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Antenatal and perinatal outcomes of refugees in high income countries

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Abstract

Objectives: The World Health Organisation (WHO) has highlighted a marked trend for worse pregnancy-related indicators in migrants, such as maternal and neonatal morbidity and mortality, poor mental health and sub-optimal care. The aim of this study was to determine whether such adverse outcomes occurred in refugees who moved to high income countries by comparing their antenatal and perinatal outcomes to those of non-immigrant women.

Methods: A literature search was undertaken. Embase and Medline databases were searched using Ovid. Search terms included “refugee”, “pregnan*” or “neonat*”, and “outcome”.

Results: The search yielded 194 papers, 23 were included in the final analysis. All the papers included were either retrospective cohort or cross-sectional studies. The refugees studied originated from a wide variety of source countries, including Eritrea, Somalia, Afghanistan, Iraq, and Syria. Refugee women were more likely to be socially disadvantaged, but less likely to smoke or take illegal drugs during pregnancy. Refugee women were more likely to have poor, late, or no attendance at antenatal care. Miscarriages and stillbirth were more common amongst refugee women than non-refugees. Perinatal mortality was higher among refugees.

Conclusions: Despite better health care services in high income countries, refugee mothers still had worse outcomes. This may be explained by their late or lack of attendance to antenatal care.

Keywords: antenatal outcomes; miscarriages; perinatal mortality; refugees; still birth.

Introduction

The current refugee crisis has led to the highest levels of displacement on record according to the United Nations High Commissioner for Refugees (UNHCR); 70.8 million people worldwide have been forcibly displaced, 25.9 million of whom are refugees. Fifty-seven percent originate from three countries: Syria, Afghanistan and South Sudan [1]. Although women represent almost half of refugee populations, they are not given the same opportunities as male refugees. Only 0.4% of funding to fragile states went to women’s groups or women’s ministries from 2012 to 2013 [2] and refugee girls represented only 30% of refugee children enrolled in secondary school [3].

Six to 14% of women in refugee populations would be expected to be pregnant [3]. The United Nations (UN) has stated that 60% of preventable maternal deaths take place in humanitarian settings [2], and the World Health Organization (WHO) highlighted a “marked trend for worse pregnancy-related indicators in migrants”, such as increased maternal and neonatal morbidity and mortality, poorer mental health, and more frequently suboptimal care [4]. Despite the challenges of studying maternal and neonatal outcomes within refugee camps, available data suggest that outcomes for this population are poor, with a stillbirth rate as high as 9.4 per 1,000 total births in the Zaatari camp in Jordan [5].

Over 3,000,000 refugees have resettled in high-income countries [6], where healthcare provision would be expected to be better than in low income countries. Good quality antenatal and perinatal healthcare in high income countries might mitigate some of the risks associated with being a refugee mother. The aim of this study was to undertake a literature review to determine if, in high income countries, the antenatal, perinatal and neonatal outcomes of refugee women differed from those of non-

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immigrant women. These results would enable better targeting of care if differences were highlighted.

Materials and methods

Embase and Medline databases were searched using Ovid. Search terms included “refugee”, “pregnan*” or “neonat*”, and “outcome”. Articles were included if they were published in peer-reviewed journals in English, and compared neonatal outcomes of infants born to refugee mothers who had migrated to high-income countries (using the World Bank definition [7]) with neonatal outcomes in the native population, or non-refugee migrants resident in the same country. Articles were excluded if they did not compare refugee outcomes to non-refugee outcomes, if they were not published in English or if they studied refugee women who had migrated to low- or middle-income countries. Bibliographies of relevant articles were searched for additional papers meeting the inclusion and exclusion criteria.

Ethical approval

Ethical approval was not required for this study as it was a literature review.

Results

The search yielded 194 papers, 55 of which were identified as duplicates. Titles and abstracts were screened and 91 papers were excluded. Of these, 52 were excluded for studying an inappropriate population, 19 due to the outcome studied, 14 due to publication type and six due to study design. A total of 48 papers were read in full, of which 23 were included in the final analysis. All the papers included were either retrospective cohort or cross-sectional studies.

Demographic factors

The refugees studied originated from a wide variety of source countries, including Eritrea, Somalia, Afghanistan, Iraq, and Syria [8–12].

In one study, refugee mothers were found to have fewer medical risk factors pre-pregnancy such as hypertension or diabetes on retrospective review of medical records [8]. A Swedish study, however, found self-rated pregnancy health in refugees, asylum seekers and undocumented migrants to be poorer than in native-born women [13]. In another study, refugee women were more likely to be socially disadvantaged [10], but less likely to smoke or take illegal drugs during pregnancy than US-born women [8].

The body mass index (BMI) of presumed refugee women varied according to country of origin and

comparator population. Two studies, both of which compared refugee women from Africa to native-born women in the USA and in Israel, found no significant difference in pre-pregnancy BMIs between the groups [8, 14]. The study in Israel also recorded weight gain during pregnancy, which was lower in the refugee population [14]. Two studies compared refugee women to non-humanitarian migrants in Australia. One study, which included refugee women from Africa, Asia, and the Middle East found that refugees had a higher pre-pregnancy BMI than non-humanitarian migrants [11]. In the other, which assessed only refugees from Africa they were found to have a lower pre-pregnancy BMI than non-humanitarian migrants from the same continent [15].

Most studies found that refugee mothers were younger than non-refugee mothers [10–12, 14, 16, 17], although one study found that refugees from West Asia were less likely to be under 20 years of age than non-refugees originating from the same region [12], and another reported that refugees had an older mean age than US-born women [18]. The mean age of the US-born women, however, was 25.7 which was similar to the mean age (25.9) of refugees in another study [14] (See Table 1).

Maternal risk factors

The majority of studies found that refugee women were more likely to be multiparous or of higher parity than native women [8, 10, 17, 19, 20] and other migrant women [11, 15]. One study found that refugee mothers were more likely to be nulliparous than non-refugees [14], but the number of refugees included was small.

Refugee women were more likely to have poor, late, or no attendance at antenatal care [8, 11, 12, 16, 18], including no ultrasound screening [13]. One study found that 20% of refugee women had no antenatal care [17]. Refugee women were also more likely to give birth before arriving at hospital [11].

Refugee women were reported to be less likely to have high-risk pregnancy conditions [21] such as pre-eclampsia [13, 17, 19], gestational diabetes [11, 12], and antepartum haemorrhage [11]. One study, found no significant difference in rates of gestational diabetes or pregnancy induced hypertension between refugees and non-refugees, but only 13 refugee women in the study had gestational diabetes [16]. One study reported an increased risk of gestational diabetes amongst refugee women, although this was the only study comparing refugee women to Swedish-born women [13]. There was no significant difference in the risk of gestational diabetes when refugee women were compared to

undocumented migrants and asylum seekers [13]. In Canada, amongst women with gestational diabetes, refugees were more likely to have endocrinology visits only late in pregnancy and were at increased risk of new-onset diabetes after pregnancy compared to native-born women [19].

Gestational age at delivery

Most studies found that refugee women were less likely to have a preterm delivery than other migrant groups and native-born women in the USA, Canada, Australia or Sweden [8, 11–13, 18–20]. Two studies, however, found refugees were more likely to have a preterm delivery than native-born women in Israel and Greece respectively [14, 17]. A study of expatriated and non-displaced women in Croatia found that in the first 2 years of the study (1990–91), expatriated women were more likely to deliver prematurely, but this difference was no longer significant in the final year (1992) of the three-year study leading up to the Bosnian War [22]. One study compared primary refugees (those who had come directly from their country of origin) and secondary refugees (those who had lived elsewhere before arriving in their host country) to primary and secondary migrants. It demonstrated that the primary refugees had similar rates of very and moderate preterm birth, whereas the secondary refugees had a higher risk of preterm birth than secondary non-refugee migrants [23]. Two studies found no significant difference in gestational age at delivery between refugees and non-refugees [9, 16], and two studies found that refugee women were more likely to deliver post-term as well as pre-term [11, 12].

Mode of delivery

Most studies found that refugee women were more likely to deliver vaginally [8, 9] and less likely to have an instrumental [10–12, 15] or operative birth [9]. Refugee women were also less likely to have obstructed [9] or induced [8, 10, 11] labour, except in a study comparing Southeast Asian refugees to other Southeast Asian migrants [12]. In one Finnish study comparing Kurdish and Somali refugee women to Russian migrant women, Somali women were more likely to have delivery-related complications such as obstructed labour, fetal stress, perineal laceration, and postpartum haemorrhage, although the difference was only significant after adjustment for confounding factors [9]. Postnatal complications were found to be higher in asylum-seeking women compared with German residents, except in the 12–20 years old age group [21]. One study

found a higher rate of instrumental births in refugee women, although this was in comparison to Swedish-born women as opposed to another migrant group [13]. It was reported in two studies that refugee mothers were more likely to have meconium in their liquor [8, 14].

Seven studies reported that refugee women were less likely to undergo a Caesarean section [8, 10–12, 15, 21, 24], except refugee women aged between 41 and 50 years [21]. Five studies reported that presumed refugees (migrants from a humanitarian source country) were more likely to have Caesarean sections than non-refugees [13, 14, 17, 20, 25]. However, of these studies, one compared refugee women to economic migrants [25], three to native-born women [13, 14, 17] and one to non-refugee women including other migrants and native-born women [20]. Of the seven studies reporting that refugee women were less likely to undergo Caesarean delivery, four used comparison groups of other migrants [11, 12, 15, 24]. One study found no significant difference in the rate of Caesarean deliveries when comparing Kurdish and Somali women to the general Finnish population [9] and another also found no significant difference with the exception of refugee multiparous women, who were more likely to have Caesarean sections than non-refugee multiparous women [16].

Antenatal outcomes

Stillbirth appears commoner amongst refugee women than non-refugees [11, 13, 17, 20, 21]. No significant differences were found in the rates of fetal abnormalities in two studies [11, 12], although another study reported lower rates of congenital anomalies than in infants of native-born women [20].

Neonatal and perinatal mortality

A study in Croatia of expatriated (women from occupied areas of Croatia and Bosnia and Herzegovina) and non-displaced women (from free areas of Croatia) found that the perinatal mortality was significantly higher amongst expatriated women [22]. Similarly, a study in the Netherlands reported that presumed refugees and asylum seekers had a higher perinatal mortality rate, which was only partly explained by prematurity [26]. A study in Canada also found higher perinatal mortality amongst refugees [20]. Subsequent mortality has been rarely reported, but one study found no significant differences in the neonatal mortality rate when comparing refugee

populations to other non-refugee immigrants [20] and another no significant difference in neonatal death before discharge when comparing presumed refugees (migrants from humanitarian source countries [HSCs]) to other migrants [11].

Neonatal morbidity

The evidence regarding fetal growth restriction and low birthweight is conflicting. Refugee women were found to be less likely to have low birthweight or growth restricted infants in three studies [8, 11, 12], two of which compared women from HSCs (presumed refugees) to non-refugee migrants from the same subcontinent [11, 12]. Two studies, however, reported no significant difference in the rates of low birthweight [14, 16], although both of these studies included native-born women in their comparison group. Three other studies reported higher rates of low birthweight, fetal growth restriction and small for gestational age infants amongst refugee/asylum seeking populations [13, 17, 22], although two of these studies used an exclusively native-born comparison group.

There have been few studies assessing the requirement for neonatal intensive care unit (NICU) admission and the evidence is conflicting. One study found no significant difference in the rate of admission to the NICU between infants of refugee and non-refugee migrant women [24]. Two studies reported that babies from HSCs were less likely to require NICU admission than non-refugee migrant women from the same subcontinent [11, 12], but two other studies reported that babies born to refugees were more likely to require NICU admission, one used native-born women as the comparator group [14] the other a non-refugee comparator group including other migrants and native-born women [20].

One study used a composite measure of adverse outcome, including stillbirth, preterm birth, growth restriction, low birthweight, NICU admission, and congenital abnormality and found no significant association between refugee status and adverse outcome [27]. Other studies, however, found that infants born to refugees were more likely to have respiratory conditions, congenital anomalies, hospital readmission due to inadequate weight gain [28] or require ventilatory support, intravenous fluids, or blood transfusions [29]. Amongst babies born to women with gestational diabetes, those born to refugees were less likely to have respiratory distress or jaundice [19] and be macrosomic than those born to non-refugees [19]. One study found no significant difference in Apgar scores at 5 min [11] but three studies found that infants of refugees

and asylum seekers were more likely to have low Apgar scores [13, 14, 17]. Furthermore, refugee infants have been reported to have higher rates of hypoxic ischaemic encephalopathy than other immigrants [29]. Infants born to refugees in the USA were almost nine times more likely to have congenital toxoplasmosis even after adjustment for the mother's educational level, gravidity, and country of birth than other migrants or native born women [30].

Discussion

This review has highlighted that that refugee women were more likely to have poor, late or no antenatal care [8, 11–13, 16–18]. Furthermore, despite the lack of medical risk factors, many studies found that fetuses born to refugee women were more likely to be stillborn [11, 1, 17, 20, 21], and some studies reporting their infants were more likely to have low Apgar scores [13, 14, 17] and had higher morbidity [27–30]. This was despite studies reporting that refugee women started pregnancy as lower-risk patients (being younger and with fewer comorbidities) [8, 10–12, 14–17]. In addition, they had medically lower-risk pregnancies with fewer pregnancy-related conditions [11–13, 17, 19, 21] and were less likely to have preterm [8, 11–14, 18–20] or assisted and operative deliveries [8–12, 15, 21, 24].

Previous studies comparing all immigrant women (including economic migrants) to native women in high-income countries found that rates of pregnancy-related maternal conditions, prematurity and neonatal morbidity were all lower in migrants [31, 32]. This contrasts to our findings that refugee women and their infants had poorer outcomes with regards to stillbirth, low Apgar scores, and neonatal morbidity. This may indicate that there are risks experienced by refugee women that are not faced by economic migrants to high-income countries. A systematic review found that outcomes were worse for neonates born to immigrant mothers and that outcomes were related to the integration policies of their host country [33]. Although there may be a 'healthy migrant effect' in some cases this may lead to immigrant women being medically lower-risk, restricted access to healthcare, poor financial stability and/or low social support may lead to poorer outcomes [34, 35]. This is supported by studies reporting that migrant women face numerous barriers to healthcare including communication and language barriers and a lack of information regarding expected levels of antenatal care [36]. In addition, socio-economic factors amongst migrant women relate to adverse outcomes [37], as also seen in native-born women in high-income countries [38].

Table 1: Summary of included studies.

		n=	Results
Author	Country of origin		
Study	Host country and comparison group		
Design			
Agbemenu 2019	Burundi, Democratic Republic of Congo, Eritrea, Rwanda, Somalia	789 refugees	Maternal:
J Women's Health [8]	USA: US-born white and black women	77,102 controls	- Fewer maternal medical risk factors (34.5%; $p < 0.001$) vs. U.S.-born Black women (41.3%) and U.S.-born white women (44.0%)
Retrospective cohort			- Similar prepregnancy BMI to U.S.-born white women (mean 26.72, standard deviation [SD] 0.24)
			- Smoked less (0.5%; $p < 0.001$), less likely to take illegal drugs during pregnancy (0.6%; $p < 0.001$) vs. U.S.-born white women (12.2% smoked; 4.5% took illegal drugs) and U.S.-born Black women (15.3% smoked; 18.6% took illegal drugs)
			- More multiparous (88%; $p < 0.001$) vs. 75% black women and 68% white women
			- Delayed initiating prenatal care until 2nd trimester (33.4%) vs. (19.2% white women; 28.4% Black women; $p < 0.001$)
			- 27.3% received inadequate prenatal care vs. 11.8% of white women, 23.9% of Black women ($p < 0.001$)
			Gestation:
			- Fewer births <37 weeks gestation (6.3% refugee; 8.9% U.S.-born white; 13.6% U.S.-born Black; $p < 0.001$)
			Intrapartum:
			- More vaginal births (73.4% refugee; 65.3% U.S.-born white; 66.6% U.S.-born Black)
			- Fewer caesareans (13.2% refugee; 19.1% U.S.-born white; 18.3% U.S.-born Black)
			- Fewer inductions (19.1% refugee; 29.7% U.S.-born white; 25.6% U.S.-born Black; $p < 0.001$)
			- More meconium (25.0% refugee; 14.2% U.S.-born white; 14.9% U.S.-born Black; $p < 0.001$)
			Neonatal:
			- Fewer low birth weight infants (5.5% refugee; 7.0% U.S.-born white; 13.6% U.S.-born Black; $p < 0.001$)
Bastola 2019	Somali, Kurdish	584 Somali, 373 Kurdish	Gestation:
Birth [9]	Finland: Finnish women, Russian migrants	eral population	- No significant difference in gestational age at delivery
Retrospective cohort			Intrapartum:
			- Kurdish women less likely to have caesarean (15.4%) than gen pop (21.3%), $p < 0.05$
			- Kurdish women less likely to have obstructed labour than general population (2.7 vs. 6.5%, $p < 0.01$)

Table 1: (continued)

	Author	Study	Design	Country of origin	Host country and comparison group	n=	Results
-	Biro 2017	Aust N Z J Obstet Gynaecol [10]	Cross-sectional	Afghanistan, Bhutan, Burma, Burundi, Democratic Republic of Congo, Guinea, Iraq, Liberia, Rwanda, Sierra Leone and Sudan	Australia: non-refugee women	1,547 likely refugee 18,020 non refugee	<p>Maternal:</p> <ul style="list-style-type: none"> - More likely to be multiparous (74.5 vs. 55.9%, p<0.001) - Younger (p<0.00) <p>Intrapartum:</p> <ul style="list-style-type: none"> - More likely to have spontaneous (69.7 vs. 60.06%) vs. induced (19.7% refugees vs. 25.0% non-refugees) labour (p<0.001) - Less likely to have instrumental (10.2% refugee, 14.8% non-refugee), or emergency caesarean (refugee 14.3%, non-refugee 15.7%) deliveries (p<0.001) - Less likely to have severe foetal growth restriction (3.9% refugee, 4.4% non-refugee, p<0.01)
-	Gibson-Helm 2015 Birth [11]	Retrospective cohort	Various humanitarian source countries (HSCs)	Australia: migrants from various non-HSCs		2,713 from HSCs, 10,606 from non-HSCs	<p>Maternal:</p> <ul style="list-style-type: none"> - Lower mean age (29.9 HSC vs. 28.5 non-HSC, p<0.001) - Higher mean BMI (25.1 HSC vs. 24.0 non-HSC, p<0.001) - More women with at least 1 previous birth ≥20 weeks (75.7 vs. 51.2%, p<0.001) - More likely to have first hospital pregnancy care ≥14 weeks (59.3 vs. 50.9%, p<0.05) - More likely to have poor/no pregnancy care attendance (2.9 vs. 0.7%, p<0.05) - Less likely to have gestational diabetes (OR 0.6, 0.5–0.7), APH (OR 0.5, 0.4–0.7) <p>Gestation:</p> <ul style="list-style-type: none"> - Less likely to be preterm (OR 0.8, 0.6–0.9) - More likely to be postterm (OR 2.4, 1.8–3.1) <p>Intrapartum:</p> <ul style="list-style-type: none"> - Less likely to have induced labour (OR 0.8, 0.7–0.9) - Less likely to have caesarean (OR 0.5, 0.5–0.6), assisted vaginal birth (OR 0.4, 0.4–0.5) <p>Neonatal:</p> <ul style="list-style-type: none"> - More likely to have stillbirth (OR 1.5, 1.0–2.3) unless excluding foetal abnormality before discharge - No significant difference in foetal abnormality, 5 min appgar <7, or neonatal death - Less likely to be low birthweight (OR 0.5, 0.4–0.7) or SGA (OR 0.5, 0.4–0.7) - Less likely to be admitted to NICU/SCBU (OR 0.8, 0.7–0.9)
-	Gibson-Helm 2015 Int J Gynecol Obstet [12]	Retrospective cohort	Women from HSCs	Afghanistan, Bhutan	Women from "non-HSCs"	1,930 women from HSCs, 7,412 from non-HSCs	<p>Maternal:</p> <ul style="list-style-type: none"> - More likely to be aged <20 (2.1 vs. 0.4%, p<0.001) - More likely to have booking visit ≥14 weeks (adjusted OR [AOR] 1.3, 1.1–1.5), poor/no pregnancy care attendance (AOR 4.2, 2.5–7.3) - Less likely to have GDM (AOR 0.6, 0.5–0.7)

Table 1: (continued)

		n=	Results
-	Author		
-	Study		
-	Design		
	- Country of origin		
	- Host country and comparison group		
			<p>Gestation:</p> <ul style="list-style-type: none"> - More likely to have post-term birth (AOR 3.0, 2.0–4.5) <p>Intrapartum:</p> <ul style="list-style-type: none"> - Less likely to have caesarean (AOR 0.4, 0.4–0.5), assisted vaginal birth (AOR 0.7, 0.6–0.9) <p>Neonatal:</p> <ul style="list-style-type: none"> - No sig difference in foetal abnormality, stillbirth, rate of 5 min Apgar <7 - Less likely to have LBW <2.5 kg (AOR 0.6, 0.4–0.8), admission to NICU/SCBU (AOR 0.8, 0.7–0.9) <p>Maternal:</p> <ul style="list-style-type: none"> - More likely to be aged <20 (6.5 vs. 1.4%, p<0.001), - Less likely to have booking visit ≥14 weeks (AOR 0.5, 0.3–0.9) <p>Intrapartum:</p> <ul style="list-style-type: none"> - More likely to have induced labour (AOR 2.0, 1.1–3.5) <p>Maternal:</p> <ul style="list-style-type: none"> - Less likely to be aged <20 (0.4 vs. 2.6%, p=0.02) - More likely to have nulliparous term singleton vertex caesarean (AOR 0.3, 0.1–0.9)
		107 from HSCs, 5,574 from non-HSCs	
	- Myanmar		
	- Southeast Asian non-HSCs		
		287 from HSCs, 990 from non-HSCs	
	- Iraq		
	- West Asian non-HSCs		
		1,983 asylum seekers/undocumented migrants, 29,914 refugees, 254,973 controls	
-	Liu 2019		
-	Eur J Public Health [13]		
-	Retrospective cohort		
	- Various – refugees, asylum seekers and undocumented migrants		
	- Sweden: Swedish-born women		
			<p>Maternal:</p> <ul style="list-style-type: none"> - More likely to have poor self-rated health before pregnancy (RR 1.78, 1.73–1.83) - Less likely to have pre-eclampsia (RR 0.70, 0.64–0.77) - More likely to have GDM (RR 2.07, 1.93–2.22) - More likely to have inadequate antenatal care (RR 1.80, 1.71–1.98) - More likely to have no ultrasound screening (RR 3.40, 2.93–3.95) <p>Gestation:</p> <ul style="list-style-type: none"> - Less likely to have preterm birth (RR 0.92, 0.87–0.97) <p>Intrapartum:</p> <ul style="list-style-type: none"> - Less likely to have non-instrumental vaginal delivery (RR 0.90, 0.89–0.91) - More likely to have instrumental (RR 1.42, 1.35–1.49) - More likely to have ELCS (RR 1.12, 1.07–1.17) or EMCS (RR 1.53, 1.47–1.58) <p>Neonatal:</p> <ul style="list-style-type: none"> - More likely to have stillbirth (RR 2.24, 0.89–2.66) - More likely to be SGA (RR 2.58, 2.42–2.76) - More likely to have BW<2,500 g (RR 1.46, 1.36–1.55) - More likely to have Apgar <7 at 5 mins (RR 1.77, 1.62–1.93)

Table 1: (continued)

	Country of origin Host country and comparison group	n=	Results
Author Study Design	Eritrea, Sudan Israel: native Israeli women	247 refugees, 247 controls	
Michaan 2014 Isr Med Assoc J [14] Retrospective cohort			<p>Maternal:</p> <ul style="list-style-type: none"> - Refugees younger (mean age 25.9 vs. 32.5, $p < 0.0001$) - More likely to be primigravida (126 vs. 83, $p = 0.0002$) - More likely to be primipara (137 vs. 109, $p = 0.0016$) - No significant difference in pre-pregnancy BMI - Lower BMI at delivery (25.8 vs. 27.2, $p = 0.036$) <p>Gestation:</p> <ul style="list-style-type: none"> - More likely to have preterm delivery at < 37 weeks (9.3 vs. 4%, $p = 0.02$), and < 34 weeks (3.6 vs. 0.8%, $p = 0.036$) <p>Intrapartum:</p> <ul style="list-style-type: none"> - More likely to have EMCS rather than ELCS (97 vs. 53, $p < 0.0001$) More likely to have meconium (31 vs. 12.5%, $p < 0.0001$) <p>Neonatal:</p> <ul style="list-style-type: none"> - No significant difference in % with neonatal weight < 2.5 or 2 kg - No significant difference in neonatal weight > 4 kg - More likely to have Apgar < 8 at 5 mins (3.7 vs. 1%, $p = 0.035$) - More likely to have NICU admission (6 vs. 2%, $p = 0.03$)
Gibson-Helm 2014 BMC Pregnancy Childbirth [15] Retrospective cohort	Sudan North African non-HSCs	1,147 HSCs, 214 non-HSCs	<p>Maternal:</p> <ul style="list-style-type: none"> - More likely to be < 20 years (6.7 vs. 1.4%, $p < 0.01$), have had ≥ 1 birth at ≥ 20 weeks (80.1 vs. 62.2%, $p < 0.01$) - Less likely to have BMI ≥ 25 (43.9 vs. 75.6%, $p < 0.01$) <p>Intrapartum:</p> <ul style="list-style-type: none"> - Less likely to have non-cephalic presentation (AOR 0.4, 0.2–0.8), caesarean section (AOR 0.4, 0.3–0.7), assisted vaginal birth (AOR 0.4, 0.2–0.8) <p>Maternal:</p> <ul style="list-style-type: none"> - More likely to be multiparous (70.1 vs. 56.4%, $p = 0.02$), more likely to have GDM (AOR 3.5, 1.8–7.1) <p>Maternal:</p> <ul style="list-style-type: none"> - Less likely to be aged ≥ 35 (4.4 vs. 34.4%, $p < 0.01$) <p>Intrapartum:</p> <ul style="list-style-type: none"> - Less likely to have caesarean (22.2 vs. 42.6%, $p = 0.03$)
	DRC, Burundi, Eritrea, Rwanda, Tanzania Middle and East African non-HSCs	87 HSCs, 619 non-HSCs	
	Guinea, Liberia, Mauritania, Sierra Leone West African non-HSCs	45 HSCs, 61 non-HSCs	

Table 1: (continued)

		n=	Results
– Author	– Country of origin		
– Study	– Host country and comparison group		
– Design			
– Kandasamy 2014	– Various, refugees	274 refugee women, 273 controls	Maternal:
– J Obstet Gynaecol Can [16]	– Canada: non refugees		– Younger (mean age 28.70 refugees, 31.4 non-refugees, p<0.001)
– Retrospective cohort			– More likely to be HIV positive (3.6 vs. 0.4%, p=0.006)
			– No significant difference in GDM or PIH
			– More likely to have late prenatal care (10.2 vs. 1.8%, p<0.001)
			Gestation:
			– No significant difference in preterm delivery
			Intrapartum:
			– No significant difference in caesarean section except for multiparous women, who were more likely to have C-section if refugees (36.4 vs. 22.9%, p=0.014)
			Neonatal:
			– No significant difference in low birthweight
– Theodora 2019	– Syria, Afghanistan, Iraq	878 refugees, 7,103 controls	Maternal
– J Perinat Med [17]	– Greece: native population		– Younger and of higher parity
– Retrospective cohort			– Most had inadequate antenatal care
			– More likely to have pre-eclampsia
			– 1/5 refugees had no antenatal care
			Gestation:
			– More likely to have late preterm and <34 weeks delivery
			Intrapartum:
			– More likely to have caesarean section
			Neonatal:
			– More likely to have low Apgar scores
			– More likely to have foetal growth restriction
			– More likely to be stillborn
– Miller 2016	– Various	575 presumed refugees, 966 other	Maternal:
– Matern Child Health J [18]	– USA – refugees statistically compared to USA-born mothers	foreign-born women, 5,388 US-born mothers	– Older (mean 28.25 vs. 25.66 US-born, p<0.001)
– Retrospective cohort			– More likely to have late or no prenatal care (7.1 vs. 4.6% p<0.01)
			Gestation:
			– Less likely to have preterm birth (RR0.56, CI 0.38–0.81, p=0.002)
– Khan 2017	– Various refugees	2,106 refugees, 16,232 other im-	Maternal:
– Diabet Med [19]	– Canada – other immigrants and non-immigrants	migrants, 22,564 non-migrants	– Higher parity (p<0.001), less likely to have pre-eclampsia (ARR 0.65, 0.44–0.95), more likely to have endocrinologist visit during late pregnancy (ARR 1.13, 1.10–1.15)
– Retrospective cohort			Gestation:
			– Less likely to have preterm birth (ARR 0.87, 0.75–0.995)
			Neonatal:
			– Less likely to have macrosomia (ARR 0.74, 0.65–0.85), RDS (ARR 0.83, 0.70–0.97), jaundice (ARR 0.81, 0.68–0.95)

Table 1: (continued)

	Author	Study	Design	Country of origin Host country and comparison group	n=	Results
-	Wanigaratne 2018 BMJ Open [20]	-	-	Sri Lanka, Somalia, Afghanistan, Iraq and China	34,233 refugee immigrant mothers, 243,439 non-refugee immigrant mothers, 615,394 Canadian-born mothers	Maternal: - High parity – 10% ≥3 previous births compared with non-refugee immigrant (3.2%) and Canadian-born mothers (2.7%) - More likely to have HIV (AOR 1.82, CI 1.19–2.79) Gestation: - Less likely to have moderate preterm birth (AOR 0.90, CI 0.87–0.93) than Canadian born mothers - No significant difference in very preterm birth Intrapartum: - caesarean section (AOR 1.04, 95% CI 1.00–1.08) was significantly higher among refugees Neonatal: - Less likely to have congenital anomaly (AOR 0.91, CI 0.83–0.99) than Canadian born mothers - No significant difference in neonatal mortality - More likely to have NICU admission than Canadian born mothers (AOR 1.07, CI 1.05– 1.10) - More likely to have perinatal mortality (AOR 1.17, CI 1.06–1.29) than Canadian born mothers - More likely to have stillbirth (AOR 1.20, CI 1.07–1.34) than Canadian born mothers
-	Bozorgmehr 2018 BMC Pregnancy Childbirth [21]	-	-	Asylum seekers from various source countries Germany: non-asylum seeking patients	569 asylum seekers, 19,115 controls	Maternal: - Less likely to have “high risk” pregnancy (OR 0.68, p<0.0001) Intrapartum: - Less likely to have caesarean section (OR 0.64, p<0.0001) Neonatal: - More likely to have abortive outcome/stillbirth (OR 1.68, p=0.001)
-	Kuvacic 1996 Acta Obstet Gynecol Scand [22]	-	-	Bosnia and Herzegovina, Serbia Croatia	593 refugees, 7,845 non-displaced women	Gestation: - Expatriated women delivered prematurely significantly more often than non- displaced persons in 1990 and 1991 (p<0.01) – significant difference disappeared in 1992 Neonatal: - Perinatal mortality in expatriated population was significantly higher (p<0.01) - Birth weight for expatriated women was more often under 2,500 g. (p<0.01) – significant difference disappeared in 1992

Table 1: (continued)

	Country of origin Host country and comparison group	n=	Results
Author	Various – refugees and secondary refugees (i.e. had lived elsewhere between country of birth and Canada)	100,894 primary non-refugees, 116,18 primary refugees, 9,746 secondary non-refugees, 1,295 secondary refugees	Gestation: – Similar risk of very and moderate preterm birth between primary refugees and primary non-refugees. Higher rate of very PTB (1.2 vs. 0.6 per 100 live births) and moderate PTB (5.9 vs. 4.4 per 100 live births) in secondary refugees vs. secondary non-refugees – Refugees overall had 17% greater cumulative odds of PTB compared with non- refugees after adjustment (ACOR 1.7, CI 1.07–1.28)
Study	Canada – non-refugee immigrants and secondary non-refugee immigrants		
Design			
Wanigaratne 2016	Various – refugees and secondary refugees (i.e. had lived elsewhere between country of birth and Canada)	100,894 primary non-refugees, 116,18 primary refugees, 9,746 secondary non-refugees, 1,295 secondary refugees	Gestation: – Similar risk of very and moderate preterm birth between primary refugees and primary non-refugees. Higher rate of very PTB (1.2 vs. 0.6 per 100 live births) and moderate PTB (5.9 vs. 4.4 per 100 live births) in secondary refugees vs. secondary non-refugees – Refugees overall had 17% greater cumulative odds of PTB compared with non- refugees after adjustment (ACOR 1.7, CI 1.07–1.28)
J Epid Comm Health [23]	Canada – non-refugee immigrants and secondary non-refugee immigrants		
Retrospective cohort			
Gagnon 2013	Various (refugees and asylum seekers)	149 refugees, 71 asylum seekers, 505 other migrants	Intrapartum: – Less likely to have an emergency caesarean if an asylum seeker (OR 0.3) or refugee (OR 0.5) Neonatal: – No significant difference in rate of NICU admission (p = 0.073)
Int J Gynecol Obstet [24]	Canada: other migrants		
Prospective cohort			
Merry 2016	Various – refugee/humanitarian migrants	79 humanitarian migrants, 1,769 others	Intrapartum: – Having a humanitarian migrant classification was a predictor for unplanned caesarean (OR 4.24, CI 1.16–15.46) compared to being an economic immigrant/ temporary resident
Birth [25]	Canada – other migrant categories from low- and middle-income countries		
Case-control			
Schulpen 2001	Various – presumed refugees/ asylum seekers	Examined 42,282 records, unspec- ified how many presumed refugees	Neonatal: – Higher perinatal mortality – RR 1.8 (1.5–2.0), only partly explained by prematurity
Arch Dis Child [26]	Netherlands – presumed refugees compared to Dutch population		
Retrospective cohort			
Thomas 2010	Various, including Afghanistan, Bosnia-Herzegovina, Burma, Eritrea, Ethiopia, Iraq, Somalia, Sudan		Used a composite measure of adverse outcomes including: stillbirth, preterm birth (<37 weeks), caesarean section, PPH ≥ 1 L, eclampsia, intra-uterine growth restriction, birthweight <2.5 kg, admission to NICU, congenital abnormality and 3rd/4th degree perineal trauma. One point allocated per adverse event. No significant relationship between adverse outcomes and refugee status (p=0.863)
Aust N Z J Obstet Gynaecol [27]	Australia – non-refugee		
Retrospective cohort			
Wanigaratne 2013	Various	Not specified	Neonatal: – Refugees had higher risk of neonatal morbidity including: respiratory conditions (OR 1.09, 1.06–1.12), congenital anomaly (OR=1.05, 1.02–1.09), hospital read- mission due to inadequate weight gain (OR=1.16, 1.03–0.32)
Am J Epid [28]	Canada		
Retrospective cohort			

Table 1: (continued)

	Author	Study	Design	Country of origin	Host country and comparison group	n=	Results
-	Wanigaratne 2016	-	Various	-	Various	29,765 refugees, 230,914 other immigrants, 860,617 non-immigrants. 15,122 non-sponsored refugees, 10,571 sponsored refugees	Neonatal: - Refugees vs. other immigrants: more likely to need ventilatory support (RR 1.11, 1.01–1.23), IV fluids (RR 1.22, 1.08–1.39), have RDS (RR1.22, 1.04–1.42), have primary atelectasis respiratory failure (RR1.32, 1.02–1.71), have CVC or central arterial line (RR 1.33, 1.02–1.73), have a seizure (RR 1.59, 1.15–2.19), have HIE (RR 2.46, 1.47–4.12)
-	Matern Child Health J [29]	-	Canada: other immigrants, non-immigrants	-	Canada: other immigrants, non-immigrants		- Refugees vs. non-immigrants: less likely to need ventilatory support (RR 0.85, 0.78–0.94), have sepsis/septicaemia (RR 0.86, 0.75–0.98). More likely to have birth weight >1.5 kg (RR 1.28, 1.09–1.51), have HIE (RR 1.89, 1.19–3.00), have blood transfusion (RR 2.21, 2.02–2.41)
-	Jara 2001	-	Vietnam, Laos, Cambodia	-	Vietnam, Laos, Cambodia	314 refugees, 23,251 other immigrants and US born mothers	Neonatal: - More likely to have congenital toxoplasmosis (OR 8.6, CI 4.3–17.4); adjusted for mother's educational level, gravidity, and country of birth OR 8.9, CI 4.2–19.1
-	Pediatr Infect Dis [30]	-	USA: Other migrants and US-born mothers	-	USA: Other migrants and US-born mothers		
-	Case-control	-		-			

This review has a number of strengths, but some limitations. A number of large, population-based studies which included hundreds of refugee and asylum-seeking women were identified. The design of the cross-sectional and retrospective cohort studies limited the potential for bias, as the data included was quantitative and objective such as gestational age at delivery, method of delivery, and birth-weight. Some studies directly compared refugees to other categories of migrants, reducing the potentially confounding effects of ethnicity and childhood access to healthcare. Limitations of the study include there are relatively few studies examining outcomes for refugee only, as opposed to broader groups of migrants. As we report, outcomes can differ significantly between refugees and non-refugees who have migrated from the same region to the same host country [11, 12, 15], as such findings of studies that included economic migrants cannot necessarily be generalised to refugees. Additionally, despite the inclusion of 26 studies, only 10 host countries were represented. This is a small fraction of high-income countries and the heterogeneous healthcare systems between countries may produce significantly different outcomes for socially disadvantaged mothers. The inclusion of a small fraction of high-income countries may reflect the small proportion (2.7% in 2017) of global refugees and asylum seekers who are hosted in high-income countries compared to low- or middle-income countries [39]. The findings of this review that there is poor uptake of antenatal care and higher neonatal morbidity – may not be generalisable to all high-income countries, as some may have different payment structures and access provisions that can exacerbate or mitigate the barriers in immigrant access to healthcare.

Conclusions

Infants born to refugee and asylum-seeking women are more likely to be stillborn or to suffer increased neonatal morbidity in comparison to economic migrants and native-born women in high-income countries. This was despite refugee women being of medically low risk, with fewer pregnancy-related complications and has fewer instrumental or operative deliveries. They were, however, more likely to have poor, late or no access to antenatal care, which may explain the poorer neonatal outcomes.

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