Tampere University

KALPANA BASTOLA

Health of Pregnant Migrant Women and their Newborns in Finland

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ACADEMIC DISSERTATION
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ACADEMIC DISSERTATION
Tampere University, Faculty of Social Sciences
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Responsible supervisor and Custos	Docent Tarja I Kinnunen Tampere University Finland	
Supervisor	Docent Mika Gissler University of Oulu Finland	
Pre-examiners	Professor Brigitta Essen Uppsala University Sweden	Private Docent Erika Sievers University of Kiel Germany
Opponent	Associate Professor Bernadette N Kumar University of Oslo Norway	

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Dedication

Dedicated to my parents, Ramji Bastola and Sarita Bastola, and my beautiful family, Kishor and Krishal.

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Tampere, April 2020

Kalpana Bastola

ABSTRACT

The general aim of this dissertation was to examine the health of pregnant migrant women and their newborns in Finland. To accomplish the aim, four studies were conducted (papers I–IV) in total. The objectives of this thesis were to study mean pre-pregnancy body mass index and inter-pregnancy weight change (paper I); prevalence of pregnancy complications, mainly gestational diabetes and hypertensive disorders (paper II); mode of delivery; and prevalence of delivery complications (paper III) among women of Russian, Somali and Kurdish origin as well as the general Finnish population. Paper IV studied differences in the prevalence of elective and emergency caesarean delivery and neonatal outcomes, mainly preterm birth, low birthweight, Apgar score and admission in the neonatal intensive care unit between all women of migrant origin and Finnish women in Finland.

The data for the first three papers were based on a sample of migrant women of Russian, Somali and Kurdish origin. These groups were identified from the Population Register of the Migrant Health and Wellbeing Survey. The sample of the reference group, women in the general population, were identified from the national-level Health 2011 Survey. Their data were extracted from the Finnish Medical Birth Register (MBR), Statistics Finland and the Care Register for Health Care. In total, 318 Russian, 583 Somali, 373 Kurdish and 243 women from the general population and data on their most recent singleton birth in Finland, between years 2004–2014, were included in papers I–III. The main method of analysis was linear regression for paper I and logistic regression for papers II and III, adjusted for confounders.

The data for paper IV was based on nationwide data from MBR and Statistics Finland. Paper IV included data on the most recent singleton delivery of all women who gave birth in Finland between years 2004–2014 (N=382,233). Women were classified into nine regional categories based on their country of origin. Generalised linear models were used to examine associations between the country of origin and mode of delivery or neonatal outcomes, adjusted for confounders. Finnish women were the reference group.

In paper I, the mean pre-pregnancy BMI was lower in Russian women (adjusted coefficients −1.93, 95% CI −2.77 to −1.09), and higher in Somali (adjusted coefficients 1.82, 95% CI 0.89–2.75) and Kurdish women (adjusted coefficients 1.30, 95% CI 0.43 to 2.17) compared with women in the general population. No

statistically significant differences were observed in the mean inter-pregnancy weight change between the Russian, Somali and Kurdish women compared with women in the general population. Paper II reported that Kurdish women had higher odds for gestational diabetes mellitus (adjusted OR 1.98, 95% CI; 1.20 to 3.32) compared with the general population, but the odds for hypertensive disorders did not differ between the migrant groups and women in the general population. In paper III, Russian women had lower odds (adjusted OR 0.49, 95% CI 0.29 to 0.82) of having a caesarean delivery, whereas Somali and Kurdish women did not differ from the reference group. Somali women had an increased risk of any delivery complications (adjusted OR 1.62, 95% CI 1.03 to 2.55) compared with women in the general population. Furthermore, no differences were observed in the use of pain medication between the groups.

Paper IV reported that, compared with Finnish women, Sub-Saharan African women had higher risks for emergency caesarean delivery (adjusted RR 2.98, 95% CI 2.70 to 3.29), preterm births (adjusted RR 1.21, 95% CI 1.03 to 1.42), low birthweight (adjusted RR 1.99, 95% CI 1.60 to 2.33), lower 5-minute Apgar score (adjusted RR 2.59, 95% CI 2.18 to 3.08) and intensive care unit care (adjusted RR 1.36, 95% CI 1.23 to1.51) for newborns. South Asian and East Asian women were at an increased risk for emergency caesarean delivery (adjusted RR 2.17, 95% CI 1.91 to 2.46; adjusted RR 1.41, 95% CI 1.28 to 1.54, respectively), preterm birth (adjusted RR 1.45, 95% CI 1.19 to 1.77; adjusted RR 1.28, 95% CI 1.13 to 1.46, respectively), low birthweight (adjusted RR 2.43, 95% CI 2.08 to 2.94; adjusted RR 1.25, 95% CI 1.08 to 1.46, respectively) and lower 5-minute Apgar score (adjusted RR 2.06, 95% CI 1.55 to 2.76; adjusted RR 1.36, 95% CI 1.11 to 1.67, respectively) compared with Finnish women. Latin America/Caribbean women had higher risks for both elective and emergency caesarean delivery (adjusted RR 1.46, 95% CI 1.14 to1.87; adjusted RR 1.74, 95% CI 1.41 to 2.15, respectively) and lower 5-minute Apgar score (adjusted RR 1.95, 95% CI 1.30 to 2.91) compared with Finnish women.

In conclusion, this study contributed to evidence on differences in pre-pregnancy BMI, prevalence of pregnancy and delivery complications, caesarean delivery and neonatal outcomes among women of migrant origin and Finnish women in Finland. More research is needed to better understand the reasons and mechanisms behind these differences and to develop interventions for improving the health outcomes among the higher-risk groups.

TIIVISTELMÄ

Tämän väitöskirjan yleisenä tavoitteena oli tutkia raskaana olevien maahanmuuttajanaisten ja heidän vastasyntyneiden lastensa terveyttä Suomessa. Tutkimukseen kuuluu neljä osatyötä (Artikkelit I-IV). Tutkimuksen tavoitteina oli tutkia raskautta edeltävää keskimääräistä kehon painoindeksiä ja raskauksien välistä painonmuutosta (Artikkeli I), raskauskomplikaatioiden kuten raskausdiabeteksen ja verenpainetautien yleisyyttä (Artikkeli II), ja synnytystapaa ja synnytyskomplikaatioiden yleisyyttä (Artikkeli III) venäläis-, somalialais- ja kurditaustaisilla naisilla ja suomalaisilla naisilla. Artikkelissa IV tutkittiin eroja suunnitellun ja hätäkeisarileikkauksen yleisyydessä ja vastasyntyneeseen lapseen liittyvien vasteiden yleisyydessä (ennenaikaisen syntymä, pienipainoisuus, Apgarin pisteet ja vastasyntyneen tehohoito) kaikkien maahanmuuttajataustaisten ja suomalaistaustaisten naisten välillä Suomessa.

Kolmen ensimmäisen osatyön aineisto perustui otokseen venäläis-, somalialais- ja kurditaustaisista naisista. Nämä naiset tunnistettiin väestörekisteristä Maahanmuuttajien terveys ja hyvinvointi -tutkimusta varten. Vertailuotoksen suomalaiseen väestöön kuuluvat naiset otettiin kansallisesta Terveys 2011 -tutkimuksesta. Heidän tietonsa saatiin Terveyden ja hyvinvoinnin laitoksen (THL) syntyneiden lasten rekisteristä ja hoitoilmoitusrekisteristä sekä Tilastokeskuksesta. Artikkeleihin I-III otettiin mukaan yhteensä 318 venäläis-, 583 somalialais- ja 373 kurditaustaista naista sekä 243 suomalaiseen väestöön kuuluvaa naista ja tiedot heidän viimeisimmästä yhden lapsen synnytyksestä vuosien 2004 ja 2014 välillä. Lineaarinen regressioanalyysi oli tärkein analyysimenetelmä Artikkelissa I ja logistinen regressioanalyysi artikkeleissa II ja III. Sekoittavia tekijöitä vakioitiin analyyseissä.

Artikkelin IV aineisto perustui koko maan kattavaan aineistoon THL:n syntyneiden lasten rekisteristä ja Tilastokeskuksen taustatiedoista. Artikkeliin IV otettiin mukaan kaikilta Suomessa vuosina 2004-2014 synnyttäneiltä naisilta tiedot viimeisimmästä yhden lapsen synnytyksestä (n=382,233). Naiset luokiteltiin yhdeksään alueelliseen luokkaan alkuperämaan perusteella. Alkuperämaan ja synnytystavan tai vastasyntyneen lapsen vasteiden välisiä yhteyksiä tutkittiin yleistetyillä lineaarisilla malleilla, sekoittavat tekijät vakioiden. Suomalaiset naiset olivat vertailuryhmänä.

Artikkelin I tulosten mukaan raskautta edeltävä painoindeksi oli pienempi venäläistaustaisilla (vakioitu kerroin -1,93, 95 % luottamusväli (lv) -2,77; -1,09) ja suurempi somalialaistaustaisilla (vakioitu kerroin 1,82, 95 % lv 0,89; 2,75) ja kurditaustaisilla (vakioitu kerroin 1,3, 95 % lv 0.43; 2,17) naisilla suomalaisväestöön nähden. Raskauksien välisessä painonmuutoksessa ei havaittu tilastollisesti merkitseviä eroja venäläis-, somalialais- ja kurditaustaisten naisten ja suomalaisten naisten välillä. Artikkelin II tulosten mukaan raskausdiabetes oli yleisempää kurditaustaisilla naisilla suomalaisiin naisiin verrattaessa (vakioitu vetosuhde, OR 1,98, 95 % lv 1,20; 3,32), mutta verenpainetautien yleisyydessä ei ollut eroa maahanmuuttajaryhmien ja suomalaisten naisten välillä. Artikkelissa III havaittiin, että keisarileikkaukset olivat harvinaisempia venäläistaustaisilla naisilla (vakioitu OR 0,49, 95 % lv 0,29; 0,82), mutta somalialais- ja kurditaustaisten ja suomalaisten naisten välillä ei havaittu eroa. Synnytyskomplikaatiot olivat yleisempiä somalialaistaustaisilla naisilla (vakioitu OR 1.62, 95 % lv 1,03; 2,55) kuin suomalaisilla naisilla. Ryhmien välillä ei ollut eroa kipulääkityksen käytössä.

Artikkelin IV tulokset osoittivat, että Saharan eteläpuolisesta Afrikasta kotoisin olevilla oli suurempi hätäkeisarileikkauksen (vakioitu RR 2,98, 95 % lv 2,70; 3,29), ennenaikaisen synnytyksen (vakioitu RR 1,21, 95 % lv 1,03; 1,42), pienipainoisuuden (vakioitu RR 1,99, 95 % lv 1,60; 2,33), matalampien 5 minuutin Apgar-pisteiden (vakioitu RR 2,59, 95 % lv 2,18; 3,08) ja vastasyntyneen tehohoidon riski (vakioitu RR 1,36, 95 % lv 1,23; 1,51). Etelä-Aasiasta ja Itä-Aasiasta kotoisin olevilla oli suurempi hätäkeisarileikkauksen (vakioidut RR:t 2,17, 95 % lv 1,91; 2,46 ja 1,41, 95 % lv 1,28; 1,54), ennenaikaisuuden (vakioidut RR:t 1,45, 95 % lv 1,19; 1,77 ja 1,28, 95 % lv 1,13; 1,46), pienipainoisuuden (vakioidut RR:t 2,43, 95 % lv 2,08; 2,94 ja 1,25, 95 % lv 1,08; 1,46,) ja matalampien 5 minuutin Apgar-pisteiden riski (vakioidut RR:t 2,06, 95 % lv 1,55; 2,76 ja 1,36, 95 % lv 1,11; 1,67) suomalaistaustaisiin synnyttäjien nähden. Etelä-Amerikasta tai Karibialta kotoisin olevilla oli suurempi riski sekä suunnitellulle että hätäkeisarileikkaukselle (vakioidut RR:t 1,46, 95 % lv 1,14; 1,87 ja 1,74, 95 % lv 1,41; 2,15) ja matalammille 5 minuutin Apgar pisteille (vakioitu RR 1.95, 95 % lv 1.30; 2,91) suomalaisiin vertaillessa.

Johtopäätöksenä voidaan todeta, että tämä tutkimus tuo uutta tietoa raskautta edeltävästä painoindeksistä ja raskaus- ja synnytyskomplikaatioiden, keisarileikkausten ja vastasyntyneen lapsen vasteiden yleisyydestä Suomessa asuvilla maahanmuuttajataustaisilla naisilla. Tarvitaan lisää tutkimusta, jotta voidaan ymmärtää paremmin näiden erojen taustalla olevia syitä ja mekanismeja sekä kehittää interventioita riskiryhmien terveyden parantamiseen.

CONTENTS

ABBREVIATIONS

BMI	Body Mass Index
CI	Confidence Interval
EU	European Union
FGM/C	Female Genital Mutilation/Cutting
GDM	Gestational Diabetes Mellitus
ICD	International Classification of Disease
IOM	International Organization for Migration
Maamu	Migrant Health and Wellbeing Survey
MBR	Medical Birth Register
NICU	Neonatal in Intensive Care Unit
OR	Odds Ratio
RR	Risk Ratio
SD	Standard Deviation
THL	Finnish Institute of Health and Welfare
UN	United Nations
UNHCR	United Nations High Commission for Refugees
USSR	Union of Soviet Socialist Republics
WHO	World Health Organization

ORIGINAL PUBLICATIONS

This thesis is based on the following publications:

Paper I Bastola, K., Koponen, P., Härkänen, T., Gissler, M., & Kinnunen, T. I. (2017). Pre-pregnancy body mass index and inter-pregnancy weight change among women of Russian, Somali and Kurdish origin and the general Finnish population. *Scandinavian Journal of Public Health, 45*(3), 314–321.

Paper II Bastola K., Koponen P., Härkänen T., Luoto R., Gissler M., Kinnunen T.I. Pregnancy complications in women of Russian, Somali, and Kurdish origin and women in the general population in Finland, *Women's Health (London, England), 16*, 1745506520910911.

Paper III Bastola, K., Koponen, P., Härkänen, T., Luoto, R., Gissler, M., & Kinnunen, T.I. (2019). Delivery and its complications among women of Somali, Kurdish, and Russian origin, and women in the general population in Finland. *Birth, 46*(1), 35–41.

Paper IV Bastola K., Koponen P., Gissler M., Kinnunen T. I.: Differences in caesarean section and neonatal outcomes among women of migrant origin in Finland – A population-based study, *Paediatric and Perinatal Epidemiology.* 2020; 34(1), 12–20.

1 INTRODUCTION

Migration has always occurred throughout human history. People migrate for various reasons: education, employment, family reunification, medical treatment and some to avoid natural disaster, war and persecution (International Organisation for migration, 2019). Migration from one country to another requires extensive adjustments, can be experienced as severe stress and could result in family and social disruption, in addition to altered health (WHO Regional Office for Europe, 2018a). Migrant populations often face challenges in accessing healthcare in their destination country due to lack of availability, adequacy, accessibility, affordability and appropriateness of the healthcare (WHO Regional Office for Europe, 2018b; WHO Regional Office for Europe, 2018a). It is essential to provide healthcare for the migrant population not only because it is a basic human right but also because the healthy population can contribute to active development of the destination country as well as the country of origin (WHO Regional Office for Europe, 2018a; WHO Regional Office for Europe, 2018b). Additionally, low access to healthcare among migrants can also lead to negative outcomes for the communities; for example, outbreaks of communicable diseases. Early diagnosis and treatment of disease will save enormous treatment and rehabilitation costs (WHO Regional Office for Europe, 2018a; WHO Regional Office for Europe, 2018b). Pregnant women, minors and seniors are the most vulnerable migrant population segment, and these groups should be prioritised in providing health services (WHO Regional Office for Europe, 2018a; WHO Regional Office for Europe, 2018b).

The care received during pregnancy, delivery and postpartum are important for overall health and wellbeing of the mothers and their newborns. Body mass index (BMI) is defined as bodyweight in kilogram per squared height in meters. Higher BMI during pregnancy is associated with several complications of pregnancy, delivery and neonatal outcomes, and increases the risk of long-term chronic conditions such as diabetes and cardiovascular diseases (Athukorala, Rumbold, Willson, & Crowther, 2010; Aune, Saugstad, Henriksen, & Tonstad, 2014;

Bhattacharya, Campbell, Liston, & Bhattacharya, 2007; Ruager-Martin, Hyde, & Modi, 2010). Gestational diabetes mellitus (GDM) and hypertensive disorders are common complications of pregnancy. These complications during pregnancy are linked with various chronic complications, such as diabetes mellitus, cardiovascular diseases, kidney disease, thromboembolism, hypothyroidism and even impaired memory later in life (Clausen et al., 2008; Haukkamaa et al., 2009; Kjos & Buchanan, 1999; Ma, Chan, Tam, Hanson, & Gluckman, 2013; Williams, 2012). Health at birth contributes to the long-term health and wellbeing of the newborns (Aizer & Currie, 2014). Caesarean section is associated with maternal morbidity and mortality (Quinlan & Murphy, 2015a). Newborns with low birthweight and those born preterm have a higher risk of poor neonatal outcomes, long-term cognitive and motor impairments in childhood and longer hospitalisations for complications (Boyle et al., 2012; Flenady, Koopmans et al., 2011; Larroque et al., 2008).

Some previous studies from other European countries reported unfavourable pregnancy, delivery and neonatal outcomes for migrant origin women, especially for caesarean delivery, risk of GDM, stillbirths and infant mortality (Almeida, Caldas, Ayres-de-Campos, Salcedo-Barrientos, & Dias, 2013; Bollini, Pampallona, Wanner, & Kupelnick, 2009; Gagnon et al., 2009a; Gagnon et al., 2011; Jenum et al., 2013; Small et al., 2008) However, a few of these studies also showed some better or similar pregnancy, delivery and neonatal outcomes among migrant-origin women compared with women in the general population (Gagnon et al., 2011; Gissler et al., 2009a; Small et al., 2008).

It is crucial to study the health of pregnant and postpartum migrant women and their newborns to identify the most vulnerable groups. It will also help to identify any inequalities in healthcare in the receiving country. The health of pregnant migrant women and their newborns is less studied in Finland. This thesis explored possible differences in mean pre-pregnancy BMI and mean inter-pregnancy weight change, and in the prevalence of pregnancy complications, mode of delivery, delivery complications and neonatal health outcomes between women of migrant origin and Finnish origin in Finland.

2 LITERATURE REVIEW

2.1 Key Concepts: Migration and Migrants

There is no universally accepted definition of migration or migrants. The International Organization for Migration (IOM) defines migration as the movement of persons from their usual place of residence to a different country or within a country (IOM, 2019). The IOM defines migrants as the movement of a single person or a group of persons, either temporarily or permanently and either across the country or within a country, voluntarily or involuntarily, including migration of refugees, displaced persons and persons moving for various other purposes, including family reunification (IOM, 2019). The United Nation High Commission for Refugees (UNHCR) defines a migrant as a person who usually moves across international borders voluntarily for different purposes that, for example, include reunification with family members, to search for better opportunities, to escape a natural disaster, etc. (UNHCR, 2019).

The terms "migrant", "refugee", "asylum-seeker" and "undocumented migrants" are generally used to describe people on the move. A refugee is a person who is forced to leave his/her country because of persecution based on race, religion, nationality, membership to a particular social group or political opinion, war or violence (Key migration terms, 2019). An asylum seeker is a person seeking protection from persecution and other serious human rights violations in another country but who has not yet been legally recognised as a refugee and is waiting to receive a decision regarding their asylum claim (Key migration terms, 2019). An undocumented migrant is a person who enters or stays in another country without the required and appropriate documents; undocumented migrants usually have more difficulties in accessing services, obtaining residence or work permits or returning to their countries of origin (IOM, 2019).

Finland has signed an international agreement, based on the 1951 Geneva Refugee Convention, other international human rights agreements and EU legislation to provide international protection to people in need (Ministry of the

Interior Finland, 2019). The Finnish government agrees on an annual refugee quota every year; under the refugee quota, Finland provides international protection to persons recognised as refugees by the UNHCR and other foreign nationals in need of international protection (Ministry of the Interior Finland, 2019). Under its quota policy, Finland prioritises the resettlement of families with children and women in a difficult position (widows, single parents and single women) and other vulnerable groups (Ministry of the Interior Finland, 2019).

"Race" and "ethnicity" are common terms in migration-related studies. The term race has traditionally been used to categorise a person based on the measurement of physical features such as skin and eye colour, hair type, head and face shape and shape of specific features such as nose and lips (Bhopal, 2014). Ethnicity is a broad term for a person or a group based on common social, cultural, religious, physical and other characteristics, including geographical and ancestral origin (Bhopal, 2014). The characteristics that define ethnicity are not fixed or easily measured; therefore, ethnicity is a complex concept. While race and ethnicity are clearly related but conceptually different, they are overlapping and often used synonymously, particularly in the United States. Race and ethnicity are important in healthcare, particularly in identifying health inequalities. If not used properly, they can also induce stereotyping, stigma and racism. In most of the migration-related studies, the individual country of birth, country of origin (country of parents'/grandparents' birth), duration of residence in the country and nature of migration status are used to identify migrant groups (Bhopal, 2014). Using country of birth as the indicator of ethnic group is problematic when a person's parents are from different countries or if a person was born abroad when the parents are travelling or on a vacation. In such situations, the country of birth cannot identify the ethnic group of children of the migrants. Therefore, country of origin is a more reliable indicator to define ethnicity. Other indicators relating mainly to the concepts of ethnicity are name, language, religion, dietary preferences and taboos, and migration history (Bhopal, 2014).

For practical and theoretical reasons, the concept of self-defined ethnicity is on the rise, which has its own advantages and disadvantages (Bhopal, 2014). "Ethnic minority group" is another commonly used term in migration studies; it usually refers to a non-white population and specific identifiable groups such as Gypsy travellers or the Roma population (Bhopal, 2014).

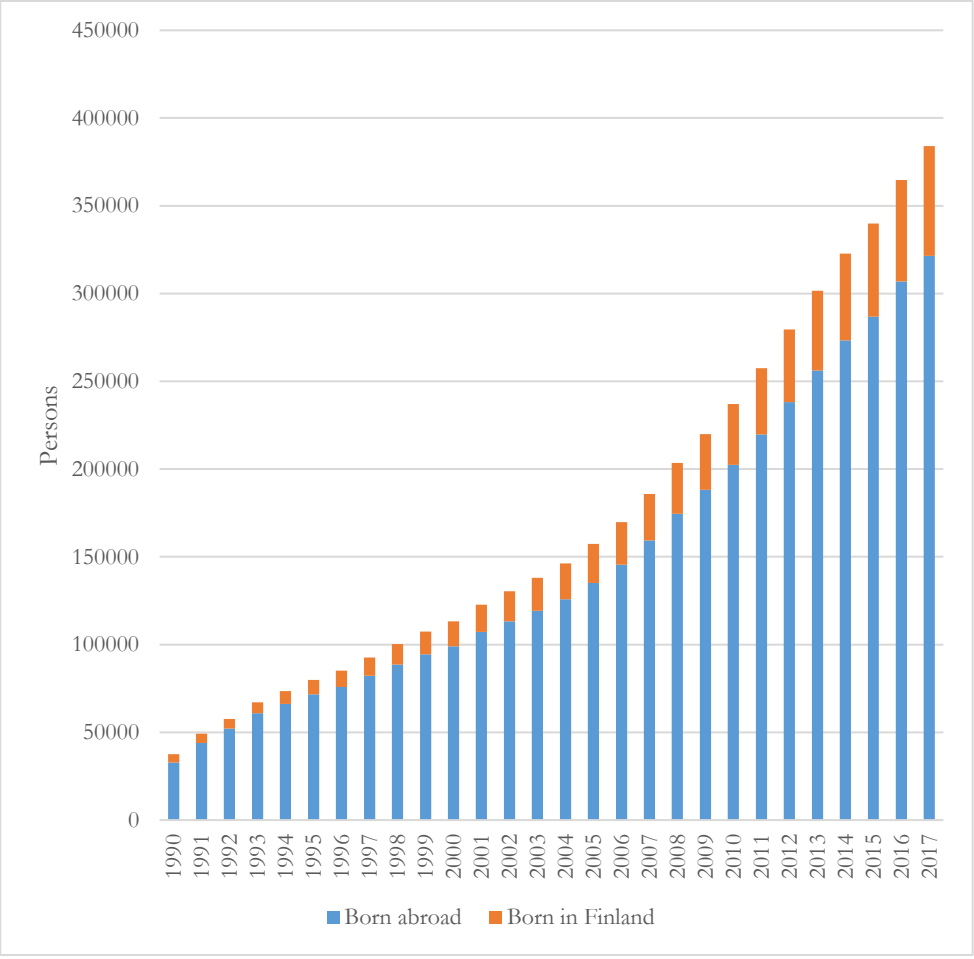
2.2 Migration and health

Migration has implications for those who move, those who are left behind and those who host migrants. The health status of migrants is generally assessed in relation to either that of the host population (also called receiving country) or that of the country of origin; it is usually easier to compare the health status with that of the host population (WHO Regional Office for Europe, 2018b). A recent report from the WHO on the health of refugees and migrants in the WHO European region reported that the prevalence of all-cause mortality, neoplasm, mental and behavioural conditions, injuries and endocrine and digestive disorder are lower, but the prevalence of infections and diseases of blood and cardiovascular diseases are higher in refugees and immigrants compared with the host population. Communicable diseases, mainly vaccine-preventable diseases, tuberculosis, hepatitis and human immune deficiency, are common among refugees and migrants. Non-communicable diseases such as type 2 diabetes mellitus, cardiovascular diseases, mental health problems, etc. are more common among migrants than in the host population (WHO Regional Office for Europe, 2018b). Regarding maternal health, the risk of adverse perinatal and obstetric outcome is highest among refugees and migrant women in general.

The hypothesis of the "healthy migrant effect" is quite popular in migration-related studies. The healthy migrant effect proposes that those who migrate often have better health status than the remaining population in their country of origin and also better health status than the population in their host country, especially after 5–10 years of migration (Wingate & Alexander, 2006). The majority of the studies observing a healthy migrant effect have been found in North America. However, a few studies from Europe also found some healthy migrant effect in studies conducted in Sweden (Helgesson, Johansson, Nordquist, Vingard, & Svartengren, 2019; Juarez & Revuelta-Eugercios, 2016), Norway (Diaz et al., 2015), Denmark (Norredam et al., 2014) and Germany (Razum, Zeeb, & Gerhardus, 1998). However, these results should be interpreted with caution, because the healthy migrant effect is outcome- and country-of-origin-specific (Urquia, O'Campo, & Heaman, 2012) and affected by several factors such as the presence of unobserved confounders, cultural and lifestyle factors (Fuentes-Afflick, Hessol, & Perez-Stable, 1999).

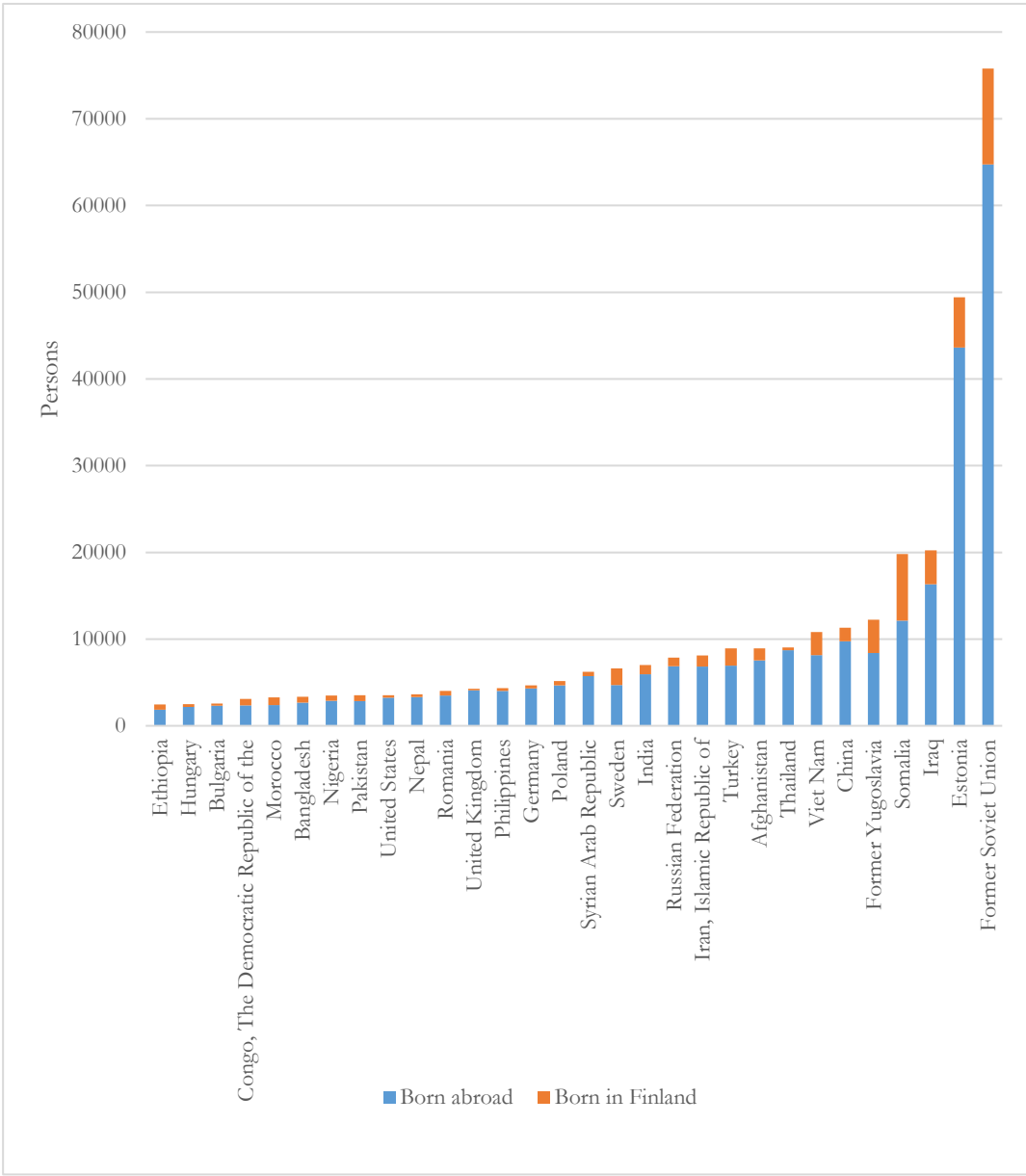
2.3 Migration in Finland

Migration in Finland slowly started to rise in the 1990s and increased after 2000 (Figure 1). Around 38,000 people of foreign background were living in Finland in 1990 (Figure 1), which escalated to 384,123 (almost 7% of the total population) by the end of 2017 (Foreign citizens in Finland, 2019). The biggest share of persons of foreign background in 2017 were from neighbouring countries of the former Soviet Union and Estonia, followed by Iraq and Somalia (Figure 2) (Foreign citizens in Finland, 2019).



Source: Statistics Finland

Figure 1. Population by foreign background, Finland (1990–2017)



Source: Statistics Finland

Figure 2. Population by the largest background country groups, Finland 2017

2.4 Social security and health services in Finland

People who live permanently in Finland have the rights to social security and health services (Keskimäki et al., 2019). In addition, EU citizens, citizens of Norway, Iceland, Switzerland and Lichtenstein and people with a residence permit for a permanent or continuous residence, or who have a temporary residence permit but demonstrate the intention to live in Finland with their family members, can reside in Finland. Furthermore, Finland provides health services to other groups covered by the EU social security or international agreement of social security (Keskimäki et al., 2019). Health services are provided by the municipality of residence. These services include maternity and child health clinics, immunisation, testing and treatment of certain communicable diseases. Moreover, for people with limited mobility, medical aids such as wheelchairs or related devices, prostheses, transportation for treatment, inpatient medication, nurse appointment and diagnostic tests are provided.

Asylum seekers and undocumented migrants are special groups. Healthcare and social services for asylum seekers are arranged separately by reception centres until the residence permit is decided on. Upon denial of asylum, these rights stop after a certain time. Undocumented migrants have the right to receive urgent healthcare from public providers. In addition to emergency care, urgent care includes care for sudden illness, injury, worsening of a long-term condition, dental, mental health and substance abuse. However, undocumented migrants are not insured by the government and must cover their medical cost themselves (Keskimäki et al., 2019).

2.5 Maternity and child healthcare in Finland

In Finland, services for children under school age and pregnant women are provided by municipal maternity and child health clinics, which are governed by the Finnish Health Care Act (Finlex, 2019). Maternity and child health clinics provide regular check-ups for pregnant women, ensuring healthy growth and development of the newborn (Keskimäki et al., 2019). Pregnant women typically have 11–15 appointments with a nurse and doctor throughout the pregnancy; first-time mothers usually have more appointments (Keskimäki et al., 2019). Almost all women visit a maternity clinic during pregnancy, and almost all deliveries take place in a public hospital (Kiuru & Gissler, 2018). To be eligible for maternity benefits, women must attend a maternity clinic by the end of the 18th week of gestation (The Social

Insurance Institution of Finland, 2019). Maternal and child health clinics provide neonatal check-ups at approximately one month during the first year of life and annually thereafter or as needed. Further, maternity and child healthcare services include oral health check-ups, parenthood support, promotion of healthy living environments for children and families, early identification of any special needs and, if necessary, referrals to tests and treatment. These services are provided in coordination with the organisation responsible for preschool education, child welfare, specialised medical care and other relevant actors (Finlex, 2019).

2.6 Studies on migrant health in Finland

In recent years, THL has conducted a few surveys among the migrant population in Finland. One of those is the Migrant Health and Wellbeing Survey (Maamu), which was conducted among immigrants from Russia, Somalia and Iraq/Iran from 2010–2012 (Castaneda, Rask, Koponen, Mölsa, & Koskinen, 2012). A representative sample of persons 18–64 years-old, 1,000 from every three migrant groups, were invited to take part in the Maamu survey. The survey was conducted in six cities with relatively high proportions of migrants, with a participation rate of 50–70% among the groups. The basic report of the Maamu survey shows that migrant women have a poorer health status (e.g., more chronic diseases, obesity or type 2 diabetes) compared to migrant men. Kurdish and Russian-origin women self-rated their health as significantly worse than any other group. Overweight, obesity and lower physical activity levels were common, especially in women of Somali and Kurdish origin. However, the Maamu survey did not provide any information on health among pregnant migrant women (Castaneda et al., 2012).

FinMONIK is another ongoing cross-sectional survey carried out by THL, focusing on wellbeing among foreign-born population (FinMONIK). The duration of the study period is 2018–2020. The study sample is 13,650 subjects. FinMONIK collected information about health and wellbeing, work ability, functional capacity, use of services, and experiences of the migrant population, as well as employment opportunities and barriers to employment and discrimination. Data collection was completed recently, and the preliminary results are expected to be published soon (Finnish Institute of Health and Welfare, 2018).

THL has recently developed a National Mental Health Policy for refugees and individuals with comparable backgrounds. In addition, THL conducted a survey

among asylum seekers called TERTTU. The aim of the TERTTU survey is to produce representative data on the health, wellbeing and service needs of newly arrived asylum seekers. This survey is being conducted among 1,000 children and adults at the reception centres in Helsinki, Turku, Oulu and Joutseno. The basic report of the TERTTU project is yet to published (Finnish Institute of Health and Welfare, 2019).

2.7 Main pregnancy complications

2.7.1 Gestational hypertension, preeclampsia and eclampsia

Hypertensive disorders, especially gestational hypertension, pre-eclampsia and eclampsia, are common complications of pregnancy. Hypertension is defined as a blood pressure of ≥ 140 mm Hg systolic or ≥ 90 mm Hg diastolic. Gestational hypertension is first identified in pregnancy after 20 weeks of gestation without the presence of protein in the urine (Working group on high blood pressure in pregnancy, 2000). Preeclampsia is hypertension during pregnancy accompanied by protein in the urine after 20 weeks of gestation in women who have had normal blood pressure before 20 weeks of gestation (Working group on high blood pressure in pregnancy 2000). Eclampsia is the occurrence of seizures in a woman with preeclampsia that cannot be attributed to other causes (Working group on high blood pressure in pregnancy, 2000). Globally, approximately 1 out of 10 pregnant women have high blood pressure at some point during pregnancy (Duley, 2009). Pre-eclampsia and eclampsia account for almost 15% of all maternal deaths worldwide (Duley, 2009; Say et al., 2014). Women who have preeclampsia are at increased risk of chronic hypertension, ischemic heart disease, cerebrovascular disease, atherosclerosis, kidney disease, diabetes mellitus, thromboembolism, hypothyroidism and impaired memory later in life (Haukkamaa et al., 2009; Williams, 2012).

2.7.2 Gestational Diabetes Mellitus

Gestational diabetes is a common complication of pregnancy that represents a higher blood sugar level due to failure in maintaining a normal glucose tolerance level during

pregnancy (Kjos & Buchanan, 1999). Women with GDM have an increased risk of developing hypertensive disorders during pregnancy and type 2 diabetes mellitus after pregnancy. Their offspring are often macrosomic and prone to obesity and type 2 diabetes later in life (Bener, Saleh, & Al-Hamaq, 2011; Buchanan, Xiang, & Page, 2012; Clausen et al., 2008; Ma et al., 2013). The prevalence of GDM varies between 5–16% globally, depending upon the population, screening and diagnostic criteria (Buckley et al., 2012). The prevalence of GDM in Finland was 15.6% in 2017 (Heino, Vuori, & Gissler, 2018). In Finland, GDM is diagnosed by a 2-hour 75-gram oral glucose tolerance test with at least one abnormal plasma glucose value determined as fasting value ≥ 5.3 mmol/l ; 1 h value ≥ 10.0 mmol/l or 2 h value ≥ 8.6 mmol/l at 24–28 week gestation (The Finnish Medical Society Duodecim, 2019). Oral glucose tolerance testing is recommended to be performed in all pregnant women, except in those who are at lower risk (primiparae women <25 years old, normal weight and without a family history of type 2 diabetes) (The Finnish Medical Society Duodecium, 2019).

2.8 Characteristics of delivery and main delivery complications

2.8.1 Use of pain relief

In general, pharmacological pain relief is used frequently for pain relief during labour; analgesic and anaesthetics are the two types of drugs for such purposes (Decherney, Nathan, Laufer, Roman, 2013). Analgesic relieves pain without loss of sensation or muscle function, whereas anaesthetics relieve pain by blocking most of the muscle functions, including the sensation of pain. Epidural, spinal, epidural–spinal combined (anaesthetics) and nitrous oxide (analgesic) are the most common types of drugs for pain relief during labour (Thomson, Feeley, Moran, Downe, & Oladapo, 2019). A combined spinal-epidural is used when there is a need to quickly relieve pain for a longer period. Nitrous oxide is used as a labour analgesic, which makes it easier to deal with pain by reducing anxiety and increasing the feeling of wellbeing (Medications for pain reliefs, 2017). Previous findings suggest that epidural, epidural-spinal combined and inhaled analgesia effectively help relieve pain during labour but may have several side effects. Women receiving epidural were more likely to have instrumental vaginal and caesarean delivery for foetal distress, hypotension, motor

blockade, fever or urinary retention when compared with placebo. Women receiving inhaled analgesia were more likely to have vomiting, nausea and dizziness (Jones et al., 2012). Some other non-pharmacological pain relievers are also used in labour, which includes continuous labour support, baths, touch and massage, maternal movement and positioning, and intradermal water blocks for back pain relief (Simkin & O'Hara, 2002). These methods may improve pain management with fewer side effects.

2.8.2 Mode of delivery

Vaginal spontaneous delivery is the safest and the most common method of delivery, whereas operative deliveries have increased rapidly due to the development of medical technology (Betran et al., 2016; Sakala & Mayberry, 2006). Operative delivery can be divided into operative vaginal delivery and caesarean delivery. Operative vaginal delivery is also called assisted delivery, due to the use of instruments such as vacuums and forceps to assist in delivery of the foetus (Decherney, Nathan, Laufer, Roman, 2013). Forceps are used to assist in delivering the baby's head, to expedite the delivery or to assist with certain abnormalities that interfere with head advancement during labour. Recently, vacuum-assisted delivery has become more popular than forceps delivery due to the perception that vacuums are easier to use and have less risk to the mother and foetus. In vacuum-assisted delivery, a suction device is applied to the foetal scalp to help deliver the head. Use of both forceps and vacuum can cause a range of maternal and neonatal injuries if not operated properly. Though both forceps and vacuum are proved to be acceptable and safe in assisting delivery, the vacuum is the preferred choice (Decherney, Nathan, Laufer, Roman, 2013)

Caesarean delivery is the process of delivering a foetus, placenta and membranes through an abdominal and uterine incision. Cephalopelvic disproportion, dystocia, abnormal foetal lie and malpresentation, foetal heart rate anomaly, placenta previa, preeclampsia and eclampsia, placental abruption, multiple gestations, foetal abnormalities, cervical cancer, active genital herpes infections and uterine rupture are common indications of caesarean delivery (Decherney, Nathan, Laufer, Roman, 2013, Toppenberg & Block 2002). Some of the indications of caesarean delivery are clear and straightforward. However, in some cases, careful judgement is necessary to determine whether caesarean section is better. A woman's choice to have an elective caesarean delivery continues to increase in popularity and is prevalent in many

communities (Decherney, Nathan, Laufer, Roman, 2013). Although caesarean delivery is a lifesaving procedure in many pregnancies, it is associated with a significantly increased risk of maternal morbidity and mortality from complications of anaesthesia, puerperal infection and venous thromboembolism (Cohen et al., 2001; Declercq, Young, Cabral, & Ecker, 2011; Pallasmaa et al., 2010; Quinlan & Murphy, 2015b).

2.8.3 Obstructed labour

Obstructed labour is a condition in which the foetus cannot progress into the birth canal, even when the uterus is contracting normally, the most common cause being a mismatch between foetal head and mother's pelvic brim and occasionally mal-presentation and malposition of the foetus (AbouZahr, 2003). Neglected obstructed labour is a major cause of both the maternal and newborn's morbidity and mortality. The obstruction can only be eased by either caesarean delivery or instrumental delivery. It is estimated that obstructive labour occurs in approximately 4.6% of live births globally (AbouZahr, 2003). The complications followed by obstructive labour include intrauterine infections, haemorrhage, shock, obstetric fistula or even death. Complications in the newborns include asphyxia leading to stillbirth, brain damage or neonatal death (AbouZahr, 2003).

2.8.4 Foetal distress

Foetal distress is a condition in which the foetus does not receive enough oxygen during pregnancy or in labour. It is usually detected through monitoring of foetal heartrate (Decherney, Nathan, Laufer, Roman, 2013). Anaemia, oligohydramnios, pregnancy-induced hypertension, post-term pregnancies, intrauterine growth retardation and meconium-stained amniotic fluid are some common causes of foetal distress (Decherney, Nathan, Laufer, Roman, 2013). Foetal distress is primarily corrected by different methods of intrauterine resuscitation, e.g., changing the woman's position and ensuring the woman has adequate oxygen and is well hydrated. If these methods do not help, the baby is delivered as soon as possible by operative procedures (Decherney, Nathan, Laufer, Roman, 2013).

2.8.5 Perineal Laceration

A perineal laceration is a tear of the skin and other soft tissue structures, either because of tear or of episiotomy during vaginal childbirth. It is a common form of obstetric injury and is classified from first-degree to fourth-degree tears (Alan H Decherney, Lauren Nathan, Neri Laufer, Ashley S Roman, 2013). First-degree tears involve the perineal skin only; second-degree tears involve the perineal muscles and the skin; third-degree tears involve the anal sphincter complex and fourth-degree tears involve the anal sphincter complex and anal epithelium (Aasheim, Nilsen, Reinar, & Lukasse, 2017). Perineal laceration is associated with significant short- and long-term morbidity such as dyspareunia and faecal incontinence. These problems can lead to various physical, psychological and social problems (Aasheim et al., 2017).

2.8.6 Obstetric haemorrhage

Obstetric haemorrhage is the condition of bleeding from the genital tract during pregnancy (antepartum), during delivery (intrapartum) or after delivery (postpartum). Obstetric haemorrhage is one of the most common causes of major maternal morbidity and mortality, accounting for almost 27% of all maternal deaths worldwide (Say et al., 2014). Postpartum haemorrhage contributes significantly to maternal morbidity and mortality, which accounts for more than two-thirds of all haemorrhagic deaths (Say et al., 2014).

2.9 Neonatal outcomes

2.9.1 Gestational age at birth

Gestational age describes how far along the pregnancy is and is measured in weeks. A normal full-term pregnancy ranges from 38–42 weeks. Babies born before 37 completed weeks of gestation are premature, and those born after 42 weeks are postmature (Decherney, Nathan, Laufer, Roman, 2013). The WHO estimates that 15 million babies are born preterm each year globally, and almost 1 million babies die each year due to complications of preterm birth. Low-income countries, particularly African and South Asian countries, have the highest prevalence of

preterm birth (WHO, 2019a). Infants born preterm are at a higher risk of mortality, morbidity and impaired motor and cognitive development in childhood as compared with infants born at full-term (Boyle et al., 2012; Larroque et al., 2008). Preterm infants have higher risk of chronic diseases and mortality later in life (Crump, Sundquist, Sundquist, & Winkleby, 2011). Infants born post-term have higher risk of adverse neonatal outcomes such as neonatal convulsions, meconium aspiration syndrome, lower Apgar score, NICU admission, respiratory morbidity, sepsis and antibiotic treatment (Alexander, McIntire, & Leveno, 2000; Balchin, Whittaker, Lamont, & Steer, 2011; Clausson, Cnattingius, & Axelsson, 1999; Linder et al., 2017).

2.9.2 Foetal mortality/stillbirth

Half of all deaths during the perinatal period (22 weeks completed gestation up to 7 days after birth) are foetal deaths, often called stillbirths (WHO, 2019a). For international comparison, the WHO defines stillbirth as the number of foetal deaths ≥28 weeks of gestation or foetus weighing ≥ 1,000 grams in a given year, expressed per 1,000 live births and stillbirths within the same year. However, for national statistics, stillbirths are defined as all deaths in the perinatal period; if the gestational age is missing, weight ≥500 gram is recommended. The incidence of stillbirths was 2.6 million in 2015. Most stillbirths occurred in low- and middle-income countries (WHO, 2019a). Some known causes of foetal deaths are foetal growth restriction, preterm births, maternal complications of pregnancy and congenital anomalies, whereas the cause of 30–50% of these deaths remains unknown (Flenady, Middleton et al., 2011). BMI above 25 kg/m^2, smoking during pregnancy and being a mother at an older age are some of the risk factors for foetal mortality (Flenady et al., 2011).

2.9.3 Neonatal and infant mortality

All infant deaths occurring within 0–27 days of life are neonatal deaths. They are subdivided as early neonatal deaths (0–6 days after live birth) and late neonatal deaths (7–27 days). Globally in 2018, 2.5 million newborns died before reaching the first month of their life (WHO, 2019b). The neonatal mortality rate is an important indicator of health during pregnancy and delivery. Preterm birth, intrapartum-related complications, infections and congenital anomalies are the most common causes of neonatal deaths (WHO, 2019b). Infant mortality is the probability of total infant

deaths during the first year (0–365 days) of life per 1,000 live births. In 2018, 4.0 million infant death occurred worldwide, the highest being in the WHO African region. The main causes of infant deaths are prematurity, infections, diarrhoea, birth effects, injuries, malaria and other non-communicable diseases (WHO, 2019b).

2.9.4 Apgar score

The Apgar score is a standardized assessment of a newborn's health immediately after birth (ACOG, 2015). The Apgar score is based on the assessment of five components: colour, heartrate, reflexes, muscle tone and respiration. Each item is scored 0, 1, or 2; the total score ranges between 0–10. The score is reported at 1 minute and 5 minutes after birth for all newborns, and at 5-minute intervals thereafter until 20 minutes for newborns with a score less than 7. The value of Apgar score at 5 minutes is strongly associated with neonatal mortality and is used as the best predictive value for subsequent mortality (ACOG, 2015). A score of 0 to 6 (out of 10) at 5 minutes after birth is alarming, and the baby may need resuscitation (ACOG, 2015; Casey, McIntire, & Leveno, 2001).

2.9.5 Birthweight

Birthweight is an important indicator of newborn health status. Babies born with low birthweight (<2,500 g) or high birthweight (4,500 g or more) are associated with various immediate and long-term complications. Low birthweight babies are at risk of poor perinatal outcomes and of long-term cognitive and motor impairment (Flenady et al., 2011; McIntire, Bloom, Casey, & Leveno, 1999). High birthweight babies are at higher risk of stillbirth, neonatal mortality, birth injury, neonatal asphyxia, caesarean delivery and long-term chronic complications later in life (Zhang, Decker, Platt, & Kramer, 2008).

2.10 Risk factors for poor pregnancy, delivery and neonatal outcomes

2.10.1 Pre-pregnancy body mass index

Several studies have suggested that a greater maternal BMI (≥25.0 kg/m^2) before or during early pregnancy are associated with an increased risk of a number of complications such as recurrent miscarriage, pregnancy-induced hypertension, gestational diabetes, pre-eclampsia, delivery complications, premature delivery, caesarean delivery, postpartum weight retention, infertility, small for gestational age, macrosomia and obesity in the offspring (Larroque et al., 2008, Flenady et al., 2011, Almedia et al., 2013, Gagnon et al., 2011). Other neonatal complications of overweight and obesity (≥25.0 kg/m^2) before and during pregnancy include increased risk of foetal death, stillbirth, neonatal, perinatal and infant death (Aune et al., 2014).

A lower pre-pregnancy BMI (<18.5 kg/m^2) is also associated with a higher incidence of miscarriage, intrauterine growth retardation, small for gestational age infants and preterm deliveries (Ehrenberg, Dierker, Milluzzi, & Mercer, 2003; Helgstrand & Andersen, 2005; Hickey, Cliver, McNeal, & Goldenberg, 1997; Sekiya, Anai, Matsubara, & Miyazaki, 2007).

2.10.2 Weight gain during pregnancy

Total weight gain during pregnancy is different among women and may be influenced by age, ethnicity and pre-pregnancy BMI (Institute of Medicine (US) and National Research Council (US) Committee to Reexamine IOM Pregnancy Weight Guidelines, 2009). In normal-term pregnancies, weight gain is higher in the second and third trimester than in the first trimester (Institute of Medicine (US) and National Research Council (US) Committee to Reexamine IOM Pregnancy Weight Guidelines, 2009). The Institute of Medicine recommends that pregnant women gain weight according to their pre-pregnancy BMI, with obese women gaining the least (Table 1). These recommendations are based on observational studies, which provide a lower level of evidence than experimental studies, and little is known about

applicability to all ethnic groups. These recommendations are used in various countries including Finland (Klemetti & Hakulinen-Viitanen 2013).

Table 1. Recommended weight gain during pregnancy by pre-pregnancy BMI

Pre-pregnancy BMI	Weight gain recommendation
Underweight <18.5 kg/m²	12.5–18 kg
Normal weight 18.5–24.9 kg/m²	11.5–16 kg
Overweight >25.0–29.9 kg/m²	7–11.5 kg
Obese ≥30.0 kg/m²	5–9 kg

(Institute of Medicine (US) and National Research Council (US) Committee to Reexamine IOM Pregnancy Weight Guidelines, 2009).

2.10.3 Inter-pregnancy weight change

Inter-pregnancy weight change is the change in the bodyweight or BMI between the start of one pregnancy and start of another pregnancy (Villamor & Cnattingius, 2006). An increased BMI between two pregnancies is related to a higher incidence of adverse pregnancy complications such as pre-eclampsia, gestational diabetes, gestational hypertension, caesarean delivery, stillbirth and large for gestational age infants in later pregnancies (Getahun, Ananth et al., 2007; Getahun, Ananth, Peltier, Salihu, & Scorza, 2007; Getahun, Kaminsky et al., 2007; Villamor & Cnattingius, 2006; Whiteman, Aliyu et al., 2011; Whiteman, McIntosh, Rao, Mbah, & Salihu, 2011; Whiteman, Crisan et al., 2011). A recent systematic review and meta-analyses of 280,672 women from 27 studies worldwide confirm that inter-pregnancy weight gain impacts the risk of developing the above-mentioned perinatal complications in a subsequent pregnancy (Teulings, Masconi, Ozanne, Aiken, & Wood, 2019). Therefore, women are encouraged to return to their pre-pregnancy weight before planning a subsequent pregnancy to reduce the risk of perinatal complications (Teulings et al., 2019).

2.10.4 Other factors

Being pregnant at a younger age and an older age both are risk factors for poor pregnancy and neonatal outcomes (Fraser, Brockert, & Ward, 1995; Odibo, Nelson,

Stamilio, Sehdev, & Macones, 2006). Similarly, a lower socioeconomic position has been associated with unfavourable pregnancy, delivery and neonatal outcomes (Kramer, Seguin, Lydon, & Goulet, 2000). Other common risk factors for unfavourable pregnancy, delivery and neonatal outcomes are smoking during pregnancy, being a single mother and having a higher parity (Shah, Zao, Ali, & Knowledge Synthesis Group of Determinants of preterm/LBW births, 2011; Villamor & Cnattingius, 2006). Previous studies reported that giving birth to two or more children in short (<12 months) or long (>59 months) inter-pregnancy intervals increases the risk of maternal and child morbidity and mortality (Conde-Agudelo, Rosas-Bermudez, & Kafury-Goeta, 2006; Conde-Agudelo, Rosas-Bermudez, & Kafury-Goeta, 2007). Women with a short inter-pregnancy interval may have a higher risk of obesity, either because of weight retained from pregnancy or gained postpartum (Davis et al., 2014).

2.11 Previous literature on the health of pregnant migrant women and their newborns in European countries

This summary of previous literature on the health of pregnant migrant women and their offspring only includes studies that were based on data from European countries. However, some systematic reviews and meta-analyses included studies outside Europe, mainly from the USA, Canada and Australia. The reason for not including studies outside Europe was because of the fairly homogenous distribution of migrant groups in the European countries. The majority of migrants in the European countries are documented. Migrant groups in Europe and the majority population are quite different in countries outside Europe.

2.11.1 Pre-pregnancy body mass index and inter-pregnancy weight change

Very few studies compared pre-pregnancy BMI among migrant groups and women in the general population in European countries (Table 2). Among those studies, most of them reported that pre-pregnancy BMI was higher among women of African and Middle Eastern origin compared with women in the general population. One review (Jenum et al., 2013) reported lower pre-pregnancy BMI in South Asian and East Asian women compared to women in the general population. We found

no study that compared inter-pregnancy BMI change among migrant populations and women in the general population in European countries.

2.11.2 Gestational diabetes and hypertensive disorders

Studies on gestational diabetes and hypertensive disorders of pregnancy showed inconsistent results (Table 3). The majority of the studies showed that women of African, Caribbean and Asian origin were at greater risk of GDM compared to women in the general population. One study showed no major differences in maternal and neonatal outcomes (Kosman et al., 2016), whereas another showed that non-Nordic women have better maternal and neonatal outcomes compared to women in the general population (Fadl, Ostlund, & Hanson, 2012). Hypertensive disorders of pregnancy were lower among migrant women in Norway compared with Norwegians (Naimy, Grytten, Monkerud, & Eskild, 2015), whereas it was higher among those of Afro-Caribbean origin in the UK (Khalil, Rezende, Akolekar, Syngelaki, & Nicolaides, 2013) compared with Caucasians.

Table 2. Summary of findings for pre-pregnancy BMI and inter-pregnancy weight change among migrant women in European countries

Authors	Host country	Migrant origin	Study size	Design	Study years	Study aims	Main findings
Jenum et al., 2013	The Netherlands, Norway, UK, Switzerland	Asian and African origin in Europe	Number of studies = 6 Total women = 670,304	Systematic Review	2003–2012	To review ethnic differences in adiposity among migrant women	Compared with women in the general population, African and Middle Eastern women had a higher pre-pregnancy BMI, and East and South Asian women had lower pre-pregnancy BMI.
Bahadoer et al., 2015	The Netherlands	Dutch, Turkish, Moroccan, Dutch Antillean, Surinamese and Cape Verdean	Total women = 6,444	Prospective cohort study	2001–2005	To examine ethnic differences in maternal pre-pregnancy obesity and gestational weight gain	Women of Dutch Antillean, Moroccan, Surinamese and Turkish origin had a higher prevalence of pre-pregnancy overweight and obesity compared to women of Dutch origin.
Torkildsen et al., 2019	Norway	All pregnant women	Total deliveries = 219,555	Register based	2006–2014	To study the effects of country of birth, educational level and county of residence on overweight and obesity among	Women born in the Middle East/North Africa and Sub-Saharan Africa had the highest odds for overweight and obesity compared with Norwegian women.

						pregnant women in Norway	
Jenum et al., 2012	Norway	Western Europe, Eastern Europe, South Asia, East Asia, Middle East, Africa	Total women = 823	Population-based cohort study	2008–2010	To determine the prevalence of gestational diabetes	Mean pre-pregnancy BMI was higher among women of African origin compared with Western women.
Djelantik et al., 2012	The Netherlands	Dutch, African descent, Turkish, Moroccan, other non-Western, other Western	Total women = 8,266	Community-based cohort study	2003–2004	To evaluate the contribution of women's pre-pregnancy overweight/obesity to adverse pregnancy outcomes	The prevalence of overweight/obesity was higher among women of African, Moroccan and Turkish origin compared to Dutch women.

2.11.3 Mode of delivery and delivery outcomes

There were more studies reporting mode of delivery and delivery complications among migrant-origin women (Table 4). The majority of these studies reported unfavourable outcomes for migrant-origin women. The identified vulnerable groups for caesarean delivery were Sub-Saharan African, Somali, South Asian and Afro-Caribbean women. Eastern European and East Asian women were less likely to have a caesarean delivery. One study from Germany (David et al., 2017) found no differences in obstetric and perinatal outcomes among migrant and non-migrant women. In general, migrant women were a risk group for poor obstetric and delivery outcomes.

2.11.4 Neonatal outcomes

Previous studies showed mixed results on neonatal outcomes (Table 5). Results from a review and meta-analyses showed that preterm birth, low birthweight, and health-promoting behaviour were as good as those for receiving women in the general population. However, results for stillbirth and infant mortality was worst for migrant women of Asian and African origin compared with women in the general population in the receiving country (Gagnon et al., 2009). Another review reported that refugees were more likely to have stillbirths, neonatal mortality or infant mortality compared to women in the general population (Gissler et al., 2009). Women of African origin, mainly Somali and Sub-Saharan African, had higher risks for stillbirth and infant mortality. South Asian, Sub-Saharan African and Latin America/Caribbean women were at an increased risk for low birthweight and preterm birth. Studies from most other European countries were based on a smaller sample and included certain catchment areas, which limit the comparison between different migrant groups.

Table 3. Summary of findings for gestational diabetes and hypertensive disorders among migrant women in European countries

Authors	Host country	Migrant origin	Study size	Design	Study years	Study aims	Main findings
Gagnon et al., 2011	USA, UK, Israel, Norway, Australia, Spain, Bahrain, The Netherlands, Austria	All immigrant women	Number of studies = 24 Total women = 126,298	Systematic review	1990–2009	To compare rates of gestational diabetes mellitus (GDM) among international migrant women in resettlement countries	Compared to the women in the general population in the receiving country, Caribbean, African, European and Northern European women are at higher risk of GDM.
Jenum et al., 2013	The Netherlands, Norway, UK, Switzerland	Ethnic minorities of Asian and African origin in Europe	Number of studies = 6 Total women = 251,237	Literature review	2003–2012	To review ethnic differences in hyperglycaemia and pre-eclampsia during pregnancy	Compared with women in the general population in the receiving country, African and Asian origin women and their offspring are at increased risk of type 2 diabetes and cardiovascular diseases.
Fadl et al., 2012	Sweden	Nordic and non-Nordic	Total births = 8,560	Cohort study	1998–2007	To analyse maternal and neonatal outcomes for women with GDM in Sweden	Non-Nordic women with GDM have better obstetrical and neonatal outcomes than Nordic women in Sweden.

Kosman et al., 2016	The Netherlands	Moroccan, Turkish, Caucasian, Suriname-Creole, Suriname-Hindu and others	Total women = 388	Cross-sectional study	2010–2013	To compare the perinatal outcomes in women with gestational diabetes between different ethnic groups in the Netherlands	No major differences in maternal and neonatal complications observed between different migrant groups.
Khalil et al., 2013	United Kingdom	Caucasian, Afro-Caribbean, South Asian, East Asian or mixed	Total pregnancies = 79,158 singleton pregnancies	Hospital records	Not mentioned in the study	To examine the association between maternal racial origin and adverse pregnancy outcomes	Afro-Caribbean women had an increased risk for preeclampsia, gestational hypertension and gestational diabetes compared with Caucasians.
Naimy et al., 2015	Norway	Norwegian, Pakistani, Vietnamese, Somali, Sri Lankan, Filipino, Iraqi, Thai, Afghan	Total women = 1,033,204	Registry based	1986–2005	To compare the prevalence of pre-eclampsia by the length of stay for migrant women compared with Norwegian women	The risk of pre-eclampsia was lower in migrants compared with Norwegians but increased with the length of stay in Norway.

Table 4. Summary of findings for the mode of delivery and delivery outcomes among migrant women in European countries

Authors	Host country	Migrant origin	Study size	Design	Study years	Study aims	Main findings
Almeida et al., 2013	Scotland, the Netherlands, Germany, Australia, Sweden, USA, Italy, Canada, Finland, France, Spain	All immigrant women	Number of studies = 30 Total women = 5,773,363	Literature review	1990–2012	To review the existing evidence on access, use and quality of healthcare in immigrant populations during pregnancy and postpartum	Immigrant women had a higher incidence of pregnancy, delivery and neonatal complications, reduced access to health facilities, poor communications with caregivers and less optimal care compared to the general population in the receiving country.
Small et al., 2008	Australia, Belgium, Canada, Finland, Norway, Sweden	Somali	Total women = 2,179,322	Meta analyses	1997–2004	To investigate pregnancy outcomes in Somali-born women with women born in each of the six receiving countries: Australia, Belgium, Canada, Finland, Norway and Sweden	Compared with women in the general population in the receiving country, Somali women were more likely to have caesarean sections.
Merry et al., 2013	Australia, Belgium, Canada, Finland, France, Germany, Greece,	All migrant women	Number of studies = 76 Total women = 1,029,454	Review and meta-analyses	1963–2012	To determine if migrants in Western industrialized countries consistently have different caesarean rates than women born in the receiving country	Consistently higher overall caesarean rates for Sub-Saharan African, Somali and South Asian women, lower overall rates for Eastern European and Vietnamese women compared with women in the

	Holland, Ireland, Israel, Italy, Norway, Portugal, Spain, Sweden, Switzerland, UK, USA						general population in the receiving countries.
Juarez et al., 2017	Sweden	All migrant women	Total births = 1,311,885 births	Register-based study	1999–2012	To investigate the association between the parents' country of origin and caesarean birth in Sweden	Women from Ethiopia, India, South Korea, Chile, Thailand, Iran and Finland had an increased risk of both planned and unplanned caesarean sections compared to Swedish women. Women and their partners being foreign-born increased the odds of caesarean section.
Vangen et al., 2000	Norway	Morocco, Pakistan, Sri Lanka/India, Vietnam, the Philippines, Somalia/Ethiopia/Eritrea and Chile/Brazil	Total births = 553,491 births	Register-based study	1986–1995	To study prevalence and risk factor for caesarean section among immigrant women in Norway	Compared with Norwegians, women from the Philippines, Chile/Brazil, Horn of Africa and India/Sri Lanka had a higher prevalence of caesarean delivery.

Vangen et al., 2002	Norway	Somalis	Total women = 703,925	Register-based study	1986–1998	To examine the risk of perinatal complications among Somali women in Norway	Perinatal complications like foetal distress, emergency caesarean delivery, lower Apgar score and pre-labour foetal deaths were more frequent among Somali women compared with Norwegians.
Rassjo et al., 2013	Sweden	Somalis	Total women = 785	Case-control study	2001–2009	To describe the use of antenatal care, other health services and pregnancy outcomes among Somali-origin women in Sweden	Somali women had fewer antenatal check-ups and were more likely to have anaemia, severe hyperemesis, a higher rate of caesarean sections and high perinatal mortality compared with Swedish women.
Ekeus et al., 2010	Sweden	Former Yugoslavia, Finland, Iraq, Iran, Turkey, Poland, Chile, Somalia	Total women = 455,274	Register based	1992–2005	To investigate differences in the use of epidural analgesia during labour between native Swedes and migrant-origin women	Compared with Swedish women, women from Chile, Iran, Poland and Finland more often used epidural analgesia.
David et al., 2017	Germany	All migrant women living in Berlin	Total women = 6,702	Hospital records	2011–2012	To assess if there are disparities in obstetric and perinatal health outcomes between migrant and non-migrant women in Berlin, Germany	No differences in obstetric and perinatal outcomes exist between migrant women and Germans.

Walsh et al., 2011	Ireland	Eastern Europeans	Total women = 2,551	Hospital records	2008	To examine if women from Eastern European countries have lower caesarean delivery rates and a higher spontaneous labour rate compared with Irish women in a tertiary hospital in Ireland	Eastern European women were more likely to go into labour spontaneously, required less epidural analgesia and were less likely to have a caesarean delivery than Irish women.
Almedia et al., 2014	Portugal	All immigrant women delivering in one public hospital in Portugal	Total women = 277	Hospital records	2012	To evaluate differences in obstetric care between immigrant and native women in Portugal	Immigrant women were more likely to have a caesarean delivery, perineal laceration or postpartum haemorrhage than Portuguese.
Khalil et al., 2013	United Kingdom	Caucasian, Afro-Caribbean, South Asian, East Asian or mixed	Total = 76,158 singleton pregnancies	Hospital records	Not mentioned	To examine the association between maternal racial origin and adverse pregnancy outcomes	Afro-Caribbean women had an increased risk for caesarean delivery compared with Caucasians.

Table 5. Summary of findings on neonatal outcomes among migrant women in European countries

Authors	Host country	Migrant origin	Study size	Design	Study years	Study aims	Main findings
Gagnon et al., 2009	USA, UK, France, Italy, Norway, Australia, Sweden, Spain, other European countries, Canada	All migrant women	Number of studies = 133 reviewed, 23 meta analysed Total women = 20,152,134 (reviewed) 3,022,178 (meta-analysed)	Review and meta analyses	1995–2008	To investigate if migrant women in Western industrialized countries have consistently poorer perinatal health outcomes than women in the receiving population	Results for preterm birth, low birthweight, and health-promoting behaviour were as good as those for receiving women in the general population. Asian, North African and Sub-Saharan African women had an elevated risk for stillbirth and infant mortality.
Gissler et al., 2009	USA, Spain, Italy, Belgium, Australia, UK, Sweden, Croatia, Ireland, the Netherlands, Italy, Serbia, Norway, France	All migrant women	Number of studies = 34 Total women = 9,014,636	Systematic review	1995–2006	To compare if migrant women in Western countries have higher risks of stillbirth, neonatal mortality or infant mortality	More than half of the studies reported worst mortality outcomes, one third reported no differences and a few reported better neonatal outcomes among migrant women compared with women in the receiving population. Refugees were the most vulnerable group for stillbirths, neonatal mortality or infant mortality.

Li et al., 2012	Sweden	All migrant women	Total births = 1,060,467 births	Birth registry-based	1973–2006	To examine the association between birth country of parents and SGA in a first singleton birth	African, Asian and Southern European parents had a higher risk of SGA babies compared to Swedes.
Urquia et al., 2009	USA, UK, Belgium, Sweden, France, Norway	All migrants	Number of studies = 24 Total births = 31,021,461	Review	1995–2007	To examine if low birthweight and preterm birth differ between migrant and non-migrants	Sub-Saharan African, Latin American and the Caribbean and South-Central Asians migrant women were at increased risk for delivering low-birthweight babies in Europe compared with women in the general population.
Small et al., 2008	Australia, Belgium, Canada, Finland, Norway, Sweden	Somali	Total women = 2,179,322	Meta analyses	1997–2004	To investigate pregnancy outcomes in Somali-born women with those women born in each of the six receiving countries: Australia, Belgium, Canada, Finland, Norway and Sweden	Compared with women in the receiving country, Somali women were more likely to have stillbirths and less likely to have preterm births and low-birthweight babies.
Reeske et al., 2011	Germany	Germany, Middle/ Northern	2,670,048 live births and stillbirths	Nationwide perinatal database	2004–2007	To examine differences in risk of stillbirth among migrant-origin and German women	Women of Middle Eastern/North African, Asian and Mediterranean origin were at higher risk of stillbirth compared with Germans.

		Europe, North America, Mediterranean, East European, Middle Eastern and Asian					
Malin & Gissler 2009	Finland	All migrant women in Finland	Total women = 165,001	Register-based study	1999–2001	To compare access to and use of maternity services and their outcomes among immigrant women giving birth in Finland	Somali and African-origin women had the highest perinatal mortality rates. East European, Middle Eastern, North African and South Asian women had a higher risk for low-birthweight babies.
Villadsen et al., 2010	Austria, Belgium, Denmark, England and Wales, Germany, the Netherland	Turkish	Total births = 239,387 births	Birth registry and previous publications	1990–2005	To study variation of stillbirth and neonatal mortalities among Turkish women between societies in Northern Europe	The risk for stillbirth was higher for Turkish-origin women in all countries compared with the native women, whereas for neonatal mortality, the results were heterogeneous, with excess risk among Turkish-origin women living in Denmark,

	s, Norway, Sweden, Switzerland						Switzerland, Austria and Germany.
Pedersen et al., 2012	Denmark	Yugolasvia, Somalia, Labanon, Pakistan and Turkey	Total births = 1,684,807 births	Register-based study	1978–2007	To examine the association of age at immigration and length of residence with preterm birth and SGA delivery among immigrants in Denmark	All immigrant groups had a higher risk for small for gestational age delivery with the highest risk among Lebanese, Somali and Pakistani women compared with Danish women.
Khalil et al., 2013	United Kingdom	Caucasian, Afro-Caribbean, South Asian, East Asian or mixed	Total pregnancies = 79,158 singleton pregnancies	Hospital records	Not mentioned	To examine the association between maternal racial origin and adverse pregnancy outcomes	Afro-Caribbean women had an increased risk for miscarriage, stillbirth, preterm birth and small for gestational age compared with Caucasians.

2.11.5 Identified gaps in research

The health of migrant pregnant women and their offspring is still a relatively new research area globally and in Finland. Most of the research in the European countries is based on the smaller sample of migrant women, limiting their generalisability. Another problem in migrant research is a lack of uniformity in the classification of migrant groups. Some studies identify migrant groups based on country of birth, whereas some studies identified based on country of origin. Many studies lack information on migration status, language skills and length of stay. This is important information for identifying the access and use of health services among the migrant population.

The present study tried to fill in this gap in research by including the major migrant groups living in Finland. In the first three papers, in addition to age, the country of birth, mother tongue and length of stay were used as the eligibility criteria. Finally, while, performing the analyses of paper I–III, a need for a study including all migrant groups in Finland was identified. That is why paper IV included all migrant women giving birth in Finland between 2004–2014. In paper IV, country of origin is used to identify the migrant groups.

3 AIMS OF THE STUDY

The general aim of this study was to provide the knowledge necessary to improve the health of pregnant migrant women and their newborns in Finland.

The specific aims of the study were:

1. To study differences in the prevalence of mean pre-pregnancy BMI and the mean inter-pregnancy weight change between migrant women of Russian, Somali and Kurdish origin and women in the general population.
2. To examine differences in the prevalence of pregnancy complications (such as gestational diabetes, pre-eclampsia and hypertension) between migrant women of Russian, Somali and Kurdish origin and women in the general population.
3. To study differences in the prevalence of caesarean delivery and its complications among migrant women of Russian, Somali and Kurdish origin and women in the general population.
4. To investigate differences in the prevalence of caesarean delivery and neonatal outcomes among migrant women in Finland between the years 2004–2014.

4 MATERIALS AND METHODS

4.1 Migrant Health and Wellbeing Study

The samples for papers I–III were identified from the first large-scale migrant health examination survey in Finland, the Migrant Health and Wellbeing Study (Maamu). The Maamu survey was conducted by the Finnish Institute for Health and Welfare (THL) in collaboration with the Finnish Ministry of Social Affairs and Health. THL conducted the Maamu survey in the cities of Helsinki, Espoo, Vantaa, Turku, Tampere and Vaasa from 2010–2012. The participants of the study were randomly selected from the National Population Register. A random sample of 3,000 persons (1,000 migrant per origin group) was drawn from the National Population Register (Castaneda, Rask, Koponen, Mölsä, & Koskinen, 2012). The selection criteria were age (16–64 years), country of birth (Russia/former Soviet Union, Somalia, Iran/Iraq), mother tongue (Russian or Finnish for persons born in Russia, Sorani dialect of Kurdish for persons born in Iran/Iraq) and length of stay (at least one year) in Finland. The study was conducted in six cities that have a higher proportion of migrants than most other Finnish cities. When this study was planned, Russian-origin migrants were the largest migrant group in Finland. Somali-origin migrants were the fourth-largest migrant group and the largest migrant group with a refugee background and of the Muslim faith. Kurdish-speaking migrants were the sixth-largest migrant group and were among the largest groups of quota refugees accepted in Finland in recent years (Castaneda et al., 2012). An additional sample of 3,000 migrants with similar inclusion criteria was selected at the same time as the Maamu survey for register-based studies. Of the total sample of 6,000 adults, all women aged 18–64 (n=3,158) were included in papers I–III.

The data collected from these women were linked to the Finnish Medical Birth Register with the help of personal identification numbers to obtain data on all their previous births while living in Finland from 1 January 2004 to 31 December 2014. Additionally, these data were linked to the Finnish Hospital Discharge Register to obtain information on all medical diagnoses registered during pregnancy for the same period.

4.2 Health 2011 Survey

The reference group comprises 18–64-year-old Finnish women who participated in the Health 2011 study in the same cities as the Maamu survey. The Health 2011 survey is a national survey on changes in the health status, functional capacity and welfare of the general population in Finland (Koskinen, Lundqvist, & Ristiluoma, 2012). The Health 2011 survey was a follow-up survey to the Health 2000 survey, which was conducted among the general Finnish population in the year 2000. Altogether, 8,135 persons belonging to the Health 2000 Survey sample, who had not declined future contact during the baseline survey and who were still alive in July 2011, lived in Finland and had contact information available, were invited to participate in the Health 2011 Survey. The baseline Health 2000 survey consisted of adults aged 18 years or older; therefore, upon follow-up participants were aged 29 years or older. To gather information on the health and wellbeing of young adults, an additional sample of adults aged 18–28 was drawn from the National Population Register (n=1,994). Thus, the total sample for the Health 2011 Survey was 10,129 persons. The Health 2011 Survey followed a comparable standardised study protocol as the Maamu survey. Participation rate in at least one part of the Health 2011 survey was 73.6% (Koskinen et al., 2012). Women aged 18–64 and living in the Maamu cities (Helsinki, Espoo, Vantaa, Turku, Tampere, Vaasa) were selected as the reference group (n=1,163) for the present study. A flowchart is presented to describe the Maamu survey and the Health 2011 survey (Figure 3).

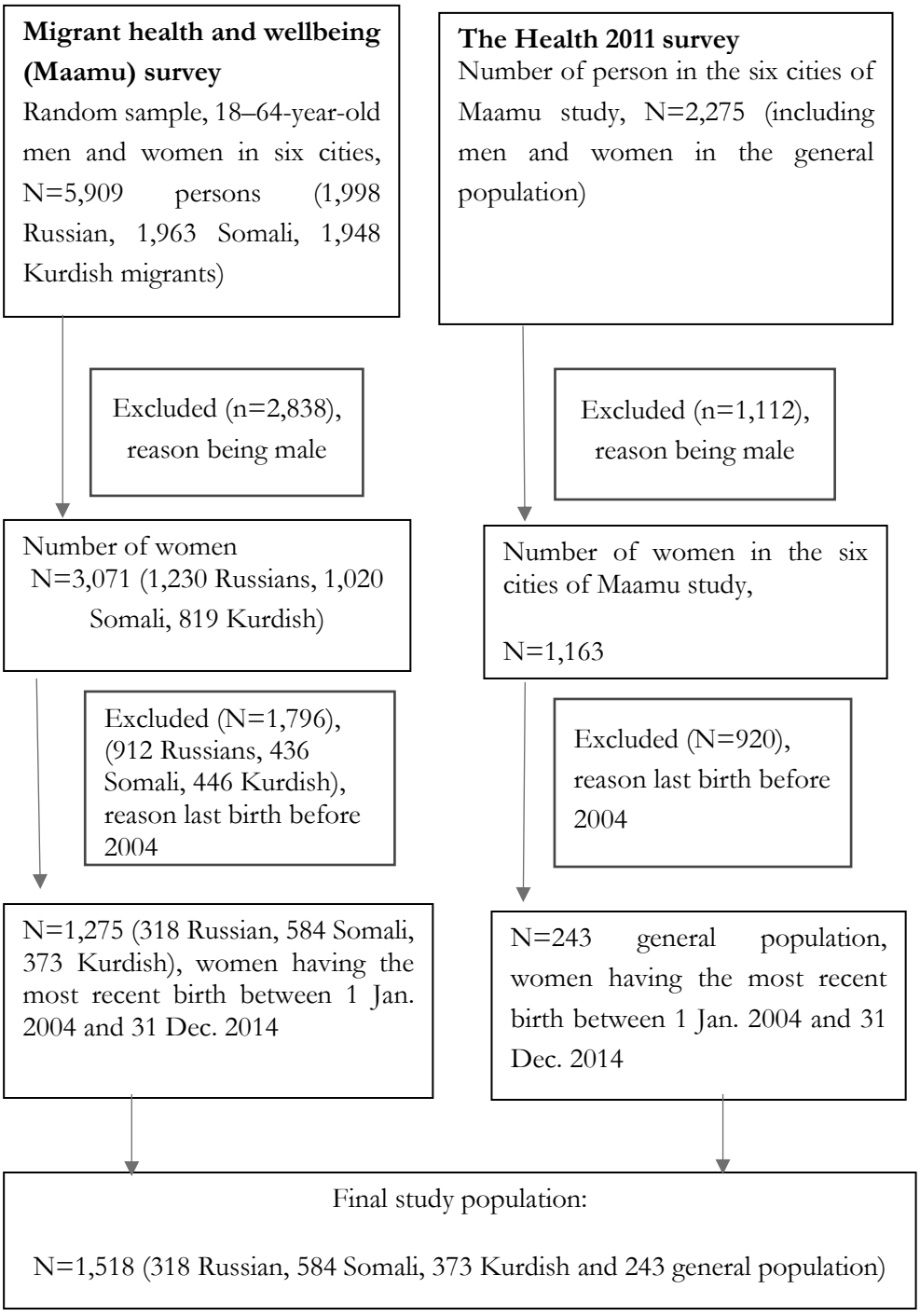


Figure 3. Flowchart of the study population (papers I–III)

4.3 Register-based data

4.3.1 Papers I–III

All papers were based on data from the Medical Birth Register (MBR), maintained by the THL. For papers I–III, data of all women in the Maamu sample and the Health 2011 Survey sample were linked to the MBR from 1987 to 2014 to obtain data on all previous pregnancies and births, that occurred in Finland. The data on the socioeconomic position were obtained from Statistics Finland for the year 2011. The MBR includes information on mothers' sociodemographic background, healthcare and interventions during pregnancies and deliveries, as well as smoking and pre-pregnancy weight and height (Medical Birth Register, 2019). The information is recorded at the maternity clinic and health centres during antenatal check-up by midwives and later uploaded to the register. Self-reported pre-pregnancy height and weight have only been recorded in the MBR since 2004, and for the Helsinki region it started in autumn 2005. The personal identification numbers, which were available in all data sources, were used in all data linkage but removed from the dataset before analysis.

For papers II and III, data from the MBR and the Hospital Discharge Register were linked. The Hospital Discharge Register includes information on all inpatient and outpatient hospital care, with diagnoses recorded as ICD-10 codes (Medical Birth Register, 2019). The Hospital Discharge Register was used to complete the diagnoses in the MBR. For paper I–III, the final sample was women having at least one birth between 1 January 2004 and 31 December 2014 (n=1,518).

4.3.2 Paper IV

Paper IV was based on the MBR data on all pregnancies and births from 1 January 2004 to 31 December 2014. Later, it became possible to link the MBR data with Statistics Finland to obtain information on country of origin. This made it possible to study birth outcomes among all groups of migrant women and Finnish women in Finland. All women of migrant origin were included in the study, regardless of the duration of their stay in Finland. Paper IV included information on each woman's most recent birth in Finland between January 2004 and December 2014 (n=389,758). Multiple births (n=7,525) were

excluded and only singleton births (n= 382,233) were included. Information on the country of origin and socioeconomic position were obtained from Statistics Finland, and this information was linked together using personal identification codes for each woman. Country of origin is based on the country of birth of the woman's parents; when discussing pregnant women and related complications, country of origin is based on the country of birth of the woman's parents. However, when discussing the newborn's characteristics, the country of origin is the newborn's grandparents' country of birth. If both parents were born abroad, the country of birth of the pregnant woman's biological mother is the primary country of origin. If one of the parents was born in Finland, the country of origin is Finland (Statistics Finland, 2019). This definition, therefore, includes both the migrants and their children. Women were classified into nine categories, according to their country of origin: (i) Finland; (ii) Western Europe/North America/Oceania (i.e., other Western); (iii) Eastern Europe; (iv) Russia/former Union of Soviet Socialist Republics (USSR); (v) South Asia; (vi) East Asia; (vii) Sub-Saharan Africa; (viii) Middle East/North Africa; and (ix) Latin America/Caribbean. A small number of women (n=231) with an unknown country of origin were excluded. A list of the countries and numbers of women in each group is presented in Table 6.

Table 6. List of countries and numbers of women in each migrant group by country of origin

Groups	Number of women
Finland	**350,548**
Other Western/North America/Oceania	**2,290**
Australia	35
Austria	35
Belgium	17
Canada	64
Cyprus	1
Denmark	33
France	147
Germany	370
Greece	30
Hungary	212
Iceland	21
Ireland	23
Italy	103
Luxembourg	3
Malta	1
New Zealand	8
Norway	60
Papua New Guinea	1
Portugal	28
Solomon Island	1
Spain	132
Sweden	507
Switzerland	39
The Netherlands	54
United Kingdom	138
United States of America	230
Eastern Europe	**2,566**
Albania	26
Bosnia- Herzegovina	89
Bulgaria	166
Croatia	20
Czech Republic (Czechia)	25
Czechoslovakia	71
Former Yugoslavia	1,410
Macedonia	24
Montenegro	1
Poland	413
Romania	277
Serbia	18
Slovakia	24

Slovenia	2
Russia/former USSR	**11,994**
Armenia	17
Azerbaijan	14
Belarus	34
Estonia	3,513
Former USSR	7,154
Georgia	8
Kazakhstan	24
Kyrgyzstan	3
Latvia	202
Lithuania	122
Moldova	26
Russia	685
Tajikistan	3
Turkmenistan	1
Ukraine	173
Uzbekistan	15
South Asia	**1,904**
Afghanistan	529
Bangladesh	262
Bhutan	1
India	624
Nepal	115
Pakistan	237
Sri Lanka	136
East Asia	**4,948**
Cambodia	56
China	1,138
Indonesia	89
Japan	230
Laos (Lao)	16
Malaysia	46
Mongolia	6
Myanmar	184
Philippines	479
Singapore	19
South Korea	57
Thailand	1,662
Vietnam	964
Africa including Sub-Saharan Africa	**3,548**
Angola	85
Benin	2
Botswana	3
Burundi	8

Cameron	108
The Central African Republic	1
Comoros	1
Congo	256
Cote d´Ivoire	9
Djibouti	3
Eritrea	22
Ethiopia	208
Gabon	1
The Gambia	53
Ghana	165
Guinea and Equatorial Guinea	9
Kenya	215
Liberia	18
Madagascar	2
Malawi	1
Mauritius	5
Mozambique	9
Namibia	6
Niger	1
Nigeria	182
Rwanda	25
Seychelles	3
Senegal	13
Somalia	1,778
South Africa	23
Sudan	187
Tanzania	74
Togo	6
Uganda	30
Zambia	31
Zimbabwe	7
Middle East & North Africa	**3,465**
Algeria	98
Bahrain	1
Egypt	63
Iran	557
Iraq	1,277
Israel	43
Jordan	36
Kuwait	14
Lebanon	55
Libya	24
Morocco	338
Oman	1

Palestine	4
Qatar	1
Saudi Arabia	17
Sierra Leone	10
Syria	89
Tunisia	71
Turkey	757
UAE	4
Yemen	5
Latin America & Caribbean	**738**
Antigua & Barbuda	1
Argentina	45
Bahamas	1
Bolivia	22
Brazil	219
Chile	44
Colombia	58
Costa Rica	9
Cuba	43
Dominican Republic	19
Ecuador	27
El Salvador	12
Guatemala	8
Guyana	2
Haiti	1
Honduras	12
Jamaica	13
Mexico	77
Nicaragua	10
Panama	4
Paraguay	2
Peru	76
Saint Lucia	1
Samoa	1
Trinidad & Tobago	4
Uruguay	7
Venezuela	20
Other	**231**
Asylum seeker (unknown)	203
Unknown	28

4.4 Outcome variables and confounders

The lists of outcome variables and adjusted confounders and their definitions in each paper are described in Table 7 and Table 8.

Table 7. List of outcome variables and their definitions in papers I–IV

Paper	Variable name	Definition
I	Pre-pregnancy BMI	<18.5 kg/m² (underweight), 18.5–24.9 kg/m² (normal weight), 25–29.9 kg/m² (overweight) ≥30.0 kg/m² (obesity)
I	Inter-pregnancy weight change	The difference in weight (and BMI) from the beginning of the second-latest pregnancy to the beginning of the latest pregnancy.
II	Gestational diabetes mellitus	Yes (ICD-10 codes O24.4, O24.9, P08.0 or P08.1); or No
II	Hypertensive disorders	Yes (ICD-10 codes O13, O16, O14.0, O14.1, or O14.9); or No
III	Mode of delivery	Vaginal (spontaneous vaginal/breech/vacuum extractor/forceps) and caesarean (elective caesarean/emergency caesarean/urgent caesarean/other caesarean)
III	Delivery complications	Obstructed labour; Yes (ICD-10 codes O64.0 – O64.5, O64.8 – O64.9, O65.0 – O65.4, O65.8 – O65.9 or O66.0 – O66.3); or No Foetal stress; Yes (ICD-10 codes O68.0 – O68.3, O68.8 – O68.9); or No Perineal laceration; Yes (ICD-10 codes O70.0 – O70.3 or O70.9); or No Postpartum haemorrhage; Yes (ICD-10 codes O72.0 – O72.3); or No
III	Pain Medication	Epidural/spinal/epidural spinal combined (Yes or No); Paracervical/pudendal (Yes or No); Inhalation (Yes or No); Others (Yes or No)
IV	Elective caesarean delivery	Elective caesarean deliveries (versus all other deliveries)
IV	Emergency caesarean delivery	Emergency caesarean delivery (versus all other deliveries except elective caesarean)
IV	Gestational age	Preterm (≤36 weeks +6 days), full-term (37 weeks +0 days to 41 weeks +6 days) and post-term (≥42 weeks +0 days)
IV	Birthweight	Low birthweight (<2,500 g), normal birthweight (2,500–3,999 g) and high birthweight (≥4,000 g)
IV	Five-minute Apgar score	0–6 (low) or 7–10 (high).
IV	NICU care	Yes or No

Table 8. List of confounders and their definitions in papers I–IV

Papers	Variables adjusted for	Definition
I, II, III, IV	Age	Years, used as a continuous variable
I, II, IV	Socioeconomic position	Upper-level employees, lower-level employees, manual workers, others or unknown
I, III, IV	Smoking during pregnancy	Yes or No
I, IV	Marital status	Unmarried/divorced/widowed or married/cohabitation/registered partnership
I, II, III, IV	Parity	None, one, two or more
I	Inter-pregnancy interval	Years, used as a continuous variable
II, III, IV	BMI	Kg/m^2, used as a continuous variable
III	Gestational age	Preterm (≤36 weeks +6 days), full-term (37 weeks +0 days to 41 weeks +6 days) and post-term (≥42 weeks +0 days)
IV	Delivery year	Years, used as a continuous variable

4.5 Ethical consideration

We obtained permission to use the data from respective registries from THL and Statistics Finland. The THL obtained ethical approval for the Maamu and the Health 2011 studies, including the use of register data from the Coordinating Ethical Committee of the Helsinki and Uusimaa Hospital Region. No separate informed consent was required from the participants, as we used register data according to Finnish legislation and guidelines for register-based research. We analysed and stored the data at the THL, following THL data safety regulations.

4.6 Statistical methods

We performed statistical analyses for papers I–III with Stata version 14 (Stata Corp LP, College Station, TX, USA). The inverse sampling probability weights were applied to the stratified sampling method, and finite populations were accounted for in all analyses for papers I–III to correct for the effect of non-response and differential sampling probabilities (Castaneda et al., 2012).

Descriptive data were reported as numbers of observations and prevalence (%). χ^2 tests were used to compare crude percentages. To study inter-pregnancy weight change between the two most recent pregnancies, women who had at least two births from 2004 to 2014 were included. For paper I, linear logistic regression method was used as the main method of analyses. For papers II–III, logistic regression was used as the main method of analysis. For paper IV, all analyses were performed using Statistical Package for Social Sciences (SPSS, version 23, SPSS Inc. Chicago, IL). A generalised linear model was the main method of analysis. All regression analyses were adjusted for confounders in all papers.

5 RESULTS

5.1 Papers I–III

5.1.1 Background characteristics

Background characteristics of the study population are described in Table 9. The distribution of age at most recent birth was similar among all study groups. More than half of all births occurred in the age group 25–34 years. The majority of the women (87–97%) were either married, cohabiting or had a registered partnership. A lower percentage of all migrant women were upper- or lower-level employees (18–41%) than women in the general population (63%). Women in the general population were more likely to smoke during pregnancy (18%) compared with all migrant women (2–14%). A higher percentage of Somali women were multiparous (72%) compared with women in the general population (22%).

Table 9. Characteristics of women in the general population and in the migrant groups at most recent delivery, all singleton births, Finland (2004–2014)

	General population (n=243)	Russian (n=318)	Somali (n=584)	Kurdish (n=373)
Age, years, n (%)				
18–24	24 (10.5)	35 (11.6)	115 (17.6)	59 (16.1)
25–34	152 (62.2)	203 (62.5)	295 (50.8)	232 (62.0)
35 or older	67 (27.2)	80 (25.8)	174 (31.4)	82 (27.2)
Marital status, n (%)				
Married/cohabiting/ registered partnership	214 (88.0)	280 (86.9)	519 (89.0)	361 (97.5)
Single/divorced/widow	29 (12.0)	38 (13.1)	64 (11.0)	10 (2.5)
Employment status, n (%)				
Upper-level employees[1]	63 (25.8)	46 (14.3)	16 (2.7)	10 (2.8)
Lower-level employees[2]	91 (37.5)	86 (26.7)	82 (15.0)	53 (14.4)
Manual workers	42 (17.2)	54 (15.9)	52 (9.1)	69 (18.2)
Other	28 (11.6)	100 (31.9)	241 (39.3)	175 (47.2)
Unknown	19 (7.7)	32 (11.0)	193 (33.7)	66 (17.2)
Smoking, n (%)				
No	191 (81.5)	268 (86.0)	558 (98.0)	348 (95.1)
Yes	44 (18.4)	43 (13.9)	14 (2.0)	19 (4.4)
Previous births, n (%)				
0	98 (40.7)	118 (37.8)	59 (9.4)	87 (23.7)
1	91 (37.3)	136 (43.4)	109 (18.2)	136 (36.7)
2 or more	54 (22.0)	64 (18.6)	416 (72.3)	149 (39.4)

[1] Upper-level employees with administrative, managerial, professional and related occupations

[2] Lower-level employees with administrative and clerical occupations

5.1.2 Major findings

Paper I observed differences in the mean pre-pregnancy BMI and mean inter-pregnancy weight change between women of Russian, Somali and Kurdish origin and women in the general Finnish population. Somali and Kurdish women were more likely to be overweight or obese (54–64%) compared to women in the general population (29%). The unadjusted mean pre-pregnancy BMI was higher in Somali (27.0 kg/m²) and Kurdish women (25.8 kg/m²) but lower in Russian women (22.2 kg/m²) compared with women in the general Finnish population (24.1 kg/m²) (Table 10). Unadjusted mean inter-pregnancy

weight change was higher in Kurdish (3.2 kg) and Somali (3.1 kg) and lower in Russian (1.0 kg) than women in the general population (2.1 kg) (Table 10). The adjusted coefficients for the differences in the mean pre-pregnancy BMI were –1.99 (95% CI –2.83 to –1.16,) for Russian, 1.80 (95% CI 0.88 to 2.73) for Somali and 1.26 (95% CI 0.39 to 2.13) for Kurdish women compared with women in the general Finnish population (Table 11). No statistically significant differences were observed in mean inter-pregnancy weight change between the migrant groups and women in the general Finnish population after adjusting for confounders (Table 11).

Paper II compared the prevalence of GDM and hypertensive disorders in the most recent pregnancy among women of Russian, Somali and Kurdish origin and women in the general population in Finland. The prevalence of GDM was 19.1% in Kurdish women, 14.4% in Somali women, 9.3% in Russian women and 11.8% in the general population (Table 10). The prevalence of hypertensive disorders was 5.4% in the general population, 3.8% in Somalian, 3.1% in Kurdish and 1.7 in Russians (Table 10). When adjusted for confounders, Kurdish women had two-fold odds for GDM (OR 1.98; 95% CI; 1.20–3.32) compared with the general population (Figure 4), but the odds for hypertensive disorders did not differ between groups (Figure 5).

Paper III compared mode of delivery, delivery complications and use of pain medication during delivery between migrant women of Somali, Kurdish and Russian origin and women in the general population in Finland. Findings revealed that vaginal delivery was the most common mode of delivery among all study groups (79–89%), (Table 10). The variable "any delivery complications" was created as the summary variable for delivery complications, obstructed labour, foetal stress, perineal laceration and postpartum haemorrhage. The prevalence of any delivery complications varied between 15–19% among all study groups. Use of pain medication during vaginal delivery varies from 76–84% among the study groups (Table 10). When adjusted for confounders, Russian women had lower odds (OR 0.49; CI 0.29–0.82) of having a caesarean delivery, whereas Somali and Kurdish women did not differ from the reference group (Figure 6). Somali women had increased odds of any delivery complications (OR 1.66; CI 1.06–2.60) compared with the reference group (Figure 7). No differences were observed in the use of pain medication between the groups (Figure 8).

Table 10. Pregnancy and delivery-related characteristics in the most recent delivery by women in the general population and migrant women, Finland (2004–2014)

	General population (n=243)	Russian (n=318)	Somali (n=584)	Kurdish (n=373)
Pre-pregnancy BMI, kg/m², n (%)[1]				
Underweight	14 (5.8)	30 (11.1)	26 (4.5)	5 (1.5)
Normal weight	149 (64.5)	201 (71.5)	183 (32.2)	157 (44.7)
Overweight	44 (19.1)	40 (12.6)	196 (36.0)	126 (37.1)
Obese	24 (10.4)	17 (4.6)	146 (27.3)	57 (16.5)
Mean pre-pregnancy BMI, kg/m², (SD)	24.1 (4.7)	22.2 (4.4)	27.0 (5.4)	25.8 (4.4)
Mean interpregnancy weight change, kg²[2], (SD)	2.1 (5.9)	1.0 (6.6)	3.1 (6.9)	3.2(5.7)
Mean inter-pregnancy BMI change, kg/m², (SD)	0.7 (2.1)	0.3 (2.4)	1.1 (2.6)	1.2 (2.2)
GDM, n (%)	29 (11.8)	29 (9.3)	84 (14.4)	72 (19.4)
Hypertensive disorders, n (%)	13 (5.5)	6 (1.8)	23 (3.9)	12 (3.2)
Gestational age, n (%)				
Preterm	10 (4.4)	15 (4.8)	35 (6.3)	20 (5.5)
Full term	213 (87.6)	288 (91.0)	486 (83.7)	335 (89.8)
Post-term	20 (8.0)	15 (4.2)	62 (10.0)	17 (4.7)
Mode of delivery, n (%)				
Spontaneous vaginal	172 (70.5)	256 (80.6)	441 (75.2)	281 (75.0)
Breech	1 (0.4)	4 (1.5)	2 (0.3)	6 (1.6)
Vacuum extractor	19 (7.7)	22 (7.3)	25 (4.1)	30 (8.0)
Elective caesarean section	24 (10.0)	16 (5.1)	51 (8.6)	19 (5.1)
Urgent caesarean section	27 (11.3)	20 (5.2)	65 (11.5)	36 (10.0)
Any delivery complications, n (%)	47 (19.2)	55 (14.9)	98 (16.5)	70 (18.4)
Any pain medication	161 (84.0)	225 (79.7)	357 (76.2)	251 (78.7)

[1] The number of women in the general population, Russian, Somali and Kurdish origin for pre-pregnancy BMI were 231, 288, 521 and 345, respectively

[2] The number of women in the general population, Russian, Somali and Kurdish origin for mean interpregnancy weight change and BMI change were 81, 88, 386 and 171 respectively

Table 11. Coefficients and 95% confidence intervals for differences in pre-pregnancy body mass index (BMI) and inter-pregnancy weight change among migrant women compared with women in the general population

Groups	Pre-pregnancy BMI		Inter-pregnancy weight change	
	Model I* Coefficient (CI) (N=1,397–1,416)	**Model II* Coefficient (N=1,397)**	**Model I* Coefficient (CI) (N=717–726)**	**Model II* Coefficient (N=712)**
General population	Reference	Reference	Reference	Reference
Russian	**–1.91 (–2.71 to –1.10)**	**–1.93 (–2.77 to –1.09)**	–1.06 (–2.87 to 0.74)	–1.64 (–3.52 to 0.23)
Somali	**2.92 (2.17 to 3.68)**	**1.82 (0.89 to 2.75)**	1.01 (–0.39 to 2.43)	1.31 (–0.37 to 3.02)
Kurdish	**1.74 (1.00 to 2.47)**	**1.30 (0.43 to 2.17)**	1.12 (–0.35 to 2.59)	0.64 (–1.12 to 2.41)

*Model I – Crude model

*Model II – Adjusted for age, smoking habit, marital status, socioeconomic position and parity. Interpregnancy weight change is additionally adjusted for interpregnancy interval.

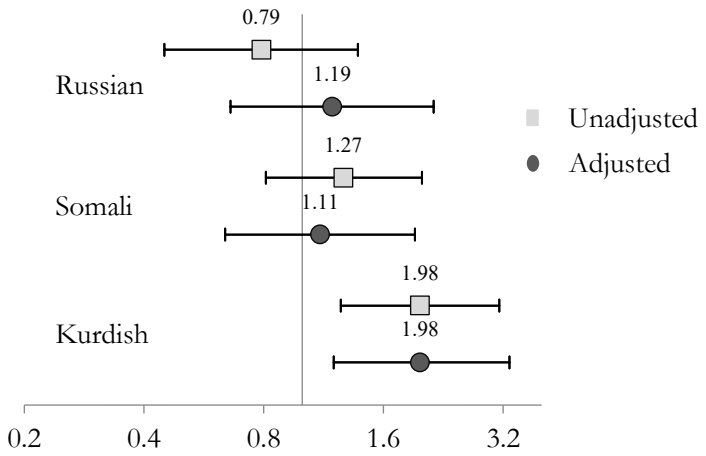


Figure 4. Gestational diabetes among migrant-origin women and women in the general population: odds ratio (95% confidence interval) adjusted for age, pre-pregnancy BMI, socioeconomic position and parity

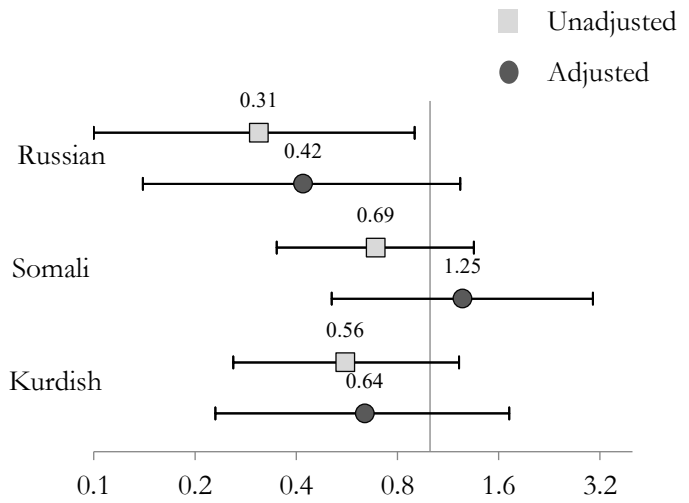


Figure 5. Hypertensive disorders among migrant-origin women and women in the general population: odds ratio (95% confidence interval) adjusted for age, pre-pregnancy BMI, socioeconomic position and parity

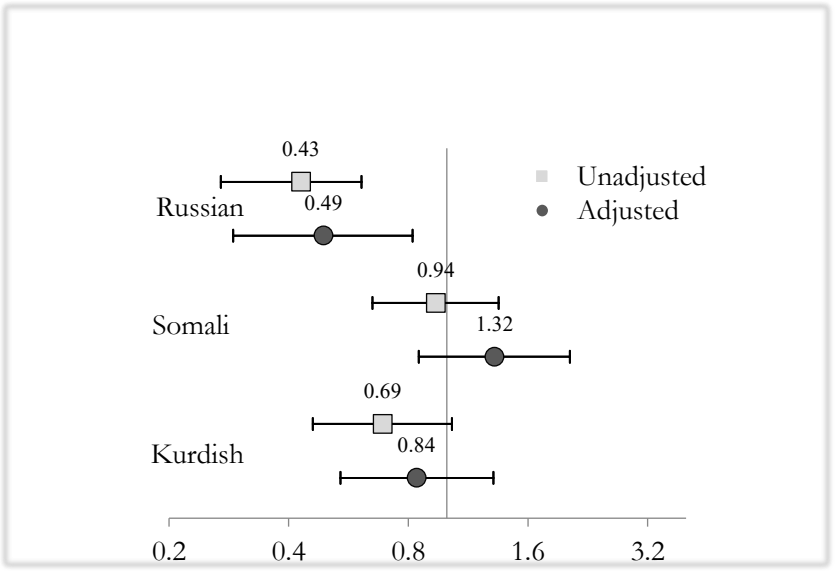


Figure 6. Caesarean delivery among migrant-origin women and women in the general population: odds ratio (95% confidence interval) adjusted for age, pre-pregnancy BMI, socioeconomic position, gestational age, smoking and parity

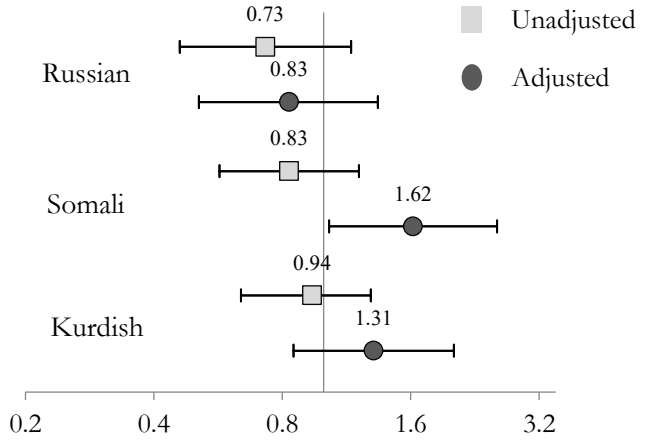


Figure 7. Complications of delivery among migrant-origin women and women in the general population: odds ratio (95% confidence interval), adjusted for age, pre-pregnancy BMI, socioeconomic position, gestational age, smoking and parity

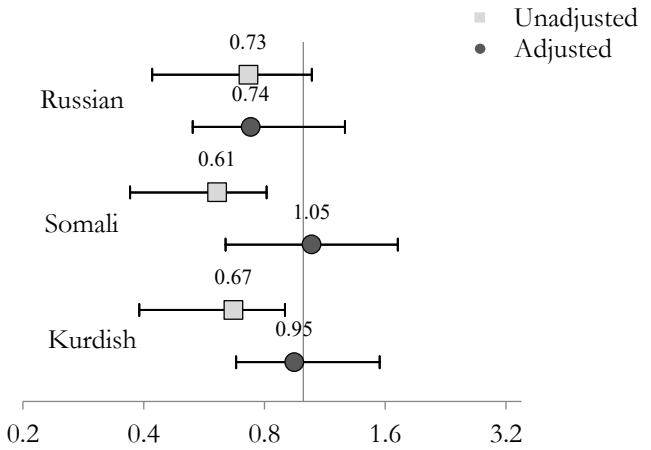


Figure 8. Use of pain medication among migrant-origin women and women in the general population: odds ratio (95% confidence interval), adjusted for age, pre-pregnancy BMI, socioeconomic position, gestational age, smoking and parity

5.2 Paper IV

5.2.1 Background characteristics

Almost 8% of the study population was of migrant origin. The largest migrant group was Russian/former USSR-origin women (n=11,994), whereas the smallest group was Latin American/Caribbean-origin women (n=739), (Table 12). Very few (0.01%) women of migrant origin were born in Finland. Compared with Finnish women, the percentages of women in the upper- and lower-level employee categories were lower for all other migrant-origin women, except for women from other Western countries. Finnish, Eastern European and Russian/former USSR-origin women were more likely to smoke during pregnancy (16–17%) than other groups. Women of Russian/former USSR origin had a higher prevalence and women of South Asian origin had a lower prevalence of at least one previous abortion compared with Finnish-origin women. Women of Sub-Saharan African and Middle Eastern origin had a higher prevalence and women of East Asian origin had a lower prevalence of overweight and obesity compared with Finnish-origin women.

Table 12. Background characteristics of migrant-origin and Finnish-origin women at most recent delivery, all singleton births, Finland (2004–2014), (number & crude percentage).

Variables	Finnish, (n=350,548)	Other Western[a] (n=22,90)	Eastern Europe (n =2,566)	Russia, former USSR (n=11,994)	South Asia, (n =1,904)	East Asia (n=4,948)	Sub-Saharan Africa (n =3,548)	Middle East (n=3,465)	Latin America, Caribbean (n =739)
	Number (%)								
Age at birth (years)									
<25	44,671 (12.7)	161 (7.0)	492 (19.2)	1,924 (16.0)	355 (18.6)	538 (10.9)	743 (20.9)	682 (19.7)	73 (9.9)
25–29	93,177 (26.6)	445 (19.4)	799 (31.1)	3,666 (30.6)	728 (38.2)	1,335 (27.0)	978 (27.6)	1,009 (29.1)	167 (22.6)
30–34	122,549 (35.0)	870 (38.0)	771 (30.0)	3,614 (30.1)	583 (30.6)	1,704 (34.4)	1,010 (28.5)	929 (26.8)	256 (34.6)
≥35	90,151 (25.7)	814 (35.5)	504 (19.6)	2,790 (23.3)	238 (12.5)	1371 (27.7)	817 (23.0)	845 (24.4)	243 (32.9)
Socioeconomic position									
Upper-level employees	72,235 (20.6)	772 (33.7)	298 (11.6)	1,253 (10.4)	313 (16.4)	716 (14.5)	139 (3.9)	156 (4.5)	177 (24.0)
Lower-level employees	136,900 (39.1)	556 (24.3)	439 (17.1)	2,515 (21.0)	244 (12.8)	777 (15.7)	438 (12.3)	291 (8.4)	159 (21.5)
Manual workers	77,953 (22.2)	436 (19.0)	885 (34.5)	4,193 (35.0)	448 (23.5)	1,813 (36.6)	683 (19.3)	889 (25.7)	160 (21.7)
Others	43,168 (12.3)	269 (11.7)	559 (21.8)	2,392 (19.9)	579 (30.4)	1,072 (21.7)	1,137 (32.0)	1,146 (33.1)	163 (22.1)
Unknown	20,292 (5.8)	257 (11.2)	385 (15.0)	1,641 (13.7)	320 (16.8)	570 (11.5)	1151 (32.4)	983 (28.4)	80 (10.8)
Marital status									
Single	19,377 (5.5)	43 (1.9)	71 (2.8)	723 (6.0)	20 (1.1)	184 (3.7)	315 (8.9)	77 (2.2)	25 (3.4)

Married/ cohabiting	316,743 (90.4)	2,135 (93.2)	2,438 (95.0)	10,485 (87.4)	1,868 (98.1)	4,593 (92.8)	2,974 (83.8)	3,329 (96.1)	697 (94.3)
Unknown	14,428 (4.1)	112 (4.9)	57 (2.2)	786 (6.6)	16 (0.8)	171 (3.5)	259 (7.3)	59 (1.7)	17 (2.3)
Smoking during pregnancy	56,030 (16.0)	200 (8.7)	438 (17.1)	1,992 (16.6)	19 (1.0)	209 (4.2)	72 (2.0)	226 (6.5)	43 (5.8)
Parity									
None	104,720 (29.9)	887 (38.8)	833 (32.5)	4,331 (36.1)	814 (42.8)	2,004 (40.5)	879 (24.8)	955 (27.6)	329 (44.5)
One	142,413 (40.6)	868 (38.0)	999 (38.9)	4,992 (41.6)	670 (35.3)	1,885 (38.1)	912 (25.7)	1,187 (34.3)	275 (37.2)
Two or more	103,251 (29.5)	530 (23.2)	734 (28.6)	2,665 (22.2)	416 (21.9)	1,057 (21.4)	1,755 (49.5)	1,320 (38.1)	135 (18.3)
Pre-pregnancy BMI[b]									
Underweight	10,393 (3.1)	112 (5.3)	146 (6.0)	857 (7.5)	106 (5.9)	674 (14.4)	143 (4.3)	106 (3.3)	30 (4.4)
Normal weight	203,463 (60.7)	1,420 (66.6)	1,557 (63.9)	7,725 (67.8)	1,043 (58.1)	3,406 (72.9)	1,431 (43.2)	1,561 (48.1)	489 (71.4)
Overweight	76,324 (22.8)	383 (18.0)	531 (21.8)	1,952 (17.1)	496 (27.6)	499 (10.7)	1,059 (31.9)	1,086 (33.5)	122 (17.8)
Obese	44,826 (13.4)	218 (10.2)	201 (8.3)	860 (7.5)	150 (8.4)	94 (2.0)	682 (20.6)	489 (15.1)	44 (6.4)

[a] Western Europe, North America and Oceania, [b] Missing values for pre-pregnancy BMI in each category from left to right were 4.4%, 6.8%, 5.1%, 5.0%, 5.7%, 5.5%, 6.5%, 6.4% and 7.3%, respectively; missing values for all other variables were <1% in each category

5.2.2 Major findings

Paper IV investigated the differences in caesarean delivery and neonatal outcomes between women of migrant origin and Finnish women in Finland. The unadjusted prevalence of vaginal deliveries varied from 73% to 87% (Table 13). Women from Latin America and the Caribbean were more likely to have a caesarean delivery (26.8%) compared with Finnish women (17.0%). The prevalence of preterm birth varied from 4% to 5.8% among the study groups. South Asian (6.3%) and Sub-Saharan African (5.0%) women were more likely to have low birthweight newborns compared with Finnish women (3.1%). Sub-Saharan African women were more likely to received NICU care (13.3%) than Finnish women (10.5%). Sub-Saharan African (4.4%), Latin American/Caribbean (3.8%) and South Asian (3.0%) newborns were more likely to have lower 5-minute Apgar scores compared to Finnish newborns (1.8%).

The adjusted results show that, compared with Finnish women, women of Sub-Saharan African, South Asian and East Asian origin were at greater risk of emergency caesarean delivery, preterm birth, low birthweight and lower 5-minute Apgar scores for newborns (Table 14). Latin American/Caribbean-origin women were at an increased risk of both elective and emergency caesarean delivery and lower 5-minute Apgar scores compared with Finnish women. Women of Russian/former USSR origin overall had a lower risk of caesarean delivery and poor neonatal outcomes compared with Finnish women.

Table 13. Mode of delivery and neonatal outcomes among women of migrant origin and Finnish-origin women at most recent delivery, all singleton births, Finland (2004–2014), Number (%)

Variables	Finnish (n=350,548)	Other Western[a] (n =2,290)	Eastern Europe (n =2,566)	Russia/ former USSR (n=11,994)	South Asia (n=1,904)	East Asia (n=4,948)	Sub-Saharan Africa (n =3,548)	Middle East (n=3,465)	Latin America, Caribbean (n =739)
Mode of delivery									
Spontaneous vaginal	265,736 (75.8)	1,690 (73.8)	2,002 (78.0)	9,355 (78.0)	1,214 (63.8)	3,420 (69.1)	2,443 (68.9)	2,531 (73.0)	458 (62.0)
Vacuum/forceps	25,149 (7.2)	184 (8.0)	224 (8.7)	964 (8.0)	264 (13.9)	567 (11.5)	248 (7.0)	324 (9.4)	83 (11.2)
Elective CS	26,293 (7.5)	173 (7.6)	129 (5.0)	643 (5.4)	108 (5.7)	357 (7.2)	269 (7.6)	260 (7.5)	78 (10.6)
Emergency CS	33,183 (9.5)	241 (10.5)	208 (8.1)	1,026 (8.6)	317 (16.6)	602 (12.2)	587 (16.5)	348 (10.0)	120 (16.2)
Unknown	187 (0.1)	2 (0.1)	3 (0.1)	6 (0.1)	1 (0.1)	2 (0.0)	1 (0.0)	2 (0.1)	0 (0.0)
Gestational age									
Preterm	15,702 (4.5)	104 (4.6)	101 (4.0)	528 (4.4)	111 (5.8)	277 (5.6)	183 (5.2)	145 (4.2)	36 (4.9)
Full-term	318,777 (91.1)	2,052 (90.0)	2,307 (90.3)	10,740 (89.7)	1,706 (89.9)	4,545 (92.0)	3,039 (85.7)	3,172 (91.7)	670 (90.7)
Post-term	15,310 (4.4)	125 (5.5)	147 (5.8)	710 (5.9)	81 (4.3)	118 (2.4)	321 (9.1)	142 (4.1)	33 (4.5)
Birthweight									
<2,500 g	10,868 (3.1)	66 (2.9)	66 (2.6)	369 (3.1)	120 (6.3)	199 (4.0)	179 (5.0)	121 (3.5)	20 (2.7)
2,500–3,999 g	275,355 (78.6)	1,877 (82.1)	2,085 (81.3)	9,396 (78.4)	1,645 (86.5)	4,257 (86.1)	2,945 (83.0)	2,942 (85.0)	621 (84.0)
≥4,000 g	64,064 (18.3)	344 (15.0)	412 (16.1)	2,219 (18.5)	137 (7.2)	486 (9.8)	423 (11.9)	398 (11.5)	98 (13.3)
NICU care	36,794 (10.5)	206 (9.0)	215 (8.4)	1,121 (9.3)	216 (11.3)	443 (9.0)	473 (13.3)	341 (9.8)	72 (9.7)
Apgar Score									
7–10	342,846 (98.2)	2,228 (98.1)	2,511 (98.3)	11,758 (98.4)	1,831 (97.0)	4,804 (97.8)	3,352 (95.6)	3,362 (97.6)	710 (96.6)
0–6	6,254 (1.8)	43 (1.9)	43 (1.7)	186 (1.6)	56 (3.0)	107 (2.2)	155 (4.4)	81 (2.4)	25 (3.4)

[a] Western Europe, North America and Oceania

Table 14. Risk ratio (RR) and 95% confidence interval (CI) for having an elective caesarean delivery, an emergency caesarean delivery, preterm birth, low birthweight, lower 5-minute Apgar score and NICU care at most recent delivery in migrant groups compared with Finnish women

	Finnish	Other Western	Eastern Europe	Russia/Former USSR	South Asia	East Asia	Sub-Saharan Africa	Middle East	Latin America/ Caribbean
Elective caesarean delivery									
Model I RR (CI) (N=381,798)	Reference	1.00 (0.86–1.17)	**0.65 (0.54–0.78)**	**0.69 (0.64–0.75)**	**0.74 (0.61–0.90)**	0.95 (0.86–1.06)	1.01 (0.89–1.14)	1.00 (0.88–1.13)	**1.45 (1.15–1.84)**
Model II RR (CI) (N=365,352)	Reference	0.95 (0.81–1.12)	**0.71 (0.59–0.85)**	**0.76 (0.70–0.82)**	0.88 (0.72–1.08)	1.08 (0.96–1.21)	1.06 (0.92–1.21)	1.03 (0.90–1.17)	**1.46 (1.14–1.87)**
Emergency caesarean delivery									
Model I RR (CI) (N=353,488)	Reference	1.12 (0.98–1.29)	**0.81 (0.71–0.94)**	**0.87 (0.81–0.93)**	**1.88 (1.66–2.12)**	**1.32 (1.21–1.44)**	**1.91 (1.74–2.09)**	1.06 (0.95–1.19)	**1.94 (1.59–2.37)**
Model II RR (CI) (N=338,583)	Reference	1.01 (0.88–1.17)	0.91 (0.78–1.05)	**0.87 (0.81–0.93)**	**2.17 (1.91–2.46)**	**1.41 (1.28–1.54)**	**2.98 (2.70–3.29)**	**1.23 (1.10–1.39)**	**1.74 (1.41–2.15)**
Preterm birth									
Model I RR (CI) (N=381,182)	Reference	1.01 (0.83–.23)	0.87 (0.71–1.06)	0.98 (0.89–1.07)	**1.32 (1.09–1.60)**	**1.26 (1.11–1.42)**	1.15 (0.99–1.34)	0.93 (0.78–1.10)	1.09 (0.77–1.52)
Model II RR (CI) (N=365,039)	Reference	0.96 (0.78–1.18)	0.89 (0.72–1.08)	0.94 (0.86–1.03)	**1.45 (1.19–1.77)**	**1.28 (1.13–1.46)**	**1.21 (1.03–1.42)**	0.94 (0.79–1.12)	1.10 (0.78–1.56)

Low birthweight									
Model I RR (CI) (N=381,712)	Reference	0.92 (0.72–1.18)	0.82 (0.64–1.05)	0.99 (0.89–1.10)	**2.10 (1.74–2.53)**	**1.31 (1.13–1.51)**	**1.66 (1.42–1.93)**	1.13 (0.94–1.35)	0.86 (0.55–1.35)
Model II RR (CI) (N=365,281)	Reference	0.87 (0.67–1.12)	0.80 (0.62–1.04)	**0.89 (0.79–0.99)**	**2.43 (2.08–2.94)**	**1.25 (1.08–1.46)**	**1.99 (1.60–2.33)**	**1.21 (1.00-1.46)**	0.85 (0.53–1.34)
Lower 5-minute Apgar Score									
Model I RR (CI) (N=380,352)	Reference	1.05 (0.78–1.43)	0.93 (0.69–1.27)	0.86 (0.70–1.00)	**1.67 (1.28–2.19)**	**1.22 (1.00–1.48)**	**2.53 (2.15–2.98)**	**1.32 (1.05–1.64)**	**1.93 (1.292–.87)**
Model II RR (CI) (N=364,382)	Reference	1.02 (0.74–1.39)	0.92 (0.68–1.26)	**0.82 (0.71–0.96)**	**1.68 (1.27–2.21)**	**1.30 (1.07–1.59)**	**2.59 (2.18–3.08)**	**1.30 (1.04–1.64)**	**1.95 (1.30–2.91)**
Neonatal intensive care unit									
Model I RR (CI) (N=382,002)	Reference	**0.84 (0.73–0.97)**	**0.78 (0.67–0.89)**	**0.87 (0.82–0.93)**	1.09 (0.94–1.25)	**0.83 (0.76–0.92)**	**1.31 (1.19–1.44)**	0.93 (0.83–1.04)	0.92 (0.72–1.17)
Model II RR (CI) (N=365,365)	Reference	**0.84 (0.73–0.98)**	**0.78 (0.67–0.90)**	**0.86 (0.81–0.92)**	**1.15 (1.00–1.33)**	0.93 (0.84–1.03)	**1.36 (1.23–1.51)**	0.89 (0.79–1.00)	0.97 (0.76–1.24)

Model I: unadjusted model

Model II: model adjusted for age, socioeconomic position, pre-pregnancy body mass index, previous births, marital status, smoking during pregnancy and delivery year

6 DISCUSSION

6.1 Key findings

This dissertation examined the possible differences in the pre-pregnancy BMI, inter-pregnancy weight change, pregnancy complications, mode of delivery, complications of delivery and use of pain medications during delivery among migrant women of Russian, Somali and Kurdish origin. The dissertation also examined differences in the prevalence of caesarean delivery and adverse neonatal outcome by the women's country of origin among all women giving birth in Finland. In paper I, Somali and Kurdish women had higher and Russian women had lower mean pre-pregnancy BMIs compared with women in the general population. Paper II observed that women of Kurdish origin had higher odds of GDM, whereas the migrant groups did not differ from women in the general population for hypertensive disorders. Findings from paper III showed that Russian women had lower odds for a caesarean delivery, whereas Somali women had higher odds for having any delivery complications compared with women in the general population. Paper IV identified three distinct vulnerable groups for emergency caesarean delivery and poor neonatal outcomes: women of Sub-Saharan African, South Asian and East Asian origin. Additionally, women of Latin American/Caribbean origin had an excess risk of both elective and emergency caesarean delivery. Likewise, Russian/former USSR-origin women had a lower risk of caesarean delivery and poor neonatal outcomes.

6.2 Discussion of key findings

Similar to findings from paper I, a review and previous studies conducted in Norway and the Netherlands reported that women of African and Middle Eastern origin had higher pre-pregnancy BMI compared with women in the general population (Jenum et al., 2013; Djelantik, Kunst, van der Wal, Smit, & Vrijkotte, 2012; Torkildsen, Svendsen, Raisanen, Sole, & Laine, 2019)).

However, it is difficult to directly compare the present study to these findings from Norway and the Netherlands because of the broad classification of the migrant groups. It was difficult to find any study that examined pre-pregnancy BMI as a separate outcome variable, as it is often included as a covariate in the analyses. The reasons for higher pre-pregnancy BMI among Somali and Kurdish women in our study may be attributable to a change in lifestyle and food habits while living in Finland. For example, the Maamu basic report shows that Somali women eat very few fresh vegetables or fruit every day. Further, persons of Somali and Kurdish origin exercised less frequently than the general population of the same age group in the study municipalities (Castaneda et al., 2012). Similarly, socio-cultural and religious factors also play an important role in overweight and obesity (Kanter & Caballero, 2012). Physical activity is restricted among women in many African and Middle Eastern countries due to cultural and religious reason (Kanter & Caballero, 2012). Moreover, obesity is more culturally accepted in some African countries where weight gain is associated with maternity and nurturing.

Russian women had a lower pre-pregnancy BMI than women in the general Finnish population. No similar study was available with which to compare this result. The WHO reported that the age-standardised mean BMI in non-pregnant women in Russia in 2016 was 26.4 kg/m^2 (WHO, 2016), which is higher than our findings (22.2 kg/m^2). Therefore, Russian women having lower pre-pregnancy BMI than women in the general population can be argued as a healthy migrant effect. The adverse effect of inter-pregnancy weight gain in a subsequent pregnancy in developing perinatal complications is confirmed by previous reviews and meta-analyses (Oteng-Ntim et al., 2018; Teulings et al., 2019). However, no studies compared the differences in inter-pregnancy weight change between different ethnic groups.

Findings from paper II suggested that women of Kurdish origin had higher odds of GDM, whereas no differences were observed among migrant groups and women in the general population for hypertensive disorders. Studies on gestational diabetes and hypertensive disorders of pregnancy among migrant women have shown inconsistent results (Gagnon et al., 2011; Jenum et al., 2013; Kosman et al., 2016; Khali et al., 2013). The majority of previous studies showed that women of African, Caribbean and Asian origin were at a greater risk of GDM compared to women in the general population (Gagnon et al., 2011; Jenum et al., 2013; Naimy et al., 2015). A previous study using the Maamu data found that the prevalence of physical inactivity and metabolic

syndrome was the highest among non-pregnant Kurdish women (Skogberg et al., 2016). Similarly, a higher prevalence of elevated fasting glucose, a low high-density lipoprotein (HDL) cholesterol level, elevated triglycerides and higher abdominal obesity were observed among them (Skogberg et al., 2016). Another study from Austria reported that migrant Turkish women in Austria had a higher prevalence of GDM, which was suggested to be due to a diet that includes more high-fat foods and refined carbohydrates (Hoppichler & Lechleitner, 2001). Physical activity and dietary habits play an important role in the development of GDM, and these could explain the higher odds of GDM among Kurdish women in our study.

The adjusted results for hypertensive disorders did not show any significant differences among the migrant groups and women in the general population. However, the general prevalence of hypertensive disorders of pregnancy was lower in the migrant groups than women in the general population in Finland and Norway (Metsala, Stach-Lempinen, Gissler, Eriksson, & Koivusalo, 2016; Naimy et al., 2015). A review and meta-analyses including studies from the European countries, the USA and Australia found that, in general, the risk of hypertensive disorders of pregnancy is lower among immigrants compared with women in the general population (Mogos, Salinas-Miranda, Salemi, Medina, & Salihu, 2017). The lower risk of hypertensive disorders among immigrants is partly explained by the healthy migrant effect, under-diagnosis of hypertensive disorders due to barriers in accessing health care, or genetic or environmental factors (Mogos et al., 2017).

Findings from study III reported that Somali women had higher odds of having delivery complications compared to women in the general population. Previous studies identified women of Sub-Saharan African origin (including Somali origin) to have an excess risk for caesarean section and delivery complications (Almedia et al., 2013; Small et al., 2008; Khalil et al., 2013; Merry et al., 2013; Vangen et al., 2002; Rassjo et al., 2013). One explanation for excess delivery complications among Somali women could be the practice of female genital mutilation/cutting (FGM/C). FGM/C has been linked with pregnancy and delivery complications such as prolonged labour, obstruction, perineal tears and postpartum haemorrhage (Andro, Cambois, & Lesclingand, 2014). However, FGM/C may not increase the risk of all delivery complications. In our study, the outcome was "any delivery complication", and it was not possible to study individual complications separately. In Finland, the prevalence of FGM/C is almost 70% among Somali origin and 31% among

Kurdish women, but no information on the type of FGM/C is available (Koukkula, Keskimaki, Koponen, Molsa, & Klemetti, 2016). We could not adjust for FGM/C in our study because information on FGM/C was not available in the MBR before 2017. In addition, study III showed that Russian women had lower odds of caesarean delivery, which is also confirmed by a larger sample of Russian/former USSR women in study IV. Further, no significant differences in the use of pain medication were observed among migrant groups and women in the general population.

Study IV observed differences in the risks of caesarean delivery and adverse neonatal outcome by women's country of origin. Russian/former USSR women had a lower risk of overall caesarean delivery, whereas Latin American/Caribbean women had an overall risk of caesarean delivery. Further, South Asian, East Asian, Sub-Saharan African and Middle Eastern women had a higher risk of emergency caesarean delivery. Our finding on caesarean delivery is broadly similar to previous findings from Sweden (Juarez et al., 2017) and Norway (Vangen et al., 2000). A systematic review and meta-analyses including studies from the European countries, the USA, Canada and Australia (Merry et al., 2013) found results similar to the present study. The explanation for excess caesarean delivery in certain groups is often complex and includes combinations of biological, cultural, physical and psychological factors (Merry, Vangen, & Small, 2016). The most common risk factors associated with caesarean delivery among migrants are low-level language skills of the receiving country language, a lower socioeconomic position, poor maternal health, a higher pre-pregnancy BMI, foetopelvic disproportion and lack of prenatal care (Merry et al., 2013). The higher risks of elective caesarean deliveries among Latin American/Caribbean-origin women may also be related to their cultural preferences (Merry et al., 2013; Merry et al., 2016).

South Asian and Sub-Saharan African women had a higher risk of preterm birth, low birthweight and newborns in NICU care than Finnish women. Furthermore, South Asian, East Asian, Sub-Saharan African, Middle Eastern and Latin American/Caribbean newborns were more likely to have lower Apgar scores than Finnish newborns. One previous study from Sweden has linked suboptimal perinatal care as a reason for more perinatal deaths among East-African women in Sweden (Essen, Bödker, Sjöberg, Langhoff-Ross, Gudmundsson et al., 2002). A recent systematic review has concluded that migrant women of refugee, asylum-seeker or undocumented migrant background often face obstacles in maternity care services due to diminished

negotiation power, a sense of insecurity and experienced care-related discrimination in Norway, Sweden and Finland (Leppälä, Laminpää, Gissler, Vehviläinen-Julkunen 2020). However, we do not have information on sub-optimal care among migrant women in Finland in general. Furthermore, maternal body composition and height varies by ethnicity, and this is one of the explanations for differences in the risk of preterm birth, low birthweight and other neonatal differences among the groups (Cnattingius et al., 2013); (Leary et al., 2006). Other factors, such as maternal diet, physical activity, alcohol consumption, illness and social class vary across different migrant groups, and these, along with genetic mechanisms, may explain differences in neonatal outcomes among women of migrant origin and Finnish women.

Findings from the smaller samples in papers I–III and the larger sample in paper IV suggested better pregnancy and delivery outcomes for Russian (or former USSR) women than women in the general Finnish population. One possible explanation for this is the healthy migrant effect, which should be confirmed by comparing pregnancy and delivery outcomes between Russian women living in Finland and in Russia.

6.3 Methodological considerations

6.3.1 Strengths of the study

This study has several strengths. This study contributes to the limited information available on pregnancy, delivery and neonatal outcomes among women of migrant origin and Finnish women not only in Finland but also elsewhere in the European region. We used data from the MBR, and Finnish register data have good validity and reliability in general (Sund, 2012). Almost all deliveries in Finland take place in public hospitals, and data on maternal health, obstetric history, delivery events and newborn outcomes for all births are recorded in the MBR. We used information from the Hospital Discharge Register to complement the data from the MBR for pregnancy and delivery complications. Furthermore, we were able to adjust for important confounders like age, socioeconomic position, pre-pregnancy BMI, parity and smoking during pregnancy. The sample size in our study IV was large, and we were able to classify women of migrant origin into nine categories based on

their parents' countries of origin. These findings are likely to be generalisable to similar populations of migrant origin in other countries with universal access to maternity care for all citizens.

6.3.2 Limitations of the study

The first three papers were based on smaller samples of women of Russian, Somali and Kurdish origin. Therefore, the results cannot be generalised for all migrant-origin women living in Finland. Pre-pregnancy BMI was calculated based on self-reported weight and height at the first antenatal check-up at the maternity clinic. Thus, there may be some possibility of reporting bias. It was not known if the degree of error in reporting was similar or different between the groups.

In our study, socioeconomic position was based on occupation and employment status, and this information was missing for many women; this information may be difficult to obtain for migrants. For example, the Maamu basic report showed that only 17% of Somali women were employed, 35% were housewives and almost 35% had no basic education (Castaneda et al., 2012). The information on education and employment is not available in registers for those who didn't complete education in Finland or those who didn't register as job seekers in the unemployment office in Finland.

Our study was based on the data from the MBR; therefore, information on several important migration indicators (for example, migration status, length of stay and language skills) were not available. Information on migration status, length of stay and language skills was available only for those who participated in the Maamu health survey. Since we only used the larger Maamu sample but not the actual survey data, the sample size would have been about half of our participants if we had adjusted for these variables. Additionally, the MBR has limited information on other factors possibly related to poor neonatal outcomes (for example, women's other specific health conditions), which might have some effect on the outcome variables. The heterogeneity of the migrant groups means that multiple mechanisms and risk factors may be responsible for the observed associations, and we were not able to address them all.

6.3.3 Implications for future research and policy

This study has identified some risk groups for poor pregnancy, delivery and neonatal outcomes. Women of Somali and Kurdish origin had higher pregnancy and delivery complications. We need to confirm the findings from our smaller samples with the larger samples. For example, more studies on pre-pregnancy BMI, hypertensive disorders of pregnancy and gestational diabetes can be conducted in the larger data set by the country of origin in Finland. More information is needed to explore why a certain group has higher or lower risk for certain outcomes. For example, in this study, we observed that, in general, Russian women had a lower risk for pregnancy and delivery complications. Hence, another study can be conducted among Russian-origin women (if possible, by including information on dietary habits and physical activity) to explore the reasons. This study also identified high-risk groups for emergency caesarean delivery and poor neonatal outcomes. Future research is recommended to understand the reasons for these outcomes. Latin American/Caribbean women consistently had a higher emergency and elective delivery, which is reasoned as a cultural preference. We need more information on cultural and lifestyle factors to discuss the possible mechanisms and reasons for the observed differences between the groups. The identified high-risk groups for pre-pregnancy overweight and obesity (such as Somali and Kurdish women) can be given more in-depth counselling on weight management at maternity clinics during antenatal check-ups. Identifying high-risk groups and reasons for differences between the groups can help authorities plan health promotion and effective interventions targeting these groups.

7 CONCLUSION

In conclusion, this study contributes to evidence on differences in poor pregnancy, delivery and neonatal outcomes among migrant origin women and their newborns in Finland where such information is very limited. Women of Somali and Kurdish origin were identified as the high-risk groups for pre-pregnancy overweight and obesity. Similarly, Kurdish-origin women were identified as a high-risk group for the development of gestational diabetes and Somali-origin women as a risk group for complications of delivery. Women of Sub-Saharan African, South Asian and East Asian origin had a higher risk for an emergency caesarean delivery and poor neonatal outcomes. Additionally, women of Latin American/Caribbean origin had an excess risk of both elective and emergency caesarean delivery. In general, women of Russian/former USSR origin were identified as having lower risks of poor pregnancy, delivery and neonatal outcomes. More research is recommended to better understand the underlying mechanisms for these differences among migrant-origin women in Finland.

Previous research provided evidence that overweight and obesity before or during pregnancy is a risk factor for pregnancy, delivery and neonatal complications (Almedia et al., 2013; Aune et al., 2014). Therefore, prevention of pre-pregnancy overweight and obesity is an important factor to consider among the identified risk groups. Clinics that provide maternity and child health services could be one relevant setting for prevention programmes.

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PUBLICATIONS

PUBLICATION I

Pre-pregnancy body mass index and inter-pregnancy weight change among women of Russian, Somali and Kurdish origin and the general Finnish population

Bastola, K., Koponen, P., Härkänen, T., Gissler, M., & Kinnunen, T. I.

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ORIGINAL ARTICLE

Pre-pregnancy body mass index and inter-pregnancy weight change among women of Russian, Somali and Kurdish origin and the general Finnish population

KALPANA BASTOLA[1], PÄIVIKKI KOPONEN[2], TOMMI HÄRKÄNEN[2], MIKA GISSLER[3,4,5] & TARJA I KINNUNEN[1]

[1]Faculty of Social Sciences, University of Tampere, Finland, [2]Department of Health, National Institute for Health and Welfare, Finland, [3]Department of Information Services, National Institute for Health and Welfare, Finland, [4]Research Centre for Child Psychiatry, University of Turku, Finland, [5]Karolinska Institute, Department of Neurobiology, Care Sciences and Society, Division of Family Medicine, Sweden

Abstract

Objectives: We studied the differences in the mean pre-pregnancy body mass index (BMI) and mean inter-pregnancy weight change in women of Russian, Somali and Kurdish origin and women in the general Finnish population. **Methods:** The population-based samples were from the Migrant Health and Wellbeing Study and the Health 2011 Survey conducted in six cities in Finland in 2010–2012. This study included women with at least one birth in Finland. Data on their previous pregnancies in Finland were obtained from the National Medical Birth Register for 318 Russian, 584 Somali and 373 Kurdish origin women and for 243 women in the general Finnish population (reference group). Data on pre-pregnancy weight and height were self-reported in early pregnancy. Linear logistic regression was the main method of analysis. **Results:** The unadjusted mean pre-pregnancy BMI was higher in Somali (27.0 kg/m², $p<0.001$) and Kurdish (25.8 kg/m², $p<0.001$) women, but lower in Russian (22.2 kg/m², $p<0.001$) women than in the reference group (24.1 kg/m²). The adjusted coefficients for the difference in the mean pre-pregnancy BMI were −1.93 (95% CI −2.77 to −1.09) for Russian, 1.82 (95% CI 0.89–2.75) for Somali and 1.30 (95% CI 0.43–2.17) for Kurdish women compared with the reference group. Among women with at least two births, no statistically significant difference was observed in the mean inter-pregnancy weight change between the migrant groups and the reference group. ***Conclusions:*** **Somali and Kurdish women had higher mean pre-pregnancy BMIs than women in the general Finnish population and may need special support and health promotion strategies for weight management.**

Key Words: *Pre-pregnancy, body mass index, inter-pregnancy weight change, women, migrants*

Background

Overweight and obesity during pregnancy are associated with a number of complications, such as recurrent miscarriage, pregnancy-induced hypertension, gestational diabetes, pre-eclampsia, delivery complications, premature delivery, caesarean delivery, post-partum weight retention, infertility, small for gestational age, macrosomia, metabolic syndrome and obesity in the offspring [1–4].

The interval between the end of one pregnancy and the start of the next pregnancy (the inter-pregnancy interval) is one important factor to consider for pregnancy-related risk factors, including maternal obesity. Previous studies have shown that giving birth to two or more children in short (<12 months) or long (>59 months) inter-pregnancy intervals increases the risk of maternal and child morbidity and mortality [5,6]. Women with short inter-pregnancy intervals and high parity may have a higher risk of obesity

Correspondence: Kalpana Bastola, Faculty of Social Sciences, University of Tampere, Postal Code 33014, Tampere, Finland. Email: Bastola.Kalpana.X@student.uta.fi

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either because of weight retained from pregnancy or gained post-partum [7]. Findings from previous population-based studies indicate that an increase in body mass index (BMI) between two pregnancies is related to a higher incidence of adverse pregnancy complications, such as pre-eclampsia, gestational diabetes, gestational hypertension, caesarean delivery, stillbirth and large for gestational age infants in the later pregnancy [8–14].

Only a few European countries compile national data on pre-pregnancy BMI. In countries for which data are available, the proportion of overweight or obese women was about 30–37% and was highest in Scotland (48%) [15]. In Finland, 25% of women were overweight and 12% were obese before pregnancy in 2010 [15]. Very limited information is available on inter-pregnancy weight change in Europe. A Swedish study found that women gained on average nearly one BMI unit during a mean inter-pregnancy interval of 24 months [8]. Another Scottish study found an average gain of one BMI unit during a mean inter-pregnancy interval of 40 months [16].

Previous studies on migration to industrialized countries and perinatal health has shown that some migrant groups have the same or even better perinatal health (gestational age, birth weight, mode of delivery, maternal and infant infection) than the population of the receiving country, whereas other migrant groups have been found to have poorer perinatal health outcomes [17–19]. None of these studies focused on comparing pre-pregnancy BMI or inter-pregnancy weight change between different groups of migrant women and the majority population.

This is the first study focusing on pre-pregnancy BMI and inter-pregnancy weight change among women of migrant origin in Finland. Our results will help to identify high-risk groups for maternal overweight and to plan interventions to promote healthy lifestyles. The aim of the study was to examine differences in the mean pre-pregnancy BMI and the mean inter-pregnancy weight change among migrant women of Russian, Somali and Kurdish origin compared with women in the general population in Finland.

Methods

Selection of study population

The sample population was based on the Migrant Health and Wellbeing Study (Maamu) conducted by the National Institute of Health and Welfare in 2010–2012 in the cities of Helsinki, Espoo, Vantaa, Turku, Tampere and Vaasa. The sample was a stratified random sample selected from the national population register. The participants (n=3000, of whom 1579 were women) were 18–64 years old, of Russian, Somali or Kurdish origin and had lived in Finland for at least one year [20]. An additional study sample, selected with the same criteria, included 3000 migrants (of whom 1492 were women) who were not invited to take part in the survey, but were included in the present register-based study. The inclusion criteria for those of Russian origin were being born in Russia or the Soviet Union and having Russian or Finnish as their mother tongue; for those of Somali origin the inclusion criterion was being born in Somalia and for those of Kurdish origin the inclusion criteria were being born in Iraq or Iran and having Kurdish (Sorani) as their mother tongue. The reference group consisted of women aged 18–64 years in the general population from the Health 2011 Survey sample in the same cities (n=1163) [21].

Register data

The present study was based on data from the National Medical Birth Register of Finland. Data for all women in the Maamu sample and the Health 2011 Survey sample were linked with the National Medical Birth Register from 1987 to 2014 to obtain data on all their previous pregnancies and births occurring in Finland. Self-reported pre-pregnancy height and weight have only been recorded in the National Medical Birth Register since 2004. Therefore only women having at least one birth between 1 January 2004 and 31 December 2014 (n=1518) were included in the study. Data on migrant origin had to be obtained from the Maamu survey sample because the National Medical Birth Register is not allowed to collect these data. The Maamu and Health 2011 samples allow comparisons between migrant groups and the general population, which would not otherwise have been possible. The data on socioeconomic status was obtained from the Statistics Finland for the year 2011 based on occupation and employment status. The personal identification numbers, which were available in all data sources, were used in all data linkages, but were removed from the dataset before analysis.

The National Institute for Health and Welfare obtained ethical approval for both studies, including approval to use the register data, from the Coordinating Ethical Committee of the Helsinki and Uusimaa Hospital Region.

Measurement of variables

The outcome variables were pre-pregnancy BMI in the latest pregnancy (referred to as the index pregnancy hereafter) and the mean inter-pregnancy weight change between the index pregnancy and the

second latest pregnancy. A public health nurse recorded the self-reported pre-pregnancy weight and height at the first antenatal visit of each pregnancy in the public maternity clinics and the information was uploaded to the birth registry system. BMI was calculated as maternal pre-pregnancy weight (kg) divided by squared height (m^2) and categorized as follows: <18.5 kg/m^2 (underweight), 18.5–24.9 kg/m^2 (normal weight), 25–29.9 kg/m^2 (overweight) and ⩾30.0 kg/m^2 (obese) [22]. We calculated the inter-pregnancy change in weight (and BMI) as the difference in weight (and BMI) from the beginning of the second latest pregnancy to the beginning of the index pregnancy. Pre-pregnancy height and weight, pre-pregnancy BMI, inter-pregnancy interval and inter-pregnancy weight change were used as continuous variables.

Socioeconomic status was classified based on occupation and employment status (upper white collar workers, lower white collar workers, manual workers, others and unknown) and was based on the year 2011 data from Statistics Finland. Age at the latest birth was categorized as 17–24, 25–34 or 35–49 years; smoking habits during pregnancy to no smoking or any smoking during pregnancy; and marital status to unmarried/divorced/widowed or married/registered partnership/cohabiting. Other pregnancy-related variables were the number of miscarriages (none, one or more), the number of previous induced abortions (none, one or more) and parity defined as the total number of deliveries before the index pregnancy (none, one or more) that occurred in Finland or elsewhere.

Statistical analysis

All statistical analyses were performed in Stata version 13. The inverse sampling probability weights were applied to the stratified sampling method and finite populations were accounted for in all analyses. Descriptive data were reported as numbers of observations (prevalence, %) or mean±standard deviation (SD) values. χ^2 tests were used to compare the crude percentages and Wald tests to compare the means between the migrant groups and the general Finnish population. Linear regression models were used to test differences in the outcome means between groups using the women in the general Finnish population as the reference group. Model I represented the crude linear regression models, whereas in model II the age at last birth, smoking status, marital status, socioeconomic status, educational level and parity were adjusted for. Socioeconomic status was classified into three categories (upper/lower white collar workers, manual workers and others) for the regression models. Point estimates of the coefficients and their 95% confidence intervals (CIs) were reported for the regression models. We also tested the statistical significance of interaction terms between the migrant groups and the other variables in the adjusted models for both outcome variables.

Results

A total of 1518 women were eligible, i.e. had at least one birth registered in Finland since 2004, and were included in this study. Descriptive information on the background characteristics of these women are presented by origin/study group in Table I. More than half of all the latest births occurred in the age group 25–34 years across all study groups. A higher percentage of Somali and Kurdish origin women had their latest birth at a younger age. Smoking during pregnancy was most common among women in the general population (reference group) and least common among Somali women. The prevalence of being a single mother was almost similar among women of Somali, Finnish and Russian origin (11.0–13.0%) and lowest among women of Kurdish origin (2.5%). More than half of the women in the reference group belonged to upper and lower white collar workers, whereas only 17% of Somali and Kurdish origin women belonged to these socioeconomic positions; there were many women in these two groups with an unknown socioeconomic position (i.e. never registered as having an occupation in Finland). One in four women in each study group had had one or more miscarriages. A higher percentage of the Russian origin women had a previous induced abortion than women in the other groups. More than 70% of Somali women and 40% of Kurdish women had at least two previous births, whereas only about 20% of Russian women and women in the reference population had at least two previous births.

Table II describes the unadjusted anthropometric data and BMI by migrant origin in the index pregnancy. Compared with women in the reference population, the mean height of Kurdish and Somali women was lower. Somali women had a higher and Russian women had a lower mean pre-pregnancy body weight than women in the reference group. Compared with women in the reference population, Somali and Kurdish women had a higher, whereas Russian women had a lower, mean pre-pregnancy BMI. A higher percentage of Somali (63.2%) and Kurdish (53.7%) women were overweight and obese compared with the reference group.

The unadjusted and adjusted linear regression models for the difference in pre-pregnancy BMI in the index pregnancy between the study groups are

Table I. Characteristics of the study population at the time of the latest pregnancy by study group (weighted percentages).

	Finnish women	Russian women	Somali women	Kurdish women	p^a
Age (years)[b]					
17–24	10.5	11.7	17.7	16.2	<0.001
25–34	62.2	62.5	50.9	62.1	
⩾35	27.3	25.8	31.5	21.8	
Smoking status[c]					<0.001
No	81.5	86.1	98.0	95.2	
Yes	18.5	13.9	2.0	4.8	
Marital status[d]					<0.001
Married/partnership/cohabiting	88.0	87.0	89.0	97.5	
Single	12.0	13.0	11.0	2.5	
Socioeconomic status[e]					<0.001
Upper white collar workers	25.8	14.3	2.8	2.9	
Lower white collar workers	37.5	26.7	15.0	14.4	
Manual workers	17.3	16.0	9.2	18.2	
Others	11.7	31.9	39.3	47.3	
Unknown	7.8	11.1	33.8	17.3	
Previous miscarriage[f]					0.09
0	78.6	79.9	73.3	76.5	
⩾1	21.4	20.1	26.7	23.5	
Previous induced abortions[g]					<0.001
0	89.8	77.5	90.2	83.8	
⩾1	10.2	22.5	9.8	16.2	
Previous births[h]					
0	40.7	37.9	9.4	23.8	
1	37.4	43.4	18.2	36.7	<0.001
⩾2	21.9	18.7	72.4	39.5	

[a]Pearson χ^2 test.
[b]Number of Finnish, Russian, Somali and Kurdish women was 243, 318, 584 and 373, respectively.
[c]Number of Finnish, Russian, Somali and Kurdish women was 235, 311, 572 and 367, respectively.
[d]Number of Finnish, Russian, Somali and Kurdish women was 243, 318, 583 and 371, respectively.
[e]Number of Finnish, Russian, Somali and Kurdish women was 243, 318, 584 and 373, respectively.
[f]Number of Finnish, Russian, Somali and Kurdish women was 243, 318, 584 and 372, respectively.
[g]Number of Finnish, Russian, Somali and Kurdish women 243, 318, 584 and 372, respectively.
[h]Number of Finnish, Russian, Somali and Kurdish women 243, 318, 584 and 372, respectively.

Table II. Anthropometric data and body mass index by study group in the index pregnancy compared with women in the general Finnish population.

	Finnish women	Russian women	*p*	Somali women	*p*	Kurdish women	p^a
Height (cm)[b]	165.9±6.2	165.9±6.2	0.99	163.4±5.7	<0.001	159.2±5.5	<0.001
Weight (kg)[c]	66.6±14.1	61.4±13.5	<0.001	72.2±14.7	<0.001	65.5±11.4	0.33
Body mass index (kg/m^2)[d]	24.1±4.7	22.2±4.4	<0.001	27.0±5.4	<0.001	25.8±4.4	<0.001
Categories of body mass index (%)[e]			0.002		<0.001		<0.001
Underweight	5.8	11.2		4.5		1.5	
Normal weight	64.5	71.5		32.1		44.7	
Overweight	19.2	12.6		36.0		37.2	
Obese	10.5	4.6		27.2		16.5	

Data presented as weighted unadjusted mean±SD values or percentages.
[a]Wald test to compare means, Pearson χ^2 test to compare percentages.
[b]Number of Finnish, Russian, Somali and Kurdish women 233, 288, 556 and 352, respectively.
[c]Number of Finnish, Russian, Somali and Kurdish women 231, 288, 552 and 347, respectively.
[d]Number of Finnish, Russian, Somali and Kurdish women 231, 288, 551 and 346, respectively.
[e]Number of Finnish, Russian, Somali and Kurdish women 231, 288, 551 and 343, respectively.

presented in Table III. Compared with women in the reference group, Russian women had a 1.93 kg/m² unit lower BMI, whereas Somali and Kurdish women had a 1.82 and 1.30 unit higher BMI on average in the fully adjusted model.

Table IV describes the unadjusted mean inter-pregnancy interval and change in weight and BMI between the previous pregnancy and the index pregnancy in each group. Kurdish and Russian women had longer mean inter-pregnancy intervals compared with the

Table III. Linear regression model for differences in pre-pregnancy BMI in the index pregnancy.

Study group	Model I[a] coefficient (CI) (n=1397–1416)	p	Model II[b] coefficient (n=1397)	p
Finnish women	Reference		Reference	
Russian women	−1.91 (−2.71 to 1.10)	<0.001	−1.93 (−2.77 to −1.09)	<0.001
Somali women	2.92 (2.17–3.68)	<0.001	1.82 (0.89–2.75)	<0.001
Kurdish women	1.74 (1.00–2.47)	<0.001	1.30 (0.43–2.17)	0.003

Data presented as coefficient (95% CI).
[a]Model I, crude model.
[b]Model II, adjusted for age, smoking habit, marital status, socioeconomic status and parity.

Table IV. Inter-pregnancy interval and change in weight and body mass index between the previous pregnancy and the index pregnancy by migrant group compared with women in the general Finnish population.

	Finnish women	Russian women	p	Somali women	p	Kurdish women	p
Inter-pregnancy interval (months)[b]	23.2± 17.8	30.5±22.9	0.009	22.3±18.1	0.65	34.4±23.1	<0.001
Change in weight (kg)[c]	2.1±5.9	1.0±6.6	0.25	3.1±6.9	0.16	3.2±5.7	0.14
Change in body mass index (kg/m^2)[d]	0.7±2.1	0.3±2.4	0.25	1.1±2.6	0.10	1.2±2.2	0.06

Data presented as unadjusted weighted mean±SD values.
[a]Wald test to compare means.
[b]Number of Finnish, Russian, Somali and Kurdish women 104, 100, 440 and 196, respectively.
[c]Number of Finnish, Russian, Somali and Kurdish women 81, 88, 386 and 171, respectively.
[d]Number of Finnish, Russian, Somali and Kurdish women 81, 88, 385 and 169, respectively.

Table V. Linear regression model for differences between study groups in weight change between the previous pregnancy and the index pregnancy.

Study group	Model I[a] coefficient (CI) (n=717–726)	p	Model II[b] coefficient (CI) (n=712)	p
Finnish women	Reference		Reference	
Russian women	–1.06 (−2.87 to 0.74)	0.250	–1.64 (–3.52 to 0.23)	0.087
Somali women	1.01 (–0.39 to 2.43)	0.158	1.31 (–0.37 to 3.02)	0.129
Kurdish women	1.12 (–0.35 to 2.59)	0.137	0.64 (–1.12 to 2.41)	0.477

Data presented as coefficient (95% CI).
[a]Model I, crude model.
[b]Model II, adjusted for age, smoking habit, marital status, socioeconomic status, parity and inter-pregnancy interval.

reference group. The mean inter-pregnancy weight gain was 3.1–3.2 kg and the mean increase in BMI was 1.1–1.2 kg/m^2 in Somali and Kurdish women, but these changes did not differ statistically significantly from those observed in the reference group. The linear regression model for the weight change between the second latest pregnancy and the index pregnancy is presented in Table V. After adjusting for all variables in the model, none of the migrant groups differed statistically significantly from the reference group.

When using the pre-pregnancy BMI as the outcome variable, significant interactions were observed for age (p<0.001) and parity (p=0.009). When stratifying the analysis by age group (17–24, 25–34 and 35–64 years), Kurdish women in the oldest age group had the highest pre-pregnancy BMI, whereas Russian women in the youngest age group had the lowest pre-pregnancy BMI. When stratifying the analysis by parity (none, one, more than one), Kurdish women with highest parity had the highest pre-pregnancy BMI and Russian women with the lowest parity had the lowest pre-pregnancy BMI. This might be due to higher parity in Somali and Kurdish origin women and higher parity is related to older age.

The test of interaction for the difference in weight change between the second latest pregnancy and the index pregnancy among the groups was significant for socioeconomic position (p=0.009), abortion (p=0.03) and parity (p=0.001) in the adjusted model. When the analysis was stratified by socioeconomic position, Somali women in upper and white collar jobs had gained more weight, whereas Russian women in the 'Others' category had lost most weight. Similarly, Somali women with no induced abortion had gained the most weight. When stratified by parity, Russian women having only one child had lost most weight. Therefore, even after the stratified analysis, Somali women in general had gained more weight and Russian women had lost more weight, which is similar to the adjusted results.

Discussion

This is the first study with a primary aim of examining the mean pre-pregnancy BMI and inter-pregnancy weight change among migrant women of Russian, Somali and Kurdish origin and the general population in Finland. The main findings of the study show that Somali and Kurdish women had higher and Russian women had lower mean BMIs than women in the general population. No statistically significant difference was observed in the mean inter-pregnancy weight change between the migrant groups and the reference group when adjusted for the confounders.

To our knowledge, there have been no previous study comparing pre-pregnancy BMI in these specific migrant groups. However, a few studies have compared the pre-pregnancy BMI among other migrant groups across different countries. A review article found that women originating from African and Middle Eastern countries had a higher pre-pregnancy BMI than the majority population in Norway, Switzerland and the Netherlands [23], which is similar to the findings from this study. A study from the Netherlands (n=6444) found that the prevalence of pre-pregnancy overweight and obesity was significantly higher in Dutch Antillean origin, Moroccan origin, Surinamese–Creole origin and Turkish origin women than in Dutch origin women [24]. Another previous study from the Netherlands based on data from the Amsterdam Born Children and their Development Study (n=7871) found that obesity was much more common among women from Turkey, Morocco or elsewhere from Africa [25], which is similar to the findings from our study. Another study from Norway (n=823) comparing the mean pre-pregnancy BMI among women from different origins living in Norway [26] reported that the mean pre-pregnancy BMI was 26.8 kg/m^2 in Somali women and 25.6 kg/m^2 in Middle Eastern women, which is similar to the findings from our study. The results of our study are not directly comparable with the findings from these studies from Norway and the Netherlands. The ethnic groups, methods of analysis and sampling were different in each study. In addition, the pre-pregnancy BMI was a secondary outcome or a covariate only in many of the studies. A recent study based on the Maamu survey shows that, compared with the general Finnish population, 30–64-year-old Somali and Kurdish women had a higher age-adjusted prevalence of overweight and there was a higher age-adjusted prevalence of abdominal obesity among Kurdish migrants and Somali women [27].

The age-standardized mean BMI among women in 2014 was 26.8 kg/m^2 in Russia, 27.2 kg/m^2 in Iran, 28.8 kg/m^2 in Iraq and 22.5 kg/m^2 in Somalia [28]. When these mean BMI values were compared with those observed in our study, migrant women of Somali origin clearly had a higher BMI than Somali women living in Somalia. This discrepancy may be a result of changes in their environment and lifestyle after migration. For instance, >80% of Somali people were used to a labour-intensive lifestyle such as cattle-rearing in their home country [29]. Therefore they can gain weight in the host country, where they have easy access to high-energy foods and have a physically less active lifestyle. The prevalence of obesity in the Middle East is at least partly attributed to socio-cultural and religious factors. For example, physical activity for women is restricted for cultural and religious reasons [30]. Obesity is more culturally accepted among women in some African countries because excessive weight gain is associated with maternity and nurturing [30]. For women of Russian and Kurdish origin, their mean BMI was lower among those living in Finland than among those living in their home country. The 'healthy migrant effect' may explain this difference or these groups of women have, as opposed to the Somali women, not gained weight after migration.

Strengths and weaknesses

The present study has several strengths. This study used data from recent population-based study samples including the three major migrant groups in Finland during 2010–2012. The information on all previous births while living in Finland was retrieved from the National Medical Birth Register, for which reporting is obligatory. As for Finnish registers in general, the data from the National Medical Birth Register are reliable and their validity has been found to be good [31,32].

There are also some limitations. The sample size of the study is relatively small and does not represent all migrant origin women living in Finland. We used data on weight and height before pregnancy, which was self-reported and recorded at the first prenatal visit. We cannot rule out the possibility of differential reporting among the four study groups. Our indicator on socioeconomic position was based on occupation and employment status and this information was missing for many women, especially women of Somali and Kurdish origin. Better indicators of socioeconomic position, such as education and income, are needed for future studies. We did not use education in the analysis due to an even larger number of missing data on the educational level of Somali and Kurdish women than the number of missing data for their socioeconomic position. The Finnish register data for education is available only for those finalizing

their education in Finland or having their education registered when visiting employment offices.

Obesity is a risk factor for several pregnancy complications [1–4]. Our findings show that women of Somali or Kurdish origin have several pregnancies and a higher pre-pregnancy BMI, which highlights the importance of preventing overweight and obesity among these groups. The Finnish maternity and child health clinics provide guidance in all matters related to pregnancy and childbirth and also monitor the health of mothers and infants after delivery. The services are free of charge to all those living permanently in Finland [33]. Almost all pregnant women and their children in Finland, including those of foreign origin, use these services, which make them an ideal setting for such studies and health promotion interventions.

Conclusions

Our study shows that Russian women had a lower pre-pregnancy BMI than the other study groups. There is no detailed data on lifestyle available to explore the reasons for this finding. The high prevalence of overweight and obesity among Somali and Kurdish origin women in Finland could be related to differences in complex interacting factors, such as physical inactivity, low socioeconomic position, culture and lifestyle, or poor access to health information. More information is needed on dietary intake and physical activity in women of Somali and Kurdish origin before interventions among these groups can be planned.

Declaration of conflicting interests

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PUBLICATION II

Pregnancy complications in women of Russian, Somali, and Kurdish origin and women in the general population in Finland

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Pregnancy complications in women of Russian, Somali, and Kurdish origin and women in the general population in Finland

Kalpana Bastola[1], Päivikki Koponen[2], Tommi Härkänen[2], Riitta Luoto[3], Mika Gissler[4,5] and Tarja I Kinnunen[1]

Abstract

Objective: We compared the prevalence of gestational diabetes and hypertensive disorders in the most recent pregnancy among women of Russian, Somali, and Kurdish origin and women in the general population in Finland.

Methods: The study groups were selected from population-based samples of 18- to 64-year-old women. The women were of Russian (n = 318), Somali (n = 583), and Kurdish (n = 373) origin or from the general population (n = 243), and had given birth in Finland between 2004 and 2014. The data were obtained from the National Medical Birth Register and the Hospital Discharge Register. Data on gestational diabetes and hypertensive disorders were extracted based on relevant *International Classification of Diseases, Tenth Revision* codes. The main statistical methods were logistic regression analyses adjusted for age, parity, body mass index, socioeconomic status, and smoking.

Results: The prevalence of gestational diabetes was 19.1% in Kurdish, 14.4% in Somali, 9.3% in Russian, and 11.8% in the general population. The prevalence of hypertensive disorders was 5.4% in the general population, 3.8% in Somali, 3.1% in Kurdish, and 1.7% in Russian. When adjusted for confounders, Kurdish women had two-fold odds for gestational diabetes (odds ratio = 1.98; 95% confidence interval = 1.20–3.32) compared with the general population, but the odds for hypertensive disorders did not differ between groups.

Conclusion: Women of Kurdish origin were more likely to develop gestational diabetes. Studies with larger samples are required to confirm these findings to develop prevention strategies for later development of type 2 diabetes. Future research including other migrant groups is recommended to identify differences in pregnancy complications among the women in migrant and general population.

Keywords

Finland, gestational diabetes, hypertensive disorders, migrants, pregnancy, pregnancy complications

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Background

Gestational diabetes mellitus (GDM) is a common complication of pregnancy, affecting 1%–14% of all pregnancies globally.[1] GDM represents a failure to maintain normal glucose tolerance during the extreme metabolic stress of pregnancy. Women with GDM have an increased risk of developing hypertensive disorders during pregnancy and type 2 diabetes mellitus after pregnancy. Their offspring are often macrosomic and are prone to obesity and type 2 diabetes later in life.[2–5] Hypertensive disorders, especially gestational hypertension (GHTN) and preeclampsia (PE),

[1]Faculty of Social Sciences/ Health Sciences, Tampere University, Tampere, Finland
[2]Department of Health, National Institute for Health and Welfare, Helsinki, Finland
[3]Faculty of Medicine and Health Technology, Tampere University, Tampere, Finland
[4]Department of Information Services, National Institute for Health and Welfare, Helsinki, Finland
[5]Department of Neurobiology, Care Sciences and Society, Division of Family Medicine, Karolinska Institute, Stockholm, Sweden

Corresponding author:
Kalpana Bastola, Faculty of Social Sciences/Health Sciences, Tampere University, 33014 Tampere, Pirkanmaa, Finland.
Email: Kalpana.bastola@tuni.fi

are other common complications in pregnancy. Globally, approximately 10% of all pregnant women have their blood pressure recorded above normal at some point in pregnancy and before delivery.[6] PE and eclampsia account for almost 15% of all maternal deaths worldwide.[7,8] Women who had PE are at increased risk of chronic hypertension, ischemic heart disease, cerebrovascular disease, atherosclerosis, kidney disease, diabetes mellitus, thromboembolism, hypothyroidism, and even impaired memory later in life.[9,10]

A few studies have reported the general prevalence of gestational diabetes and hypertensive disorders in the European countries.[11–13] However, limited information is available on pregnancy complications in women of migrant origin in the European countries.[14–16] This would be important since studies in non-pregnant populations suggest that many migrant groups have higher prevalence of type 2 diabetes or hypertension compared with the general population.[17,18] A previous systematic review and meta-analysis including 24 studies mainly from Australia, United States, and Europe showed that, in general, migrant women were more likely to have GDM compared with women in the receiving (general) population. Similarly, women in some migrant groups (e.g. Caribbean, African, European, and Northern European) were at greater risk of GDM, while some had risks similar (e.g. North African and North Americans) to women in the general population.[19] A recent review on pregnancy-related hypertensive disorders and immigrant status mainly based on studies from European countries and the United States reported that immigrant women had lower risk for hypertensive disorders compared to the women in the general population.[20] None of these reviews included any studies from Finland. Some explanations for the higher risk of pregnancy complications among migrants have been proposed, such as alteration in the normal lifestyle factors such as diet and physical activity, rapid weight gain, and higher stress level after migration to high income countries.[21–23] In addition, migration status, length of stay in the receiving country, and language skills are important determinants of pregnancy complications among migrant women. These factors are related to the access to the information and healthcare services.[19,24]

There are no data on these specific complications among any group of migrant women living in Finland. Russians, Somali, and Kurdish migrant are among the main migrant groups in Finland.[25] GDM and hypertensive disorders complicate many pregnancies, and it is important to identify the risk groups for these complications to mitigate the complications. In this study, we compared the prevalence of GDM and hypertensive disorders among women of Russian, Somali, and Kurdish origin and women in the general Finnish population.

Methods

Selection of the study population

The study included the sample of women from the Migrant Health and Wellbeing Study (Maamu) and the Health 2011 survey. The National Institute of Health and Welfare (THL) conducted Maamu study in the cities of Helsinki, Espoo, Vantaa, Turku, Tampere, and Vaasa during 2010–2012. The study population was selected according to criteria of age (18–64 years), country of birth, and native language and length of stay, representing those of Russian, Somali, and Kurdish origin, and those who had lived in Finland at least 1 year.[26] The study groups were selected to represent major migrant groups from different geographical areas.[25] Russian-origin migrants were the largest migrant group in Finland. Somali-origin migrants were the fourth-largest migrant group and the largest migrant group with refugee background and of Muslim faith. Kurdish-speaking migrants were the sixth-largest migrant group. These Iraqi and Iranian refugees have been among the largest groups of quota refugees accepted to Finland in the recent years. The study was conducted in six cities with a higher proportion of migrants than in most other Finnish cities. A total sample of 5909 people, about 2000 from each study group (Russian, Somali, and Kurdish origin), were selected from the national population register for the register-based study. To compare the migrant women with the general population, the Health 2011 sample (N = 2275) from the same six cities was used as the reference group. The Health 2011 survey collected information on the health and well-being of the general Finnish population.[27] Detailed information on the selection of the study population is described in the flow chart (Figure 1). Women who had given birth between 1 January 2004 and 31 December 2014 (n = 1518) were included in this study.

Data source

Data from the Medical Birth Register and the Hospital Discharge Register were linked with the personal identification numbers of each woman in the study samples. The Medical Birth Register includes information on mothers' sociodemographic background, smoking status, pre-pregnancy height, weight, visits to health care, and interventions during pregnancies and deliveries. The Hospital Discharge Register includes information on all inpatient and outpatient hospital care, with diagnoses recorded as *International Classification of Diseases, Tenth Revision* (ICD-10) codes.[28] For women who had more than one delivery during the time period, we included data only on their latest pregnancy between 1 January 2004 and 31 December 2014 in the present study. The data on socioeconomic status for the year 2011 were obtained from Statistics Finland.

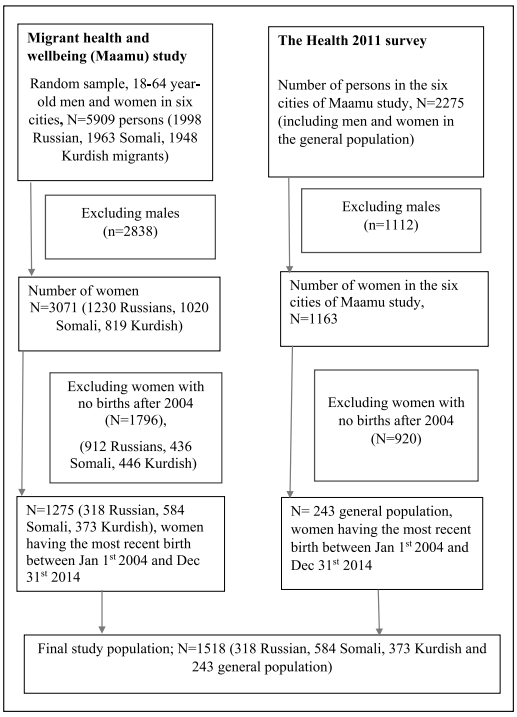

Figure 1. Flowchart of the study population.

Ethical approval

We obtained permission to use the data from the respective registries from the THL. The THL obtained ethical approval for Maamu and Health 2011 studies, including the use of register data from the Coordinating Ethical Committee of the Helsinki and Uusimaa Hospital Region. According to the Finnish legislation and guidelines for register-based research, no informed consent was needed from the participants as we used register data only.

Outcomes

In Finland, the diagnostic criteria for GDM slightly changed in 2008. Before 2008, GDM diagnosis was made if at least one of the following plasma glucose levels was observed in the 75-g oral glucose tolerance test: fasting value ⩾5.1 mmol/L, 1 h value ⩾10.0 mmol/L, or 2 h value ⩾8.6 mmol/L.[12] The oral glucose tolerance test was recommended at gestational weeks 24–28 for pregnant women with a pre-pregnancy body mass index (BMI) ⩾25 kg/m^2, presence of glycosuria, age >40 years, fetal macrosomia in current or previous pregnancy, GDM in previous pregnancy, or a first-degree family history of diabetes.[12] Since 2008, GDM has been diagnosed when with fasting plasma glucose value ⩾5.3 mmol/L, the 1 h value ⩾10.0 mmol/L, or the 2 h value ⩾8.6 mmol/l.[24] The oral glucose tolerance test is recommended for all pregnant women, except those at low risk (nulliparous women <25 years old with normal BMI and no family history of type 2 diabetes, and parous women <40 years old with normal BMI and no GDM or macrosomic child in a previous pregnancy).[29] GHTN is diagnosed if the systolic blood pressure of ⩾140 mm Hg or the diastolic blood pressure of ⩾90 mm Hg is identified after 20 weeks' gestation for the first time. PE is diagnosed if the presence of high blood pressure is accompanied by 24-hr proteinuria ⩾0.3 g after 20 weeks' gestation.[6] The information on GDM, GHTN, and PE were extracted from the registers using the ICD-10 codes. For GDM, we included ICD-10 codes O24.4, O24.9 (maternal), P08.0, or P08.1 (newborn); for GHTN, O13 or O16 (maternal); and for PE, O14.0, O14.1, or O14.9 (maternal). For each woman, up to 20 maternal diagnoses and 10 newborn diagnoses were recorded in the Medical Birth Register. All the ICD-10 codes were compiled together for each specific complication and finally categorized as yes/no. Due to the smaller number of women with GHTN and PE, the variables were combined, and hypertensive disorders are used to refer to them in the text.

Exposures

Migrant groups were classified into three categories: Russian-, Somali-, and Kurdish-origin women. Women in the general population were used as the reference category. Age at latest birth was classified as 17–24, 25–34, and ⩾35 years. Marital status was classified as married/cohabiting/partnered and single. We classified socioeconomic position into five categories: upper-level employees (administrative, managerial, professional, and related occupations), lower-level employees (administrative and clerical occupations), manual workers, others (including pensioners/homemakers/students), and unknown. Smoking during pregnancy was classified as yes/no and previous births as 0, 1, and 2 or more. BMI was calculated as maternal pre-pregnancy weight (kg) divided by height squared (m^2), and categorized as underweight (<18.5 kg/m^2), normal weight (18.5–24.9 kg/m^2), overweight (25–29.9 kg/m^2), and obese (⩾30 kg/m^2). Pre-pregnancy weight and height are usually self-reported at the first antenatal visit to the maternity clinic, and the information is recorded in the Medical Birth Register.

Statistical analyses

All statistical analyses were performed with Stata version 14 (Stata Corp LP, College Station, TX, USA). The inverse sampling probability weights were applied to the stratified sampling method, and finite populations were accounted for in all analyses to correct for the effect of differential sampling probabilities.[26,30] Descriptive data were reported

Table 1. Characteristics of the study population at the time of the most recent pregnancy by study groups, all singleton births, 2004–2014 (weighted percentages).

	General population (n = 243)	Russian (n = 318)	Somali (n = 584)	Kurdish (n = 373)
Age, years				
18–24	10.5	11.6	17.6	16.1
25–34	62.2	62.5	50.8	62.0
35 or more	27.2	25.8	31.4	27.2
Marital status				
Married/cohabiting/partnership	88.0	86.9	89.0	97.5
Single	12.0	13.1	11.0	2.5
Socioeconomic status				
Upper white-collar workers	25.8	14.3	2.7	2.8
Lower white-collar workers	37.5	26.7	15.0	14.3
Manual workers	17.2	15.9	9.1	18.2
Others	11.6	31.9	39.3	47.2
Unknown	7.7	11.0	33.7	17.2
Smoking during pregnancy				
No	81.5	86.0	98.0	95.1
Yes	18.4	13.9	2.0	4.4
Previous births				
0	40.7	37.8	9.4	23.7
1	37.3	43.4	18.2	36.7
2 or more	22.0	18.6	72.3	39.4
Body mass index, kg/m^2				
Underweight	5.8	11.1	4.5	1.5
Normal weight	64.5	71.5	32.2	44.7
Overweight	19.1	12.6	36.0	37.1
Obese	10.4	4.6	27.3	16.5

[a]Missing values for smoking during pregnancy in each category from the left to the right were 3.4%, 2.2%, 2.9%, and 1.6% respectively.
[b]Missing values for pre-pregnancy body mass index in each category from the left to the right were 5.1%, 10.4%, 5.9%, and 8.1% respectively; missing values for all other variables were <1% in each category.

as numbers of observations and prevalence (%). Chi-square tests were used to compare the crude percentages. We used logistic regression models to test differences in pregnancy complications using women in the general population as the reference group. Age and BMI were used as continuous variables, whereas socioeconomic status was categorized as upper and lower white-collar workers, manual workers, and unemployed/unknown for the regression models. Model I was adjusted for age at latest birth. Model II was adjusted for age at latest birth, BMI, socioeconomic status, and parity. Odds ratios (ORs) with their 95% confidence intervals (CIs) were reported for the regression models.

Results

Overall, most of the recent births occurred in 25–34 years age group. A majority of women (88%–97%) in all the study groups were married/cohabiting or in a registered partnership. A higher percentage of all migrant-origin women had a lower socioeconomic status and were multiparous than of women in the general population (the reference group) (Table 1). Higher percentages of Somali- and Kurdish-origin women were overweight and obese compared to the reference group. The prevalence of smoking during pregnancy was higher in women in the reference group compared with the other study groups.

The prevalence of GDM was higher in Kurdish-origin women (19.4%) (Table 2) as compared with the reference group. No statistically significant differences were observed in the prevalence of GDM among Somalis and Russians as compared to the reference group. Similarly, the overall prevalence of hypertensive disorders was between 2% and 6%, being highest in the reference group. However, the difference between the groups was statistically insignificant. Among all women with hypertensive disorders (n = 54), almost 26% (n = 14) also had GDM.

The age-adjusted OR for GDM was significantly higher (OR = 1.98; 95% CI = 1.25–3.13) in Kurdish women compared with the reference group (Table 3). For every 1-year increase in age, there were 1.07 (95% CI = 1.04–1.09) increased odds for GDM. In the fully adjusted model, Kurdish-origin women still had almost doubled odds for

Table 2. Prevalence of pregnancy complications during the most recent pregnancy as compared with women in the general Finnish population (weighted percentages).

	General population, n = 243	Russian, n = 318	p value[a]	Somali, n = 584	p value[a]	Kurdish, n = 373	p value[a]
Gestational diabetes							
Yes	11.8	9.3	0.340	14.4	0.311	19.4	0.010
No	88.2	90.7		85.6		80.6	
Hypertensive disorders							
Yes	5.5	1.8	0.024	3.9	0.285	3.2	0.144
No	94.5	98.2		96.1		96.8	

[a]Pearson's chi-square test.

Table 3. Logistic regression model for having gestational diabetes in the most recent pregnancy, OR and 95% Confidence interval (CI).

	Model I[a] OR (CI) (N = 1518)	p value	Model II[b] OR (CI) (N = 1416)	p value
Study groups				
General population	Reference		Reference	
Russian	0.79 (0.45–1.38)	0.417	1.19 (0.66–2.14)	0.553
Somali	1.27 (0.81–2.0)	0.298	1.11 (0.64–1.92)	0.706
Kurdish	**1.98 (1.25–3.13)**	**0.003**	**1.98 (1.20–3.32)**	**0.009**
Age, years	**1.07 (1.04–1.09)**	**<0.001**	**1.06 (1.03–1.09)**	**<0.001**
Body mass index, kg/m^2			**1.13 (1.10–1.17)**	**<0.001**
Socioeconomic status				
Upper and lower white-collar workers			Reference	
Manual workers			1.03 (0.63–1.67)	0.892
Unemployed			0.94 (0.65–1.35)	0.760
Previous births				
0			Reference	
1			**0.56 (0.36–0.86)**	**0.008**
2 or more			**0.56 (0.35–0.90)**	**0.018**

OR = odds ratio; CI = confidence interval.
[a]Model I is adjusted for age.
[b]Model II is adjusted for age, body mass index, socioeconomic position, and number of previous births.

GDM (OR = 1.98; 95% CI = 1.20–3.32) compared with the reference group. The OR for age and BMI was 1.06 (95% CI = 1.03–1.09) and 1.13 (95% CI = 1.10–1.17), respectively, whereas primiparous (OR = 0.56; 95% CI = 0.36–0.86) and multiparous (OR = 0.56; 95% CI = 0.35–0.90) women had lower odds for GDM compared with nulliparous women in the fully adjusted model.

Table 4 presents the logistic regression model for having hypertensive disorders in the most recent pregnancy. In the age-adjusted model (Model I), Russian-origin women had lower OR (0.31; 95% CI = 0.10–0.90) for having hypertensive disorders, whereas it was statistically insignificant in the fully adjusted model (Model II). Somali and Kurdish women did not differ from the reference group for having hypertensive disorders in either Model. Multiparous women had lower OR (0.21; 95% CI = 0.10–0.47) for having hypertensive disorders than nulliparous women in the fully adjusted model. We also adjusted for smoking during the latest pregnancy (yes/no), and the results were essentially the same as in Model II (results not shown).

Discussion

Women of Kurdish origin had significantly higher odds for having GDM compared to the reference group, whereas Somali and Russian women did not differ from the reference group for having GDM after adjusting for confounders. No differences between migrant groups and the general population were observed for hypertensive disorders when adjusted for confounders.

A previous review from Europe found that the prevalence of GDM ranged between 2% and 27% of all pregnancies in Europe, being lowest in the North Atlantic seaboard region and Nordic countries, excluding Finland, and highest in the South Mediterranean region, mostly in Italy, Spain, and Portugal.[11] This huge difference is at least partly due to

Table 4. Logistic regression model for having hypertensive disorders in the most recent pregnancy, OR and 95% Confidence interval (CI).

	Model I[a] OR (CI) (N = 1416–1518)	p value	Model II[b] OR (CI) (N = 1416)	p value
Study groups				
General population	Reference		Reference	
Russian	**0.31 (0.10–0.90)**	**0.033**	0.42 (0.14–1.23)	0.116
Somali	0.69 (0.35–1.35)	0.288	1.25 (0.51–3.05)	0.623
Kurdish	0.56 (0.26–1.22)	0.150	0.64 (0.23–1.72)	0.380
Age, years	0.99 (0.95–1.04)	0.857	1.04 (0.99–1.09)	0.094
Body mass index, kg/m^2			1.04 (0.99–1.10)	0.071
Socioeconomic status				
Upper and lower white-collar workers			Reference	
Manual workers			1.72 (0.68–4.39)	0.250
Unemployed			1.64 (0.83–3.22)	0.149
Previous births				
0			Reference	
1			0.58 (0.28–1.19)	0.141
2 or more			**0.21 (0.10–0.47)**	**<0.001**

OR = odds ratio; CI = confidence interval.
[a]Model I is adjusted for age.
[b]Model II is adjusted for age, body mass index, socioeconomic position, and number of previous births.

a lack of consistency in diagnostic criteria in European countries.[11] The overall prevalence of GDM in Finland was 15.6% in 2017 according to data from the National Medical Birth Register.[31] The prevalence of GDM was almost 12% among the general population in our study, which is slightly less than the national prevalence. This is because our data were slightly older (i.e. from 2004–2014).

A previous study using Maamu survey data found that physical inactivity was highest among non-pregnant Kurdish women.[32] Likewise, a higher prevalence of metabolic syndrome was reported among Kurdish women through higher prevalence of elevated fasting glucose, low high-density lipoprotein (HDL) cholesterol level, elevated triglycerides, and higher abdominal obesity.[32] Physical inactivity and unhealthy dietary habits play a role in the development of GDM and may explain the higher odds of GDM among Kurdish women in our study.

Older age and higher BMI are well-known risk factors for GDM.[33,34] Likewise, our study also found that older age and pre-pregnancy overweight and obesity increased the odds for GDM. Despite having the highest general prevalence of overweight and obesity, and a statistically non-significantly higher prevalence of GDM in the unadjusted model (Tables 1 and 2), Somali women did not have a statistically significantly higher prevalence of GDM than women in the reference group, when adjusted for confounders. We observed that having at least one previous birth compared with none decreased the odds for GDM. We could not find any study reporting parity as an independent risk or protective factor for GDM.

We combined GHTN and PE due to the small number of cases in some study groups. A previous study showed that the general prevalence of hypertensive disorders is 4%–6% in Finland,[34] which is similar to the findings from our study. A study in Norway using Medical Birth Registry data showed that the prevalence of PE in native Norwegian women was slightly higher (3.7%) than in any migrant-origin women (2.7%). Similarly, the prevalence of PE in Somali and Afghan/Iraqi women was 4.0% and 2.2%, respectively.[15] The results are comparable to our findings. Mogos et al. 2016 published a review, which reported that migrant status is generally associated with lower risk of hypertensive disorders in pregnancy as compared to women in the general population.[20] Similarly, previous studies from Sweden have reported a lower risk of hypertensive disorders in non-Nordic women relative to Nordic women.[13,14] It was difficult to compare our findings to Mogos et al. 2016 and Swedish studies because they used very broad categories for the migrant groups. However, our study could not find any significant differences in hypertensive disorders between migrant-origin women and women in the general population after adjusting for confounders. Small sample size and few migrant groups could at least partly explain the divergence. It is known that the risk of PE is lower in multiparous women than in nulliparous women.[35,36] Our findings support this, as being multiparous decreased the odds for hypertensive disorders compared with being nulliparous.

A recent meta-analysis studied the effects of diet and physical activity–based interventions in pregnancy on

gestational weight gain and pregnancy outcomes. The study reported that the interventions had minor effects on prevention of GDM and hypertensive disorders during pregnancy.[37] We need more information on dietary intake and physical activity in women of Somali and Kurdish origin. Nevertheless, healthy diet, physical activity, and weight management are recommended not only during pregnancy but for all people, especially for high-risk groups.

This study contributes to the limited information on pregnancy complications among migrant-origin women, not only in Finland but also elsewhere in Europe and in North America. Another strength of this study is the use of random population-based samples, including three major migrant groups in Finland. Finnish register-based data have good validity and reliability in general.[38] Almost all deliveries in Finland take place in public hospitals, and data on maternal health, obstetric history, delivery events, and newborn outcomes for all births are recorded in the Medical Birth Register. The Hospital Discharge Register was used to complete the diagnoses in the Medical Birth Register.

Our study has also limitations. We cannot generalize these results to groups of migrant women beyond the three study groups. We used information on socioeconomic position derived from occupation and employment status, and this information was missing for many women of Somali and Kurdish origin. We could not use any variables on education, as this had even more missing information for all groups of migrant women. It is difficult to obtain the data on migrant women education completed outside Finland. Whenever possible, we recommend using better indicators of socioeconomic position, such as highest educational attainment and family income, for future studies. As we used only register data, we also did not have information on the diet, physical activity, length of stay in Finland, and language skills for the migrant population. The only indicator of health behavior in Medical Birth Register is smoking.

In conclusion, migrant women of Kurdish origin had two-fold odds for GDM compared with women in the general population, and therefore, they need special attention in maternity care and after pregnancy to prevent development of type 2 diabetes. The prevalence of hypertensive disorders did not differ significantly between the three migrant groups and women in the general population. Further research with larger samples and including other migrant groups is required to identify possible differences in pregnancy complications among migrant women and women in the general population as well as reasons for the differences.

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ORCID iD

Kalpana Bastola https://orcid.org/0000-0002-2922-2876

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PUBLICATION III

Delivery and its complications among women of Somali, Kurdish, and Russian origin, and women in the general population in Finland

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ORIGINAL ARTICLE

WILEY BIRTH ISSUES IN PERINATAL CARE

Delivery and its complications among women of Somali, Kurdish, and Russian origin, and women in the general population in Finland

Kalpana Bastola MHS[1] | Päivikki Koponen PhD[2] | Tommi Härkänen PhD[2] | Riitta Luoto PhD[1,3] | Mika Gissler PhD[4,5] | Tarja I. Kinnunen PhD[1]

[1]Faculty of Social Sciences (Health Sciences), University of Tampere, Tampere, Finland

[2]Department of Public Health Solutions, National Institute for Health and Welfare, Helsinki, Finland

[3]The Social Insurance Institution of Finland, Tampere, Finland

[4]Department of Information Services, National Institute for Health and Welfare, Helsinki, Finland

[5]Division of Family Medicine, Department of Neurobiology, Care Sciences and Society, Karolinska Institute, Stockholm, Sweden

Correspondence
Kalpana Bastola, Faculty of Social Sciences (Health Sciences), University of Tampere, Tampere, Finland.
Email: bastola.kalpana.x@student.uta.fi

Abstract

Introduction: Limited information is available on delivery and its complications among migrant women in Finland. We compared mode of delivery, delivery complications, and use of pain medication during delivery between migrant women of Somali, Kurdish, and Russian origin and women in the general population in Finland.

Methods: The women were of Russian (n = 318), Somali (n = 583), and Kurdish (n = 373) origin and 243 women from the general population (reference group) who had given birth in Finland between 2004 and 2014. The data were obtained from the National Medical Birth Register and the Hospital Discharge Register. The most recent birth of each woman was included in the analyses. The main statistical methods were logistic regression analyses adjusting for age, parity, body mass index, gestational age, and smoking during pregnancy.

Results: Vaginal delivery was the most common mode of delivery among all study groups (79%-89%). The prevalence of any delivery complications varied between 15% and 19% among all study groups. When adjusted for confounders, Russian women had lower odds (OR 0.49; CI 0.29-0.82) of having a cesarean delivery, whereas Somali and Kurdish women did not differ from the reference group. Somali women had an increased risk of any delivery complications (OR 1.62; CI 1.03-2.55) compared with the reference group. No differences were observed in the use of pain medication between the groups.

Conclusion: Delivery complications were more common among migrant Somali women than among women in the general Finnish population. Somali women represent a high-risk group calling for special attention and care.

KEYWORDS
delivery complications, delivery mode, Finland, migrants, pain medication

1 | INTRODUCTION

Spontaneous vaginal delivery is the safest method of delivery, but cesarean and other types of assisted delivery have increased rapidly in recent years.[1,2] Cesarean birth is associated with a significantly increased risk of maternal morbidity and mortality from complications of anesthesia, puerperal infection, and venous thromboembolism.[3-5]

In some previous studies, migrant women in general had a higher risk of adverse pregnancy outcomes.[6-9] However,

some of these studies grouped migrants as a whole, or into broad groups without grouping by individual country of origin, thus making it difficult to tease out results for specific groups. Thus, it is not entirely clear whether the incidence of adverse pregnancy outcomes is high in a particular group or is a general phenomenon among migrant groups. In studies that did differentiate by country of origin, Somali women generally had a higher incidence of cesarean delivery and delivery complications compared with women in the general population. We were not able to find similar studies for Russian and Kurdish migrant women. It is essential to identify risk groups for delivery complications to take timely action to reduce maternal and neonatal morbidity and mortality. In Finland, information on delivery complications and use of pain medication among migrant women is very scarce.[8] In this study, we studied the mode of delivery, incidence of delivery complications, and use of pain medication among women of Somali, Kurdish, and Russian origin living in Finland and compared them with women in the general Finnish population.

2 | METHODS

2.1 | Selection of the study population

The study population was based on the Migrant Health and Wellbeing Study (Maamu) and the Health 2011 survey conducted by the National Institute of Health and Welfare in 2010-2012. The Maamu study population was selected according to criteria of age (18-64 years), country of birth (Russia/former Soviet Union, Somalia, and Iran/Iraq), native language (Russian/Finnish, Somali, and the Sorani dialect of Kurdish), municipality of residence (Helsinki, Espoo, Vantaa, Turku, Tampere, and Vaasa), and at least 1 year of residence in Finland.[10] A representative sample of 5909 people (3071 women), about 2000 from each study group (Russian, Somali, and Kurdish origin), was identified from the National Population Register. The study was conducted in 6 cities that have a higher proportion of migrants than most other Finnish cities. Russian-origin migrants are the largest migrant group in Finland. Somali-origin migrants are the fourth largest migrant group, and the largest migrant group with a refugee background and of Muslim faith. Kurdish-speaking migrants are the sixth largest migrant group and are among the largest groups of quota refugees accepted in Finland in recent years.

To compare the migrant women with the general population, the Health 2011 sample (2275 persons, 1163 women) from the same 6 cities was used as the reference group. Health 2011 was a national survey carried out to monitor the health and well-being of the general Finnish population.[11] More than 99% of the reference group had Finnish or Swedish (the main official languages in Finland) as their native language, indicating that there were only a few people of potentially foreign origin. Detailed information on the selection of the study population is described in the flowchart (Figure 1).

The data for this study were obtained from the Finnish Medical Birth Register and the Hospital Discharge Register from January 1, 2004 to December 31, 2014. Data from both these registers were linked together with the personal identification numbers for each woman in the study samples to specify the study groups (the 3 migrant groups and the women in the general population). The register data included information on mothers' sociodemographic backgrounds, interventions during pregnancy and delivery, as well as smoking, prepregnancy weight, and height, covering all inpatient and outpatient hospital care that occurred in Finland with diagnoses recorded as ICD-10 codes.[12] For women who had more than one birth between 2004 and 2014 (n = 1518), information on the most recent birth during the period was included in the analyses. The National Institute for Health and Welfare obtained ethical approval for both studies, including approval to use register data, from the Coordinating Ethical Committee of the Helsinki and Uusimaa Hospital Region.

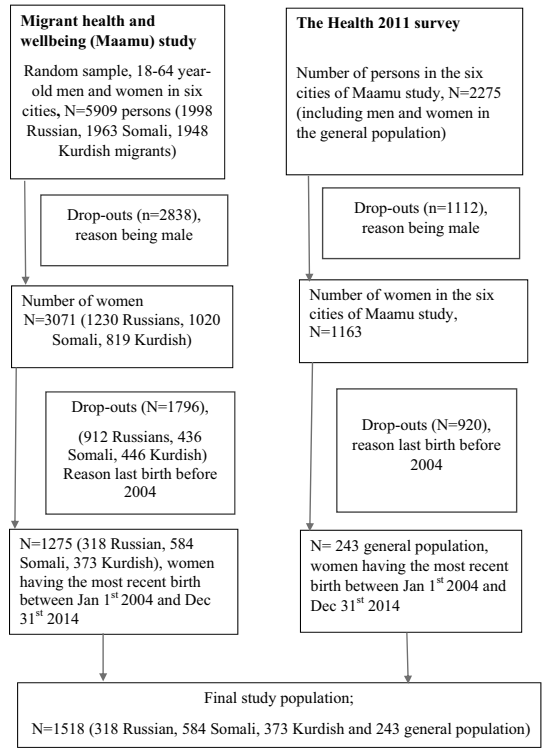

FIGURE 1 Flowchart of the study population

2.2 | Definition of variables

Mode of delivery was classified into 5 categories: spontaneous vaginal, breech, vacuum extractor/forceps, elective cesarean, and emergency cesarean/urgent cesarean/other cesarean. Mode of delivery was further categorized as vaginal (spontaneous vaginal/breech/vacuum extractor/forceps) and cesarean section (elective cesarean/emergency cesarean/urgent cesarean/other cesarean) for the regression models. Gestational age was classified as preterm (<36 week +6 days), full term (37 weeks +0 days to 41 weeks +6 days), and postterm (more than 42 weeks +0 days). Use of pain medication in vaginal delivery was categorized as follows: epidural/spinal/epidural spinal combined as yes/no; paracervical/pudendal as yes/no; inhalation as yes/no; other (medical/nonmedical) as yes/no.

Delivery complications considered in this study were obstructed labor, fetal stress, perineal laceration, and postpartum hemorrhage. The information on all the delivery complications was extracted from the registers, using relevant ICD-10 codes. For obstructed labor, we included ICD-10 codes O64.0–O64.5, O64.8–O64.9, O65.0–O65.4, O65.8–O65.9, and O66.0–O66.3. For fetal stress, we included ICD-10 codes O68.0–O68.3 and O68.8–O68.9. For perineal laceration, we included ICD-10 codes O70.0–O70.3 and O70.9. For postpartum hemorrhage, we included O72.0–O72.3. All the ICD-10 codes were compiled for each specific complication and finally categorized as yes/no. We created a summary variable as any delivery complications (yes/no) for the regression models.

Age at the most recent birth was classified as 18-24, 25-34, and ≥35 years. Marital status was classified as married/cohabiting/partnered and single/divorced/widowed. Socioeconomic status was categorized into 5 categories based on employment status: upper-level employees with administrative, managerial, professional, and related occupations; lower-level employees with administrative and clerical occupations; manual workers; others, including pensioners, homemakers, and students; and unknown. Smoking habit during pregnancy was categorized as yes/no and previous births as 0, 1, and 2 or more. Body mass index (BMI) was calculated as maternal prepregnancy weight (kg) divided by height in meters squared and categorized as underweight (<18.5 kg/m^2), normal weight (18.5-24.9 kg/m^2), overweight (25-29.9 kg/m^2), and obese (≥30 kg/m^2).

2.3 | Statistical analyses

All statistical analyses were performed with Stata version 14 (Stata Corp LP, College Station, TX, USA). The different sampling probabilities and nonparticipation were accounted for using inverse sampling probability weights.[10,13] The stratified sampling and finite population correction were also accounted for in all analyses. Descriptive data were reported as numbers of observations and prevalence (%). Chi-square tests were used to compare the crude percentages. We used logistic regression models to test differences in having a cesarean delivery, having any delivery complications, and using any pain medication, using women in the general population as the reference group. In the model where we used pain medication as the outcome variable, we excluded urgent and elective cesarean delivery because of potential reporting bias from the hospitals. Age and BMI were used as continuous variables for the regression models. Model I was adjusted for age at most recent birth. Model II was adjusted for age at most recent birth, BMI, gestational age, previous births, and smoking during pregnancy. Odds ratios (OR) with 95% confidence intervals were reported for the regression models.

3 | RESULTS

More than half of all births occurred in the 25-34 age group across all study groups (Table 1). Similar percentages (11%-13%) of Somali women, women in the general population (reference group), and Russian women were single mothers. A lower percentage of all migrant women were upper- and lower-level employees than in the reference group. Women in the reference group were more likely to smoke during pregnancy compared with all migrant women. Higher percentages of Somali and Kurdish women were multiparous compared with women in the reference group. Somali and Kurdish women were more likely to be overweight and obese compared with the reference group.

Almost all the deliveries (n = 1511, 99.5%) took place in hospital; one delivery was on the way to hospital, and 6 occurred unplanned outside hospital. There were no planned home births. Among all study participants, only 4.4%-6.3% had a preterm delivery, whereas the prevalence of postterm delivery was between 4% and 10% (Table 2). Spontaneous vaginal delivery was the most common method of delivery among all study groups. Russian and Kurdish women were more likely to have a vaginal delivery (89% and 85%, respectively) compared with the reference group (79%). Women in the general population were more likely to have obstructed labor (6.5%) than Russian (2.6%) and Kurdish women (2.7%). The prevalence of fetal stress did not differ significantly between the migrant groups and the reference group. Russian women differed significantly from the reference group for having a higher incidence of perineal laceration (4.4% vs 1.2%). None of the migrant groups differed significantly from the reference group in the incidence of postpartum hemorrhage. Overall, having any delivery complications (obstructed labor, fetal stress, perineal laceration, and/or postpartum hemorrhage) was slightly more common among women in the general population compared with

TABLE 1 Characteristics of women in the general population and migrant women at the time of the most recent pregnancy, Finland, 2004-2014

	General population (n = 243) n (%)	Russian (n = 318) n (%)	Somali (n = 584) n (%)	Kurdish (n = 373) n (%)
Age, y				
18-24	24 (10.5)	35 (11.6)	115 (17.6)	59 (16.1)
25-34	152 (62.2)	203 (62.5)	295 (50.8)	232 (62.0)
35 or more	67 (27.2)	80 (25.8)	174 (31.4)	82 (27.2)
Marital status				
Married/cohabiting/registered partnership	214 (88.0)	280 (86.9)	519 (89.0)	361 (97.5)
Single/divorced/widow	29 (12.0)	38 (13.1)	64 (11.0)	10 (2.5)
Employment status				
Upper-level employees[a]	63 (25.8)	46 (14.3)	16 (2.7)	10 (2.8)
Lower-level employees[b]	91 (37.5)	86 (26.7)	82 (15.0)	53 (14.4)
Manual workers	42 (17.2)	54 (15.9)	52 (9.1)	69 (18.2)
Others (students/pensioners/ homemakers)	28 (11.6)	100 (31.9)	241 (39.3)	175 (47.2)
Unknown	19 (7.7)	32 (11.0)	193 (33.7)	66 (17.2)
Smoking				
No	191 (81.5)	268 (86.0)	558 (98.0)	348 (95.1)
Yes	44 (18.4)	43 (13.9)	14 (2.0)	19 (4.4)
Previous births				
0	98 (40.7)	118 (37.8)	59 (9.4)	87 (23.7)
1	91 (37.3)	136 (43.4)	109 (18.2)	136 (36.7)
2 or more	54 (22.0)	64 (18.6)	416 (72.3)	149 (39.4)
Prepregnancy body mass index, kg/m^{2}[c]				
Underweight	14 (5.8)	30 (11.1)	26 (4.5)	5 (1.5)
Normal weight	149 (64.5)	201 (71.5)	183 (32.2)	157 (44.7)
Overweight	44 (19.1)	40 (12.6)	196 (36.0)	126 (37.1)
Obese	24 (10.4)	17 (4.6)	146 (27.3)	57 (16.5)

[a]Upper-level employees with administrative, managerial, professional and related occupations.
[b]Lower-level employees with administrative and clerical occupations.
[c]Number of women in the general population, Russian, Somali, and Kurdish origin for prepregnancy body mass index were 231, 288, 521, and 345, respectively.

any other study group, although the differences between the groups were not statistically significant. A lower percentage of Somali women (76%) used any pain medication compared with women in the reference group (84%). The most popular choice of pain medication during delivery was inhalation (use of nitrous oxide) (Table 2).

Compared with the women in the reference group, Russian women had significantly lower odds (OR 0.49; 95% CI 0.29-0.82) of having a cesarean delivery when adjusted for the potential confounders (Table 3). Kurdish and Somali women did not differ from women in the general population for having a cesarean delivery. Somali women had higher odds (OR 1.62; 95% CI 1.03-2.55) of any delivery complication after adjustment for the confounders compared with the reference group (Table 3). There were no differences in the use of pain medication between migrant women and women in the general population after adjustment for the confounders (Table 3).

4 | DISCUSSION

Vaginal delivery was the most common mode of delivery among all study groups (79%-89% of all deliveries). The prevalence of any delivery complications (obstructed labor, fetal stress, and perineal laceration) varied between 15% and 19% among all study groups. A large percentage of women (76%-84% in each study group) used at least one

TABLE 2 Mode of delivery, delivery-related complications, and use of pain medication in the most recent delivery by women in the general population and migrant women, Finland, 2004-2014

	General population (n = 243) n (%)	Russian (n = 348) n (%)	Somali (n = 584) n (%)	Kurdish (n = 373) n (%)
Gestational age				
Preterm	10 (4.4)	15 (4.8)	35 (6.3)	20 (5.5)
Full term	213 (87.6)	288 (91.0)	486 (83.7)	335 (89.8)
Postterm	20 (8.0)	15 (4.2)	62 (10.0)	17 (4.7)
Mode of delivery		**		
Spontaneous vaginal	172 (70.5)	256 (80.6)	441 (75.2)	281 (75.0)
Breech	1 (0.4)	4 (1.5)	2 (0.3)	6 (1.6)
Vacuum extractor	19 (7.7)	22 (7.3)	25 (4.1)	30 (8.0)
Elective cesarean	24 (10.0)	16 (5.1)	51 (8.6)	19 (5.1)
Urgent cesarean	27 (11.3)	20 (5.2)	65 (11.5)	36 (10.0)
All cesareans	51 (21.3)	36 (10.5)***	116 (20.2)	55 (15.4)*
Obstructed labor	16 (6.5)	11 (2.6)*	22 (3.7)	11 (2.7)**
Fetal stress	22 (9.3)	17 (5.4)	51 (8.8)	31 (8.3)
Perineal laceration	3 (1.2)	20 (4.4)*	7 (1.0)	12 (3.1)
Postpartum hemorrhage	15 (6.1)	12 (3.6)	28 (4.9)	18 (4.7)
Any delivery complications	47 (19.2)	55 (14.9)	98 (16.5)	70 (18.4)
Epidural/spinal pain medication	116 (61.0)	160 (59.8)	139 (30.8)***	161 (50.4)*
Paracervical/pudendal pain medication	24 (13.0)	42 (10.4)	51 (9.0)	64 (19.6)*
Inhalation pain medication	116 (60.7)	151 (53.5)	293 (63.8)	163 (50.4)*
Other pain medication	48 (25.3)	54 (15.8)*	59 (10.8)***	63 (20.4)
Any pain medication	161 (84.0)	225 (79.7)	357 (76.2)*	251 (78.7)

There were no missing cases for women in the general population, almost 10% missing cases for Russian women, and <1% for Somali and Kurdish women in some variables.

*$P < .05$, **$P < .01$, ***$P < .001$ compared with women in the general population.

type of pain medication. After adjustment for confounders, Russian women had lower odds of having a cesarean delivery, whereas Somali women had higher odds of having any delivery complications compared with women in the general population. No differences were observed between study groups for the use of pain medication after adjustment for confounders.

In Nordic countries, the overall prevalence of cesarean delivery varies from 15% to 22%, and it is 17% in Finland.[14] A previous study among ethnic minority women in Finland found that, among primiparous women, cesarean delivery was significantly more common among women of Somali origin compared with Finnish women.[8] Another review comparing rates of cesarean births between migrant and nonmigrant women living in countries in the Organization for Economic Cooperation and Development found an excess of cesarean births among women of sub-Saharan African, Somali, and South Asian origin compared with women in the receiving countries.[9] Similarly, a study on delivery among immigrants in Norway found that women from Somalia, Eritrea, or Ethiopia had a higher prevalence (20%) of cesarean delivery compared with ethnic Norwegians (12%).[6] Contrary to these findings, we did not find any statistically significant difference in the prevalence of cesarean delivery between Somali women and women in the general population in this study. Moreover, we found that Russian women were less likely to have a cesarean delivery compared with women in the general population. Our previous studies on prepregnancy BMI[15] and pregnancy complications (unpublished, under review) among migrant women in Finland showed that Russian women had 1.93 kg/m^2 units lower prepregnancy BMI, and they had a statistically insignificant lower incidence of gestational diabetes and gestational hypertension compared with women in the general population. Therefore, Russian women in general had better pregnancy and delivery outcomes compared with the reference group. One possible explanation for Somali women having no difference in the prevalence of cesarean delivery compared with the general population could be better prenatal care and carefully planned delivery processes in Finland.

TABLE 3 Adjusted odds ratios (OR) and 95% confidence intervals (CI) for cesarean birth, delivery complications, and use of pain medication in the most recent delivery for women in the general population and migrant women, Finland, 2004-2014

Study groups	Model I[a] OR (95% CI)	Model II[b] OR (95% CI)
Dependent variable = cesarean birth	(N = 1517)	(N = 1399)
General population	Reference	Reference
Russian	**0.43 (0.27-0.71)**	**0.49 (0.29-0.82)**
Somali	0.94 (0.65-1.35)	1.32 (0.85-2.04)
Kurdish	0.69 (0.46-1.03)	0.84 (0.54-1.31)
Dependent variable = any complications	(N = 1518)	(N = 1399)
General population	Reference	Reference
Russian	0.73 (0.46-1.16)	0.83 (0.51-1.34)
Somali	0.83 (0.57-1.21)	**1.62 (1.03-2.55)**
Kurdish	0.94 (0.64-1.39)	1.31 (0.85-2.02)
Dependent variable = use of pain medication	(N = 1407)	(N = 1163)
General population	Reference	Reference
Russian	0.73 (0.42-1.05)	0.74 (0.53-1.27)
Somali	**0.61 (0.37-0.81)**	1.05 (0.64-1.72)
Kurdish	**0.67 (0.39-0.90)**	0.95 (0.58-1.55)

[a]Adjusted for maternal age.
[b]Adjusted for maternal age, body mass index, gestational age, previous births, and smoking during pregnancy.
Bolded values are statistically signficant at $P < .05$ level.

Vangen et al[6] studied perinatal complications among Somalis in Norway. They found that perinatal complications such as induction of labor, fetal distress, secondary arrest, prolonged second stage of labor, operative delivery, and perinatal death were more frequent among Somali-origin women living in Norway than among Norwegian women. We found that Somali women had higher odds of having any delivery complications (obstructed labor, fetal stress, perineal laceration, or postpartum hemorrhage) compared with women in the general population, which is in line with previous findings. One explanation for this could be female genital mutilation/cutting (FGM/C). FGM/C is widely practiced among African-origin women, and it is associated with several delivery complications in addition to pregnancy complications, such as prolonged labor, obstruction, perineal tears, and postpartum hemorrhage.[16,17] A previous study found the prevalence of FGM/C was 69% among women of Somali origin and 32% among women of Kurdish origin living in Finland.[18] We are not aware of any previous studies on mode of delivery or delivery complications among migrant Kurdish or Russian women in European countries, making it difficult to compare our results with other studies. Our previous study found that Somali and Kurdish women had higher prepregnancy BMI and Russian women had lower prepregnancy BMI compared with women in the general population.[16] Higher BMI is associated with various delivery complications.[19,20] Our analyses were adjusted for prepregnancy BMI.

A previous study reported that almost similar percentages (90%) of migrant-origin women and Finnish women used any pain medication during their first births,[8] whereas we found that prevalence of using any pain medication was 75% among Finnish women and 67% to 74% among migrant women. Another study, from Sweden, found that the prevalence of using epidural analgesia during vaginal delivery was significantly higher among migrant Finnish and Iranian women and significantly lower among Somali, Iraqi, and Turkish women compared with native Swedish women after adjustment for confounders.[21] We found no differences between women in the general population and the migrant groups after adjustment for confounders.

Our study has several strengths. It is one of the first studies on this topic in Finland, and it is based on data for 11 years from the Medical Birth Register and Hospital Discharge Register. We used information from the Hospital Discharge Register to validate the data from Medical Birth Register for delivery complications. Data from Finnish registers have been proven to be of high quality.[22,23] We were able to adjust for important confounders such as age, employment status, BMI, parity, and smoking during pregnancy. Our study also has some limitations. The sample size in our study was relatively small, limiting our ability to observe statistically significant differences in some of the variables. Information on employment status was missing for many women of Somali and Kurdish origin. We could not use level of education as an alternative indicator of socioeconomic position in our analyses because of incomplete information for migrant women. We had no information on FGM/C, as this information was not available in the Medical Birth Register before 2017. We cannot generalize the findings from our study to other migrant women beyond the three study groups. However, we would expect to make similar findings among migrant women of Somali, Kurdish, and Russian origin living in other Nordic countries.

In conclusion, vaginal nonassisted delivery, which is the safest method, is also the most common mode of delivery among all the study groups. Compared with women in the general population, Russian women had lower odds of having an assisted delivery, whereas Somali women had higher odds of having any delivery complications. Kurdish women did not differ from the reference group for having a cesarean delivery or any delivery complications after adjustment for confounders. No differences were observed in the use of pain medication among the study groups. These results need to be confirmed with larger data sets. Somali women may need

more routine follows-up to maintain healthy pregnancy and safe delivery.

ORCID

Kalpana Bastola http://orcid.org/0000-0002-2922-2876

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PUBLICATION IV

Differences in caesarean section and neonatal outcomes among women of migrant origin in Finland – A population-based study

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ORIGINAL ARTICLE

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Differences in caesarean delivery and neonatal outcomes among women of migrant origin in Finland: A population-based study

Kalpana Bastola[1] | Päivikki Koponen[2] | Mika Gissler[3,4] | Tarja I. Kinnunen[1]

[1]Faculty of Social Sciences, Unit of Health Sciences, Tampere University, Tampere, Finland

[2]Department of Public Health Solution, National Institute for Health and Welfare, Helsinki, Finland

[3]Department of Information Services, National Institute for Health and Welfare, Helsinki, Finland

[4]Department of Neurobiology, Care Sciences and Society, Karolinska Institute, Stockholm, Sweden

Correspondence
Kalpana Bastola, Unit of Health Sciences, Faculty of Social Sciences, Tampere University, Tampere, Finland.
Email: Kalpana.bastola@tuni.fi

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Abstract

Background: In Finland, limited information is available on neonatal disparities among women of migrant origin.

Objective: This study investigated differences in caesarean delivery and neonatal outcomes between women of migrant origin and Finnish women in Finland.

Methods: The study was based on nationwide data from the Medical Birth Register of Finland. Our study included information on the most recent singleton birth of women delivering between January 2004 and December 2014 (N = 382 233). Women were classified into nine regional categories based on their country of origin. Generalized linear models were used to describe associations between country of origin and pregnancy outcomes adjusted for maternal age, socio-economic status, pre-pregnancy body mass index, parity, marital status, smoking during pregnancy, and delivery year. Finnish women were the reference group.

Results: Among the study population, almost 92% of women were of Finnish origin; the remaining 8% were of migrant origin. Among the migrant women, those of Russian/former USSR origin were the largest group (n = 11 994); the smallest group was women of Latin American/Caribbean origin (n = 739). Compared with Finnish women, women of sub-Saharan African, South Asian, and East Asian origin were at greater risk of emergency caesarean delivery, preterm birth, low birthweight, and lower five-minute Apgar scores for newborns. Latin American/Caribbean-origin women were at increased risk of both elective and emergency caesarean delivery and lower five-minute Apgar scores compared with Finnish women. Women of Russian/former USSR origin overall had a lower risk of caesarean delivery and poor neonatal outcomes compared with Finnish women.

Conclusions: We identified sub-Saharan African, South Asian, and East Asian women as higher-risk groups, and women from Russia/former USSR as a lower-risk group, for emergency caesarean delivery and poor neonatal outcome compared with Finnish women. More research is needed to identify the reasons for these differences by country of origin in Finland.

KEYWORDS
caesarean delivery, Finland, migrants, neonatal outcomes

1 | BACKGROUND

Variations in caesarean delivery and neonatal outcomes persist among women of migrant origin and women in native populations. Some studies have shown that the prevalence of caesarean delivery is consistently higher for some groups of women, especially women of African and South Asian origin, compared with women in native populations.[1-3] A systematic review and meta-analysis including studies from the USA, Canada, and 15 European countries (excluding Finland) found that women from Asia and sub-Saharan Africa were at greater risk of preterm birth compared with women in the native population.[4] Another review of low birthweight among migrant women concluded that the prevalence of low birthweight varies by the host country and the characteristics of the migrant groups.[5] In European countries, some migrant groups were at higher risk of having low birthweight babies, but some groups did not differ from the general population, and some groups had a lower risk of low birthweight compared with women in the native population.[5]

Data on caesarean delivery and neonatal outcome among women of migrant origin living in Finland are limited. An earlier Finnish study found that women from Eastern Europe, the Middle East, North Africa, South Asia, and Somalia had a significantly higher risk of low birthweight and preterm birth than Finnish women.[2] Some more recent studies with relatively small sample sizes among women of Somali, Kurdish, and Russian origin in Finland found that women of Somali and Kurdish origin had a higher pre-pregnancy body mass index (BMI),[6] and Somali women had an increased risk of any delivery complication (obstructed labour, foetal stress, perineal laceration, or postpartum haemorrhage)[7] compared with women in the general Finnish population. Based on these findings, we assumed that some differences would be observed in neonatal outcomes between women of migrant origin and women of Finnish origin.

We identify vulnerable groups at risk of caesarean delivery and poor neonatal outcome among women of migrant origin living in Finland. Identifying such vulnerable groups could help to improve maternal and child health services for migrant populations. In this study, we investigated differences in elective and emergency caesarean delivery, and neonatal outcomes including preterm birth, low birthweight, newborn care in a neonatal intensive care unit (NICU), and lower Apgar scores at five minutes between women of migrant and Finnish origin, using data on all registered births in Finland between 2004 and 2014.

Synopsis

Study question

- We investigated differences in the prevalence of caesarean delivery and neonatal outcomes between women of migrant origin and Finnish women in Finland.

What's already known

- Studies outside Finland have reported inconsistent results regarding differences in caesarean delivery and neonatal outcomes between women of migrant women and women in the native population
- There is limited information on this topic in Finland

What this study adds

- This study identified three distinct vulnerable groups for emergency caesarean delivery and poor neonatal outcome: women of Sub-Saharan African, South Asian, and East Asian origin.
- Women of Russian/former USSR origin had a lower prevalence of caesarean delivery and poor neonatal outcomes compared with women of Finnish origin.

2 | METHODS

2.1 | Selection of the study population

This study was based on data from the national Medical Birth Register (MBR) of Finland. The MBR collects data on the mother's sociodemographic characteristics, previous pregnancies and deliveries, present pregnancy and its monitoring, delivery and complications, and information on the newborn health.[8] Our study included information on each woman's most recent birth in Finland between January 2004 and December 2014 (n = 389 758). We excluded multiple births (n = 7525) and included only singleton births (n = 382 233). We obtained data on country of origin and socioeconomic position from Statistics Finland, and this information was linked using the personal identification code for each woman.

2.2 | Exposure

We defined migrant status based on country of origin using the United Nations classification of world regions.[9] In our data, country of origin is based on the country of birth of the woman's parents. If both parents were born abroad, the country of birth of the woman's biological mother is considered to be the primary country of origin. If one of the parents was born in Finland, the country of origin is Finland.[10] This definition therefore includes both first- and second-generation migrants. Women were classified into nine categories according to their country of origin: (a) Finland; (b) Western Europe/North America/Oceania (ie other Western); (c) Eastern Europe; (d) Russia and the former Union of Soviet Socialist Republics (USSR); (e) South Asia; (f) East Asia; (g) sub-Saharan Africa; (h) Middle East/North Africa; and (i) Latin America/Caribbean. A small number of women (n = 231) had an unknown country of origin and were excluded from the analyses. A list of the countries and numbers of women in each group is presented in Table S1.

2.3 | Outcomes

The primary outcomes that were examined included caesarean delivery, gestational age, low birthweight, five-minute Apgar

score, and NICU care. For the generalized linear models, we classified all outcome variables into binary variables. For caesarean delivery, we distinguished between elective caesarean deliveries (versus all other deliveries) and emergency caesarean delivery (versus all other deliveries except for elective caesarean). For elective caesarean delivery, the decision has been made before the labour started. Gestational age was classified as preterm (≤36 week + 6 days), full-term (37 weeks + 0 days to 41 weeks + 6 days), and post-term (≥42 weeks + 0 days), and further to preterm versus other deliveries. Birthweight was categorized as low birthweight (<2500 g), normal birthweight (2500-3999 g), and high birthweight (≥4000 g), and further to low birthweight versus other. Apgar score at five minutes was categorized as 0-6 (lower) and 7-10. The variable for a transfer to a neonatal intensive care unit (NICU) either in level III or level II hospital was dichotomized as yes or no.

2.4 | Background characteristics

We defined background characteristics as follows. We classified the mother's age at the child's birth into four categories: <25 years, 25-29 years, 30-34 years, and ≥35 years. We classified socio-economic position into five categories: upper-level employees (administrative, managerial, professional, and related occupations), lower-level employees (administrative and clerical occupations), manual workers, other (including pensioners/homemakers/students), and unknown. Smoking during pregnancy was categorized as yes/no, and marital status as single/unmarried/widowed/divorced, married/cohabitating, and unknown. Parity, numbers of previous abortions, and previous miscarriages were categorized as 0, 1, and 2+. Pre-pregnancy BMI was categorized as underweight (<18.5 kg/m^2), normal weight (18.5-24.9 kg/m^2), overweight (25-29.9 kg/m^2), and obese (≥30 kg/m^2). We included age, socio-economic position, parity, pre-pregnancy BMI, marital status, smoking during pregnancy, and year of delivery in our analyses because these variables have been associated with caesarean delivery and neonatal outcomes and are also associated with migrant origin.[11-14]

2.5 | Statistical analyses

We reported descriptive data as numbers of observations and prevalence (%). We used generalized linear models with the log-link function to obtain relative risk (RR) estimates. Finnish women were the reference group. Initially, we used the traditional definition of confounding; that is, we defined confounders as variables that were causally associated with the outcome and either causally or non-causally associated with the exposure, but which did not lie on the causal pathway between the exposure and the outcome.[15] We also drew a directed acyclic graph (DAG) to aid our selection of co-variables (Figure S1). Final model was adjusted for age, socio-economic position, BMI, parity, smoking during pregnancy, marital status, and delivery year. Assessing causality is challenging for our analysis, as parents' country of origin precedes other maternal characteristic and these can be conceptualized as mediators. However, adjusting for them in the analyses informs us about whether the observed differences between the migrant groups are at least partly explained by these variables. We also present unadjusted results to show the overall differences between the migrant groups. We performed all analyses using Statistical Package for the Social Sciences (SPSS, version 23; SPSS Inc).

2.6 | Missing data

The 5-minute Apgar score was missing for 14%-39% of the newborns in each group, mainly for those whose Apgar score at one minute was at least 7. In many hospitals in Finland, the five-minute score is often not reported if the one-minute score is 7 or higher. Therefore, we replaced the missing five-minute values with one-minute values for women whose one-minute value was at least 7. Consequently, <1% of participants had missing values at 5 minutes. The proportion of missing data of all other variables were <1%, except for pre-pregnancy BMI (4.5%).

2.7 | Ethics approval

We obtained permission to use the data from the respective registries from the National Institute of Health and Welfare (THL) and Statistics Finland. We analysed and stored the data at THL, following THL's data safety regulations.

3 | RESULTS

Among the study population, almost 92% of women were of Finnish origin, and the remaining 8% of migrant origin. Only 216 (0.01%) of all women were second-generation women of migrant origin. Among the migrant women, women of Russian/former USSR origin were the largest group (n = 11 994); the smallest group was women of Latin American/Caribbean origin (n = 739; Table 1). Compared with Finnish women, the percentages of women in upper- and lower-level employees' categories were lower for all other migrant-origin women except for women from other Western countries. Finnish, Eastern European, and Russian/former USSR-origin women were more likely to smoke during pregnancy (16%-17%) than other women. Russian/former USSR women had a higher and South Asian women a lower prevalence of at least one previous abortion compared with Finnish women. The percentage of women of having at least one previous miscarriage varied from 16.4% to 23% among the study groups. Sub-Saharan African and Middle Eastern women had a higher and East Asian woman a lower prevalence of overweight and obesity compared with Finnish women.

The percentage of vaginal deliveries varied from 73% to 87% (Table 2). Women from Latin America and the Caribbean were more likely to have a caesarean delivery (26.8%) compared with Finnish women (17.0%). The percentage of preterm birth varied from 4%

TABLE 1 Background characteristics of the migrant-origin and Finnish-origin women in the most recent delivery, all singleton births, 2004-2014 (number and unadjusted percentage)

Variables	Finnish (n = 350 548)	Other Western[a] (n = 2290)	Eastern Europe (n = 2566)	Russia, former USSR (n = 11 994)	South Asia (n = 1904)	East Asia (n = 4948)	Sub-Saharan Africa (n = 3548)	Middle East (n = 3465)	Latin America, Caribbean (n = 739)
	Number (%)								
Age at birth (years)									
<25	44 671 (12.7)	161 (7.0)	492 (19.2)	1924 (16.0)	355 (18.6)	538 (10.9)	743 (20.9)	682 (19.7)	73 (9.9)
25-29	93 177 (26.6)	445 (19.4)	799 (31.1)	3666 (30.6)	728 (38.2)	1335 (27.0)	978 (27.6)	1009 (29.1)	167 (22.6)
30-34	122 549 (35.0)	870 (38.0)	771 (30.0)	3614 (30.1)	583 (30.6)	1704 (34.4)	1010 (28.5)	929 (26.8)	256 (34.6)
≥35	90 151 (25.7)	814 (35.5)	504 (19.6)	2790 (23.3)	238 (12.5)	1371 (27.7)	817 (23.0)	845 (24.4)	243 (32.9)
Socio-economic position									
Upper-level employees	72 235 (20.6)	772 (33.7)	298 (11.6)	1253 (10.4)	313 (16.4)	716 (14.5)	139 (3.9)	156 (4.5)	177 (24.0)
Lower-level employees	136 900 (39.1)	556 (24.3)	439 (17.1)	2515 (21.0)	244 (12.8)	777 (15.7)	438 (12.3)	291 (8.4)	159 (21.5)
Manual workers	77 953 (22.2)	436 (19.0)	885 (34.5)	4193 (35.0)	448 (23.5)	1813 (36.6)	683 (19.3)	889 (25.7)	160 (21.7)
Others	43 168 (12.3)	269 (11.7)	559 (21.8)	2392 (19.9)	579 (30.4)	1072 (21.7)	1137 (32.0)	1146 (33.1)	163 (22.1)
Unknown	20 292 (5.8)	257 (11.2)	385 (15.0)	1641 (13.7)	320 (16.8)	570 (11.5)	1151 (32.4)	983 (28.4)	80 (10.8)
Marital status									
Single	19 377 (5.5)	43 (1.9)	71 (2.8)	723 (6.0)	20 (1.1)	184 (3.7)	315 (8.9)	77 (2.2)	25 (3.4)
Married/ cohabiting	316 743 (90.4)	2135 (93.2)	2438 (95.0)	10 485 (87.4)	1868 (98.1)	4593 (92.8)	2974 (83.8)	3329 (96.1)	697 (94.3)
Unknown	14 428 (4.1)	112 (4.9)	57 (2.2)	786 (6.6)	16 (0.8)	171 (3.5)	259 (7.3)	59 (1.7)	17 (2.3)
Smoking in pregnancy	56 030 (16.0)	200 (8.7)	438 (17.1)	1992 (16.6)	19 (1.0)	209 (4.2)	72 (2.0)	226 (6.5)	43 (5.8)
Parity									
None	104 720 (29.9)	887 (38.8)	833 (32.5)	4331 (36.1)	814 (42.8)	2004 (40.5)	879 (24.8)	955 (27.6)	329 (44.5)
One	142 413 (40.6)	868 (38.0)	999 (38.9)	4992 (41.6)	670 (35.3)	1885 (38.1)	912 (25.7)	1187 (34.3)	275 (37.2)
Two or more	103 251 (29.5)	530 (23.2)	734 (28.6)	2665 (22.2)	416 (21.9)	1057 (21.4)	1755 (49.5)	1320 (38.1)	135 (18.3)
Previous abortions									
None	302 325 (86.4)	2033 (89.1)	2332 (90.9)	8847 (73.9)	1755 (92.4)	4296 (86.9)	3083 (87.0)	3107 (89.8)	654 (88.9)
One	37 719 (10.8)	202 (8.9)	175 (6.8)	1884 (15.7)	122 (6.4)	477 (9.7)	309 (8.7)	281 (8.1)	58 (7.9)
Two or more	9975 (2.8)	46 (2.0)	58 (2.3)	1244 (10.4)	22 (1.2)	168 (3.4)	153 (4.3)	73 (2.1)	24 (3.3)
Previous miscarriages									
None	269 845 (77.0)	1771 (77.5)	2069 (80.7)	9485 (79.2)	1574 (82.9)	4130 (83.6)	2804 (79.1)	2702 (78.0)	592 (80.1)
One	58 998 (16.8)	367 (16.1)	373 (14.5)	1875 (15.6)	262 (13.8)	644 (13.0)	518 (14.6)	535 (15.5)	114 (15.4)
Two or more	21 425 (6.1)	146 (6.4)	123 (4.8)	623 (5.2)	63 (3.3)	168 (3.4)	223 (6.3)	225 (6.5)	33 (4.5)
Pre-pregnancy BMI[b]									
Underweight	10 393 (3.1)	112 (5.3)	146 (6.0)	857 (7.5)	106 (5.9)	674 (14.4)	143 (4.3)	106 (3.3)	30 (4.4)
Normal weight	203 463 (60.7)	1420 (66.6)	1557 (63.9)	7725 (67.8)	1043 (58.1)	3406 (72.9)	1431 (43.2)	1561 (48.1)	489 (71.4)
Overweight	76 324 (22.8)	383 (18.0)	531 (21.8)	1952 (17.1)	496 (27.6)	499 (10.7)	1059 (31.9)	1086 (33.5)	122 (17.8)
Obese	44 826 (13.4)	218 (10.2)	201 (8.3)	860 (7.5)	150 (8.4)	94 (2.0)	682 (20.6)	489 (15.1)	44 (6.4)

Note: Missing values for all other variables were <1% in each category.

[a]Western Europe, North America, and Oceania.

[b]Missing Values for pre-pregnancy BMI in each category from the left to the right were 4.4%, 6.8%, 5.1%, 5.0%, 5.7%, 5.5%, 6.5%, 6.4%, and 7.3%, respectively.

TABLE 2 Mode of delivery and neonatal outcomes among women of migrant origin and Finnish-origin women in the most recent delivery, all singleton births, 2004-2014

Variables	Finnish (n = 350 548)	Other Western[a] (n = 2290)	Eastern Europe (n = 2566)	Russia, former USSR (n = 11 994)	South Asia (n = 1904)	East Asia (n = 4948)	Sub-Saharan Africa (n = 3548)	Middle East (n = 3465)	Latin America, Caribbean (n = 739)
	Number (%)								
Mode of delivery									
Spontaneous vaginal	265 736 (75.8)	1690 (73.8)	2002 (78.0)	9355 (78.0)	1214 (63.8)	3420 (69.1)	2443 (68.9)	2531 (73.0)	458 (62.0)
Vacuum/ forceps	25 149 (7.2)	184 (8.0)	224 (8.7)	964 (8.0)	264 (13.9)	567 (11.5)	248 (7.0)	324 (9.4)	83 (11.2)
Elective CS	26 293 (7.5)	173 (7.6)	129 (5.0)	643 (5.4)	108 (5.7)	357 (7.2)	269 (7.6)	260 (7.5)	78 (10.6)
Emergency CS	33 183 (9.5)	241 (10.5)	208 (8.1)	1026 (8.6)	317 (16.6)	602 (12.2)	587 (16.5)	348 (10.0)	120 (16.2)
Unknown	187 (0.1)	2 (0.1)	3 (0.1)	6 (0.1)	1 (0.1)	2 (0.0)	1 (0.0)	2 (0.1)	0 (0.0)
Gestational age									
Preterm	15 702 (4.5)	104 (4.6)	101 (4.0)	528 (4.4)	111 (5.8)	277 (5.6)	183 (5.2)	145 (4.2)	36 (4.9)
Full term	318 777 (91.1)	2052 (90.0)	2307 (90.3)	10 740 (89.7)	1706 (89.9)	4545 (92.0)	3039 (85.7)	3172 (91.7)	670 (90.7)
Post-term	15 310 (4.4)	125 (5.5)	147 (5.8)	710 (5.9)	81 (4.3)	118 (2.4)	321 (9.1)	142 (4.1)	33 (4.5)
Mortality									
Stillbirths	496 (0.1)	3 (0.1)	3 (0.1)	13 (0.1)	7 (0.1)	7 (0.1)	16 (0.5)	11 (0.3)	3 (0.4)
Neonatal deaths	282 (0.1)	2 (0.1)	5 (0.2)	15 (0.1)	0 (0.0)	4 (0.1)	9 (0.3)	3 (0.1)	0 (0.0)
Post-neonatal deaths	151 (0.0)	0 (0.0)	1 (0.0)	11 (0.1)	1 (0.1)	0 (0.0)	2 (0.1)	1 (0.0)	0 (0.0)
Survived 365 d	349 619 (99.7)	2285 (99.8)	2557 (99.6)	11 955 (99.7)	1896 (99.6)	4937 (99.8)	3521 (99.2)	3450 (99.6)	736 (99.6)
Birthweight									
<2500 g	10 868 (3.1)	66 (2.9)	66 (2.6)	369 (3.1)	120 (6.3)	199 (4.0)	179 (5.0)	121 (3.5)	20 (2.7)
2500-3999 g	275 355 (78.6)	1877 (82.1)	2085 (81.3)	9396 (78.4)	1645 (86.5)	4257 (86.1)	2945 (83.0)	2942 (85.0)	621 (84.0)
≥4000 g	64 064 (18.3)	344 (15.0)	412 (16.1)	2219 (18.5)	137 (7.2)	486 (9.8)	423 (11.9)	398 (11.5)	98 (13.3)
NICU care	36 794 (10.5)	206 (9.0)	215 (8.4)	1121 (9.3)	216 (11.3)	443 (9.0)	473 (13.3)	341 (9.8)	72 (9.7)
Apgar score									
7-10	342 846 (98.2)	2228 (98.1)	2511 (98.3)	11 758 (98.4)	1831 (97.0)	4804 (97.8)	3352 (95.6)	3362 (97.6)	710 (96.6)
0-6	6254 (1.8)	43 (1.9)	43 (1.7)	186 (1.6)	56 (3.0)	107 (2.2)	155 (4.4)	81 (2.4)	25 (3.4)

Note: Missing values for all variables were <1%.
[a]Western Europe, North America, and Oceania

to 5.8% among the study groups. Sub-Saharan African women had post-term births more often (9.1%) compared with Finnish women (4.4%). South Asian (6.3%) and Sub-Saharan African (5.0%) women were more likely to have low birthweight newborns compared with Finnish women (3.1%). Sub-Saharan African women were more likely to have infants who died (0.9%) and received NICU care (13.3%) than Finnish women (0.2% and 10.5%, respectively). Sub-Saharan African (4.4%), Latin American/Caribbean (3.8%), and South Asian (3.0%) newborns were more likely to get lower five-minutes Apgar score compared to Finnish newborns (1.8%).

The results of the unadjusted and adjusted models were broadly similar (Tables S2-S7). The associations for elective caesarean delivery showed that Eastern European women and Russian/former USSR women had a lower risk, while Latin American/Caribbean women had an increased risk, compared with Finnish women (Figure 1). Similarly, Russian/former USSR women had a lower risk of emergency caesarean delivery compared with Finnish women, while South Asian, East Asian, Sub-Saharan African, Middle Eastern, and Latin American women had a higher risk of emergency caesarean delivery compared with Finns.

We observed a higher risk of preterm birth among South Asian, East Asian, and sub-Saharan African women compared with Finnish women (Figure 2). We observed that Russian/former USSR women had a decreased risk of low birthweight newborns, whereas South Asian, East Asian, Sub-Saharan African, and Middle Eastern women were at higher risk of low birthweight newborns (Figure 2).

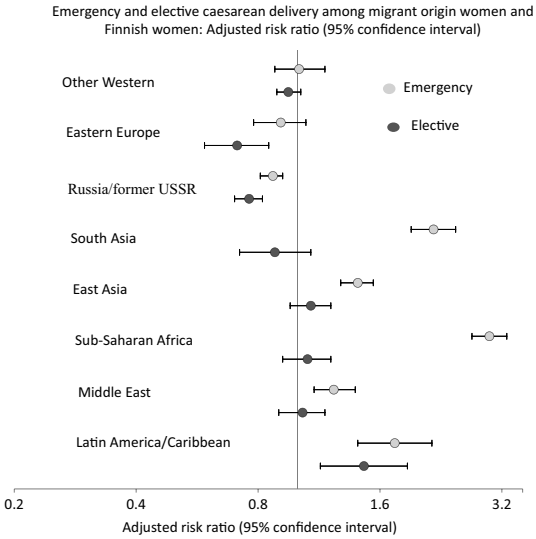

FIGURE 1 Emergency and elective caesarean delivery among migrant-origin women and Finnish women

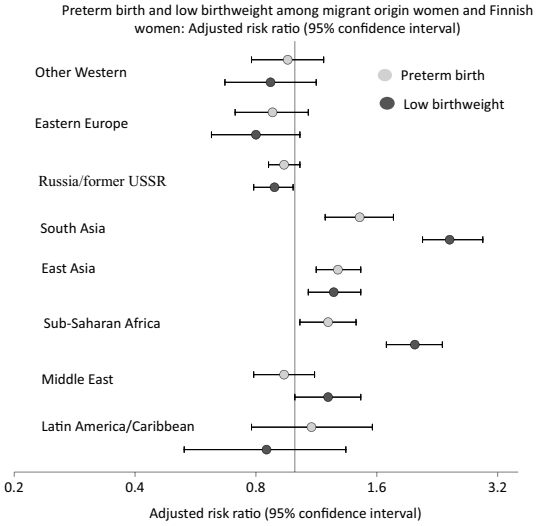

FIGURE 2 Preterm birth and low birthweight among migrant-origin women and Finnish women

Regarding the distribution of lower 5-minute Apgar scores (Figure 3), newborns of Russian/former USSR women were at lower risk, whereas newborns of South Asian, East Asian, Sub-Saharan African, Middle Eastern, and Latin American/Caribbean women were at increased risk compared with Finnish newborns. Compared with Finnish women, women from other Western countries, Eastern Europe, and Russia/former USSR were at decreased risk of NICU care. Newborns of South Asian and sub-Saharan African women had an increased risk of NICU care (Figure 3).

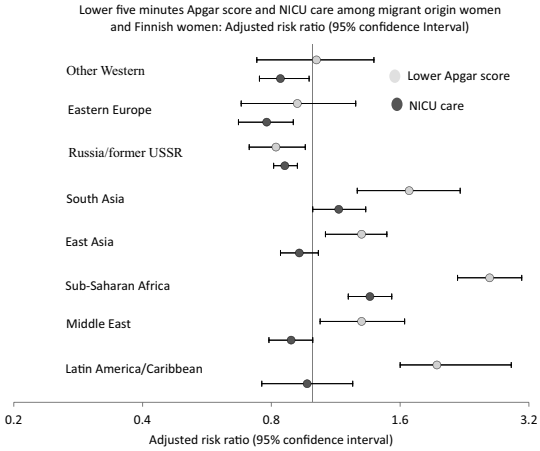

FIGURE 3 Lower five-minute Apgar score and newborns in intensive care unit (NICU) among migrant-origin women and Finnish women

4 | COMMENT

4.1 | Principal findings

In this study, we observed differences in the risks of caesarean delivery and adverse neonatal outcome by women's country of origin. Women from Russia/former USSR were at lower risk, while women from Latin America and the Caribbean were at higher risk of both elective and emergency caesarean delivery compared with Finnish women. Women of South Asian, East Asian, sub-Saharan African, and Middle Eastern origin were at higher risk of emergency caesarean delivery than Finnish women. Women of South Asian, East Asian, and sub-Saharan African origin had a higher risk of preterm birth and low birthweight than Finnish women. Newborn of women from South Asia, East Asia, Sub-Saharan Africa, the Middle East, and Latin America/the Caribbean had an increased risk of lower five-minute Apgar scores compared with Finnish newborn. Higher risks of care in the NICU were observed for newborn born to women of South Asian and sub-Saharan African origin, compared with Finnish newborn.

4.2 | Strengths of the study

This study contributes to the limited information available on caesarean delivery and neonatal outcome among women of migrant origin and Finnish women in Finland. We used information from the national MBR, which includes all the most recent births that occurred in Finland in 2004-2014 and has good data quality.[16,17] The sample size in our study was large, and we were able to classify childbearing women into nine categories based on their parents' countries of origin.

These findings are likely to be generalizable to populations of migrant origin in other countries with universal access to maternity care for all citizens.

4.3 | Limitations of the data

Due to limitations in data availability, we had no information on several important migration indicators, such as migration status, length of stay, and language skills, which might contribute to the differences between the groups. In addition, the MBR has limited information on other factors possibly related to poor neonatal outcomes—for example, women's other specific health conditions—which might have some effect on the outcome variables. Also, the information on the indication of caesarean delivery is not available in the MBR. The heterogeneity of the migrant groups means that multiple mechanisms and risk factors may be responsible for the observed associations and we were not able to address all these hypotheses.

4.4 | Interpretation

A meta-analysis of international migration and caesarean delivery found a consistently higher overall risk of caesarean delivery for sub-Saharan African, Somali, and South Asian migrant women, higher risk of emergency caesarean delivery for North African, West Asian, and Latin American migrant women, and a lower overall risk of caesarean delivery for Eastern European women.[1] In Norway, all migrant groups except the Vietnamese had a higher overall risk of caesarean delivery compared with Norwegians.[3] In Sweden, women from Ethiopia, India, South Korea, Chile, Thailand, Iran, and Finland had significantly higher odds of caesarean delivery compared with Swedish-born women, while women from Syria, former Yugoslavia, and Germany had lower odds.[18] Our findings are broadly comparable to these findings, although we studied emergency and elective caesarean deliveries separately. Our previous study on delivery complications among Somali-, Russian-, and Kurdish-origin migrant women in Finland reported that Russian women were less likely to have a caesarean delivery,[7] which is similar to the findings of this study. We had a smaller and individual country-specific sample in our previous study, whereas the current study used a larger nationwide data set.

Previous literature suggests that the mechanisms leading to caesarean delivery are often complex and are likely to involve a combination of biological, cultural, physical, and psychological factors that affect health.[19] The most common risk factors associated with caesarean delivery among migrants are low-level language skills, lower socio-economic position, poor maternal health, higher BMI, foetopelvic disproportion, and lack of prenatal care.[1] It has been suggested that the higher risk of elective caesarean deliveries among Latin American/Caribbean-origin women may also be related to their cultural preferences.[1-19] Our previous studies on pre-pregnancy BMI[20] and pregnancy complications (unpublished, under review) among migrant women in Finland showed that Russian women had lower pre-pregnancy BMI and statistically insignificant lower incidence of pregnancy-related diabetes and pregnancy-induced hypertension compared with women in the general population. Therefore, we assume that the healthy migrant effect might explain the better pregnancy and delivery outcomes among women of Russian origin in Finland.

An earlier systematic review found that Asian and sub-Saharan African migrants had a greater risk of preterm birth.[4] A Swedish study reported that South Asian, sub-Saharan African, and East Asian migrants had an increased risk of early- and late-preterm births compared with Swedish-born women.[21] Our findings are in line with these studies. Previously, a Finnish study reported that women from the Middle East, North Africa, and South Asia had higher percentages of preterm births.[2] Our results are similar for South Asian but not for Middle Eastern and North African women. This earlier study used data for the years 1999-2001 and used maternal country of birth to identify foreign origins. Since that time, Finland has become more diverse and multicultural (ie 4% vs 8% of those living in Finland are of foreign origin). Another review comparing the pregnancy outcomes of native and migrant women in European countries during 1966-2004 found that migrant women had a 24% higher risk of preterm delivery compared with the native populations.[22] The risk varied by country, according to the countries' integration policies.[21] The differences in the risk of preterm birth may be due to differences in genetics or other factors, which were not measured in our study. Maternal height and body composition vary by ethnicity, and this may affect the risk of preterm birth.[23]

Previous studies have reported mixed results on the distribution of low birthweight among migrant women.[5,24-26] A previous systematic review reported that sub-Saharan African, South/Central Asian, and Latin American/Caribbean women had an increased risk of low birthweight newborns in European countries.[24] A Belgian study showed that migrant women had a lower risk of low birthweight newborns.[25] Another study from Sweden reported that foreign-born women had a higher risk of low birthweight babies than Swedish-born mothers.[26] This divergence in results could be partly explained by the use of different classifications of migrant groups, reference groups, and adjustments for confounders.

There are very few studies reporting differences in lower five-minute Apgar scores and NICU care between migrant groups and native populations. A previous study from Italy reported that the five-minute Apgar score was lower among West and sub-Saharan Africans and Central and Latin Americans compared with Italian women.[27] Overall, our findings are similar. Merten and colleagues[28] found that African and Asian newborns were at increased risk of being transferred to a NICU. We found that newborns of women of other Western, East European, and Russian/former USSR origin were at lower risk of NICU treatment, and newborns of women of sub-Saharan African and South Asian origin at greater risk, compared with Finnish newborns. Merten and colleagues[28] grouped all mothers from South and East Asia together, which may explain this divergence in the results for Asian women.

Maternal body composition is one of the most important factors that account for geographical variation in neonatal outcomes.[29]

Other factors, such as maternal diet, physical activity, alcohol consumption, illness, and social class, vary across different migrant groups, and these along with genetic mechanisms may explain differences in neonatal outcomes among women of migrant origin and Finnish women.[29]

5 | CONCLUSIONS

In conclusion, our study contributes to evidence on differences in caesarean delivery and neonatal outcomes among women of migrant origin in Finland. We found that being of Russian/former USSR origin was associated with lower risks of caesarean delivery and poor neonatal outcomes. We identified three distinct vulnerable groups for emergency caesarean delivery and poor neonatal outcome: women of sub-Saharan African, South Asian, and East Asian origin. In addition, we found that women of Latin American/Caribbean origin had an excess risk of both elective and emergency caesarean delivery. More information is needed to better understand the reasons and mechanisms behind these differences to support the development of interventions to support higher-risk groups.

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CONFLICTS OF INTEREST

The authors stated explicitly that there are no conflicts of interest to declare in connection with this article.

ORCID

Kalpana Bastola https://orcid.org/0000-0002-2922-2876

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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