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Frequency and determinants of perinatal asphyxia in a specialized health service, Popayán Colombia

Frecuencia y determinantes de la asfixia perinatal en un servicio especializado de salud, Popayán Colombia

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Abstract

Background: The worldwide incidence of perinatal disease is 1 per thousand live births, with a mortality of 1 million cases, which represents up to 30% of neonatal mortality. Cerebral palsy is the most serious consequence in neonates. The absence of prenatal check-ups, the extreme ages of the mother and the extreme poverty are the main risk factors.

Objective: To determine the frequency and social determinants of perinatal asphyxia in a hospital in Popayán Colombia during 2014.

Methods: A case-control study was carried out, collecting retrospective information of newborns in this institution and admitted to the neonatal intensive care unit during 2014. The cases were diagnosed by specialists in neonatology according to clinical management characteristics.

Results: A total of 137 cases and 277 controls completed the sample of this study. The variables were associated with perinatal asphyxia, ethnicity (OR: 2.07; 95% IC: 1.1-3.6, p: 0.01), obstetric history (OR: 3.5; 95% IC: 2.0-5.9, p: 0, 00), maternal complications in the last trimester of pregnancy (OR: 1.8; IC 95%: 1.1-3.1, p: 0.01)

Conclusion: The results of this investigation that the frequency of the PA in the hospital Susana López de Valencia is high compared with other reports in the countries of the region. It was determined that asphyxia in HSLV is closely related to the complications inherent in the gestation period.

Resumen

Antecedentes: La incidencia mundial de asfixia perinatal es de 1 por cada mil nacidos vivos, con una mortalidad de 1 millón de casos, la cual representa hasta el 30% de la mortalidad neonatal. La consecuencia más grave en los neonatos es la parálisis cerebral. La ausencia de controles prenatales, las edades extremas de la madre y la condición extrema de pobreza son los principales factores de riesgo.

Objetivo: Determinar la frecuencia y los determinantes sociales de la asfixia perinatal en un hospital de Popayán Colombia durante el 2014.

Métodos: Se realizó un estudio de casos y controles, recolectando información retrospectiva de recién nacidos en esta institución e ingresados a la unidad de cuidado intensivo neonatal durante 2014. Los casos fueron diagnosticados por especialistas de neonatología de acuerdo a las guías clínicas institucionales de manejo

Resultados: Un total de 137 casos y 277 controles completaron la muestra de este estudio. Las variables asociadas con asfixia perinatal fueron, etnia (OR: 2.07; IC 95%: 1.1-3.6, p: 0.01), antecedentes obstétricos (OR: 3.5; IC 95%: 2.0-5.9, p-0,00), complicaciones maternas en el último trimestre del embarazo (OR: 1.8; IC 95%: 1.1-3.1, p: 0.01)

Conclusión: La frecuencia de la AP en el hospital Susana López de Valencia es alta comparada con otros informes en países de la región. Se determinó que la asfixia en el HSLV está estrechamente relacionada con complicaciones (maternas y fetales) inherentes al periodo de gestación.

Key contribution of the study:

Objective	To determine the frequency and social determinants of perinatal asphyxia in a hospital in Popayán Colombia during 2014
Study design	Case control
Source of information	Clinical histories
Population/sample	Recién nacidos en el HSLV durante 2014. Los casos fueron neonatos con un diagnostico clínico de asfixia perinatal. Los controles fueron recién nacidos con factores de riesgo y características similares pero sin el diagnostico de AP
Statistical analysis	Descriptive statistics. The incidence of PA and the ORs with their 95% CI were determined. Cases and controls were compared with a chi square. Finally, a multivariate analysis was performed with the logistic binomial regression.
Principle findings	An association between PA and ethnicity (mestizo) was determined. OR: 2.7; 95% CI: 1.1-3.6; obstetric history (presentation of dystocia, fetal cardiac deceleration, circular cord in neck OR: 3.5; 95% CI: 2.0-5.9; complications in the last trimester (maternal infection, pre-eclampsia, umbilical cord prolapse, gestational diabetes OR: 1.8; 95% CI: 1.1-3.1.

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Introduction

Perinatal asphyxia (PA) is a clinical syndrome that affects multiple organs and can lead to hypoxic ischemic encephalopathy (1). It is the aggression produced to the fetus or newborn at birth due to the lack of oxygen and / or adequate tissue perfusion, this leads to hypoxemia and hypercapnia with significant metabolic acidosis (2). The most common mechanism of hypoxic injury is intrauterine asphyxia caused by circulatory problems, such as clotting of the placental arteries, placental abruption, or inflammatory processes, causing loss of fetal well-being and leading to decreased oxygen and carbon dioxide exchange. and at the same time to severe lactic acidosis (3).

Hypoxic encephalopathy is defined as a lack of oxygen in the circulatory system of the fetus or neonate and causes multiple alterations in the neurological function of the newborn, which generates disability and neurodevelopmental disorder, as well as important social and emotional disorders (4). PA is a major cause of morbidity and mortality worldwide in newborns. Each year approximately 4 million children are born with PA, resulting in one million deaths. In those affected, it can cause serious neurological consequences, such as cerebral palsy, mental retardation and epilepsy. Due to its clinical, social and economic implications, for those who suffer from it and their caregivers, this is considered a determining factor in the educational, social and economic development of the child for the family (5).

Every year 2.6 million infants die in the world during their first month of life, almost half of them occur in the first 24 hours and 75% during the first week; the majority of these deaths are due to premature birth, asphyxia during childbirth and infections; These figures have dropped in low- and middle-income countries from 5.1 million in 1990 to 2.6 million in 2017; however, it has been slower than that of post-neonatal mortality in children under five years: 49% and 62%, respectively. These countries will have to accelerate their progress in reducing mortality to reach the goal of the Sustainable Development Goals (SDG) by 2030, consisting of achieving a neonatal mortality rate of 12 deaths per 1,000 live births, improving the probabilities of survival and maternal and neonatal health, with actions focused on the prevention of preventable mortality, such as prenatal controls and vaccination (6).

PA causes 23% of all neonatal deaths in the world (7), and is the fifth leading cause of death in children under 5 years of age. In low-income countries like those in Africa, the highest death rates are reported, reported at 4.6 per 1,000 live births in South Africa and up to 26 per 1,000 live births in Nigeria (7). In Colombia there are few data. A study carried out in the neonatal intensive care unit of the Hospital Universitario del Valle, reported that PA was the third cause of admission, representing 13.2% of all patients treated and was the basic cause of death in 23.0% and the final cause in 31.5% (8).

As the diagnosis of perinatal asphyxia is based on clinical and gasometric criteria that include evidence of cardiorespiratory depression, umbilical cord blood acidemia, poor postnatal vitality (low APGAR at ten minutes) and early evidence of neurological alteration as a manifestation of encephalopathy hypoxic-ischemic (9), there may be an underreporting of the incidence of the event due to the lack of the necessary resources to establish an adequate diagnosis in low complexity health institutions (level I and II). In Colombia, PA is associated with the occurrence of extreme neonatal morbidity and is an indication of unsafe care that compromises quality and safety during pregnancy monitoring and delivery care; therefore, from the perspective of public health, it is a priority to work on this issue (10).

Cauca is a multicultural, multiethnic department, with a predominantly rural territory, where its inhabitants face serious poverty (11); currently does not have follow-up data for PA despite the importance of the event. The development of PA can be linked to a great extent to health determinants of the communities and the solution should therefore focus not only on the treatment of events but also on the prevention of their occurrence. For this reason, we set ourselves the objective of determining the frequency and identifying possible determinants of PA in a specialized service in Popayán Colombia, during 2014.

Methods

An analytical observational study of cases and controls was carried out in neonatal patients, born and cared for between January 1 and December 31, 2014 in the maternal and child unit of the Susana López Hospital in Valencia de Popayán. During this period, 3,140 live births were reported, which were evaluated for compliance with the selection criteria, of which 148 were diagnosed with PA. Information from 137 records defined as cases and 277 cases (two controls for each case) was included in this study, for a total of 414 records (Figure 1). Controls were selected by simple random sampling with replacement.

Newborns with malformations, chromosomopathies and metabolic diseases, Encephalopathy not attributable to hypoxia were not included, nor those hospitalized in the SLVH neonatology unit born in another institution. Although all available case records were included, the size and power of the sample was confirmed through the Openepi statistical package available at https:// www. openepi.com/SampleSize/SSCC.htm, taking as parameters, a reliability of 95% (1-alpha), a power of 80%, (probability of detection), a hypothetical proportion of exposure in controls of 40% and in the cases of 57%, and an OR of 2.

A case was defined as any newborn of 37 weeks or more gestational age, born in the SLVH and hospitalized in the neonatology service, with onset of symptoms in the first 24 hours of life and with a medical diagnosis of PA or Hypoxic Ischemic Encephalopathy according to the institutional clinical guidelines, based in turn on the guide of the Colombian Ministry of Health, (12). The records or medical records were selected by the institutional statistics department according to the ICD10 codes: (P20 intrauterine hypoxia, P200 intrauterine hypoxia first noticed before the onset of labor, P201 intrauterine hypoxia first noticed in the labor and delivery, P209 unspecified intrauterine hypoxia, P21 birth asphyxia, P210 severe birth asphyxia, P211 mild and moderate birth asphyxia, P219 unspecified birth asphyxia) (13). Newborns of 37 or more weeks of gestational age, born in SLVH, with a sociodemographic characterization similar to the cases, were

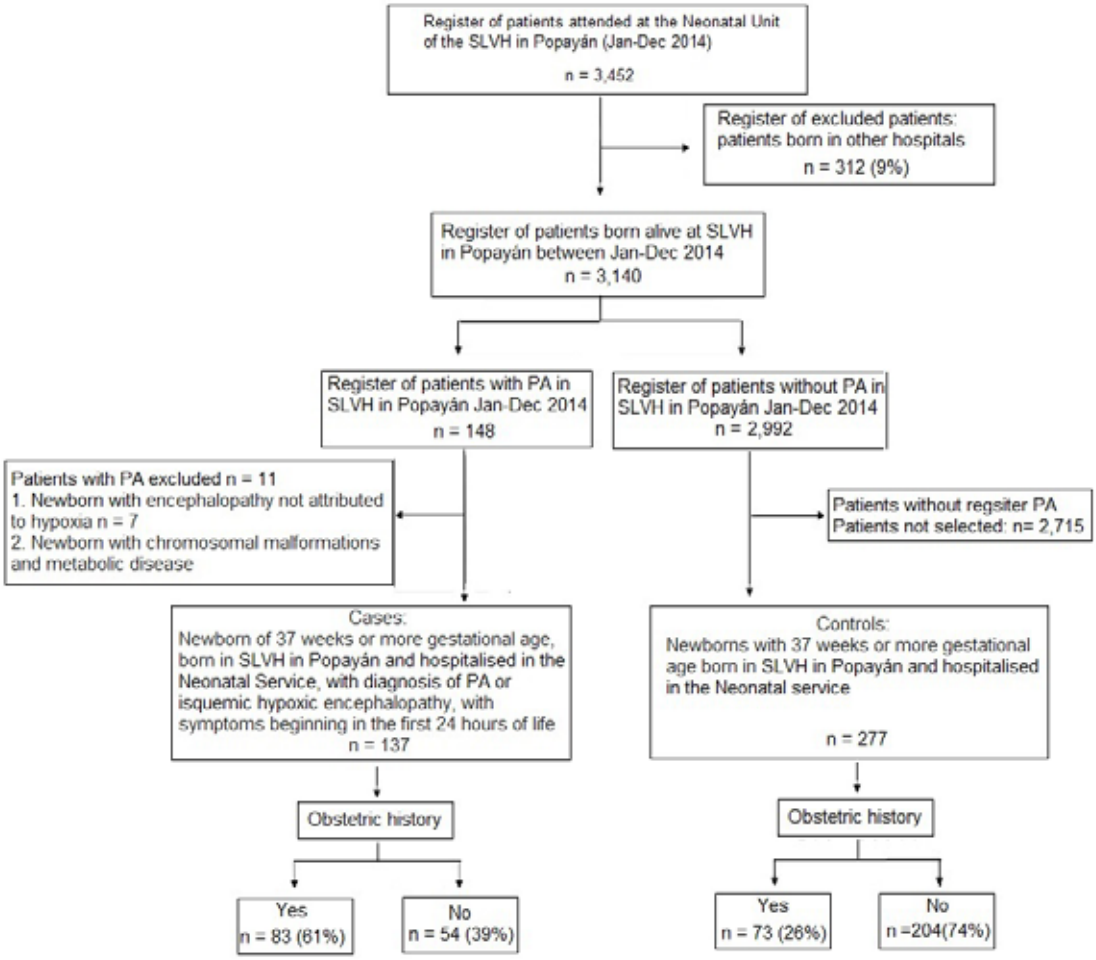

Figure 1. Diagram for the selection and classification of patients with HSLV perinatal asphyxia. Popayan, Cauca 2014

defined as controls. Controls were selected probabilistically from all the registries of newborns born at the institution during the same period and who were not diagnosed with PA.

Area of Study

The Susana López de Valencia Hospital in Popayán is an accredited institution of the third level of complexity, which is located in southern Colombia in the Department of Cauca, in Popayán, in commune six. The institution was founded in 1947 as an anti-TB sanatorium, having different advances within the field of care, as well as the level of complexity until it became the first and only institution in the department of Cauca in 2014 to receive the Health Accreditation granted, at the time, by the Ministry of Health and Social Protection through ICONTEC (Colombian Institute of Technical Standards and Certification) and renewed this year. At the time of the study, it had 136 enabled beds distributed in adult hospitalization services 45, obstetrics 32, pediatric hospitalization 24, neonatal unit 26, pediatric intensive care unit 9, which receives patients from the entire department of Cauca.

The social, demographic and clinical information was obtained from the medical records of the patients admitted to the study, which was consigned in an electronic database (Excel ® Windows 2010) built for the study. All the information on the exposure variables was collected, without the researchers knowing the case or control classification of the records. To protect the identity of the participants, the name and identification of the patients and their mothers were masked. The information was analyzed in the statistical software Stata 14.0 ® (Stata Corp, 2014, College Station, TX, USA). The description of the characteristics of the study population was made through descriptive statistics.

The variables included in the study were age, ethnicity, education, marital status, residence, socioeconomic status, social security, birth history, full-term pregnancy, type of delivery, number of adequate prenatal check-ups, obstetric history, complications in the last trimester of pregnancy, sex of the newborn.

The normality of the numerical variable was evaluated using the Shapiro-Wilk test, and it was summarized using the mean as measures of central tendency and the standard deviation as a measure of dispersion. The qualitative variables were summarized through proportions and presented in frequency tables. Contingency tables were used to explore the possible associations between the exposure variables and the outcome variable "having or not having PA" and the strength of association was measured through odds ratio (OR), with their respective 95% confidence intervals.

To assess whether the reported associations were significant, Chi-square statistical tests were used, according to the normality criteria. Subsequently, a multivariate analysis was performed using a binomial logistic regression to adjust for possible confounders and determine the variables that were independently associated with having or not having APN. In the construction of the models, those variables that in the bivariate analysis reported p values less than or equal to 0.20 were included. The model that involved the least number of variables was selected according to the likelihood ratio statistical test.

Ethical considerations

This study was endorsed by the Committee for the ethical and scientific evaluation for research in human beings of the Free University, as a risk-free investigation according to act number 04-1 in Santiago de Cali, on the twenty-eighth (28) of October 2015.

Results

During 2014, the selection criteria were evaluated for 3,140 records of patients born at the Susana López de Valencia Hospital in Popayán. All patients who met the case definition of PA were included. The frequency of PA obtained during 2014 was 4% (137 cases diagnosed with some degree of PA out of 3,140 born in the hospital). Clinical and demographic information was collected from 414 records, 137 cases, and 277 controls (Figure 1).

The mean age of the mother was 23.4 years (± 6 years); the highest percentage of mothers was found in the age group 18-24 years (42%). 26.5% of the patients were classified as indigenous ethnicity. 99.0% of the mothers had finished high school; the predominant marital status was free union (56.0%); half of the population resided in rural areas and the outstanding socioeconomic stratum was the low one (strata 1 and 2) with 83.0%; 83.5% belonged to the subsidized social security scheme. Regarding parity, 50.0% of them had at least one delivery as antecedent. In pregnancy complications in the last trimester of gestation, 25.0% had at least one of the complications studied (maternal infection 17.0%; pre-eclampsia 6.0%, gestational diabetes 1.5%, umbilical cord prolapse 0.5%) (Table 1).

55% of the newborns included in the study were male; Regarding gestational age, 91% were considered at term (between 37 and 41 weeks of gestational age. 67% did not have the number of adequate prenatal controls (6 or more); 52% were born by vaginal delivery and 38 % had some history or complications during pregnancy (dystocia of presentation 27%; fetal cardiac decelerations 7%, circular umbilical cord in neck 3%, among others less relevant) (Table 1)

In the bivariate analysis within the variables with statistical significance, they were: ethnicity (OR: 1.6; 95% CI: 0.98-2.77, p: 0.04), type of delivery (OR: 2.8; 95% CI: 1.8-4.4, p : 0.00), obstetric history (OR: 4.2; 95% CI: 2.7-6.7, p: 0.00), maternal complications in the last trimester of pregnancy (OR: 1.6; 95% CI: 1.0-2.6, p: 0.03), sex (OR: 0.5; 95% CI: 0.3-0.8, p: 0.04) (Table 2).

Table 1. Sociodemographic charateristics of the study population. Susana Lopez de Valencia Hospital, Popayán, 2014.

	Characteristics	n	%
Age	<18	81	19.6
	18-24	173	41.8
	25-35	138	33.3
	>35	22	5.3
Ethnicity	Indigenous	110	26.6
	Mixed	304	73.4
Schooling	No school	3	0.2
	Primary	1	0.7
	Secondary	409	98.8
	University	1	0.2
Marital status	Single	151	36.5
	Unmarried	231	55.8
	Married	31	7.5
	Divorced	1	0.2
Residence	Rural	207	50.0
	Urban	207	50.0
Socioeconomic status	Low	343	82.8
	Medium	71	17.2
Social security	Subsidised	346	83.6
	Contributes	68	16.4
Birth history	No	207	50.0
	Yes	207	50.0
Previous full-term pregnancies	No	37	8.9
	Yes	377	91.1
Type of birth	Vaginal	216	52.2
	Caesarian	198	47.8
Number of prenatal controls	Yes	136	32.9
	No	278	67.1
Obstetric history	None	260	62.3
	Circular cord	14	3.4
	Fetal decelerations	26	6.3
	Presentation distocia	111	26.8
	Twin pregnancy	1	0.2
	Intrauterine restriction of growth	1	0.2
	Uterine rupture	1	0.2
Complications in the last trimester of the pregnancy	Gestational diabetes	6	1.5
	Maternal infection	71	17.2
	None	311	75.1
	Pre-eclampsia	24	5.8
	Prolapsed umbilical cord	2	0.5
Sex of newborn	Male	228	55.1
	Female	186	44.9

Factors associated with perinatal asphyxia

In the multivariate analysis, an association was found between PC and the following variables: Ethnicity (mixed race), obstetric history (presenting dystocia, fetal cardiac decelerations, neck cord circularity, complications in the last trimester of pregnancy (maternal infections, pre-eclampsia, umbilical cord prolapse, gestational diabetes (Table 3).

Discussion

In our study, it was found that the risk factors associated with PA were ethnicity, obstetric history and maternal complications in the last trimester. PA is a problem in the population studied. The results of the present study reported an approximate frequency of PA of 4% in live births and with predisposing factors inherent to the gestation stage and the development of the newborn during its fetal stage. Similar data reported by Gonzales et al., Performed in hospitals in Spain, where the report was 4.8% (14). Some developing countries provide different data, in Bolivia it was between 1.0-1.5% (15). In Nicaragua, a multi-ethnic and multicultural country, PA was reported in 6.5% of those born alive (16). While in the United States, similar data was reported for Bolivia (17).

It could be inferred that the frequency of perinatal asphyxia in our region is higher compared to other low-income countries due to the quality of maternal-fetal surveillance during prenatal controls, although the information on the frequency of the event in Colombia and similar countries is limited. According to the World Health Organization (WHO), an average of 4 to 9 million cases of perinatal asphyxia were registered worldwide, especially in developing countries. Of this total, 20% are responsible for the death of newborns and 8% of deaths in children under five years of age (4).

Regarding determinants of PA, it was found that the factors strongly associated are some maternal complications during the last trimester of pregnancy (gestational diabetes, pre-eclampsia, umbilical cord prolapse, urinary tract infection, chorioamnionitis, vaginosis). In

Table 2. Evaluation of the risk factors of the SLVH, Popayán, 2014. Bivariate analysis.

Characteristic	Description	n	Case (n=137)	Control (n=277)	OR	IC 95%	p
Ethnicity	Indígenous	110	28	82	1.60	0.98-2.77	0.04
	Mixed	304	109	195			
Extreme Maternal Age	Yes	92	33	59	1.17	0.69-1.95	*0.52
	No	322	104	218			
Marital status	Partner	262	83	179	0.80	0.50-1.31	0.42
	No partner	152	54	98			
Residence	Rural	207	77	130	0.68	0.44-1.00	0.07
	Urban	207	60	147			
Socioeconomic status	Low	343	120	223	0.58	0.30-1.08	0.07
	Medium	71	17	54			
Social security	Subsidised	346	121	225	0.57	0.29-1.07	0.06
	Contributes	68	16	52			
Birth history	No	207	70	137	0.93	0.60-1.40	0.75
	Yes	207	67	140			
Gestational age	Full	377	120	257	0.54	0.26-1.16	0.08
	Not full	37	17	20			
Type of birth	Vaginal	216	48	168	2.8	1.80-4.40	0.00
	Caesarian	198	89	109			
Adequate prenatal controls	Yes	136	37	99	0.66	0.40-1.04	0.07
	No	278	100	178			
Obstetric history	Yes	156	83	73	4.20	2.70-6.70	0.00
	No	258	54	204			
Complications in the last trimester of the pregnancy	No	311	94	217	1.60	1.00-2.60	0.03
	Yes	103	43	60			
Sex	Male	228	89	139	0.50	0.30-0.80	0.04
	Female	186	48	138			

Table 3. Evaluation of the risk factors of the people of the SLVH, Popayán, 2014. Multivariate analysis.

Characteristic	Description	n	Case	Controls	OR	IC 95%	p	OR adjusted	IC 95%	p
Ethnicity	Indígenous	110	28	82	1.6	0.98-2.77	0.04	2.07	1.1-3.6	0.01
	Mixed	304	109	195						
Obstetric history	Yes	156	83	73	4.2	2.7-6.7	0.00	3.50	2.0-5.9	0.00
	No	258	54	204						
Complications in the last trimester of the pregnancy	No	311	94	217	1.6	1.0-2.6	0.03	1.80	1.1-3.1	0.01
	Yes	103	43	60						

a case-control study, an association with similar results was shown in Peru: maternal chorioamionitis (OR: 6.13; 95% CI: 1.06-35.62, p: 0.033) (18). This similarity in results may be related to the damage that these maternal events cause in the normal development of the fetus. Hermansen and Hermansen (19) reported relationships between maternal colonization and infection (chorioamnionitis, vaginosis) with placental insufficiency where a decrease in oxygen supply to the fetus and secondary asphyxia is generated. Prolapse or descent of the cord through the cervical or when the membranes are ruptured, can cause asphyxia due to compression of the cord and vasospasm of the umbilical vessels that alters the flow of blood to and from the fetus (20).

Another aspect of statistically significant association with PA was the presence of complications related to the fetus (presenting dystocia, cardiac decelerations and umbilical cord circularity). Similar data are described in a retrospective case-control study where an association with cardiac decelerations was found (OR: 29.4; CI: 5.7-540.8 (21). Fetal decelerations express an imbalance between the supply and demand of a myocardium in need of oxygen decreasing its transfer to the fetus generating fetal hypoxia (22). In the present study, it was found that the chance of having perinatal asphyxia was greater in the indigenous population compared to the mestizo ethnic group (OR 2.07; CI 1.1-3.6, p: 0.01) this can be related to ancestral beliefs and care practices (accommodation of the fetus through physical maneuvers performed on the pregnant woman's abdomen, hot baths with water made from medicinal plants such as brevo, mugwort, anamú, rue, marijuana, sage and rosemary to facilitate childbirth , consumption of hot foods such as chicken broth, chocolate and arracacha, among other customs) (23), typical of the indigenous people of the department of Cauca.

In this department there are 115 indigenous councils that are divided into nine zones: Nasa-Paéz, Guambiano-Yanaconas, Coconucos, Epiraras-siapiraras (Emberas), Totoroes, Inganos and Guanacos (24). The qualitative study Interculturality and perceptions in maternal-perinatal health, developed in Toribío Cauca 2008-2009, concluded that care practices during pregnancy are governed, by the cultural roots of pregnant women and family hegemony, as a right (23). There are no data on studies carried out in which this ethnic variable has been analyzed and associated or not with the development of PA.

Factors such as deficit in the number of adequate controls (less than 6) did not show a statistically significant association with PC, as in a study carried out in Cali where the variable insufficient prenatal care (mothers with less than three prenatal visits) showed an association borderline, not significant with the presence of the condition (OR: 0.33: 95% CI: 0.09-1.03, p: 0.036) (8). While what was reported in Nicaragua found a direct relationship with insufficient prenatal controls (OR: 1.0 p: 0.45) (16).

Other variables such as marital status, educational level and social security system in health were not statistically relevant in the present study, unlike the findings of Torres (8) where being a mother without a partner (OR: 2.56) represented a state of vulnerability for the mother-fetus dyad. Not being affiliated with the social security system and having a low level of education predominated among the case mothers in the multiple correspondence factor analysis, indicating that social difficulties can endanger the normal development of pregnancy (8).

The extreme maternal age (under 18 and over 38 years old) did not obtain statistical significance with respect to the development of PA (p = 0.52), contrary to what is stated in the literature regarding reproductive risk where it is referred to as a set of clinical conditions that are usually associated with high perinatal risk, some triggers of PAD (25).

Weaknesses and strengths

The results cannot be inferred to the general population or to other institutions because only one institution was included and information from a single year was analyzed. Given the retrospective nature of the information, which was collected for clinical and not research purposes, it may have some weaknesses with respect to the accuracy of the data; To correct this event, bivariate and multivariate analyzes were performed. All patients with a medical diagnosis of PAD from that year were included in the cases and controls were randomly selected to avoid selection bias.

Conclusions

The related findings in this study determine that the PA present in patients born during 2014 at the Susana López Hospital in Valencia de Popayán is closely related to complications (maternal and fetal) inherent to the gestation period. The results of this research suggest that the frequency of PAD at the Susana López de Valencia hospital is high compared to other reports in countries in the region and is closely related to biological determinants such as obstetric history (circular cord, dystocia of presentation, decelerations fetal heart), complications in the last trimester of pregnancy and sociocultural (maternal ethnicity).

Recommendations
Given the complexity of the event, it is recommended that each institution evaluate the frequency and determinants of the appearance of PA, in order to identify the population at risk in a timely manner. Due to the magnitude of the complications in the neurological and psychomotor development of the patient and others in the family context, the importance and need of primary health care institutions to strengthen the surveillance of pregnant women with the aim of reducing factors of risk is corroborated, via modifiable risk event triggers. Institutions that provide health services can continue to strengthen their functional units, work teams and seek health technology strategies that are at the forefront and allow to provide treatment and management of high standards in order to mitigate and prevent complications in these patients.

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Conflict of interests
The researchers declare that they have no conflict of interest.

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