Term Low Birth Weight or Macrosomia among Immigrant Mothers in Korea

Jung Eum Lee, MD,
Hyon Jee Yoon, MD,
Yu-Ri Jang, RN,
Hyun Sun Ko, MD, PhD

Department of Obstetrics and
Gynecology, Seoul St. Mary's
Hospital, College of Medicine, The
Catholic University of Korea, Seoul,
Korea

Received: 1 June 2020
Revised: 30 June 2020
Accepted: 13 July 2020

Correspondence to
Hyun Sun Ko, MD, PhD
Department of Obstetrics and
Gynecology, Seoul St. Mary's
Hospital, College of Medicine, The
Catholic University of Korea, 222
Banpo-daero, Seocho-gu, Seoul
06591, Korea

Tel: +82-2-2258-3021
Fax: +82-2-595-1549
E-mail: mongkoko@catholic.ac.kr

Copyright© 2020 by The Korean Society
of Perinatology

This is an Open Access article distributed
under the terms of the Creative Com-
mons Attribution Non-Commercial
License ([http://creativecommons.org/
license/by-nc/4.0/](http://creativecommons.org/licenses/by-nc/4.0/)), which permits
unrestricted non-commercial use,
distribution, and reproduction in any
medium, provided that the original work
is properly cited.

Objective: The aim of this study was to analyze the relationship between maternal origin and risks of term low birth weight (TLBW) or macrosomia in Korea.

Methods: Using Korean birth statistics from 2009 to 2015, we examined the association between maternal nationality and risks of TLBW (less than 2.5 kg) or term macrosomia (over 4.0 kg). Birth statistics included singleton live births in women, from 37 to 41 weeks' gestation, during the period 2009-2015. Immigrant mothers were defined as women born in any country other than Korea, and were grouped by economic level of maternal country of origin. Odds ratios (ORs) and 95% confidence intervals (CIs) were estimated with multivariate logistic regression analysis.

Results: There were significant differences in neonatal birth weights between Korean mothers and immigrant mothers (3.28 ± 0.38 kg vs. 3.24 ± 0.39 kg, $P < 0.001$). In multivariate logistic regression analysis, the risk of TLBW was significantly higher (OR: 1.268, 95% CI: 1.181-1.361, $P < 0.001$) and the risk of macrosomia was significantly lower (OR: 0.607, 95% CI: 0.518-0.71, $P < 0.001$), in mothers from low and lower middle income countries, compared to Korean mothers. The risk of macrosomia was significantly higher (OR: 1.387, 95% CI: 1.228-1.566, $P < 0.001$) and the risk of TLBW was significantly lower (OR: 0.879, 95% CI: 0.81-0.954), in mothers from high and upper middle income countries, compared to Korean mothers.

Conclusion: After adjustment for relevant characteristics, the risk of TLBW was higher in immigrant mothers from low and lower middle income countries, but the risk of macrosomia was higher in immigrant mothers from high and upper middle income country. Prenatal care and education needs to consider the origin of immigrant mothers.

Key Words: Immigrants, Low birth weight, Macrosomia, Mothers, Prenatal care

Introduction

Low birth weight (LBW) reflects intrauterine growth. It is an important determinant for perinatal morbidity and death, growth and cognitive development in childhood. It also increases the risk of morbidity later in life such as insulin resistance, obesity, dyslipidemia, and hypertension.¹⁻⁵

LBW is defined as a birth weight of an infant of 2,499 g or less, regardless of gestational age.⁶ LBW can be caused by preterm birth or small for gestational age at term with or without intrauterine growth restriction. LBW at term (TLBW) can be constitutional (i.e., without an underlying pathological cause) or secondary to intrauterine growth restriction. Risk factors for TLBW include poor maternal nutrition,⁷ maternal infections and other morbidities,⁸ young maternal age,⁹ and so on. And it has been reported that TLBW is highly prevalent in low and middle-income countries, particularly in South Asia.¹⁰ The numbers of international marriages in Korea has increased significantly during the first decade of the 21st century, from 111 834 in 2007 to 281 295 in 2015.¹¹ The majority (83.9%) of international marriages in South Korea involve Korean men and women from East Asian countries, including China

(40.2%), Vietnam (26.3%), Japan (8.3%) and the Philippines (7.3%). Because of this rapid growth in international marriage in Korea, 3.4% of all live births in the country involve immigrant women.¹¹

Although term macrosomia is considered for newborns who weigh 4,500 g or more at birth by American College of Obstetricians and Gynecologists,¹² definition of macrosomia in Asian countries remains unclear. Newborn weight exceeding 4,000 g is also a frequently used threshold to define macrosomia.¹³ Newborns with macrosomia are prone to neonatal complications, as well as cardiovascular or metabolic disease in childhood.^{14,15} Immigrant women and children are a vulnerable group that faces health challenges different from native ones.¹⁶ Whether immigrant status is a risk factor for adverse fetal and infant health is currently unclear, yet.¹⁷ Some studies have reported that immigrant mothers are associated with higher rates of prematurity, lower birth weights and higher rates of perinatal mortality compared to native mothers.¹⁸ However, other studies have reported that fetal/infant mortality and the risk of LBW are comparable between immigrant women and native-born women after adjusting for influencing factors.^{19,20} The aim of this study was to determine risks of TLBW and term macrosomia associated with immigrant mothers compared to native-born mothers living in South Korea according to economic level of origin countries of immigrant mothers.

Methods

De-identified Korean Vital Statistics Birth Certificate data were obtained from Statistics Korea, a nationwide database. This study was approved by Institutional Review Boards (IRB) (approval number: KC17ZESI0265). The IRB waived the need for consent because records were accessed anonymously. Raw data on all live fetuses delivered from 2009 to 2015 (444,849 in 2009, 470,171 in 2010, 471,265 in 2011, 484,550 in 2012, 436,455 in 2013, 435,435 in 2014 and 438,420 in 2015) were analyzed.¹¹ Our results were based on 2,369,329 singleton live births after applying exclusion criteria. Data regarding newborns at gestational age (GA) <37 weeks or >42 weeks (n=207,845), twin (n=98,229), triplet (n=1,865), unknown number of fetuses (n=5,142), unknown maternal nationality (n=451,632), unknown

paternal nationality (n=467,562), unknown maternal age or paternal age (n=36,570), extreme maternal age (<15 or >45 years old, n=1,572), extreme paternal age (<19 or >50 years old, n=14,440), unknown paternal education status (n=40,754), unknown maternal education status (n=16,300), unknown paternal occupation status (n=110,820) and unknown maternal occupation status (n=28,715) were excluded. Some of these exclusions (n=726,818) were duplicated. Pregnancy date was determined using the best obstetric estimate rather than the last menstrual period. However, if the estimated age based on the last menstrual period was significantly different from that estimated by ultrasound, GA determined by ultrasound was used. GA correction following birth was not allowed. GA was expressed in intervals of completed weeks. For example, a GA of 40 weeks refers to 40 weeks plus 0–6 days. Body weight was measured to the nearest 10 g.

This study used anonymous registry data. The mother's origin was defined based on her nationality at birth. Immigrants were defined as women born in a country other than Korea. An immigrant's country of origin was classified according to income group defined with the 2015 World Bank Atlas Method.²¹ Based on gross national income per capita, a country's economy was categorized as low income (US \$1025 or less), lower middle income (US\$2016–\$4035), upper middle income (US \$4035–\$12475), or high income (US \$12475 or more). This method considers the average income of a country's citizens that reflects social, economic and environmental well-being of the country and its people. Then we combined 'low income' and 'lower middle income' to 'lower middle income countries'. And we combined 'upper middle income' and 'high income' to 'high and upper middle income countries'.

1. Outcome measures

TLBW was defined as birth weight of an infant of 2,499 g or less while term macrosomia was defined as birth weight of an infant of 4,000 g or more among live births between 37 and 41 gestational weeks.

2. Statistical analysis

Statistical calculations were performed with SPSS version 24.0 (IBM Corp., Armonk, NY, USA), including means, proportions and odds ratio (OR) with 95% confidence intervals (CIs). Chi-

square tests were performed to compare proportions of independent variables. One-way analysis of variance or *t*-test was performed to compare means. OR and 95% CIs were used to evaluate the independent association between economic level of maternal origin of country and TLBW or macrosomia, using multivariate logistic regression analysis. Statistical significance was considered when *P* value was less than 0.05 or if 95% CIs did not include 1.

Results

1. Baseline characteristics

The total number of singleton live births between 37 and 41 weeks of gestation in Korea from 2009 to 2015 was 2,923,587. Our analysis included 2,389,031 singleton live births after excluding those that met the exclusion criteria. A total of 2,264,003 (94.8%) newborns had normal birth weights while 85,431 (3.6%) had macrosomia and 39,597 (1.7%) had TLBW. Baseline demographic characteristics are summarized in Table 1.

There were significant differences in gestational age at birth, birth weight, paternal age, maternal age, parity, neonatal sex, maternal and paternal occupation, level of maternal and paternal education and percentage of non-Korean maternal or paternal

nationalities. Percentages of maternal occupation and maternal/paternal education longer than 12 years were the highest in the normal birth weight group. There was no significant difference in paternal occupation between normal birth weight group and macrosomia group, although the percentage of paternal occupation in normal birth weight group was significantly higher than that in TLBW group (96.6% vs. 95.9%, $P<0.001$). The percentage of non-Korean maternal nationality was highest in TLBW group and the percentage of non-Korean paternal nationality was highest in the macrosomia group. Gestational age at birth, percentage of male neonates, maternal age and paternal age were the highest in macrosomia group.

2. Comparison of live births from Korean mothers vs. immigrant mothers grouped by country of origin according to the World Bank Atlas definition of low and lower middle income and high and upper middle income countries

Neonatal birth weights from immigrant mothers originated from low and lower middle income countries were significantly less (3.19 ± 0.38 kg) while those from immigrant mothers originated from high and upper middle income countries were significantly higher (3.31 ± 0.4 kg) than neonatal birth weights from Korean mothers (3.28 ± 0.38 kg) (Table 2). In mothers from low and lower middle income countries, the incidence of TLBW was

Table 1. Baseline Characteristics

Characteristic	Normal BW (n=2,264,003)	TLBW (n=39,597)	Macrosomia (n=85,431)	<i>P</i> -value*
Gestational age (weeks)	38.94 $\pm$ 1.06	38.06 $\pm$ 0.98 [†]	39.36 $\pm$ 1.02 [†]	<0.001
Birth weight (kg)	3.26 $\pm$ 0.33	2.32 $\pm$ 0.16 [†]	4.17 $\pm$ 0.19 [†]	<0.001
Paternal age (years)	33.9 $\pm$ 7.25	34.16 $\pm$ 10.8 [†]	34.28 $\pm$ 25.449 [†]	<0.001
Maternal age (years)	31.21 $\pm$ 4.02	31.3 $\pm$ 4.39*	31.67 $\pm$ 3.97 [†]	<0.001
Nulliparity	1,174,983 (51.9)	24,625 (62.2)*	41,305 (48.3) [†]	<0.001
Male neonate	1,140,430 (50.4)	15,425 (39.0)*	55,247 (64.7) [†]	<0.001
Maternal occupation	796,607 (35.2)	13,079 (33.0)*	29,238 (34.2) [†]	<0.001
Paternal occupation	2,185,202 (96.5)	37,942 (95.8)*	82,454 (96.5) [†]	<0.001
Maternal education more than 12 years	1,645,857 (72.7)	26,651 (67.1)*	59,555 (69.7) [†]	<0.001
Paternal education more than 12 years	1,653,360 (73.0)	26,817 (67.7)*	59,902 (70.1) [†]	<0.001
Non-Korean maternal nationality	88,888 (3.9)	1,977 (5.0)*	3,195 (3.7) [†]	<0.001
Non-Korean paternal nationality	18,344 (0.8)	277 (0.7)*	1,091 (1.3) [†]	<0.001

Values are presented as mean $\pm$ standard deviation or number (%).

Abbreviations: BW, birth weight; TLBW, term low birth weight.

*All *P*-values were calculated by one-way analysis of variance test or chi square test. The other statistical comparisons by independent *t*-test were performed with appropriate for gestational age group.

[†] $P<0.05$.

significantly higher (2.5% vs 1.6%, $P<0.001$) while the incidence of macrosomia was significantly lower (2.2% vs 3.6%, $P<0.001$) than that in Korean mothers. There was no significant difference in TLBW between immigrant mothers from high and upper middle income countries and Korean mothers. However, the incidence of macrosomia was significantly higher in mothers from high and upper middle income countries than that in Korean mothers (4.9% vs. 3.6%, $P<0.001$). Maternal and paternal origins of country were described in Table 3. 59.12% of immigrant women came from low and lower-middle income countries and 90.63% of immigrant fathers came from high and upper-middle

income countries.

3. Multivariate logistic regression analysis

In multivariate logistic regression analysis, adjusted by neonatal sex, paternal age, maternal age, gestational week at delivery, paternal occupation, maternal occupation, paternal nationality, maternal ethnicity, paternal ethnicity, and parity, the risk of TLBW was significantly higher (OR: 1.074, 95% CI: 1.016–1.136, $P=0.012$) while the risk of macrosomia was not significant in immigrant mothers compared to that in Korean mothers (Table 4, 5). The risk of TLBW was significantly higher in mothers from low

Table 2. Comparison of Live Births from Korean Mothers and Immigrant Mothers Grouped by Country of Origin

	Korean mothers (n=2,294,971)	Immigrant mothers (n=94,533)	Low and lower middle income country group (n=52,577)	High and upper middle income country group (n=41,483)
Gestational age at birth (weeks)	38.95±1.07	38.94±1.05	38.9±1.03*	39.0±1.07*
Birth weight (kg)	3.28±0.38	3.24±0.39*	3.19±0.38*	3.31±0.4*
Paternal age (years)	33.69±7.11	39.41±8.6*	41.41±9.8*	36.65±5.51*
Maternal age (years)	31.38±3.89	27.4±5.29*	24.99±4.34*	30.49±4.73*
Nulliparity	1,185,046 (51.6)	55,867 (59.4)*	31,571 (60.1)*	24,296 (58.6)*
Male neonate	1,163,150 (50.7)	47,952 (51.0)	26,734 (50.8)	21,218 (51.1)
Maternal occupation	828,063 (36.1)	10,861 (11.5)*	4,000 (7.6)*	68,631 (16.5)*
Paternal occupation	2,216,858 (96.6)	88,740 (94.3)*	49,760 (94.6)*	38,980 (94.0)*
Maternal education more than 12 years	1,702,996 (74.2)	28,967 (30.8)*	8,132 (15.5)*	20,835 (50.2)*
Paternal education more than 12 years	1,706,119 (74.3)	33,960 (36.1)*	12,866 (24.5)*	21,094 (50.8)*
Non-Korean paternal nationality	14,534 (0.6)	5178 (5.5)*	767 (1.5)*	4,411 (10.6)*
Neonatal birth weight (g)				
<2,500	37,620 (1.6)	1,977 (2.1)*	1,336 (2.5)*	641 (1.5)
>4,000	82,236 (3.6)	3,195 (3.4)*	1,156 (2.2)*	2,039 (4.9)*

Values are presented as mean±standard deviation or number (%). Statistical comparisons were performed with Korean mother group.

* $P<0.05$.

Table 3. Maternal and Paternal Origin of Countries in Immigrant Parents

	Maternal origin of country (n=2,389,031)	Paternal origin of country (n=19,267)
High and upper-middle income		
Asia	34,805 (37.00)	9,177 (47.63)
Europe	706 (0.75)	1,616 (8.00)
America and Pacific region	2,941 (3.13)	6,650 (35.00)
Africa	9 (0.01)	0 (0.00)
Low and lower-middle income		
Asia	53,839 (57.24)	1,578 (8.19)
Europe	1,770 (1.88)	37 (0.20)
America and Pacific region	0 (0.00)	0 (0.00)
Africa	16 (0.02)	155 (1.00)

Values are presented as number (%).

Table 4. Risk of Term low Birth Weight (Multivariate Analysis)

	Odd ratio	95% CI lower	95% CI upper	P-value*
Maternal nationality				
Korean	Reference			
Immigrant mothers (all)	1.074	1.016	1.136	0.012
Low and lower middle income country	1.288	1.199	1.383	<0.001
High and upper middle income country	0.874	0.806	0.949	<0.001
Maternal education more than 12 years	0.866	0.844	0.889	<0.001
Paternal education more than 12 years	0.896	0.874	0.919	<0.001

Abbreviations: CI, confidence interval.

*Multivariate logistic regression analysis. Adjusted by neonatal sex, paternal age, maternal age, gestational week at delivery, paternal occupation, maternal occupation, paternal nationality, maternal ethnicity, paternal ethnicity and parity. Less than high school graduation was used as a reference education.

Table 5. Risk of Term Macrosomia (Multivariate Analysis)

	Odd ratio	95% CI lower	95% CI upper	P-value*
Nationality				
Korean	Reference			
Immigrant mothers (all)	1.019	0.914	1.138	0.731
Low and lower middle income country	0.607	0.518	0.710	<0.001
High and upper middle income country	1.387	1.228	1.566	<0.001
Maternal education more than 12 years	0.872	0.831	0.915	<0.001
Paternal education more than 12 years	0.885	0.866	0.905	<0.001

*Multivariate logistic regression analysis. Adjusted by neonatal sex, paternal age, maternal age, gestational week at delivery, paternal occupation, maternal occupation, paternal nationality, maternal ethnicity, paternal ethnicity, and parity. Less than high school graduation was used as a reference education.

and lower middle income countries (OR: 1.268, 95% CI: 1.181–1.361, $P<0.001$) but significantly lower in mothers from high and upper middle income countries (OR: 0.879, 95% CI: 0.81–0.954, $P<0.001$) compared to that in Korean mothers. The risk of macrosomia was significantly higher in mothers from high and upper middle income countries (OR: 1.387, 95% CI: 1.228–1.566, $P<0.001$) but significantly lower in mothers from low and lower middle income countries (OR: 0.607, 95% CI: 0.518–0.71, $P<0.001$) compared to that in Korean mothers. Both maternal and paternal education for more than 12 years significantly lowered risks of TLBW and macrosomia.

Discussion

The present study analyzed associations between economic level of maternal origin of country and risks of TLBW and macrosomia using a nationwide registry data. In this study, we found significant differences in risks of TLBW and macrosomia of immigrant mothers compared to Korean mothers. Overall, the risk

of TLBW was higher while the risk of macrosomia was lower in immigrant mothers. However, results were variable according to economic level of maternal origin of country based on the classification of country income by word bank. The risk of TLBW was significantly higher in immigrant women from low and lower middle income countries compared to that in Korean mothers, but significantly higher in immigrant women from high and upper middle income countries. In addition, the risk of term macrosomia was significantly lower in immigrant mothers from low and lower middle income countries but significantly higher in immigrant mothers from middle or high-income countries compared to that in Korean mothers after adjusting for neonatal sex, paternal age, maternal age, gestational week at delivery, paternal occupation, maternal occupation, paternal nationality, maternal ethnicity, paternal ethnicity, and parity. Economic level of South Korea is included in the high income countries, but also included in Asia. Therefore, the results from multivariate analysis adjusted for variables can be meaningful.

A previous study has reported that Korean father–foreign mother pregnancies have higher risk of TLBW compared to Korean

father–Korean mother pregnancies.²² A recent study with similar population has shown that Chinese mothers have higher risk of term macrosomia but lower risk of TLBW compared to Korean mothers while mothers from Vietnam or Philippines have inverse risks.²³ Nowadays, the origin of mothers is getting more and more diverse. Therefore, it is important to evaluate available pregnancy outcomes in immigrant mothers according to their socioeconomic background including the country of origin.

There have been similar studies worldwide focusing on neonatal outcome of immigrant mothers. Women from Asia, the Pacific islands and sub-Saharan Africa have higher risks of low birth weight and preterm birth than women from Finland in a Swedish study performed between 1978 and 1990.²⁴ Newborns of Spanish mothers have higher likelihood of low birth weight but the lowest risk for macrosomia compared to immigrants from Morocco, Romania, Ecuador, Bolivia, or Colombia.²⁵ This Vik et al.²⁶ (2019) also reported that migrant women from certain countries, mostly low and lower middle income countries, are at increased risk of stillbirth.

The current study has several limitations. First, we were unable to exclude maternal complications that could affect neonatal birth weight. In addition, database did not include duration of stay in Korea for immigrant women or individual family income level. Lastly, this study did not include maternal body mass index, individual economic level, due to the limitation of data. However, in the present study, the risk of TLBW was increased in immigrant women from low and lower middle income countries and the risk of term macrosomia was increased in immigrant women from high and upper middle income countries after adjusting for neonatal sex, paternal age, maternal age, gestational week at delivery, paternal occupation, maternal occupation, paternal nationality, maternal ethnicity, paternal ethnicity, and parity. Therefore, we can consider that maternal origin of country is an independent risk factor for TLBW and term macrosomia. For example, adequate nutritional support and education for women from low and lower middle income countries can be more emphasized, but balanced diet with regular exercise plan can be more emphasized in women from high and upper middle income countries. In this study, higher level of maternal and paternal education independently decreased the risk of TLBW and term macrosomia in this study. This suggests that more education of expecting parents might lead to better

pregnancy outcomes.

Cultural globalization is accelerating due to technical development, resulting in more international marriages from diverse countries, in accordance with increasing ‘marriage-based immigration’ in rural areas, in Korea. However, conservative culture or unified policy does not help diverse couples. Results of this study suggest that risks of abnormal neonatal birth weights could be different for immigrant mothers depending on economic level of maternal country of origin. Antenatal care and education including diet, exercise, weight gain and possible adverse pregnancy outcomes according to maternal background and socioeconomic characteristics might be able to improve pregnancy outcomes that could affect future health of neonates in childhood and adulthood, especially for immigrant women.

Ethical approval

This study was approved by Seoul St. Mary’s hospital Institutional Review Boards (IRB) of Catholic University of Korea (approval number: KC17ZESI0265).

Acknowledgement

The authors wish to acknowledge the financial support of the Catholic Medical Center Research Foundation made in the program year of 2019.

Conflict of interest

No potential conflict of interest relevant to this article was reported.

References

- 1) Lawn JE, Cousens S, Zupan J; Lancet Neonatal Survival Steering Team. 4 million neonatal deaths: when? where? why? *Lancet* 2005;365:891-900.
- 2) Katz J, Lee AC, Kozuki N, Lawn JE, Cousens S, Blencowe H, et al. Mortality risk in preterm and small-for-gestational-age infants in low-income and middle-income countries: a pooled country analysis. *Lancet* 2013;382:

- 417-25.
- 3) Murray E, Fernandes M, Fazel M, Kennedy SH, Villar J, Stein A. Differential effect of intrauterine growth restriction on childhood neurodevelopment: a systematic review. *BJOG* 2015;122:1062-72.
 - 4) Hanson MA, Gluckman PD. Early developmental conditioning of later health and disease: physiology or pathophysiology? *Physiol Rev* 2014;94:1027-76.
 - 5) Taal HR, Vd Heijden AJ, Steegers EA, Hofman A, Jaddoe VW. Small and large size for gestational age at birth, infant growth, and childhood overweight. *Obesity (Silver Spring)* 2013;21:1261-8.
 - 6) ICD10Data. P07-Disorders related to short gestation and low birth weight in ICD-10. [online] 2019 Oct 20 [cited 2018 Nov 29]. Available from: <https://www.icd10data.com/ICD10CM/Codes/P00-P96/P05-P08/P07->
 - 7) Imdad A, Bhutta ZA. Maternal nutrition and birth outcomes: effect of balanced protein-energy supplementation. *Paediatr Perinat Epidemiol* 2012;26 Suppl 1:178-90.
 - 8) Robinson JS, Moore VM, Owens JA, McMillen IC. Origins of fetal growth restriction. *Eur J Obstet Gynecol Reprod Biol* 2000;92:13-9.
 - 9) Kozuki N, Lee AC, Silveira MF, Sania A, Vogel JP, Adair L, et al. The associations of parity and maternal age with small-for-gestational-age, preterm, and neonatal and infant mortality: a meta-analysis. *BMC Public Health* 2013;13 Suppl 3:S2.
 - 10) Lee AC, Kozuki N, Cousens S, Stevens GA, Blencowe H, Silveira MF, et al. Estimates of burden and consequences of infants born small for gestational age in low and middle income countries with INTERGROWTH-21st standard: analysis of CHERG datasets. *BMJ* 2017;358:j3677.
 - 11) Statistics Korea. International Marriage Immigrants (female) (2007-2015). [online] 2016 Nov 29 [cited 2018 Nov 29]. Available from: http://kosis.kr/statHtml/statHtml.do?orgId=110&tblId=TX_11025_A010&vw_cd=MT_OTITLE&list_id=110_11025_005&scrId=&seqNo=&lang_mode=ko&obj_var_id=&itm_id=&conn_path=E1#.
 - 12) Practice Bulletin No. 173 summary: fetal macrosomia. *Obstet Gynecol* 2016;128:1191-2.
 - 13) Cunningham FG. *Williams Obstetrics*. 24th ed. New York: McGraw-Hill Education/Medical; 2014.
 - 14) Weissmann-Brenner A, Simchen MJ, Zilberberg E, Kalter A, Weisz B, Achiron R, et al. Maternal and neonatal outcomes of large for gestational age pregnancies. *Acta Obstet Gynecol Scand* 2012;91:844-9.
 - 15) Kuciene R, Dulskiene V, Medzioniene J. Associations between high birth weight, being large for gestational age, and high blood pressure among adolescents: a cross-sectional study. *Eur J Nutr* 2018;57:373-81.
 - 16) Adanu RM, Johnson TR. Migration and women's health. *Int J Gynaecol Obstet* 2009;106:179-81.
 - 17) Gissler M, Alexander S, MacFarlane A, Small R, Stray-Pedersen B, Zeitlin J, et al. Stillbirths and infant deaths among migrants in industrialized countries. *Acta Obstet Gynecol Scand* 2009;88:134-48.
 - 18) Bollini P, Pampallona S, Wanner P, Kupelnick B. Pregnancy outcome of migrant women and integration policy: a systematic review of the international literature. *Soc Sci Med* 2009;68:452-61.
 - 19) Racape J, Schoenborn C, Sow M, Alexander S, De Spiegelaere M. Are all immigrant mothers really at risk of low birth weight and perinatal mortality? The crucial role of socio-economic status. *BMC Pregnancy Childbirth* 2016;16:75.
 - 20) Gillet E, Saerens B, Martens G, Cammu H. Fetal and infant health outcomes among immigrant mothers in Flanders, Belgium. *Int J Gynaecol Obstet* 2014;124:128-33.
 - 21) The World Bank. The world bank country and lending groups. [online] [cited 2019 Mar 15]. Available from: <http://data.worldbank.org/about/country-classifications>.
 - 22) Yang SY, Jung US, Hong HR, Hwang SY, Oh MJ, Kim HJ, et al. Analysis of pregnancy outcomes among interracial couples in Korea. *J Korean Med Sci* 2017;32:1657-61.
 - 23) Song IG, Kim MS, Shin SH, Kim EK, Kim HS, Choi S, et al. Birth outcomes of immigrant women married to native men in the Republic of Korea: a population register-based study. *BMJ Open* 2017;7:e017720.
 - 24) Rasmussen F, Oldenburg CE, Ericson A, Gunnarskog J. Preterm birth and low birthweight among children of Swedish and immigrant women between 1978 and 1990. *Paediatr Perinat Epidemiol* 1995;9:441-54.
 - 25) Restrepo-Mesa SL, Estrada-Restrepo A, González-Zapata LI, Agudelo-Suárez AA. Newborn birth weights and related factors of native and immigrant residents of Spain. *J Immigr Minor Health* 2015;17:339-48.
 - 26) Vik ES, Aasheim V, Schytt E, Small R, Moster D, Nilsen RM. Stillbirth in relation to maternal country of birth and other migration related factors: a population-based study in Norway. *BMC Pregnancy Childbirth*. 2019 Jan 5 [Epub]. <https://doi.org/10.1186/s12884-018-2140-3>.