

## ORIGINAL ARTICLE

# MATERNAL AND PERINATAL OUTCOMES OF PERUVIAN PREGNANT WOMEN IN CHILE: EXPLORING THE HEALTHY IMMIGRANT EFFECT

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## ABSTRACT

**Objectives:** To compare maternal and perinatal outcomes between Chilean and Peruvian pregnant women in Santiago, Chile, between January and July 2017. **Materials and methods:** Analytical cross-sectional study of 1,578 Chilean and 318 Peruvian women who attended a clinical hospital in Santiago. We conducted a comparative analysis of maternal and perinatal variables by nationality. Crude and adjusted logistic models were carried out with a 95% confidence interval (95% CI). **Results:** Peruvian pregnant women resided an average of 5.7 years in Chile, were older ( $28.1 \pm 6.5$  vs.  $26.6 \pm 6.5$  years), had less unemployment (52.3% vs. 60.6%), were more likely to enter prenatal care (PC) late (OR: 2.17, 95% CI: 1.69-2.78) and had higher probability of having anemia (OR: 3.45, 95% CI: 2.13-5.56) associated with late entry to PC (adjusted OR: 0.43, 95% CI: 0.33-0.56). On the other hand, Chilean pregnant women were more likely to be obese upon entry to PC (OR: 2.48, 95% CI: 1.81-3.41) and at the time of delivery (OR: 2.03, 95% CI: 1.57-2.62). In addition, Chilean women had higher rates of gestational diabetes (GD) (OR: 2.12, 95% CI: 1.24-3.61), premature delivery (OR: 2.82, 95% CI: 1.59-5.01) and low birth weight (LBW) (OR: 3.10, 95% CI: 1.51-6.33). In the adjusted model, obesity was independently associated with GD (adjusted OR: 3.8, 95% CI: 2.44-6.18) and LBW (adjusted OR: 3.34, 95% CI: 2.33-4.85). **Conclusions:** The healthy immigrant effect was observed in pregnant Peruvian immigrants, mainly regarding the perinatal outcomes. It is necessary to promote early access to prenatal care and to establish measures to prevent anemia and obesity, in order to avoid adverse maternal and perinatal outcomes in the studied population.

**Keywords:** Human Migration; Maternal Health; Obstetric Delivery; Pregnancy; Morbidity (Source: MeSH NLM).

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## INTRODUCTION

Although in recent years there has been an increase of immigrants from Central America to southern countries of the Americas such as Chile, cross-border migration continues to have a major role in this process. In this regard, Peruvians are the main permanent migratory group in Chile, being 15.8% of all immigrants in the country<sup>(1)</sup>. Unlike other migratory groups, Peruvian migration is characterized by the large number of migrant women, most of whom are of reproductive age; for every 100 men, 107 women migrate from Peru<sup>(1)</sup>. Most of these women are incorporated into jobs such as domestic service under poor working conditions and tend to suffer social vulnerability. Likewise, many of them live in environments of social and institutional discrimination<sup>(2)</sup>. In this sense, it has been demonstrated that gender and migration are social determinants that affect women's health<sup>(3)</sup>, which becomes a more complex issue along with other determinants such as education, poverty, and job opportunities, in addition to other more specific ones such as access to and acceptability of health services<sup>(3)</sup>.

In this scenario, reproductive health is even more relevant since gestation and childbirth are the main reasons for using health services among the immigrant population in Chile. Likewise, Peruvian women giving birth are the most frequent among immigrants in Chile <sup>(4)</sup>.

In Chile, maternal health benefits are guaranteed by law for all pregnant women and immigrants, regardless of their migratory status <sup>(5)</sup>. Women who migrate from Peru, like other cross-border groups, have gaps in the access to reproductive health care <sup>(2)</sup>. These access gaps are mainly due to convergent labor problems, bureaucracy, and lack of knowledge about the care system, all of which make access to care even more difficult. There are also interpersonal barriers, which are characterized by the perception of mistreatment and discrimination that affect the experience of women who migrate from Peru <sup>(2)</sup>.

These access gaps cause immigrant women to have a late entry into prenatal care, and less controls than the local population <sup>(6)</sup>, which could affect their maternal and perinatal health <sup>(7)</sup>. However, despite these gaps, there are studies that have reported better maternal-perinatal outcomes in the immigrant population in Chile <sup>(6,8)</sup>. This phenomenon is known as the “healthy immigrant effect”, which shows better health outcomes. However, this effect has been evaluated in migrants in general, without considering the particularities of each migrant group and the factors associated with it.

According to literature, the healthy immigrant effect is produced by a greater migration of young and healthy people, with better nutritional and health habits than the population of the receiving country <sup>(9)</sup>. However, this effect is observed in different ways; there is evidence that it could be influenced by sociodemographic and economic aspects such as age, occupation, and the educational level of the immigrant population <sup>(10)</sup>. In addition, morbid conditions concomitant with the pregnancy — mainly chronic and nutritional conditions such as anemia, obesity, hypertension, and diabetes — could have influence on the effect. These conditions could have a differentiated influence on the effect’s expression and are consistent with the stage of obstetric transition in the country of origin, reflecting indicators of maternal and perinatal morbidity and mortality and the causes associated with them <sup>(11)</sup>.

Additionally, it has been reported that the healthy immigrant effect can disappear after a long stay in the receiving country, because of an acculturation process. This concept is understood as a phenomenon that generates individual and population changes due to the adoption

## KEY MESSAGES

**Motivation for the study:** The existence of the healthy immigrant effect on Peruvian women in Chile is unknown, even though it is the largest cross-border group and the one with the longest stay in that country.

**Main findings:** Pregnant Peruvian immigrants living in Chile show the healthy immigrant effect, mainly regarding perinatal health, since they are less likely to give birth prematurely and to have children with low birth weight than pregnant Chilean women.

**Implications:** There is an urgent need for measures and strategies to prevent the health problems of Peruvian immigrant women in Chile, such as anemia. Also, it is necessary to stop the progression towards obesity, and to maintain the healthy immigrant effect on maternal and perinatal health.

of habits and behaviors of the receiving culture <sup>(12)</sup>. This phenomenon generates epidemiological and demographic changes in the immigrants, who could assimilate the health problems of the receiving country; thus, affecting their maternal and perinatal health <sup>(12)</sup>.

Therefore, it is important to consider that Chile, as a receiving country, presents characteristics typical of a stage IV obstetric transition, such as low fertility rates, low maternal and infant mortality rates, high rates of obesity and chronic conditions <sup>(11)</sup>. Additionally, it presents low rates of maternal malnutrition, anemia, gestational pathologies, prematurity, and low birth weight <sup>(13)</sup>.

Peru as a source of migrants and as a border country with Chile, is a country that remains in a stage III obstetric transition, with average fertility rates of two children per woman and a maternal mortality rate close to 299 maternal deaths per 100,000 live births <sup>(11)</sup>, as well as higher rates of maternal and perinatal pathologies, such as anemia, malnutrition, prematurity, low birth weight, etc. <sup>(14)</sup>

The aim is to determine and compare maternal-perinatal characteristics and results between Chilean and Peruvian pregnant women living in the Metropolitan Region of Santiago de Chile, considering the differences in the epidemiological, obstetric, and perinatal profiles between both countries, and the fact that Peruvian migrants represent the main permanent immigrant population in Chile. Most Peruvian immigrants are women of reproductive age, have

problems to access healthcare and are influenced by the healthy immigrant effect. Therefore, the purpose of this study is to determine if there is a difference in the populations under study and the potential factors associated with them. Our hypothesis is that Peruvian pregnant women have better maternal-perinatal indicators than Chilean pregnant women, and therefore express the healthy immigrant effect.

## MATERIALS AND METHODS

### Design and population

Analytical cross-sectional observational study carried out between January and July 2017. The population was made up of 1,896 Chilean and Peruvian women, coming from ten districts of the Metropolitan Region of Santiago de Chile (MR). This study considered the total number of women of these nationalities who gave birth in a public hospital of the MR, which receives the largest proportion of immigrant women in Santiago de Chile. The study period was chosen by convenience, we considered six months of data collection.

Chilean and Peruvian women who gave birth at the mentioned hospital during the study period were included. Data was obtained from the hospital's postpartum unit through two secondary sources: the document where prenatal care is recorded (woman's agenda) and the pregnant woman's medical record, by previously trained interviewers.

### Variables

Nationality was the predictor variable, and it was categorized as Chilean (pregnant women born in Chile) and Peruvian (pregnant women born in Peru). We considered 1 = Chilean and 0 = Peruvian, based on studies in which being Chilean was a risk factor for adverse outcomes compared to immigrants in general <sup>(6,8)</sup>.

The sociodemographic covariables were age (in years and categorized into <20, 20-35 and >35), educational level (years of study categorized into <9, 9-12 and >12), unemployment (absence of employment, yes/no), relationship status (with and without partner) and lack of foresight (health insurance, yes/no).

The nutritional covariables were the nutritional status (NS) at the time of admission to prenatal control (PC) and at the time of delivery. We categorized this variable into low maternal weight and obesity, as described by Atalah *et al.* <sup>(15)</sup> In addition, we measured the percentage increase in NS and obesity between admission to PC and delivery.

The maternal and obstetric covariables were parity (primiparous/multiparous), gestational age (GA) at PC entry (early <12 weeks / late 12 weeks and more), maternal morbidity categorized as chronic morbidity (high blood pressure [HBP] yes/no, diabetes mellitus [DM] yes/no and insulin resistance [IR] yes/no) and sexually transmitted diseases (STD) and HIV (yes/no).

The response variables were type of delivery (vaginal/cesarean) and obstetric conditions (pre-eclampsia [PE], gestational diabetes [GD], anemia and postpartum hemorrhage [PPH], all dichotomized as yes/no).

The perinatal response variables were preterm delivery (pediatric gestational age <37 weeks), low birth weight (LBW) (<2500 g), macrosomia (weight ≥ 4000 g), small and large for gestational age (SGA and LGA, respectively) newborn (NB) according to the pediatric diagnosis and based on the intrauterine growth curve recommended by Milad *et al.*

### Statistical analysis

The analysis was carried out by stages in STATA 16.0. A descriptive analysis was performed, including absolute frequency and percentage for categorical variables and mean and standard deviation for continuous variables.

We compared sociodemographic, nutritional, obstetric, infectious, and chronic maternal morbidity characteristics, as well as maternal-perinatal outcomes among Chilean and Peruvian women. We used association tests such as, Chi-square and Fisher's exact test to compare the qualitative variables and Student's T-test for the continuous variables. A statistically significant difference was considered with a value of  $p < 0.05$ .

A crude logistic regression model was made for each response variable whenever a statistically significant association was found between the variables. Then, a multiple logistic regression model was made with the variables that, according to the background and literature review, could influence maternal and perinatal outcomes <sup>(10,17)</sup>. For the variables about maternal outcomes, the model considered the sociodemographic covariables (age, education, unemployment), parity, late entry to PC, low maternal weight, obesity, HBP and DM (A adjusted model). For the variables about perinatal outcomes, the multivariate model considered the same sociodemographic variables, as well as parity, late entry to PC, low maternal weight, obesity; plus, maternal morbidity and gestational conditions such as pre-eclampsia, GD, and anemia (B adjusted model).

We determined the raw and adjusted odds ratios (OR) and the 95% confidence intervals, this was done considering that the proportions for each variable were in most cases less than 20%, which is when this analysis of the strength of association is recommended<sup>(18)</sup>. When Chilean nationality behaved as a protective factor (OR <1), the OR analysis was inverted, and we considered Peruvian nationality = 1 and Chilean nationality = 0, to assess the risk chance in both nationalities<sup>(18)</sup>.

### Ethical considerations

All participants signed the informed consent form authorizing the anonymous collection of their data, after being informed and consulted. The identity of the participants was protected by giving a numerical code to each survey. This study was authorized by the Research Ethics Committee of the Santiago Central and Northern Metropolitan Service, with resolution No. 036/2016.

## RESULTS

Information was collected from 1,578 Chilean and 318 Peruvian women. The Peruvian pregnant women were residing in Chile for an average of  $5.7 \pm 3.2$  years. The average age was statistically lower for Chilean pregnant women ( $26.6 \pm 6.5$ ) than for Peruvian pregnant women ( $28.1 \pm 6.5$ ) ( $p < 0.001$ ). The proportion of pregnant women under 20 years of age

(adolescents) was higher in Chilean than in Peruvian women (13.9% vs. 5.7%) ( $p < 0.001$ ) (Table 1). The proportion of pregnant women over 35 years of age was significantly lower in Chilean than in Peruvian women (13.9% vs. 19.2%) ( $p = 0.015$ ). Although there was no difference in the education level between the two groups, Chilean women had a higher proportion of women with less than 9 years of study (5.5% vs. 4.7%), and Peruvian women had a higher proportion of women between 9 and 12 years of study (72.5% vs. 74.2%).

Regarding the relationship status, Chilean pregnant women had significantly fewer partners than Peruvian women (70.5% vs. 84.7%) ( $p < 0.001$ ). On the other hand, unemployment was significantly higher in Chilean women than in Peruvian women (60.2% vs. 52.4%) ( $p < 0.001$ ). The lack of foresight was significantly lower in Chilean women (0.3%) than in Peruvian women (1.9%) ( $p < 0.001$ ).

Regarding nutritional status (Table 2), Chilean women at the first prenatal control were 2.4 times more likely to be obese than Peruvian women, 32.8% vs. 16.4%, respectively. At the time of delivery, the obesity rate increased to 48.8% in Chilean women and 32.0% in Peruvian pregnant women, with Chilean pregnant women twice as likely to be obese as Peruvian women. The percentage variation in the obesity rate between admission to prenatal care and delivery in Chilean pregnant women was 48.9%, which means that the proportion of obesity in Chilean pregnant women increased by that percentage between both periods. On the other hand, the proportion of obese Peruvian pregnant women increased by 94.5% between the first prenatal control and delivery.

**Table 1.** Comparison of sociodemographic variables between Chilean pregnant women and Peruvian immigrant pregnant women, from 10 districts of the Metropolitan Region of Santiago de Chile, 2017.

Sociodemographic variables	Chileans (n = 1578)		Peruvians (n = 318)		p value <sup>a</sup>
	n	%	n	%	
Age range (years)					
<20	219	13.9	18	5.7	<0.001
20-35	1,140	72.2	239	75.2	0.287
>35	219	13.9	61	19.2	0.015
Educational level (years of study)					
<9	92	5.8	15	4.7	0.437
9-12	1,147	72.5	236	74.2	0.543
>12	342	21.6	67	21.1	0.824
Relationship status					
With partner	1,116	70.5	271	84.7	<0.001
Without partner	466	29.4	49	15.3	
Unemployment	960	60.6	167	52.4	<0.001
Lack of foresight	5	0.3	6	1.9	0.001

<sup>a</sup> Chi-square test

**Table 2.** Comparison of nutritional variables, morbid and obstetric conditions between Chilean pregnant women and Peruvian immigrant pregnant women, from 10 communes of the Metropolitan Region of Santiago de Chile, 2017.

Variables	Chileans (n = 1578)		Peruvians (n = 318)		p value	OR (95% CI) <sup>b</sup>	OR (95% CI) <sup>c</sup>
	n	%	n	%			
Nutritional status at first prenatal control							
Low maternal weight	104	6.7	20	6.45	0.861	-	-
Obesity	509	32.9	51	16.40	<0.001	2.48 (1.81-3.41)	-
Nutritional status at delivery							
Low maternal weight	57	3.6	9	2.84	0.473	-	-
Obesity	767	48.9	102	31.97	<0.001	2.03 (1.57-2.62)	-
Morbidity							
Infectious diseases							
STD	47	3.0	15	4.7	0.112	-	-
HIV	3	0.3	1	0.3	0.521 <sup>a</sup>	-	-
Chronic conditions							
High blood pressure	39	2.5	5	1.6	0.331	-	-
Gestational diabetes	23	1.5	1	0.3	0.162 <sup>a</sup>	-	-
Insulin resistance	28	1.8	2	0.6	0.214 <sup>a</sup>	-	-
Obstetric conditions							
Parity							
Primiparous	561	35.4	120	37.5	0.469	-	-
Multiparous	1,025	64.6	200	62.5		-	-
Late entry to prenatal control	625	40.5	184	59.5	<0.001	0.46 (0.36-0.59)	2.17 (1.69-2.77)

95% CI: 95% confidence intervals

<sup>a</sup> Fisher's exact test was applied to those variables where frequency was less than 5.<sup>b</sup> Crude odds ratios with 95% confidence intervals to express the probability ratio when comparing Chilean (1) and Peruvian (0) pregnant women. Calculated when there was a statistical difference when comparing the proportions of each variable between Chileans and Peruvians<sup>c</sup> Crude odds ratios with 95% confidence intervals to express the probability ratio when comparing Peruvian (1) and Chilean (0) pregnant women. Calculated when Chilean nationality behaved as a protective factor for the corresponding variable to visualize the OR as a measure of risk for Peruvian pregnant women.

There was no difference between the obstetric variables analyzed regarding parity between pregnant women from both countries; multiparity predominated in both groups. Late admission to prenatal care was lower in Chilean women (40.5%) than in Peruvian women (59.5%) ( $p < 0.001$ ). There was no difference between Chilean and Peruvian pregnant women regarding infectious and chronic maternal morbidity (Table 2). Regarding obstetric and perinatal outcomes (Table 3), there was no difference in cesarean sections between Chilean and Peruvian pregnant women, even though there was a lower rate for the latter.

The prevalence of GD was significantly higher in Chilean pregnant women than in Peruvian pregnant women ( $p < 0.001$ ), in a 2:1 ratio, respectively. Obesity (AOR: 3.8, 95% CI: 2.44-6.18) and age < 20 years (AOR: 4.05, 95% CI: 2.25-7.29) were the variables most associated with GD in Chilean women (details

of the A model not shown in Table 3). No statistically significant differences were found in PE or PPH.

Chilean pregnant women were less likely to present anemia during pregnancy than Peruvian pregnant women, which was observed in the adjusted model (AOR: 0.29, 95% CI: 0.18 - 0.47). Additionally, in the adjusted model we also observed that late entry to prenatal control was independently associated with anemia in Peruvian pregnant women (AOR: 0.43, 95% CI: 0.33-0.56).

Premature birth was almost three times more likely in Chilean than in Peruvian pregnant women, regardless of the adjustment variables.

LBW was three times more likely in Chilean women's NB than in Peruvian women's NB; obesity was the variable mostly associated to this condition in the adjusted model (AOR: 3.34, CI 95%: 2.33- 4.85). No statistically significant differences were found when comparing Chilean and Peruvian pregnant women in the presence of macrosomia, SGA and LGA.

**Table 3.** Comparison of maternal and neonatal outcomes between Chilean pregnant women and Peruvian immigrant pregnant women from 10 communes of the Santiago de Chile Metropolitan Region, 2017

Variables	Chileans (n = 1578)		Peruvians (n = 318)		p value	OR <sup>b</sup> (95% CI)	AOR <sup>c</sup>	AOR <sup>d</sup> (95% CI)
	n	%	n	%				
Obstetric outcomes <sup>a</sup>								
Cesarean section	427	27.8	77	24.1	0.292	-	-	-
Gestational diabetes	200	12.6	17	5.3	<0.001	2.50 (1.5-4.2)	2.12 (1.24-3.61) <sup>Modelo A</sup>	-
Pre-eclampsia	89	5.6	13	4.1	0.262	-	-	-
ICE	41	2.6	4	1.3	0.223 <sup>a</sup>	-	-	-
Postpartum hemorrhage	74	4.7	14	4.4	0.823	-	-	-
Anemia	64	4.0	39	12.2	<0.001	0.30 (0.19-0.45)	0.29 (0.18-0.47) <sup>Modelo A</sup>	3.44 (2.12-5.55)
Premature birth	183	11.7	16	5.1	0.001	2.44 (1.44-4.14)	2.82 (1.59-5.01) <sup>Modelo A</sup>	-
Neonatal outcomes <sup>b</sup>								
Low birth weight	130	8.2	11	3.5	0.003	2.5 (1.33-4.6)	3.10 (1.51-6.33) <sup>Modelo B</sup>	-
Macrosomia	118	7.5	25	7.8	0.813	-	-	-
SGA	154	10.6	24	7.5	0.120	-	-	-
LGA	159	10.0	27	8.4	0.384	-	-	-

ICE: Intrahepatic cholestasis, SGA: Small for gestational age, SGA: Large for gestational age, 95% CI: 95% confidence intervals

<sup>a</sup> Fisher's exact test was applied to those variables where frequency was less than 5.

<sup>b</sup> Crude odds ratios with 95% confidence intervals to express the probability ratio when comparing Chilean (1) and Peruvian (0) pregnant women. Calculated when there was a statistical difference when comparing the proportions of each variable between Chileans and Peruvians

<sup>c</sup> Adjusted odds ratios with 95% confidence intervals adjusted for each model to express the probability ratio when comparing Chilean (1) and Peruvian (0) pregnant women. Calculated when there was a statistical difference when comparing the proportions of each variable between Chileans and Peruvians. For each model of multiple logistic regression, the A model was considered (adjusted by age, education, low maternal weight, obesity, entry to PC, parity, chronic conditions: HBP, Diabetes) and the B model (adjusted by age, education, parity, late entry to prenatal control, low maternal weight, obesity, maternal morbidity, and gestational conditions such as pre-eclampsia, GD, and anemia)

<sup>d</sup> Adjusted odds ratios with 95% confidence interval to express the probability ratio when comparing Peruvian (1) and Chilean (0) pregnant women. Calculated when Chilean nationality behaved as a protective factor for the corresponding variable to visualize the OR as a measure of risk for Peruvian pregnant women.

## DISCUSSION

In our study, we observed a demographic and nutritional difference between Chilean and Peruvian immigrant women, characterized by a higher average age in Peruvian women and higher unemployment in Chilean women. Additionally, a higher rate of obesity was found in Chilean pregnant women, which is consistent with previous studies carried out in Chile<sup>(6)</sup> and explains some adverse results observed in Chilean pregnant women. Although there were no major differences in the history of morbidity in women of both nationalities, the maternal and perinatal results we used to evaluate the effect of healthy immigrants on pregnant women who had migrated from Peru, support our hypothesis in most of the response variables studied.

Regarding maternal-perinatal outcomes, there was no difference between Peruvian immigrant pregnant women (PIPW) and Chilean pregnant women in the proportion of cesarean sections; the proportion in both groups was higher

than what is recommended by the World Health Organization<sup>(19)</sup>. However, the proportion of cesarean sections in pregnant Peruvian women (24.1%) was less than the 34% reported for Peru<sup>(14)</sup>. The constant increase in the number of cesarean sections is a major public health challenge for both countries<sup>(11)</sup>. The similar rates in pregnant women from both countries could be explained by the length of the time of residence of the Peruvian pregnant women in Chile and by the similar epidemiological profile they have at the time of delivery<sup>(20)</sup>.

When it comes to obstetric morbidity, the possibility of GD was found to be greater in Chilean women, mainly associated with greater obesity, thus showing the effect of healthy migrant in this variable. This aspect is consistent with what is described in the literature, which shows that the increase in fatty tissue accentuates insulin resistance, with the consequent hyperinsulinemia and intolerance to carbohydrates, typical of gestational diabetes<sup>(21)</sup>. However, despite being less

likely to experience this condition, the prevalence of GD in pregnant Peruvian women was higher than what is described for Peru <sup>(21)</sup>.

Additionally, the fact that the PIPW showed a significant increase in the proportion of obesity between entry to PC and delivery, along with a higher proportion of women over 35 years old, demonstrate that the epidemiological indicators for GD and obesity in this population are tending to be similar to those of the receiving country, as described in other studies on immigrants <sup>(9,22)</sup>. In this regard, it has been observed that the change of eating habits and lifestyles of migrants settled in urban areas, as well as the socioeconomic determinants, put them at greater risk of suffering from obesity and cardiometabolic diseases, which means that if the healthy immigrant effect disappears, they could become increasingly vulnerable to the mentioned conditions <sup>(23)</sup>.

Anemia was the only condition that was more prevalent in Peruvian pregnant women than in Chilean women. However, women in our study had half the prevalence of what is reported for Peru <sup>(24)</sup>. The association of anemia with late entry into prenatal care could indicate that the preventive strategies that favor early entry into prenatal care could decrease this condition in Peruvian pregnant immigrants <sup>(25)</sup>.

The healthy immigrant effect on PIPW was observed in most indicators for perinatal outcomes. The premature birth rate was less than half of what was found for Chilean pregnant women. The same effect happened with the percentage of low birth weight, which was less than the 8% reported for Peru <sup>(26)</sup>. The healthy immigrant effect has also been reported in studies carried out in the United States on Peruvian immigrants <sup>(27)</sup> and on Latino immigrants in general <sup>(28)</sup>.

Maternal obesity emerges as an important variable to consider, especially given its association with gestational diabetes, premature birth, and low birth weight <sup>(29)</sup>. Thus, the underlying mechanisms involved in this association indicate that maternal obesity and gestational diabetes are associated with positive regulation of inflammation via increased production of adipokines by adipose tissue. In addition, the

systemic secretion of pro-inflammatory cytokines increases, thereby contributing to premature delivery through endothelial dysfunction, insulin resistance and oxidative stress, which is associated with placental dysfunction, fetal malnutrition, and low birth weight <sup>(29)</sup>.

The low frequency of some morbidity indicators could be considered as a limitation of the study, possibly associated with the limited time for data collection. However, there was no statistical difference in these indicators.

In conclusion, the results of this study reflect that Peruvian pregnant immigrants in Chile experience the healthy immigrant effect, mainly regarding perinatal outcomes, and show better indicators than those reported in the literature for Peru <sup>(14)</sup>. These aspects are also consistent with the fact that those who emigrate are in better health conditions <sup>(24,26)</sup>, which represents a potential improvement of demographic and health indicators for Chile as the receiving country.

However, it is necessary to promote intersectoral strategies of access and acceptability in prenatal care, to allow a preventive and curative approach to conditions such as anemia, as well as the promotion of healthy lifestyle habits to prevent obesity. To avoid the assimilation and acculturation processes, which imply the progression of Peruvian immigrant pregnant women to the morbid obesity profile of Chilean pregnant women. Finally, knowing that this population presents the healthy immigrant effect, encourages to take preventive and protective measures, to maintain and promote maternal and perinatal health.

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