Length of residence and pregnancy outcomes in women of migrant origin

Risks of stillbirth, infant death, caesarean section and preterm delivery

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TABLE OF CONTENTS

PREFACE

My late father, a biochemist who studied the coagulation of chicken blood, introduced me to the world of research at a very young age. I used to assist him with his laboratory experiments. First, I would help him hold the chicken; then, he would slowly draw the dark red blood. It was at this point that I inevitably found myself on the floor, fainting at this overly exciting show. I do not know whether these early impressions kept me away from experimental research.

I have been fortunate to work within obstetrics and public health in low-income settings such as Nepal, East Timor, Afghanistan, Kenya, Tanzania and Somalia. This work showed me the importance of social and cultural contexts in applying biomedicine. This experience naturally pushed me towards obstetrics because women's health is primarily about access to reproductive health services. After my return to Norway, I faced some of the same obstacles that I had experienced in the field. These issues included the discomfort of not having a shared language and cultural reference with all patients, not having sufficient knowledge or guidance to properly counsel certain women about whether they had increased risks compared with other women and a discomfort in applying Norwegian majority standards to all.

The migrant population is growing, as is the proportion of births to migrants. This contribution to Norwegian society presents obstetricians with challenges because we cannot simply rely on the past to guide the future. Migrants are increasingly heterogeneous, and their make-up changes every year. Any general statement about migrants living in Norway is most likely going to be incorrect; however, a crude application of Norwegian standards could represent an even greater error. Studying obstetric outcomes combined with understanding the dynamic changes experienced

by migrant populations can provide the most valuable information. We can learn a substantial amount from studying migrants' pregnancy outcomes throughout their duration of residence, which could help us understand how inclusive the health services are. Such information could also help us determine whether any groups need sustained attention to prevent adverse events. Finally, these data remind us that when facing rare adverse outcomes, perfect maternity care for 99% of women does not help substantially if the remaining 1% has the highest risk of problems.

ACKNOWLEDGEMENTS

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Furthermore, this project would not have been possible without the staff at the Medical Birth Registry of Norway; Stein Emil Vollset and Jon Gunnar Tufta and at Statistics Norway: Christina Lyle, Kåre Vassenden and Minja Tea Dzamarija.

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Finally, I could not have achieved this without the inexhaustible encouragement, suggestions and support from my husband Austen, the extensive help from my mother Inge, and the energy from my children Frøy, Owen and Mira.

Oslo, May 2014
Ingvil Krarup Sørbye

DEFINITIONS AND ABBREVIATIONS

DEFINITIONS

Migration indicators:

Age at migration	maternal age in years at first immigration
Country of birth	the individual's mothers residency at the time of birth
Country of descent	the individual's mother's country of birth
Descendant	an individual born in the receiving country of foreign-born parents (second generation of migrant origin)
Ethnicity	the fact or state of belonging to a social group that has a common national or cultural tradition
Generational status	foreign-born (first generation) or born in the receiving country of foreign-born parents (second generation)
Immigrant/migrant	an individual born abroad of foreign-born parents whom have immigrated (first generation immigrant)
Minority	the smaller number of part, especially a number or part representing less than half of the whole
Non-immigrant	an individual born in Norway of Norwegian-born parents (majority population; host population)
Reason for migration	the legal basis for the granting of residence
Receiving country	the country to which individuals are immigrating
Source country	the country from which individuals are emigrating
Year of arrival	calendar year of first immigration

Pregnancy outcome indicators:

Stillbirth	death of a fetus mature enough to have survived outside the uterus (22 completed gestational weeks)
Infant death	live born who die in the first year of life
Early death	stillbirth and infant death combined
Perinatal death	stillbirths and deaths during the first week combined
Neonatal death	live born who die during the first 4 weeks

Caesarean section	delivery by caesarean section
Caesarean rate	number of caesareans per 100 births
Planned caesarean section	delivery by caesarean section more than 8 hours after the decision was made and performed as a planned procedure
Emergency caesarean section	delivery by caesarean section within 8 hours of making the decision and performed as an emergency procedure

Preterm delivery	delivery before 37 completed weeks of pregnancy of a fetus mature enough to have survived outside the uterus (22 completed gestational weeks)
Preterm rate	number of preterm deliveries per 100 deliveries
Spontaneous preterm delivery	preterm delivery where birth start was by spontaneous labour or rupture of membranes
Non-spontaneous preterm delivery	preterm delivery where birth start was by caesarean section or medical induction of labour

ABBREVIATIONS

CI	confidence interval
CPD	cephalopelvic disproportion
CS/CD	caesarean section/delivery
EU	European Union
GDM	gestational diabetes mellitus
ICD	International Classification of Diseases
LGA	large-for-gestational-age
LMP	last menstrual period
MBRN	Medical Birth Registry of Norway
OR	odds ratio
PTB/D	preterm birth/delivery
RR	risk ratio; relative risk
SD	standard deviation
SEP	socioeconomic position
SGA	small-for-gestational-age
SPSS	Statistical Package of the Social Sciences

SUMMARY

Background Reducing ethnic disparities in reproductive health and in access to and utilisation of reproductive health services is a public health priority. An elevated risk of adverse pregnancy outcomes has been found in several immigrant groups in Norway, but changes in this risk based on the length of residence in Norway have not previously been assessed.

Aims The aims of these studies that constitute this PhD project were to examine the risk of the following:
Study I stillbirth and infant death according to migrants' generational status
Study II caesarean section and subtypes according to immigrants' length of residence
Study III preterm delivery and subtypes according to immigrants' length of residence
Migrant groups were compared to the host population according to their country of birth and origin and their length of residence in Norway.

Materials and methods We matched birth records from the Medical Birth Registry of Norway (MBRN) with immigration data from the National Population Register (1990–2010). Length of residence was calculated as the difference between the year of first immigration to Norway and the year of delivery. Associations between length of residence and the outcomes were assessed using multivariable regression models. For the study of stillbirth and infant death (Study I), we included Norwegian- and Pakistani-born women of Pakistani descent. For the study of caesarean section (Study II) and preterm delivery (Study III), we included births among the largest groups of immigrants from outside of Scandinavia.

Results *Study I:* The risk of stillbirth and infant death was approximately twice as high among offspring across generations of women of Pakistani descent compared with non-immigrants; however, this finding translated to a small number of excess deaths. First-cousin marriage and lower educational status were risk factors for stillbirth and infant death in offspring of women of both Pakistani and Norwegian descent.
Study II: A longer length of residence was associated with increases in planned caesarean section among immigrants. The association depended on the absolute caesarean rate. In the group with low CS rates the likelihood of planned caesarean reached the risk level for non-

immigrants after two years of residence. The risk of emergency caesarean in this group did not vary across length of residence. Conversely, in the group with high caesarean rates, the risk of a planned caesarean was similar to that of non-immigrants, and the risk of an emergency caesarean was increased by 51–75%, independent of the length of residence.

Study III: A longer length of residence was associated with an increased risk of non-spontaneous preterm delivery. Adjusting for maternal and infant morbidity, such as diabetes, hypertensive and growth disorders, reduced the effect size. Immigrant women were also more likely than non-immigrants to experience a spontaneous preterm delivery; however the length of residence did not mitigate this effect. Furthermore, the risk of spontaneous preterm delivery varied among country groups and was associated with shorter gestational lengths in most minority groups.

Conclusions and recommendations An elevated risk of adverse pregnancy outcomes persists for certain migrant groups in Norway across the length of residence. Action is required to enhance equity of outcomes and to promote integration among specific subgroups.

Study I: Clinical efforts to reduce early mortality in the offspring of women of Pakistani origin should focus on preconception counselling, early diagnosis and the optimal management of fetal disorders.

Study II: Although the current policy to reduce the planned caesarean rate is appropriate for non-immigrants, the policy focus for certain migrant groups – Somali, Philippine and Sri Lankan women – should be to reduce emergency caesarean deliveries.

Study III: Addressing the known causes of preterm obstetric intervention, rather than reducing overall preterm delivery rates, should be the priority. The spontaneous preterm delivery rate has limited value as an indicator of adverse pregnancy outcomes for minority groups, a finding with implications for clinical decision making based on gestational length estimates.

LIST OF PAPERS

Study I

Sørbye IK, Stoltenberg C, Sundby J, Daltveit AK, Vangen S.

Stillbirth and infant death among generations of Pakistani immigrant descent: a population-based study.

Acta Obstet Gynecol Scand. 2014;93:168-174.

Study II

Sørbye IK, Daltveit AK, Sundby J, Stoltenberg C, Vangen S.

Caesarean section by immigrants' length of residence in Norway: a population-based study.

Second submission 15 April 2014 to the European Journal of Public Health; Minor revisions.

Study III

Sørbye IK, Daltveit AK, Sundby J, Vangen S.

Preterm subtypes by immigrants' length of residence in Norway: a population-based study

Submitted to BMC Pregnancy and Childbirth, 29 April 2014.

I INTRODUCTION

1.1 Background

International migration to Europe has greatly increased over the last 50 years. Approximately half of current international migrants are women.[1] Many of these women are of reproductive age and migrate to establish or reunite with families. As a result many European countries, including Norway, have experienced steep increases in births to immigrant women.[2] Migrants are diverse in terms of their country of origin, ethnicity, childhood exposures and reasons for migration. Because only selected groups choose to or are able to leave their country of origin, migrants do not necessarily represent the population of the source country. However, the process of migration is common to migrants and is associated with an initial breakdown of social networks, loss of socioeconomic position (SEP) and social exclusion.[3] The resulting vulnerability can be further aggravated by pregnancy.

Within immigrant populations in various high-income receiving countries, there are disparities in pregnancy outcomes according to the maternal country of birth.[4, 5] Although certain immigrant groups to Norway experience better pregnancy outcomes than non-immigrants, many groups have a consistently higher risk of maternal or infant complications or disease. Previous studies have shown an elevated risk of stillbirth, infant death and preterm birth among major immigrant groups.[6-8] Adverse maternal outcomes, such as caesarean delivery and maternal morbidity, are also more common in certain immigrant groups compared with the host population.[9] Among migrants to Scandinavia, explanations for the variation in pregnancy outcomes have ranged from socioeconomic differences and consanguinity[6] to suboptimal care due to inadequate communication, health literacy and trust of the health system.[10-12]

However, migrants are increasingly diverse, not only in ethnic origin, but also concerning other aspects of migration, such as the length of their residence in the receiving country. On the one hand, length of residence can be used as a measure of social and cultural integration. A longer length of residence is associated with improved SEP in many receiving societies.[13] A longer length of residence is also associated with worse health outcomes due to changes in lifestyle and exposure to health risks.[14] Less is known about how length of residence affects access to and utilisation of health care. Studies from several contexts suggest that pregnancy outcomes are influenced by the time spent in the receiving country.[15-18] The association varies according to the population and the specific pregnancy outcome being studied;[19] however, there are no studies examining this relationship among immigrants to Norway.

We examined the following four globally recognised indicators of adverse pregnancy outcomes: stillbirth, infant death, preterm delivery (PTD) and caesarean section (CS). We hypothesised that with increasing time spent in Norway, pregnancy outcomes among migrant populations would approximate those of the host population; however, the pattern could vary according to the outcome. If our assumptions were incorrect, we reasoned that changes in the risk of adverse outcomes over the duration of residence would enable us to identify both subgroups at elevated risk and modifiable factors that could be targeted to improve equity and participation in reproductive health care.

1.2 Classification of migrants

Migrants are not consistently labelled; often ambiguous terminology is used for migrants.[20] In this thesis, we use the term "immigrants" to describe foreign-born women who have migrated to Norway; the term "descendants" is used to describe Norwegian-born women with foreign-born parents; and the term "non-immigrants" is used to describe Norwegian-born women of Norwegian origin (Figure 1.1). Many foreign-born women living in Norway have attained citizenship; however, for simplicity, they will be referred to as immigrants, disregarding their naturalisation status.

		Country of birth	
		Born outside of Norway	**Born in Norway**
Country of descent	**Foreign descent**	Immigrant First-generation	Descendant Second-generation
	Norwegian descent		Non-immigrant

Figure 1.1 Classification terms, as defined by Statistics Norway.[21]

The challenge of classifying migrants

Different terms and groupings are used to describe the origins of migrants. Any classification system assumes either shared genetic traits, shared social/cultural traits or both. The majority of previous studies on pregnancy outcomes have classified migrants according to their geographical "region of origin" (e.g. South Asian, sub-Saharan African, or simply Asian or African). Fewer studies have categorised migrants by their country of birth. Others have labelled migrants according to the characteristics of their country of origin, such as the level of development[22] or economic characteristics.[23] A broad geographical grouping assumes similarities, but it may also average out real differences. A classification by "ethnicity", involves the "ascribed or self-identified sharing of cultural and linguistic characteristics".[24] Ethnicity is considered important for system adaptation.[25, 26] However, a problem with using ethnicity in research is that this concept tends to change according to context. Furthermore, broad ethnic categorisations, such as "Asian" or "African", are likely to average out internal differences.[27] Many countries, including Norway, do not register ethnic affiliations.

The Reproductive Outcomes and Migration international research collaboration (ROAM) has recognised "country of birth" as the most relevant and useful classification term for migrants when assessing pregnancy outcomes.[28] This recommendation was followed in this thesis.

1.3 Social inclusion and immigrants' pregnancy outcomes

1.3.1 Length of residence as proxy for social inclusion

The theory of acculturation (i.e., the social and cultural inclusion in the majority population[13]) implies that migrants converge towards health outcomes that match the majority population over time (Figure 1.2). Because migration is usually selective, some immigrants may enjoy an initial health advantage. However, this "healthy migrant" effect, or the protective factors that are typical of the cultural and social background of the country of origin, can be lost with increasing length of residence.[13,29]

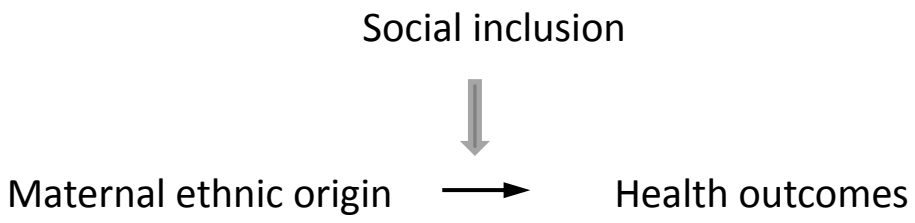


Figure 1.2 The relationship between ethnic origin, social inclusion and health outcomes.

In Norway, length of residence is positively associated with a command of the majority language, increased education level, lower use of state economic benefits and less poverty.[30] Increased length of residence is also associated with urban living and a decrease in the total fertility rate in most country groups.[21] However, not all aspects of integration increase uniformly with increasing length of residence across country and gender strata, such as work force participation.[30] Age at immigration to Norway also influences social inclusion. A study comparing Norwegian-born

descendants and immigrants who arrived before the age for starting school found that language skills and social inclusion were comparable.[31] However, those who arrived at a later age had consistently worse language acquisition and social integration scores. Immigrants generally have an SEP disadvantage, which could explain the inequities in pregnancy outcomes. However, SEP indicators developed for non-immigrants (education, profession and income) do not necessarily capture the true social determinants of health across ethnic minority groups.[32] A high degree of colinearity between certain SEP indicators and ethnicity also implies that adjusting for SEP can "adjust" away part of the effect of the country of birth or origin.[33]

1.3.2 How does length of residence impact on pregnancy outcomes?

Explanations for ethnic disparities primarily fall into two categories; they suggest that disparities are primarily due to either biological (racial/genetic) differences[34] or to the lower SEP and exclusion of migrants in host societies.[35] In addition, differences could be primarily physiological or pathological. However, advances in the understanding of early programming and health later in life have resulted in these theories appearing to merge.[36]

Length of residence is likely to affect pregnancy outcomes through improvements not only in SEP but also in majority language skills, health literacy and the use of health services. In turn, these factors can influence access to timely health care through communication, trust, and access to and compliance with health providers and medical advice.[11] However, length of residence can also be negatively associated with pregnancy outcomes. An association between increasing length of residence and the adoption of adverse maternal health behaviours, such as smoking, alcohol consumption or drug abuse, has been described for UK immigrants.[37] In US immigrants, associations between length of residence and diabetes,[38] obesity,[39] and an unfavourable cardiovascular risk profile[40] have been shown. Furthermore, changes in lifestyle could have a larger health impact on immigrant populations compared with

non-immigrant populations due to specific gene-environment interactions. Examples of such interactions include consanguineous marriage in highly intermarried populations[41] and interactions between low birth weight and the risk of diabetes and hypertension later in life.[42]

1.3.3 Why study pregnancy outcomes and the impact of length in residence among immigrants to Norway?

Although several Norwegian studies, such as the Oslo Immigrant Health Study,[43] have investigated the relationship between country of birth and physical and mental health, there have been few recent studies of ethnic differences in pregnancy outcomes. Existing studies often combine migrants into broad categories or do not have the strength to assess rare outcomes. Previous studies have not addressed the diversity of migrants with respect to the length of residence in Norway or across generations living in Norway. Consequently, although these studies have demonstrated differences between immigrants and the Norwegian population, they have not elucidated the direction of these differences, such as whether there is an increasing or decreasing trend in equity in access to, participation in and consumption of health care.[44, 45] Migrant health is no longer a minority issue. By 2040, individuals of migrant origin will compose 24% of the total Norwegian population compared with the current level of 12%.[46] This prediction is based on the knowledge that once migration flows begin, they become self-sustaining social processes.[47] Research comparing different immigrant groups utilises a naturally occurring test situation, which can generate new hypotheses and elucidate more general mechanisms and mediators of disease, uptake of health care services and mortality.

In the next chapter, we will summarise the current knowledge about migration and pregnancy outcomes, focusing on the four selected indicators; stillbirth, infant death, CS and PTD.

A request from WHO to analyse migrants' health outcomes

Because many aspects of migration influence health, the 61st World Health Assembly appealed to member states to assess and analyse trends in migrant health to facilitate evaluations of access to health care and inequity among population groups.[48]

1.4 Migration and pregnancy outcomes

The relationship between migration and adverse pregnancy outcomes varies across epidemiological studies. Due to the heterogeneity of the studied populations, this lack of consistency is not surprising. We will discuss previous findings in the context of the outcome indicators studied in this thesis (Table 1.1), and, where possible, we will emphasise contexts that resemble the Norwegian context. Finally, we will assess studies that take into account migrants' duration of residence.

Table 1.1 Indicators of adverse infant and maternal pregnancy outcomes studied in this thesis

	Outcome	Definition
Infant outcome	Stillbirth	Death of a fetus mature enough to have survived outside the uterus (22 weeks)[49]
	Infant death	Live born who dies in the first year of life
	Preterm delivery	Birth before 37 completed weeks of pregnancy of a fetus mature enough to have survived outside the uterus (22 weeks)[50]
Maternal outcome	Caesarean section	Delivery by Caesarean section

1.4.1 Stillbirth and infant death

The risks of stillbirth and infant death vary across populations.[51, 52] Meta-analyses of migrants to industrialised countries have found that the offspring of Asian, North African and sub-Saharan migrants are at greater risk of fetal and infant mortality compared with the offspring of non-immigrants.[4] A systematic review found that approximately one-half of the examined studies reported worse mortality outcomes, one-third reported no differences and 13% reported better outcomes for births to immigrants compared with the majority population.[5] Overall, refugees were found to have elevated risks of fetal and infant mortality compared with those who migrated for other reasons.[5] However, characteristics of the receiving country affect the rate of fetal and infant mortality.[19] For example, receiving countries with strong integration policies, as measured by their naturalisation rates, have less disparity in perinatal mortality between immigrants and non-immigrants.[53] Consistently higher mortality risks have been found for infants born to women in particular groups, such as Somali, Pakistani and Turkish immigrants,[54-59] whereas the opposite has been shown for women from East Asia.[60] Norwegian studies have confirmed elevated stillbirth or perinatal mortality risk among Pakistani and Somali immigrants.[6, 8]

Few studies from Europe have assessed changes in infant mortality in migrant groups across their length of residence. Transgenerational studies, primarily conducted in the US, have found better infant outcomes in the offspring of first-generation compared with second-generation women of migrant origin.[15, 61] A Dutch study comparing infant mortality rates between offspring born to immigrants and descendants found that changes across generations varied by maternal ethnicity.[17] We are not aware of any Norwegian studies that have investigated infant mortality according to length of residence or generational status.

Stillbirth, perinatal mortality and infant mortality

Historically, stillbirths and deaths in the first week were grouped together as perinatal deaths. This grouping was due to a lack of reliable estimates of the incidence of stillbirths, whereas most countries were able to estimate perinatal mortality.[49, 62] In the past, stillbirths and deaths during the first week shared a major determinant – birth asphyxia. However, this commonality no longer applies due to improvements in intrapartum fetal surveillance.[62] The etiology of stillbirth, which can be caused by a number of maternal and fetal health conditions,[63] differs from that of death during the first week. Therefore, there are now reasons for the separate reporting of stillbirths and neonatal deaths.[64]

Infant mortality is a benchmark of how a nation cares for its future generations. Infant mortality exhibits a consistent socioeconomic gradient in most societies and is a sensitive indicator for assessing health policies and programmes.[65] The primary causes of infant mortality vary with increasing infant age, from factors related to congenital conditions to environmental factors such as infectious disease.[66]

1.4.2 Preterm delivery (PTD)

PTD is strongly associated with neonatal death and disability.[67-69] The PTD rate (i.e., the number of births that occur before 37 gestational weeks out of all births) is widely used as an indicator of adverse pregnancy outcomes,[65] and a reduction in the PTD rate is a target of maternal and child health programmes.[70] Recent studies have shown that even infants born at 34–36 weeks have an increased risk of severe complications and neonatal and infant death.[71, 72]Although gestational length has been shown to vary according to the maternal country of origin,[73, 74] the nature of this discrepancy (physiological or pathological) remains controversial.[75, 76] Studies of ethnic disparities in PTD rates have found both lower and higher PTD rates among foreign-born compared with US-born women.[77, 78] A 2009 meta-analysis of immigrants to industrialised countries found that the migrants' overall risk of preterm birth and low birth weight was the same or lower than that of non-immigrants.[4] European studies of PTD/low birth weight rates have shown a somewhat different pattern, with increases in risk consistently found among South Asian and sub-Saharan immigrants.[7, 34, 79-82] Although few studies have distinguished by preterm subtypes, the same pattern of increased risk among South Asian and sub-Saharan immigrants seem to persist for spontaneous PTD (spontaneous labour or rupture of membranes) and non-spontaneous PTD (induced labour or CS before labour).[74, 80, 83] In Hispanic US immigrants, elevated PTD rates have not been found to translate into higher infant mortality, a phenomenon known as the "immigrant paradox".[84, 85] European studies have also shown that mortality outcomes among preterm infants are improved in certain minority ethnic groups.[7, 86]

With respect to the impact of length of residence, early studies of women of Hispanic origin in the US supported predictions of increases in immigrants' PTD rates with increasing length of residence.[16, 87] A Canadian study showed that recent immigrants had a lower risk of PTD compared with non-immigrants; however, with increasing length of residence, the rates among immigrants eventually exceeded those of non-immigrants.[88] However, this trend was not fully replicated in a Danish study,[89] and no comparable studies have been conducted in Norway.

Spontaneous and non-spontaneous preterm delivery (PTD)

PTD can be classified into spontaneous or non-spontaneous subtypes, depending on the mode of the initiation of labour.[85] Differentiation between subtypes is recommended to provide clues about the underlying mechanisms and to identify patient subgroups with elevated risks.[90] However, the two subtypes share many determinants.[85] The cascade of events that cause spontaneous PTD are not well understood,[91] and attempts to develop predictive models have been disappointing.[92] In cases of non-spontaneous or provider-initiated PTD, it is important to consider both the underlying conditions and local obstetric policies concerning indications for caesarean delivery and the medical induction of labour.[93]

1.4.3 Maternal morbidity and caesarean section among migrants

A higher risk of pregnancy complications, such as diabetes, is well known among immigrants from Southern Asia and the Mediterranean region in a range of contexts.[77, 94] The occurrence of severe maternal morbidity, or near-miss cases, is elevated among foreign-born women in Sweden.[95] Maternal death is a rare outcome in high-income countries; however, maternal death cases are disproportionately more common in immigrant women compared with non-immigrants in the UK, the Netherlands and Sweden,[96-98] and these cases are associated with suboptimal care factors.[99] In US studies, a longer length of residence is associated to a higher occurrence of pregnancy complications.[16] In Norway, one study found a decreasing trend in the occurrence of hyperemesis gravidarum across residence categories,[100] whereas the effect of residence length on other pregnancy outcomes has not been assessed.

The caesarean section (CS) rate is a marker of pregnancy complications and has been used as an indicator of the quality of obstetric care.[101] The CS rate varies widely among sending and receiving countries.[102-105] Previous studies have shown

both higher and lower CS rates among migrants compared with the majority populations.[106, 107] In the US, Hispanic migrants have low caesarean rates compared with US-born women.[16] However, as the CS rate is strongly influenced by economic incentives, the impact of private-for-profit vs. public provider and insurance schemes can be difficult to differentiate from the effect of ethnic origin.[108] In European and Norwegian settings, studies have confirmed variations in CS rates according to the maternal country of origin.[9, 109-111] A consistently elevated risk has been found among Somali immigrants,[54, 112] whereas a low CS rate has been found in former East European, primarily labour migrants.[113, 114] However, few population-based studies have stratified CS rates according to the length of residence and none of these have distinguished between subtypes of CS, such as planned or emergency CS.[106, 107, 115] Thus, the relationship between migrants' length of residence and caesarean risk is still not clear.

Caesarean section (CS)

Although CS is a potentially lifesaving intervention, caesarean delivery is associated with increased maternal risk.[116] Furthermore, the risk associated with an emergency caesarean procedure is higher than that of an elective or planned procedure.[117] Subsequent pregnancies also carry an elevated risk of severe haemorrhage, uterine rupture and placenta accreta and abruptio.[118-121]

In the next chapter we will describe the population of immigrants to Norway in terms of their migration history, reasons for migration and birth patterns.

1.5 Immigrants to Norway

Before 1970, immigration to Norway mostly occurred at a steady low rate from neighbouring countries.[122] However, beginning in 1969 there was a significant increase in net immigration, which was primarily due to labour migration from Pakistan, Turkey and Morocco.[21] From 1970 to 1980, more than 90% of Pakistani migrants originated from Punjab, whereas the minority came from urban centres, such as Lahore, Karachi and Islamabad.[123] By 1971, restrictions on labour immigration had been implemented; in 1975, unskilled labour immigration was halted altogether. Beginning in the late 1970s, waves of refugees arrived from Vietnam, followed by refugees fleeing wars in northern Sri Lanka and the Balkan (from 1993). Somali refugees primarily arrived after 2000, whereas Iraqi migrants mainly arrived from 2003 onwards.[30] Immigration due to family establishment or education (including au pairs) from Thailand and the Philippines has increased gradually, with a considerable proportion married to spouses of Norwegian origin. After the allocation of European Union (EU) membership to former Eastern European countries in 2004, significant and increasing labour immigration has occurred, especially from Poland and the Baltic countries. Figure 1.2 shows the numbers of immigrants and descendants from the 15 largest country groups registered as living in Norway as of January 1, 2012.

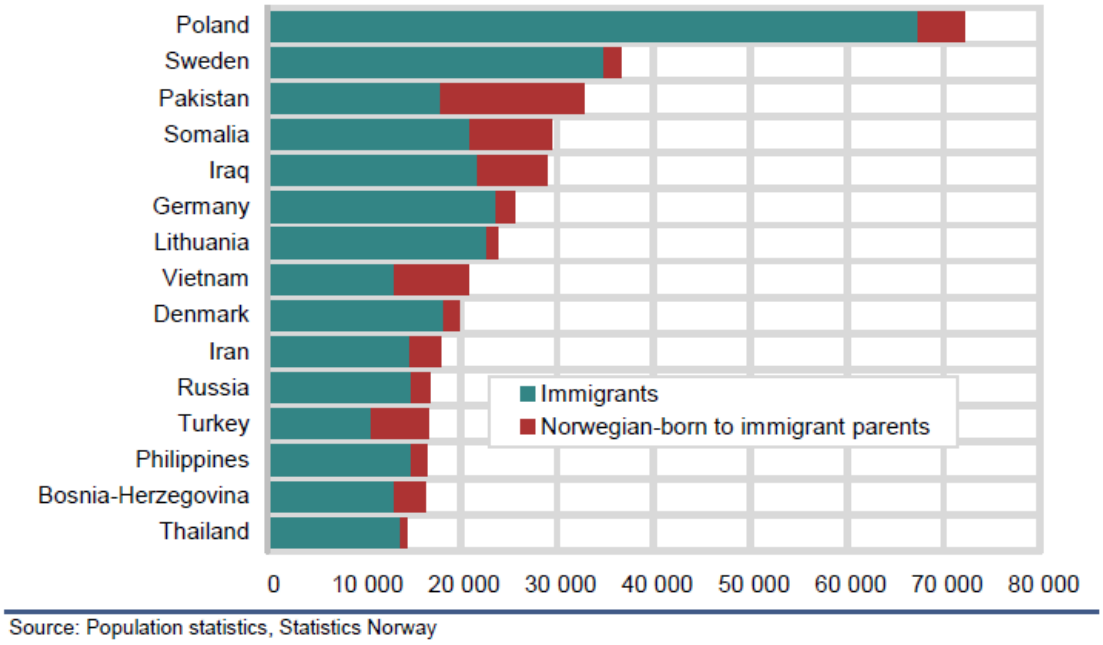


Figure 1.2 The 15 largest immigrant groups living in Norway as of January 1, 2012.[124]

An assessment of the reason for immigration, as registered by the Ministry of Justice, indicated that four out of ten immigrants to Norway between 1990 and 2009 migrated due to family reunification or establishment.[125] Similarly, three out of ten arrived as a result of labour immigration and two out of ten as refugees or asylum seekers. As of January 1, 2013, the largest proportion of refugees was Somali immigrants, followed by Iraqi immigrants. However, these categories refer to the legal basis for the granting of immigration and might differ from the real reasons for immigration, or there could be multiple reasons for migration. Most migrants' motivations are complex and multidimensional and do not always fit in the categories of "refugee" or "family immigrant.[3]"

In 2010, approximately 40% of all foreign-born residents had lived in Norway for shorter than five years. In terms of immigrants originating outside Scandinavia, Pakistanis and Vietnamese have the longest residencies.[21] Those with the shortest residencies are Polish, Iraqi and Somali immigrants.

1.6 Birth patterns among migrant populations in Norway

In Norway, 4.0% of infants were born to foreign-born women in 1980; this proportion had increased to 21.9% in 2010 (Figure 1.3) In contrast, the descendants of immigrants are still young, and few have begun bearing children.[30] In 2010, only 0.9% of all infants were born to Norwegian-born women of foreign descent; these mothers were primarily Norwegian-born women of Pakistani descent.[126] Only a handful of the offspring of descendants ("third-generation" of migrant origin) have begun bearing children.[21] Many migrant women are in early reproductive age upon arrival to Norway, causing a high initial fertility at the group level, which subsequently tapers off.[127] On average, immigrant women from Africa have higher fertility than non-immigrants; there are no major differences for other regions. With respect to descendants, their fertility pattern resembles that of non-immigrants.[127]

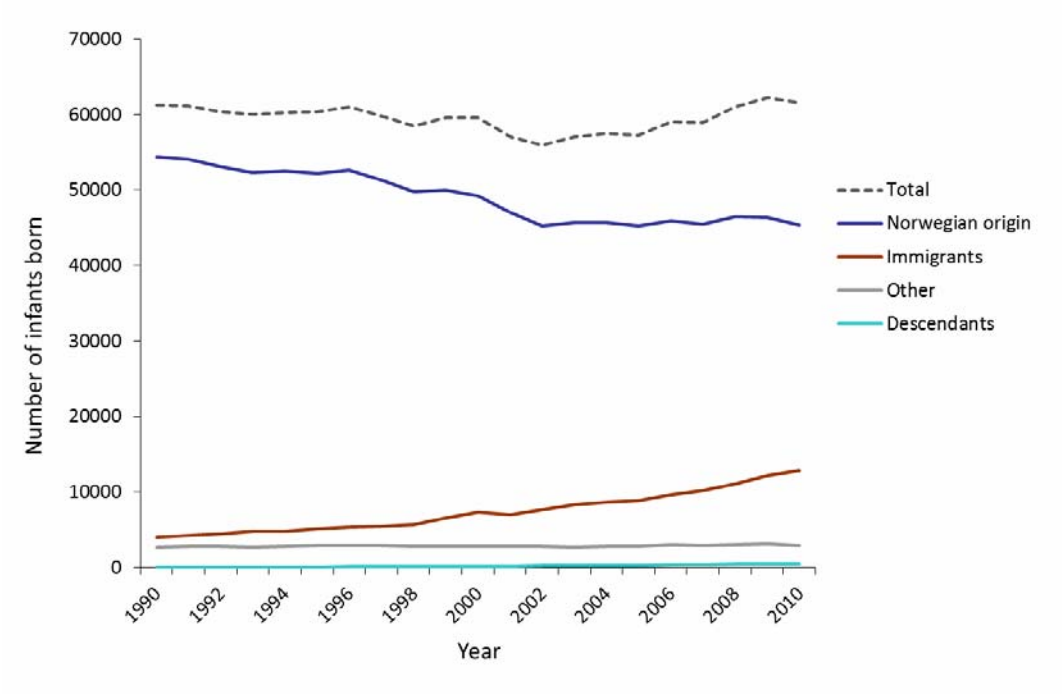


Figure 1.3 Infants born to immigrants, descendants, non-immigrants and others in Norway from 1990–2010. "Other" includes infants with one parent of Norwegian descent, adoptees, and foreign-born infants with parents of Norwegian descent. (Source: MBRN)

The pattern of births by country group is primarily explained by the groups' immigration history. The numbers of infants born to the ten largest country groups are shown in Figure 1.4.

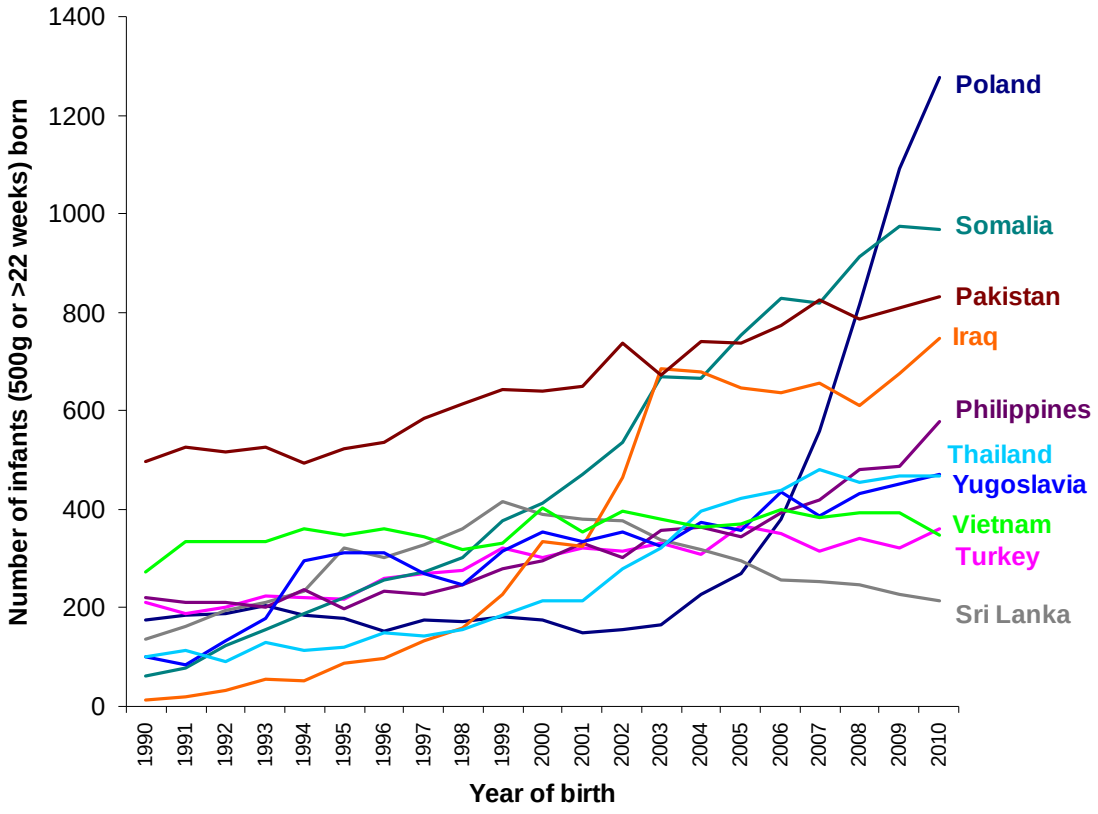


Figure 1.4 The number of infants born in Norway from 1990–2010 to the ten largest immigrant groups from outside Scandinavia, according to the maternal country of birth. (Source: MBRN)

II AIMS OF THESIS

The overall aim of this thesis was to examine the association between migrant populations' length of residence in Norway and the likelihood of adverse pregnancy outcomes, as well as to compare these results to those of non-immigrants.

More specifically, the aims were to examine the risk of the following:

- stillbirth and infant death among women of immigrant descent, according to generational status (Study I)
- CS and its subtypes, according to the immigrants' length of residence (Study II)
- PTD and its subtypes, according to the immigrants' length of residence (Study III)

III MATERIALS AND METHODS

3.1 Study design

All three studies were population-based registry-studies based on birth data from the Medical Birth Registry of Norway (MBRN) and immigration and socioeconomic data from the National Population Register and from Statistics Norway. These studies investigated the relationships among maternal country of origin and birth, time in Norway and pregnancy outcomes (Figure 3.1).

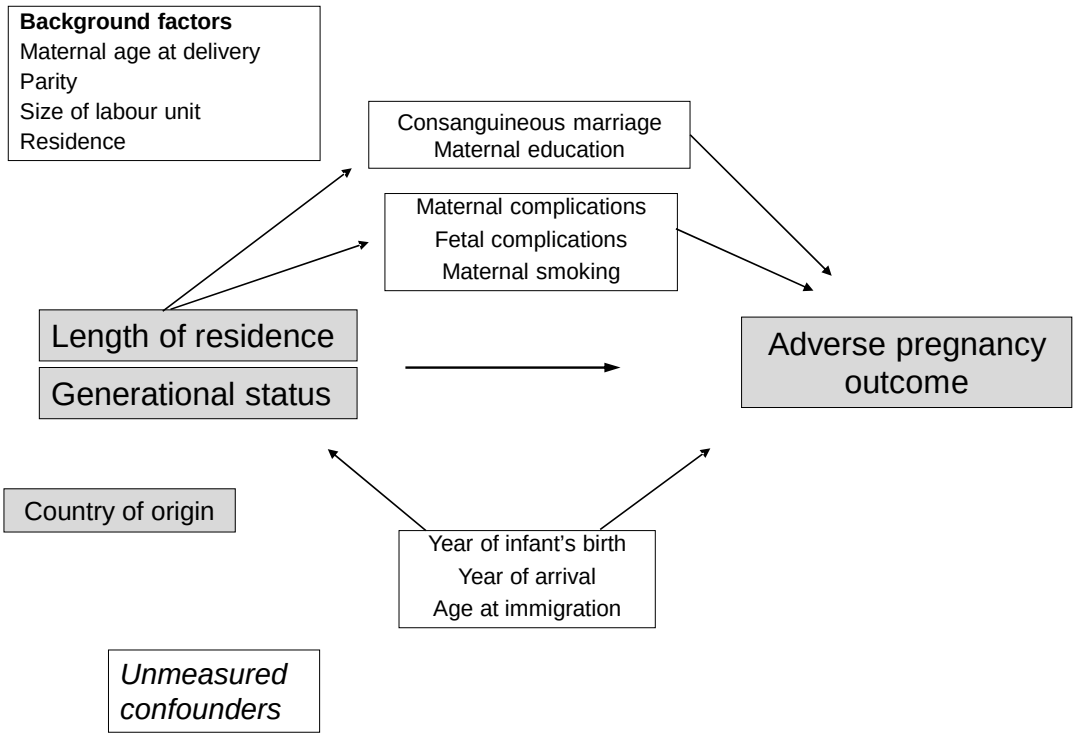


Figure 3.1 Project diagram: main exposures and outcomes.

3.2 Data sources

3.2.1 The Medical Birth Registry of Norway

All births or pregnancies ending after 12 weeks of gestation are required to be submitted to the MBRN. The registry was established in 1967 to improve the surveillance of infant outcomes in response to the thalidomide tragedy.[128] Since then, the scope of the registry has expanded to provide more details on maternal outcomes. The registry includes information about live births, stillbirths, early neonatal deaths and abortions. The information collected includes data on maternal health before and during pregnancy as well as birth outcomes for mother and infant. A midwife or physician completes a standardised notification form within one week of delivery using information from the antenatal card, medical records and personal interview. In 1999, a new form was created and is presently in use. Both forms are presented in the Appendix.

3.2.2 The National Population Register and Statistics Norway

The National (or Central) Population Register includes information about all individuals with the right to reside in Norway.[129] The right to establish residence in Norway is awarded after the completion of an individual application and includes individuals with the intention and documented means to remain in the country for a minimum of 6 months. A date of first immigration to Norway is assigned to all legally migrated individuals. For immigrants from countries outside the EU and the European Economic Community area, the acquisition of a temporary or permanent residence permit is typically required for inclusion in the resident register. For citizens of the EU, registration with the Directorate of Immigration is sufficient for obtaining residence. Asylum seekers are included when they receive an official

permission to remain in Norway. Irregular (unauthorised) migrants or foreigners are not included. The registered year of arrival is the basis for national population statistics as the best representation of an immigrants' length of stay in Norway.[21, 30]

Statistics Norway provided information for this thesis on the legal immigration status of individuals, country of origin and country of birth. The National Education Database,[130] managed by Statistics Norway, provided information about the achieved level of maternal education at the time of registry linkage.

3.2.3 Registry linkages

On October 8, 2010, we received ethnical approval to link the registry information (approval no. 2010/2231–3). The record linkages were performed in April 2012 and were enabled by the 11-digit unique personal identification number allocated to all residents of Norway. We received the final linked data file from Statistics Norway on May 8, 2012.

3.3 Study populations

The three studies are based on different study populations, which were specifically selected according to the associations studied. The study objective, inclusion criteria, subpopulations, study period and outcomes for each study are described in Table 3.1.

Table 3.1 Overview of the studies included in the thesis. Study objectives, study populations and main variables in Study I - III.

	Study I Stillbirth and infant death	Study II Caesarean section (CS) and residence	Study III Preterm delivery (PTD) and residence
Study objective	To assess risk of stillbirth and infant death across generations of Pakistani origin	To assess risk of CS by immigrants' length of residence	To assess risk of PTD by immigrants' length of residence
Study group	10 615 women of Pakistani descent 712 430 non-immigrants	23 147 immigrants 385 306 non-immigrants	40 709 immigrants 868 832 non-immigrants
Inclusion criteria	Singleton births ≥22 gestational weeks or ≥500 grams	Singleton + multiple births among primiparous women ≥22 gestational weeks	Singleton births Live born, or stillborn ≥28 weeks
Sub-groups	Women of Pakistani descent: Born abroad n=8814 Born in Norway n=1801	Women born in: Iraq n=2165 Pakistan n=3086 Philippines n=2457 Poland n=2400 Somalia n=2014 Sri Lanka n=2265 Thailand n=1965 Vietnam n=2695 Yugoslav c. n=2187 *Norway n=385 306*	Women born in: Iraq n=5879 Pakistan n=10 096 Philippines n=5069 Somalia n=8094 Sri Lanka n=5235 Vietnam n=6336 *Norway n=868 832*
Study period	January 1995 - December 2010	January 1990 - December 2009	January 1990 - December 2009
Main outcomes	Stillbirth Infant death	CS - Planned - Emergency	PTD - Spontaneous - Non-spontaneous
Main exposure	Pakistan origin - immigrant or descendant Norwegian origin	Length of residence	Length of residence
Association measure	Odds ratio (OR)	Risk ratio (RR)	Risk ratio (RR)

Due to the limited number of births to descendants of Pakistani origin prior to 1995, Study I was limited to 1995 onwards. Studies II and III were limited to 1990 onwards due to limited numbers of births in some country groups prior to 1990 (see Figure 1.4). In all of the studies, only women with known exposures were included. Study I included births from gestational week 22 onwards (or, if missing, a birth weight of ≥500 g) in accordance with the classification of the International Federation of Gynecology and Obstetrics.[131] The sample in Study II was limited to primiparous women because previous delivery mode is a strong determinant of subsequent delivery modes. In Study III, stillbirths <28 gestational weeks were not included due to a change in the prognosis for very preterm infants over the study period. However, we included stillbirths ≥28 weeks in the nominator and denominator to determine the true burden of PTD and due to similar pathophysiology of live births and stillbirths.[132] In Study III, we further excluded cases with missing information about gestational length (3.8%) and cases with improbable Z-score values (differing from the majority standard by >4 standard deviations [SD]) (0.5%).[133]

3.4 Outcome identification and verification

Study I: Stillbirth and infant death

Stillbirths included deaths occurring before or during labour and deaths with an unknown time of death. Infant deaths included live-born infants who died within 365 days after birth. Stillbirths and neonatal deaths during the first week after birth are reported to the MBRN by obstetric and pediatric units. The National Population Registry and the Cause of Death Registry, which are routinely linked to the MBRN, validate all births and postnatal deaths, including those not reported to the birth registry. These registries also provide information about deaths occurring during the first year of life. To obtain the correct denominator for offspring at risk, we calculated the stillbirth rate per 1000 fetuses/infants and the infant mortality per 1000 live-born infants.[64]

Study II: CS

The registration of CSs with the MBRN changed slightly over the study period.[134] Between 1990 and 1998, information about CS was provided in text from, and additional information was in the form of procedure codes from the International Classification of Diseases (ICD), version 8. After 1998, planned CS was defined by a decision to perform the procedure a minimum of eight hours before the initiation of surgery.[135] Emergency CS was defined as a procedure that was begun fewer than eight hours after the decision was made. Of all of the caesarean deliveries in Study II, 5.5% (n=3458) were unspecified procedures. We reclassified unspecified procedures as planned if the initiation of delivery (birth start) was by CS; otherwise, procedures were recoded as emergencies. We did not have information about whether the CSs had been scheduled antenatally.

Study III: PTD

PTD was identified as delivery at <37 completed gestational weeks. We limited the sample to singleton births ≥22 weeks. Stillbirths were included if the gestational length was ≥28 weeks. Before December 1998, the MBRN defined gestational length as the time from the last menstrual period (LMP) to the day of delivery.[136] From 1999 onwards, biometric measurements from routine ultrasonography performed early in the second trimester were used to determine the gestational length. After 1999, the LMP was still noted, but it was used only as a secondary source of gestational length data when ultrasound data were missing (<3% of births during 1999–2010). Non-spontaneous PTD was defined as PTD with a birth start either by CS before labour began or by medical induction of labour, in the absence of preterm prelabour rupture of membranes. All other cases were classified as spontaneous PTD.

3.5 Exposure assessment

Immigrants, descendants and non-immigrants

Study subjects were classified as immigrants, descendants or non-immigrants based on information provided by Statistics Norway. The classification is mainly based on information on the country of birth and the country of descent.[21]

Maternal country of birth and descent

Information about the maternal country of birth and country of descent was provided by Statistics Norway.[21] Multiple sources are used to generate these variables, and the data were nearly complete (<1% missing). The father's country of birth and descent are reported if information on the mother was missing.

Length of residence and age at immigration

Length of residence was calculated as the difference between the registered year of the first immigration to Norway and the year of delivery. Age at immigration was calculated as the difference between the mother's first immigration year and her year of birth; the year of arrival in Norway was considered the year of first legal immigration. The mathematical relationship among the time variables is illustrated in Figure 3.2. Women with different lengths of residence gave birth throughout the study period.

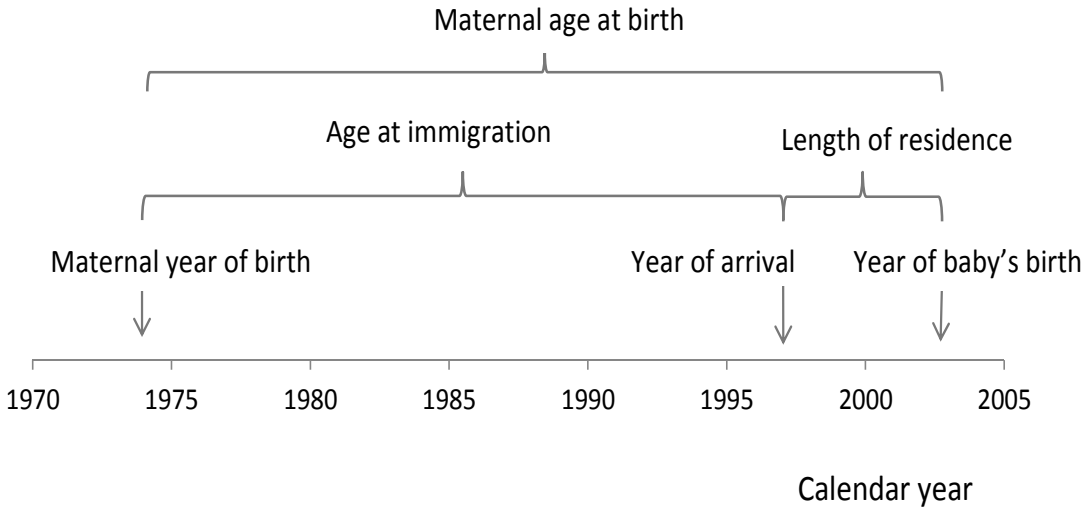


Figure 3.2 The relationships among the time variables in Study II and III.

3.6 Definitions of covariates

Based on previous knowledge and assumptions, we preselected covariates that were potentially associated with the outcomes. The covariates were evaluated as potential confounders or effect modifiers in the relation between exposures and outcomes.[137] The definitions and uses of covariates in the different studies are presented in Tables 3.2 and 3.3. The information was from the MBRN, except where stated otherwise.

Table 3.2 Sociodemographic and migration covariates in Studies I–III.

Variable	Definition	I	II	III
Year of arrival*	Immigrants' year of first immigration		+	+
Age at migration*	Difference between the mother's first immigration year and mother's year of birth		+	+
Maternal education**	Maternal years of education at linkage	+	+	+
Year of birth	Year of infant's delivery	+	+	+
Maternal age	Maternal age at delivery in years	+	+	+
Parity	Number of previous children	+	+	+
Residency	Residence at time of birth	+		
Marital status	Marital status at time of birth	+		+
Level of birth facility	The annual number of births		+	+
Consanguinity	Reported consanguineous relation between infant's mother and father	+		+

*From the National Population Register **From the National Educational Database.

Table 3.3 Maternal and fetal health-related covariates in Studies I–III.

Variable	Definition	I	II	III
Gestational length	Completed gestational week at birth	+	+	+
Gestational length ascertainment	Ascertainment by LMP (1990-1998) or ultrasound (1999-2010)			+
Multiple gestation	Multiple gestations (two or more)		+	
Pregestational diabetes	Diabetes mellitus or the prescription of antidiabetic drugs (O 24, excl. O 24.4**)	+	+	+
Gestational diabetes	Gestational diabetes in current pregnancy (0.24.4*)		+	+
Preeclampsia/Pregnancy-induced hypertension	Hypertension, preeclampsia or eclampsia in current pregnancy	+	+	+
Smoking*	Any smoking before/during pregnancy	+	+	+
Placenta previa	O 44*		+	+
Placenta abruption	O 45*		+	+
Dystocia (CS births)	Cephalopelvic disproportion or inadequate labour (MBRN definition)		+	
Major birth defect	According to MBRN variable definition		+	+
Small-for-gestational age	Infant with Z-score ≤5 percentile [133]		+	+
Large-for-gestational age	Infant with Z-score ≥95 percentile [133]		+	+

*Data for smoking available from 1999 onwards. LMP=last menstrual period.** International Classification of Diseases version 8/10.[138]

3.7 Statistical analyses

For all three studies, the means of continuous variables were compared using a t-test/analysis of variance (ANOVA), and categorical variables were compared using the χ^2 test. Trends were assessed with the Mantel-Haenszel test for trend (linear-by-linear association) and with univariable logistic regression.

To assess effect modification, we performed sensitivity analyses in the form of stratified or restricted analyses using subpopulations of the samples, such as among particular obstetric groups.[139] We did not attempt to construct predictive models for the outcomes, but we fitted multivariable regression models to provide statistical control of potential imbalances among covariates that might affect the estimators.[140] The models differed according to the outcome under study and are presented in detail in each paper. In the adjusted models, we included background factors and potential confounders based on previous knowledge, assumptions and the results of data analyses. Confounders were typically retained in the model if they changed the effect estimate >10%. All of the models were tested for clinically plausible interactions between the main exposures and covariates, and interaction terms were included in the models if the Wald coefficient was statistically significant. Fewer than 1% of cases had missing values; these cases were excluded from the multivariable analyses. A two-sided p-value less than 0.05 was considered significant. All of the analyses were performed using SPSS versions 18 and 20 (IBM Corp., Armonk, NY, US).

3.8 Ethical considerations

This research raises several ethical issues. First, immigrants to Norway are diverse. The selection of study populations for the different research questions was considered carefully to prevent averaging out real differences. There were substantial differences *between* the immigrant groups. However, we used labels such as "immigrants" versus "non-immigrant" to explore exposures common to migrants. There were also important disparities *within* populations originating from the same nation state or country. The registry data did not provide details on factors such as the immigrants' urban/rural origin, SEP in childhood, ethnicity, main language spoken, naturalisation status, profession, income or employment status. Thus, it is important to consider the known variations within groups when interpreting the results of this research.

Migrants are often excluded from large research cohorts designed to represent the inhabitants of a country.[141] This decision is often based on practical reasons, such as migrants' lack of majority language proficiency, the added costs of translation and other factors. The results of our research might therefore counteract myths and reduce stigma. We believe that the benefits of better and updated knowledge, better policy decisions and potentially improved health outcomes outweigh a potential labelling effect. However, the communication of the results of studies such as this one should be nuanced.

IV SYNOPSIS OF RESULTS

4.1 Study I

Stillbirth and infant death among generations of Pakistani immigrant descent: a population-based study

We examined the risk of stillbirth and infant death in Norway between 1995 and 2010 births/infants to Pakistani-born women and Norwegian-born women of Pakistani descent. We linked records from the MBRN to immigration data from Statistics Norway. Women of Pakistani descent were classified as Pakistani-born (n=8814) or Norwegian-born (n=1801), and were compared to non-immigrants (n=712 430). The relative risk (RR) of stillbirth and infant death by country of descent and birth was estimated using binary logistic regression models, and the results are presented as odds ratios (ORs) with 95% confidence intervals (CIs).

The risk of stillbirth was highest in the Pakistani-born group (7.4/1000, 95% CI 5.7–9.4) followed by the Norwegian-born (5.0/1000, 95% CI 1.7–8.3) and non-immigrant groups (3.5/1000, 95% CI 3.3–3.6). Relative to non-immigrants, the risk of stillbirth was higher in both the Pakistani-born (OR 2.8, 95% CI 2.2–3.6) and Norwegian-born (OR 2.2, 95% CI 1.1–4.2) groups, after adjusting for year of birth, age, parity, and residence. For infant death, absolute risks were highest in the Pakistani-born group (6.9/1000, 95% CI 5.2–8.8), followed by the Norwegian-born (5.6/1000, 95% CI 2.7–10.2), and non-immigrant groups (2.9/1000, 95% CI 2.7–3.0). Relative to non-immigrants, the adjusted ORs for infant death were 2.8 (95% CI 2.1–3.7) in the Pakistani-born group and 2.4 (95% CI 1.3–4.6), in the Norwegian-born group.

In summary, the risks of stillbirth and infant death in Norway between 1995 and 2010 were twice as high for the offspring of Pakistani- and Norwegian-born women of Pakistani descent compared with non-immigrants.

Table 4.1 Relative risks of stillbirth and infant death according to maternal countries of birth and descent, Norway 1995–2010.

Country of descent	Unadjusted		Adjusted[a]	
Stillbirth				
Norway	1.00		1.00	
Pakistan	2.01	1.60–2.54	2.69	2.11–3.43
By country of birth				
Pakistani-born	2.13	1.66–2.73	2.77	2.15–3.59
Norwegian-born	1.44	0.75–2.78	2.19	1.13–4.24
Infant death				
Norway	1.00		1.00	
Pakistan	2.34	1.84–2.97	2.74	2.13–3.53
By country of birth				
Pakistani-born	2.42	1.87–3.10	2.80	2.14–3.67
Norwegian-born	1.96	1.05–3.66	2.44	1.30–4.58

[a]Adjusted for year of birth, mother's age, parity and residence.

4.2 Study II

Caesarean section by immigrants' length of residence in Norway: a population-based study

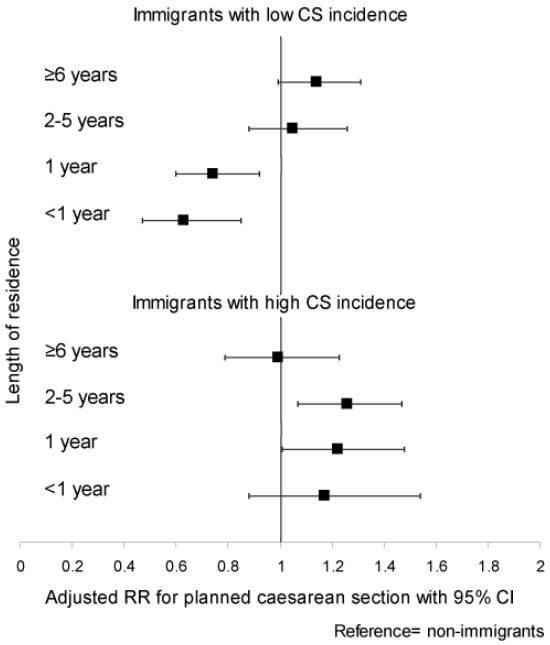
We examined the risks of planned and emergency caesarean section (CS) according to immigrants' length of residence in Norway and compared the results to those of non-immigrants. We used birth and immigration data collected between 1990 and 2009 for first deliveries of 23 147 immigrants from ten countries and 385 306 non-immigrants. Countries were grouped as having low CS rates (<16%; Iraq, Pakistan, Poland, Turkey, Yugoslavia and Vietnam) or high CS rates (>22%; the Philippines, Somalia, Sri Lanka and Thailand). Using multivariable models, we estimated associations between length of residence and planned/emergency CS as RRs with 95% CIs.

In the immigrant group with low CS rates, only planned CS was independently associated with a longer length of residence. Compared with recent immigrants (<1 year), the risk of planned CS was 70% greater among immigrants with 2-5 years of residency (RR 1.70, 95% CI 1.19-2.42), and was doubled among immigrants with ≥6 years of residency. (RR 2.01, 95% CI 1.28-3.17). When comparing the same group to non-immigrants, immigrants with <2 years of residency had a lower risk of planned CS, whereas those with 2-5 years of residency had a greater risk of emergency CS.

In the immigrant group with high CS rates, the risk of planned CS was similar to that of non-immigrants, whereas the risk of emergency CS was 51–75% higher, irrespective of length of residency.

In summary, the risk of planned CS increased with increasing length of residence in immigrants with low CS rates, whereas the risk of emergency CS remained elevated in immigrants with high CS rates compared with non-immigrants, independent of length of residence.

(a) Planned CS



(b) Emergency CS

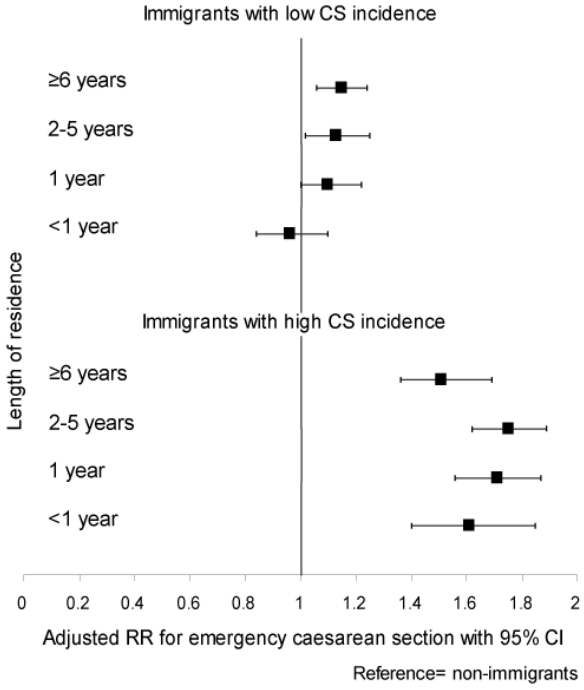


Figure 4.2 The relative risks of (a) planned and (b) emergency caesarean section in immigrant subgroups according to the length of residence, Norway 1990–2009.

Estimates were adjusted for the year of delivery, maternal age, size of the labour unit, gestational age, multiple gestation, pregestational diabetes, preeclampsia, placental disorders, SGA and LGA. The immigrant group with low CS rates included women from Iraq, Pakistan, Poland, Turkey, Vienam and the former Yugoslavia. The immigrant group with high CS rates included women from the Philippines, Somalia, Sri Lanka and Thailand.

4.3 Study III

Preterm subtypes by immigrants' length of residence in Norway: a population-based study

We examined the risk of spontaneous and non-spontaneous PTD among six major immigrant groups according to length of residence and country of birth, and we compared the results to the risks in the non-immigrant population.

We used population-based birth and immigration data for 40 709 singleton births to immigrant women from Iraq, Pakistan, the Philippines, Somalia, Sri Lanka and Vietnam and 868 832 singleton births to non-immigrant women from 1990–2009. Associations between length of residence and subtypes of PTD were estimated as RRs with 95% CIs using multivariable models.

In total, there were 48 191 preterm births. Both the spontaneous and non-spontaneous PTD rates were higher among immigrants (4.8% and 2.0%, respectively) compared with non-immigrants (3.6% and 1.6%, respectively). Only non-spontaneous PTD was associated with a longer length of residence (p trend <0.001). Recent immigrants (<5 years of residence) and non-immigrants had similar risks of non-spontaneous PTD, whereas immigrants with lengths of residence of 5–9 years, 10–14 years and ≥15 years had adjusted RRs of 1.18 (95% CI 1.03–1.35), 1.43 (95% CI 1.20–1.71) and 1.66 (95% CI 1.41–1.96), respectively. The association was reduced after further adjustments for maternal and infant morbidity. Conversely, the risk of spontaneous PTD among immigrants was not mitigated by length of residence, but at country level the risk was associated to a shorter duration of full-term pregnancies.

In summary, the risk of non-spontaneous PTD increased with increasing length of residence, which was due to the increased registration of maternal/infant morbidity; however, spontaneous PTD remained elevated regardless of length of

residence, which was partly due to a shorter duration of term pregnancies in most minority groups.

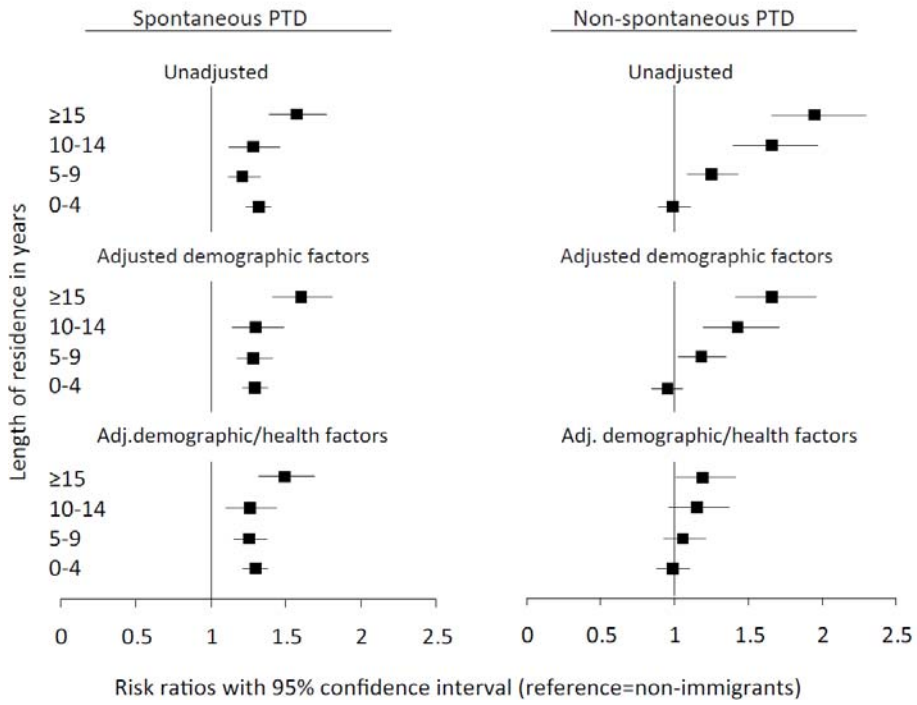


Figure 4.4 Estimated risk ratios of spontaneous and non-spontaneous preterm delivery (PTD) in non-immigrants (reference line) and immigrants according to length of residence. Demographic factors included the year of delivery, maternal age, parity and size of the labour unit. Health factors included gestational and pregestational diabetes, hypertensive and placental disorders, smoking, small- and large-for-gestational age infants and major birth defects.

V DISCUSSION

5.1 Main results

This thesis is based on information about births occurring in Norway in the largest immigrant groups during a 20-year period. We compared the impact of length of residence on the risk of four adverse pregnancy outcomes in immigrant versus non-immigrant populations, and according to the maternal country of birth. Our main findings were as follows:

- The risk of stillbirth and infant death in singleton offspring was approximately twice as high across generations of women of Pakistani descent compared with non-immigrants. First-cousin marriage and lower educational status were risk factors for stillbirth and infant death in offspring to women of both Pakistani and Norwegian descent. Although the risk of early mortality was higher in the offspring of two generations of Pakistani origin compared with non-immigrants, our findings translate to a small number of excess deaths.

- A longer length of residence was associated with increases in planned, but not emergency, CS among immigrants. The association depended on the absolute rate of CS. In the group of women from countries with low CS rates (Iraq, Pakistan, Poland, Turkey, former Yugoslav countries and Vietnam), the likelihood of planned CS reached the risk level for non-immigrants after two years of residence. The risk of emergency CS in this group did not vary across length of residence. Conversely, in the group of women from countries with high CS rates (the Philippines, Somalia, Sri Lanka and Thailand), the planned and emergency CS rates did not vary with the length of residence. The likelihood of a planned CS was similar to that of non-immigrants, and the

likelihood of an emergency CS was increased by 51–75%. Our expectation that the risk of caesarean subtypes among immigrants would converge with those of non-immigrants was not fulfilled.

- Immigrant' length of residence was associated with the risk of non-spontaneous PTD. Adjusting for health-related factors, such as diabetes and hypertensive disorders, reduced the effect size. Immigrant women were also more likely than non-immigrants to experience spontaneous PTD; however, this pattern was not mitigated by the length of residence, and it varied according to country of birth, primarily due to the shorter full-term gestational length in most minority groups. Our findings suggest that there was no convergence between the immigrants' risks of either subtype of PTD and the risk levels in the receiving population.

5.2 Methodological considerations

Observational studies are non-experimental by nature. We did not control or have information about all subject exposures. The associations that we identified could result from random events or bias in the study methods. However, genuine associations may exist. To judge whether the identified association truly does or does not exist, we must assess the *validity* of the study results, which can be defined as the degree to which the inferences drawn are warranted, considering the study methods and the characteristics of the participants.[142] This evaluation is performed by assessing possible sources of error. In principle, two types of error, random and systematic error, must be considered; both can cause biased effect estimates.

In this section, we first discuss the overall strengths and limitations of the study methods. Second, we discuss the reliability and the internal and external validity of the study results.

5.2.1 Strengths and limitations of the study

The strengths of this study include the population-based design; all the subjects belonged to defined populations, which minimised selection bias. Furthermore, the registry design provided us with a relatively large sample size of foreign-born women compared with many clinical studies of migrants. This factor enabled us to study rare outcomes such as early mortality and subtypes of CS and PTD. Other relevant pregnancy cohorts either did not include non-Norwegian-speaking women (such as The MoBa cohort)[143] or include samples that are too small to evaluate outcomes according to length of residence and country of birth (STORK Groruddalen).[144] Finally, the quality and completeness of the national data on exposures and outcomes were high.

The present study also had limitations. First, the unique migration history of each country group caused a differential distribution of births across the duration of residence. Groups were somewhat artificially pooled together as "immigrants" (Studies II and III). However, the common exposure of interest in these analyses was the experience of migration. Second, for some analyses, the sample size limited further sub-analyses and stratification. Third, the registry data did not contain all of the desired information. We would have wished to consider potential confounders or effect modifiers such as maternal weight/height/body mass index (BMI), vitamin D intake, previous maternal morbidity and previous PTD; however, these data were not available. In addition, the registration of the indication(s) for obstetric interventions (caesarean sections and induction of labour) was incomplete. This deficiency is unfortunate because such information would have enabled us to further interpret the findings and draw more clinically relevant conclusions. Finally, it is important to distinguish an effect of country of birth from the confounding effect of SEP in migrant studies. Education was the only available SEP indicator in our data. Because information about the level of education was incomplete, information about other indicators (profession and income) would have helped. However, capturing SEP is more challenging in immigrant populations than in non-immigrants, even when using multiple indicators.[32]

5.2.2 Random errors and reliability

Random errors, or flaws in the consistency and dependability of measurements, can reduce the *reliability* of data, or the degree to which the results can be repeated.[142] Random errors are due to chance and lead to a loss of precision. With increasing sample sizes, the precision of an effect estimate (such as the RR or OR) increases. This phenomenon was observed in Study I; there was a wide 95% CI for the mortality estimates for the offspring of second-generation women, whereas the corresponding 95% CI for women of Norwegian origin was narrow. However, because we included all of the subjects in the study population, we were unable to increase our study sample.

5.2.3 Internal validity: confounding, information bias and selection bias

Systematic errors can *bias* or reduce the *internal validity* of the results, which can cause a systematic deviation in the results.[142] Violations of internal validity can be categorised as *confounding*, *information bias* or *selection bias.*[145] The implications of each aspect for our study results are discussed below.

Confounding

An important shortcoming of observational studies is that the results may be vulnerable to confounding. Confounding is a distortion in the measurement of an exposure's effect because the effects of other variables are mistaken for, or combined with, the actual exposure effect.[145] The examination of pathways that explain differences in pregnancy outcomes according to length of residence and country of birth is not straightforward. Due to the nature of our data, we chose to use a conservative definition of confounders, implying associations to the exposure and the outcome but not assuming causal inference.[137] We considered the demographic covariates included in the models, such as maternal age, parity, size of birthing facility and residence, as background covariates. Conditioning or adjusting for baseline or background covariates is not thought to introduce bias.[146] Adjustments for

the year of delivery were important due to the secular changes in the outcome measures over the study period. Due to the mathematical creation of the length of residence (Figure 3.2), only two out of three of the desired covariates could be simultaneously included in the models (100% colinearity). To accommodate this limitation, we performed stratified and restricted analyses.

We cannot exclude the possibility that the adjusted analyses were biased by residual confounding, which is confounding that persists even after attempts to adjust for it.[142] The categorisation of continuous variables could cause such residual confounding;[147] however, in such cases, we also performed analyses with continuous variables (including exponential terms), and we obtained the same pattern of results.

Our results could be confounded by unmeasured confounders. We would especially have wished to include information on maternal BMI, which is associated to several of the outcomes we studied; however, BMI was not registered by MBRN during the study period. We also did not have information on previous PTD and previous maternal morbidity. However, based on the information that was available to us, we find it unlikely that the demonstrated associations resulted from confounder bias.

We also examined the influence of *intermediate* variables, which are variables on the causal pathway between the exposure and outcome.[142] We hypothesised that a portion of the effect of the exposures (length of residence and country of birth) would be primarily acting through intermediate factors. The intermediate factors considered in each study varied, but they mainly included maternal and fetal complications or morbidity, consanguinity and education. Education was not included in the final models due to several reasons. First, information about educational level was missing for more than one-third of the immigrants. Second, missing information was highest among recent immigrants due to registration practices. Third, there was a strong colinearity between educational categories and the country of birth for several outcomes. Finally, education level was not a predictor of some of the outcomes among migrants in the univariate analyses.

Adjusting for intermediate factors in regression models produced the controlled direct effect of the exposure. However, in the presence of unmeasured

confounding, as in our case, conditioning on an intermediate variable can introduce bias.[148] We therefore presented estimates with and without adjustments for intermediate factors and with careful interpretation.

Information bias

Information bias occurs when a flaw in the registration of an exposure, covariate or outcome variable results in different levels of quality of information among the compared groups.[142] The main exposures, country of birth/descent and length of residence, were unlikely to be differentially registered. To reduce the impact of registration errors in gestational length and birth weight data, we excluded cases with improbable Z-values. However, our application of a majority growth standard (Study III) resulted in a differential likelihood of being classified as SGA and LGA among ethnic groups with short average gestations. Other covariates from the MBRN were primarily generated from tick boxes and were less likely to be misclassified compared with information in free text form.[149] Data from before 1999 were primarily recorded as free text. Data on maternal and fetal morbidity were not specifically registered for the current research purpose. However, the validation of pregestational diabetes[150] and hypertensive disorders[151] was satisfactory, whereas gestational diabetes is likely under-registered in the MBRN.[152]

With respect to the misclassification of outcome measures, due to the validation of the Cause of Death Registry, we have no reason to expect a differential misclassification of stillbirth or infant death according to immigrant status (Study I). For Studies II and III the information concerning birth start and delivery mode was generated from tick-boxes, and differential registration according to immigrant status or maternal country of birth was unlikely. A validation study of caesarean delivery using data from an early period showed satisfactory results, and we do not anticipate that these data would differ from data gathered using the more recent registry form.[153] The differential classification of PTD subtypes by migrant status finally did not influence the association measures. In addition, any misclassification of outcomes would underestimate rather than overestimate the associations found. It is therefore

unlikely that information bias significantly distorted the associations observed in this work.

Selection bias

Our sample included the total population of births that fulfilled the inclusion criteria. Therefore, there was no selection bias relevant to the internal validity of the study. Fewer than 1% of cases were excluded from the adjusted analyses due to missing information in the covariates, which is not likely to impact on the results.

After assessing the different aspects of internal validity, we conclude that bias is not likely to have had a major impact on the observed associations.

5.2.4 External validity

After assessing the internal validity, we should also determine whether the results are applicable to populations outside of the study sample, i.e., the *external validity*.[142] Whether our findings can be generalised to immigrants in other countries remains unknown, especially for countries with different immigration and integration policies and without universal access to maternity care. Thus, caution should be exercised when generalising our findings outside of Northern Europe.

5.3 Interpretation of the results

Our findings did not fulfill our expectations of the approximation of risks between immigrants and the majority population. How did the risks differ, and what are the implications?

Outcomes with persisting differences across migration/time in residence

The risk of early mortality, emergency CS and spontaneous PTD were all elevated in particular immigrant groups compared with non-immigrants in this study. The differences in these risks persisted throughout the length of residence. However, we found large disparities between the country groups.

Our finding of a doubled risk for stillbirth and infant death among the first-generation Pakistani migrants is comparable to findings from a previous time period.[6] Similar disparities in mortality risk have been found in Denmark, where this divergent risk did not change after adjustments for SEP.[59] However, these studies did not separately assess generational status. The similarities in educational level and choice of spouse that we found across generations indicate a limited acculturation of second-generation women who have given birth in Norway. A study of primarily UK born women of South Asian descent found a stillbirth rate (7.5/1000) similar to our estimate for the first-generation group.[86] The pattern of an elevated risk across generations in infant mortality is also similar to the pattern for infants born to women of Turkish descent in the Netherlands, among whom consanguineous marriage is common.[17] However, this pattern differed from that found for infants born to women of Surinamese descent living in the Netherlands, for whom the risk of infant death decreased across generations. Our findings differ from US studies, where migration appears to be selected on qualities that contribute to favourable health outcomes for offspring, but where those qualities are later lost with exposure to the receiving country.[16, 84, 154] Although early mortality risks are higher in women of Pakistani

origin than among the receiving population, the absolute risks are considerable lower than among women living in Pakistan.[155]

The risk of spontaneous PTD was influenced by the shorter duration of pregnancy in most minority groups, which can explain the lack of change with length of residence. Thus, a portion of the high rates of spontaneous PTD was likely caused by the application of majority standards, leading to the admixture of "normal" pregnancies in the PTD group.[156, 157] This finding is in agreement with a Dutch study that found elevated spontaneous PTD risk among African and South Asian women, compared to European white women, but the associated adverse outcomes were less severe.[158] Ethnic differences in PTD and birth weight appear to withstand short-term acculturative effects,[159] which is a likely result of fetal programming in an environment where the maternal pelvic size is compromised.[160] The large variations in spontaneous PTD rates, highlight the importance of classification by country of birth, and not broader regions, because the findings for countries within the same geographical world region (e.g.Vietnam and the Philippines) differed markedly.

Our expectations of a convergence in the likelihood of CS towards that of non-immigrants with increasing length of residence was fulfilled in immigrant groups with low CS rates, but not in those with high CS rates. As with early mortality and spontaneous PTD, the risk of *emergency CS* did not change according to length of residence in any group. In one way, this finding is reassuring and signifies that women in need of an emergency CS have consistent access irrespective of their degree of acculturation. A recent Canadian study comparing emergency CS to planned CS or vaginal delivery found no effect of length of residence (cut-off <2 years).[161] A UK study found a positive effect of length of residence on the risk of emergency CS in multiparous, but not primiparous, women.[115] However, the high emergency CS rates among Somali, Thai, Philippine and Sri Lankan women expose these women to higher risks compared with a planned procedure. These groups also have elevated CS rates in other contexts.[106] Although intrapartum complications cannot generally be anticipated, it is likely that certain groups, such as Somali

women, receive inadequate opportunities for planned CS, likely due to both medical and non-medical factors.[112, 162]

Outcomes that changed across migration/time in residence

In contrast, among particular minority groups, we found that planned CS and non-spontaneous PTD increased with length of residence. Planned CS and non-spontaneous PTD are partly overlapping categories because some planned CSs will occur before term. However, the pattern of CS risk did not change when we excluded PTDs. The rapid change in the planned CS risk with increasing length of residence was independent of maternal and fetal morbidity and background characteristics. One reason for this finding could be that it represents increased access to CS due to maternal demand (without medical reasons). This phenomenon could be linked to patient factors, provider factors or both. Maternal choice has been responsible for an increasing proportion of CS among nulliparous women.[163] The clinical consensus in Norway is to control or reduce planned CS in the absence of medical indication. Immigrants could increasingly adopt attitudes about delivery mode that are prevalent in the majority population; this is likely facilitated through improved language command and knowledge as well as trust of the health system. The only country group that did not follow this pattern was Somali women, among whom the likelihood of having a planned CS *decreased* with length of residence. Although women of the Somali diaspora have been shown to prefer vaginal birth,[54, 112, 164] this finding could also reflect the increasing uptake of elective deinfibulation before first births. Our findings indicate that antenatal identification of high-risk women and these women's compliance with undergoing planned procedures were low, but these rates changed over time in most groups. However, we cannot assume that the caesarean rate among non-immigrants is optimal and should be normative.

A recent systematic review found few differences between what immigrant and non-immigrant women want from maternity care; however immigrant women were less content with the care they received due to suboptimal levels of communication and understanding of care provision.[165] Immigrants with poor

majority language skills may be the least likely to voice and communicate their preferred delivery mode.[12] Women from countries with low CS rates included both immigrants with a labour immigration background (Poland) and refugees (Iraq and former Yugoslav countries); therefore we do not believe that the reason for migration is relevant to the above finding. A parallel finding has been reported from the primary care sector; an increased length of residence in Norway was associated with higher rates of planned versus emergency care services.[166] However, it is unknown how the use of antenatal care varies across the length of residence in Norway. To understand the reasons underlying the parallel increases in planned CS rates and time of residence and to determine whether this finding represents improvement in care, we would need better information about the indications for the procedure.

The risk of PTD increased across the length of residence in Norway. This trend is consistent with findings from Canada.[19, 88] Contrary to the findings of a Danish study, recent immigrants were not at elevated risk of PTD.[89] The time since migration has been found to modify the socioeconomic influences on the PTD rates.[167] However, the increase in non-spontaneous PTD with length of residence found here was primarily driven by increases in maternal and infant complications. To determine whether the increase in preterm obstetric intervention is necessary and represents improved access to care, further studies on the indications for the procedures are needed. The iatrogenic or non-spontaneous preterm rate is more suitable than the overall PTD rate as an indicator for monitoring adverse infant outcomes among ethnic minority groups. Alternatively, adjustments for ethnic disparities in full-term pregnancy duration should be attempted.

Healthy migrants?

The healthy migrant effect was first described among immigrants to the United States and has since been observed in other, but not all, migrant populations.[15, 154] Compared with the host population of Norway, we found that a healthy migrant effect was present in only a few subgroups, such as recent arrivals. One reason could be that

there is no scoring system for immigrants to Norway based on the characteristics desired by the host country, as is common elsewhere. In addition, compared with most high-income countries, Norway has very low rates of early mortality, preterm birth and overall CS rates.[168-170] Immigrants in Norway report both more somatic and mental complaints than non-immigrants.[171] The overall consumption of health services by immigrants is also higher.[172] We found that the occurrence of diabetes in pregnancy was elevated in most immigrant groups, and women from Pakistan, Sri Lanka and India has been shown to have particularly high susceptibility to diabetes.[152] We found that gestational and pregestational diabetes as well as hypertensive disorders were independently associated with length of residence. This finding has policy implications for the primary prevention of these conditions due to the health consequences for both mothers and infants.[42] High maternal BMI could have contributed to several of the studied outcomes because obesity is a risk factor for stillbirth, CS and PTD.[63, 173, 174] Although obesity is prevalent in certain immigrant groups,[43] we need to know more about the changes across time in Norway and particularly among women entering reproductive age.

The importance of classification of migrants

In this thesis, we classified immigrants by their country of birth.[28] As a result, we had limited sample sizes with less power for subanalyses and stratification. However, when we repeated the analyses using a classification based on larger groupings, such as geographical regions or World Bank classifications, the important differences were averaged out, which concealed intraregional variation. Furthermore, we classified migrants by length of residence as a proxy for exposure to the receiving country context. However, length of residence, although a good indicator of social inclusion, might not fully capture changes in health behaviour. Majority language proficiency might be a better parameter and could be used prospectively as a clinical risk factor. Finally, we chose not to classify migrants by their reason for migration. Although refugee status has been associated to poor infant outcomes in meta-analyses,[5] the two largest refugee groups in our sample population were Somali and Iraqi women. The outcomes in these two groups differed markedly from each other. Therefore, it did

not make sense to incorporate the reason for migration in our classification, and findings that were stratified for this variable did not reveal real differences between the types of immigrant groups.

VI CONCLUSIONS

Immigration changes the overall population characteristics. This fact has only just begun to be reflected in health policies and strategies for the health of all individuals living in Norway.[44, 45] Groups migrate from different countries and for a variety of reasons, and this dynamic is constantly changing. However, bearing these issues in mind, it is possible to draw the following conclusions from our findings:

- Immigrant populations in Norway have on average worse reproductive health outcomes than the non-immigrant population. Some of these differences persist regardless of length of residence and generational change, indicating that specific action is required to promote equitable health outcomes. However, the differences between immigrant subgroups are larger than those between immigrants and non-immigrants; therefore broad classifications are likely to obscure, rather than clarify, associations.
- Acculturation impacts, albeit not uniformly, adverse outcomes. The impact of length of residence and country of birth differed according to the outcome being studied.
- Indicators that capture different aspects of integration should be available as routine health information, including indicators that measure different aspects of SEP and language/communication skills.

- **Stillbirth and infant death:**
  Clinical efforts to reduce early mortality among the offspring of women of Pakistani origin should focus on preconception counselling, early diagnosis and optimal management of fetal disorders among both Pakistani-born and Norwegian-born women.

- **CS:**

  Although the current policy to reduce the planned CS rate is appropriate for non-immigrants, the policy focus for some immigrant groups (Somali, Philippine and Sri Lankan women) should be to reduce the proportion of emergency CSs.

- **PTD:**

  Spontaneous PTD has limited value as an indicator of adverse pregnancy outcomes in minority groups due to the physiological variation in pregnancy duration among groups. The underlying reasons for preterm medical intervention, rather than reductions in the overall PTD rates, should be addressed.

VII FUTURE STUDIES

Several suggestions for future research have emerged from our studies. These suggestions are summarised below in the form of research questions:

General

- What is the impact of time in Norway on maternal pre-pregnancy BMI?
- Does a lack of majority language proficiency predict adverse pregnancy outcomes?
- What is the impact of registering migrants' language skills on the rate of interpreter use?

Stillbirth and infant death:

- What are the effects of the maternal country of birth and origin on the termination rate in pregnancies with a diagnosis of fetal pathology?

CS:

- What is the impact of language skills on the likelihood of planned CS?
- Does the association between maternal country of birth and CS vary according to language proficiency?
- What is the impact of immigrants' length of residence on the initiation of antenatal care?

PTD

- Can the date of birth be better predicted using first or second trimester biometry in minority ethnic groups?
- Are there ethnic differences in the indications for preterm obstetric intervention?
- What is the optimal gestational length according to maternal ethnicity?

VIII CLINICAL AND PUBLIC HEALTH IMPLICATIONS

- Obstetric and pediatric care providers should consider the sustained, elevated risks of adverse infant outcomes in offspring born to generations of Pakistani origin.

- Information about country of birth/origin should be made available through routine data collection. However, this information would be useful for clinical assessment, such as assessments of fetal growth, diagnosis of SGA and LGA and emergency CS risk, only if the associated risks were known.

- The routine registration of majority language skills at the first antenatal contact could identify groups at high risk of suboptimal care. Recent immigrant could be specifically targeted for primary prevention and improved healthy literacy.

- In groups at high risk of emergency CS, the threshold for planned CS should be carefully evaluated after individual assessment and counselling by culturally competent health professionals. A regular audit of caesarean deliveries at the institutional level would be helpful to identify obstacles to optimal care and to inform clinical decision making.

- The overall preterm rate is difficult to interpret in an ethnically mixed population; subtypes of PTD should be distinguished. Ethnic minority groups with durations of pregnancy that differ from the majority standard should be treated with different standards concerning viability in early gestation, therapeutic cut-offs, and the management of post-term pregnancy.

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X APPENDICES

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
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.: /

IS-1002 23011. 07.06. Andvord Grafisk.

REPORT ON COMPLETED PREGNANCY AFTER 12 WEEKS
BIRTHS, STILLBIRTHS, MISCARRIAGES

A – Civil information

Institution no: A01 Institution name A02		**Birth outside institution** A03 ☐ At home, planned A04 ☐ At home, not planned A05 ☐ During transportation A06 ☐ Elsewhere	Mother's full name and address A09 Maiden name (Surname) A10
Mother's marital status A11 ☐ Married A13 ☐ Unmarried/single A15 ☐ Others A12 ☐ Cohabitant A14 ☐ Divorced/separated/widow			
Are parents related A16 ☐ No ☐ Yes If yes, how? A18		**Mother's municipality** A21	A22
Father's date of birth A19	Father's full name A20	**Mother's National ID no. (11 digits)** A07 A08	

Autorisert

Dato: 23/8-2007

Signatur:

B –About the pregnancy and mother's health

Last menstrual period:

1st day of bleeding B01

B02 ☐ Certain ☐ Uncertain

Mother's previous pregnancies/births

Live births	Stillborn (24 wks or more)	Miscarriages / stillborn (12-23 wks)	Miscarriages (under 12 wks)
B04	B05	B06	B07

Ultrasound performed? B08 ☐ No ☐ Yes

Ultra-sound due date B10

Other prenatal diagnostics? B11 ☐ No ☐ Yes, specify: B13

Pathological findings at prenatal diagnostics? B14 ☐ No ☐ Yes, if confirmed – specify

Special conditions before pregnancy:

B16 ☐ **None**

B17 ☐ Asthma
B18 ☐ Allergy
B19 ☐ Previous caesarean
B20 ☐ Recurring urinary tract infection
B21 ☐ Chronic renal disease
B22 ☐ Chronic hypertension
B23 ☐ Rheumatoid arthritis
B24 ☐ Heart disease
B25 ☐ Epilepsy
B26 ☐ Diabetes type 1
B27 ☐ Diabetes type 2
B49 ☐ other, specify in "B"

Regular dietary supplement:

B70 ☐ No

	Before pregn.	During pregn.
Multi vitamins	B28 ☐	B29 ☐
Folic acid	B30 ☐	B31 ☐

Specification of conditions before or during pregnancy

B

B66

Special conditions during pregnancy:

B32 ☐ **None**

B33 ☐ Bleeding< 13 wk
B34 ☐ Bleeding 13-28 wk
B35 ☐ Bleeding> 28 wk
B36 ☐ Glycosuria
B37 ☐ Gestational diabetes
B38 ☐ Hypertension only
B39 ☐ Preeclampsia light
B40 ☐ Preeclampsia severe
B41 ☐ Preeclampsia<34wks
B42 ☐ HELLP syndrome
B43 ☐ Eclampsia
B44 ☐ Hb< 9.0 g/dl
B45 ☐ Hb > 13.5 g/dl
B46 ☐ Thrombosis, treated
B48 ☐ Infections, specify in "B"
B47 ☐ Other, specify in "B"

Medication during pregnancy

B50 ☐ No ☐ Yes – specify in "B"

Smoking and Occupation
Conditioned on mother's consent – see instructions on reverse.

B52 ☐ Written info given to mother

B53 ☐ Does not consent to smoking info

Did mother smoke at start of pregnancy? B54 ☐ No B56 ☐ Daily B55 ☐ Sometimes **No. of** cigs. daily: B57

- **at the end of of pregnancy?** B58 ☐ No B60 ☐ Daily B59 ☐ Sometimes **No. of** cigs. daily: B61

Mother's occupation B62 ☐ **Does not consent to employment info**

B63 ☐ Not emplyed
B64 ☐ Employed fulltime
B65 ☐ Employed part time

Mother's occupation:

Business, trade, line etc.:

B67

C – about birth

Presentation

C01 **Normal cephalic**

C02 Breech

C03 Transverse

C04 Cephalic, abnormal

C05 Other, specify in "C"

Inception of labour

C06 **Spontaneous**

C07 Induced

C08 Caesarean

Induction method

C09 Prostaglandin

C10 Oxytocin

C11 Amniotomy

C12 Others, specify in "C"

Indication for intervention and/or induction

C13 Complications, as described below

C14 Birth defects

C15 Postterm

C16 Other, specify in "C"

Intervention

C17 **None**

C18 Low forceps, cephalic

C19 Other forceps, cephalic

C20 Vacuum extractor

C21 Episiotomy

Assistance at breech delivery:

C22 Usual procedure

C23 Extraction

C24 Forceps on head

Caesarean section

Was the section planned prior to delivery?

No C27 Yes

C25 Performed elective section

Performed emergency section

Specification of conditions during delivery / other complications

C C84

Complications

C29 **None**

C30 Rupture of membrane 12-24 hours

C31 Rupture of membrane >24 hours

C32 Mechanical obstruction

C33 Complicated shoulder delivery

C34 Placenta previa

C35 Abruptio placentae

C36 Perineal rupture (degree 1-2)

C37 Sphincter ruptur (degree 3-4)

C38 Haemorrhage >1500 ml, transf

C39 Haemorrhage 500-1500 ml

C40 Eclampsia during delivery

C41 Prolaps of cord

C42 Threatening intrauterine asphyxia

C43 Reduced contractions - stimulated

C44 Slow progress

C45 Uterine atony

C86 Other:

Anaesthetics / analgesic

C46 **None**

C47 Nitrous oxide

C48 Pethidine

C49 Epidural

C50 Spinal

C51 Pudendal

C52 Infiltration

C53 Paracervical block

C54 General anaesthetics

C87 Other:

Placenta

C55 **Normal**

C56 Membranal residue

C57 Incomplete

C58 Infarction

C59 Blood clots

C60 Curettage

C61 Manual extraction

Weight of Placenta: C62

Umbilical cord

C63 **Normal**

C64 Velamentous attachment

C65 Peripheral attachment

C66 Vessel anomalies

C67 Coiled round neck

C68 Other form of coiling

C69 Genuine knot

Length of umbilical cord: C85

Amniotic fluid

C70 **Normal**

C71 Polyhydramnion

C72 Oligohydramnion

C73 Discoloured

C74 Malodorous, infected

C75 Bloodstained

After-delivery complications - mother

C76 **None**

C77 Fever >38.5 C

C78 Thrombosis

C79 Eclampsia postpartum

C80 Mother transferred

C81 Mother intensive care

C82 Sepsis

C83 Other, specify

D – About the child

Date of Birth: D01

Time: D02

Plurality

D03 **Single delivery**

D04 Multiple birth

For multiple birth:

No.: D05

Of total: D06

Sex

D07 Male D08 Female

If uncertain, specify in "D"

For stillborn: D09 Uncertain sex

Child's weight: D10

Total length: D12

Head circumference: D11

Buttocks-vertex length: D13

Apgar score:

1 min: D14

5 min: D15

The child was:

D16 **Live born** D17 Stillborn/miscarriage

Specify cause of death in "D"

For stillborn: D18 Died before labour

D19 Died during labour

D20 Time of death unknown

For stillborn, note also:

D21 Dead before arrival

D22 Dead after arrival

Live birth, died within 24 hours

Life lasted:

Hours: D23 Mins.: D24

Died later:

Date: D25

Time: D26

Transferred to neonatal unit:

☐ No D27 ☐ Yes

Date: D29

Transferred to (name of unit): D30

Indication for transfer:

D31 Respiratory problems

D32 Pre-mature

D33 Birth defects

D34 Perinatal infections

D35 Other, specify

Neonatal diagnoses: (To be completed by physician / pediatrician)

D36 **None**

D37 Hypoglyco. (<2 mmol/l)

D38 Cong.anaemia (Hb<13.5 g/dl)

D39 Hip joint dysplasia treated with pillow

D40 Transit. tachypnea

D41 Resp. distress syndrome

D42 Aspiration syndrome

D43 Intracranial hemorrhage

D44 Cerebral irritation

D45 Cerebral depression

D46 Abstinence

D47 Neonatal fits

D48 Conjunctivitis treated

D49 Navel/dermal infection treated

D50 Perinatal infections, bacterial

D51 Perinatal infections, other

D52 Fract. claviculae

D53 Other fracture

D54 Facial paresis

D55 Plexus injury

Treatment codes:

D56 Systematic antibiotics

D57 Respiratory treatment

D58 CPAP treatment

Icterus, treated:

D59 Light treatment

D60 Transfusion

Icterus, cause:

D61 ABO incompatible

D62 RH immunization

D63 Physiological

D64 Other cause

Signs of birth defects:

☐ No D65 ☐ Yes

Specification of injuries, neonatal diagnoses and birth defects – to be completed by physician:

D D67

Record no: D68 / D69

Physician:

Maternity ward / Pediatric ward:

Discharged date:

Mother: D70 **Child:** D71

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:

Sted (sykehusets stempel) | Dato | Jordmor | Lege

50 000. 5.96. SEM GRAFISK

PAPER I

PAPER II

PAPER III