Received: 2 July 2019 | Revised: 18 November 2019 | Accepted: 25 November 2019

DOI: 10.1111/aogs.13777

ORIGINAL RESEARCH ARTICLE

Offspring birthweight and placental weight in immigrant women from conflict-zone countries; does length of residence in the host country matter? A population study in Norway

Anne Eskild[1,2] | Silje Sommerfelt[1,2] | Irene Skau[3] | Jostein Grytten[1,3]

[1]Division of Obstetrics and Gynecology, Akershus University Hospital, Lørenskog, Norway

[2]Institute of Clinical Medicine, University of Oslo, Oslo, Norway

[3]Department of Community Dentistry, University of Oslo, Oslo, Norway

Correspondence
Anne Eskild, Division of Obstetrics and Gynecology, Akershus University Hospital, 1478 Lørenskog, Norway.
Email: anne.eskild@medisin.uio.no

Funding information
The study was funded by the Norwegian South-East Regional Health Authority grant number 273910.

Abstract

Introduction: We aimed to estimate differences in offspring birthweight and placental weight between Norwegian women and immigrants in Norway from countries with armed conflicts. We also studied whether length of residence in Norway was associated with offspring birthweight and placental weight.

Material and methods: We included in our study all singleton births in Norway at gestational week 28 or beyond during the years 1999-2014, to mothers who were born in Somalia, Afghanistan, Iraq (total immigrants n = 18 817), or Norway (n = 668 439). Data were obtained from The Medical Birth Registry of Norway and the Central Person Registry of Norway. We estimated the differences between Norwegian and immigrant women in mean offspring birthweight and mean placental weight by applying linear regression analyses. Adjustments were made for maternal age, parity, year of delivery, gestational age at delivery, preeclampsia, and diabetes.

Results: The immigrant women had 206 g (95% CI 199 to 213 g) lower mean offspring birthweight and 16 g (95% CI 14 to 18 g) lower mean placental weight than Norwegian women. Immigrant women with ≥5 years of residence in Norway had higher offspring birthweight (40 g) and higher placental weight (17 g) than immigrant women with <5 years of residence.

Conclusions: Immigrant mothers from Somalia, Afghanistan, and Iraq gave birth to infants and placentas with lower weight than Norwegian women. However, the difference between Norwegian women and immigrant women was reduced by length of residence in Norway.

KEYWORDS

birthweight, immigrants, placental weight, population study, refugees

1 | INTRODUCTION

Low birthweight has been associated with increased morbidity and mortality in childhood, and also in adult life.[1-4] Low birthweight is considered a significant global health problem, and the World Health Organization has a goal of 30% reduction in the occurrence of low birthweight by 2025.[5] Such a goal assumes that low birthweight is caused by modifiable factors.

Immigrants from non-western countries represent an increasing proportion of women who give birth in Europe and the USA,[6] and women from Africa and Asia give birth to offspring with lower birthweight than native women.[7-11] Such differences in birthweight have partly been attributed to genetic factors, and it has been suggested that ethnicity-specific fetal growth centiles should be used to better identify the pregnancies and offspring with true increased risk of adverse outcome.[12-15]

A counter argument for ethnicity-specific growth centiles has been that the lower offspring birthweight in immigrants is caused by poor living conditions, and that poor living conditions for the mother compromise fetal growth.[16,17] If this is true, it is to be expected that improvements of deprived women's living conditions will lead to higher offspring birthweight. Hence, long-term residence in an affluent country for women emigrating from deprived regions could possibly increase their offspring's birthweight. However, a study from Sweden[18] found only marginal changes in offspring birthweight with the immigrants' duration of residence. Another study from the USA reported an initial decline in offspring birthweight after immigration.[19] Changes in offspring birthweight after emigration could possibly depend on the level of change in living conditions.[6] Particularly, women who live in an armed conflict region may have been exposed to deprived living conditions and thus be at high risk of giving birth to a low-birthweight infant.[20]

The placenta is essential for fetal growth and development.[21] Placental dysfunction may therefore impair fetal growth, and a small placenta could indicate impaired placental function.[22-24] We are not aware of any studies of placental weight in immigrants or of changes in placental weight by duration of residence in a host country.

In the present study, we compared offspring birthweight and placental weight in women from Somalia, Iraq, and Afghanistan who gave birth in Norway, with Norwegian women. We also studied birthweight and placental weight according to length of residence in Norway.

Key message

Immigrant women from Somalia, Afghanistan, and Iraq deliver offspring with lower weight than Norwegian women, but the difference is reduced by length of residence in Norway.

2 | MATERIAL AND METHODS

2.1 | Study design and study sample

We performed a population-based registry study in Norway during the years 1999-2014 by using data from the Medical Birth Registry[25] and the Central Person Registry of Norway.[26] Almost all births in Norway take place in hospitals, and antenatal and obstetric care is free of charge. All births have been compulsorily notified to the Medical Birth Registry since 1967.

Women from countries with armed conflict who gave birth in Norway in gestational week 28 and beyond were included, as well as births to Norwegian mothers. Somali, Iraqi, and Afghan women represented the largest immigrant groups from countries with armed conflict, and women from these countries were therefore included. Information about the women's country of birth and length of residence in Norway was obtained by individual linkage between the Medical Birth Registry and the Central Person Registry of Norway using the women's unique person identification numbers. All individuals with legal residence in Norway receive a unique person identification number. Women without legal residence, who give birth, receive a temporary person identification number. A woman was defined as Norwegian if both of her parents were born in Norway.

Placental weight has been reported to the Medical Birth Registry since 1999. Therefore, our study period started in 1999.

A total of 711 073 births were eligible for our study (Figure 1). We excluded births with missing information about birthweight (n = 375), placental weight (n = 22 648), parity (n = 0), and maternal age (n = 63). Additionally, a total of 740 births to immigrant women were excluded because of missing information about length of residence in Norway. Hence, a total of 687 247 births could be included in our data analyses, representing 668 439 Norwegian, 9281 Somali, 2113 Afghan, and 7423 Iraqi women.

2.2 | Study factors

Our outcome variables were birthweight and placental weight, in grams. According to obstetric standards in Norway, the placenta is weighed at the obstetric ward with membranes and umbilical cord attached, within 1 hour after delivery.[27]

Birthweight and placental weight may be associated with maternal age, parity, year of delivery, gestational age at delivery, maternal diabetes, and preeclampsia, and these factors may also be associated with country of birth. We therefore made adjustment for these factors, and the information was obtained from the Medical Birth Registry. Maternal age at delivery was coded as <20, 20-34, or ≥35 years old, parity was coded as none, 1, 2, or 3 or more previous deliveries. Year of delivery was coded as 1999-2002, 2003-2006, 2007-2011, or 2011-2014. Gestational age at delivery was coded as 28-36 weeks, 37-41 weeks, or ≥42 weeks. Maternal diabetes was reported to the Medical Birth Registry as diabetes mellitus type 1, diabetes mellitus type 2, gestational diabetes, and unspecified diabetes, and was coded in our analyses as diabetes (yes or no). Preeclampsia was defined as blood pressure 140/90 mm Hg or higher after 20 weeks of gestation in addition to proteinuria (more than 0.3 g/24 h or +1 on dipstick). Length of residence in Norway was coded as <5 years or ≥5 years.

2.3 | Statistical analyses

Mean birthweight and placental weight according to the women's country of birth were calculated, and differences in mean were tested by applying Student's *t* test. We used crude and multivariable linear regression analyses to estimate differences by country of birth in birthweight (in grams) and in placental weight (in grams), with 95% CI,

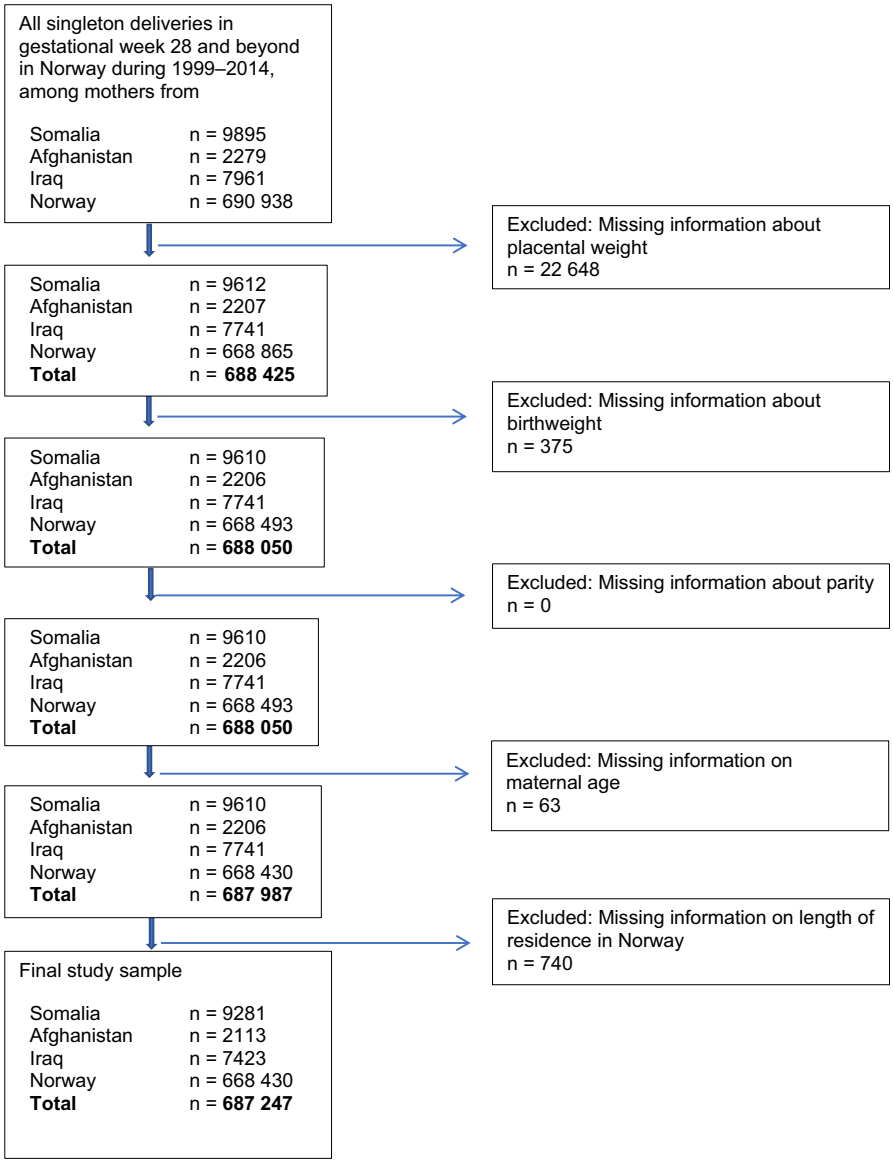

FIGURE 1 Flow chart of the study sample [Color figure can be viewed at wileyonlinelibrary.com]

using births to Norwegian women as the reference group. In multivariable analyses, we made adjustments for maternal age, parity, year of delivery, gestational age at delivery, diabetes, and preeclampsia. First, we studied all women. Thereafter we studied immigrant women with <5 years and ≥5 years of residence in Norway, separately.

2.4 | Ethical approval

This research project was approved by the Norwegian Regional Committee for Medical and Health Research Ethics (reference number 2012/1433).

3 | RESULTS

Immigrant women from Somalia, Afghanistan, and Iraq represented an increasing proportion of the women who gave birth in Norway during our study period, from 1.3% in 1999-2002 to 3.9% in 2011-2014 (Table 1). Immigrant women were more often multiparous than Norwegian women. They had higher prevalence of diabetes, but lower prevalence of preeclampsia.

3.1 | Birthweight

Mean birthweight was 3578 g for offspring of Norwegian women, but in offspring of immigrant women, birthweight was 171 g lower, on average (Table 2; Figure 2). After adjustment for maternal age, parity, gestational week at delivery, year of delivery, diabetes, and preeclampsia, the difference in offspring birthweight between immigrant women and Norwegian women increased, and birthweight was estimated to be 206 g lower in immigrants than among Norwegian women. Offspring of Somali women had the lowest crude birthweight, at 185 g below the Norwegian mean, and the adjusted difference in birthweight was 245 g below the Norwegian mean (Table 2).

TABLE 1 Characteristics of 687 247 singleton deliveries in Norway during the years 1999-2014, according to the women's country of birth

	Norway, % (n)	Immigrants, total % (n)	Somalia, % (n)	Afghanistan, % (n)	Iraq, % (n)
Total (n)	668 439	18 817	9281	2113	7423
Maternal age at delivery (y)					
<20	2.36 (15 789)	2.55 (480)	2.83 (263)	1.99 (42)	2.36 (175)
20-34	81.01 (541 482)	79.82 (15 019)	79.75 (7402)	83.67 (1768)	78.80 (5849)
≥35	16.63 (111 159)	17.63 (3318)	17.41 (1616)	14.34 (303)	18.85 (1399)
Parity					
0	41.57 (277 895)	28.13 (5293)	22.90 (2125)	32.94 (696)	33.30 (2472)
1	36.50 (243 948)	25.66 (4828)	21.60 (2005)	27.12 (573)	30.31 (2250)
2	16.21 (108 339)	18.54 (3488)	18.23 (1692)	18.55 (392)	18.91 (1404)
3+	5.72 (38 250)	27.68 (5208)	37.27 (3459)	21.39 (452)	17.47 (1297)
Year of delivery					
1999-2002	25.63 (171 324)	12.02 (2262)	12.69 (1178)	4.69 (99)	13.27 (985)
2003-2006	24.86 (166 176)	24.11 (4536)	22.95 (2130)	19.64 (415)	26.82 (1991)
2007-2011	25.51 (170 504)	29.73 (5595)	29.71 (2757)	30.67 (648)	29.50 (2190)
2011-2014	24.00 (160 428)	34.14 (6424)	34.65 (3216)	45.01 (951)	30.41 (2257)
Gestational age at delivery (wk)					
28-36	5.04 (33 694)	4.74 (892)	4.65 (432)	4.59 (97)	4.89 (363)
37-41	88.28 (590 073)	86.31 (16 241)	82.44 (7651)	90.58 (1914)	89.94 (6676)
≥42	6.68 (44 663)	8.95 (1684)	12.91 (1198)	4.83 (102)	5.17 (384)
Diabetes					
No	99.31 (663 807)	99.09 (18 645)	99.08 (9196)	99.15 (2095)	99.07 (7354)
Yes	0.69 (4623)	0.91 (172)	0.92 (85)	0.85 (18)	0.93 (69)
Preeclampsia					
No	96.40 (644 343)	97.51 (18 349)	96.99 (9002)	98.06 (2072)	98.01 (7275)
Yes	3.60 (24 087)	2.49 (468)	3.01 (279)	1.94 (41)	1.99 (148)
Length of residence in Norway (y)					
<5	n/a	53.56 (10 078)	48.73 (4522)	63.74 (1347)	56.70 (4209)
≥5	n/a	46.44 (8739)	51.28 (4759)	36.25 (766)	43.30 (3214)

Immigrant women with ≥5 years of residence in Norway had higher offspring birthweight than immigrant women with shorter length of residence (Table 2). Women from Afghanistan had the greatest increase in offspring birthweight according to length of residence, and mean offspring birthweight was 66 g higher in Afghan women with 5 or more years of residence compared with Afghan women with shorter length of residence (Table 2; Figure 2).

3.2 | Placental weight

Mean placental weight was 675 g in Norwegian women. Immigrant women had lower placental weight, on average at 7 g lower than the Norwegian mean (Table 2; Figure 2). After adjustment for the above study factors, the difference between immigrant women and Norwegian women increased, and mean placental weight was estimated to be 16 g lower in immigrant women. Afghan women had the lowest crude mean placental weight, at 17 g below the Norwegian mean. After adjustment, placental weight in Afghan women was estimated to be 20 g below the Norwegian mean (Table 2).

Immigrant women with ≥5 years residence in Norway had higher placental weight than immigrant women with shorter length of residence (Table 2; Figure 2). In immigrants, the placenta was 24 g less than the Norwegian mean after <5 years of residence, and the placenta was 7 g less than the Norwegian mean after ≥5 years of residence (17 g increase). Women from Afghanistan had the greatest increase in mean placental weight, an increase of 20 g. Interestingly, mean placental weight in Afghan and Iraqi women with ≥5 years of residence in Norway was not significantly different from the Norwegian mean (Table 2; Figure 2). The increase in placental weight by length of residence was relatively larger than for birthweight.

TABLE 2 Crude and adjusted* difference in mean offspring birthweight and placental weight (in grams) between Norwegian women (reference) and immigrant women, according to the mother's country of birth and length of residence in Norway (<5 y or ≥5 y)

Women's country of birth	Crude birthweight, g (95% CI)	Adjusted birthweight, g (95% CI)	Adjusted birthweight by length of residence, g (95% CI)		Crude placental weight, g (95% CI)	Adjusted placental weight, g (95% CI)	Adjusted placental weight by length of residence, g (95% CI)	
Norway (n = 687 247)								
Mean (reference)	3578	3473		3473	675	650		650
Somalia (n = 9281)	−185 (−197 to −174)	−245 (−255 to −235)	<5 y (n = 4522)	−264 (−279 to −250)	−7 (−10 to −4)	−18 (−21 to −15)	<5 y (n = 4522)	−26 (−30 to −21)
			≥5 y (n = 4759)	−227 (−241 to −213)			≥5 y (n = 4759)	−11 (−16 to −7)
Afghanistan (n = 2113)	−163 (−190 to −140)	−174 (−195 to −154)	<5 y (n = 1347)	−198 (−224 to −172)	−17 (−23 to −10)	−20 (−26 to −14)	<5 y (n = 1347)	−27 (−35 to −20)
			≥5 y (n = 766)	−132 (−166 to −97)			≥5 y (n = 766)	−7 (−17 to +4)
Iraq (n = 7423)	−155 (−168 to −142)	−167 (−178 to −156)	<5 y (n = 4209)	−191 (−206 to −176)	−9 (−12 to −5)	−12 (−15 to −9)	<5 y (n = 4209)	−20 (−25 to −16)
			≥5 y (n = 3214)	−135 (−152 to −119)			≥5 y (n = 3214)	−1 (−6 to +4)
Immigrants Total (n = 18 817)	−171 (−179 to −163)	−206 (−213 to −199)	<5 y (n = 10 078)	−224 (−234 to −215)	−9 (−11 to −7)	−16 (−18 to −14)	<5 y (n = 10 078)	−24 (−26 to −21)
			≥5 y (n = 8739)	−184 (−195 to −174)			≥5 y (n = 8739)	−7 (−10 to −4)

Note: 95% CI are presented and Norwegian women are used as reference.

*Adjustments were made for maternal age, parity, year of delivery, gestational age at delivery, diabetes, and preeclampsia.

4 | DISCUSSION

We found that offspring birthweight and placental weight were lower among Somali, Afghan, and Iraqi women than among Norwegian women, but the difference was reduced by length of residence in Norway.

We are not aware of any previous population study that has compared birthweight and placental weight in immigrant women from conflict zones with native women in a European country.

We aimed to include all women from Norway, Somalia, Afghanistan, and Iraq who gave birth to a singleton infant in Norway during the years 1999-2014. We used data from the Medical Birth Registry of Norway, and all births in Norway are reported by law to this registry. In total, 23 826 (3.35% of total) of all eligible births in the Medical Birth Registry could not be included because of missing information about study factors. However, there was little difference in non-inclusion between women from the different countries (3%-7%). Missing information about placental weight was the most common reason for non-inclusion, independent of the women's country of birth, and very few women were excluded because of missing information about length of residence in Norway. Skewed selection to the study sample is therefore not a likely source of bias.

We made adjustments for maternal age, parity, year of delivery, gestational age at delivery, diabetes, and preeclampsia, and such adjustment strengthened our findings. Offspring birthweight, and placental weight are known to be positively associated with maternal body mass index.[3,28,29] Hence, the lower offspring birthweight and placental weight in Somali, Afghan, and Iraqi women could be explained by lower body mass index in immigrant women. Unfortunately, we had no information about maternal body mass index in our study.

Both birthweight and placental weight increase by gestational age at birth,[30] and immigrant women may have increased risk of preterm delivery.[31] Also, our findings could be explained by changes during our study period in the selection of women who have immigrated to Norway. However, adjustments for gestational age and year of delivery did not alter the direction of our estimates.

In agreement with our results, several previous studies report that immigrant women from developing countries give birth to infants with lower birthweight than European women.[32-34] In particular, women from conflict-zone countries seem to give birth to low birthweight infants.[7,20]

We are not aware of any previous studies of placental weight in women who have recently immigrated. However, two studies from the USA found higher prevalence of placental growth restriction in African American women than among white women,[29,35] and an Australian study found higher placental weight in people of Asian ethnic origin than in those of European origin.[22] A Malaysian study compared women of Indian, Chinese, and Malay origin, and they found significant differences in offspring birthweight and placental weight between these groups.[36] A study of placentas in very-low-birthweight

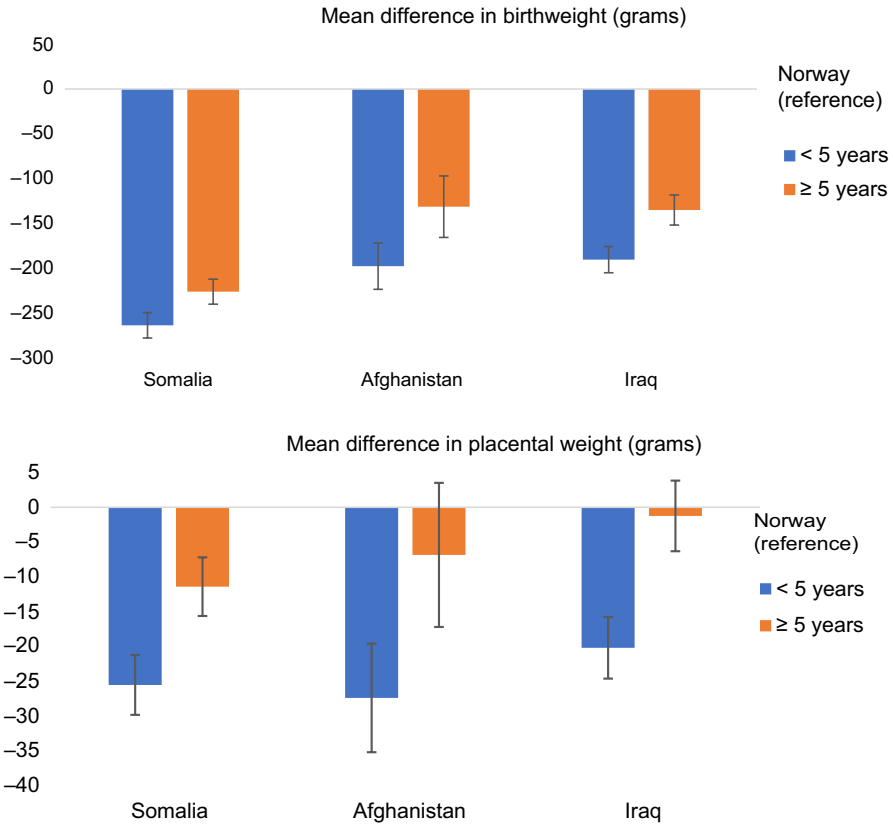

FIGURE 2 Adjusted difference in mean offspring birthweight and placental weight (in grams), with 95% CI, between immigrant women and Norwegian women (reference), according to the women's country of birth and length of residence in Norway (<5 y or ≥5 y) [Color figure can be viewed at wileyonlinelibrary.com]

infants in the USA found no difference in placental weight according to ethnicity.[37] A Canadian study suggested increasing risk of pre-eclampsia according to length of residency in Canada.[38]

We are aware of 4 previous studies that have addressed whether length of residence in a host country is associated with offspring birthweight. Neither a Swedish nor a Canadian study found significant trends in offspring birthweight by length of residence.[18,39] However, two studies from the USA found low offspring birthweight among the women with the shortest and the longest lengths of residence.[19,40] For those women, the standard of living may not have increased after immigration.

It is under discussion whether the observed differences in birthweight between ethnic groups are caused by genetic differences,[33,41,42] or by differences in intrauterine exposures.[16,32,43,44] A study from the USA found an association between low birthweight and foreign-born status, as well as with educational level.[45] Also, a Swedish study suggests that the mother's ethnicity does not sufficiently explain the differences in offspring birthweight between mothers born in Sweden and mothers born in developing countries.[46] A systematic review concluded that immigrant status in itself is not a good marker for risk of adverse perinatal outcomes.[6]

Besides maternal nutritional status, exposure to stress may also influence birthweight.[47] Our findings suggest that settlement in a welfare state, such as Norway, may gradually have improved the immigrant women's nutritional status and reduced their level of stress, and thereby the potentials for offspring intrauterine growth may have improved. The increasing offspring birthweight with length of residence in Norway therefore suggests that ethnicity-specific fetal growth charts made at one point in time, may not be valid at another point in time. Our findings question the usefulness of ethnicity-specific fetal growth charts.[48]

5 | CONCLUSION

Immigrant mothers in Norway from Somalia, Afghanistan, and Iraq had lower offspring birthweight and placental weight than Norwegian mothers. This difference was reduced by length of residence in Norway. Our findings suggest that changes in living conditions may influence birthweight and placental weight, and that valid ethnicity-specific fetal growth centiles may be difficult to establish.

CONFLICT OF INTEREST

There are no conflicts of interest.

ORCID

Anne Eskild https://orcid.org/0000-0002-2756-1583
Irene Skau https://orcid.org/0000-0003-1212-9162
Jostein Grytten https://orcid.org/0000-0002-7946-6385

REFERENCES

1. Watkins WJ, Kotecha SJ, Kotecha S. All-cause mortality of low birthweight infants in infancy, childhood, and adolescence: population study of England and Wales. *PLoS Med*. 2016;13:e1002018.

2. Ro A, Goldberg RE, Kane JB. Racial and ethnic patterning of low birth weight, normal birth weight, and macrosomia. *Prev Med*. 2019;118:196-204.
3. Taricco E, Radaelli T, Nobile de Santis MS, Cetin I. Foetal and placental weights in relation to maternal characteristics in gestational diabetes. *Placenta*. 2003;24:343-347.
4. Barker DJ, Larsen G, Osmond C, Thornburg KL, Kajantie E, Eriksson JG. The placental origins of sudden cardiac death. *Int J Epidemiol*. 2012;41:1394-1399.
5. WHO. WHA Global Nutrition Targets 2025: Low Birth Weight Policy Brief. 2014. http://www.who.int/nutrition/topics/globaltargets_lowbirthweight_policybrief.pdf
6. Gagnon AJ, Zimbeck M, Zeitlin J, et al. Migration to western industrialised countries and perinatal health: a systematic review. *Soc Sci Med*. 2009;69:934-946.
7. Bakken KS, Skjeldal OH, Stray-Pedersen B. Immigrants from conflict-zone countries: an observational comparison study of obstetric outcomes in a low-risk maternity ward in Norway. *BMC Pregnancy Childbirth*. 2015;15:163.
8. Malin M, Gissler M. Maternal care and birth outcomes among ethnic minority women in Finland. *BMC Public Health*. 2009;9:84.
9. Stoltenberg C, Magnus P. Children with low birth weight and low gestational age in Oslo, Norway: immigration is not the cause of increasing proportions. *J Epidemiol Community Health*. 1995;49:588-593.
10. Essen B, Hanson BS, Ostergren PO, Lindquist PG, Gudmundsson S. Increased perinatal mortality among sub-Saharan immigrants in a city-population in Sweden. *Acta Obstet Gynecol Scand*. 2000;79:737-743.
11. Pedersen GS, Mortensen LH, Gerster M, Rich-Edwards J, Andersen AM. Preterm birth and birthweight-for-gestational age among immigrant women in Denmark 1978–2007: a nationwide registry study. *Paediatr Perinat Epidemiol*. 2012;26:534-542.
12. Urquia ML, Sorbye IK, Wanigaratne S. Birth-weight charts and immigrant populations: a critical review. *Best Pract Res Clin Obstet Gynaecol*. 2016;32:69-76.
13. Ray JG, Sgro M, Mamdani MM, et al. Birth weight curves tailored to maternal world region. *J Obstet Gynaecol Can*. 2012;34:159-171.
14. Vangen S, Stoltenberg C, Skjaerven R, Magnus P, Harris JR, Stray-Pedersen B. The heavier the better? Birthweight and perinatal mortality in different ethnic groups. *Int J Epidemiol*. 2002;31:654-660.
15. Hanley GE, Janssen PA. Ethnicity-specific birthweight distributions improve identification of term newborns at risk for short-term morbidity. *Am J Obstet Gynecol*. 2013;209:428.e1-428.e6.
16. Villar J, Papageorghiou AT, Pang R, et al. The likeness of fetal growth and newborn size across non-isolated populations in the INTERGROWTH-21st Project: the Fetal Growth Longitudinal Study and Newborn Cross-Sectional Study. *Lancet Diabetes Endocrinol*. 2014;2:781-792.
17. David R, Collins J Jr. Disparities in infant mortality: what's genetics got to do with it? *Am J Public Health*. 2007;97:1191-1197.
18. Juarez SP, Hjern A. The weight of inequalities: duration of residence and offspring's birthweight among migrant mothers in Sweden. *Soc Sci Med*. 2017;175:81-90.
19. Teitler JO, Hutto N, Reichman NE. Birthweight of children of immigrants by maternal duration of residence in the United States. *Soc Sci Med*. 2012;75:459-468.
20. Wanigaratne S, Shakya Y, Gagnon AJ, et al. Refugee maternal and perinatal health in Ontario, Canada: a retrospective population-based study. *BMJ Open*. 2018;8(4):e018979.
21. Vorherr H. Factors influencing fetal growth. *Am J Obstet Gynecol*. 1982;142:577-588.
22. Williams LA, Evans SF, Newnham JP. Prospective cohort study of factors influencing the relative weights of the placenta and the newborn infant. *BMJ*. 1997;314:1864-1868.
23. Shehata F, Levin I, Shrim A, et al. Placenta/birthweight ratio and perinatal outcome: a retrospective cohort analysis. *BJOG*. 2011;118:741-747.
24. Salafia CM, Charles AK, Maas EM. Placenta and fetal growth restriction. *Clin Obstet Gynecol*. 2006;49:236-256.
25. Irgens LM. The Medical Birth Registry of Norway. Epidemiological research and surveillance throughout 30 years. *Acta Obstet Gynecol Scand*. 2000;79:435-439.
26. Statistics Norway. https://www.ssb.no/en/omssb/om-oss
27. Staff A, Harsem NK, Roald B, Rollag H. Norwegian Society of Obstetrics and Gynecology. Guidelines in Obstetrics 2014;209-214 (in Norwegian). https://legeforeningen.no/Fagmed/Norsk-gynekologisk-forening/Veiledere/Veileder-i-fodselshjelp-2014/Placenta
28. Jenum AK, Sommer C, Sletner L, Morkrid K, Baerug A, Mosdol A. Adiposity and hyperglycaemia in pregnancy and related health outcomes in European ethnic minorities of Asian and African origin: a review. *Food Nutr Res*. 2013;57(1):18889.
29. Baptiste-Roberts K, Salafia CM, Nicholson WK, Duggan A, Wang NY, Brancati FL. Maternal risk factors for abnormal placental growth: the national collaborative perinatal project. *BMC Pregnancy Childbirth*. 2008;8:44.
30. Dombrowski MP, Berry SM, Johnson MP, Saleh AA, Sokol RJ. Birthweight-length ratios, ponderal indexes, placental weights, and birthweight-placenta ratios in a large population. *Arch Pediatr Adolesc Med*. 1994;148:508-512.
31. Sorbye IK, Daltveit AK, Sundby J, Vangen S. Preterm subtypes by immigrants' length of residence in Norway: a population-based study. *BMC Pregnancy Childbirth*. 2014;14:239.
32. Kelly Y, Panico L, Bartley M, Marmot M, Nazroo J, Sacker A. Why does birthweight vary among ethnic groups in the UK? Findings from the Millennium Cohort Study. *J Public Health*. 2009;31:131-137.
33. Harding S, Rosato MG, Cruickshank JK. Lack of change in birthweights of infants by generational status among Indian, Pakistani, Bangladeshi, Black Caribbean, and Black African mothers in a British cohort study. *Int J Epidemiol*. 2004;33:1279-1285.
34. Li X, Sundquist K, Sundquist J. Risks of small-for-gestational-age births in immigrants: a nationwide epidemiological study in Sweden. *Scand J Public Health*. 2012;40:634-640.
35. Chen Y, Huang L, Zhang H, Klebanoff M, Yang Z, Zhang J. Racial disparity in placental pathology in the collaborative perinatal project. *Int J Clin Exp Pathol*. 2015;8:15042-21554.
36. Sivarao S, Vidyadaran MK, Jammal AB, Zainab S, Goh YM, Ramesh KN. Weight, volume and surface area of placenta of normal pregnant women and their relation to maternal and neonatal parameters in Malay, Chinese and Indian Ethnic Groups. *Placenta*. 2002;23:691-696.
37. de Jongh BE, Mackley A, Jain N, Locke R, Paul DA. Effects of advanced maternal age and race/ethnicity on placental weight and placental weight/birthweight ratio in very low birthweight infants. *Matern Child Health J*. 2015;19:1553-1558.
38. Ray JG, Vermeulen MJ, Schull MJ, Singh G, Shah R, Redelmeier DA. Results of the Recent Immigrant Pregnancy and Perinatal Long-term Evaluation Study (RIPPLES). *CMAJ*. 2007;176:1419-1426.
39. Urquia ML, Frank JW, Moineddin R, Glazier RH. Immigrants' duration of residence and adverse birth outcomes: a population-based study. *BJOG*. 2010;117:591-601.
40. Ceballos M, Palloni A. Maternal and infant health of Mexican immigrants in the USA: the effects of acculturation, duration, and selective return migration. *Ethn Health*. 2010;15:377-396.
41. Patel RR, Steer P, Doyle P, Little MP, Elliott P. Does gestation vary by ethnic group? A London-based study of over 122,000 pregnancies with spontaneous onset of labour. *Int J Epidemiol*. 2004;33:107-113.
42. Heude B, Le Guern M, Forhan A, et al. Are selection criteria for healthy pregnancies responsible for the gap between fetal growth

in the French national Elfe birth cohort and the Intergrowth-21st fetal growth standards? *Paediatr Perinat Epidemiol*. 2019;33:47-56.
43. Shiono PH, Rauh VA, Park M, Lederman SA, Zuskar D. Ethnic differences in birthweight: the role of lifestyle and other factors. *Am J Public Health*. 1997;87:787-793.
44. Goedhart G, van Eijsden M, van der Wal MF, Bonsel GJ. Ethnic differences in term birthweight: the role of constitutional and environmental factors. *Paediatr Perinat Epidemiol*. 2008;22:360-368.
45. Acevedo-Garcia D, Soobader MJ, Berkman LF. The differential effect of foreign-born status on low birth weight by race/ethnicity and education. *Pediatrics*. 2005;115:e20-e30.
46. Mulinari S, Juarez SP, Wagner P, Merlo J. Does maternal country of birth matter for understanding offspring's birthweight? A multilevel analysis of individual heterogeneity in Sweden. *PLoS ONE*. 2015;10:e0129362.
47. Buffa G, Dahan S, Sinclair I, et al. Prenatal stress and child development: a scoping review of research in low- and middle-income countries. *PLoS ONE*. 2018;13:e0207235.
48. Kramer MS. Foetal growth standards: description, prescription, or prediction? *Paediatr Perinat Epidemiol*. 2019;33:57-58.

How to cite this article: Eskild A, Sommerfelt S, Skau I, Grytten J. Offspring birthweight and placental weight in immigrant women from conflict-zone countries; does length of residence in the host country matter? A population study in Norway. *Acta Obstet Gynecol Scand*. 2019;00:1–8. https://doi.org/10.1111/aogs.13777