonda Small (La Trobe University, Australia).

The research was funded by HVL who also provided an excellent work environment at the Centre for Evidence-Based Practice. At HVL I was part of the research group Reproductive Health and Health Promotion Work in a Life Course Perspective, and affiliated with the Midwifery education program where I did my teaching.

I have also been a member of the international perinatal research collaboration ROAM (Reproductive Outcomes And Migration), the EMMA-program (Enhanced Maternity care for Migrant women: research to Action) and EPINOR (the National Research School in Population Based Epidemiology).

UNIVERSITY OF BERGEN

Western Norway
University of
Applied Sciences

EPINOR

Preface

My great grandmother, Aðalheiður Níelsdóttir, finished her midwifery education in Iceland in June 1925. She worked as a midwife in Svalbarðsströnd, near Akureyri, for more than 30 years. My father remembers being proud of his grandmother who made a difference in the local community and was the only woman he knew who had her own income. Close to a hundred years later, in the same year the World Health Organization has designated The Year of the Nurse and Midwife [1], I am a nurse-midwife ready to defend my thesis. I am humbled by the opportunity given to me.

My dream of becoming a midwife started when I was a teenager. I met a midwife who worked with planned homebirths and when I saw the spark in her eyes as she spoke of her work, I knew I wanted that same feeling for myself. A fellow PhD-candidate once spoke of our work as a job-y, combining the two words job and hobby. I agree. Both as a researcher and a midwife I have been blessed with a job-y, and I wish the same strong and wonderful feeling for all my peers. Choose whatever rocks your boat. The world needs you, and the world needs diversity.

Bergen 2020,

Eline Skirnisdottir Vik

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I thank all the inspiring student midwives and my wonderful colleagues at the Midwifery education program at HVL, including Vigdis, Anne Britt Vika Nilsen, Bodil Molander Dale, Katrine Aasekjær, Tone Engen, Linn Marie Sørbye and Tone Kringeland. I thank my colleagues at the Centre for Evidence-Based Practice; it has been a blessing to be a part of the inclusive environment led by Birgitte Graverholt. I thank my fellow PhD-candidates, and in particular Beate Eltarvåg Gjesdal for inspiring me to run and work hard, Thomas Potrebny for reminding me to breathe and drink coffee, Lene Kristiansen for the warmest welcome, and Merete Selveson

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It was my love for midwifery that inspired me to become a PhD candidate. I therefore welcome fellow midwives to insert their own name on the following line: _____ I dedicate my thesis to you, and the important work you do every day. Please feel inspired to take on the challenge to do your own PhD work one day. The world needs educated midwifery researchers.

Midwives who will forever be a part of my midwifery soul include my wonderful colleagues at Haukeland University Hospital, my all-time hero Edna Adan Ismail (Somaliland), Magnhild Gulbrandøy and Eli Waage who taught me the old secrets of midwifery, Kari Nordøy who was like a mother to me when I was a newly qualified midwife, Anne Gro Nordseth Klokkehaug and Rose-Marie Eckerbom who showed me it is possible to keep calm no matter the situation, Lotta Åkerrén Halvorsen and Liv Stangeland who inspired me to learn more about homebirth, Berit Margareth Aldahl (deceased 2016) who was the most knowledgeable midwife I have met, and Sonja Guðbjörg Guðjónsdóttir (deceased 2018) who mentored me at The National University Hospital of Iceland (Landspítalinn) in 2007. I am also grateful for the collaboration I have with Gunn Terese Haukeland, Kristine Selvik Jacobsen and my former supervisor Bente Dahl. I thank my colleagues and friends Randi Skei Fossland, Siv Seland and Ragnar Kvie Sande for inspiring me to undertake a PhD. Further, I thank all the people I have worked with in the Norwegian Association of Midwives for good discussions and for giving me courage in public debates on women's health; especially Kari Aarø, Ingrid Brita Lid Nordø, Siw Kristine Gjelsten, Inger Sofie Stensland and Gunvor Raundalen.

I also have friends who are not midwives or colleagues. Thank you Siv Midtun Hollup and Ove Gram Nipen for memorable boat trips, first-class board games and sharing of knowledge. Thank you, Maren Klovning Hansen and Runar Vasstrand, for opening your hearts, home, and the occasional bottle of champagne. Thank you Lila Grønsnes and Gaute Nordeide for good food and laughter around the bonfire. Thank you Magne Nordeide for patiently helping us with our house and garden.

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Most importantly, I thank my supportive and understanding family: My parents Torill Albrigtsen and Skírnir Garðarsson for raising me with love and always believing in me. I thank my sister Anita Skirnisdottir Bekkstrand and her family for encouraging me to be the best version of myself. My brother David Skirnisson, his wife and five children, for inspiring me to be creative and release my inner peacock. My in-laws and closest neighbours Per Jonny Vik and Annbjørg Helland Vik for patience and helping hands. I thank my extended family in both Norway and Iceland. Most especially, I thank my charming and always helpful husband André Heie Vik, and my two children, Sunniva and Linus, who cheer me up and help me keep my feet on the ground.

Finally, I thank my little niece Alva for giving me the first four-leafed clover she ever found. I am sure this clover made all the difference.

Introduction

Today, one in seven of the world's population are migrants [2] and nearly half are women, most of whom are of reproductive age [3]. In Norway, close to 15% of the total population are first generation migrants and a little over 3% are second generation migrants [4]. Nearly 29% of babies however, are born to mothers with a migrant background [5].

Over my years as a midwife I have often cared for migrant families, and I have become increasingly aware of the diversity migrant families represent. Compared to non-migrant women, migrant women have been identified with increased risk of adverse neonatal outcomes, such as low birthweight [6, 7], preterm birth [6, 8-10] and perinatal morbidity and mortality [6, 8, 11, 12]. There are variations in health status however, and migrant women may be of good health, or even better health than the host population [8, 13, 14]. Recognizing the complexity of migration is therefore crucial when addressing the need to improve maternity care for migrant women [13, 15].

In Norway, and other countries, national guidelines in maternity care pay little attention to the diverse needs of migrant women [16, 17]. With increasing international migration, more knowledge is needed regarding migrant women's pregnancies and births, so that health systems can be improved and we can reach the goal of providing equitable maternity care for all expectant families [15]. Investigating the risk of adverse neonatal outcomes in migrant families is therefore vital.

Abstract

Background: With increasing international migration, more knowledge is needed regarding migrant women's pregnancies and births. Migrant families represent great diversity and investigating the risk of adverse neonatal outcomes in sub-groups of migrant women is therefore vital.

Overall aim: To investigate associations between migration related factors (maternal country of birth, paternal origin, reason for immigration, length of residence and country of a woman's first birth) and adverse neonatal outcomes (very preterm birth, moderately preterm birth, post-term birth, small for gestational age, large for gestational age, low Apgar score, stillbirth and neonatal death) in migrant and non-migrant women giving birth in Norway.

Material and methods: All three papers are based on population-based register studies. Data were retrieved from the Medical Birth Registry of Norway and Statistics Norway. We investigated associations between: (1) migration related factors (maternal country of birth, paternal origin, reason for immigration, length of residence, and birthplace of firstborn child) and stillbirth in births to migrant and non-migrant women (1990-2013); (2) country of a woman's first birth and adverse neonatal outcomes (very preterm birth (22^{+0}-31^{+6} gestational weeks), moderately preterm birth (32^{+0}-36^{+6} gestational weeks), post-term birth (≥42 gestational weeks), small for gestational age, large for gestational age, low Apgar score (<7 at 5 minutes), stillbirth and neonatal death) in multiparous migrant and non-migrant women (1990-2016); and (3) paternal origin and adverse neonatal outcomes (very preterm birth, moderately preterm birth, low Apgar score and stillbirth) in migrant women (1990-2016). Associations were investigated using multiple logistic regression and reported as adjusted odds ratios (aORs) with 95% confidence intervals (CI). Analyses were performed separately for primiparous and multiparous women.

Results: ***Paper 1:*** Primiparous women from Sri-Lanka and Pakistan, and multiparous women from Pakistan, Somalia, the Philippines and the Former Yugoslavia had

higher odds of stillbirth when compared to non-migrant women (adjusted ORs ranged from 1.58 to 1.79 in primiparous and 1.50 to 1.71 in multiparous women). Primiparous migrant women whose babies were registered with a Norwegian-born father had decreased odds of stillbirth compared to migrant women whose babies were registered with a foreign-born father (aOR = 0.73; CI 0.58–0.93). Primiparous women migrating for work or education had decreased odds of stillbirth compared to Nordic women who migrate freely between the Nordic countries (aOR = 0.58; CI 0.39–0.88). Multiparous migrant women who gave birth to their first baby before arriving in Norway had higher odds of stillbirth in later births in Norway compared to multiparous migrant women who had had their first baby after arrival (aOR = 1.28; CI 1.06–1.55). Length of residence in Norway was not associated with stillbirth. ***Paper 2:*** Multiparous migrant women with a first birth before immigration to Norway had increased odds of adverse outcomes in subsequent births relative to those with a first birth after immigration: very preterm birth (aOR=1.27; CI 1.09-1.48), moderately preterm birth (aOR=1.10; CI 1.02-1.18), post-term birth (aOR=1.19; CI 1.11-1.27), low Apgar score (aOR=1.27; CI 1.16-1.39) and stillbirth (aOR=1.29; CI 1.05-1.58). Similar results were found in births to Norwegian-born women who had their first baby abroad. ***Paper 3:*** Compared with births to migrant women with a foreign-born partner, births to migrant women with a Norwegian-born partner were associated with lower ORs for very preterm birth (primiparous: aOR 0.83; 95% CI 0.73-0.96, multiparous: aOR 0.85: 95% CI 0.73-0.98), stillbirth (primiparous: aOR 0.68; 95% CI 0.55-0.86, multiparous: aOR 0.80; 95% CI 0.64-0.99), and low Apgar score (multiparous: aOR 0.87; 95% CI 0.80-0.96). Unregistered paternal origin and unknown paternal identity were both associated with increased odds of adverse neonatal outcomes.

Conclusion and clinical implications: The risk of adverse neonatal outcomes varied across sub-groups of migrant women and was higher in women from a number of countries, multiparous women who had their first baby before immigration to Norway, women whose babies had foreign-born fathers and births where paternal origin was unregistered or paternal identity was unknown.

Specifically, the risk of stillbirth was lower in primiparous women who had migrated for work or education compared to Nordic migrants who are permitted to migrate freely between the Nordic countries. Stillbirth was not associated with length of residence in Norway.

This thesis highlights the need to improve care for sub-groups of migrant women at increased risk of stillbirth and other adverse neonatal outcomes. The results should serve as a reminder of the diverse needs of migrant women, and the importance of midwives and other health care providers collecting a thorough obstetric history in migrant women attending maternity care services.

Norwegian summary

I Norge utgjør førstegenerasjons innvandrere nær 15% av befolkningen, og 18% hvis vi regner med annengenerasjons innvandrere. Samtidig er antall barn med innvandrerbakgrunn økende, og i dag har nær 29% av alle nyfødte en mor med innvandrerbakgrunn. Tidligere studier har vist at kvinner med innvandrerbakgrunn er sårbare i svangerskaps- og fødselsomsorgen, og risikoen for uheldige neonatale utfall, som prematuritet og dødfødsel, er større blant innvandrerkvinner sammenlignet med de som ikke har innvandrerbakgrunn. Innvandrerkvinners behov er ulike og sammensatte, og vi ser at variasjoner i helse og neonatale utfall blant annet kan bero på hvilket land kvinnen kommer fra, hvor barnefar kommer fra, kvinnens årsak til innvandring, hvor lenge kvinnen har vært i landet, og om hun var flergangsfødende eller førstegangsfødende da hun innvandret til Norge. Utfordringen med tidligere studier er at de gjerne baserer seg på et begrenset antall fødsler eller har begrenset tilgang til variabler som er relevant for innvandrerkvinners helse. Definisjonen av hvem som er innvandrer og de uheldige neonatale utfallene varierer mellom studier, noe som kompliserer tolkning av funn og gjør det vanskelig å trekke konklusjoner. Gjennom Medisinsk fødselsregister og Statistisk sentralbyrå har vi hatt tilgang til et rikt materiale med en rekke migrasjonsrelaterte faktorer, og disse danner grunnlaget for analysene i de ulike artiklene som er inkludert i denne avhandlingen. Vi har hatt tilgang til informasjon om nær alle fødsler i Norge mellom 1990 og 2013/2016 (N=1,439,913/N=1,620,532). Prosjektet har gjennomgått en vurdering av personvernskonsekvenser (Data Protection Impact Assessment - DPIA) og er godkjent av Regional Etisk Komité (REK; referansenummer: 2014/1278/REK Sør-Øst).

Resultatene viser at det er forskjell i risiko for uheldige neonatale utfall mellom ulike grupper innvandrerkvinner. Artiklene i avhandlingen identifiserer kvinner med økt behov for oppfølging gjennom svangerskap og fødsel, og funnene vil også kunne danne grunnlag for fremtidige studier med fokus på: 1) årsaker til ulikhetene mellom ulike grupper, og 2) å teste ut forbedringstiltak for innvandrerkvinner i praksis.

List of publications

Vik, E. S., Aasheim, V., Schytt, E., Small, R., Moster, D. & Nilsen, R. M.: "Stillbirth in relation to maternal country of birth and other migration related factors: a population-based study in Norway", BMC Pregnancy and Childbirth 2019, 19:5.

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Vik, E. S., Aasheim, V., Nilsen, R. M., Small, R., Moster, D. & Schytt, E.: "Associations between paternal origin and adverse neonatal outcomes in births to migrant women: a Norwegian population-based study". Submitted.

Contents

Scientific environment **3**

Preface **4**

Acknowledgements **5**

Introduction **8**

Abstract **9**

Norwegian summary **12**

List of publications **13**

Contents **14**

Abbreviations **17**

Definitions **18**

1. Background **20**

1.1 Definition of migrants *20*

1.2 The migrant population in Norway *22*

1.3 Adverse neonatal outcomes *24*

1.3.1 Explanations for differences in adverse neonatal outcomes 25

1.4 The healthy migrant effect *27*

1.5 Maternity care in Norway *28*

1.5.1 Migrant women in maternity care 28

1.5.2 Antenatal care and changes in practice over the study period 29

1.6 What does this thesis add to existing knowledge? *30*

1.7 Epidemiology *30*

1.8 In summary *31*

1.9 Aims *31*

2. Material and methods **33**

2.1 The Medical Birth Registry of Norway *33*

2.1.1 Data collected by the MBRN 33

2.2 Statistics Norway *35*

2.3 Data linkage *35*

2.3.1 Births included in this thesis 36

2.4 Sample selection criteria *37*

2.5 Variables of interest *38*

2.5.1 Exposure variables 38

2.5.2 Outcome variables 41

2.5.3 Covariates 42

2.5.4 Other variables 43

2.6 Analysis *45*

2.6.1 Missing data 46

2.7 Ethical considerations *46*

2.7.1 Ethical approval 47

2.7.2 Funding 47

3. Results 48

3.1 Paper 1 ..... *48*

3.2 Paper 2 ..... *52*

3.3 Paper 3 ..... *55*

3.4 Summary of key findings *57*

4. Discussion 58

4.1 Methodological considerations *58*

4.1.1 Strengths and limitations of the thesis 58

4.1.2 Information bias 59

4.1.3 Selection bias 60

4.1.4 Confounding 61

4.1.5 Other methodological considerations 63

4.1.6 External validity 63

4.2 Discussion of key findings *64*

4.2.1 Maternal country of birth 64

4.2.2 Country of a woman's first birth 68

4.2.3 Paternal origin 70

4.2.4 Reason for immigration 72

4.2.5 Length of residence 74

5. Conclusions 75

6. Clinical implications 76

7. Future research 77

8. Errata 78

Source of data 79

Abbreviations

aOR	Adjusted Odds Ratio
CI	Confidence Interval
D number	A temporary national identity number. The letter D has a historical explanation; Maritime Authority (Direktoratet for sjømenn, 1962-1992) were the first to use the D number [18]
DAG	Directed Acyclic Graph
DPIA	Data Protection Impact Assessment
DUF number	An identity number used by the national computer system of The Norwegian Directorate of Immigration [19] (DUF; Datasystem for Utlendings- og Flyktningsaker)
FGM/C	Female Genital Mutilation/Cutting
FH number	A common emergency identity number (FH; Felles Hjelpenummer)
GBD	Global Burden of Disease
H number	An emergency identity number (H; Hjelpenummer)
LGA	Large for Gestational Age
MBRN	Medical Birth Registry of Norway
OR	Odds Ratio
SGA	Small for Gestational Age
SIDS	Sudden Infant Death Syndrome

Definitions

Adverse neonatal outcomes

Very preterm birth	Infant born between 22^{+0} and 31^{+6} gestational weeks [20].
Moderately preterm birth	Infant born between 32^{+0} and 36^{+6} gestational weeks [20].
Post-term birth	Infant born ≥42 gestational weeks [20, 21].
Small for gestational age (SGA)	Defined as birthweight below the 10^{th} percentile for the gestational age. Calculated using a Norwegian standard combining information on gestational age, birthweight and gender [21, 22].
Large for gestational age (LGA)	Defined as birthweight above the 90^{th} percentile for the gestational age. Calculated as above [22].
Low Apgar score	Apgar score <7 at 5 minutes [23].
Stillbirth	Pregnancy loss at ≥22 weeks of gestation, or with a birthweight ≥500 grams if data on gestational age were missing [20].
Neonatal death	Death of an infant from birth to 28 days of life [21, 24].

Migration related factors

Birthplace of firstborn child	The country of a woman's first birth (Norway/other country than Norway).

Country of birth	The country where the mother of the infant was registered when he or she was born [25], applies to both maternal and paternal country of birth.
Immigrant	Migrants (see *Migrant*) are referred to as immigrants when we speak of migrants relative to their destination [26].
Paternal identity	A father was registered as *known* when paternal identity was known to the MBRN by means of his national identity number or his date of birth. Otherwise, *unknown*.
Length of residence	Calculated as the difference between the baby's year of birth and the year of the mother's official permission to stay in Norway. For asylum seekers this would be the year they registered for asylum.
Migrant	In this thesis a migrant is a first-generation migrant who has moved from his or her own country of birth. See chapter 1.1 for details.
Paternal origin	Paternal country of birth categorized into foreign-born, Norwegian-born and unregistered.
Reason for immigration	Based on data obtained by Statistics Norway from the Norwegian Directorate of Immigration in relation to a non-Nordic foreigner's reason for first stay in Norway [25, 27].

Definitions have been assessed against commonly used terms and concepts in relation to epidemiological studies on migrants [26] and reproductive and perinatal health [21].

1. Background

Improving maternity care for migrant families is declared a priority by the World Health Organization [15]. A growing number of babies are born to migrant parents [5, 28], and the risk of adverse neonatal outcomes, such as preterm birth, low birthweight and stillbirth, is often described as higher in migrant women when compared to non-migrant women [6-9, 11, 12]. Existing literature is extensive regarding migrant women's overall risks of adverse neonatal outcomes, however, variations in the definition of migrants and outcomes, heterogeneity in study design, restricted numbers of births in each study, and the fact that most studies lack relevant migration related factors, limit the conclusions that can be drawn [6, 8, 14].

In the following chapters I present background information especially relevant when discussing the findings in this thesis. First, I present the definition of migrants as used in this thesis and give a short description of the migrant population in Norway. Next, I highlight the importance of studying adverse neonatal outcomes followed by possible explanations for observed differences in adverse neonatal outcomes between different groups of migrant and non-migrant women. Thereafter, I present the epidemiological paradox known as *the healthy migrant effect.* I give a short presentation of maternity care in Norway and present the main changes in antenatal care over the study period. I describe what this thesis adds to existing knowledge and comment on relevant aspects of epidemiology, the discipline within which my study has been undertaken. Finally, I summarise the information given in the background and present the aims of the included papers.

1.1 Definition of migrants

There is variation in terminology used across studies and disciplines describing and defining migrants and the concept of migration [26, 29]. Studies may base their definition on one or more indicators depending on data available, such as maternal country of birth, region of origin, length of residence, legal status, reason for migration or first language [29].

In this thesis, women born abroad to two foreign-born parents were defined as migrant women, and non-migrant women were defined as women born in Norway of two Norwegian-born parents. Information on maternal and paternal country of birth was retrieved from Statistics Norway. Data on maternal country of birth are considered essential, feasible to collect and relatively easy to define, and therefore recognized as a core indicator when comparing perinatal outcomes in migrant populations [13]. Heterogeneity in the definition of migrants may limit the possibilities of comparing results between studies [13], thus using a core indicator adds value to the current study.

Statistics Norway categorizes migrants and non-migrants into the following six categories: A) Born in Norway to Norwegian-born parents, B) Immigrants, C) Norwegian-born to immigrant parents, E) Foreign-born with one Norwegian-born parent, F) Norwegian-born with one foreign-born parent, and G) Foreign-born to two Norwegian-born parents [30]. The former category, D) Adopted, has not been used as a separate category after year 1994 [31]. Women in categories C and F have not migrated to Norway, while women in categories E and G have migrated, but their circumstances mean that their experience of migration has been mediated by a parental connection to Norway, not present for other migrants. Therefore, this thesis only includes births to women in categories A and B; explained in more detail in Table 1 [31].

Table 1. Definitions of migrant and non-migrant women based on their parents' and grandparents' country of birth according to Statistics Norway.

Woman's parents		**Woman's grandparents**			
Parent 1	Parent 2	Grandparent 1	Grandparent 2	Grandparent 3	Grandparent 4
Migrant women*					
F	F	F	F	F	F
Non-migrant women†					
N	N	N	N	N	N
N	N	N	N	N	F
N	N	N	N	F	F
N	N	N	F	F	F
N	N	F	F	F	F
N	F	N	N	N	N
F	F	N	N	N	N

N = Norwegian-born, F = Foreign-born

* Category *B - Immigrants*. In cases of missing information on the origin of parents or grandparents the Statistics Norway uses an imputation technique to generate their likely origin [31].

† Category *A - Born in Norway to Norwegian-born parents*. This category includes seven groups. The last group is small and is likely not to influence the demographic situation in Norway [31].

Statistics Norway uses the term *immigrant* defined as a person born abroad to two foreign-born parents *and four foreign-born grandparents* [32]. In cases of missing information on the origin of parents or grandparents Statistics Norway uses an imputation technique to generate their likely origin [31].

Notably, information on the categories (A-G) was only available for the women in our dataset. Therefore, in analyses investigating the impact of paternal origin (Paper 1 and 3), a father was not presented as migrant/non-migrant, but rather *foreign-born*, *Norwegian-born* or *unregistered* (i.e. cases where paternal origin was missing).

1.2 The migrant population in Norway

Today, first generation migrants account for 15% of the total population [4]. The number of migrants in Norway has grown steadily over the last four decades, and

today, immigration is mainly linked to growing labour demand, family reunion and refugees fleeing war and political conflicts [33]. Migrants in Norway originate from more than 200 different countries and independent regions, and the majority of migrants come from Europe (48%), Asia (34%) and Africa (14%) (Figure 1) [34].

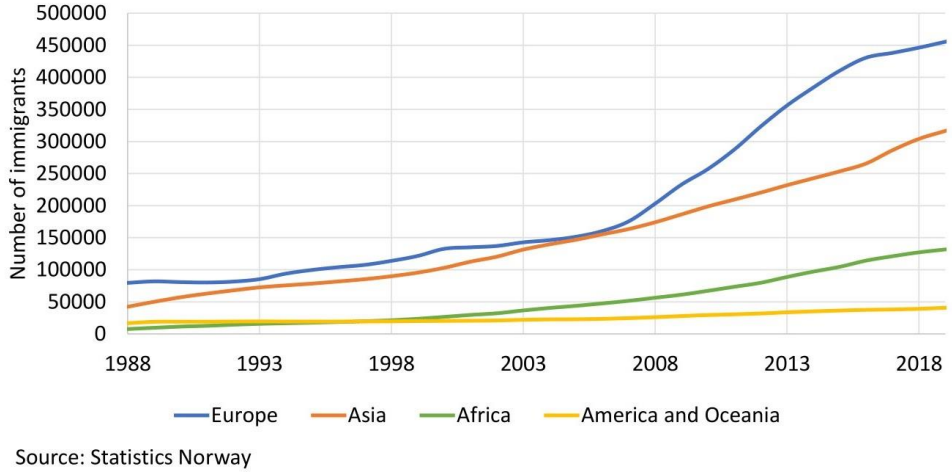


Figure 1. First and second-generation immigrants in Norway by region of origin. Changes shown in absolute numbers for the period 1988 to 2019 (Statistics Norway).

The population-based sample investigated in this thesis represents births to parents from 217 different countries and independent regions: 209 and 206 maternal and paternal countries of birth, respectively. Figure 2 shows the number of births to migrant and non-migrant women giving birth in Norway over the study period 1990-2016 in absolute numbers. The number of births to non-migrant women is decreasing, while the number of births to migrant women is increasing. Today, nearly 29% of newborn babies are born to a mother with a migrant background [5].

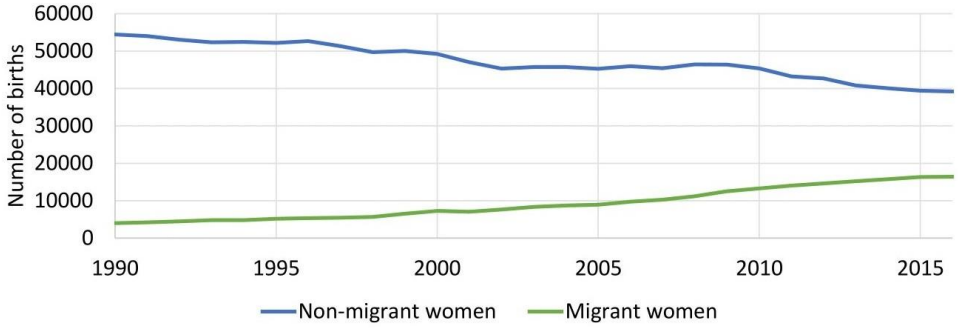


Figure 2. Births to migrant and non-migrant women in Norway (source: the Medical Birth Registry of Norway and Statistics Norway). Changes shown in absolute numbers for the study period 1990 to 2016 (unpublished). The figure includes 1,523,284 births after the following exclusions: immigrant categories other than A and B (n=87,696), and pregnancies if the gestational age was <22 weeks or if the infant's birthweight was <500 grams when data on gestational age were missing (n=9552).

1.3 Adverse neonatal outcomes

Although the rates of adverse neonatal outcomes are relatively low in high-income countries, the health burden to women and their families affected is extensive [12, 35]. Preterm babies are at increased risk of morbidity and mortality, and preterm birth is a leading cause of neonatal death and deaths in children under five [36, 37]. Further, caring for preterm babies renders high economic costs [37, 38], and the health sequelae of preterm birth may follow the individual throughout their life [37]. Addressing preterm birth, and other outcomes such as post-term births, fetal growth restriction, macrosomia and low Apgar score may contribute to a reduction in infant morbidity and mortality [39-41]. In particular, the burden of losing a baby is massive and highly underestimated, with direct and indirect costs to mothers, partners and family, society, and health care providers [42].

The definitions of adverse neonatal outcomes included in this thesis are presented at chapter 2.5.2 *Outcome variables*. Internationally, an inconsistent use of definitions and limited data related to adverse neonatal outcomes may challenge interpretation and comparison between existing studies [21, 43].

1.3.1 Explanations for differences in adverse neonatal outcomes

Compared to non-migrant women, migrant women have been identified as at increased risk of a range of adverse neonatal outcomes, such as low birthweight [6, 7], preterm birth [6, 8-10] and perinatal morbidity and mortality [6, 8, 11, 12]. Being a migrant is *not* a consistent marker for poor outcomes, however; health outcomes in migrant women may be as good or even better than those for non-migrant women [8, 14]. A systematic review from 2009 found that the risk of preterm birth, low birthweight and health promoting behaviour were equal or better in migrants when compared to non-migrants in more than 50% of included studies [8], while another systematic review, from the same year, found an overall increased risk in migrant women for all the outcomes investigated: low birthweight, preterm birth, perinatal mortality and congenital malformations [6].

Explanations for the differences in pregnancy outcomes between migrant and non-migrant women are many [15], and a poor outcome may depend on a range of factors, such as: language barriers [15, 44-47], poor health literacy [48], socioeconomic differences [12, 48], lack of trust in the health care system, differences in health behaviours [44-46], late booking [45, 46, 49, 50], fewer antenatal visits [45, 46], refusal of care [45, 47], being unfamiliar with the health care system or not knowing their rights [44, 51], incomplete medical records [7, 15, 52-54], increased risk of unplanned out-of-hospital births [55, 56], being vulnerable to sexual or non-sexual violence, history of trauma [15, 57, 58], health problems related to high burden of disease in their country of birth [15, 59], discrimination [51] and genetic factors, such as consanguinity [60, 61].

In high-income countries, migrant women have been found to receive suboptimal maternity care [47, 62]. In Norway, migrant women have been less likely to attend antenatal education classes [63], and family members have often been used as a substitute for professional interpreters [64]. A Norwegian study investigating maternity care for migrant women reported an increased level of sub-optimal care from caregivers related to stillbirth, including a failure to identify and act on signs of poor fetal status or obstetric complications, such as placental abruption, pre-

eclampsia, preterm rupture of the membranes or mal-presentations, and poor interpretation of labour progress [47]. In the same study, miscommunication between the woman and her caregiver was documented in 47% of the stillbirth cases when women were of non-western origin. Sub-optimal self-care in relation to stillbirth, including late or non-attendance at antenatal care, not bringing a urine sample to antenatal visits, and refusal to undress to allow appropriate symphysis-fundus measurement or to stay in hospital when recommended [47]. Notably, after a stillbirth, non-western women had significantly lower rates of autopsy of the fetus compared to western women (46% vs 84%) [47], a practice which may provide valuable information for future pregnancies and medical research.

Further, severe and uncommon diagnoses may represent a diagnostic challenge [15, 46, 62], such as tuberculosis (TB) [46, 65], hepatitis B [46, 66] and human immunodeficiency virus (HIV) [46, 67]. In Norway, the majority of migrants diagnosed with these conditions were infected in their country of origin [68]. Female genital mutilation/cutting (FGM/C) is another growing concern in European settings [69], and a cross-sectional Norwegian study including 159 Somali women found that only one in five women with FGM/C used health care services for their FGM/C problems [70]. Distinguishing between women who migrate of free will and detecting those who are victims of different levels of human trafficking may add to the challenge of caring for migrant women [57, 58].

While being a migrant may be considered an independent risk factor for adverse outcomes, an increased risk in migrant women may also be a proxy for other risk factors or explanations [15], such as different aspects of lifestyle (overweight/obesity, underweight, smoking, drug use), socioeconomic factors (high and low maternal age, low level of education and income, poor nutrition, discrimination, intimate partner violence, the cumulative effects of stressful life events), medical issues (diabetes, hypertension, infections), pregnancy related factors (placenta dysfunction, abruption, preeclampsia, poor antenatal care, non-term birth, multiple pregnancy, parity), and genetics (congenital anomalies, consanguinity) [12, 37, 61, 71]. As concerns lifestyle, non-European women in Sweden have been found to be less likely to engage in

harmful lifestyle habits, such as consuming alcohol or smoking before or during pregnancy, and the authors suggest the differences may be explained by cultural or religious factors [72]. The World Health Organization highlights that a migrant woman's background characteristics may differ on average from those of a non-migrant woman, thus awareness of migrant women's background is considered a key component of quality of care [15].

1.4 The healthy migrant effect

A common theory explaining the variation in pregnancy outcomes in migrant women is *the healthy migrant effect* (i.e. the epidemiological paradox). The theory refers to a phenomenon repeatedly observed where migrants are often healthy, and healthier at arrival than individuals from the host population [26]. Differences in health outcome tend to disappear over time, and as time passes by migrants will often reach the rates observed in the host population, such as when a Canadian study found lower use of alcohol and tobacco in recent migrants, however, the use increased with length of stay after immigration and similar results were also found for the women's Body Mass Index [73]. The poorest in a population often lack the resources to migrate [74]. Notably, those who are forced to migrate may be at higher risk of psychological trauma and poor health, while those who migrate for pulling factors such as work or education may be of better health [29].

The risks of adverse neonatal outcomes have been described as both higher and lower in migrant women when compared to non-migrant women [6, 8, 9, 11, 12, 14, 43, 75]. Recognizing the complexity of migration is therefore crucial when addressing the need to improve maternity care for migrant women [13, 15]. The healthy migrant effect has been observed in epidemiological studies investigating a range of adverse pregnancy related outcomes, such as lower rates of preeclampsia [76] and preterm birth [73]. The effect may not apply equally to all migrants however [26], depending on factors such as the health status or harmful lifestyle habits in the host population [72, 77], reason for migration [49, 76, 78] or length of residence [10, 73, 76]. The effect does also seem to be outcome-specific, as seen in a Canadian study which

reports that the healthy migrant effect applied to illness during pregnancy and preterm birth but not to postpartum depression [73].

1.5 Maternity care in Norway

In Norway, the health care system is managed by the government and provides more than 95% of all health care in the country [79]. Pregnancy related care is built on the principle of equal access for all regardless of ethnicity or social background, and is free of charge for all women regardless of legal status [79, 80]. All women have the right to receive adequate information suited to their age, maturity, language and culture [81]. Healthy women with healthy pregnancies may choose between a hospital or home birth [82], however, the practice of home births is limited and nowadays nearly all women give birth in public hospitals (99%, 2018) [83]. The primary caregivers in maternity care are midwives [82], and there are no private alternatives for women in need of emergency care [79]. In Norway, it is not uncommon that migrant women's first encounter with the health care system is related to pregnancy and childbirth [84, 85].

1.5.1 Migrant women in maternity care

Internationally, migrant and non-migrant women wish for similar things when asked what they need from maternity care; high quality, safe, individualised and attentive care, with adequate information and support [51].

To improve maternity care for migrant women, the World Health Organization states that it is crucial to address inequity in maternal and newborn health in a migration perspective [15]. In March 2020, the Norwegian Directorate of Health published a report assessing the consequences of recent changes in the birthing population in Norway [86]. In this report, increasing migration, maternal country of birth, reason for migration, length of residence, and language barriers are mentioned as important factors that may influence the risk of adverse outcomes in migrant women in Norway. The report calls for increased knowledge, and emphasises that national guidelines need updating [86]. Consistent with the findings of this report, other national

documents such as the Finance Department's *Opportunities for All report* describing factors relevant for reaching equal opportunities for all citizens in Norway [86], and the *National Strategy for Equal Rights in Health Care* [87] identify similar factors as important, including both reason for migration and length of residence.

1.5.2 Antenatal care and changes in practice over the study period

The time span of this study was 26 years, from 1990 to 2016. This chapter therefore offers a short overview of the main changes in antenatal care practice in Norway during the study period.

In 1984, the Norwegian Ministry of Health published the first Norwegian Official Report on perinatal care [88], and in 1995 the first national guidelines for antenatal care were published by the Norwegian Directorate of Health [89]. Antenatal care based in community health centres, staffed by midwives, was not mandatory until 1995 [85], in contrast to a strong community based midwifery service dating back to the 1930s in our neighbouring countries: Sweden, Denmark and Finland [85, 90]. Until the national guidelines were updated in 2005, eleven antenatal visits were recommended for first-time mothers, and seven for multiparous women [91]. Today, a healthy woman with a healthy pregnancy may choose antenatal care offered either by a midwife or a general practitioner, or a combination of the two [92]. Today too, pregnant women, regardless of parity, are recommended to have eight antenatal visits during pregnancy, including one routine ultrasound visit in gestational weeks 17-19 [17].

While most pregnant women seem to follow the recommended number of visits, there is also a discussion about overutilization of the services [90, 93, 94]. In recent years, pregnant women have made on average twelve visits, shared between four visits to a community midwife, three visits to a general practitioner, and five visits to specialist services [94].

1.6 What does this thesis add to existing knowledge?

The number of studies investigating migration and the risk of adverse neonatal outcomes is extensive, but the results are inconclusive [6, 8, 14, 43] possibly due to the heterogeneity of study designs, small study samples, a lack of relevant migration related factors or co-variables, in addition to differences in definitions of both migrants and outcomes [6, 8, 12, 13, 21, 43]. Previous studies have typically reported data describing large heterogeneous groups of migrant women, thus masking potential variations in sub-groups of migrant families [8, 43]. Only a few studies have included paternal factors in their analyses [95-99]. To my knowledge, no previous studies have investigated the impact of migrating from one country to another between births.

In Norway, detailed information on maternal and infant health, pregnancy, and migration factors related to both the mother and the father, are available for research and surveillance purposes [34, 100]. In this thesis, we had access to a large, nationwide, population-based dataset including data on nearly all births in Norway over a period of 23/26 years (1990-2013/16). The dataset allowed for reports on a range of adverse neonatal outcomes (very preterm birth, moderately preterm birth, post-term birth, small for gestational age, large for gestational age, low Apgar score, stillbirth and neonatal death) in sub-groups of migrant women. Births to migrant women were analysed separately for the following migration related factors: maternal country of birth, paternal origin, reason for immigration, length of residence and country of a woman's first birth. The strengths of the approach taken in this thesis made it possible to identify specific groups of migrant women in need of improved maternity care.

1.7 Epidemiology

This thesis is written within the discipline of epidemiology. There are various definitions of epidemiology, however, one commonly accepted definition is that

epidemiology is *the study of the distribution and determinants of disease frequency in human populations* [101].

Regarding causality in observational studies, there are few or no outcomes with only one clear cause, as most outcomes are caused by a combination of different mechanisms [101]. Identifying a statistical association between two variables does not imply causation, and therefore we rely on words such as *may*, *could*, *indicate* or *suggest* when interpreting the findings [101].

1.8 In summary

In Norway, maternity care is considered of high quality with low risks for adverse neonatal outcomes. However, inequalities in health and healthcare persist.

Existing literature is extensive regarding migrant women's overall risks of adverse neonatal outcomes, however, variations in the definition of migrants and outcomes, heterogeneity in study design, restricted numbers of births in each study, and the fact that most studies lack relevant migration related factors, limit the conclusions that can be drawn. Previous studies investigating migration and the risk of adverse neonatal outcomes give inconclusive results which may be difficult to interpret, and few other studies have had access to such a large, high-quality dataset similar to the one used in this thesis. This thesis adds to existing knowledge by identifying specific groups of migrant women in need of improved maternity care.

The aims of each of the three studies which comprise this thesis are presented in detail in the following chapter.

1.9 Aims

The overall aim of the studies was to investigate associations between maternal country of birth and other migration related factors, and adverse neonatal outcomes in migrant women giving birth in Norway.

Specific aims were to investigate possible associations between:

Paper 1: Stillbirth and maternal country of birth and other migration related factors (paternal origin, reason for immigration, length of residence and birthplace of firstborn child) in migrant women in Norway.

Paper 2: Country of a woman's first birth and adverse neonatal outcomes (very preterm birth, moderately preterm birth, post-term birth, small for gestational age, large for gestational age, low Apgar score, stillbirth and neonatal death) in multiparous migrant and Norwegian-born women in Norway.

Paper 3: Paternal origin and adverse neonatal outcomes (very preterm birth, moderately preterm birth, low Apgar score and stillbirth) in births to migrant women giving birth in Norway.

2. Material and methods

All three studies are nationwide population-based studies. Data were retrieved from two sources: the Medical Birth Registry of Norway (MBRN) and Statistics Norway. Paper 1 includes births between 1990 and 2013, and Paper 2 and 3 include births between 1990 and 2016.

2.1 The Medical Birth Registry of Norway

The Medical Birth Registry of Norway (MBRN) is a national compulsory health registry containing information on all births in Norway [102] since 1967 [103]. It is mandated by the Personal Health Data Filing System Act [104] and the Medical Birth Register Regulations [100] that registration in the MBRN is compulsory for all births in Norway.

Data are collected for research and surveillance purposes, with an overarching aim of improving maternity care for pregnant women and their infants [100]. The National Institute of Public Health is responsible for the data collection and the quality control of the registry [100]. As part of the MBRN quality control, data may be routinely linked with other national registers including the National Population Register [100].

The registry is unique, and only a few other countries have similar nationwide registers, such as the other Nordic countries [103, 105, 106]. On the proviso that systematic and consistent validation of the registers is conducted, the Nordic medical birth registers have been described as potential goldmines for epidemiological and clinical research [106].

2.1.1 Data collected by the MBRN

How births are reported, and the content of the birth report, have changed over the study period. From 1967 to 1998 the birth report was in paper form only (Appendix 1), and updated versions of the notification form were introduced in 1998 and 2002 (Appendix 2 and 3, respectively). In 1998, an electronic version of the birth report was introduced as the preferred method of reporting. Birth reports are filled out by a

midwife, doctor or other caregiver, and are routinely sent to the MBRN with a separate copy to the National Population Register [107]. In addition to information from hospital records, the birth reports include information reported by midwives and doctors on the woman's antenatal record card, which routinely follows the woman throughout her pregnancy (Appendix 4). In Norway, national standardised antenatal record cards in paper form have been used in antenatal care since 1984 [108].

Maternal and infant related data include: 1) detailed information on the mother's health prior to pregnancy, during pregnancy and birth, 2) maternal background characteristics, 3) complications and interventions related to the pregnancy, labour and birth and early post-partum, and 4) data on the infant's health [100].

Paternal data routinely collected by the MBRN are limited and include just two variables with direct personal information (i.e. date of birth and the father's full name) and three variables with indirect information (i.e. one concerning maternal civil status, and two concerning consanguinity) (Figures 3 and 4). In the open text box assigned for entry of the father's full name, it is possible to include other information about the father, in case the father's full identity is unclear.

Figure 3 shows paternal factors routinely collected by the MBRN using a paper version of the notification form for births from 1998. Figure 4 shows paternal factors as presented in the MBRN data system today (version 1.1). The father's eleven digit national identity number is preferred over his date of birth (6 digits).

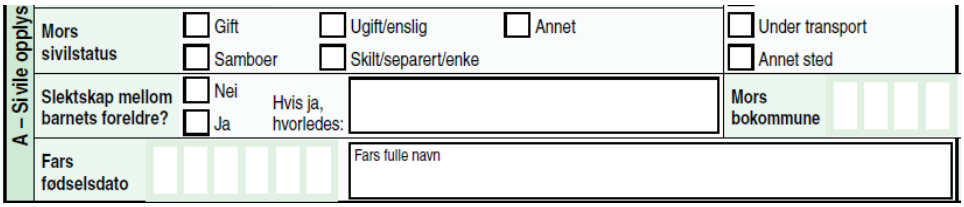


Figure 3. Paternal factors routinely collected by the Medical Birth Registry of Norway: paper version [Norwegian] (source: The Medical Birth Registry of Norway, 1998).

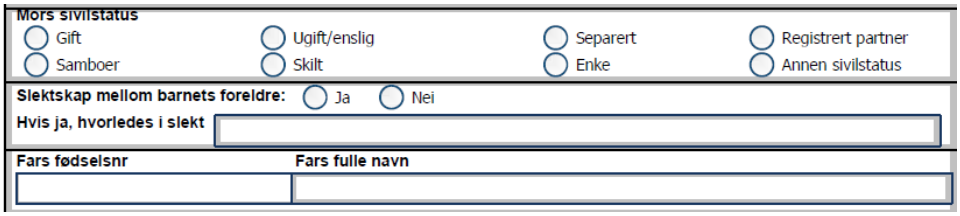


Figure 4. Paternal factors routinely collected by the Medical Birth Registry of Norway: an electronic version as presented in the Medical Birth Registry of Norway's data system (version 1.1) [Norwegian] (source: The Medical Birth Registry of Norway, 2020).

Notably, paternal data collected by the MBRN may also include his address, occupation and smoking habits [100]. However, such data are not routinely collected [100] and were not available in this thesis.

2.2 Statistics Norway

Statistics Norway was formally established in 1876, and is responsible for producing official statistics about Norwegian society [34]. For this thesis, Statistics Norway provided information on maternal country of birth, the year of the mother's official permission to stay in Norway (source: FD-Trygd) [109], paternal country of birth, maternal reason for immigration (source: population data) [110], mother's gross income (source: income data) [111] and maternal level of education (source: The National Education Database (NUDB)) [112] (Appendix 5 and 6).

2.3 Data linkage

The MBRN prepared a data file containing national identity numbers (i.e. national identity numbers and D numbers) on nearly all births in Norway between 1990 and 2013. A pseudonymous identity number was generated for each individual. The first

data file was sent from the MBRN to Statistics Norway in 2015, and later an update was sent in 2017 including births through 2016. Statistics Norway used the national identity numbers and D numbers to locate information on the given individuals in their databases. We received separate de-identified data files from both the MBRN and Statistics Norway. Data linkage between the data files was performed by merging data files using the pseudonymous identity numbers generated by the MBRN. The linkage was performed so that data on a birth received from the MBRN was kept, even in cases where there was no matching data in the files received from Statistics Norway.

Paper 1 was based on the 2015 data (1990-2013). Papers 2 and 3 were based on the 2017 data (1990-2016).

2.3.1 Births included in this thesis

This thesis includes births to all women who gave birth in Norway in the given time periods (1990-2013 and 1990-2016) who either had a national identity number or a D number (i.e. a temporary national identity number). These are the only identity numbers that may be linked with data from Statistics Norway. In the following text I explain the differences between women who are registered with a national identity number, D number or other identity numbers in the MBRN.

A national identity number is given to everyone born in Norway, anyone who settles in Norway for more than six months, and anyone born abroad with a right to obtain a Norwegian passport [113]. The Norwegian Directorate of Immigration may however assign an individual with a DUF number (i.e. a registration number in the computer system of the Norwegian Directorate of Immigration) if a person applies for protection (i.e. asylum) or for a residence permit in Norway [19]. After having been granted a residence permit in Norway, the individual is assigned a D number or a national identity number [19]. Notably, a DUF number is not necessarily compliant with computer systems used in Norwegian health care, as DUF numbers consist of a 12 digit number compared to the standard of 11 [19]. Individuals who receive medical help in Norway who are registered with a DUF number or if their identity for

some reason is questioned, may be given an emergency identity number; a so called H number (e.g. a local emergency identity number) or an FH number (e.g. a national emergency identity number) [114]. The practice involving emergency identity numbers has changed over the study period, and in 2010 a standard for the national emergency identity numbers was developed (i.e. FH numbers) [114]. Due to challenges adapting the new standard to existing computer systems within Norwegian health care however, the new standard was not successfully implemented within the study period (2013-2016) [115].

Unfortunately, we did not have access to births where the mother was registered with a DUF number, H number, FH number or births where the woman's identity for some reason was unclear. Thus, there are a few groups of women we lack information about, such as newly arrived asylum seekers, paperless immigrants or tourists giving birth in Norway. From personal communication (i.e. telephone and e-mail) with the MBRN this is in line with standard MBRN procedure of providing data for research, and these women comprise a very small part of the whole registry.

2.4 Sample selection criteria

Paper 1 included 198,520 and 1,156,444 births to migrant and non-migrant women, respectively. Paper 2 and 3 included 96,068 and 521,004 births to migrant and non-migrant women, respectively. Paper 3 included 240,759 births to migrant women only. How migrant and non-migrant women were defined in this thesis is explained in chapter *1.1 Definition of migrants*, and which births we had data on is explained in chapter *2.3.1 Births included in this thesis*.

To reduce the heterogeneity between the compared groups, births were excluded using the following criteria:

- Papers 1, 2 and 3: births where data on maternal country of birth were missing, births to Norwegian-born women with foreign-born parents, births to migrant women with Norwegian-born parents, and pregnancies where the gestational

age was <22 weeks or the infant's birthweight was <500 grams when data on gestational age were missing.

- Additional exclusions, Paper 2: multiple births, and the analyses were limited to second time mothers and any subsequent births to the same mother.
- Additional exclusions, Paper 3: multiple births and births to non-migrant women.

Flowcharts illustrating the derivation of the study samples are available in all three papers, respectively.

2.5 Variables of interest

In this section, I will give a brief description of exposure variables, outcome variables, potential confounders and other variables included in the three papers.

2.5.1 Exposure variables

Details about exposure variables are shown in Table 2. Exposure variables were retrieved from Statistics Norway, and some were created based on a combination of Statistics Norway and MBRN variables.

Table 2. Exposure variables for Papers 1, 2 and 3.

			Paper		
Exposure variable	**Explanation**	**Data source**	**1**	**2**	**3**
Country of birth	Maternal country of birth	Statistics Norway	X		
Paternal origin	Foreign-born, Norwegian-born and unregistered	Statistics Norway	X		X
Reason for immigration	Nordic migrants, work/education, family reunion or establishment, refuge	Statistics Norway	X		
Length of residence	<2, 2-5, 6–9, ≥10 years	Statistics Norway/MBRN	X		
Country of a woman's first birth*	Norway/other than Norway	Statistics Norway/MBRN	X	X	
Paternal identity	Known/unknown	MBRN			X

* i.e. *birthplace of firstborn child*.

In Paper 1 *maternal country of birth* was reported for countries represented by a minimum of 6000 births in the dataset (12 countries, including Norway), or a stillbirth frequency of ≥20 over the study period (5 additional countries) from 1990 to 2013. The category *Former Yugoslavia* included births represented by Croatia, Slovenia, Bosnia and Herzegovina, Macedonia, Serbia, Montenegro and Kosovo. In statistical analyses, the reference category was *Norway*. In both Paper 1 and Paper 3, *Paternal origin* was a categorical variable with three levels based on paternal country of birth: foreign-born, Norwegian-born, and unregistered (i.e. when paternal origin was missing). In statistical analyses, the reference category was *foreign-born*, as this was the most common category.

Reason for immigration (maternal) is based on data obtained by Statistics Norway from the Norwegian Directorate of Immigration in relation to non-Nordic foreigners' legal reason for first stay in Norway (since 1990) [27]. Not all migrants were registered with a reason for immigration, such as Nordic migrants who may move freely between the countries due to a cross-national agreement; the common Nordic labour market, created in 1954 [116]. In relation to non-Nordic foreigners, their reason for immigration may or may not accurately reflect their motivation for migration to Norway [27]. Data on reason for immigration provided by Statistics Norway are less detailed than the original data, because Statistics Norway have aggregated the original categories to better suit a demographic purpose [27]. In Paper 1, reason for immigration was reported as *Nordic migrants*, *Work/Education*, *Family reunion or establishment* and *Refuge*. *Nordic migrants* included births represented by Denmark, Sweden, Finland, Iceland, Greenland, and the Faroe Islands. The original Statistics Norway categories Work and Education are related reasons for immigration and were combined due to small numbers in each category. In statistical analyses in Paper 1, the category *Nordic migrants* was chosen as the reference category because Nordic countries share similarities in language, politics, economy and culture, and the focus here was on the women who had *migrated* to Norway, not the Norwegian-born.

Length of residence was calculated as the difference between the baby's year of birth and the year of the mother's official permission to stay in Norway, registered asylum

seekers included. In Paper 1, length of residence was analysed as a categorical variable (<2, 2-5, 6–9, ≥10 years), and the category *<2 years* was chosen as the reference category in statistical analyses. Information on recent immigration is relevant when investigating perinatal health from a migration perspective [13]. Information available in this thesis was restricted however, to a baby's year of birth, while identifying shorter length of residence (than *<2 years*) would have required information on a baby's month of birth.

Country of a woman's first birth (Paper 2) and *Birthplace of firstborn child* (Paper 1) refers to the same variable, but the term was changed after Paper 1 was published because the word *birthplace* may be misunderstood (i.e. a woman's choice of birthplace; at home, in a midwifery led unit or at the hospital). Direct information on whether a multiparous woman had given birth to her first baby in Norway or not was however not available, and a new variable was therefore created. The variable was a dichotomous variable (Norway, Other), and having given birth to the first baby in Norway was chosen as the reference category (i.e. Norway). A more detailed description of the variable can be read in Paper 2.

Paternal identity (Paper 3) is registered as known in the MBRN when the father's national identity number or his date of birth has been given by the mother-to-be *or* retrieved from the National Population Register via routine updates; otherwise, his identity is registered as unknown.

2.5.2 Outcome variables

All outcome variables were retrieved from the MBRN (Table 3).

Table 3. Neonatal outcomes for Papers 1, 2 and 3.

		Paper		
Outcome	**Data source**	**1**	**2**	**3**
Very preterm birth (22^{+0}-31^{+6} weeks)	MBRN		X	X
Moderately preterm birth (32^{+0}-36^{+6} weeks)	MBRN		X	X
Post-term birth (≥42 weeks)	MBRN		X	
Small for gestational age (SGA)	MBRN		X	
Large for gestational age (LGA)	MBRN		X	
Low Apgar score (<7 at 5 minutes)	MBRN		X	X
Stillbirth	MBRN	X	X	X
Neonatal death (within 28 days)	MBRN		X	

In Papers 2 and 3, very preterm and moderately preterm birth were defined as births in gestational week 22^{+0}-31^{+6} and 32^{+0}-36^{+6}, respectively, and post-term birth was defined as births at ≥42 weeks of gestation [20]. Births where information on gestational age was missing were excluded from the analyses with preterm and post-term births as outcomes. Gestational age was based on ultrasound estimation. If such information was lacking, gestational age was calculated from the last menstrual period. Notably, ultrasound estimation of gestational age was only available in the MBRN from 1998 onwards [105].

Small for gestational age (SGA) and large for gestational age (LGA) were calculated using a Norwegian standard combining information on gestational age, birthweight and sex [22]. Low Apgar score was defined as Apgar score <7 at 5 minutes postpartum [23]. Stillbirth was defined as pregnancy loss at ≥22 weeks of gestation, or with a birthweight ≥500 grams if data on gestational age were missing [20]. Neonatal death was defined as death of an infant from birth through the first four weeks of life (up to 28 days) [24].

2.5.3 Covariates

In this section I will provide a description of the variables adjusted for in the statistical models. Inclusion of potential confounders is discussed in chapter 4, at 4.1 *Methodological considerations*.

A confounding factor (confounder) must be associated with the exposure in the source population, as well as being a risk factor for the outcome, and it must not be an intermediate step in the causal pathway between the exposure and outcome [101]. In this thesis, the analyses were adjusted for year of birth, maternal age, mother's gross income and level of education (Table 4). In addition, adjustments were made for consanguinity in Paper 1, and marital status in Papers 1 and 2. All analyses including births to multiparous women were adjusted for parity.

Table 4. Brief description of variables adjusted for, Papers 1, 2 and 3.

			Paper		
Variable	**Explanation**	**Data source**	**1**	**2**	**3**
Year of birth*	Continuous variable	MBRN	X	X	X
Maternal age†	< 25, 25–29, 30–34, 35–39, ≥40	MBRN	X	X	X
Marital status	Married/cohabiting, not married/cohabiting	MBRN	X	X	
Consanguinity	Second cousin or closer (yes, no)	MBRN	X		
Parity†	0, 1, 2, 3, 4, ≥5	MBRN	X	X	X
Mother's gross income	Categorised into quartiles	Statistics Norway	X	X	X
Mother's education	No education, primary school, secondary school, university/college, missing	Statistics Norway	X	X	X

* Paper 1: 1990-2013, Papers 2 and 3: 1990-2016

† Reported with fewer categories in Papers 2 and 3 (maternal age: <25, 25-34, ≥35 years; parity: 0, 1, 2, 3, ≥4)

Each adjustment variable was carefully chosen based on information from existing literature. Migration is a complex phenomenon [13], and there is no firm consensus about which covariates to adjust for in epidemiological studies investigating health risks in migrant populations [8]. Year of birth was considered the most important

adjustment variable due to the long time span of the study (i.e. changes in migration and clinical practice over time).

Factors associated with infant mortality and morbidity are many, and risk factors often coexist [117]. Advanced maternal age and teenage pregnancies, have both been associated with increased risk of very preterm birth, moderately preterm birth, post-term birth, SGA, low Apgar score, stillbirth and neonatal death [12, 117, 118]. Socioeconomic status, usually represented by mother's gross income, level of education and single status, are all factors associated with adverse outcomes, such as stillbirth [12, 117]. Consanguinity has also been associated with an increased risk of recurrent stillbirth and infant death [61].

A woman's parity has been associated with increased risk of adverse outcomes [71], and clinical guidelines in antenatal care often manage primiparous and multiparous women separately [16, 91]. In this thesis, separate analyses were therefore undertaken for primiparous and multiparous women and analyses involving multiparous women were adjusted for parity.

2.5.4 Other variables

In this section I will provide a description of other variables available in the study samples (Table 5). These variables were not adjusted for in the statistical models.

Maternal and paternal country of birth were categorized and reported by the seven *Global Burden of Disease (GBD)* super regions (GBD 2017 locations hierarchy, dated November 8, 2018) [119]. The GBD categorization is based on demographic similarities between countries and geographic closeness, and the scientific effort behind the categorization provides researchers and policymakers with a unique opportunity to compare trends in health [119]. In Paper 1, 2% of births did not fall under the original categories and were therefore referred to as *Other*. In Papers 2 and 3, these births were manually classified into existing GBD-categories based on the country's geographical location and historical perspectives (i.e. primarily island states that are former colonies, such as Aruba, Cayman Islands and Falkland Islands).

Maternal age at immigration was calculated as the difference between maternal age at the index birth and her length of residence in Norway (<18 years, ≥18 years).

Table 5. Brief description of other variables, not adjusted for, Papers 1, 2 and 3.

			Paper		
Variable	**Explanation**	**Data source**	**1**	**2**	**3**
Maternal factors					
Chronic hypertension	Yes, no	MBRN	X		
Pre-eclampsia/eclampsia	Yes, no	MBRN	X		
Pre-pregnancy diabetes	Type 1/type 2	MBRN	X		
Maternal overweight§	BMI ≥ 25, not overweight, missing	MBRN	X		
Smoking before pregnancy†	Yes, no, missing	MBRN	X		
Smoking in early pregnancy†	Yes, no	MBRN		X	
Previous stillbirth	Yes, no	MBRN	X	X	
Gestational age (weeks)	Very preterm, moderately preterm, term, post-term, missing	MBRN	X		
Maternal origin (GBD)*	GBD categorization	Statistics Norway		X	X
Reason for immigration	Nordic migrants, work/education, family reunion or establishment, refuge	Statistics Norway		X	
Length of residence	<2, 2-5, 6–9, ≥10 years	Statistics Norway/MBRN		X	
Maternal age at migration	<18 years, ≥18 years	Statistics Norway/MBRN		X	
Paternal factors					
Paternal age (years)	<25, 25-34, ≥35 years, missing	MBRN			X
Paternal origin	Foreign-born, unregistered	Statistics Norway		X	
Paternal origin (GBD)*	GBD categorization	Statistics Norway			X
Consanguinity	Second cousin or closer (yes, no)	MBRN			X

* High-income countries; Central and Eastern Europe, Central Asia; North Africa, Middle East; Sub-Saharan Africa; Southeast Asia, East Asia, Oceania; South Asia; Latin America, Caribbean

† Maternal overweight and smoking include data from 2008 and 1999 onwards, respectively

2.6 Analysis

All three studies in this thesis are epidemiological studies. Associations between exposures and outcomes (all dichotomous variables) were assessed using binary logistic regression analyses.

First, simple regression analyses were conducted including only the independent (exposure) and the dependent variable (outcome) to estimate the crude strength of the associations. Second, multiple regression analyses were conducted by adding potential confounding variables to the statistical model. Finally, the associations were reported as crude and adjusted odds ratios (ORs) with 95% confidence intervals (CI). In Paper 1 and 3 associations were reported in two steps (crude and adjusted), while in Paper 2 associations were reported in four steps; 1) crude, 2) adjusted for year of birth, parity, maternal age and marital status, 3) additional adjustments for level of education, and 4) additional adjustments for mother's gross income. To account for dependency between births by the same mother, we used robust standard errors that allowed for within-mother clustering.

Descriptive analyses were used to describe the sample characteristics. When comparing the prevalence of different adverse outcomes between births in different groups of women, Pearson's chi-squared test was used to obtain an indication of the significance of the differences between the groups. Level of significance was defined as p-value <0.05. P-values were reported in Papers 1 and 2.

For Papers 2 and 3, the STROBE statement checklist was used to improve the reporting quality of the studies [120].

Analyses were performed using Stata IC version 14 and 16 (Stata Statistical Software, College Station, TX, USA) for Windows. In addition, part of the analyses in Paper 1 were performed using Statistical Package for Social Science version 23 (SPSS Inc., Chicago, IL, USA).

2.6.1 Missing data

The regression models in all three paper were adjusted for maternal level of education and mother's gross income (i.e. the woman's pensionable income as reported by Statistics Norway) [34]. However, both variables had fairly high proportions of missing values; overall, maternal level of education was missing in 4%, and mother's gross income was missing in 12% of births to migrant and non-migrant women (1990-2016). If systematic differences can be explained by other variables in the dataset, the missing data can be assumed to be missing at random (MAR) [121]. To avoid list-wise deletion in the final regression models (i.e. excluding births with missing data on maternal level of education or gross income), we therefore used a multiple imputation technique to replace missing values assumed to be missing at random (MAR).

In Papers 1 and 3, the exposure variable *paternal origin* was assigned a separate missing category when information on paternal origin was unregistered. Missing paternal demographics has been reported as a potential indicator for identifying high-risk pregnancies associated with an increased risk of adverse outcomes including preterm birth, fetal growth restriction, low Apgar score, stillbirth and neonatal mortality [122-124]. Therefore, missing paternal origin was included as a separate category in this thesis. The same strategy was used when investigating the variable *known father* in Paper 3.

2.7 Ethical considerations

This thesis was conducted according to the WMA Declaration of Helsinki Principles for Medical Research in Human Subjects [125]. The use of Norwegian health register data for research has its legal basis in the Personal Health Data Filing System Act [104], and does therefore not require consent from each individual.

This thesis is based on de-identified data from both the MBRN and Statistics Norway. The key for linking the data was kept by Statistics Norway, and all data are analysed and reported on a group level. Grouping migrants into sub-groups based on their

country of birth, or other shared factors, may be viewed as intensifying existing stigma of already vulnerable groups in society, however, there is a need for increased knowledge on which groups of migrant women are in need of improved maternity care. Hopefully, the results in this thesis may contribute to such improved care for pregnant migrant women in Norway and in similar settings.

Publishing studies where the main aim is to identify migrant women at increased risk of adverse neonatal outcomes may reinforce society's prejudices against migrants in general. On the other hand, if such studies expose areas where care is inequitable it serves to shed light on the need for system change, rather than adding to social prejudices about migrant women.

2.7.1 Ethical approval

The Regional Committees for Medical and Health Research Ethics (REK) approved this study, reference number: 2014/1278/REK South-East, Norway (Appendix 7). As this thesis is part of a larger project, a supplement to the original REK approval was issued when I was included in the project, including an approval for expanding the project until 2021 (Appendix 8). In addition, all researchers with data access have signed a personal contract for supply of research data with Statistics Norway (Appendix 9). In 2019, The Norwegian Data Protection Authority requested a DPIA (Data Protection Impact Assessment) for the project. The DPIA was conducted and approved the same year (Appendix 10).

2.7.2 Funding

This thesis was funded by the Faculty of Health and Social Sciences (Western Norway University of Applied Sciences, Norway). The Centre for Clinical Research Dalarna funded work time for Erica Schytt. Additional data costs were funded by the Norwegian SIDS and Stillbirth Society.

3. Results

Following a summary of Papers 1, 2 and 3, an overall summary is presented of the key findings related to each migration related factor based on the results from all papers (Box 1).

3.1 Paper 1

Stillbirth in relation to maternal country of birth and other migration related factors

In this first study, we investigated associations between a range of migration related factors (maternal country of birth, paternal origin, reason for immigration, length of residence and birthplace of firstborn child) and stillbirth in births to migrant (n=198,520) and non-migrant (n=1,156,444) women giving birth in Norway.

In general, the prevalence of stillbirth was slightly higher in migrant women compared to non-migrant women (migrants 0.56% *vs* non-migrants 0.49%; $p < 0.001$). Further, the stillbirth prevalence was higher in multiparous migrant women compared with the non-migrants (migrants 0.57% *vs* non-migrants 0.46%, $p < 0.001$), though not in primiparous women (migrants 0.54% *vs* non-migrants 0.52%, $p = 0.37$).

The prevalence and odds of stillbirth varied by maternal country of birth (Figure 5). In primiparous women the highest prevalence of stillbirth was found in women from Sri Lanka, Somalia and Pakistan, and in multiparous women in those from Pakistan, Somalia and Afghanistan. The lowest prevalence of stillbirth was found in primiparous women from Russia, Poland and the Philippines, and in multiparous women from Sweden, Vietnam and Thailand.

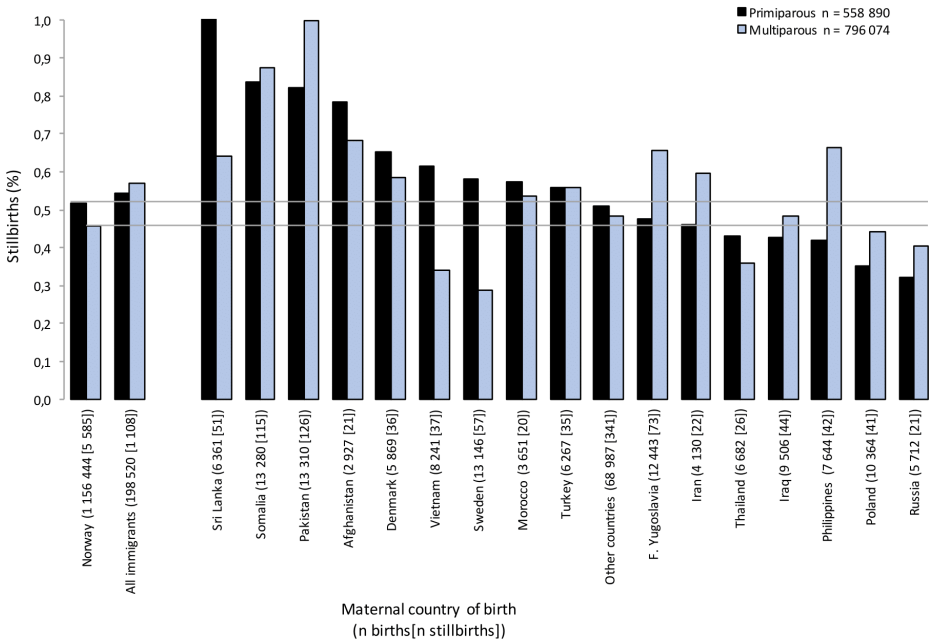


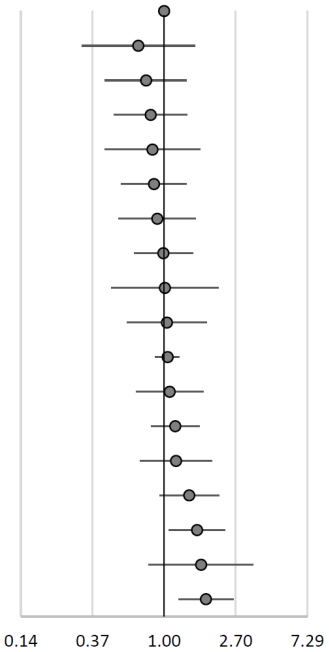
Figure 5. Prevalence of stillbirth in relation to maternal country of birth (N = 1,354,964) in Norway. Maternal country of birth is presented with total number of births, and the number of stillbirths in brackets. The bars are ordered by the highest prevalence of stillbirth to primiparous women.

In primiparous women, there were increased odds of stillbirth for women from Sri Lanka (aOR = 1.79; 95% CI 1.22–2.63) and Pakistan (aOR = 1.58; 95% CI 1.07–2.34), relative to non-migrant women. In multiparous women, there were increased odds of stillbirth for women from Pakistan (aOR = 1.71; 95% CI 1.34–2.18), Somalia (aOR = 1.67; 95% CI 1.30–2.16), the Philippines (aOR = 1.60; 95% CI 1.09–2.33), and Former Yugoslavia (aOR = 1.50; 95% CI 1.11–2.01), relative to non-migrant women (Figure 6).

A

Primiparous women

Maternal country of birth (n births [n stillbirths])	Crude OR (95% CI)	Adjusted OR (95% CI)
Norway (477 577 [2 478])	1.00	
Russia (2 490 [8])	0.62 (0.28 to 1.34)	
Thailand (2 788 [12])	0.83 (0.47 to 1.46)	
Philippines (3 584 [15])	0.81 (0.48 to 1.34)	
Iran (1 954 [9])	0.89 (0.46 to 1.71)	
Poland (5 404 [19])	0.68 (0.43 to 1.06)	
Iraq (3 280 [14])	0.82 (0.49 to 1.39)	
F. Yugoslavia (4 842 [23])	0.92 (0.61 to 1.38)	
Morocco (1 218 [7])	1.11 (0.53 to 2.33)	
Turkey (2 332 [13])	1.07 (0.62 to 1.86)	
Other countries (30 529 [155])	0.98 (0.83 to 1.16)	
Vietnam (3 248 [20])	1.19 (0.75 to 1.89)	
Sweden (6 537 [38])	1.12 (0.81 to 1.56)	
Denmark (2 452 [16])	1.26 (0.77 to 2.06)	
Somalia (3 112 [26])	1.62 (1.10 to 2.38)	
Pakistan (3 904 [32])	1.58 (1.12 to 2.25)	
Afghanistan (1 022 [8])	1.51 (0.75 to 3.04)	
Sri Lanka (2 617 [27])	2.00 (1.37 to 2.93)	



B

Multiparous women

Maternal country of birth (n births [n stillbirths])	Crude OR (95% CI)	Adjusted OR (95% CI)
Norway (678 867 [3 107])	1.00	
Vietnam (4 993 [17])	0.74 (0.45 to 1.23)	
Sweden (6 609 [19])	0.63 (0.40 to 0.98)	
Thailand (3 894 [14])	0.78 (0.46 to 1.33)	
Morocco (2 433 [13])	1.17 (0.68 to 2.01)	
Russia (3 222 [13])	0.88 (0.51 to 1.52)	
Iraq (6 226 [30])	1.05 (0.74 to 1.51)	
Turkey (3 935 [22])	1.22 (0.79 to 1.89)	
Other countries (38 458 [186])	1.06 (0.91 to 1.23)	
Iran (2 176 [13])	1.31 (0.76 to 2.25)	
Denmark (3 417 [20])	1.28 (0.81 to 2.03)	
Poland (4 960 [22])	0.97 (0.64 to 1.47)	
Sri Lanka (3 744 [24])	1.40 (0.92 to 2.13)	
F. Yugoslavia (7 601 [50])	1.44 (1.07 to 1.93)	
Philippines (4 060 [27])	1.46 (1.00 to 2.12)	
Afghanistan (1 905 [13])	1.49 (0.83 to 2.68)	
Somalia (10 168 [89])	1.92 (1.54 to 2.40)	
Pakistan (9 406 [94])	2.20 (1.76 to 2.74)	

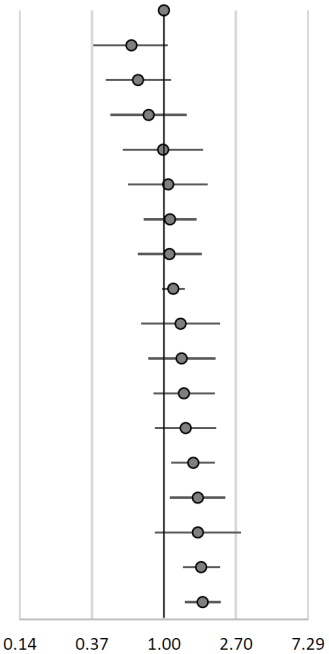


Figure 6. Associations between maternal country of birth and stillbirth in women giving birth in Norway, 1990–2013. Associations were estimated as odds ratios with 95% confidence intervals. The reference group was non-migrant women. All analyses were adjusted for year of birth, maternal age, marital status, consanguinity, level of education and income. Analyses of multiparous women were also adjusted for parity. Analyses for primiparous women in panel A and multiparous women in panel B. Abbreviations: OR, odds ratio; CI, confidence interval.

Primiparous migrant women whose babies were registered with a Norwegian-born father had decreased odds of stillbirth (aOR = 0.73; 95% CI 0.58–0.93) compared to migrant women whose babies were registered with a foreign-born father. Unregistered paternal origin was associated with increased odds of stillbirth regardless of the migrant woman's parity (primiparous: aOR = 6.29; 95% CI 4.64–8.51; multiparous: aOR = 5.72; 95% CI 4.70–6.96). Primiparous women migrating for work or education had decreased odds of stillbirth compared to Nordic migrants who are permitted to move freely between the countries due to a cross-national agreement (aOR = 0.58; CI 0.39–0.88). Length of residence in Norway was not associated with stillbirth. Finally, multiparous migrant women who had given birth to their first child before arriving in Norway had higher odds of stillbirth in later births when compared to multiparous migrant women who had their first child in Norway (aOR = 1.28; 95% CI 1.06–1.55).

3.2 Paper 2

Country of a woman's first birth and neonatal outcomes in migrant and Norwegian-born multiparous women in Norway

In Paper 1, multiparous migrant women who had given birth to their first child before arriving in Norway had higher odds of stillbirth in later births in Norway compared with multiparous migrant women who had their first child after arrival. In Paper 2, we therefore undertook more in-depth analyses and investigated a wider range of adverse neonatal outcomes in migrant women with a first birth before immigration to Norway (n=30,062) versus those with a first birth after immigration (n=66,006). In addition, outcomes were compared between births to Norwegian-born women with a first birth outside Norway (n=6,205) and those with a first birth in Norway (n=514,799).

The prevalence of most adverse outcomes was slightly higher in births to migrant women with a first birth *before* immigration to Norway compared to those with a first birth *after* immigration (Figure 7): very preterm birth (1.0% vs 0.8%; $p < 0.001$), moderately preterm birth (4.4% vs 3.9%; $p < 0.001$), post-term birth (5.8% vs 4.6%; $p < 0.001$), SGA (12.7% vs 11.9%; $p < 0.001$), low Apgar score (2.7% vs 2.2%; $p < 0.001$), and stillbirth (0.5% vs 0.4%; $p < 0.01$). Among the migrant women, the prevalence of LGA (11.8% vs 12.1%; $p = 0.178$) and neonatal death (0.2% vs 0.2%; $p = 0.988$) was similar in both groups.

Compared to those with a first birth in Norway (Figure 7), Norwegian-born women with a first birth outside Norway had higher prevalence of moderately preterm birth (5.0% vs 3.6%; $p < 0.001$), SGA (10.2%vs 7.4%; $p < 0.001$), low Apgar score (3.0% vs 1.8%; $p < 0.001$) and stillbirth (0.5% vs 0.4%; $p < 0.05$), and lower prevalence of post-term birth (4.7% vs 6.6%; $p < 0.001$) and LGA (13.5% vs 19.0%; $p < 0.001$). Among the Norwegian-born women, the prevalence of very preterm birth (0.9% vs 0.7%; $p = 0.141$) neonatal death (0.2% vs 0.2%; $p = 0.472$) was similar in both groups.

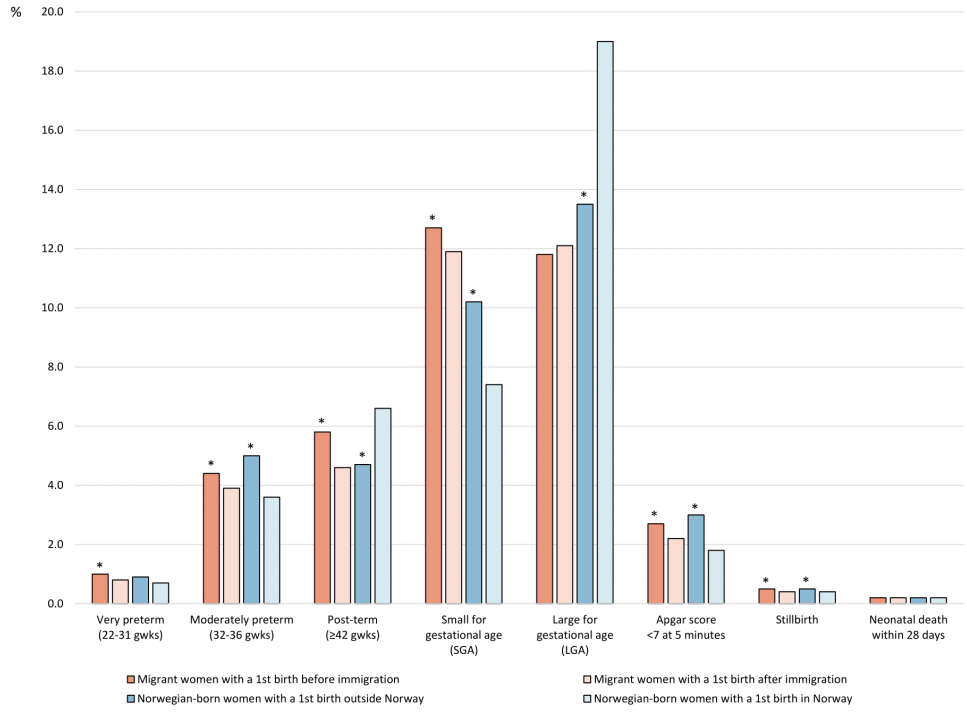


Figure 7. Prevalence of adverse neonatal outcomes in second and subsequent births in migrant and Norwegian-born women (1990-2016). * p-values <0.05, when comparing birth outcomes in either the two groups of migrant women or the two groups of Norwegian-born women.

Migrant women with a first birth before immigrating to Norway had increased odds of adverse outcomes in subsequent births relative to those with a first birth after immigration: very preterm birth (aOR=1.27; CI 1.09-1.48), moderately preterm birth (aOR=1.10; CI 1.02-1.18), post-term birth (aOR=1.19; CI 1.11-1.27), low Apgar score (aOR=1.27; CI 1.16-1.39) and stillbirth (aOR=1.29; CI 1.05-1.58) (Table 6).

Norwegian-born women with a first birth outside Norway also had increased odds of most adverse outcomes in subsequent births relative to those with a first birth in Norway: moderately preterm birth (aOR = 1.36; CI 1.19–1.55), post-term birth (aOR = 1.23; CI 1.08–1.40), SGA (aOR = 1.43; CI 1.31–1.57), low Apgar score (aOR = 1.61; CI 1.38–1.88) and stillbirth (aOR = 1.69; CI 1.18–2.42), and decreased odds of LGA (aOR = 0.74; CI 0.68–0.80).

Table 6. Associations between migrant women's country of first birth and adverse neonatal outcomes (1990-2016).

Adverse neonatal outcomes	n births	n cases	Crude OR (95% CI)	Adjusted OR (95% CI) *
Very preterm (22-31 weeks) †				
Norway	62366	532	1.00	1.00
Other	27965	308	1.29 (1.12-1.50)	1.27 (1.09-1.48)
Moderately preterm (32-36 weeks) †				
Norway	64348	2514	1.00	1.00
Other	28938	1281	1.14 (1.06-1.22)	1.10 (1.02-1.18)
Post-term (≥42 weeks) †				
Norway	62096	2994	1.00	1.00
Other	27825	1701	1.29 (1.20-1.37)	1.19 (1.12-1.27)
Small for gestational age (SGA)				
Norway	65092	7738	1.00	1.00
Other	29401	3743	1.08 (1.03-1.13)	1.05 (1.00-1.10)
Large for gestational age (LGA)				
Norway	65092	7847	1.00	1.00
Other	29401	3454	0.97 (0.93-1.02)	0.98 (0.93-1.03)
Apgar score <7 at 5 minutes				
Norway	66006	1418	1.00	1.00
Other	30062	824	1.28 (1.18-1.40)	1.27 (1.16-1.39)
Stillbirth				
Norway	66006	261	1.00	1.00
Other	30062	157	1.32 (1.08-1.62)	1.29 (1.05-1.58)
Neonatal death within 28 days				
Norway	66006	138	1.00	1.00
Other	30062	63	1.00 (0.74-1.36)	0.95 (0.69-1.30)

* Adjusted for year of birth, parity, maternal age, marital status, maternal education, and mother's gross income.

† Weeks of gestation; term births were used as comparison group.

3.3 Paper 3

Associations between paternal origin and adverse neonatal outcomes in births to migrant women

In Paper 1, we also found that paternal origin was associated with the risk of stillbirth. This finding generated a new hypothesis; that a father from the host population might be associated with decreased risk of a wider range of adverse neonatal outcomes in births to migrant women. In Paper 3, we therefore investigated associations between paternal origin, and very preterm birth, moderately preterm birth, low Apgar score and stillbirth in migrant women giving birth in Norway (n=240,759).

In births to primiparous migrant women, a Norwegian-born father was associated with decreased odds of very preterm birth (aOR 0.83; CI 0.73-0.96) and stillbirth (aOR 0.68; CI 0.55-0.86) compared to births with a foreign-born father (Table 7). In births where paternal origin was unregistered, the odds were increased for very preterm birth (aOR 2.20; CI 1.79-2.70), moderately preterm birth (aOR 1.18; CI 1.03-1.34), low Apgar score (aOR 1.77; CI 1.57-1.99) and stillbirth (aOR 5.13; CI 4.06-6.49) compared to births with a foreign-born father.

In births to multiparous migrant women, a Norwegian-born father was associated with decreased odds of very preterm birth (aOR 0.85; CI 0.73-0.98), low Apgar score (aOR 0.87; CI 0.80-0.96) and stillbirth (aOR 0.80; CI 0.64-0.99) compared to births with a foreign-born father (Table 8). In births where paternal origin was unregistered, the odds were increased for very preterm birth (aOR 1.91; CI 1.66-2.19), moderately preterm birth (aOR 1.23; CI 1.13-1.33), low Apgar score (aOR 1.71; CI 1.56-1.88) and stillbirth (aOR 2.92; CI 2.45-3.47) compared to births with a foreign-born father to the baby.

In addition, we conducted sub-group analyses investigating associations between paternal identity (with known father as the reference) and adverse neonatal outcomes.

Unknown paternal identity was associated with increased odds of all adverse outcomes investigated, although the sub-group numbers were relatively small.

Table 7. Associations between paternal origin and adverse neonatal outcomes in births to primiparous and multiparous migrant women in Norway (1990-2016).

	Very preterm (22^{+0}-31^{+6} weeks)	Moderately preterm (32^{+0}-36^{+6} weeks)	Apgar score <7 at 5 minutes	Stillbirth
Primiparous migrant women				
Paternal origin				
Foreign-born (n)	54,964	57,119	59,294	59,294
no cases (%)	636 (1.2)	2791 (4.9)	2192 (3.7)	267 (0.5)
Reference	1.00	1.00	1.00	1.00
Norwegian-born (n)	31,968	33,379	34,684	34,684
no cases (%)	326 (1.0)	1737 (5.2)	1205 (3.5)	114 (0.3)
OR, 95% CI	0.82 (0.71-0.93)	1.07 (1.00-1.14)	0.94 (0.87-1.01)	0.73 (0.59-0.91)
aOR, 95% CI*	0.83 (0.73-0.96)	1.05 (0.98-1.11)	0.93 (0.86-1.00)	0.68 (0.55-0.86)
Unregistered (n)	4.452	4,603	4,919	4,919
no cases (%)	116 (2.6)	267 (5.8)	335 (6.8)	107 (2.2)
OR, 95% CI	1.91 (1.66-2.19)	1.20 (1.05-1.36)	1.90 (1.69-2.14)	4.92 (3.92-6.16)
aOR, 95% CI*	2.20 (1.79-2.70)	1.18 (1.03-1.34)	1.77 (1.57-1.99)	5.13 (4.06-6.49)
Multiparous migrant women				
Paternal origin				
Foreign-born (n)	85,635	88,694	92,803	92,803
no cases (%)	937 (1.1)	3996 (4.5)	2210 (2.4)	428 (0.5)
Reference	1.00	1.00	1.00	1.00
Norwegian-born (n)	32,337	33,477	34,793	34,793
no cases (%)	289 (0.9)	1429 (4.3)	679 (2.0)	115 (0.3)
OR, 95% CI	0.82 (0.71-0.93)	0.95 (0.89-1.01)	0.82 (0.75-0.89)	0.72 (0.58-0.88)
aOR, 95% CI†	0.85 (0.73-0.98)	0.98 (0.92-1.05)	0.87 (0.80-0.96)	0.80 (0.64-0.99)
Unregistered (n)	13,067	13,545	14,266	14,266
no cases (%)	270 (2.1)	748 (5.5)	600 (4.2)	187 (1.3)
OR, 95% CI	1.91 (1.66-2.19)	1.24 (1.14-1.34)	1.80 (1.64-1.97)	2.87 (2.41-3.41)
aOR, 95% CI†	1.91 (1.66-2.19)	1.23 (1.13-1.33)	1.71 (1.56-1.88)	2.92 (2.45-3.47)

* Adjusted for year of birth, maternal age, maternal education and mother's gross income

† Additional adjustments for parity

3.4 Summary of key findings

Box 1. Summary of key findings, Papers 1, 2 and 3.		
Key findings	**Primiparous women**	**Multiparous women**
Maternal country of birth Reference group: Non-migrant women	**Paper 1:** Women from Sri-Lanka and Pakistan had higher odds of stillbirth when compared to non-migrant women (adjusted OR ranged from 1.58 to 1.79).	**Paper 1:** Women from Pakistan, Somalia, the Philippines and Former Yugoslavia had higher odds of stillbirth when compared to non-migrant women (adjusted OR ranged from 1.50 to 1.71).
Birthplace of firstborn child/Country of a woman's first birth Reference group: Norway	Not applicable.	**Paper 1 and 2:** Migrant women who had given birth to their first child before arriving in Norway had higher odds of stillbirth in later births in Norway compared with migrant women who had their first child after arrival (Paper 1: aOR = 1.28; CI 1.06–1.55, Paper 2: aOR=1.29; CI 1.05-1.58). Paper 2 adds similar results for very preterm birth (aOR=1.27; CI 1.09-1.48), moderately preterm birth (aOR=1.10; CI 1.02-1.18), post-term birth (aOR=1.19; CI 1.11-1.27) and low Apgar score (aOR=1.27; CI 1.16-1.39). Similar results were found in births to Norwegian-born women who had their first baby abroad.
Paternal origin* Reference group: Foreign-born father	**Paper 1 and 3:** Migrant women whose babies were registered with Norwegian-born fathers had decreased odds of stillbirth compared to migrant women whose babies were registered with foreign-born fathers (Paper 1: aOR = 0.73; CI 0.58–0.93, Paper 3: aOR 0.68; CI 0.55-0.86). Paper 2 adds similar results for very preterm birth (aOR 0.83; CI 0.73-0.96).	**Paper 3:** A Norwegian-born father was associated with decreased odds of very preterm birth (aOR 0.85; CI 0.73-0.98), low Apgar score (aOR 0.87; CI 0.80-0.96) and stillbirth (aOR 0.80; CI 0.64-0.99) compared to births with a foreign-born father.
	Unregistered paternal origin (**Paper 1 and 3**) and unknown paternal identity (**Paper 3**) were both associated with increased odds of adverse outcomes.	
Reason for immigration* Reference group: Nordic migrants †	**Paper 1:** Women migrating for work or education had decreased odds of stillbirth compared to Nordic migrants (aOR = 0.58; CI 0.39–0. 88).	**Paper 1:** Reason for immigration was not associated with stillbirth in births to multiparous migrant women.
Length of residence* Reference group: < 2 years	**Paper 1:** Length of residence was not associated with stillbirth in births to primiparous or multiparous migrant women.	
* Births to non-migrant women were not included in the analysis. † Nordic migrants are permitted to move freely between the countries due to a cross-national agreement.		

4. Discussion

This thesis identifies sub-groups of migrant women who are at an increased risk of stillbirth and other adverse neonatal outcomes and highlights the need to improve care for them.

The results demonstrate that extra attention should be paid to women from certain countries, multiparous women who have their first baby before immigration to Norway and women whose babies have foreign-born fathers, births were paternal origin is unregistered or paternal identity is unknown. The risk of stillbirth was lower in primiparous women who had migrated for work or education compared to Nordic migrants who are permitted to migrate freely between Nordic countries. Stillbirth was not associated with length of residence in Norway.

In the following sections I will present methodological considerations, followed by a discussion of key findings.

4.1 Methodological considerations

In this population-based register study I have investigated associations between maternal country of birth and other migration related factors (paternal origin, reason for immigration, length of residence and country of a woman's first birth), and a range of adverse neonatal outcomes (very preterm birth, moderately preterm birth, post-term birth, small for gestational age, large for gestational age, low Apgar score, stillbirth and neonatal death) in migrant and non-migrant women giving birth in Norway between 1990-2013/2016.

4.1.1 Strengths and limitations of the thesis

The main strengths of the thesis include the standardized collection of high-quality data including migration related factors, adverse neonatal outcomes and socioeconomic factors. The long time span of the studies (23/26 years) allowed for identifying women who had given birth to their first baby before immigration.

Further, the large number of covariates available in the dataset made it possible to adjust for relevant covariates in the regression analyses.

The large study sample allowed for investigation of rare outcomes [101]. The data were not collected by the researchers however, and some variables important to the research question were not available [126]. In observational studies, there is always a question of how residual confounding may bias the effect estimates [101]. Unmeasured variables may bias the effect estimates, however, confounding may also still be present after adjustments if the variable adjusted for fails to completely block the confounding path between the exposure variable and the outcome variable [101]. This thesis has several limitations related to unmeasured variables recognized as key elements when caring for migrant families, such as those described in chapter 1.6 *Explanations for differences in adverse neonatal outcomes.* Variables describing both mothers' and fathers' first language, fluency in Norwegian, number of antenatal visits, information on uncommon diagnoses and family's total income, could potentially have added value to the interpretation of the findings.

The validity of the study results depends on both internal validity (i.e. information bias from mismeasurements of study variables, selection bias, and confounding) and external validity (i.e. to what degree the results may apply to individuals outside the study population) [101]. In the following chapters I will discuss internal and external validity in relation to study findings.

4.1.2 Information bias

Information bias is a systematic error that occurs in case of incorrect measurement or misclassification of the exposure or outcome variable under study [101]. In observational studies, validated data increase the credibility of study results [101]. While both the MBRN and the SSB are considered high-quality registers, missing data, incorrect information or changes in data management over the study period may introduce information bias. In the MBRN, the most frequently used variables are standardized and systematically tested for quality [127]. Only a few validation studies including MBRN data have been published in recent years however [128-130].

There is a need for further validation studies, as these could possibly increase the quality of the registers and future research [131]. As concerns Paper 3, we suggest that the MBRN variable *paternal identity* needs validation. Routine validation of data from registries is necessary to ensure the quality of epidemiological research. In particular, variables less studied (e.g. paternal identity) can be associated with erroneous values which in worst case may lead to less valid results and false conclusions [131].

In this thesis, information bias may have been introduced when creating a separate category for missing data in analyses including paternal origin (i.e. unregistered paternal origin). The results regarding paternal origin should therefore be interpreted with caution. This approach was chosen because missing paternal demographics has been reported as a potential indicator for identifying high-risk pregnancies associated with an increased risk of adverse outcomes including preterm birth, fetal growth restriction, low Apgar score, stillbirth and neonatal mortality [122-124]. Excluding births where paternal information is missing could lead to families at high risk of adverse outcomes being removed from the sample [124].

4.1.3 Selection bias

Selection bias will occur as a result of a systematic error from the methods used to include study participants or from factors that influence study participation [101]. All three studies were nationwide population-based register studies, and one of the main strengths of such studies is that the study sample includes information on nearly all births in a population, thus the risk of selection bias is limited [126]. A limitation to the study was that we lacked information on births to women who did not have a national identity number or a D number (i.e. a temporary national identity number). Not including births to particularly vulnerable women suggests that the risk of adverse neonatal outcomes in migrant populations in Norway may be underestimated in this thesis.

4.1.4 Confounding

Confounding will occur if the observed association between the exposure and the outcome investigated is in fact explained fully or partly by another variable or factor [101]. To reduce the effect of a possible confounder, the observed association should be corrected for its effect. Ruling out confounding is, however, a constant challenge in observational studies [101, 132]. In the following text, I will explain common challenges with adjustments in observational studies. Finally, I will discuss challenges related to the specific papers included in this thesis.

A common challenge in epidemiological studies is over-adjustment bias or unnecessary adjustments [133]. Over-adjustment bias may be defined as control for an intermediate variable on a causal path from exposure to outcome [133]. One example of a possible intermediate variable that could have led to over-adjustment bias in this thesis would be if we had adjusted for *infant birthweight* (Figure 8). On a timeline, infant birthweight would be placed after the exposures investigated (i.e. maternal country of birth and other migration related factors), thus should not be handled as a confounding factor.

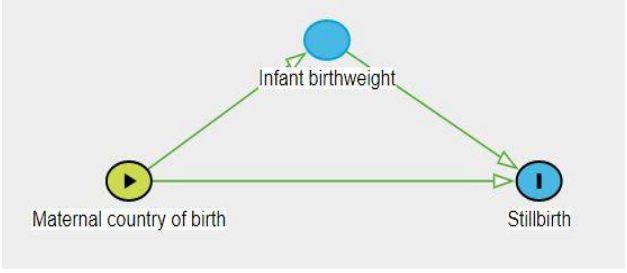


Figure 8. Visualization of causal pathways between variables of interest. Infant birthweight as an example of a possible intermediate variable that could have led to over-adjustment bias in this thesis.

In this thesis, the number of adjustment variables was kept to a minimum. Unnecessary adjustment may be defined as control for a variable that does not affect the relation between exposure and outcome but may affect its precision [133]. Unnecessary adjustments (Figure 9) may occur if adjustments are made for variables: 1) completely outside the system of interest (e.g. mother's favourite flavour of ice-

cream), 2) that are only associated with the exposure (e.g. woman's mother's country of birth), 3) that are descendants of the exposure (e.g. number of siblings), and 4) that are only associated with the outcome of interest (e.g. Covid-19) [133]. The examples presented in brackets in the text above do not reflect the variables available in the current study sample, however, illustrate different types of variables not adjusted for in the current study. Figure 8 and 9 were created using directed acyclic graphs (DAGs); DAGitty [134] version 3.0. Such causal diagrams provide a visual model of an investigator's assumptions about causal relations between exposure, outcome and other covariates, and is therefore useful when identifying potential confounding factors [101].

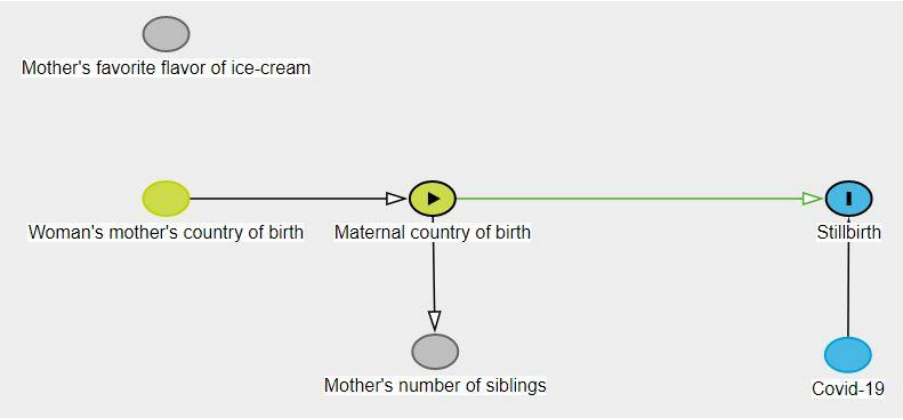


Figure 9. Visualization of causal pathways between variables of interest. The examples do not reflect the variables available in the current study sample, however, illustrate different variables that would cause unnecessary adjustments (i.e. possible confounding bias).

In Paper 1, we adjusted for chronic hypertension and recurrent stillbirths. These variables may be potential confounding factors, however, both outcome variable (stillbirth) and the potential confounders (chronic hypertension and recurrent stillbirths) are rare conditions, thus including these variables did not affect the results, and the final statistical models did not include these variables in the models.

In all three papers, analyses were adjusted for mother's gross income. However, it is a limitation of the study that this variable gives limited information on the family's total economic situation. Smoking and maternal overweight are examples of highly

relevant risk factors found to influence the risk of prematurity [37, 135, 136], fetal growth [137], stillbirth [71, 117, 136, 137], transfer to neonatal unit [137] and neonatal death [137]. However, analyses were not adjusted for maternal overweight or smoking, as these variables were only routinely collected from 2008 and 1999, respectively. Results in all three papers may be biased due to unmeasured confounders [138].

4.1.5 Other methodological considerations

In all three studies, we aimed to minimize the risk of introducing multicollinearity [139]. The problem of multicollinearity occurs when, for example, maternal country of birth and reason for immigration are included in the same statistical model, as these two variables are known to be highly correlated [139]. Therefore, migration related factors were treated one-by-one in separate analyses. With a larger sample, which would be possible by linking data from all Nordic countries [106], one could investigate the impact of a selection of migration related factors by including interactions in the models, or stratifying data by different sub-groups of migrant women [101].

Consistent with the American Statistical Association statement on p-values [140], the use of p-values for summarizing results has been held to a minimum in this thesis. The strength of the conclusion can easily be misunderstood, especially in large samples (>10,000 observations) where the p-values go quickly to zero [141]. All three studies were based on such large samples: a total of 1,439,913 births (Paper 1) and 1,620,532 births (Paper 2 and 3). Conclusions drawn are primarily based on an interpretation of ORs with 95% CIs. The p-values were reported as supporting information (Papers 1 and 2).

4.1.6 External validity

External validity, or generalizability, is the validity of the findings as they pertain to people outside the population under study [101]. By including all births in Norway, the results are considered representative for the Norwegian and similar settings; however, the findings should be interpreted with caution outside Norway.

In Paper 1, the risk of stillbirth was reported by maternal country of birth. While these findings may be valid in a Norwegian or similar setting, there are limitations to the findings relevant when interpreting the results. First, a limited number of specific maternal countries of birth were highlighted; countries represented by a minimum of 6000 births (12 countries, Norway included), a stillbirth frequency of ≥20 throughout the study period (another 5 countries added), and the remaining countries were combined into a separate category (*other countries*). Women from the specific countries comprise only a selection of women from their home country, thus the results cannot be generalized to their home country population, and one should be careful not to generalize the results to migrant populations in other receiving countries merely based on their country of birth. Second, there have been great changes in migration over the study period, and the needs of women from the specific countries and the care women receive, may therefore have changed over the period. To account for changes over the long study period in relation to migration, obstetric practice and maternity care, analyses were adjusted for year of birth.

4.2 Discussion of key findings

In the following I will discuss the key findings of this thesis: the impact of maternal country of birth, country of a woman's first birth, paternal origin, reason for immigration and length of residence.

4.2.1 Maternal country of birth

Country of birth has been recognised as an important predictor for adverse pregnancy outcomes in this as in other studies [13]. In the first paper, we found increased odds of stillbirth in primiparous women from Sri-Lanka and Pakistan, and multiparous women from Former Yugoslavia, the Philippines, Somalia and Pakistan. The reference group was Norwegian-born women. Several previous studies have investigated associations between maternal country of birth and the risk of stillbirth. In the following text, I will discuss the results country by country.

Pakistani women had the highest odds of stillbirth of all women, and similar findings have been reported in previous studies based on large population-based datasets from Norway from the periods 1967-1994 [61], 1985-2005 [59], 1995-2010 [142], and from Denmark from 1981-2003 [143]. The current thesis adds value by the inclusion of more recent data (1990-2013) [144]. The first Pakistani migrants came to Norway in the late 1960s, and were the first group of non-European migrants in the country [116, 145]. The majority of Pakistani migrants came for work (i.e. mostly men) or family reunification (i.e. mostly women) [145]. Traditionally, it has been uncommon for Pakistani women to marry Norwegian-born men [145], and in the current study, one in four Pakistani women reported a close family relationship with the baby's father (i.e. consanguinity) [144]. Notably, consanguinity is less common among second generation Pakistani women in Norway [146]. While analyses were adjusted for consanguinity, such information over generations was not available. The results may however be explained by other factors and should therefore be interpreted with caution. Nonetheless, the findings suggest that migrant communities with high levels of consanguinity may benefit from public health awareness programs and genetic counselling.

Further, primiparous Sri Lankan women were also found to have increased odds of stillbirth compared to their Norwegian-born counterparts. Births to Sri Lankan women have been associated with an increased risk of stillbirth in previous studies based on large population-based datasets from Norway (1985-2005) [59] and Ontario, Canada (2002-2011) [96]. This thesis includes recent nationwide data (1990-2013), and the results are reported separately for primiparous and multiparous women [144]. In Norway, the majority of Sri Lankan migrants are Tamils who came in the mid-1980s as refugees, asylum seekers, or were reunited with a family member with refugee status [145]. During the civil war in Sri Lanka, the Tamils suffered from higher rates of stillbirth, neonatal death and maternal mortality compared to the Sri Lankan national average [147]. Further, women in the Tamil areas were likely to be underweight (BMI <19), suffer from malaria infections, and primiparous women were found to have an elevated risk of giving birth to babies weighing less than 2500 grams [147]. In 2009, the 25-year long Sri Lankan civil war ended, other receiving

countries may have welcomed other groups than Tamils compared to Norway, and the situation for Sri Lankan migrants in general has changed over the years. Thus, comparing outcomes across borders and studies may not be entirely appropriate. The associations found in this thesis related to parity may have been present in other studies, but previous studies investigating associations between Sri Lankan migrant women and stillbirth have not distinguished between primiparous and multiparous women. Future studies are warranted to confirm the robustness of these findings.

Next, multiparous Filipino women had higher odds of stillbirth compared to Norwegian-born women. We suggested that this finding may be explained by their increased risk of type 2 diabetes [144, 148]. However, primiparous Filipino women were among those with the lowest rates of stillbirth. One previous Norwegian study found that Filipino women had similar odds of stillbirth compared to Norwegian-born women, but this study was from an earlier period (1986-2005), and it did not distinguish between primiparous and multiparous women [59].

As concerns Somali women, their increased risk of stillbirth is well documented by a wide range of studies, from Norway in the periods 1986-2005 [59] and 1986-1998 [149], Sweden 1990-1996 [150] and 2001-2009 [46], Denmark 1981-2003 [143], Ontario, Canada 2002-2011 [96], and one cross-national study including regional and national datasets from Australia, Belgium, Canada, Finland, Norway and Sweden over periods of 3-6 years 1997-2004 [151]. In the current thesis, the increased crude odds of stillbirths in primiparous Somali women was no longer evident after adjustments were made for factors such as maternal age, level of education and income [144]. Notably, part of the increased risk may therefore be a proxy for other known risk factors, such as low socioeconomic status, low health literacy or language barriers [15]. Pregnant women who do not share a first language with the caregiver may have fewer opportunities to understand and discuss recommendations given [152]. Unfortunately, we did not have access to information related to health literacy or language. In Norway, Somali families constitute a diverse group. Most have a refugee background and live in large households with low income [145, 153]. Several studies have investigated Somali families and their needs and experiences related to

maternity care after migration [44, 45, 154, 155]. However, one Norwegian study found that Somali women had a lower risk of perinatal death after migration to Norway when compared to Somali women in Somalia [59]. This suggests that migrant women from countries with high risk of perinatal death may benefit from high-quality care given in countries such as Norway [59]. With a growing body of knowledge related to Somali women and their needs in maternity care, implications for practice should therefore involve designing and testing interventions aimed at improving maternity care and birth outcomes in Somali families.

To my knowledge, the increased odds of stillbirth found in multiparous women from Former Yugoslavia have not been reported in previous studies. However, one Danish population-based study (1981-2003) found that Former Yugoslavian minorities were at the same risk level as the host population [143]. While both studies did include the same countries in the category *Former Yugoslavia*, cross-national comparison between studies from different receiving countries may not be entirely appropriate due to heterogeneity within the migrant group. Migrant minorities from Former Yugoslavia sought refuge in Norway in the 1990s due to war and political conflicts in their home areas [145]. Even though we did adjust our analyses for year of birth, it is possible that the needs and outcomes of migrant women from these areas will be different today compared to the migrant women from Former Yugoslavia included in the current study. Thus, the clinical value of these findings may be limited.

Regardless of maternal country of birth, the World Health Organization highlights that policymakers must be aware that some women migrate from countries with a high burden of disease [15]. Thus, it is possible that the increased risk of stillbirth found associated with sub-groups of migrant women may be explained by variables not available in the dataset, such as diagnoses that are uncommon in the majority of European countries: e.g. tuberculosis (TB), human immunodeficiency virus (HIV) or hepatitis B [15]. In Norway between the years 1986 and 1999, the majority of migrants diagnosed with TB were from many of the same countries as those identified in our study; Pakistan, Former Yugoslavia, the Philippines, Somalia and Vietnam [156]. Finally, investigating adverse neonatal outcomes on a country level

may lead to overlooking the needs of women from smaller regions or countries, such as Djibouti (i.e. neighbouring country of Somalia), or Kosovo (i.e. one of the countries represented by Former Yugoslavia). In particular, it is well known that sub-groups of African migrant women suffer from high rates of stillbirth [14, 157, 158]. It may therefore have added value to the discussion if we had also reported the risk of stillbirth by larger regions, such as the GBD regions, in addition to country level reports.

In summary, maternal country of birth may be considered an independent risk factor for stillbirth. However, the variation in health outcomes between different groups of migrant women may also be explained by other factors, known or unknown in this thesis. Maternal country of birth may indeed be a proxy measure for all kinds of disadvantage for specific groups of women, including lack of familiarity with care systems, language fluency and communication issues, traumatic migration journeys, discrimination or sub-optimal care. These are factors unavailable to register studies and require specific investigation. Regardless, one should be careful in generalising maternal country of birth findings, as generalisation may lead to increased stigma for certain groups. Migration is not a new phenomenon, and different flows of migrants will continue to shift and change over the years to come. Notably, findings related to specific countries are time and place specific. Suggestions for future research include investigating associations between recent migrant flow and stillbirth, including the growing group of Syrian refugees in Europe [159]. Investigating associations between maternal country of birth and a wider range of adverse neonatal outcomes should be considered with results reported both on a country and regional level.

4.2.2 Country of a woman's first birth

In this thesis, we found an increased risk of adverse neonatal outcomes in women who had migrated after giving birth to their first baby outside Norway, relative to women who had given birth to their first and subsequent child(ren) in Norway. To my knowledge, this is a novel finding, and it was made possible in this thesis due to the long time span of the study (23 and 26 years, respectively) and the richness of the data material.

The findings do however support the interpretation in a critical review on infant birthweight that suggests that minority status be regarded as a marker alerting clinicians to the need for vigilant care, especially if the parents have migrated to a new country and their medical history is incomplete [7]. Further, one Danish [52], one Norwegian [53] and one cross-national European [54] qualitative study describe how incomplete medical records may hamper the care provided to migrant women. In the Danish study, midwives explained how a lack of information in medical records sometimes affected their work when assessing migrant women's needs, thus increasing the risk of delays in referrals to specialist care [52]. It is also possible that women with incomplete medical records are more likely to be newly arrived immigrants and therefore lack knowledge about the local health care system or experience communication barriers. In the Norwegian study, emergency medical technicians (EMTs) explained how a poorly filled out antenatal record card sometimes made it difficult to make appropriate decisions in out-of-hospital care [53]. The EMTs added that some women were difficult to communicate with, especially when in labour, and mentioned non-Norwegian women in particular [53]. The results from the Danish and the Norwegian studies support the findings in the larger cross-national European study. The cross-national study adds that if the woman's medical record is available, it is usually in a foreign language [54].

In Papers 1 and 2, we suggested that the results related to country of a woman's first birth should serve as a reminder of the importance of collecting a thorough obstetric history from multiparous women who give birth in a new country after migration. Notably, the results also applied to a limited sample of Norwegian-born women. Collecting a thorough obstetric history in multiparous women who move after a first birth can be challenging as the caregiver may be dependent on maternal recall of previous births and possible complications rather than birth records. However, women's recall of birth and pregnancy characteristics has been found to be both feasible and inexpensive [160]. Nonetheless, collecting obstetric history may be challenging, for example due to communication issues, and if parity is not being recorded correctly by health care providers, this could lead to bias. It has been suggested that the number of children reported for each woman in the Norwegian

registers may not be entirely correct for all women [161, 162]. Data on parity in women who migrate to a new setting may also be biased for various reasons, including when the definition of a pregnancy loss varies [117] or in cases where previous stillbirths are intentionally, or unintentionally, not counted towards parity [21].

In summary, the increased risk of adverse neonatal outcomes associated with multiparous women who migrate after giving birth to a first baby outside Norway is a novel finding. Little is known about this group of multiparous women, suggesting researchers take this into consideration when planning and conducting future observational and intervention studies related to neonatal health in multiparous migrant and non-migrant women.

4.2.3 Paternal origin

In births to migrant women, we found that a Norwegian-born father was associated with decreased odds of very preterm birth, low Apgar score and stillbirth. Few studies have addressed the impact of paternal origin in relation to the risk of adverse neonatal outcomes in migrant women [95-99]. The findings in this thesis support the findings from previous studies from Sweden [98], Canada [96, 99] and Australia [97]. A partner from the host population may benefit a migrant woman in several ways, such as by facilitating communication, guiding her through the health care system [59, 144], or providing her with increased wealth and social capital [95]. The protective influence may not apply to all migrant women however, and I will therefore discuss some of the limitations of this finding in the following paragraph.

Seven of ten migrants who come to Norway to marry a Norwegian partner are women [163], and a common question when Norwegian men marry women form Eastern Europe or Asia is whether the motivation for marriage is dependent on the woman not questioning traditional gender roles, seeing the man as the decision-maker in the marriage [164]. A migrant woman's residence permit may be dependent on the marriage, making her vulnerable to exploitation [165] and her motivation for a transnational marriage may be attributed to her willingness to trade being a sexual

partner for financial security [166, 167]. According to the Norwegian Immigrant Act a residence permit may be refused if it appears that the applicant is entering a marriage of convenience with the main purpose of receiving a residence permit in Norway [168]. Upon suspicion, the Norwegian Directorate of Immigration investigates: how long the couple has been together, how much contact they have had, what they know about each other, the age difference, whether the marriage is uncommon in the applicant's culture, and whether the applicant has previously applied for a residence permit in Norway or another country [169]. Alternatively, the positive impact of a partner from the host population may be explained by maternal origin, rather than paternal origin. The fact that paternal and maternal country of birth often correlate, makes interpreting findings related to paternal origin difficult. To better understand the impact of paternal origin, future studies are warranted to explore these possible explanations in more detail.

In this thesis, both unregistered paternal origin and unknown paternal identity were associated with increased odds of adverse outcomes in births to migrant women. An Australian study reports that missing paternal information is associated with factors such as having a minority background, living in areas of high socioeconomic disadvantage, smoking during pregnancy, preterm birth and low birth weight [124]. The findings in the Australian study are supported by a study from the US, however this study only included twin births [122]. The US study also found an increased risk of stillbirth and neonatal death when paternal information was missing [122]. A recent Canadian study reports similar findings to those of the Australian and the US studies [123]. Other studies investigating associations between paternal factors and adverse neonatal outcomes have excluded births where paternal country of birth [96, 98, 99], race or ethnicity were missing [170]. Excluding births due to missing paternal demographics seems problematic given our results. Unfortunately, the reasons that some births lacked paternal demographics are unknown. Women may withhold information on a child’s biological father for a variety of reasons, however missing information may also be for reasons such as female same-sex couples, multiple sexual partners, artificial insemination or in vitro fertilisation [124]. Our findings suggest that births where little or no information about the baby’s father is

forthcoming should alert clinicians. Future studies are warranted to confirm the robustness of these findings.

In summary, in births to migrant women a partner from the host population seems to influence the birth outcome positively. However, these findings may be dependent on a wider range of circumstances including maternal origin and the quality of the mother-father relationship. Both unregistered paternal origin and unknown paternal identity were associated with increased odds of adverse outcomes in births to migrant women.

4.2.4 Reason for immigration

In Paper 1, non-Nordic primiparous women migrating to Norway for work or education had lower odds of stillbirth when compared to Nordic migrants who may migrate freely between the Nordic countries. To my knowledge, no previous studies have investigated associations between a range of reasons for immigration and stillbirth, similar to the analyses presented in this thesis. However, a few other population-based studies in Norway have investigated health outcomes in migrants using similar data. These studies report results in favour of migrants who come to Norway for work or education compared to the host population [76] and family reunification immigrants (i.e. *family reunion or establishment*) [171], respectively. A review article investigating stillbirth and infant death among migrants in industrialised countries concluded that mortality risks appears to be greatest among refugees [14]. There were however some differences in results related to refugee women, and the authors suggested this may be due to failing to differentiate between political refugees with advantageous socioeconomic backgrounds and other refugees fleeing from wars and conflicts [14]. Further, a large population-based study from Denmark found that Palestinian refugees, represented by a Lebanese migrant group, had the same stillbirth risk as the majority population, however, these women were not identified as refugees per se [143]. The World Health Organization stresses that the wide variation in definitions of migrants, and the inconsistent use of terminology, represent a major challenge in sourcing evidence to support public health policies when planning health care for migrants [29]. An inconsistent use of definitions, and

failure to identify specific groups of migrant women, such as refugees and asylum seekers, limit the conclusions that can be drawn [43]. Due to methodological differences between studies investigating the impact of reason for immigration, comparing results across studies may not be entirely appropriate.

It is a limitation of this thesis that we did not have access to information on births to newly arrived asylum seekers, paperless migrants or tourists (i.e. all women without a national identity number or a D number (i.e. a temporary national identity number)). The hidden nature of being paperless makes it difficult to make a sound estimate of how many people live under such conditions [172]. Nonetheless, a Norwegian study reported that 23% of general practitioners (n=237/1027) had treated undocumented migrants, and pregnancy-related issues were one of the most frequently reported reasons for contact [173]. A similar study from the United Kingdom reported that 13% of asked health care professionals suspected having treated a victim of trafficking, of which one-fifth of the cases were related to maternity care [174]. Due to this limitation, the risk of adverse neonatal outcomes in migrant populations in Norway may be underestimated in this thesis.

Further, the category *family reunion or establishment* is a heterogeneous group, as it includes both women who may be categorized as refugees in other studies, and women who come to Norway for other reasons, such as to marry a Norwegian-born man. In 2016, one in four migrants who were categorized into the Statistics Norway category *family reunion or establishment* came from a conflict area and were reunited with a person categorized as a refugee [175].

In summary, migrating to Norway for work or education was associated with decreased odds of stillbirth in primiparous migrant women compared to Nordic migrants who are permitted to migrate freely between the Nordic countries. However, the impact of reason for immigration and the risk of stillbirth needs further investigation. The results from this study related to reason for immigration do not reflect the complexity of migration. Paperless women represent a hard-to-study population, however, future studies with access to such information should be

encouraged to study adverse neonatal outcomes in sub-groups of particularly vulnerable women less studied, such as newly arrived asylum seekers and paperless women.

4.2.5 Length of residence

In Paper 1, we found no association between length of residence and the risk of stillbirth. Length of residence is associated with the healthy migrant effect, and has been found to impact adverse outcomes, such as the risk of having a non-term birth [73, 98, 176], and the occurrence of preeclampsia has been found to increase with increasing length of residence [76, 177]. In this thesis, however, the findings related to length of residence may have been different if the study sample had been larger allowing for in-depth sub-groups analyses. Unfortunately, as stillbirth is a rare outcome, the dataset did not allow for such analyses. Our findings suggest that the impact of length of residence should be investigated in a larger sample, perhaps by linking data from all Nordic countries [106]. One suggestion for future research includes doing interaction analyses investigating the association between length of residence by reason for immigration, and stillbirth or other adverse neonatal outcomes in migrant women.

5. Conclusions

The risk of adverse neonatal outcomes varied across sub-groups of migrant women and was higher in women from a number of countries, multiparous women who had their first baby before immigration to Norway, women whose babies had foreign-born fathers, and births where paternal origin was unregistered or paternal identity was unknown.

Specifically, the risk of stillbirth was lower in primiparous women who had migrated for work or education compared to Nordic migrants who are permitted to migrate freely between the Nordic countries. Stillbirth was not associated with length of residence in Norway in this study.

This thesis contributes to a growing body of knowledge regarding migrant women and their diverse pregnancy outcomes and needs in maternity care. Sub-groups of migrant women have been identified with an increased risk of a range of adverse neonatal outcomes. The findings highlight the need to improve care for migrant women at increased risk of stillbirth and other adverse neonatal outcomes.

6. Clinical implications

The results suggests that more attention should be paid to: 1) primiparous women from Sri-Lanka and Pakistan, 2) multiparous women from Pakistan, Somalia, the Philippines, and possibly Former Yugoslavia, 3) multiparous women who had their first baby before migrating to a new country, and 4) migrant women whose babies have foreign-born fathers, births where paternal origin is unregistered or paternal identity is unknown. The impact of reason for immigration and length of residence on adverse neonatal outcomes in migrant women needs further investigation.

Identified disparities between adverse neonatal outcomes in sub-groups of migrant women does not rule out within-group variation. Each woman should therefore be met with an open mind and offered individualized care based on her own protective and risk factors. The results of this study serve as a reminder of the importance of collecting a thorough obstetric history in migrant women giving birth in a new country, especially multiparous migrant women who migrate to a new country after their first birth.

It should be borne in mind that all findings are context related. The findings presented in this thesis represent a snapshot, which is time (1990-2013/2016) and place (Norway) specific.

7. Future research

First, the focus in this thesis has been on adverse neonatal outcomes in a limited number of sub-groups of migrant women. With changing international migration, new groups of migrants will cross borders for a variety of reasons. In future research I therefore suggest focus on women with mixed backgrounds such as second generation migrants, and other new and growing groups of migrants such as Syrian refugees [159], climate change migrants [178] and paperless migrant women [179]. Notably, as these words are written, healthcare providers worldwide are forced to rethink their practices and change their priorities, due to the ongoing Covid-19 outbreak [180]. Short and long-term effects of the outbreak, on migration patterns and maternity care for migrant women, are unclear, and therefore yet another relevant subject for future research.

Second, the number of adverse outcomes in sub-groups of migrant women are often limited, complicating the interpretation of findings. In future research, one should therefore consider cross-country research, such as linking data with other Nordic countries. The Nordic medical birth registers (Denmark, Finland, Norway, Sweden and Iceland) are considered comparable and of high quality [106]. The registers are based on compulsory notification of births, and uses each woman's unique national identity number, allowing for further linkage with other nationwide registers and tissue banks when relevant [106].

Third, epidemiological knowledge is the foundation of public health [101], and with knowledge from epidemiological studies, future researchers may design and test interventions aimed at improving maternity care and birth outcomes in sub-groups of migrant women, such as women from certain countries [144] or women who move from one setting to another between pregnancies [144].

Finally, increased attention should be paid to the validation of variables in both Norwegian and non-Norwegian registers. I suggest that the MBRN variable *paternal identity* needs systematic assessment and validation.

8. Errata

Paper 1:

- The number of primiparous Nordic migrants is missing from Table 2. The correct number should be n=8786 births.
- Figure 2: The bars are ordered by the highest prevalence of stillbirth to *primiparous* women. The figure legend in the published paper reads *multiparous* women.

Source of data

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Stillbirth in relation to maternal country of birth and other migration related factors: a population-based study in Norway

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Abstract

Background: Migrant women's overall increased risk of adverse pregnancy outcomes is well known. The aim of this study was to investigate possible associations between stillbirth and maternal country of birth and other migration related factors (paternal origin, reason for immigration, length of residence and birthplace of firstborn child) in migrant women in Norway.

Methods: Nationwide population-based study including births to primiparous and multiparous migrant women ($n = 198,520$) and non-migrant women (n = 1,156,444) in Norway between 1990 and 2013. Data from the Medical Birth Registry of Norway and Statistics Norway. Associations were investigated by multiple logistic regression and reported as odds ratios (ORs) with 95% confidence intervals (CIs).

Results: Primiparous women from Sri-Lanka and Pakistan, and multiparous women from Pakistan, Somalia, the Philippines and Former Yugoslavia had higher odds of stillbirth when compared to non-migrant women (adjusted OR ranged from 1.58 to 1.79 in primiparous and 1.50 to 1.71 in multiparous women). Primiparous migrant women whose babies were registered with Norwegian-born fathers had decreased odds of stillbirth compared to migrant women whose babies were registered with foreign-born fathers (aOR = 0.73; CI 0.58–0.93). Primiparous women migrating for work or education had decreased odds of stillbirth compared to Nordic migrants (aOR = 0.58; CI 0.39–0.88). Multiparous migrant women who had given birth to their first child before arriving in Norway had higher odds of stillbirth in later births in Norway compared with multiparous migrant women who had their first child after arrival (aOR = 1.28; CI 1.06–1.55). Stillbirth was not associated with length of residence in Norway.

Conclusions: This study identifies sub-groups of migrant women who are at an increased risk of stillbirth, and highlights the need to improve care for them. More attention should be paid to women from certain countries, multiparous women who had their first baby before arrival and primiparous women whose babies have foreign-born fathers.

Keywords: Stillbirth, Migrant, Maternal country of birth, Paternal origin, Length of residence, Reason for immigration, Register study

Background

Migrant women constitute a significant and growing proportion of childbearing women in high-income countries [1], and in 2016, 27% of all births in Norway were to migrant women [2]. An increased risk of several adverse pregnancy outcomes, such as low birth weight, preterm birth, congenital malformations, and perinatal morbidity and mortality has been found for some migrant women [3].

Stillbirth is associated with a wide range of health related risk factors including socioeconomic factors (high and low maternal age, low level of education and income), physical health problems (obesity, diabetes, hypertension, infections, drug use, smoking), obstetric history (primiparous, grand-multiparous, previous stillbirth), pregnancy complications (placenta dysfunction, preeclampsia, asphyxia, congenital anomalies), consanguinity, lack of antenatal care [4, 5] and

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the baby having a migrant father also seems to increase the risk of stillbirth [6]. Risk factors such as obesity and smoking are priorities for stillbirth prevention in high-income countries [5], while infections (including syphilis and HIV) and grand-multiparity are more frequently reported as causes of stillbirth in low- and middle-income countries [4].

Migrants constitute a diverse group. While refugees are likely to have been exposed to a range of health risks, others may be in better health, something which made migration possible (i.e. the healthy migrant effect) [7]. However, the healthy migrant effect does not apply to all migrants and health status deteriorates by length of residence for many [8]. The literature regarding migration and the risk of stillbirth is extensive, but the results are inconclusive [3, 7, 9] possibly due to heterogeneity of study designs and study samples, small numbers of women representing each country, and differences in the definition of migrants [9]. Most epidemiologic studies on stillbirth lack information on specific migration related factors [9]. In Norway, such information is registered for migrants, and available for research and surveillance purposes.

The aim of this study was to investigate possible associations between stillbirth and maternal country of birth and other migration related factors (paternal origin, reason for immigration, length of residence and birthplace of firstborn child) in migrant women in Norway.

Methods

Study design

This is a nationwide population-based study using data from the Medical Birth Registry of Norway (MBRN) and Statistics Norway (SSB). The MBRN is based on mandatory notification of all births in Norway since 1967 [10], and includes information on the pregnancy and the health of the mother and infant. SSB provides information on immigration and socioeconomic factors [11]. Data from MBRN and SSB were linked using each woman's unique personal identification number.

Setting

The health care system in Norway provides high quality care, antenatal and obstetric care is free of charge for all, and the risk of adverse neonatal health outcomes is in general low [12]. Antenatal care is provided either by general practitioners or midwives depending on the individual woman's choice and medical needs and compliance with care is high [13]. However, migrant women make fewer visits and may not follow given recommendations to the same extent as non-migrants [14]. The vast majority of women in Norway give birth in hospitals (99%) [15].

In Norway, immigration has mainly been linked to growing labour demand, family reunion and refugees fleeing war and political conflicts. Migrants in Norway are more likely to have lower levels of education and be unemployed compared to the host population. They also have lower incomes, especially migrants from the African continent [11]. Every patient's right to receive information suited to their age, language and culture is protected by law in Norway [16], yet an underuse of interpreting services by health care professionals has been reported, and family members or other unqualified individuals are often used as interpreters [17].

Study population

The total birth cohort from 1990 to 2013 included 1,439,913 births (Fig. 1). Exclusions were made to reduce the heterogeneity within the groups and compare births to migrant women who had non-Norwegian-born parents with births to non-migrants with Norwegian-born parents. We therefore excluded births with missing data on maternal country of birth, births to Norwegian-born women with at least one foreign-born parent and women born abroad with at least one Norwegian-born parent. We also excluded pregnancies if the gestational age was < 22 weeks or the infant birthweight was < 500 g (if missing data on gestational age) to conform with the

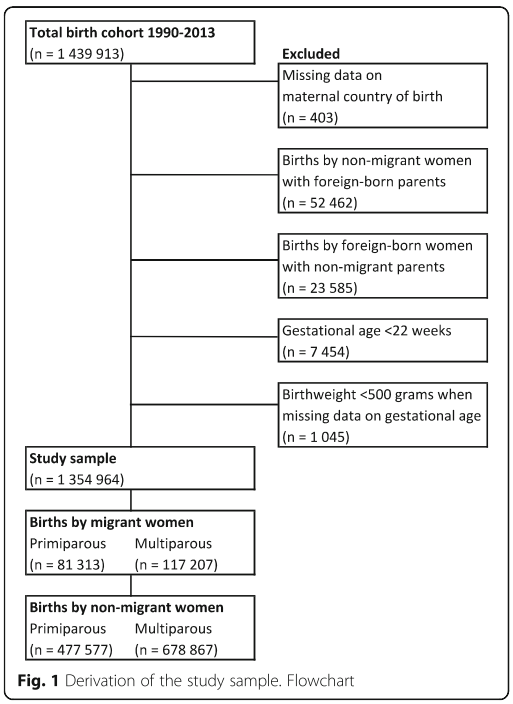

Fig. 1 Derivation of the study sample. Flowchart

definition of stillbirth (see below), leaving 1,354,964 singleton and multiple births for analyses.

Stillbirth

Stillbirth was defined as a pregnancy loss at ≥22 weeks of gestation or with a birthweight ≥500 g if data on gestational age were missing [18]. To base the definition primarily on gestational age is considered appropriate as it includes more cases and predicts the maturity of the fetus and does not exclude fetuses suffering from growth restriction [18, 19].

Migration related factors

Specific maternal countries of birth are reported for countries represented by a minimum of 6000 births (12 countries, Norway included), or by a stillbirth frequency of ≥20 throughout the study period (another 5 countries added), i.e. 17 countries altogether. The remaining countries were combined into *other countries* (34.7% of the births to migrant women). *Other countries* includes births to women from 177 different countries, which were categorized according to the Global Burden of Disease definitions [20]: Central Europe + Eastern Europe + Central Asia (16%), High-income (38%), Latin America + Caribbean (8%), North Africa + Middle East (8%), South Asia (5%), Sub-Saharan Africa (17%), Southeast Asia + East Asia + Oceania (6%) and Other (2%). Former Yugoslavia includes the following: Croatia, Slovenia, Bosnia and Herzegovina, Macedonia, Serbia, Montenegro and Kosovo.

Paternal country of birth was categorised into two groups: foreign-born and Norwegian-born. Data on paternal country of birth was missing in 5.0% of births to primiparous migrant women, and 10.3% of births to multiparous migrant women. The corresponding proportions of missing in primiparous and multiparous non-migrant women were 1.7 and 4.0%, respectively. Missing paternal country of birth may occur for various reasons and does not necessarily mean that the father was unknown.

Migrant women were grouped according to reasons for immigration to Norway using the categories *work/education, family (reunion or establishment), refuge,* and *unspecified/other* [21]. Nordic citizens may move freely to Norway without reporting their reason for immigration and were therefore categorized into a separate exposure group (*Nordic migrants*). Work and education are related reasons for immigration and were combined due to small numbers.

The mother's length of residence (in years) was calculated as the difference between the year of delivery and the year of official permission to stay in Norway. Most migrants from outside the European Union/European Economic Area will have received a residence permit before entering Norway. The exception is those applying for asylum who will have received a decision within 6 months of applying [22]. Birthplace of multiparous women's first child (*Norway*, *Other than Norway*) was assessed by their parity registered in the MBRN. If a woman's first birth in the MBRN was registered with parity 0, the birthplace of her first child was in Norway. If a woman's first birth in the MBRN was registered with parity 1 or higher, the birthplace of her first child was outside Norway.

Information on *reason for immigration* was only available from 1990 onwards. Further, due to data truncation we did not have information on previous pregnancies in migrant women coming to Norway before 1990. Therefore, women who received permission to stay in Norway before 1990, but gave birth from 1990 onwards, were excluded from the analyses when investigating the association with stillbirth of *reason for immigration* ($n = 34,303$ births excluded) and *birthplace of firstborn child* ($n = 23,890$ births to multiparous migrant women excluded).

Other variables

From the MBRN we obtained data on year of birth, maternal age (< 25, 25–29, 30–34, 35–39, ≥40), marital status (married/cohabiting, not married/cohabiting), consanguinity (second cousin or closer, not related), chronic hypertension (yes, no), pre-eclampsia/eclampsia (yes, no), pre-pregnancy diabetes (yes, no), maternal overweight (BMI ≥ 25), smoking before pregnancy (yes, no), parity (0, 1, 2, 3, 4, ≥5), gestational age (very preterm (22–27 weeks), moderately preterm (28–36 weeks), term (37–41 weeks), or post term birth (≥ 42 weeks)) and recurrent stillbirth (yes, no). For each birth year SSB provided data on mother's gross income (categorised into quartiles) and level of education (no education, primary school, secondary school, university/college).

Statistics

The analyses were performed for primiparous and multiparous women separately, as these groups are managed differently in clinical guidelines in antenatal care [23].

To investigate the association between maternal country of birth and other immigration related factors and stillbirth, we estimated crude and adjusted odds ratios (aOR) with 95% confidence intervals (CI) using logistic regression analysis. Adjustments were made for year of birth, parity, maternal age, marital status, mother's income, level of education and consanguinity. Country of birth and the other immigration related factors were investigated one at a time and not mutually adjusted. To account for dependency between births to the same mother, we used robust standard errors that allowed for within-mother clustering [24].

Information on education and income was missing in 4 and 13% of the total sample (25 and 42% in the migrant

group), respectively. To avoid discarding valuable data in adjusted regression analyses, a multiple imputation technique was used to replace missing values assumed to be *missing at random*. The imputation algorithm used was multivariate normal [25], and a total number of 10 imputed datasets were created. The imputation model used for analyses of maternal country of birth included stillbirth, maternal country of birth, year of birth, parity, maternal age, marital status, consanguinity, education and income. The imputation models used for analyses of each of the other migration related factors also included paternal origin, reason for immigration, length of residence, or birthplace of firstborn child.

In the analyses of maternal country of birth, the non-migrant women were defined as the reference group. For other migration related variables (paternal origin, reason for immigration, length of residence and birthplace of firstborn child), the most common category among migrants was chosen as the reference, non-migrant women excluded.

All analyses were performed using Stata IC version 14 (Stata Statistical Software, College Station, TX, USA) and Statistical Package for Social Science version 23 (SPSS Inc., Chicago, IL, USA).

Results

Characteristics of the study sample are shown in Table 1. Primiparous migrant women were more likely to be older (> 35 years), single, and to have a lower level of education and income, and less likely to be < 25 years, to be overweight or to smoke compared to primiparous non-migrant women. Multiparous migrant women were more likely to be older, to have a lower level of education and income, to have diabetes type 2 and to have more children than multiparous non-migrant women; however, they were less likely to smoke. Parental consanguinity was also more common in some migrant women (Table 1). Consanguinity was more common among migrant women from Pakistan (primiparous 25.8%, multiparous 26.3%) and Turkey (primiparous 11.6%, multiparous 11.3%), compared to non-migrant women (primiparous 0.1%, multiparous 0.2%) (not shown in tables).

The overall prevalence of stillbirth was slightly higher in migrant than in non-migrant women (migrants 0.56% vs non-migrants 0.49%, $p < 0.001$). However, the stillbirth prevalence was only higher in multiparous migrant women compared with the non-migrants (migrants 0.57% vs non-migrants 0.46%, $p < 0.001$), and not in the primiparous women (migrants 0.54% vs non-migrants 0.52%, $p = 0.37$). We found no difference between migrant and non-migrant women in whether the death of the infant had occurred before or after onset of labour. The time for the death of the infant for primiparous women was: migrants 89% before onset and 11% after onset vs non-migrants 87% before onset and 13% after onset ($p = 0.26$); and for multiparous women: migrants 87% before onset and 13% after onset vs non-migrants 90% before onset and 10% after onset ($p = 0.11$). However, information about the time of death was missing for 25% of all stillbirths (Additional file 1: Table S1).

The prevalence of stillbirth by maternal country of birth is shown in Fig. 2. In primiparous women the highest prevalence of stillbirth was found in women from Sri Lanka, Somalia and Pakistan, and in multiparous women in those from Pakistan, Somalia and Afghanistan. The lowest prevalence in primiparous women was found in women from Russia, Poland and the Philippines, and in multiparous women, in those from Sweden, Vietnam and Thailand. The crude and adjusted ORs for stillbirth in relation to maternal country of birth are shown in Fig. 3. In primiparous women (Fig. 3, panel A), there was an increased adjusted odds of stillbirth for women from Sri Lanka (aOR = 1.79; 95% CI 1.22–2.63) and Pakistan (aOR = 1.58; 95% CI 1.07–2.34), relative to non-migrant women. In multiparous women (Fig. 3, panel B), there was an increased adjusted odds of stillbirth for women from Pakistan (aOR = 1.71; 95% CI 1.34–2.18), Somalia (aOR = 1.67; 95% CI 1.30–2.16), the Philippines (aOR = 1.60; 95% CI 1.09–2.33), and Former Yugoslavia (aOR = 1.50; 95% CI 1.11–2.01), relative to non-migrant women.

The associations between stillbirth and other migration related factors, in terms of paternal origin, reason for immigration, length of residence in Norway and birthplace of firstborn child, are shown in Table 2. Primiparous migrant women whose babies were registered with a Norwegian-born father had a decreased adjusted odds of stillbirth (aOR = 0.73; 95% CI 0.58–0.93) compared to migrant women whose babies were registered with a foreign-born father. In contrast, and regardless of parity, migrant women with missing data on paternal origin had an increased adjusted odds of stillbirth (primiparous: aOR = 6.29; 95% CI 4.64–8.51; multiparous: aOR = 5.72; 95% CI 4.70–6.96).

Primiparous women migrating for work or education had decreased odds of stillbirth compared to Nordic migrants (aOR = 0.58; CI 0.39–0.88), whereas multiparous refugees had a higher crude odds of stillbirth, relative to Nordic migrant women (Table 2). However, the finding in multiparous women did not reach statistical significance in adjusted regression analyses. Length of residence in Norway at the time of the index birth was not significantly associated with stillbirth in either crude or adjusted regression analysis.

Finally, multiparous migrant women who had given birth to their first child before arriving in Norway had higher odds of stillbirth in later births in Norway compared with multiparous migrant women who had their first child after arrival (aOR = 1.28; 95% CI 1.06–1.55).

Table 1 Maternal characteristics by migrant and non-migrant women giving birth in Norway, 1990–2013[a]

	Primiparous women		Multiparous women	
	Migrant	Non-migrant	Migrant	Non-migrant
	(*n* = 80,119)	(*n* = 468,983)	(*n* = 115,606)	(*n* = 667,654)
	n (%)	*n (%)*	*n (%)*	*n (%)*
Age (years)				
< 25	23,983 (29.9)	163,323 (34.8)	12,629 (10.9)	63,940 (9.6)
25–29	29,379 (36.7)	180,607 (38.5)	34,481 (29.8)	212,756 (31.9)
30–34	19,392 (24.2)	93,888 (20.0)	40,957 (35.4)	254,405 (38.1)
35–39	6338 (7.9)	26,923 (5.7)	22,501 (19.5)	116,858 (17.5)
≥40	1027 (1.3)	4242 (0.9)	5038 (4.4)	19,695 (2.9)
Single status [b]	6652 (8.3)	58,059 (12.4)	8864 (7.7)	34,807 (5.2)
Consanguinity, second cousin or closer	2082 (2.6)	594 (0.1)	4467 (3.9)	1167 (0.2)
Mother's education				
No education	856 (1.1)	4 (0.0)	3541 (3.1)	41 (0.0)
Primary education	15,538 (19.4)	96,802 (20.6)	30,960 (26.8)	147,867 (22.1)
Secondary school	15,897 (19.8)	180,494 (38.5)	23,811 (20.6)	255,916 (38.3)
University/college	26,002 (32.5)	190,883 (40.7)	29,978 (25.9)	262,404 (39.3)
Missing	21,826 (27.2)	800 (0.2)	27,316 (23.6)	1426 (0.2)
Mother's income[c]				
≤25 percentile	18,250 (22.8)	98,494 (21.0)	26,044 (22.5)	146,471 (21.9)
25–50 percentile	12,391 (15.5)	98,342 (21.0)	16,943 (14.7)	163,221 (24.4)
50–75 percentile	8793 (11.0)	121,703 (26.0)	10,600 (9.2)	148,630 (22.3)
≥75 percentile	9898 (12.4)	122,450 (26.1)	11,149 (9.6)	142,284 (21.3)
Missing	30,787 (38.4)	27,994 (6.0)	50,870 (44.0)	67,048 (10.0)
Chronic hypertension	245 (0.3)	2043 (0.4)	518 (0.4)	3506 (0.5)
Pre-eclampsia/eclampsia	2971 (3.7)	25,391 (5.4)	2252 (1.9)	15,988 (2.4)
Pre-pregnancy diabetes [d]				
Type 1	152 (0.2)	1616 (0.3)	314 (0.3)	2057 (0.3)
Type 2	157 (0.2)	402 (0.1)	476 (0.4)	746 (0.1)
Maternal overweight (BMI ≥ 25) [e]	3501 (10.4)	17,673 (16.1)	7454 (16.5)	26,520 (17.7)
Not overweight	12,622 (37.5)	33,785 (30.8)	12,887 (28.5)	42,331 (28.2)
Missing	17,548 (52.1)	58,371 (53.1)	24,952 (55.1)	81,359 (54.2)
Smoking before pregnancy [e]	3133 (5.0)	21,990 (7.9)	3014 (3.4)	22,603 (5.7)
Non-smoker	21,343 (33.7)	67,540 (24.4)	29,655 (33.3)	104,803 (26.6)
Missing	38,807 (61.3)	187,681 (67.7)	56,414 (63.3)	267,054 (67.7)
Former stillbirths			2639 (2.3)	9336 (1.4)
Parity				
0	80,119 (100.0)	468,983 (100.0)		
1			64,191 (55.5)	411,085 (61.6)
2			29,859 (25.8)	189,681 (28.4)
3			12,127 (10.5)	48,959 (7.3)
4			5043 (4.4)	11,999 (1.8)
≥5			4386 (3.8)	5930 (0.9)
Gestational age (weeks)				
Very preterm (22–27 weeks)	403 (0.5)	2247 (0.5)	591 (0.5)	2576 (0.4)

Table 1 Maternal characteristics by migrant and non-migrant women giving birth in Norway, 1990–2013[a] *(Continued)*

	Primiparous women		Multiparous women	
	Migrant	Non-migrant	Migrant	Non-migrant
	(*n* = 80,119)	(*n* = 468,983)	(*n* = 115,606)	(*n* = 667,654)
	n (%)	*n (%)*	*n (%)*	*n (%)*
Moderately preterm (28–36 weeks)	4951 (6.2)	30,779 (6.6)	6481 (5.6)	31,701 (4.7)
Term (37–41 weeks)	66,354 (82.8)	367,439 (78.3)	98,033 (84.8)	552,939 (82.8)
Post term (≥ 42 weeks)	6454 (8.1)	49,734 (10.6)	6969 (6.0)	52,688 (7.9)
Missing	1957 (2.4)	18,784 (4.0)	3532 (3.1)	27,750 (4.2)

[a] Information was drawn from the first child in multiple births; [b] Includes unmarried, single, divorced, separated, widowed, registered partner and other; [c] Quartiles drawn from each year; [d] Non-specific and gestational diabetes not included; [e] Maternal overweight and smoking include data from 2008 and 1999 onwards, respectively

Discussion

Main findings

This study has shown that the prevalence of stillbirth was slightly higher in migrant women compared to non-migrant women. Women from Pakistan, primiparous women from Sri-Lanka and multiparous women from Somalia, the Philippines and Former Yugoslavia were at highest risk of stillbirth. Babies with foreign-born fathers were associated with higher odds of stillbirth when compared to babies with Norwegian-born fathers, but only in births to primiparous women. Primiparous women migrating for work or education had decreased odds of stillbirth compared to Nordic migrants. Multiparous women who had given birth to their first child before immigration to Norway had an increased odds of stillbirth in later births, compared with multiparous migrant women who had their first child after immigrating. Stillbirth was not associated with length of residence.

Strengths and limitations

This register study covers all births in Norway and the large sample size allowed for detailed analysis of women's specific countries of birth and for separate analyses for primiparous and multiparous women. The inclusion of important migration related data, such as paternal origin, reason for immigration, length of residence and birthplace of firstborn child is unique and possible due to linkage between registers using personal identification numbers. Inclusion of these migration related factors led to a more complete analysis and added value to the interpretation of the data.

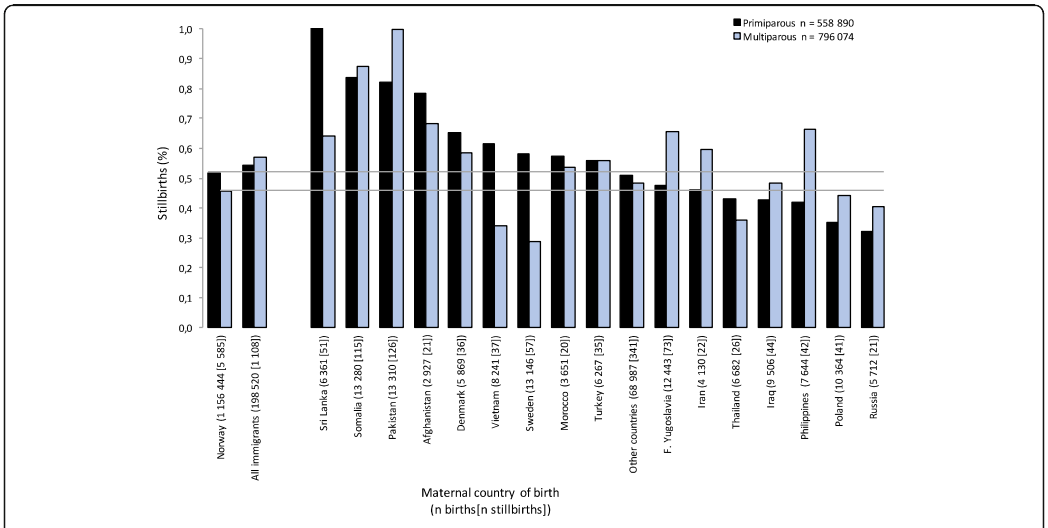

Fig. 2 Prevalence of stillbirth in relation to maternal country of birth (N = 1,354,964) in Norway, 1990–2013. Maternal country of birth is presented with total number of births, and the number of stillbirths in brackets. The bars are sorted by the highest prevalence of stillbirths to multiparous women

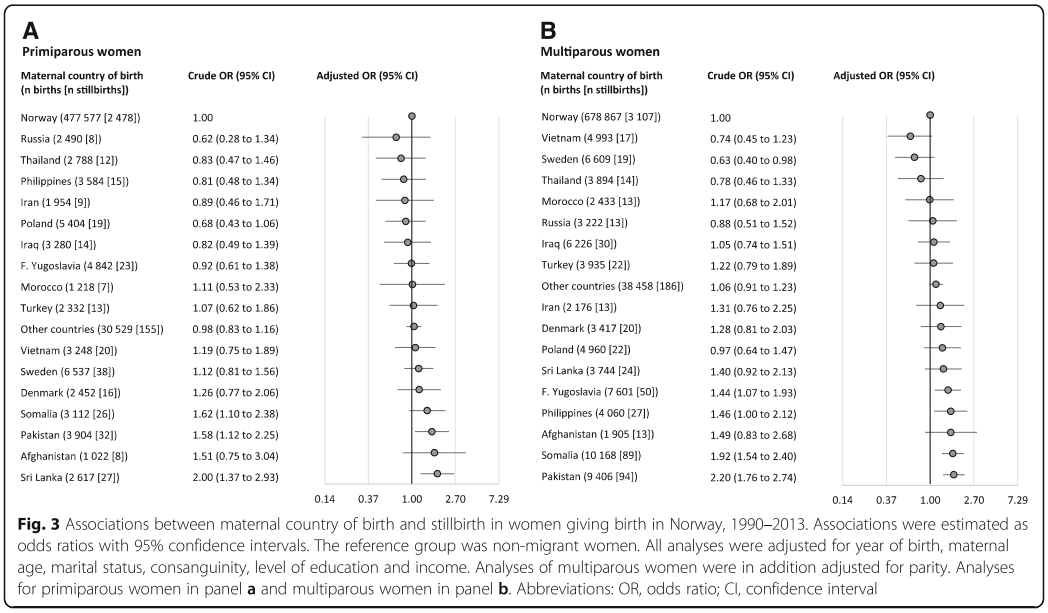

Fig. 3 Associations between maternal country of birth and stillbirth in women giving birth in Norway, 1990–2013. Associations were estimated as odds ratios with 95% confidence intervals. The reference group was non-migrant women. All analyses were adjusted for year of birth, maternal age, marital status, consanguinity, level of education and income. Analyses of multiparous women were in addition adjusted for parity. Analyses for primiparous women in panel **a** and multiparous women in panel **b**. Abbreviations: OR, odds ratio; CI, confidence interval

We did not adjust for maternal overweight or smoking as these variables were only available from 2008 and 1999, respectively. Overweight and smoking are well-documented risk factors for stillbirth, but are differently distributed in migrant women. Therefore, the observed differences in stillbirth between migrant and non-migrant women in our study might be stronger for women who represent countries with high rates of non-smokers, such as Afghanistan, Pakistan and Sri Lanka, and weaker for women from Poland and Former Yugoslavia with higher prevalence of smokers (data not shown).

Although we have adjusted for year of birth, this may not capture the full impact of changes in practice or background characteristics in sub-groups of both migrant and non-migrant women (i.e. increasing challenges with stillbirth risk factors such as overweight and diabetes [26]). The long time span of the study might therefore be seen as a limitation, also in relation to maternal country of birth as reasons for migration may have changed over the years, such as for migrant women from the Former Yugoslavia who fled the wars in the 1990s, while work or family reunion were more common reasons for immigration at other times [27].

Interpretation

Our finding that migrant women overall had slightly higher odds of stillbirth compared with non-migrant women is consistent with findings from previous studies in Norway [28]. We also confirm the findings of others that migrant women constitute a heterogeneous group and stillbirth risk varied across maternal countries of birth [6, 7, 29]. Although migrant women from most countries had similar odds of stillbirth compared with non-migrant women, women from some countries did have an increased risk (Fig. 3).

Consistent with other studies [28–31], Pakistani women had the highest odds of stillbirth of all women. Consanguinity is a well-known risk factor for stillbirth and particularly high prevalence has been reported in Pakistani women [30, 31]. The increased odds remained statistically significant however, also after adjustment for consanguinity in the analysis. One possible explanation may be linked to repeated consanguinity in one or both parents' families, which may increase the risk of perinatal loss [32]. Unfortunately, such information was lacking in the registers.

Women from Sri Lanka and Somalia also had higher risk of stillbirth in this as in other studies [6, 28, 29, 33–35]. The increased risk of stillbirth has previously been attributed to poorer health, malnutrition, consequences of flight from war and conflicts, lower attendance in antenatal care, communication difficulties, inequities in care provision [28] and for African migrant women, complications related to suboptimal care including delay in seeking health care and mothers refusing caesarean sections [35]. Somali women in particular tend to book late and make fewer visits for antenatal care [36]. We also showed that stillbirth risks were higher

Table 2 Migration related factors and their association with stillbirth in migrant women giving birth in Norway, 1990–2013

	Primiparous					Multiparous				
	n	Stillbirths	(%)	Crude OR (95% CI)	Adjusted[a] OR (95% CI)	n	Stillbirths	(%)	Crude OR (95% CI)	Adjusted[b] OR (95% CI)
Paternal origin										
Foreign-born (ref)	47,109	233	(0.5)	1.00	1.00	73,487	313	(0.4)	1.00	1.00
Norwegian-born	30,175	119	(0.4)	0.80 (0.63 to 1.00)	0.73 (0.58 to 0.93)	31,643	106	(0.3)	0.79 (0.63 to 0.98)	0.83 (0.65 to 1.05)
Missing [c]	4029	90	(2.2)	4.60 (3.59 to 5.89)	6.29 (4.64 to 8.51)	12,077	247	(2.0)	4.88 (4.12 to 5.79)	5.72 (4.70 to 6.96)
Reason for immigration [d]										
Nordic migrants (ref)		56	(0.6)	1.00	1.00	9145	37	(0.4)	1.00	1.00
Work/Education	13,410	46	(0.3)	0.54 (0.36 to 0.80)	0.58 (0.39 to 0.88)	9057	38	(0.4)	1.04 (0.66 to 1.64)	1.21 (0.76 to 1.92)
Family reunion or establishment	38,083	196	(0.5)	0.81 (0.60 to 1.09)	0.76 (0.55 to 1.06)	53,209	281	(0.5)	1.31 (0.92 to 1.86)	1.22 (0.85 to 1.74)
Refuge	9467	62	(0.7)	1.03 (0.71 to 1.48)	0.92 (0.62 to 1.37)	20,623	138	(0.7)	1.66 (1.14 to 2.41)	1.41 (0.95 to 2.11)
Length of residence										
< 2 years (ref)	30,801	148	(0.5)	1.00	1.00	18,029	99	(0.5)	1.00	1.00
2–5 years	28,095	158	(0.6)	1.17 (0.93 to 1.47)	1.20 (0.94 to 1.53)	42,549	221	(0.5)	0.95 (0.75 to 1.20)	0.97 (0.76 to 1.24)
6–9 years	10,299	64	(0.6)	1.30 (0.96 to 1.75)	1.28 (0.93 to 1.77)	27,294	160	(0.6)	1.07 (0.83 to 1.37)	1.04 (0.80 to 1.36)
≥ 10 years	12,118	72	(0.6)	1.24 (0.93 to 1.65)	1.27 (0.93 to 1.74)	29,335	186	(0.6)	1.16 (0.90 to 1.48)	1.06 (0.81 to 1.39)
Birthplace of firstborn child										
Norway (ref)						52,834	231	(0.4)	1.00	1.00
Other than Norway						40,483	267	(0.7)	1.51 (1.26 to 1.81)	1.28 (1.06 to 1.55)

[a] Adjusted for year of birth, maternal age, marital status, consanguinity, level of education and income; [b] Adjusted for year of birth, parity, maternal age, marital status, consanguinity, level of education and income; [c] Missing data only refers to information on paternal country of birth, father can still be known by other variables in the data-set; [d] Missing data not included (primiparous: 1154 births, multiparous: 1283 births)

in multiparous women, but not in primiparous women from the Philippines and the Former Yugoslavia. This finding may be supported by previous literature. In particular, grand multipara Filipino women have previously been associated with an increased risk of type 2 diabetes [37], and type 2 diabetes is an important risk factor for stillbirth [38]. Future studies are warranted to confirm the robustness of these findings. These associations might have been present in other studies, but previous studies of stillbirth and maternal country of birth have not distinguished between primiparous and multiparous women [28, 29].

The higher odds of stillbirth when both parents were migrants compared with when fathers were Norwegian-born, is consistent with findings from one study from the US [39] and one from Canada [6]. In the Canadian study, especially foreign-born couples originating from a country with a high stillbirth rate, were at greater risk of stillbirth [6]. Couples in which both parents are migrants may have several disadvantages, particularly in terms of limited knowledge about the receiving country's health care system, communication problems and access to equitable and individualised care [40]. However, the pathways between such disadvantages and stillbirth in migrant couples needs to be further investigated in order to improve maternity care for them.

Missing data on paternal origin was associated with increased odds of stillbirth. A Canadian study found that missing paternal information in general is a strong marker for increased risk of adverse birth outcomes [41]. One could speculate that missing information on paternal origin may be due to poor obstetric history taking from women, perhaps due to communication difficulties, or it may also offer important clues to caregivers related to the woman's psychosocial environment. Additional studies are needed to elucidate the increased risk among migrant women with unknown information on fathers.

Multiparous migrant women who had given birth to their first child before arriving in Norway were at higher risk for stillbirth, compared with those who had their first child after arrival. According to the national guidelines, multiparous women with a previous normal pregnancy and birth were until 2005 regarded as low-risk in Norway and were recommended to have fewer antenatal care visits than primiparous women (seven vs eleven) [42]. The possible lack of important information about the first pregnancy in multiparous women with a first child born outside Norway, in combination with communication barriers and the practice of giving more limited attention to multiparous women, may possibly contribute to the increased risk of stillbirth in these women. For instance, preeclampsia, which is a leading cause of perinatal mortality worldwide, is associated with a 10-fold increased recurrent risk in a second pregnancy [43]. Our findings, therefore, suggest increased attention should be given to multiparous migrant women with a first child born outside Norway.

In a previous study from Sweden, the risk of stillbirth was higher in migrants who had been in Sweden for a short time period (< 5 years) compared with those who had been in Sweden for a longer period [44]. We found no such association in our study. In fact there was a tendency for an increased, although not statistically significant, risk of stillbirth with longer residence in the primiparous migrant group. Comparison of findings for migrants in general compared with host country-born women across studies may not be entirely appropriate however. Differences in maternal countries of origin among migrant groups in Sweden and Norway and therefore also in proportions of high risk groups may account for differences in findings. A better approach would be to compare study results by sub-groups of migrant women rather than the overall estimate for all migrant groups combined, as the association of length of residence with different health outcomes varies between sub-groups of migrants [8, 45]. Unfortunately, the numbers of stillbirths in our study were too few to perform such sub-group analyses.

We found decreased odds of stillbirth in primiparous women migrating for work or education compared to Nordic migrants. To our knowledge, this has not been reported before. One possible explanation could be the higher use of tobacco among Nordic women in our sample [46], an important risk factor for stillbirth [5, 47]. These findings need further investigation. Refugees, on the other hand, often constitute a particularly vulnerable socio-economic group post migration [48], and refugee background has been associated with a number of adverse pregnancy outcomes including stillbirth [7]. One review article describes similar diverging results between studies, which was interpreted as a matter of selection, as some refugees may be political refugees from more advantageous socioeconomic backgrounds and others are refugees fleeing from wars and conflicts [7]. Further, we did not include non-migrant women in our analysis on reason for immigration, and the diverging results may therefore be explained by a difference in the choice of reference group, as well as sample size.

Conclusion

This study identifies sub-groups of migrant women who are at an increased risk of stillbirth, and highlights the need to improve care for them. Extra attention should be paid to women from certain countries, multiparous women who had their first baby before arrival and primiparous women whose babies have foreign-born fathers.

Additional file

Additional file 1: Table S1. Time of stillbirth. (DOCX 17 kb)

Abbreviations

aOR: Adjusted odds ratio; CI: Confidence interval; MBRN: The Medical Birth Registry of Norway; OR: Odds ratio; SSB: Statistics Norway

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Availability of data and materials

The data that support the findings of this study are available from the Medical Birth Registry of Norway (MBRN) and Statistics Norway (SSB) but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available.

Authors' contributions

ES and VA have made substantial contributions to conception, design and planning of the study; ESV, RMN, ES and VA made substantial contributions to drafting the first version of the manuscript and revising the manuscript critically for important intellectual content; ESV, RMN, ES and VA made substantial contributions to data management, statistical analysis and interpretation of data; RS and DM made their contribution in drafting and revising the manuscript. All authors read and approved the final manuscript.

Ethics approval and consent to participate

This study was approved by the Regional Committees for Medical and Health Research Ethics, reference number: 2014/1278/REK South-East, Norway.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Publisher's Note

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Country of first birth and neonatal outcomes in migrant and Norwegian-born parous women in Norway: a population-based study

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Abstract

Background: This study compares subsequent birth outcomes in migrant women who had already had a child before arriving in Norway with those in migrant women whose first birth occurred in Norway. The aim of this study was to investigate the associations between country of first birth and adverse neonatal outcomes (very preterm birth, moderately preterm birth, post-term birth, small for gestational age, large for gestational age, low Apgar score, stillbirth and neonatal death) in parous migrant and Norwegian-born women.

Methods: National population-based study including second and subsequent singleton births in Norway from 1990 to 2016. Data were retrieved from the Medical Birth Registry of Norway and Statistics Norway. Neonatal outcomes were compared between births to: 1) migrant women with a first birth *before* immigration to Norway ($n = 30,062$) versus those with a first birth *after* immigration ($n = 66,006$), and 2) Norwegian-born women with a first birth *outside* Norway ($n = 6205$) versus those with a first birth *in* Norway ($n = 514,799$). Associations were estimated as crude and adjusted odds ratios (aORs) with 95% confidence intervals (CIs) using multiple logistic regression.

Results: Migrant women with a first birth *before* immigrating to Norway had increased odds of adverse outcomes in subsequent births relative to those with a first birth *after* immigration: very preterm birth (22–31 gestational weeks; aOR = 1.27; CI 1.09–1.48), moderately preterm birth (32–36 gestational weeks; aOR = 1.10; CI 1.02–1.18), post-term birth (≥42 gestational weeks; aOR = 1.19; CI 1.11–1.27), low Apgar score (< 7 at 5 min; aOR = 1.27; CI 1.16–1.39) and stillbirth (aOR = 1.29; CI 1.05–1.58). Similar results were found in the sample of births to Norwegian-born women.

Conclusions: The increased odds of adverse neonatal outcomes for migrant *and* Norwegian-born women who had their first births outside Norway should serve as a reminder of the importance of taking a careful obstetric history in these parous women to ensure appropriate care for their subsequent pregnancies and births in Norway.

Keywords: Immigration, Parous women, Neonatal outcomes, Obstetric history, Predictor

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Background

The World Health Organization promotes reducing health inequalities for migrant families [1]. With the growing proportion of migrant women giving birth in high-income countries [1, 2], increased knowledge about their pregnancy outcomes is needed [3]. Migrant women may be of good health, sometimes even better health than the host population; a phenomenon often referred to as the healthy migrant effect [4, 5]. However, increased risk of adverse pregnancy outcomes including preterm birth [6, 7] and perinatal mortality [8] have been reported for refugees in particular.

Nearly half of women giving birth in high income countries are parous [9] and maternity care is mainly tailored to the host population with particular focus on first-time mothers and those with a complicated first pregnancy and childbirth [10]. We have previously reported that migrant women who gave birth to their first baby *before* immigration to Norway had an increased risk of stillbirth in later births compared with migrant women who gave birth to their first baby in Norway [11]. In the current study, we explore whether this increased risk applies also to other adverse neonatal outcomes, and whether the findings are unique to migrant women or if they also apply to Norwegian-born women who return to Norway after a first childbirth abroad.

The aim was to investigate the associations between country of first birth and adverse neonatal outcomes (very preterm birth, moderately preterm birth, post-term birth, small for gestational age, large for gestational age, low Apgar score, stillbirth and neonatal death) in parous migrant and Norwegian-born women in Norway.

Methods

Study design

In this national population-based study, we used individual record data from the Medical Birth Registry of Norway (MBRN) [12, 13] and Statistics Norway (SSB) [14]. The data were merged using each woman's unique national identity number. The MBRN is the repository for mandatory notification of all births in Norway, and includes information on women's obstetric background, maternal health before and during pregnancy, current pregnancy, labour and birth, and maternal and infant outcomes. The MBRN data are collected from medical records and women's self-reported obstetric history. SSB provides information on migration and socioeconomic factors.

Setting

In Norway, the health care system is considered of high quality with low maternal and child mortality rates [15]. All women are entitled to free maternity care in Norway, and the vast majority of women give birth in public hospitals (99%) [16]. Unless there are medical complications necessitating specialist obstetric care, women may choose antenatal care provided by either a general practitioner, a midwife, or a combination of the two [17]. However, inequalities in health care have been reported and migrant women in Norway appear more likely to receive suboptimal care compared to non-migrant women [18]. In 2018, 29% of children born in Norway were born to a migrant mother [19].

Study population

The main goal of this study was to compare subsequent birth outcomes in migrant women who already had a child before arriving in Norway (defined as the exposure group) with the same outcomes in migrant women with a first birth in Norway (defined as the comparison group). In order to control for possible parity-related differences between exposure and comparison groups, we restricted the exposure group to include women with only one birth before arriving in Norway (Fig. 1).

Initially, MBRN comprised 1,620,532 births during the period 1990–2016. Births to second generation migrant women, those with unknown or mixed background, such as adoptees or women with one Norwegian-born and one foreign-born parent, were excluded ($n = 87,696$). The final sample included the second and any subsequent singleton births to foreign-born women with two foreign-born parents ($n = 96,068$ births to migrant women), and Norwegian-born women with two Norwegian-born parents ($n = 521,004$ births to Norwegian-born women) giving birth in Norway between the years 1990 and 2016 (Fig. 1).

Country of woman's first birth

To derive information on whether a woman had a first child before or after immigration to Norway, we used the following algorithms:

Migrant women

The country of a woman's first birth was determined by the woman's first parity registered in the MBRN dataset. If a parous woman's first birth was in the dataset, the birthplace of her firstborn baby was classified as Norway. If the woman's first birth was not in the dataset, the birthplace was classified as other than Norway. Women with permission to stay in Norway prior to 1990 may or may not have given birth in Norway before 1990 (the study period commencement) and were therefore excluded ($n = 35,929$).

Norwegian-born women

To identify country of first birth we excluded births to any woman 13 years or older in 1990 whose first birth was not available in the MBRN dataset ($n = 193,243$) and therefore could in theory have had previous babies

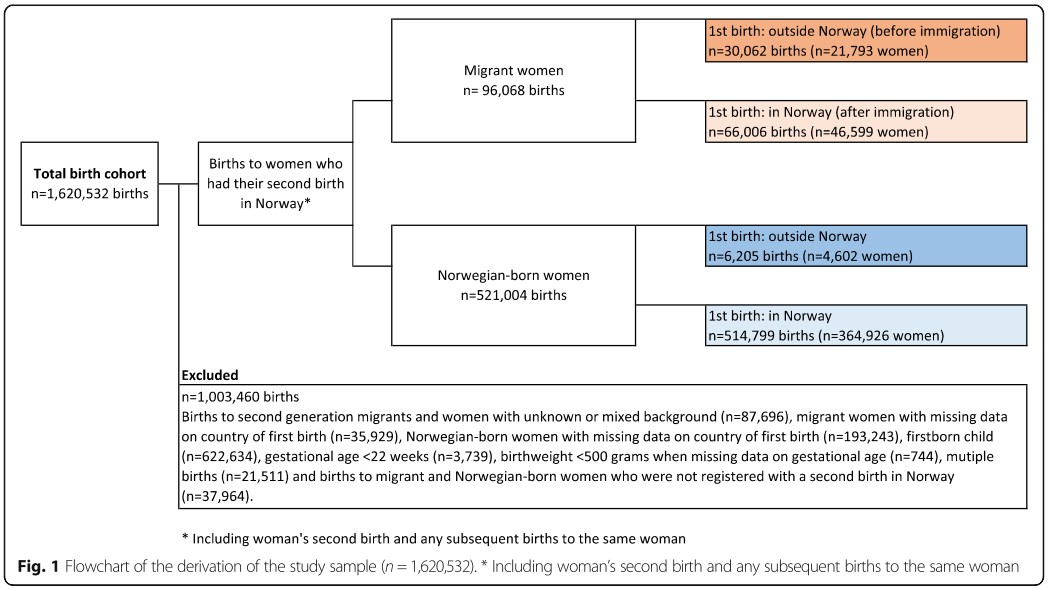

Fig. 1 Flowchart of the derivation of the study sample (n = 1,620,532). * Including woman's second birth and any subsequent births to the same woman

before 1990. The women's first parity registered in the dataset was then used to identify country of first birth in the Norwegian-born women. The age limit was chosen based on the fact that the youngest mothers in our dataset were 13 years of age.

Adverse neonatal outcomes

Gestational age was based on ultrasound estimation or, when such information was lacking, calculated from the first day of the last menstrual period. Very preterm birth, moderately preterm and post-term birth were defined as births in gestational week 22–31, 32–36 and $\geq$ 42, respectively. In the analyses of very preterm birth, moderately preterm and post-term birth, we excluded births with unknown gestational age (migrant women n = 1512; Norwegian-born women n = 12,677) and term births were used as comparison group. In the analyses of small for gestational age (SGA) and large for gestational age (LGA) we also excluded births with unknown birthweight (migrant women n = 63; Norwegian-born women n = 403). For calculating SGA and LGA, we used Norwegian standards combining information on gestational age, birthweight and gender [20]. Low Apgar Score was defined as < 7 at 5 min. Stillbirth was defined as a pregnancy loss at ≥22 weeks of gestation or birthweight ≥500 g if data on gestational age were missing. Neonatal death was defined as a live born infant at ≥22 weeks of gestation (or with a birthweight ≥500 g if data on gestational age was missing) who died within 28 days after the birth.

Other variables

From the MBRN, we also obtained data on year of birth, maternal age (< 25, 25–34, ≥35 years), single status (yes, no), parity (1, 2, 3, ≥4), smoking in early pregnancy (yes/no) and previous stillbirth (yes, no).

For each birth year, SSB provided data on maternal level of education (no education, primary school, secondary school, university/college, missing), mother's gross income (categorized into quartiles, missing), reason for immigration (Nordic migrants, work/education, family reunion or establishment, refugee, missing), and paternal origin (Norwegian-born, foreign-born, missing). Maternal country of birth from SSB was used to classify women according to seven Global Burden of Disease super regions (GBD) [21]: High income countries; Central Europe, Eastern Europe, and Central Asia; Sub-Saharan Africa; North Africa and Middle East; South Asia; Southeast Asia, East Asia, and Oceania; Latin America and Caribbean. Maternal length of residence was calculated as the difference between the year of birth and the year a woman officially received her permission to stay in Norway (< 2 years, 2–5 years, 6–9 years, ≥10 years). Maternal age at immigration was calculated as the difference between maternal age at birth and her length of residence (< 18 years, ≥18 years).

Statistics

Neonatal outcomes were compared between births to: 1) migrant women with a first birth *before* immigration to Norway versus those with a first birth *after* immigration, and 2) Norwegian-born women with a first birth *outside*

Norway versus those with a first birth *in* Norway. We also compared births to migrant women with a first birth *before* immigration to Norway versus Norwegian-born women with a first birth *outside* Norway.

Logistic regression analyses were used to investigate possible associations between country of first childbirth (Norway/Other than Norway) and adverse neonatal outcomes in subsequent births. Associations were reported as odds ratios with 95% confidence intervals. Adjustment variables were year of birth, maternal age, parity, marital status, maternal education and mother's gross income. To account for dependency between births by the same mother, we used robust standard errors that allowed for within-mother clustering.

To avoid list-wise deletion and potential bias due to missing data in covariates in the adjusted regression models, we used a multiple imputation technique to replace missing values in covariates. Ten imputed datasets were created using the multivariate normal model [22]. Separate imputation models were created for each neonatal outcome and included the respective outcome (very preterm birth, moderately preterm birth, post-term birth, SGA, LGA, low Apgar score, stillbirth or neonatal death), as well as country of first childbirth and adjustment variables.

Analyses were performed using Stata IC version 16 (Stata Statistical Software, College Station, TX, USA) for Windows.

Results

Table 1 shows the background characteristics of the four groups at the time of the woman's second birth. Compared to migrant women with a first birth in Norway, migrant women with a first birth *before* immigration to Norway had more often missing data on education, lower or missing data on income. They also reported higher smoking prevalence in early pregnancy, a higher rate of previous stillbirth, they were more often from *Central Europe, Eastern Europe & Central Asia*, shorter length of residence in Norway, higher age at migration, a foreign-born father to the baby, or missing information on paternal origin. Further, they were less likely to originate from *High income countries* or *North Africa & Middle East*. Compared with Norwegian-born women with a first birth in Norway, Norwegian-born women with a first birth *outside* Norway were more likely to: be younger, be of single status, have lower levels of education, have higher income, smoke in early pregnancy, have experienced a previous stillbirth, report a foreign-born father to the baby, or have missing information on paternal origin.

The prevalence of adverse neonatal outcomes in second and subsequent births to migrant and Norwegian-born women in relation to country of first birth is shown in Fig. 2. The prevalence of most adverse outcomes was slightly higher in births to migrant women with a first birth before immigration to Norway compared to those with a first birth after immigration: very preterm birth (1.0% vs 0.8%; $p < 0.001$), moderately preterm birth (4.4% vs 3.9%; $p < 0.001$), post-term birth (5.8% vs 4.6%; $p < 0.001$), SGA (12.7% vs 11.9%; $p < 0.001$), low Apgar score (2.7% vs 2.2%; $p < 0.001$), and stillbirth (0.5% vs 0.4%; $p < 0.01$). For the migrant women the prevalence of LGA (11.8% vs 12.1%; $p = 0.178$) and neonatal death (0.2% vs 0.2%; $p = 0.988$) was similar in both groups.

Compared to those with a first birth in Norway (Fig. 2), Norwegian-born women with a first birth outside Norway had higher prevalence of moderately preterm birth (5.0% vs 3.6%; $p < 0.001$), SGA (10.2%vs 7.4%; $p < 0.001$), low Apgar score (3.0% vs 1.8%; $p < 0.001$) and stillbirth (0.5% vs 0.4%; $p < 0.05$), and lower prevalence of post-term birth (4.7% vs 6.6%; $p < 0.001$) and LGA (13.5% vs 19.0%; $p < 0.001$). For the Norwegian-born women, the prevalence of very preterm birth (0.9% vs 0.7%; $p = 0.141$) neonatal death (0.2% vs 0.2%; $p = 0.472$) was similar in both groups.

In second and subsequent births to migrant and Norwegian-born women the prevalence of SGA was higher, and LGA lower, if the father of the baby was foreign-born compared to births where the father was Norwegian-born (SGA: 13.3% vs 8.7%; $p < 0.001$ and 8.5% vs 7.3%; $p < 0.001$; LGA: 10.8% vs 15.1%; $p < 0.001$ and 16.5% vs 19.1%; $p < 0.001$, respectively) (not shown).

The crude and adjusted associations between *migrant* women's country of first birth and adverse neonatal outcomes are shown in Table 2. After adjustments for year of birth, parity, maternal age, marital status, maternal education and income, analyses show that women who gave birth to their first baby before immigrating to Norway had increased odds of very preterm birth (aOR = 1.27; CI 1.09–1.48), moderately preterm birth (aOR = 1.10; CI 1.02–1.18), post-term birth (aOR = 1.19; CI 1.11–1.27), low Apgar score (aOR = 1.27; CI 1.16–1.39) and stillbirth (aOR = 1.29; CI 1.05–1.58) compared to foreign-born women who had their first baby after immigrating to Norway. The results were similar when women from high-income countries were excluded from the analyses (data not shown).

The crude and adjusted associations between *Norwegian-born* women's country of first birth and adverse neonatal outcomes are shown in Table 3. The adjusted analyses show increased odds of very preterm birth (aOR = 1.32; 1.00–1.73), moderately preterm birth (aOR = 1.36; CI 1.19–1.55), post-term birth (aOR = 1.23; CI 1.08–1.40), SGA (aOR = 1.43; CI 1.31–1.57), low Apgar score (aOR = 1.61; CI 1.38–1.88) and stillbirth (aOR = 1.69; CI 1.18–2.42), and decreased odds for LGA (aOR = 0.74; CI 0.68–0.80) in Norwegian-born women

Table 1 Background characteristics at the time point for 2nd birth; migrant ($n = 68,392$) and Norwegian-born women ($n = 369,528$)[a]

	Migrant women's first birth				Norwegian-born women's first birth			
	Before immigration		After immigration		Outside Norway		In Norway	
	n	%	n	%	n	%	n	%
Total	21,793	31.9	46,599	68.1	4602	1.2	364,926	98.8
Age (years)								
< 25	3027	13.9	6631	14.2	1419	30.8	46,724	12.8
25–34	14,535	66.7	31,949	68.6	2991	65.0	267,908	73.4
≥ 35	4231	19.4	8019	17.2	192	4.2	50,294	13.8
Single status[b]	1365	6.3	3073	6.6	442	9.6	16,899	4.6
Mother's education								
No education	367	2.7	653	1.8	0	0.0	3	0.0
Primary education	3889	28.3	10,275	28.3	1112	24.2	58,473	16.0
Secondary school	3518	25.6	9244	25.4	1451	31.6	135,373	37.1
University/college	5985	43.5	16,188	44.5	2023	44.1	170,715	46.8
Mother's education, missing	8034	36.9	10,239	22.0	16	0.4	362	0.1
Mother's income								
≤ 25 percentile	5194	41.9	9386	26.8	692	15.9	61,779	18.0
25–50 percentile	1971	15.9	5981	17.1	674	15.5	83,609	24.3
50–75 percentile	2784	22.4	8838	25.2	1143	26.3	98,455	28.6
≥ 75 percentile	2455	19.8	10,839	30.9	1839	42.3	100,274	29.1
Mother's income, missing	9389	43.1	11,555	24.8	254	5.5	20,809	5.7
Smoking in early pregnancy[c]	1203	7.8	1611	4.7	709	17.7	32,810	14.0
Previous stillbirth	214	1.2	235	0.6	77	1.8	1075	0.4
Migration								
Maternal origin (GBD)								
High income country	3864	17.7	10,266	22.0	4602	100.0	364,926	100.0
Central Europe, Eastern Europe & Central Asia	7488	34.4	11,076	23.8				
Sub-Saharan Africa	2714	12.5	5491	11.8				
North Africa & Middle East	2482	11.4	7797	16.7				
South Asia	873	4.0	3208	6.9				
Southeast Asia, East Asia & Oceania	3625	16.6	7516	16.1				
Latin America & Caribbean	747	3.4	1245	2.7				
Reason for immigration								
Nordic migrants	1720	8.0	5514	12.0				
Work/education	3170	14.8	7960	17.3				
Family reunion/establishment	12,789	59.5	25,338	55.1				
Refugee	3817	17.8	7137	15.5				
Reason for immigration, missing	297	1.4	650	1.4				
Length of Residence								
< 2 years	10,659	48.9	1801	3.9				
2–5 years	8618	39.5	22,952	49.3				
6–9 years	1751	8.0	13,116	28.2				
≥ 10 years	765	3.5	8730	18.7				

Table 1 Background characteristics at the time point for 2nd birth; migrant ($n = 68,392$) and Norwegian-born women ($n = 369,528$)[a] *(Continued)*

	Migrant women's first birth				Norwegian-born women's first birth			
	Before immigration		After immigration		Outside Norway		In Norway	
	n	%	n	%	n	%	n	%
Total	21,793	31.9	46,599	68.1	4602	1.2	364,926	98.8
Age at migration < 18 years	367	1.7	5231	11.2				
Foreign-born father	13,359	81.7	29,094	64.7	594	13.3	21,058	5.8
Paternal origin, missing	5431	24.9	1636	3.5	148	3.2	3282	0.9

[a]Percentages are calculated from non-missing data if not otherwise noted
[b]Includes unmarried, single, divorced, separated, widowed and other/missing.
[c]Data on smoking from 1999 onwards

with a first birth outside Norway, compared to Norwegian-born women with a first birth in Norway.

Finally, we compared the outcomes for migrants and Norwegian-born women who all had had their first birth outside Norway. After adjustments for year of birth, parity, maternal age, marital status, maternal education and income, migrant women had increased odds for SGA (aOR = 1.18; CI 1.06–1.32), and decreased odds of moderately preterm birth (aOR = 0.72; CI 0.62–0.85), LGA (aOR = 0.84; CI 0.75–0.93) and low Apgar score (aOR = 0.81; CI 0.67–0.98), relative to Norwegian-born women with a first birth outside Norway.

Discussion

Migrant women with a first birth *before* immigration to Norway were more likely to experience adverse neonatal

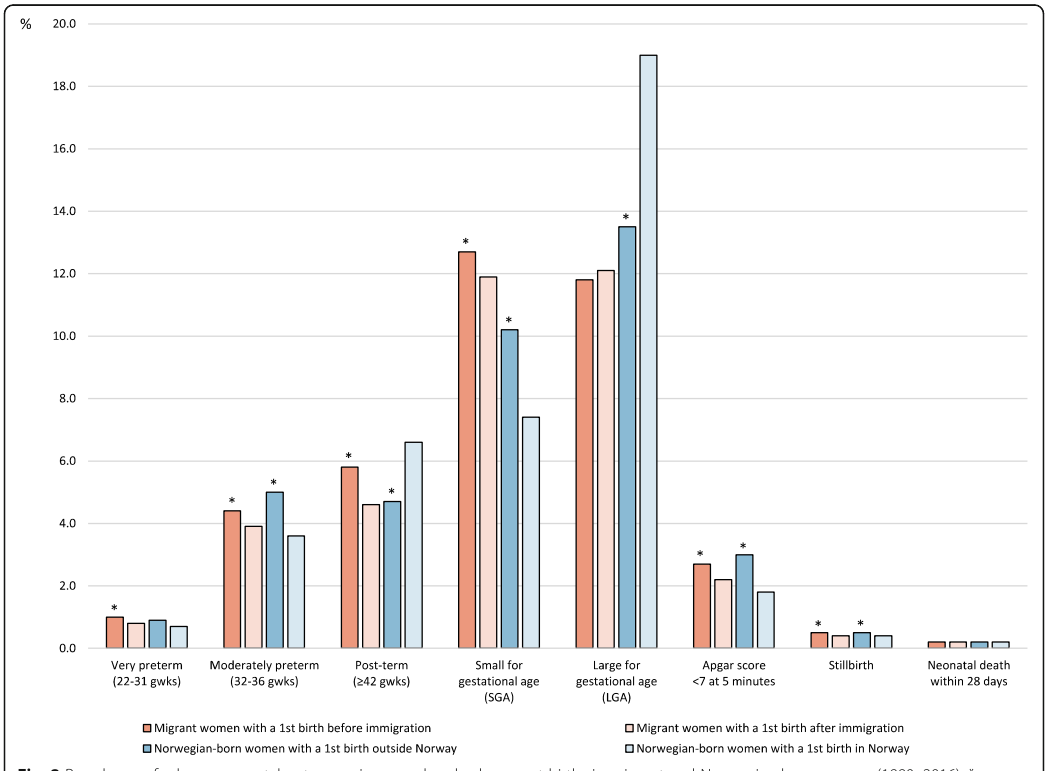

Fig. 2 Prevalence of adverse neonatal outcomes in second and subsequent births in migrant and Norwegian-born women (1990–2016). * *p*-values < 0.05, when comparing birth outcomes in either the two groups of migrant women or the two groups of Norwegian-born women

Table 2 Associations between migrant women's country of first birth and adverse neonatal outcomes (1990–2016)

Adverse neonatal outcomes	n births	n cases	Crude OR (95% CI)	Adjusted OR (95% CI)*	Adjusted OR (95% CI)†	Adjusted OR (95% CI) ‡
Very preterm (22–31 weeks)§						
Norway	62,366	532	1.00	1.00	1.00	1.00
Other	27,965	308	1.29 (1.12–1.50)	1.26 (1.09–1.47)	1.26 (1.09–1.46)	1.27 (1.09–1.48)
Moderately preterm (32–36 weeks)§						
Norway	64,348	2514	1.00	1.00	1.00	1.00
Other	28,938	1281	1.14 (1.06–1.22)	1.11 (1.03–1.19)	1.11 (1.03–1.19)	1.10 (1.02–1.18)
Post-term (≥42 weeks)§						
Norway	62,096	2994	1.00	1.00	1.00	1.00
Other	27,825	1701	1.29 (1.20–1.37)	1.21 (1.13–1.29)	1.20 (1.13–1.29)	1.19 (1.12–1.27)
Small for gestational age (SGA)						
Norway	65,092	7738	1.00	1.00	1.00	1.00
Other	29,401	3743	1.08 (1.03–1.13)	1.07 (1.02–1.12)	1.07 (1.02–1.12)	1.05 (1.00–1.10)
Large for gestational age (LGA)						
Norway	65,092	7847	1.00	1.00	1.00	1.00
Other	29,401	3454	0.97 (0.93–1.02)	0.97 (0.92–1.01)	0.97 (0.93–1.02)	0.98 (0.93–1.03)
Apgar score < 7 at 5 min						
Norway	66,006	1418	1.00	1.00	1.00	1.00
Other	30,062	824	1.28 (1.18–1.40)	1.28 (1.17–1.40)	1.27 (1.16–1.39)	1.27 (1.16–1.39)
Stillbirth						
Norway	66,006	261	1.00	1.00	1.00	1.00
Other	30,062	157	1.32 (1.08–1.62)	1.29 (1.06–1.58)	1.29 (1.05–1.59)	1.29 (1.05–1.58)
Neonatal death within 28 days						
Norway	66,006	138	1.00	1.00	1.00	1.00
Other	30,062	63	1.00 (0.74–1.36)	0.96 (0.71–1.30)	0.96 (0.70–1.30)	0.95 (0.69–1.30)

* Adjusted for year of birth, parity, maternal age and marital status
† Adjusted for * and maternal education
‡ Adjusted for *, † and mother's gross income
§ Weeks of gestation; term births were used as comparison group

outcomes in subsequent births in Norway when compared to migrant women with a first birth *after* immigration. Likewise, Norwegian-born women with a first birth *outside* Norway had increased risk for adverse neonatal outcomes in later births when compared to Norwegian-born women with a first birth *in* Norway.

To our knowledge, this is the first study to investigate a number of adverse neonatal outcomes in subsequent births after a first birth before immigrating to a new country. A first birth before immigration to Norway was associated with increased odds of very preterm, moderately preterm and post-term birth, low Apgar score and stillbirth. Even if the individual's risk for these adverse neonatal outcomes is small, the conditions are severe with consequences for the family [23] and high costs for society, such as neonatal intensive care and long-term complex health needs [24].

The higher odds of adverse outcomes in migrant women with a first birth before immigration may partly be attributed to the stress of migration. Maternal stress during pregnancy has been identified as an independent risk factor for preterm birth [25], also specific for refugee women [7]. Migrating with children may add to the stress of migration [26, 27], and some women may struggle with feelings of loss or regret after leaving older child(ren) behind [28–30]. Further, near half the women who had given birth before immigration had been in Norway for less than 2 years when their second child was born. These women may lack familiarity with the health care system [31, 32], struggle with language

Table 3 Associations between Norwegian-born women's country of first birth and adverse neonatal outcomes (1990–2016)

Adverse neonatal outcomes	n births	n cases	Crude OR (95% CI)	Adjusted OR (95% CI)*	Adjusted OR (95% CI) †	Adjusted OR (95% CI) ‡
Very preterm (22–31 weeks)§						
Norway	480,589	3592	1.00	1.00	1.00	1.00
Other	5865	54	1.23 (0.94–1.62)	1.32 (1.01–1.74)	1.31 (1.00–1.72)	1.32 (1.00–1.73)
Moderately preterm (32–36 weeks)§						
Norway	495,060	18,063	1.00	1.00	1.00	1.00
Other	6117	306	1.39 (1.22–1.58)	1.37 (1.20–1.57)	1.36 (1.19–1.55)	1.36 (1.19–1.55)
Post-term (≥42 weeks)§						
Norway	480,497	33,033	1.00	1.00	1.00	1.00
Other	5815	291	0.71 (0.63–0.81)	1.23 (1.08–1.40)	1.23 (1.08–1.40)	1.23 (1.08–1.40)
Small for gestational age (SGA)						
Norway	501,753	37,174	1.00	1.00	1.00	1.00
Other	6171	632	1.43 (1.30–1.56)	1.45 (1.33–1.59)	1.44 (1.31–1.57)	1.43 (1.31–1.57)
Large for gestational age (LGA)						
Norway	501,753	95,058	1.00	1.00	1.00	1.00
Other	6171	834	0.67 (0.62–0.73)	0.73 (0.67–0.80)	0.74 (0.68–0.80)	0.74 (0.68–0.80)
Apgar score < 7 at 5 min						
Norway	514,799	9279	1.00	1.00	1.00	1.00
Other	6205	187	1.69 (1.46–1.97)	1.62 (1.39–1.89)	1.61 (1.39–1.88)	1.61 (1.38–1.88)
Stillbirth						
Norway	514,799	1789	1.00	1.00	1.00	1.00
Other	6205	31	1.44 (1.01–2.05)	1.69 (1.18–2.42)	1.67 (1.17–2.40)	1.69 (1.18–2.42)
Neonatal death within 28 days						
Norway	514,799	808	1.00	1.00	1.00	1.00
Other	6205	12	1.23 (0.70–2.18)	1.59 (0.89–2.83)	1.58 (0.89–2.81)	1.59 (0.89–2.83)

* Adjusted for year of birth, parity, maternal age and marital status
† Adjusted for * and maternal education
‡ Adjusted for *, † and mother's gross income
§ Weeks of gestation; term births were used as comparison group

barriers [31] or make suboptimal use of the services [33–35]. Some migrant women also delay their first antenatal visit [34–36], making it difficult to collect a thorough obstetric history. Migrant women are also a heterogeneous group arriving from different countries for a variety of reasons and with different socioeconomic and cultural backgrounds, thus the findings in this study may not apply to all migrant women with a first birth before immigration. Recognizing the complexity of migration is crucial when addressing the various needs of migrant women in maternity care [37].

Somewhat surprisingly, the results related to Norwegian-born women were similar to the ones in the migrant population. A lack of access to information about obstetric history may therefore explain some of the negative outcomes in women with a first birth before immigration. Less attention is often given to parous compared to nulliparous women in antenatal care [10], and health care providers may have less access to previous medical records [31]. Hence, the needs of both migrant and Norwegian-born parous women returning after a first birth abroad may currently be inadequately addressed. Interpretation of the differences between migrant and Norwegian-born women must be made cautiously however, as although we know that migrant women immigrated for a range of reasons, including fleeing war and conflict, we lacked information on the reasons for spending time abroad in the Norwegian-born sample. An alternative explanation for the increased risk of adverse outcomes in the Norwegian-born

sample may be that Norwegian-born women who had experienced adverse birth outcomes abroad returned home before their next birth. In our sample, having experienced a previous stillbirth was more common in the Norwegian-born sample of women with a first birth outside Norway compared to Norwegian-born women who had not given birth abroad.

Both migrant and Norwegian-born women with a first birth outside Norway were more likely to report a foreign-born father to the baby compared to women who gave birth to their first child in Norway, and a foreign-born father was associated with an increased prevalence of SGA and a decreased prevalence of LGA in our material. The differences in birthweight between migrant and non-migrant women are difficult to interpret [38, 39]. Such differences may be attributed to normal biological variation as paternal factors can influence fetal growth [40, 41]. However, differences may also reflect maternal and infant health problems or suboptimal care, as infants may be growth-restricted for a variety of reasons [41]. A critical review on birthweight in immigrant populations concludes that birthweight alone is not enough to inform clinical decisions and newborn size charts should serve as screening rather than diagnostic tools [38]. The associations between a foreign-born father and adverse neonatal outcomes need further investigation.

The main strengths of this study include the large sample size and long timespan of the study allowing us to follow the same mothers and their pregnancy outcomes over time (26 years). The standardized collection of data on adverse neonatal outcomes, and the selection of available covariates adjusted for in the regression analyses, add to the strengths of the study. The differences in background characteristics in the Norwegian-born sample are mainly a result of the age limit set to determine country of first birth in these women, and this may limit the conclusions that can be drawn from the Norwegian-born sample. Additionally, we cannot rule out misclassification of self-reported parity. Finally, the low prevalence of adverse outcomes in both migrant and Norwegian-born women limited us from determining if the increased risk of adverse neonatal outcomes was primarily related to the first birth after arriving in Norway or if it also applied to later births to the same mother.

Conclusions

Both migrant and Norwegian-born women had increased odds of adverse neonatal outcomes in subsequent births if they had their first baby outside Norway compared with if they had their first baby in Norway. The results of this study should serve as a reminder of the importance of collecting a thorough obstetric history from parous women who migrate to a new country after their first birth.

Abbreviations

aOR: Adjusted odds ratio; CI: Confidence interval; MBRN: Medical Birth Registry of Norway; OR: Odds ratio; SSB: Statistics Norway

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Authors' contributions

ESV, ES, RMN and VA planned the study, drafted the first version of the manuscript and contributed to data management, statistical analysis and interpretation of data; RS and DM made their contribution in revising the manuscript. The final manuscript was read and approved by all authors.

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Availability of data and materials

The data that support the findings of this study are available from the Medical Birth Registry of Norway and Statistics Norway but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of the Medical Birth Registry of Norway and Statistics Norway.

Ethics approval and consent to participate

The study was approved by the South-East Regional Committees for Medical and Health Research Ethics in Norway (approval number: 2014/1278). Data were used under licence for the current study.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Publisher's Note

Appendix 1

STATENS HELSETILSYN
Postboks 8128 Dep.
0032 OSLO

Medisinsk registrering av fødsel

Sendes 9. dag etter fødselen til fylkeslegen (stadsfysikus) i det fylket der moren er bosatt.

Merk: Det skal fylles ut blankett for hvert barn (foster). Dør barnet etter fødselen, skal det også fylles ut legeerklæring om dødsfall, og/eller dødsfallet meldes til skifteretten (lensmannen).

Barnet

Barnet var: 1 ☐ Levende født 2 ☐ Dødfødt foster | Født dag, mnd., år | Klokkeslett | Personnr. | Skriv ikke her

1 ☐ Enkel 2 ☐ Tvilling 3 ☐ Trilling 4 ☐ Firling | Kjønn: 1 ☐ Gutt 2 ☐ Pike

Etternavn, alle fornavn (bare for levendefødte)

Fødested. Navn og adresse på sykehuset/fødehjemmet | Kommune

Faren

Etternavn, alle fornavn | Født dag, mnd., år | Bostedskommune

Moren

Etternavn, alle fornavn. Pikenavn | Født dag, mnd., år

Bosted. Adresse | Kommune

Ekteskapelig status: 1 ☐ Ugift 6 ☐ Samboende 2 ☐ Gift 3 ☐ Enke 4 ☐ Separert 5 ☐ Skilt | Ekteskapsår (gifte)

Antall tidligere fødte (før denne fødselen) | Levende fødte | Av disse i live | Dødfødte

Er moren i slekt med faren? 1 ☐ Nei 2 ☐ Ja. Hvilket slektskapsforhold:

Morens helse før svangerskapet

1 ☐ Normal 2 ☐ Sykdom (spesifiser):

Siste menstruasjons første blødningsdag

Morens helse under svangerskapet

1 ☐ Normal 2 ☐ Komplikasjoner (spesifiser):

Ble fødselen provosert

1 ☐ Nei 2 ☐ Ja

Inngrep under fødselen

1 ☐ Nei 2 ☐ Ja (spesifiser):

Inngrepet utført av: 1 ☐ Lege 2 ☐ Jordmor

Komplikasjoner i forbindelse med fødselen

1 ☐ Nei 2 ☐ Ja (spesifiser):

Fostervann, placenta og navlesnor

1 ☐ Normalt 2 ☐ Patologisk (spesifiser):

Barnets tilstand

Bare for levende fødte. Tegn på asfyksi? 1 ☐ Nei 2 ☐ Ja | Apgarscore etter 1 min. | etter 5 min.

For levende fødte og dødfødte. Tegn på medfødt anomali, på skade eller sykdom? 1 ☐ Nei 2 ☐ Ja. Hvilke:

Lengde (i cm) | Hode-omkr. (i cm) | Vekt (i g) | For døde innen 24 timer Livet varte i | Timer | Min

For dødfødte. Døden inntrådte 1 ☐ Før fødselen 2 ☐ Under fødselen
Dødsårsak:

Seksjon? 1 ☐ Nei 2 ☐ Ja

Alvorlige arvelige lidelser i slekten

1 ☐ Nei 2 ☐ Ja Sykdommens art og hos hvilke slektninger:

50 000. 5.96. SEM GRAFISK

Sted (sykehusets stempel) | Dato | Jordmor | Lege

IK - 1002.

Appendix 2

MFR

Melding om avsluttet svangerskap etter 16. uke – Fødsel, dødfødsel, spontanabort

Se utfyllingsinstruks for blanketten på baksiden

Statens helsetilsyn

A – Sivile opplysninger

Institusjonsnr: | Institusjonsnavn

Fødsel utenfor institusjon: ☐ Hjemme, planlagt ☐ Hjemme, ikke planlagt ☐ Under transport ☐ Annet sted

Mors fulle navn og adresse

Pikenavn (etternavn):

Mors sivilstatus ☐ Gift ☐ Ugift/enslig ☐ Annet ☐ Samboer ☐ Skilt/separert/enke

Slektskap mellom barnets foreldre? ☐ Nei ☐ Ja Hvis ja, hvorledes:

Mors bokommune

Fars fødselsdato | Fars fulle navn

Mors fødselsnr:

B – Om svangerskap og mors helse

Siste menstr. 1. blødn.dag ☐ Sikker ☐ Usikker

Mors tidligere svangerskap/fødte Levende-fødte | Dødfødte (24. uke og over) | Spontanabort/Død-fødte (12.–23. uke) | Spontanaborter (under 12. uke)

Ultralyd utført? ☐ Nei ☐ Ja UL termin:

Annen prenatal diagnostikk? ☐ Nei ☐ Ja, angi type:

Patologiske funn ved prenatal diagnostikk? ☐ Nei ☐ Ja, hvis bekreftet – spesifiser

Spesielle forhold før svangerskapet:
☐ Intet spesielt
☐ Astma ☐ Allergi ☐ Tidligere sectio ☐ Res. urinveisinfeksjon ☐ Kronisk nyresykdom ☐ Kronisk hypertensjon ☐ Reumatoid artritt ☐ Hjertesykom ☐ Epilepsi ☐ Diabetes type 1 ☐ Diabetes type 2 ☐ Annet, spesifiser i «B»

Regelmessig kosttilskudd: ☐ Nei
Multivitaminer: Før sv.sk. ☐ I sv.sk. ☐
Folat/Folsyre: Før sv.sk. ☐ I sv.sk. ☐

Spesifikasjon av forhold før eller under svangerskapet: B

Spesielle forhold under svangerskapet:
☐ Intet spesielt
☐ Blødning < 13 uke ☐ Blødning 13–28 uke ☐ Blødning > 28 uke ☐ Glukosuri ☐ Svangerskapsdiabetes ☐ Hypertensjon alene ☐ Preeklampsi lett ☐ Preeklampsi alvorlig ☐ Preeklampsi før 34. uke ☐ HELLP syndrom ☐ Eklampsi ☐ Hb < 9.0 g/dl ☐ Hb > 13.5 g/dl ☐ Trombose, beh. ☐ Infeksjon, spes. i «B»

☐ Annet, spesifiser i «B»

Legemidler i svangerskapet: ☐ Nei ☐ Ja – spesifiser i «B»

Røyking og yrke
Forutsetter mors samtykke – se rettledning på baksiden
☐ Skriftlig orientering gitt til mor ☐ Samtykker ikke for røykeoppl.

Røykte mor ved sv.sk. begynnelse? ☐ Nei ☐ Daglig ☐ Av og til Ant. sig. dagl.:

- ved sv.sk. avslutning? ☐ Nei ☐ Daglig ☐ Av og til Ant. sig. dagl.:

Mors yrke ☐ Samtykker ikke for yrkesoppl. ☐ Ikke yrkesaktiv ☐ Yrkesaktiv heltid ☐ Yrkesaktiv deltid

Mors yrke

Bransje:

C – Om fødselen

Leie/presentasjon:
☐ Normal bakhode
☐ Sete ☐ Tverrleie ☐ Avvikende hodefødsel ☐ Annet, spesifiser i «C»

Fødselstart:
☐ Spontan ☐ Indusert ☐ Sectio

Ev. induksjons-metode:
☐ Prostaglandin ☐ Oxytocin ☐ Amniotomi ☐ Annet, spesifiser i «C»

Indikasjon for inngrep og/eller induksjon
☐ Komplikasjoner som beskrevet nedenfor ☐ Fostermisdannelser ☐ Overtid ☐ Annet, spesifiser i «C»

Inngrep/tiltak
☐ Ingen
☐ Utskj. tang, hodeleie ☐ Annen tang, hodeleie ☐ Vakuumekstraktor ☐ Episitomi

Fremhj. ved setefødsel:
☐ Vanlig fremhjelp ☐ Uttrekning ☐ Tang på etterk. hode

Sectio:
Var sectio planlagt før fødsel? ☐ Nei ☐ Ja
☐ Utført som elektiv sectio ☐ Utført som akutt sectio

Spesifikasjon av forhold ved fødselen/andre komplikasjoner C

Komplikasjoner
☐ Ingen
☐ Vannavg. 12–24 timer ☐ Vannavg. > 24 timer ☐ Mekaniske misforhold ☐ Vanskelig skulderforløsning ☐ Placenta previa ☐ Abruptio placentae ☐ Perinealruptur (grad 1-2) ☐ Sphincterruptur (gr. 3-4) ☐ Blødn.> 1500 ml, transf. ☐ Blødning 500–1500 ml ☐ Eklampsi under fødsel ☐ Navlesnorfremfall ☐ Truende intrauterin asfyksi ☐ Risvekkelse, stimulert ☐ Langsom fremgang ☐ Uterus atoni ☐ Annet:

Anestesi/analgesi:
☐ Ingen
☐ Lystgass ☐ Petidin ☐ Epidural ☐ Spinal ☐ Pudendal ☐ Infiltrasjon ☐ Paracervical blokk ☐ Narkose ☐ Annet:

Placenta:
☐ Normal ☐ Hinnerester ☐ Ufullstendig ☐ Infarkter
☐ Koagler ☐ Utskrapning ☐ Manuell uthenting
Placenta-vekt

Navlesnor
☐ Normal ☐ Velamentøst feste ☐ Marginalt feste ☐ Karanomalier
☐ Omslyng rundt hals ☐ Annet omslyng ☐ Ekte knute
Navlesnor-lengde:

Fostervann
☐ Normal ☐ Polyhydramnion ☐ Oligohydramnion ☐ Misfarget ☐ Stinkende, infisert ☐ Blodtilblandet

Komplikasjoner hos mor etter fødsel
☐ Intet spesielt ☐ Feber > 38.5° ☐ Trombose ☐ Eklampsi post partum ☐ Mor overflyttet ☐ Mor intensivbeh. ☐ Sepsis ☐ Annet, spesifiser

D – Om barnet

Fødselsdato | **Klokken**

Pluralitet ☐ Enkeltfødsel ☐ Flerfødsel
For flerfødsel: Nr. | Av totalt

Kjønn ☐ Gutt ☐ Pike ☐ Ved tvil spesifiser i «D» ☐ For dødfødte: Usikkert kjønn

Barnets vekt:

Hode-omkrets:

Total lengde:

Eventuelt sete–issemål:

Apgar score: 1 min | 5 min

Barnet var:
☐ Levendefødt
For dødfødte: ☐ Dødfødt/sp.abort Oppgi dødsårsak i «D»
☐ Død før fødsel ☐ Død under fødselen ☐ Ukjent dødstidspunkt
For dødfødte, oppgi også ☐ Død før innkomst ☐ Død etter innkomst
Levendefødt, død innen 24 timer Livet varte: Timer | Min.
Død senere (dato): | **Klokken**

Overfl. barneavd. ☐ Nei ☐ Ja Dato:
Overfl. til
Indikasjon for overflytting: ☐ Respirasjonsproblem ☐ Prematur ☐ Medfødte misd. ☐ Perinatale infeksjoner ☐ Annet, spesifiser

Neonatale diagn.: (Fylles ut av lege/pediater)
☐ Intet spesielt
☐ Hypoglyk. (< 2 mmol/l) ☐ Medf. anemi (Hb < 13.5 g/dl) ☐ Hofteleddsdyspl. beh. m/pute ☐ Transit. tachypnoe ☐ Resp. distress syndr. ☐ Aspirasjonssyndrom ☐ Intrakraniell blødning ☐ Cerebral irritasjon ☐ Cerebral depresjon ☐ Abstinens ☐ Neonatale kramper ☐ Konjunktivitt beh. ☐ Navle./hudinf. beh. ☐ Perinat. inf. bakterielle ☐ Perinat. inf. andre ☐ Fract. claviculae ☐ Annen fraktur ☐ Facialisparese ☐ Plexusskade

Behandlingskoder:
☐ Systemisk antibiotika ☐ Respiratorbeh. ☐ CPAP beh.

Icterus behandlet:
☐ Lysbehandlet ☐ Utskifting
Årsak:
☐ AB0 uforlik. ☐ RH immunisering ☐ Fysiologisk ☐ Annen årsak

Tegn til medfødte misdannelser: ☐ Nei ☐ Ja

D Spesifikasjon av skader, neonatale diagnoser og medfødte misdannelser – utfylles av lege

☐ **Kryss av hvis skjema er oppfølgingsskjema**

Jordmor v/fødsel:

Jordmor v/utskrivning:

Lege:

Lege barsel/barneavd:

Utskrivningsdato Mor: | Barn:

Protokollnr.: /

IK-1002

Nr. 71424 Sem & Stenersen Prokom AS, USO 1-99

Appendix 3

Melding om avsluttet svangerskap etter 12. uke – Fødsel, dødfødsel, spontanabort

Se utfyllingsinstruks for blanketten på baksiden

MFR

Sosial- og helsedirektoratet

A – Sivile opplysninger

Institusjonsnr: | Institusjonsnavn

Fødsel utenfor institusjon: ☐ Hjemme, planlagt ☐ Hjemme, ikke planlagt ☐ Under transport ☐ Annet sted

Mors fulle navn og adresse

Pikenavn (etternavn):

Mors sivilstatus ☐ Gift ☐ Ugift/enslig ☐ Annet ☐ Samboer ☐ Skilt/separert/enke

Slektskap mellom barnets foreldre? ☐ Nei ☐ Ja Hvis ja, hvorledes:

Mors bokommune

Fars fødselsdato | Fars fulle navn

Mors fødselsnr:

B – Om svangerskap og mors helse

Siste menstr. 1. blødn.dag ☐ Sikker ☐ Usikker

Mors tidligere svangerskap/fødte Levende-fødte | Dødfødte (24. uke og over) | Spontanabort/Død-fødte (12.–23. uke) | Spontanaborter (under 12. uke)

Ultralyd utført? ☐ Nei ☐ Ja UL termin:

Annen prenatal diagnostikk? ☐ Nei ☐ Ja, angi type:

Patologiske funn ved prenatal diagnostikk? ☐ Nei ☐ Ja, hvis bekreftet – spesifiser

Spesielle forhold før svangerskapet:
☐ Intet spesielt
☐ Astma ☐ Allergi ☐ Tidligere sectio ☐ Res. urinveisinfeksjon
☐ Kronisk nyresykdom ☐ Kronisk hypertensjon ☐ Reumatoid artritt ☐ Hjertesykom
☐ Epilepsi ☐ Diabetes type 1 ☐ Diabetes type 2 ☐ Annet, spesifiser i «B»

Regelmessig kosttilskudd: ☐ Nei Før sv.sk. I sv.sk.
Multivitaminer ☐ ☐
Folat/Folsyre ☐ ☐

Spesifikasjon av forhold før eller under svangerskapet: B

Spesielle forhold under svangerskapet:
☐ Intet spesielt
☐ Blødning < 13 uke ☐ Blødning 13–28 uke ☐ Blødning > 28 uke ☐ Glukosuri ☐ Svangerskapsdiabetes
☐ Hypertensjon alene ☐ Preeklampsi lett ☐ Preeklampsi alvorlig ☐ Preeklampsi før 34. uke ☐ HELLP syndrom
☐ Eklampsi ☐ Hb < 9.0 g/dl ☐ Hb > 13.5 g/dl ☐ Trombose, beh. ☐ Infeksjon, spes. i «B»
☐ Annet, spesifiser i «B»

Legemidler i svangerskapet: ☐ Nei ☐ Ja – spesifiser i «B»

Røyking og yrke
Forutsetter mors samtykke – se rettledning på baksiden
☐ Skriftlig orientering gitt til mor ☐ Samtykker ikke for røykeoppl.

Røykte mor ved sv.sk. begynnelse? ☐ Nei ☐ Daglig ☐ Av og til Ant. sig. dagl.:

- ved sv.sk. avslutning? ☐ Nei ☐ Daglig ☐ Av og til Ant. sig. dagl.:

Mors yrke ☐ Samtykker ikke for yrkesoppl. ☐ Ikke yrkesaktiv ☐ Yrkesaktiv heltid ☐ Yrkesaktiv deltid

Mors yrke

Bransje:

C – Om fødselen

Leie/presentasjon: ☐ Normal bakhode ☐ Sete ☐ Tverrleie ☐ Avvikende hodefødsel ☐ Annet, spesifiser i «C»

Fødselstart: ☐ Spontan ☐ Indusert ☐ Sectio

Ev. induksjons-metode: ☐ Prostaglandin ☐ Oxytocin ☐ Amniotomi ☐ Annet, spesifiser i «C»

Indikasjon for inngrep og/eller induksjon ☐ Komplikasjoner som beskrevet nedenfor ☐ Fostermisdannelser ☐ Overtid ☐ Annet, spesifiser i «C»

Inngrep/tiltak ☐ Ingen ☐ Utskj. tang, hodeleie ☐ Annen tang, hodeleie ☐ Vakuumekstraktor ☐ Episitomi

Fremhj. ved setefødsel: ☐ Vanlig fremhjelp ☐ Uttrekning ☐ Tang på etterk. hode

Sectio: Var sectio planlagt før fødsel? ☐ Nei ☐ Ja
☐ Utført som elektiv sectio ☐ Utført som akutt sectio

Spesifikasjon av forhold ved fødselen/andre komplikasjoner C

Komplikasjoner ☐ Ingen ☐ Vannavg. 12–24 timer ☐ Vannavg. > 24 timer ☐ Mekaniske misforhold ☐ Vanskelig skulderforløsning
☐ Placenta previa ☐ Abruptio placentae ☐ Perinealruptur (grad 1-2) ☐ Sphincterruptur (gr. 3-4)
☐ Blødn.> 1500 ml, transf. ☐ Blødning 500–1500 ml ☐ Eklampsi under fødsel ☐ Navlesnorfremfall
☐ Truende intrauterin asfyksi ☐ Risvekkelse, stimulert ☐ Langsom fremgang ☐ Uterus atoni ☐ Annet:

Anestesi/analgesi: ☐ Ingen ☐ Lystgass ☐ Petidin
☐ Epidural ☐ Spinal
☐ Pudendal ☐ Infiltrasjon
☐ Paracervical blokk ☐ Narkose ☐ Annet:

Placenta: ☐ Normal ☐ Hinnerester ☐ Ufullstendig ☐ Infarkter ☐ Koagler ☐ Utskrapning ☐ Manuell uthenting
Placenta-vekt

Navlesnor ☐ Normal ☐ Velamentøst feste ☐ Marginalt feste ☐ Karanomalier ☐ Omslyng rundt hals ☐ Annet omslyng ☐ Ekte knute
Navlesnor-lengde:

Fostervann ☐ Normal ☐ Polyhydramnion ☐ Oligohydramnion ☐ Misfarget ☐ Stinkende, infisert ☐ Blodtilblandet

Komplikasjoner hos mor etter fødsel ☐ Intet spesielt ☐ Feber > 38.5° ☐ Trombose ☐ Eklampsi post partum ☐ Mor overflyttet ☐ Mor intensivbeh. ☐ Sepsis ☐ Annet, spesifiser

D – Om barnet

Fødselsdato | **Klokken**

Pluralitet ☐ Enkeltfødsel ☐ Flerfødsel For flerfødsel: Nr. Av totalt

Kjønn ☐ Gutt ☐ Pike Ved tvil spesifiser i «D» For dødfødte: ☐ Usikkert kjønn

Barnets vekt: | Hode-omkrets:

Total lengde: | Eventuelt sete–issemål:

Apgar score: 1 min | 5 min

Barnet var: ☐ Levendefødt

For dødfødte: ☐ Dødfødt/sp.abort Oppgi dødsårsak i «D»

For dødfødte, oppgi også ☐ Død før fødsel ☐ Død under fødselen ☐ Ukjent dødstidspunkt ☐ Død før innkomst ☐ Død etter innkomst

Levendefødt, død innen 24 timer Livet varte: Timer | Min.

Død senere (dato): | **Klokken**

Overfl. barneavd. ☐ Nei ☐ Ja Dato:

Overfl. til

Indikasjon for overflytting: ☐ Respirasjonsproblem ☐ Prematur ☐ Medfødte misd. ☐ Perinatale infeksjoner ☐ Annet, spesifiser

Neonatale diagn.: (Fylles ut av lege/pediater) ☐ Intet spesielt
☐ Hypoglyk. (< 2 mmol/l) ☐ Medf. anemi (Hb < 13.5 g/dl) ☐ Hofteleddsdyspl. beh. m/pute
☐ Transit. tachypnoe ☐ Resp. distress syndr. ☐ Aspirasjonssyndrom ☐ Intrakraniell blødning
☐ Cerebral irritasjon ☐ Cerebral depresjon ☐ Abstinens ☐ Neonatale kramper
☐ Konjunktivitt beh. ☐ Navle./hudinf. beh. ☐ Perinat. inf. bakterielle ☐ Perinat. inf. andre
☐ Fract. claviculae ☐ Annen fraktur ☐ Facialisparese ☐ Plexusskade

Behandlingskoder: ☐ Systemisk antibiotika ☐ Respiratorbeh. ☐ CPAP beh.

Icterus behandlet: ☐ Lysbehandlet ☐ Utskifting

Årsak: ☐ AB0 uforlik. ☐ RH immunisering ☐ Fysiologisk ☐ Annen årsak

Tegn til medfødte misdannelser: ☐ Nei ☐ Ja

D Spesifikasjon av skader, neonatale diagnoser og medfødte misdannelser – utfylles av lege

☐ **Kryss av hvis skjema er oppfølgingsskjema**

Jordmor v/fødsel:

Jordmor v/utskrivning:

Lege:

Lege barsel/barneavd:

Utskrivningsdato

Mor:

Barn:

Protokollnr.: /

IS-1002 23011. 07.06. Andvord Grafisk.

Appendix 4

HELSEKORT FOR GRAVIDE

(Se veiledning for helsekort IS-2713)

Helsekortet må tas med på hver konsultasjon og til fødsel

Bring this health card for all consultations and for labor

Mor	Fødselsnr./D-nummer (11 siffer)	Far/medmor	Fødselsnr./D-nummer (11 siffer)
Navn		Navn	Telefon
Adresse	Telefon	Full adresse	
Postnr.	Poststed	Stilling/yrke	

Fastlege	Jordmor
Sted	Sted
Telefon	Telefon

Sivilstatus
- ☐ Gift
- ☐ Samboer
- ☐ Ugift/enslig ☐ Annet

Høyeste utdanning
- ☐ Grunnskole
- ☐ Videregående
- ☐ Høyere utd.

Yrkesaktiv siste 6 mnd.
- ☐ Ja ☐ Nei

Yrke/bransje | Prosent

Mor landbakgrunn	Språk
	☐ Behov for tolk
Far/medmor landbakgrunn	Språk

Tidligere svangerskap

Totalt antall sv.sk ☐ Spont.ab. ☐

Lev. født ☐ Ex. u. ☐

Dødfødt ≥ 500 g/22 u. ☐

Merknader tidligere sv.sk.

Tidligere/nåværende sykdommer
- ☐ Intet spesielt
- ☐ Diabetes/sv.sk.dia.
- ☐ Autoimmun sykdom
- ☐ Hjertesykdom
- ☐ Allergi/astma
- ☐ Gyn. sykd./opr.
- ☐ Hypertensjon
- ☐ Epilepsi
- ☐ Psykisk helse
- ☐ Nyre/urinv.
- ☐ Trombose/behandling
- ☐ Annet, *se merkn.*

Arvelige sykd.
- ☐ Ingen kjente
- ☐ Ja, se merkn.
- ☐ Foreldre i slekt
- ☐ Hofteleddsdysplasi

Merknader/annet

Legemidler

☐ Daglig ☐ Av og til

Legemidler

☐ Legemiddelallergi

Folat
- ☐ Før svangerskap
- ☐ I svangerskap

Levevaner

	Nei	Av og til	Dagl.	Sluttet i sv.sk.
Røyking	☐	☐	☐	☐
Snus	☐	☐	☐	☐
Alkoholforbr.	☐	☐	☐	☐
Andre rusmidl.	☐	☐	☐	☐

Ant. daglig

	Sigaretter	Snus	Alkohol
Ved 1. kons.			
Ved ca. 36. uke			

☐ Levevaner: Notater

Aktuelt svangerskap

Siste mens

Termin

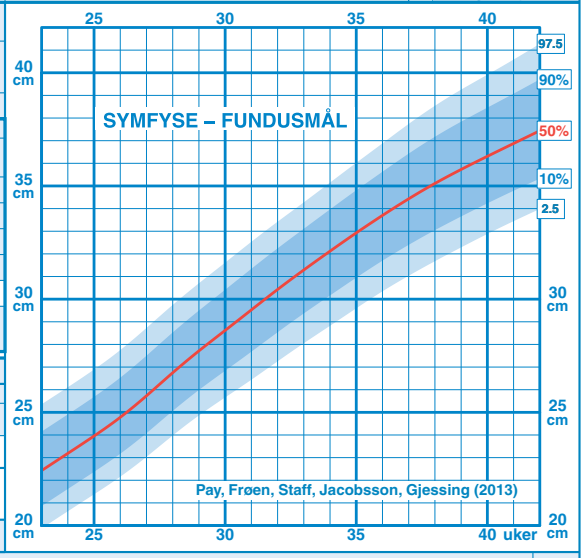
Ultralyd termin

Når korrigert

Fosterdiagnostikk på indikasjon ☐ Ja ☐ Nei

Assistert befruktning ☐ Ja Dato

☐ Flerlinger



Anbefalte prøver i første trimester

	Prøvesvar
Hb	
S-Ferritin	

	Ikke påvist	Påvist
Hepatitt B (HBsAg)	☐	☐
Hepatitt B (Anti-HBc)	☐	☐
HIV	☐	☐
Syfilis	☐	☐
ABU	☐	☐

ABO/Rh | Prøvesvar

Prøver ved behov

	Ikke påvist	Påvist
Klamydia	☐	☐
Toksoplasmose	☐	☐
Rubella antistoff	☐	☐
Hepatitt C	☐	☐
MRSA/VRE/ESBL	☐	☐

HbA1c | Prøvesvar

Glukosebelastning (uke 24-28)

Fastende | 2 timer | Dato

Blodtypeantistoff ☐ Ja ☐ Nei ☐ Ikke utført kontroll antistoff

RhD-negativ gravid

Foster-RHD uke 24 ☐ Negativ ☐ Positiv

RhD-profylakse gitt uke 28 ☐ Ja ☐ Nei

Samtykke om test av foster-RHD | Sign.

Resultat dato

Merknader (blodtypeantistoff, GBS, annet)

Før svangerskap Høyde | Vekt | KMI

Dato	Uke	Vekt	BT	U-Prot	Ødem 0/1/2/3	Pres/ leie	Fl./ min.	Kjen-ner liv	Legem. +/ –	I jobb %	Notater	Sign.

☐ Ammeveiledning ☐ Fødselsforberedende samtale ☐ Farskapserklæring utfylt

Tabellen fortsetter på baksiden ☐ Ja ☐ Nei

Fødeavdeling, telefon

Helsestasjon, adresse, telefon

IS-2714 Helsedirektoratet 4-2018

Mor	Fødselsnr. /D-nummer (11 siffer)	
	Navn	

HELSEKORT FOR GRAVIDE
Kontinuasjonsark

Dato	Uke	Vekt	BT	U-Prot	Ødem 0/1/2/3	Pres/ leie	Fl./ min.	Kjen-ner liv	Legem. +/ –	I jobb %	Notater	Sign.

For notater/merknader/fødeplan ved behov

Appendix 5

Vedlegg, SSBs ref. 14/1479
SSBs brev av 18.05.2015

DATASPESIFISERING

Populasjon:

Alle Kvinner som har født i Norge i perioden 1990-2013. Populasjonen er laget av Medisinsk fødselsregister og er på cirka 290000 individer.

Observasjonsperiode:

Årgangsopplysninger leveres på årgangene 1990-2013 eller i de årgangene der data er tilgjengelige.
Opplysningene i fra FD-Trygd leveres for årgangene 1992-2013.
Variable om faste opplysninger leveres i fra siste tilgjengelige årgang.

Variable/datasett:

Inntektsdata: løpenummer, Sum pensjonsgivende inntekt for årgangene 1990-2013

Utdanningsdata: løpenummer, Høyeste fullførte utdanning(NUS 2000) for årgangene 1990-2013.

Befolkningsdata: Fødeland andre forelder(far) barn 1-19, innvandringsgrunn (faste opplysning pr 1.1.2014)

Følgende tabeller fra FD-TRYGD med valgte variable i parentes:

F_DEMO 1992-2013 (løpenummer, bosted, statsborgerskap)
F_DEMO_SIV 1992-2013(løpenummer, sivilstand, endringsdato for sivilstand)
TAB_FLAN 1992-2013 (løpenummer, fødeland, første oppholdsdato, innvandringskategori, landbakgrunn)

Filene leveres som SPSS-datasett

Appendix 6

Vedlegg, SSBs ref. 14/1479
SSBs brev av 30.01.2017

DATASPESIFISERING

Populasjon:

Alle Kvinner som har født i Norge i perioden 1990-2016. Populasjonen er laget av Medisinsk fødselsregister og er på cirka 800 000 kvinner. Oppdtatert og utvidet populasjon oversendes fra Medisinsk fødselsregister hos FHI. SSB beholder koblingsnøkkelen.

Observasjonsperiode:

Årgangsopplysninger leveres på årgangene 1990-2016 eller i de årgangene der data er tilgjengelige. Opplysningene i fra FD-Trygd leveres for årgangene 1992-2016, så snart 2016-årgangen er tilgjengelig. Variable om faste opplysninger leveres i fra siste tilgjengelige årgang.

Variable/datasett

Inntektsdata: løpenummer, Sum pensjonsgivende inntekt for årgangene 1990-2016

Utdanningsdata: løpenummer, Høyeste fullførte utdanning (NUS 2000) for årgangene 1990-2016

Befolkningsdata: løpenummer, Fødeland andre forelder(far) barn 1-21, innvandringsgrunn (faste opplysning pr 1.1.2017).

Følgende tabeller fra FD-TRYGD med valgte variable i parentes:

F_DEMO 1992-2016 (løpenummer, bosted, statsborgerskap)
F_DEMO_SIV 1992-2016(løpenummer, sivilstand, endringsdato for sivilstand)
TAB_FLAN 1992-2016 (løpenummer, fødeland, første oppholdsdato, innvandringskategori, landbakgrunn)

Fd-trygd tabellene leveres med 2016-årgangen når disse er tilgjengelige.

Datafiler leveres som SPSS-datasett

Appendix 7

REK
REGIONALE KOMITEER FOR MEDISINSK OG HELSEFAGLIG FORSKNINGSETIKK

Region:	Saksbehandler:	Telefon:	Vår dato:	Vår referanse:
REK sør-øst	Claus Henning Thorsen	22845515	10.09.2014	2014/1278/REK sør-øst C
			Deres dato:	**Deres referanse:**
			17.06.2014	

Vår referanse må oppgis ved alle henvendelser

Vigdis Aasheim
Høgskolen i Bergen

2014/1278 Svangerskapsutfall relatert til fødeland

Forskningsansvarlig: Høgskolen i Bergen
Prosjektleder: Vigdis Aasheim

Vi viser til søknad om forhåndsgodkjenning av ovennevnte forskningsprosjekt. Søknaden ble behandlet av Regional komité for medisinsk og helsefaglig forskningsetikk (REK sør-øst) i møtet 19.08.2014. Vurderingen er gjort med hjemmel i helseforskningsloven (hfl.) § 10, jf. forskningsetikklovens § 4.

Prosjektomtale
Denne søknaden gjelder en kartlegging av innvandreres fødselsutfall i Norge. Blant kvinner som føder i Norge er 23% av disse selv født i et annet land, noe som i seg selv er en risikofaktor for komplikasjoner under graviditet og fødsel. Vi vil studere om risikoen for alvorlige graviditetsutfall er like store for utenlandsfødte kvinner som for kvinner født i Norge, samt om der er forskjeller i fødselsomsorgen. Det er viktig med en analyse av opprinnelsesland i forhold til graviditetsutfall og det å kunne kontrollere for relevante faktorer. I denne søknaden vil vi derfor, i tillegg til avidentifisert informasjon om svangerskap og fødsel fra det medisinske Fødselsregisteret, også inkludere opplysninger om kvinnenes bakgrunn, slikt som utdanning og migrasjon. Vi søker om å få bruke data fra vel to årtier, fra 1990-2012, dette blir anslagsvis 280 000 fødsler. Et stort antall er nødvendig for å få data om sjelden utfall, slikt som fosterdød.

Vurdering

Komiteen mener dette er en nyttig studie som kan gi viktige resultater. Det skal kobles mye sensitive data, men data vil være anonyme på forskers hånd og SSB vil sitte på den koblede filen. Komiteen kan ikke se at det noe stort stigmatiseringspotensial i studien, men søker har reflektert over problemstillingen.

Utlevering av opplysninger fra Medisinsk fødselsregister

De sentrale helseregistrene har egne forskrifter som regulerer utlevering av opplysninger i forskningsøyemed. I henhold til Medisinsk fødselsregisterforskriften § 3-5 andre ledd vil en forhåndsgodkjenning av medisinske og helsefaglige forskningsprosjektet etter helseforskningsloven § 33, jf § 9, innebære at databehandlingsansvarlig ved det sentrale helseregister kan utlevere data uten hinder av lovpålagt taushetsplikt.

Komiteen har etter en samlet vurdering kommet til databehandlingsansvarlig ved Medisinsk fødselsregister pasientregister kan utlevere identifiserbare helseopplysninger i tråd med prosjektsøknad og protokoll uten hinder av lovpålagt taushetsplikt.

På grunnlag av foreliggende opplysninger om studiens formål og den potensielle nytten av resultatene av undersøkelsen, samt at den enkelte registrertes integritet og velferd synes tilfredsstillende ivaretatt, godkjenner komiteen med hjemmel i helseforskningsloven § 9 jf § 33, sammenstilling av opplysninger fra Medisinsk fødselsregister og Statistisk sentralbyrå.

Når det gjelder data fra Statistisk sentralbyrå presiserer komiteen at man kun har tatt stilling til og godkjent at data kan inngå i prosjektets forskningsfil. Komiteen forutsetter at tilgangsspørsmålet avklares med Statistisk sentralbyrå, og at nødvendige tillatelser derfra foreligger før prosjektet igangsettes.

Vedtak

Prosjektet godkjennes, jf helseforskningslovens §§ 9 og 33.

Godkjenningen innebærer at databehandlingsansvarlig ved Medisinsk fødselsregister kan utlevere opplysninger i henhold til søknad og protokoll uten hinder av lovpålagt taushetsplikt.

Tillatelsen er gitt under forutsetning av at prosjektet gjennomføres slik det er beskrevet i søknaden og protokollen, og de bestemmelser som følger av helseforskningsloven med forskrifter.

Tillatelsen gjelder til 01.07.2021. Av dokumentasjons-og oppfølgingshensyn skal opplysningene likevel bevares inntil 01.07.2026. Opplysningene skal lagres avidentifisert, dvs. atskilt i en nøkkel-og en opplysningsfil. Opplysningene skal deretter slettes eller anonymiseres, senest innen et halvt år fra denne dato.

Komiteens avgjørelse var enstemmig.

Sluttmelding og søknad om prosjektendring
Prosjektleder skal sende sluttmelding til REK sør-øst på eget skjema senest 01.02.2016, jf. hfl. 12. Prosjektleder skal sende søknad om prosjektendring til REK sør-øst dersom det skal gjøres vesentlige endringer i forhold til de opplysninger som er gitt i søknaden, jf. hfl. § 11.

Klageadgang
Du kan klage på komiteens vedtak, jf. forvaltningslovens § 28 flg. Klagen sendes til REK sør-øst. Klagefristen er tre uker fra du mottar dette brevet. Dersom vedtaket opprettholdes av REK sør-øst, sendes klagen videre til Den nasjonale forskningsetiske komité for medisin og helsefag for endelig vurdering.

Vi ber om at alle henvendelser sendes inn med korrekt skjema via vår saksportal: http://helseforskning.etikkom.no. Dersom det ikke finnes passende skjema kan henvendelsen rettes på e-post til: post@helseforskning.etikkom.no

Med vennlig hilsen

Britt Ingjerd Nesheim
prof.dr.med
Leder REK sør-øst C

Claus Henning Thorsen
rådgiver

Kopi til:vaa@hib.no, Høgskolen i Bergen ved øverste administrative ledelse: post@hib.no

Appendix 8

REK
REGIONALE KOMITEER FOR MEDISINSK OG HELSEFAGLIG FORSKNINGSETIKK

Region:	Saksbehandler:	Telefon:	Vår dato:	Vår referanse:
REK sør-øst	Tor Even Svanes	22845521	16.09.2016	2014/1278/REK sør-øst C
			Deres dato:	**Deres referanse:**
			22.08.2016	

Vår referanse må oppgis ved alle henvendelser

Vigdis Aasheim
Institutt for sykepleiefag
Høgskolen i Bergen
5020 Bergen

2014/1278 Svangerskapsutfall relatert til fødeland

Forskningsansvarlig: Høgskolen i Bergen
Prosjektleder: Vigdis Aasheim

Vi viser til søknad om prosjektendring datert 22.08.2016 for ovennevnte forskningsprosjekt. Søknaden er behandlet av sekretariatet i REK sør-øst på delegert fullmakt fra REK sør-øst C, med hjemmel i helseforskningsloven § 11.

Endringen består i at Eline Skirnisdottir Vik legges til som prosjektmedarbeider. Det presiseres videre at prosjektperioden strekker seg til 01.07.2021.

Vedtak
Endringssøknaden godkjennes, jf. helseforskningslovens § 11.

Tillatelsen er gitt under forutsetning av at prosjektendringen gjennomføres slik det er beskrevet i prosjektendringsmeldingen og endringsprotokoll, og de bestemmelser som følger av helseforskningsloven med forskrifter.

Forskningsprosjektets data skal oppbevares forsvarlig, se personopplysningsforskriften kapittel 2, og Helsedirektoratets veileder for *Personvern og informasjonssikkerhet i forskningsprosjekter innenfor helse- og omsorgssektoren.*

Komiteens vedtak kan påklages til Den nasjonale forskningsetiske komité for medisin og helsefag, jf. Forvaltningslovens § 28 flg. Eventuell klage sendes til REK Sør-Øst. Klagefristen er tre uker fra mottak av dette brevet.

Med vennlig hilsen

Knut W. Ruyter
avdelingsdirektør
REK sør-øst

Tor Even Svanes
seniorrådgiver

Kopi til: *vaa@hib.no*

Appendix 9

Statistisk sentralbyrå
Statistics Norway

SSB-ref: 14/1479

Taushetserklæring

Jeg forstår

- at jeg i arbeidet med prosjektet «Svangerskaps – og fødselskomplikasjoner i forhold til mors fødeland» vil kunne få kjennskap til opplysninger som av hensyn til offentlige, enkeltpersoners, institusjoners eller bedrifters interesser, ikke må bli kjent for uvedkommende
- at statistikklovens bestemmelse om taushetsplikt § 2-4 gjelder for de opplysninger jeg får tilgang til utlevert fra Statistisk sentralbyrå

Jeg forplikter meg til

- å vise aktsomhet i behandlingen av alle opplysninger som er utlevert fra Statistisk sentralbyrå og arbeide i samsvar med retningslinjer og instrukser gitt av Statistisk sentralbyrå og Datatilsynet.
- ikke å gi opplysninger videre til noen personer i eller utenfor Høgskolen i Bergen eller Karolinska Institutet

Jeg er klar over

- at brudd på taushetsplikten og misbruk av informasjon jeg får kunnskap om, for meg selv eller andre, kan medføre straffansvar
- at taushetsplikten også gjelder etter at mitt arbeid tilknyttet Høgskolen i Bergen eller Karolinska Institutet er avsluttet.

Jeg er gjort kjent med og har forstått

- Statistikkloven § 2-4. Taushetsplikt.

  (1) De som utfører arbeid eller tjeneste for et organ som forbereder eller utarbeider offisiell statistikk, plikter å hindre at uvedkommende får adgang eller kjennskap til det de under forberedelsen eller utarbeidelsen av en statistikk får vite om personlige forhold, drifts- eller forretningsforhold, eller tekniske innretninger og fremgangsmåter. Taushetsplikten gjelder bare de opplysninger som er hentet inn med sikte på utarbeidelse av offisiell statistikk.

  (2) Taushetsplikten gjelder også etter at vedkommende har avsluttet arbeidet eller tjenesten. Vedkommende kan heller ikke utnytte opplysninger som nevnt i denne paragraf i egen virksomhet eller i arbeid eller tjeneste for andre.

  (3) Forvaltningsloven § 13 til § 13e kommer ikke til anvendelse.

- Straffeloven § 121

  Den som forsettlig eller grovt uaktsomt krenker taushetsplikt som i henhold til lovbestemmelse eller gyldig instruks følger av hans tjeneste eller arbeid for statlig eller kommunalt organ, straffes med bøter eller med fengsel inntil 6 måneder.

  Begår han taushetsbrudd i den hensikt å tilvende seg eller andre en uberettiget vinning eller utnytter han i slik hensikt på annen måte opplysninger som er belagt med taushetsplikt, kan fengsel inntil 3 år anvendes.

  Denne bestemmelse rammer også taushetsbrudd m.m. etter at vedkommende har avsluttet tjenesten eller arbeidet.

Denne taushetserklæring er undertegnet i to eksemplarer, hvorav underskriver og SSB beholder hver sitt eksemplar.

sted/dato:

BERGEN 8/12-16

Navn med blokkbokstaver
ELINE SKIRNISDOTTIR VIK

Eline S. Vik
Underskrift

Appendix 10

14.10.2019

NSD – personvernkonsekvensvurdering

Prosjektopplysninger

Prosjekttittel: Svangerskaps- og fødselskomplikasjoner i forhold til mors fødeland
(Tittel registrert hos REK: Svangerskapsutfall relatert til fødeland)

Behandlingsansvarlig: Høgskulen på Vestlandet, Fakultet for helse- og sosialvitskap, Institutt for helse- og omsorgsvitskap

Prosjektansvarlig: Vigdis Aasheim

Prosjektnummer: 130853

Om konsekvensvurderingen (DPIA)

NSD har gjennomgått innholdet i meldeskjemaet. Det er vår vurdering at den planlagte behandlingen av personopplysninger vil innebære relativt høy risiko for de registrertes rettigheter og friheter, og dermed krever en personvernkonsekvensvurdering (DPIA) jf. personvernforordningen art. 35.

Dette fordi den planlagte behandlingen av personopplysninger innebærer

- behandling av særlige kategorier av personopplysninger (sensitive opplysninger) eller opplysninger av svært personlig karakter
- behandling av personopplysninger i stor skala (utvalgsstørrelse, mengde opplysninger)
- behandling av personopplysninger om sårbare registrerte

På oppdrag fra ledelsen ved Høgskulen på Vestlandet (HVL) har NSD i samråd med prosjektansvarlig og rådgivere ved institusjonen laget utkast til en DPIA som inneholder:

1. en systematisk beskrivelse av den planlagte behandlingen av personopplysninger
2. vurdering av om behandlingsaktivitetene er nødvendige og står i rimelig forhold til formålene
3. analyse av risiko for de registrertes rettigheter og friheter
4. planlagte tiltak for å håndtere risikoene

Ved å følge de planlagte tiltakene, mener NSD at personvernrisikoen er redusert i en slik grad at behandlingen kan gjennomføres i samsvar med personvernforordningen, uten forhåndsdrøfting med Datatilsynet.

Behandlingsansvarlig institusjon (v/ledelsen) bestemmer om personvernkonsekvensvurderingen er tilfredsstillende utført, og om personvernrisikoen er redusert til et akseptabelt nivå slik at behandlingen kan gjennomføres, eller om det er nødvendig med forhåndsdrøfting (se del 6 – Ledelsens beslutning). Dette etter å ha rådført seg med sitt personvernombud og tatt hensyn til eventuelle adferdsnormer. Vi oversender derfor vår vurdering til HVL og personvernombud for godkjenning. NSD ber om å få tilsendt endelig versjon av DPIA med ledelsens beslutning i signert form.

Dersom behandling av personopplysninger igangsettes på grunnlag av DPIA, og deretter endres, minner vi om at endringene kan medføre behov for ny/oppdatert DPIA. Prosjektansvarlig skal melde endringer til NSD, og institusjonen har ansvar for å påse at dette skjer. Ved melding om endringer i prosjektet, vil NSD bistå i vurderingen av om ny DPIA er nødvendig og utfører i så fall denne i samråd med HVLs ledelse og personvernombud.

Følgende personer har deltatt i personvernkonsekvensvurderingen:

Navn	Rolle/funksjon	Virksomhet
Vigdis Aasheim	Prosjektansvarlig	HVL
Lasse Raa	Seniorrådgiver	NSD
Trine Anikken Larsen	Personvernombud	HVL
Roy Miodini Nilsen	Biostatistiker, førsteamanuensis	HVL

1. Systematisk beskrivelse av planlagte behandlingsaktiviteter og formål

Her følger en beskrivelse av den planlagte behandlingen av personopplysninger, slik den er oppgitt i meldeskjema med vedlegg. Vurdering av behandlingen følger i del 2 og 3.

1.1 Bakgrunn

Prosjektet er godkjent av REK jf. helseforskningsloven § 10 i vedtak av 10.9.2014, deres referanse 2014/1278.

REK-godkjenningen ga tilstrekkelig behandlingsgrunnlag under tidligere personvernlovverk. I forbindelse med nytt personvernlovverk, krever SSB ny vurdering innen utløpet av 2019.

Det vises videre til ytterligere vedtak fra REK, alle med samme referanse:

- 28.4.2015: Presisering av at dataene vil være indirekte identifiserende (ikke anonyme).
- 18.8.2016: Ny prosjektmedarbeider: Roy M. Nilsen
- 27.10.2016: Ny prosjektmedarbeider: Eline S. Vik
- 24.8.2017: Utvidelse med data frem til 2016 (tidligere 1990–2013).
- 7.6.2018: Utvidelse med to delstudier/artikler. Ny prosjektmedarbeider: Ragnhild B. Strandberg.
- 20.9.2018: Tre nye prosjektmedarbeidere: ikke navngitt i vedtak.
- 6.12.2018: Tre nye prosjektmedarbeidere: Mary E. Hauge, Siri Omdal og Hege T.W. Oftedal. Det bemerkes at disse aldri fikk tilgang på data.
- 9.5.2019: Utvidelse med to delstudier/artikler. Endringen innebærer samtidig at stipendiat Karolina Mæland inkluderes i prosjektgruppen.

Det bemerkes at datoene er hentet fra REKs offentlige oversikt over prosjekter, og kan avvike noe fra vedtaksdato.

1.2 Formål

Formålet med denne studien er å undersøke sammenhengen mellom fødselsufall og innvandrerstatus/fødeland. Populasjonen er første- og flergangsfødende kvinner som fødte i Norge mellom 1990 og 2016 og vi sammenligner svangerskaps- og fødselsutfall mellom de som er født i Norge og de som er født i andre land (som har migrert). Våre hypoteser er at 1) kvinner fra lav inntekts land og flyktninger har høyere risiko for svangerskaps- og fødselskomplikasjoner for både mor og barn, 2) risikoen for komplikasjoner vil variere i forhold til hvor lang tid de migrerte kvinnene har vært i landet, i forhold til hvilket land de er født, 3) migrerte kvinner med partnere født i et annet land enn Norge har dårligere helseutfall enn migrerte kvinner med partnere født i Norge.

Følgende artikler er produsert (publisert eller i publiseringsprosess):

- Preeclampsia by maternal reasons for immigration: A population-based study (publisert)
- Stillbirth in relation to maternal country of birth and other migration related factors: a population-based study in Norway (publisert).
- Epidural analgesia for labour pain in nulliparous women in Norway – the impact of country of birth and migration related factors (i publiseringsprosess).
- Country of first birth and neonatal outcomes in migrant and Norwegian-born parous women in Norway (i publiseringsprosess).

- Associations between adverse neonatal outcomes and paternal factors in births to migrant women: a population-based study in Norway (manuskript)

Der foreligger også planer om videre publisering med følgende tentative problemstillinger:

- Mode of birth in migrant women in relation to migration-related factors, such as time in Norway and country of origin.
- Perineal tears in migrant women in relation to country of birth and migration
- Augmentation in migrant women in relation to migration-related factors

I tillegg har REK godkjent nye delprosjekter der vi så at den opprinnelige søknaden ikke fullstendig dekket problemområdet. Dette gjelder for prosjektene:

- Preconception folic acid supplement use in immigrant women (1999-2016): Are current recommendations reaching all women equally? (publisert).
- To estimate the incidence of gestational diabetes in immigrant women in Norway by maternal country of birth as well as by other migration-related factors (under arbeid).
- To evaluate adverse pregnancy outcomes among immigrant women with diabetes (under arbeid).
- Risk and recurrence risk of placental abruption in immigrant women. I dette prosjektet er der ansatt en ny stipendiat og endringsmelding for hennes deltagelse er godkjent av REK og under behandling i SSB.

To artikler planlegges:

- Occurrence of placental abruption
- Recurrence of placental abruption

1.3 Registrerte

Utvalget rekrutteres fra Medisinsk fødselsregister, og består av alle kvinner som har født i Norge i perioden 1990–2016.

Det registreres også enkelte opplysninger om kvinnenes partnere, mødre og fedre.

Det anslås å være snakk om i overkant av 1 600 000 fødsler i perioden.

1.4 Type og omfang personopplysninger

Prosjektet har innhentet og koblet opplysninger fra Medisinsk fødselsregister (MFR) og Statistisk sentralbyrå (SSB). Det behandles særlige kategorier av personopplysninger (sensitive opplysninger) om helseforhold og rasemessig/etnisk opprinnelse.

Det innhentes følgende data fra SSB:

- Mors fødeland
- Fars fødeland
- Tidspunkt for immigrasjon (dato)
- Bosted (region)
- Statsborgerskap
- Innvandrerkategori
- Innvandringsgrunn
- Sivilstand
- Endringsdato for sivilstandsopplysning

- Inntekt
- Utdanningsnivå (høyeste fullførte utdanning)

Fra MFR innhentes følgende data:

Forklaring av fargekoding:

- Variable merket med **grønt** inngår i MFRs basisrecord for *anonyme* dataleveranser. I hovedsak vil disse kunne utleveres etter godkjenning av søknad og prosjektprotokoll.
- Variable merket med **gult** kan kun unntaksvis inngå i *anonyme* dataleveranser. MFR vil foreta en helhetsvurdering om det samlede datamaterialet kan klassifiseres som anonymt, herunder vurdere faren for re-identifisering av enkeltpersoner.
- Variable merket med **rødt** kan som hovedregel ikke inngå i *anonyme* dataleveranser. For å få utlevert variabler merket med rødt trengs det dispensasjon fra taushetsplikt fra REK, eller at samtykke foreligger fra personene det gjelder.

Variabelnavn	Kommentar
VERSJON_DATABASE	Samlet database, versjonsnr
VERSJON_RECORD	MFR-record, versjonsnr
MELDINGSTYPEID	Primærkilde for dataene
ID_BARN	Prosjektspesifikt løpenummer for barnet
ID_MOR	Prosjektspesifikt løpenummer for mor
ID_FAR	Prosjektspesifikt løpenummer for far
FODESTED_KAT	Fødestedskategori (10 kategorier): Sykehusstørrelse (antall fødte per år), hjemmefødsler, transportfødsler, annet
FODESTED_KAT_5	Som over, gruppert i 5 kategorier
HELSEREGION	Helseregion
BOHELSEREGION_DAGENS	Mors bostedshelseregion, gammel kommune omregnet til ny
MORS_ALDER	Mors alder
MORS_ALDER_KAT_K8	Mors alder, gruppert i 5 års intervaller
BOFYLKE	Mors bofylke ved barnets fødsel
FODELAND_KODE	Fødelandkode mor
FODELAND_KAT_NOR_GBD	Mors fødeland: 8 kategorier, Norge + GBDs 7 superregioner
MOR_BOSATT_NO	Mor er bosatt i Norge
SIVST	Mors sivilstatus – gruppert i 9 kategorier
SLEKTF	Slektskapsforhold mellom foreldrene
YRKE_KODE	Yrkesaktiv kode
KJENT_FAR	Far er kjent
FARS_ALDER	Fars alder

FARS_ALDER_KAT_K11	Fars alder, gruppert i 5 års intervaller
PARITET	Tidligere fødte: Høyeste verdi av feltene 'paritet_mor' og 'paritet_mfr'
PARITET_5	Som over, gruppert i 5 kategorier
DODFODTE_5	Som over, gruppert i 5 kategorier
LEVENDEFODTE_5	Som over, gruppert i 5 kategorier
SPABORT_12	Tidl. spontanaborter før 12.uke
SPABORT_23	Tidl. spontanaborter/dødfødte 12.-23-uke
KSNITT_TIDLIGERE	Har gjennomgått keisersnitt v/tidl. fødsler
KSNITT_TIDLIGERE_MFR	Moren har tidligere registrerte keisersnitt i MFR
SMENSD	Dato for siste menstruasjons 1. blødningsdag
SMENSD_KODE	Angir pålitelighet av oppgitt dato for siste mens.
TERMINMETODE	Terminmetode
SVLEN	Svangerskapslengde i uker. Beregnet fra UL. Hvis UL mangler: Dato for siste mens
SVLEN_DG	Svangerskapslengde i dager. Beregningsgrunnlag: Se SVLEN
SVLEN_UL_DG	Svangerskapslengde i dager basert på ultralydtermin
SVLEN_SM_DG	Svangerskapslengde i dager i forhold til siste mens
ZSCORE_BW_GA	Rå z_score basert på barnets vekt, svangerskapslengde og kjønn
PRENAT_DIAGNOSTIKK_UTF	Prenatal diagnostikk utført
ASTMA	Astma
HYPERTENSJON_KRONISK	Kronisk hypertensjon
NYRESYKDOM_KRONISK	Kronisk nyresykdom
REUM_ARTRITT	Reumatoid artritt
EPILEPSI	Epilepsi
DIABETES_MELLITUS	Diabetes
KOSTNEI	Regelmessig kosttilskudd nei
FOLATF	Brukte folat før svangerskapet
MULTIVITF	Brukte multivitaminer før svangerskapet
BLODN_F13	Blødning i svangerskapet: Før 13. uke
BLODN_13_28	Blødning i svangerskapet: 13-28. uke
BLODN_E28	Blødning i svangerskapet: Etter 28. uke
HYPERTENSJON_ALENE	Hypertensjon alene, oppstått under svangerskapet
EKLAMPSI	Eklampsi, totalt: I svangerskap, under fødsel og/eller post partum og uspes. eklampsi
PREEKL	Preeklampsi

PREEKLTIDL	Tidlig preeklampsi
HELLP	HELLP
MULTIVITU	Multivitaminer under svangerskapet
FOLATU	Folat under svangerskapet
ROYK_MOTSETTER_SEG	Samtykker ikke for røykeopplysninger
ROYK_SKRIFT_ORIENT	Gitt skriftlig orientering røykeopplysninger
ROYK_OPPL	Er det røykeopplysninger for mor?
ROYK_FOER	Røyking før svangerskap
ROYK_FOER_ANT	Antall sigaretter daglig før svangerskapet
ROYK_BEG	Røykte ved svangerskapets begynnelse
ROYK_BEG_ANT	Antall sigaretter daglig ved svangerskapets begynnelse
ROYK_AVSL	Røykte ved svangerskapets avslutning
ROYK_AVSL_ANT	Antall sig. daglig ved svangerskapets slutt
MORS_HOYDE	Mors høyde
MORS_VEKT_FOER	Mors vekt før svangerskapet
MORS_VEKT_SLUTT	Mors vekt ved svangerskapets slutt
KMI_FOER	Kroppsmasse indeks ved begynnelsen av svangerskapet (BMI)
KMI_SLUTT	Kroppsmasse indeks ved slutten av svangerskapet (BMI)
FSTART	Fødselsstart
ROBSON_10	Klassifisering av fødsel etter Robson10 kriterier
LEIE	Leie
INDUKSJON_PROSTAGLANDIN	Induksjon av fødsel: Prostaglandin
INDUKSJON_OXYTOCIN	Induksjon av fødsel: Oxytocin
INDUKSJON_AMNIOTOMI	Induksjon av fødsel: Amniotomi, hinnerivning
INDUKSJON_ANNET	Induksjon av fødsel: Annen fremgangsmåte
TANG	Bruk av tang
VAKUUM	Bruk av vakuum
EPISIOTOMI	Episiotomi
FRAMHJELP	Vanlig framhjelp ved seteleie
UTTREKKING	Uttrekking ved seteleie
VAGINAL	Vaginal fødsel
KSNITT	Keisersnitt
KSNITT_PLANLAGT	Planlagt keisersnitt

VANNAVGANG	For tidlig vannavgang før fødsel
ABRUPTIOP	Abruptio placentae
PLACENTA_PREVIA	Placenta previa, forliggende morkake
RUPTUR34	Ruptura perinei grad 3 og 4
BLODNING_O500	Blødning over 500 ml under fødselen
ENHETER_BLOD	Enheter blod tilført mor under fødsel
EPIDURAL	Epiduralanestesi
SPINAL	Spinalanestesi
ANESTESI_ANALGESI	Alle tilfeller anestesi
NARKOSE	Narkose
UTSKRAPING	Placenta: Utskraping
PLACENTAVEKT	Placenta: Vekt
MANUELL_PLACENTA	Placenta: Manuell uthenting
NAVLESNORLENGDE	Lengden på navlesnoren
FOSTERV_POLYHYDRAMNION	Fostervann: Polyhydramnion
FOSTERV_OLIGOHYDRAMNION	Fostervann: Oligohydramnion
FOSTERV_MISF_STINK_INFI	Fostervann: Misfarget, stinkende, infisert
NAVLESNOR_KOMPL	Navlesnor: Komplikasjoner
FMND	Barnets fødselsmåned
FAAR	Barnets fødselsår
FKLOKKEN	Fødselstidspunkt - klokkeslett
FLERFODSEL	Angir om fødselen er en enkeltfødsel eller del av en flerfødsel (tvilling, trilling osv.)
PLURAL	Pluralitet: Antall fødte ved denne fødselen
PLUREK	Barnets rekkefølge ved denne fødselen
KJONN	Barnets kjønn
VEKT	Barnets vekt
VEKT_MANGLER	Barnets vekt mangler
LENGDE	Barnets lengde. Hel lengde i kilde 2 og 3. Sete-issemål for enkelte fødte i kilde 1
LENGDE_MANGLER	Barnets lengde mangler
HODE	Barnets hodeomkrets i cm
HODEOM_MANGLER	Barnets hodeomkrets mangler
SETE_ISSE	Lengde fra sete til isse
APGAR1	Apgar-score etter 1 minutt

APGAR1_MANGLER	Apgar1-score mangler
APGAR5	Apgar-score etter 5 minutter
APGAR5_MANGLER	Apgar5-score mangler
APGAR10	Apgar-score etter 10 minutter
OVERFLYTTET	Barnet er overflyttet til barneavdeling
UTSKRIVINGDATO_BARN	Utskrivingdato, barn
UTSKRIVINGDATO_MOR	Utskrivingdato, mor
LIGGEDOGN_MOR	Antall mors liggedøgn
FODT_MFR	Født i henhold til MFRs definisjon
DAAR	Barnets dødsår
DODKAT	Dødstidskategori
PERINAT_FODT_MFR	Oppfyller bestemte kriterier for inklusjon i diverse perinatal dødelighetsstatistikk. Se spesifikasjon i beskrivelse av MFR-record
PERINAT_DODFODT_MFR	Som over
PERINAT_DOD_TID_MFR	Som over
PERINAT_DOD_MFR	Som over
PERINAT_DODFODT_22_EP	Som over
PERINAT_DOD_TID_22_EP	Som over
PERINAT_DOD_22_EP	Som over
PERINAT_DODFOD_500_WHO	Som over
PERINAT_DOD_TI_500_WHO	Som over
PERINAT_DOD_500_WHO	Som over
PERINAT_FODT_500_WHO	Som over
PERINAT_FODT_1000_WHO	Som over
PERINAT_FODT_22_EP	Som over
PERINAT_DODFOD_1000_WHO	Som over
PERINAT_DOD_TI_1000_WHO	Som over
PERINAT_DOD_1000_WHO	Som over
RESPIRATORISK_DISTR	Respiratorisk distresssyndrom
INTRAKRANIELL_BLODN	Intrakraniell blødning
PLEXUSSKADE	Plexusskade
SYSTEMISKANTIBIOTIKA	Behandlet med systemisk antibiotika
ICTERUS	Icterusbehandlet
MISD	Medfødt misdannelse

NEVRALRORSDEFEKTER	Nevralrørsdefekter totalt: Anencephali, encefalocele, spina bifida
HJERTE_MISD	Hjertefeil
GANESPALTE	Ganespalte uten leppespalte
LEPPE_LEPPEGANESPALTE	Leppespalte med eller uten ganespalte
GASTROS	Gastroschise

Det innhentes data i stort omfang både samlet og om den enkelte registrerte.

1.5 Datakilder

Det innhentes data fra Medisinsk fødselsregister og Statistisk sentralbyrå.

1.6 Kontakt med de registrerte

Prosjektet vil ikke være i kontakt med utvalget. Grunnet utvalgets størrelse, vil det ikke være praktisk mulig å innhente samtykke eller å gi informasjon til den enkelte registrerte.

De registrertes øvrige rettigheter gjelder i den grad de kan identifiseres i datamaterialet. Dette vil si retten til innsyn, retting, sletting, begrensning og protest.

1.7 Dataflyt – hvordan personopplysningene behandles

Dataene er allerede utlevert og koblet av SSB. Prosjektet har ikke tilgang på koblingsnøkkel, og denne oppbevares hos SSB.

1.8 Tilgang til personopplysninger

Dataene oppbevares på sikker forskningstjener ved HVL. Dataene blir ikke eksportert ut av det sikre tjenerområdet. Eksterne som skal bidra i behandling av dataene gis tilgang til det sikre tjenerområdet, og gjennomfører alle sine oppgaver inne i det sikre tjenerområdet. For at eksterne skal kunne få tilgang til tjenerområdet, inngås en «avtale med ikke-ansatt». Denne beskriver medarbeiderens plikter og rettigheter i forhold til Høgskulen på Vestlandet (HVL) når vedkommende benytter institusjonens forskningstjener. Samtidig som medarbeideren ved å signere denne avtalen, forplikter seg i rettslig sammenheng overfor HVL, sikrer HVL samtidig sin instruksjonsmyndighet overfor den eksterne knyttet til arbeid i det sikre tjenerområdet.

I tillegg til prosjektansvarlig, vil følgende ha tilgang på personopplysninger i prosjektet:

- Roy Miodini Nilsen, HVL er biostatistiker og i tillegg til å være veileder for stipendiatene er han aktiv forsker og statistiker i prosjektene
- Eline Skirnisdottir Vik, stipendiat, HVL bruker dataene aktivt i stipendiatarbeidet
- Erica Schytt, docent, Karolinska Institutet, Stockholm er veileder og medforfatter i flere prosjekter. Hun er ansatt i 20% ved HVL og har ikke vært inne i dataene.
- Ragnhild Bjarkøy Strandberg, førsteamanuensis, HVL er forsker i prosjektet og medforfatter i noen studier
- Marjolein Iversen, professor, HVL er forsker i prosjektet og medforfatter i noen studier
- Karolina Mæland, stipendiat, HVL bruker dataene aktivt i stipendiatarbeidet

Det tas høyde for at det kan bli nødvendig å gjøre endringer i prosjektgruppen i løpet av prosjektperioden. Det vurderes at det ikke er nødvendig at slike mindre endringer meldes til NSD. Dersom det skjer vesentlige endringer, slik som en større økning i antall prosjektmedarbeidere,

kreves likevel endringsmelding til NSD. Ved usikkerhet anbefaler vi at prosjektet tar kontakt med NSD eller personvernombudet ved HVL for å avklare om endringsmelding er nødvendig.

1.9 Varighet

Prosjektet avsluttes 31.12.2024. Etter dette vil datamaterialet oppbevares av dokumentasjons- og oppfølgingshensyn frem til 31.12.2029, i tråd med standard praksis for helseforskningsprosjekter. Etter dette vil opplysningene slettes.

NSD bemerker at det av REK-vedtak av 10.9.2014, referanse 2014/1278, fremgår at prosjektslutt er 1.7.2021, med oppbevaring frem til 1.7.2026. Vi legger til grunn at det sendes søknad om utvidet prosjektperiode til REK, og at vedtak lastes opp i meldeskjemaet til NSD så snart det foreligger.

2 Vurdering av om behandlingsaktivitetene er nødvendige og står i rimelig forhold til formålene

2.1 Rettslig grunnlag

Prosjektet har stor potensiell samfunnsnytte, ved at det bidrar til verdifulle opplysninger om kvinner og nyfødte i forbindelse med svangerskap og fødsel. Prosjektet vil bidra til mer kunnskap om innvandrere og kan styrke helsetilbudet til disse.

Det er svært liten risiko for at personopplysninger skal bli spredd gjennom forskningsprosjektets lagring av personopplysninger. Forskerne ved HVL har vi ikke tilgang til koblingsnøkkelen og de data som er utlevert er ikke direkte identifiserende.

NSD vurderer på dette grunnlag at behandlingen av personopplysninger i prosjektet er nødvendig for å kunne utføre en oppgave i allmennhetens interesse, og at samfunnsnytten klart overstiger personvernulempen for den enkelte.

Behandlingen av personopplysninger har således rettslig grunnlag i personvernforordningen art. 6 nr. 1 bokstav e og art. 9 nr. 2 bokstav j, jf. personopplysningsloven §§ 8 og 9 samt helseforskningsloven § 10.

2.2 Sentrale prinsipper

2.2.1 Formålsbegrensning

NSD vurderer at formålet er klart definert, spesifikt, uttrykkelig angitt og fremstår rimelig for en forskningsinstitusjon.

Vi legger til grunn at delstudier/artikler er godkjent av REK og vurdert å falle innenfor prosjektets overordnede formål.

2.2.2 Dataminimering

Det innhentes et stort omfang av særlige kategorier av personopplysninger om helseforhold og rasemessig/etnisk opprinnelse. Prosjektets formål og utvalgskriterier gjør det umulig å gjennomføre uten et visst omfang av slike opplysninger.

Prosjektet har ikke tilgang på direkte identifiserende personopplysninger. Det vil kreve et betydelig arbeid å bakveisidentifisere enkeltpersoner i datamaterialet. Enkelte opplysninger vil likevel kunne være spesielt identifiserende. Behovet for disse begrunnes i det følgende:

Variabler utlevert fra MFR er kategorisert som grønne, gule eller røde, hvorav røde variabler i kombinasjon med andre opplysninger kan være indirekte personidentifiserende. I bestillingen til MFR (Bestillingsskjema for MFR-data, Variabelspesifikasjon v5.20) søkte vi kun om én rød variabel; mors fødeland, som en sentral variabel i vårt prosjekt. Dette er i tråd prosjektets godkjenninger fra REK (2017/95/REK-sør-øst og 2014/1278/REK sør-øst).

Det er på høyeste detaljnivå (mors og fars fødeland, og statsborgerskap) vi finner den informasjonen vi trenger for å øke kunnskapen om gravide innvandrerkvinners svangerskapsutfall.

Tidspunkt for immigrasjon er en annen sentral variabel innen migrasjonsforskning, og dato for immigrasjon gir oss en ekstra detalj i forhold til at vårt prosjekt omhandler gravide kvinner der noen kvinner allerede er gravide ved immigrasjon mens andre har kortere eller lengre oppholdstid bak seg når de blir gravid. Tiden i landet har betydning for kvinnens oppfølging, kvinnens kjennskap til det norske helsevesenet og trolig også hennes språkkunnskaper.

Videre er vi avhengig av å vite noe om kvinnens sosioøkonomiske bakgrunn i våre prosjekt, og detaljerte opplysninger om kvinnens høyest fullførte utdanning for hvert fødeår (hun kan ha flere barn) er en sentral justeringsvariabel i våre analyser.

NSD vurderer at personopplysningene som skal behandles er adekvate, relevante, nødvendige og begrenset til det som er nødvendig for formålet.

2.2.3 Riktighet

Dataene innhentes fra offentlige registre og er koblet etter standard SSB-prosedyre. Det anses som lite sannsynlig at det foreligger feilaktige opplysninger i datamaterialet, og det foreligger dermed ikke et særlig behov for kontradiksjon.

2.2.4 Lagringsbegrensning

Prosjektet har en varighet på rundt ti år fra oppstart i 2015. Prosjektet kom ikke gang før 2016, og har nettopp ansatt en stipendiat med sluttdato tidligst 2023. NSD vurderer dermed at varigheten av behandlingen av personopplysninger står i et rimelig forhold til formålet.

2.2. 5 Integritet og konfidensialitet (personopplysningssikkerhet)

Personopplysningene behandles av et begrenset antall personer, og oppbevares sikkert på adgangsbegrenset tjener ved institusjonen.

De tekniske og organisatoriske tiltakene beskrevet i del 1 vurderes å gi tilstrekkelig vern mot uautorisert/ulovlig behandling av personopplysninger samt utilsiktet tap/ødeleggelse/skade av personopplysninger.

2.3 De registrertes rettigheter og friheter

Grunnet størrelsen på utvalget, vil det kreve en stor innsats fra behandlingsansvarlig institusjon å gi individuell informasjon.

Basert på en avveining mellom tiltakene som kreves for å informere og ulempen for den enkelte registrerte, vurderes det at det kan unntas fra informasjonsplikten på grunnlag av at det vil kreve en uforholdsmessig stor innsats, jf. personvernforordningen art. 14 nr. 5 bokstav b.

Institusjonen skal likevel treffe egnede tiltak for å verne den registrertes rettigheter og friheter og berettigede interesser, herunder gjøre informasjonen offentlig tilgjengelig. Det vises her til Folkehelseinstituttets offentlige oversikt over prosjekter som har fått utlevert data fra Medisinsk fødselsregister, oppdragsnummer 14-1718:

https://fhi.no/globalassets/dokumenterfiler/helseregistre/mfr/2014---mfr-prosjekter.pdf

De registrertes øvrige rettigheter gjelder like fullt. De registrerte har dermed rett til innsyn (art. 15), retting (art. 16), sletting (art. 17), begrensning (art. 18), underretning (art. 19) og protest (art. 21). Rettighetene gjelder i den grad den registrerte er mulig å identifisere i datamaterialet.

3 Vurdering av risiko for de registrertes rettigheter og friheter

Prosjektet vil behandle særlige kategorier av personopplysninger (sensitive opplysninger) om helseforhold og rasemessig/etnisk opprinnelse uten at de registrerte samtykker til eller informeres om behandlingen. Dette innebærer at det ikke foreligger reell medbestemmelse eller åpenhet.

4 Planlagte tiltak for å håndtere risikoene

Det gjøres følgende tiltak for å håndtere risikoene for de registrertes rettigheter, friheter og berettigede interesser:

- Vedtak om forlengelse fra REK lastes opp i meldeskjemaet så snart det foreligger.
- Prosjektet mottar kun indirekte identifiserende opplysninger med tilfeldig løpenummer. SSB oppbevarer koblingsnøkkel.
- Særlig identifiserende opplysninger er begrenset til et minimum. Fra MFR innhentes det kun én variabel i rød kategori (mors fødeland), jf. punkt 1.4 i denne vurdering. Behovet for høyt detaljnivå på fødeland og statsborgerskap følger direkte av prosjektets formål.
- Dataene oppbevares på sikker tjener ved HVL, og tilgangen er begrenset til seks medarbeidere ved HVL i tillegg til prosjektansvarlig.

5 NSD sin samlede vurdering av personvernet

NSD vurderer på grunnlag av ovennevnte tiltak at prosjektet håndterer de identifiserte risikoene på en akseptabel måte, og at personvernet således er tilstrekkelig ivaretatt.

NSD legger spesielt vekt på at det innhentes relativt få og lite identifiserende opplysninger. Bakveisidentifisering vil dermed kreve et betydelig arbeid.

6 Godkjenning fra institusjonens ledelse

Ledelsen ved Høgskulen på Vestlandet har gjennomgått personvernkonsekvensvurderingen, og stiller seg bak NSDs konklusjon.

NSD har i samråd med institusjonens ledelse vurdert at risikoen for de registrertes rettigheter, friheter og berettigede interesser er tilstrekkelig redusert, og at det derfor ikke er nødvendig med forhåndsdrøfting med Datatilsynet jf. personvernforordningen art. 36.

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