

# BMJ Open Birth outcomes of immigrant women married to native men in the Republic of Korea: a population register-based study

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## ABSTRACT

**Objectives** The Republic of Korea (Korea) has experienced a steady increase in the number of births from immigrant women over the last 20 years. However, little is known about the birth outcomes of immigrant women in Korea. This study compared Korean birth data from immigrant and native women who married native men, and explored the factors that affected birth outcomes among immigrant women.

**Design** Observational cross-sectional study.

**Setting** Nationwide registry-based study in Korea.

**Participants** A total of 70 258 records from immigrant women and 1700 976 records from native women were examined using the National Birth Registration Database, from 2010 to 2013.

**Independent variable** Native Korean women and immigrant women who married native men.

**Outcomes** Proportion of preterm births, post-term births, low birth weights and macrosomia.

**Results** Adjusted ORs (aOR) were calculated for the adverse birth outcomes, and subgroup analyses were performed according to parity and mothers from three Asian countries (China, Vietnam, the Philippines). Multivariate logistic regression analyses were also conducted to evaluate the association of these factors with birth outcomes among immigrant women. Immigrant women had higher OR of post-term births (aOR 1.62; 95% CI 1.44 to 1.83) and low birth weights (aOR 1.17; CI 1.12 to 1.22). Mothers from the Philippines had higher OR of preterm births (aOR 1.26; CI 1.12 to 1.52) and Chinese mothers had higher OR of macrosomia (aOR 1.55; CI 1.44 to 1.66). The OR of post-term births and low birth weights was significantly higher in the first pregnancies of immigrant women.

**Conclusions** This study has demonstrated higher proportions of adverse birth outcomes among immigrant women who married Korean men, compared with native women in Korea. Policies reducing the gap in birth outcomes between native and immigrant women are needed.

## INTRODUCTION

The Republic of Korea (Korea) has historically been considered a homogeneous country, although increasing numbers of

## Strengths and limitations of this study

- This is the first large population-based observational cross-sectional study about birth outcomes from immigrant women in Korea.
- We identified different adverse birth outcomes according to maternal nationality in subgroup analyses.
- Analysis across the whole data set identified vulnerable groups among immigrant women.
- The National Birth Registry database did not contain information about maternal health and duration of stay in Korea, which may have helped identify more precise reasons of adverse birth outcomes.

foreign workers and marriage-based immigrants during the last two decades have altered this perception. There were approximately 1.5 million immigrants living in Korea during 2015, which accounted for approximately 3% of the Korean population. As the number of immigrants have increased, the government has categorised a particular type of family structure as ‘multicultural family’. Multicultural families consist of a native Korean, a naturalised or marriage-based immigrant spouse, and their children. The number of immigrant families increased to 266 547 in 2012, and 83% of these families included marriage-based immigrants. Approximately 80% of these families originated from other Asian countries (Korean Chinese, Chinese and Vietnamese immigrants occupied 73%).<sup>12</sup> Rapid economic growth and urbanisation in Korea has led young women to frequently move to cities for improved education and greater job opportunities. However, men in rural areas typically stay at family-owned farms, which often precludes rural men from finding marriage partners. Therefore, rural men have started to look to other countries for marriage partners, which has led to the



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rate of international marriage increasing by approximately 10-fold since 1990. It is known that marriage-based immigrant women usually choose international marriage with Korean men for economic reasons, a process facilitated by marriage brokers. Therefore, they have limited information about the Korean culture and even their husbands. These marriages have accounted for approximately 10% of all marriages in 2010.<sup>3-5</sup> Compared with native Korean families, multicultural families have an older mean paternal age and a younger mean maternal age. Moreover, multicultural families have lower parental education levels and a higher proportion of blue-collar workers.<sup>2</sup> The increased number of multicultural families has led to a greater number of births to multicultural families, having accounted for 4.3% of all births in 2012.<sup>15</sup> Therefore, in order to support and care for immigrant women and multicultural families, the Korean government has enacted laws requiring immigrant women to be educated regarding perinatal care and receive medical check-ups during pregnancy, postpartum care and translation services. Furthermore, immigrant mothers are entitled to receive the same benefits as native Korean mothers, including perinatal care, emergency treatment, neonatal healthcare and vaccinations. Immigrant mothers receive \$440 from the government for every pregnancy, which is the same amount as what native mothers receive. This financial support can only be used for antenatal care, delivery and postnatal care although this amount is not sufficient enough to entirely cover the cost of pregnancy.<sup>6</sup> Because of these efforts, immigrant women receive an average of 9.1 antenatal care and their first examination for pregnancy is at 6.3 weeks' gestation.<sup>7</sup> While Korean native women's still receive earlier examinations at 5.3 weeks' gestation and more antenatal care (13.3), immigrant women nonetheless meet the recommendation of the WHO for antenatal care (12 week's gestation and eight antenatal care).<sup>8,9</sup> However, to our knowledge, few studies have examined birth outcomes among immigrant women, such as preterm births, post-term births, low birth weights and macrosomia, which are important causes of perinatal mortality and morbidity.

There are several known risk factors for preterm birth and low birth weight, including placental factors (eg, placental insufficiency and multiple gestation), maternal factors (eg, low and high maternal age, single marital status, parity, the country of origin, malnutrition, chronic diseases and pregnancy-related diseases), environmental factors (eg, medications, assisted reproductive technology) and fetal factors (eg, genetic factors and chromosomal disorders).<sup>10</sup> In addition, socioeconomic factors can affect prematurity, with Parker *et al* having reported that almost all socioeconomic indices (maternal and paternal education, maternal and paternal occupation, and family income) were related to low birth weight among both black and white women.<sup>11</sup> Preterm birth is the second most common cause of mortality among children <5 years old, and low birth weight infants have a 20-fold higher mortality rate, compared with babies with a birth weight

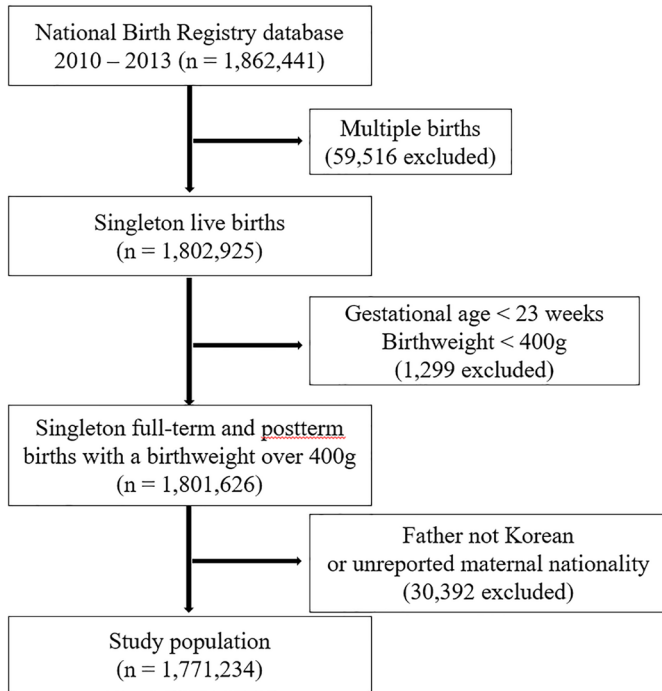
of  $\geq 2500$  g.<sup>12,13</sup> Macrosomia is known to be associated with maternal age, multiparity, maternal pre-existing diabetes mellitus or gestational diabetes mellitus, overweight or excessive weight gain during pregnancy and social deprivation.<sup>14-16</sup> The cause of post-term delivery is unknown but obesity, nulliparity, old maternal age and some ethnic groups in Sweden are at higher risks of post-term pregnancy.<sup>17,18</sup> As postmaturity increases the risks of dystocia, traumatic delivery, birth trauma, neurological damage and infant death, careful obstetric monitoring and induction of labour at 41 weeks' gestation are recommended.<sup>19</sup> Therefore, information regarding adverse birth outcomes among immigrant women would be useful for assessing the effectiveness of current policies.

This study aimed to describe current adverse birth outcomes among immigrant women married to native men (mixed-background couples), and to compare the outcomes with those of native Korean women. Such evaluations are important in recognising potential disparities in birth outcomes and to identify the demographic factors that may affect these outcomes.

## METHODS

### Study design and participants

This nationwide registry-based study examined data from 1862 441 live births during 2010–2013, which were recorded in the Korean national birth registry. The proportions of preterm births, post-term births, low birth weights and macrosomia among immigrant women and native Koreans were compared, and a cross-sectional analysis of the immigrant women was performed to identify demographic factors that affected adverse birth outcomes. In Korea, all parents must register their child's birth within 1 month at government offices, and provide the following information: date of birth, maternal residential address at the time of birth, place of birth (hospital or elsewhere), parental ages, gestational age, sex, birth weight, birth order, parity, total number of births, parental education and parental occupation. After 2010, parents were also required to indicate whether they had been naturalised and/or their original nationality. All data were obtained from Statistics Korea, which provides data to all researchers who register a study plan at the website and pay a cost relative to the quantity of extracted data. Since personal identification numbers were removed from individuals' records to protect their privacy, each birth record was treated as being from a distinct family, despite the possibility that a single couple might have had more than one child during the study period. As multiple births are an important factor affecting preterm birth and low birth weight, 59 516 observations (3.2%) involving multiple births were excluded. In addition, we excluded 1299 observations (0.07%) with a gestational age of <23 weeks and a birth weight of <400 g which are in line with guidelines for withholding of neonatal resuscitation.<sup>20</sup> To ensure that a complete dataset was obtained regarding birth outcomes from only immigrant women



**Figure 1** The study population framework illustrating the number of births assessed.

who married Korean natives, we excluded 30 392 observations (1.6%) in which the father's original nationality was not Korean or in which the mother's nationality was not reported (figure 1). Thus, this study evaluated data of 70 258 records from immigrant women and 1700 976 records from native women.

## Variables

### Dependent variables

The dependent variables in this study were the proportions of preterm births, post-term births, low birth weights and macrosomia. Each variable was defined as below: preterm birth (birth before gestational age 37 weeks), post-term birth (birth after gestational age 42 weeks), low birth weight (birth weight under 2500 g) and macrosomia (bodyweight over 4000 g).

### Independent variables

The main independent variable in this study was the mother's original nationality, which was used to categorise women as either immigrants or native Koreans. To identify the effect of the immigrant mother's nationality on birth outcomes, we further divided the country of origin into either high/upper middle income or low/lower middle income, using the World Bank's data regarding each country's per capita Gross National Income (GNI; in US\$). For the 2016 fiscal year, low-income countries had a GNI per capita of  $\leq$ \$1045, middle-income countries had a GNI per capita of \$1046–12 735 and high-income countries had a GNI per capita of  $\geq$ \$12 736. Lower middle-income and upper middle-income countries were defined using a GNI per capita threshold of \$4125<sup>21</sup>

## Statistical analysis

The multinomial logistic regression test was used to identify the risk of adverse birth outcomes among immigrants and native Koreans. We adjusted for pregnancy and birth-related factors (infant sex, marital status, parity and maternal age), and birth weight and gestational age were mutually adjusted for. Subgroup analyses were performed for the three most prevalent nationalities (China, Vietnam, the Philippines) and according to parity (primipara and multipara). We also performed multivariate logistic analyses to identify factors that affected adverse birth outcomes among mixed-background couples. All analyses were performed using the STATA software (V.12.1; Stata), p values of  $<0.05$  were considered statistically significant and relative risk ratios or OR with 95% CI were reported to describe the strengths of the associations.

## RESULTS

Table 1 shows the demographic and birth-related characteristics of the analysed birth records. In the mixed-background couple group, fathers were on average 6.2 years older and mothers were on average 4.2 years younger, compared with the native Korean group. Mixed-background couples gave birth less in metropolitan cities and 60.9% of them were primiparous compared with 51% in native couples. Approximately 70% of native Korean mothers were educated to university level or higher, while approximately 70% of immigrant mothers were educated to a high school level or lower. About 90% of immigrant mothers were unemployed, while approximately 66% of native mothers were unemployed. In the immigrant group, a majority of mothers (61.4%) were from low/lower middle-income countries, and originated from Asian countries (94.5%).

The proportion of preterm births in the immigrant mother group was higher than that in the native mother group, but the adjusted risk was not significant. The mixed-background couples group had increased prevalence of post-term births and low birth weights (adjusted OR (OR) 1.62; 95% CI 1.44 to 1.83 and aOR 1.17; 95% CI 1.12 to 1.22, respectively) but decreased prevalence of macrosomia compared with infants of Korean-born parents (aOR 0.92; 95% CI 0.85 to 0.96). Even though the odds of preterm births in the immigrant mother group was similar to that of native couple group, mothers from the Philippines had a higher odds of preterm births. In contrast to mothers from Vietnam or the Philippines, Chinese mothers had a lower OR of low birth weight but higher risk of macrosomia compared with the native couple group (table 2).

In a subgroup analysis divided births according to parity revealed that the ORs of outcomes other than post-term births in the immigrant mother group were higher or similar within the primiparous group. Especially, the prevalence of low birth weight was significantly higher in the first birth but there was no increase odds in the multiparous group. In contrast, the OR of the

**Table 1** Background characteristics of native Koreans and mixed-couples births between 2010 and 2013 in the Republic of Korea

Characteristics	Native Koreans, n (%) or mean (SD) (n=1700 976)	Mixed-background couples, n (%) or mean (SD) (n=70 258)	p Value
Infant sex			
Male	875 030 (51.4)	36 123 (51.4)	0.884
Female	825 946 (48.6)	34 135 (48.6)	
Marital status			
Married	1678 635 (98.7)	69 803 (99.4)	<0.001
Unmarried	22 341 (1.3)	455 (0.6)	
Paternal age (years)			
Mean	33.5 (4.3)	39.7 (5.8)	<0.001
<20	2755 (0.2)	7 (0.0)	<0.001
20–29	270 779 (16.0)	2626 (3.7)	
30–39	1285 993 (75.7)	31 118 (44.4)	
≥40	140 321 (8.2)	36 258 (51.8)	
Maternal age (years)			
Mean	31.2 (3.9)	27.1 (5.4)	<0.001
<20	6268 (0.4)	2588 (3.7)	<0.001
20–34	1381 027 (81.2)	60 365 (85.9)	
≥35	313 581 (18.4)	7260 (10.4)	
Area of birth			
Metropolitan city	727 158 (44.2)	23 718 (34.9)	<0.001
Others	917 798 (55.8)	44 356 (65.1)	
Place of birth			
Hospital	1674 007 (98.4)	69 171 (98.5)	0.132
Others	26 308 (1.6)	1036 (1.5)	
Paternal education			
University or higher	1234 900 (72.7)	23 157 (33.2)	<0.001
High school or lower	462 947 (27.2)	46 637 (66.8)	
Maternal education			
University or higher	1222 533 (72.0)	19 594 (28.2)	<0.001
High school or lower	475 726 (28.0)	50 011 (71.8)	
Paternal employment			
Manager or specialist	476 790 (28.0)	10 562 (15.5)	<0.001
Officer	587 945 (34.6)	12 903 (19.0)	
Service	292 060 (17.2)	12 272 (18.0)	
Blue collar	281 132 (16.5)	28 455 (41.8)	
Unemployed*	63 019 (3.7)	3882 (5.7)	
Maternal employment			
Manager or specialist	223 828 (13.2)	1879 (2.7)	<0.001
Officer	250 488 (14.7)	1439 (2.0)	
Service	78 544 (4.6)	1080 (1.5)	
Blue	29 752 (1.7)	3343 (4.8)	
Unemployed*	1118 364 (65.8)	62 517 (89.0)	
Parity			
Primiparous	867 449 (51.0)	42 747 (60.9)	<0.001

Continued

**Table 1** Continued

Characteristics	Native Koreans, n (%) or mean (SD) (n=1700 976)	Mixed-background couples, n (%) or mean (SD) (n=70258)	p Value
Multiparous	832 458 (49.0)	27 443 (39.1)	
<b>Maternal country</b>			
High and upper-middle income	NA	27 007 (38.6)	-
Asia		24 637 (35.2)	
Europe		513 (0.7)	
America and Pacific region		1857 (2.7)	
Africa		0 (0.0)	
Low and lower-middle income	NA	45 971 (61.4)	-
Asia		41 519 (59.3)	
Europe		1445 (2.1)	
America and Pacific region		0 (0.0)	
Africa		7 (0.0)	

\*Unemployed: unemployed, housewife or student.

mixed-background group's post-term birth was higher in the multiparous group compared with that of the primiparous group (table 3).

Multivariate analyses in the immigrant mother group revealed that male infants had a higher OR of preterm

births (aOR 1.36; 95% CI 1.27 to 1.46), macrosomia (aOR 1.75; 95% CI 1.59 to 1.92) and a reduced odds of low birth weights (aOR 0.87; 95% CI 0.80 to 0.94). Older maternal age ( $\geq 35$  years) was associated with higher odds of preterm births (aOR 1.49; 95% CI 1.32 to 1.67) and

**Table 2** The associations of nationality of women who married to native men and risks of adverse birth outcomes, Republic of Korea, 2010–2013

	Country	%	Adjusted OR	95% (CI)
Preterm birth	Native	4.52	1.0 (reference)	
	Immigrant	4.62	1.00	0.96 to 1.05
	China	4.01	1.01	0.93 to 1.09
	Vietnam	4.52	0.96	0.90 to 1.03
	Philippines	6.70	1.26**	1.12 to 1.52
Post-term birth	Native	0.25	1.0 (reference)	
	Immigrant	0.42	1.62**	1.44 to 1.83
	China	0.40	1.46*	1.16 to 1.83
	Vietnam	0.34	1.34*	1.10 to 1.63
	Philippines	0.44	1.79*	1.25 to 2.57
Low birth weight	Native	3.57	1.0 (reference)	
	Immigrant	4.09	1.17**	1.12 to 1.22
	China	2.82	0.77**	0.70 to 0.85
	Vietnam	4.35	1.31**	1.22 to 1.40
	Philippines	6.21	1.61**	1.43 to 1.82
Macrosomia	Native	3.06	1.0 (reference)	
	Immigrant	2.71	0.92**	0.85 to 0.96
	China	4.65	1.55**	1.44 to 1.66
	Vietnam	1.74	0.60**	0.55 to 0.66
	Philippines	1.75	0.60**	0.50 to 0.72

Adjusted with infant sex, marital status, parity, maternal age, and birth weight and gestational age were mutually adjusted  
\*p<0.05, \*\* p<0.001.

**Table 3** Subgroup analyses according to parity about risk of adverse birth outcomes in immigrant women who married to native men in the Republic of Korea 2010–2013

	Parity	Adjusted OR	95% CI
Preterm birth	Primipara	1.05	0.99 to 1.10
	Multipara	0.95	0.89 to 1.01
Post-term birth	Primipara	1.54**	1.34 to 1.76
	Multipara	1.94**	1.53 to 2.47
Low birth weight	Primipara	1.21**	1.15 to 1.28
	Multipara	1.08	1.00 to 1.17
Macrosomia	Primipara	0.90*	0.85 to 0.96
	Multipara	0.93	0.87 to 1.00

Adjusted with infant sex, marital status, maternal age, and birth weight and gestational age were mutually adjusted.

\* $p < 0.05$ , \*\* $p < 0.001$ .

low birth weights (aOR 1.71; 95% CI 1.50 to 1.93). Multiparous women had decreased prevalence of post-term births and low birth weights (aOR 0.50; 95% CI 0.38 to 0.66 and aOR 0.67; 95% CI 0.61 to 0.72, respectively), but had increased prevalence of macrosomia compared with those among primiparous women (aOR 1.12; 95% CI 1.02 to 1.23). Births occurring in places other than hospitals had increased odds of post-term births (aOR 2.91; 95% CI 1.62 to 5.21) compared with that of births that occurred in hospitals. Immigrant women from low/lowermiddle-income countries had increased odds of preterm births and low birth weights (aOR 1.28; 95% CI 1.17 to 1.40 and aOR 1.60; 95% CI 1.45 to 1.76, respectively) but decreased odds of macrosomia compared with immigrants from high/upper middle-income countries (aOR 0.40; 95% CI 0.36 to 0.45). Parental education level or occupation did not show a consistent trend of risks of adverse birth outcomes in the immigrant mother group (table 4).

## DISCUSSION

In this nationwide registry-based study, we found that the risk of post-term births and low birth weights were significantly higher in the immigrant mother group. When analysed by nationality, mothers from the Philippines had the highest risk of preterm birth, post-term birth and low birth weight. Infant sex, parity, parental age and economic status of the mother's country were also associated with birth outcomes.

The results of previous studies regarding birth outcomes among immigrants are inconsistent. For example, Mexico-born and North African-born women in the USA, France and Belgium had good birth outcomes, and some researchers assume that immigrants may have protective behaviours that promote healthy birth outcomes.<sup>22</sup> In contrast, a Swedish study performed between 1978 and 1990 revealed that women from Asia, the Pacific Islands and sub-Saharan Africa had higher risks of preterm

birth and low birth weight, compared with women from Finland.<sup>23</sup> Furthermore, a systematic review of perinatal health among immigrants in industrialised Western countries revealed that birth outcomes varied according to the country from which the mother originated. For example, immigrants from Asia and sub-Saharan Africa had a higher risk of preterm birth, which was thought to be related to gender-based violence, post-traumatic stress disorder, language challenges, nutritional issues and an increased risk of infection.<sup>24</sup> Several studies on birth outcomes among immigrant women and native men have shown worse outcomes compared with those among native women. Infants from Swedish-born father and non-Swedish-born mothers had higher risks of preterm birth but the results were different according to mother's region of birth.<sup>25</sup> Another study showed that Swedish fathers and non-Swedish mothers had higher risks of preterm birth but lower risks of post-term birth.<sup>18</sup> In a Canadian study, Canadian-origin fathers and foreign born mothers had lower birth weight and the birth weight was lower when they lived in the same ethnic high concentration area.<sup>26</sup>

In this study, the risk of post-term birth, but not preterm birth, was higher in the immigrant mother group regardless of their nationality. Maternal obesity, old maternal age and suboptimal antenatal care are known to increase the risk of post-term birth.<sup>18</sup> Mothers from other Asian countries in Korea are usually young and underweight, and have a smaller number of antenatal care. Therefore, insufficient antenatal care might explain the increased risk of post-term birth.<sup>7</sup> It is worth noting that mothers from other Asian countries in our study are married to native Korean men, implying that the father should be familiar with the knowledge required to have adequate access to antenatal care. However, despite the theoretical familiarity of the father to the healthcare system, our results suggest that immigrant mothers still nonetheless have inadequate accessibility to proper antenatal care. In table 3, immigrant mothers who gave birth outside of the hospital had higher risks of post-term birth, leading to the assumption that improper antenatal care is associated with post-term birth. Even though they received an average of 9.1 antenatal cares, immigrant mothers experienced problems with communication with the medical staff. Furthermore, cost and decreased accessibility to hospitals from rural areas are also known to act as obstacles of prenatal care for immigrant women.<sup>7 27 28</sup> In order to prevent post-term birth and related complications, the factors mentioned above should be addressed to ensure proper management in the latter part of pregnancy. Particularly, while other outcomes were similar with native mothers in the multiparous group, the OR of post-term birth was still high. Therefore, appropriate care is needed regardless of parity. Interestingly, unlike other groups, mothers from the Philippines had a higher risk of preterm births. In a previous study, Philippine-born mothers did not have more frequent prenatal care compared with mothers of other nationalities. In a study on Asian-American group, Philippine-born mothers had

**Table 4** Multivariate analyses for factors associated with adverse birth outcomes among immigrant women who married to native men in the Republic of Korea 2010–2013

	Preterm birth (aOR, 95% CI)	Post-term birth (aOR, 95% CI)	Low birth weight (aOR, 95% CI)	Macrosumia (aOR, 95% CI)
<b>Infant sex</b>				
Female	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Male	1.36 (1.27 to 1.46)**	0.86 (0.68 to 1.08)	0.87 (0.80 to 0.94)**	1.75 (1.59 to 1.92)**
<b>Marital status</b>				
Married	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Unmarried	1.11 (0.57 to 2.19)	0.95 (0.13 to 6.85)	0.97 (0.45 to 2.09)	0.83 (0.41 to 1.69)
<b>Paternal age (years)</b>				
<20	0	0	4.71 (0.54 to 41.07)	0
20–29	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
30–39	1.23 (0.98 to 1.54)	0.70 (0.43 to 1.14)	1.15 (0.91 to 1.45)	1.13 (0.88 to 1.44)
≥40	1.27 (1.01 to 1.59)*	0.61 (0.36 to 1.02)	1.13 (0.89 to 1.43)	1.35 (1.05 to 1.73)*
<b>Maternal age (years)</b>				
<20	1.08 (0.90 to 1.30)	0.76 (0.39 to 1.50)	1.13 (0.95 to 1.35)	1.02 (0.75 to 1.38)
20–34	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
≥35	1.49 (1.32 to 1.67)**	1.41 (0.97 to 2.05)	1.71 (1.50 to 1.93)**	0.99 (0.86 to 1.15)
<b>Parity</b>				
Primiparous	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Multiparous	0.96 (0.89 to 1.03)	0.50 (0.38 to 0.66)**	0.67 (0.61 to 0.72)**	1.12 (1.02 to 1.23)*
<b>Area of birth</b>				
Metropolitan	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Others	1.00 (0.93 to 1.08)	0.93 (0.73 to 1.19)	0.94 (0.87 to 1.02)	1.02 (0.92 to 1.12)
<b>Place of birth</b>				
Hospital	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Others	0.96 (0.71 to 1.28)	2.91 (1.62 to 5.21)**	1.05 (0.76 to 1.45)	1.12 (0.78 to 1.61)
<b>Paternal education</b>				
High school or below	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
University or higher	1.04 (0.95 to 1.14)	1.03 (0.78 to 1.37)	1.01 (0.92 to 1.11)	0.90 (0.80 to 1.01)
<b>Maternal education</b>				
High school or below	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
University or higher	1.02 (0.93 to 1.12)	1.24 (0.93 to 1.65)	1.04 (0.94 to 1.15)	0.93 (0.83 to 1.05)
<b>Paternal job</b>				
Manager/specialist	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Clerical workers	0.97 (0.86 to 1.10)	1.19 (0.82 to 1.73)	1.04 (0.91 to 1.19)	1.08 (0.92 to 1.26)
Service worker	0.94 (0.83 to 1.10)	0.93 (0.62 to 1.41)	0.95 (0.83 to 1.10)	1.14 (0.97 to 1.34)
Blue collar	1.00 (0.89 to 1.12)	1.00 (0.68 to 1.45)	1.09 (0.96 to 1.24)	1.04 (0.89 to 1.20)
Unemployed†	0.97 (0.81 to 1.16)	1.14 (0.65 to 1.98)	1.16 (0.97 to 1.40)	0.96 (0.75 to 1.21)
<b>Maternal job</b>				
Manager/specialist	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Clerical workers	1.03 (0.74 to 1.45)	0.86 (0.41 to 1.77)	0.74 (0.49 to 1.11)	0.88 (0.59 to 1.30)
Service workers	1.12 (0.79 to 1.61)	0.54 (0.20 to 1.48)	1.02 (0.68 to 1.53)	0.99 (0.65 to 1.52)
Blue collar	0.72 (0.53 to 0.97)*	0.64 (0.31 to 1.33)	0.88 (0.64 to 1.21)	0.92 (0.64 to 1.31)
Unemployed†	0.93 (0.74 to 1.17)	0.48 (0.29 to 0.80)*	0.95 (0.73 to 1.23)	0.93 (0.71 to 1.22)

Continued

Table 4 Continued

	Preterm birth (aOR, 95% CI)	Post-term birth (aOR, 95% CI)	Low birth weight (aOR, 95% CI)	Macrosomia (aOR, 95% CI)
Maternal country				
High and UMI†	1.0 (reference)	1.0 (reference)	1.0 (reference)	1.0 (reference)
Low and LMI§	1.28 (1.17 to 1.40)**	1.11 (0.83 to 1.48)	1.60 (1.45 to 1.76)**	0.40 (0.36 to 0.45)**

\*p<0.05, \*\* p<0.001.

†Unemployed: unemployed, housewife or student.

‡Upper middle-income countries.

§Lower middle-income countries.

aOR, adjusted OR.

a higher risk of pregnancy-induced hypertension which may cause preterm birth.<sup>28 29</sup> Further research evaluating the cause of preterm births in this group is required.

The risk of low birth weights was higher in the mixed-background couple group. Particularly, the risk of low birth weight was significantly higher compared with that in native mothers for the first birth (tables 2 and 3). When divided by nationality, Vietnamese mothers had 31% and Philippine mothers had 61% higher risks of low birth weights while Chinese mother had a 23% lower risk compared with that of native mothers. Marriage-based immigrant women which occupy the majority of mixed background couples usually choose marriage for economic reason and they come to Korea without preparation for the differences in language and culture.<sup>3</sup> Women get pregnant quite rapidly after moving to Korea (6.6 months on average), which means that they live two remarkable processes in their life at the same time: first pregnancy and resettlement process to new home country with newly wedded husband. In this study, the mean period from marriage to the first birth was 1.1 years in the immigrant group (data not shown), which indicates that immigrant women might have insufficient time to adjust to Korean society before their first pregnancy. According to previous studies, Asian immigrant pregnant women in Korea suffered from differences in diet during pregnancy and emotional stress living with their new family.<sup>28 30</sup> Furthermore, 63.4% of marriage-based immigrant women did not eat enough food during pregnancy.<sup>7</sup> These factors may affect the nutrition status of mothers and result in low birth weight of infants, especially in the first birth. In contrast, Chinese mothers had lower risk of low birth weight and a 55% higher risk of macrosomia compared with those of native mothers. About 60% of Chinese marriage-based immigrant women are Korean-Chinese, implying that Chinese immigrants may suffer less from differences in language compared with mothers from other ethnic groups.<sup>2</sup> As macrosomia is usually caused by maternal diabetes mellitus or excessive weight gain during pregnancy, Chinese mothers are more likely to suffer from diabetes or weight gain.<sup>14-16</sup> Appropriate support for perinatal care is required

depending on the nationality of the mother and their health status.

This study has several strengths. First, this is the first study to evaluate and compare birth outcomes among immigrant and native women in Korea. To date, there are no other data that can be used to evaluate the policies that have been developed to support immigrant women and achieve positive birth outcomes. Our findings have revealed that immigrant women have higher risks of post-term birth and low birth weight, and these risks were further magnified among women who were primiparous. Second, we identified different birth outcomes by maternal nationality (China, Vietnam, the Philippines), which may be used to design tailored health interventions depending on the nationality of the immigrant mother. Despite these strengths, there are several limitations that should be considered when interpreting our findings. First, data were not directly taken from hospitals but were reported by the parents. However, data are believed to be exact because they reported it with medical certificate by obstetricians and civil servants review it on site. Second, although we used data from a mandatory birth registry, it did not contain all relevant maternal and infant data. For example, additional information regarding maternal health (prepregnancy body mass index, haemoglobin levels during pregnancy, blood pressure, presence of sexual transmitted diseases and smoking status) and infant health (congenital diseases, intrauterine infections and chromosomal disorders) might lead to a more precise assessment of the effects of socioeconomic factors and physical conditions on birth outcomes.<sup>10</sup> Third, we did not have access to data regarding the immigrant mothers' duration of residency in Korea, language skills, although we speculate that primiparous immigrant women had shorter residency durations and more problems with language compared with multiparous women.<sup>27 28 30</sup> In sociological and demographical aspects, marriage-based immigration women's birth outcomes are important. Even though, we could not identify the reason of migration, as marriage-based immigrants occupy over 80% of foreign born women who married to Korean men, it is reasonable to infer birth outcomes are mostly related to marriage-based immigrants.



## CONCLUSION

This study provides evidence regarding differences in the proportions of post-term births and low birth weights among immigrant women and native women in Korea. The risk of preterm birth was higher in mothers from the Philippines, and macrosomia was prevalent in Chinese mothers' group compared with that of native parents. The risks of adverse birth outcomes were higher in the first pregnancy, which may be associated with the adaptation period after immigration. In order to give proper antenatal care, Korean governments made several services, such as translation, education and visiting services. However, less than half of marriage-based immigrant women answered that they received any of those services.<sup>31</sup> Policies that consider immigrants' nationality, health and nutrition status, and health literacy should be established and be made more accessible to immigrant mothers. Future studies should examine additional health conditions (beyond birth outcomes) among immigrants, such as infant mortality, developmental delay and growth retardation. We expect that these investigations can help reduce health disparities and support the successful settlement of immigrants in Korea.

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**Contributors** The study was designed by SMP and IGS. IGS and MSK performed the statistical analysis and drafted the manuscript. SHS, EKK interpreted the results of the analysis. HK, SC, SK and SMP made substantial contributions in revising the manuscript. The final manuscript was read and approved by all authors.

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**Patient consent** Detail has been removed from this case description/these case descriptions to ensure anonymity. The editors and reviewers have seen the detailed information available and are satisfied that the information backs up the case the authors are making.

**Ethics approval** This study was granted ethical exemption by the institutional review board at the Seoul National University, as a secondary analysis of de-identified data was performed.

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**Data sharing statement** Data are available and can be accessed by contacting IGS (pedigms@gmail.com).

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