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Clinical and epidemiological profile of cerebral palsy in Antioquia, Cauca y Nariño, Colombia

Perfil clínico y epidemiológico de la parálisis cerebral infantil en Antioquia, Cauca y Nariño, Colombia

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ABSTRACT

Keywords:

Cerebral palsy;
Epidemiological;
Risk factors;
Motor skills.

Introduction: Cerebral palsy (CP) is a group of movement and posture development disorders that limit activity, impact participation, and affect the quality of life of children. It is the most common cause of motor disability and represents a public health issue. Associated risk factors and clinical characteristics remain unknown. **Objective:** To determine the clinical and epidemiological profile of CP within the participating population. **Method:** An observational, descriptive, cross-sectional, and retrospective study of 330 children with CP from three departments in Colombia. **Results:** Male sex, prenatal infection (12.4%), prolonged labor (24.2%), and neonatal asphyxia (17.3%) were the most frequent associated factors with CP. Children who reached early motor milestones did so thirteen months later compared to typical motor development. Only 15% of the studied children exceeded all dimensions of the Gross motor function measure (GMFM-66), and 14% failed to perform any motor tasks. **Conclusions:** Term birth with prolonged labor complication was the main associated factor with CP found in this study. Investigating prenatal care and perinatal attention in the country is suggested to prevent this disorder.

RESUMEN

Palabras clave:

parálisis cerebral;
epidemiología;
factores de riesgo;
desarrollo motor.

Introducción: la parálisis cerebral infantil (PCI) es un grupo de trastornos del desarrollo del movimiento y la postura, limita la actividad, impacta en la participación y afecta la calidad de vida de los niños. Es la causa más común de discapacidad motora y representa un problema de salud pública. Se desconocen los factores de riesgo asociados y las características clínicas. **Objetivo:** determinar el perfil clínico y epidemiológico de la PCI en la población participante. **Método:** estudio observacional, descriptivo, transversal con intención analítica y retrospectivo de 330 niños con PCI, de 3 departamentos de Colombia. **Resultados:** el sexo masculino, infección prenatal (12,4%), parto prolongado (24,2%) y asfisia neonatal (17,3%) fueron los factores asociados más frecuentes con la PCI. Los niños que alcanzaron los hitos motores tempranos, lo hicieron trece meses después respecto al desarrollo motor típico. Solo el 15% de los niños estudiados superaron todas las dimensiones de *Gross motor function measure* (GMFM-66) y

el 14% no logró realizar ninguna tarea motora. **Conclusiones:** el nacimiento a término con complicación de parto prolongado fue el principal factor asociado con PCI encontrado en este estudio. Se sugiere investigar el control prenatal y atención perinatal en el país con el fin de prevenir este trastorno.

INTRODUCTION

Infantile cerebral palsy (ICP) is a group of disorders of the development of movement and posture, with non-progressive characteristics and secondary to injury to the developing brain¹⁻⁵, which limit activity and participation, affecting the quality of life of the child population⁶. ICP generally results from events that occur before, during, or after childbirth and is commonly accompanied by sensory, perceptual, cognitive, communication, and behavioral disorders⁵. It is classified as spastic, ataxic, dystonic, and mixed forms. It obeys criteria such as the impairment of muscle tone, the characteristics of the movements, and the postural patterns that the child presents^{5,7}. It is also classified according to the topographic distribution into monoparesis/monoplegia, hemiparesis/hemiplegia, diparesis/diplegia, and tetraparesis/tetraplegia, with predominant involvement of a single limb of the body, a hemibody, the lower limbs and all four extremities, respectively⁵.

The diagnosis of ICP is complex and occurs over the long term, generally at the age of one or two years⁸. It is performed based on a neurological evaluation, identification of risk factors, and neuroimaging tests. Currently, there is no cure for this condition; management is done with a comprehensive approach seeking the maximum degree of functional independence of the child in its context^{5,8}.

It is estimated that the incidence of ICP in the world is 2.0 to 3.5 cases per 1000 live births⁷, while other studies have expressed that the prevalence of ICP ranges from 1.5 to 2.5 per 1000 live births^{1,2,4,8,9}. The difference between developed countries and those in conditions of poverty is notable, such as some African countries that report up to ten cases per 1,000 live births; in developing countries such as Peru, up to five cases are observed for every 1000 live births¹, while in others such as Australia, Europe, Canada, Sweden, China and Japan, a decrease in prevalence is evident mainly among premature and low birth weight newborns^{2,3,8,9}.

The National Disability Observatory in Colombia reported that for the year 2012, 1.2% of children from 0 to 17 years old had some disability; however, there

is no specific information on the prevalence of ICP in the country¹.

ICP represents a severe public health problem worldwide since it is the most common cause of motor disability in childhood^{1-3,6,7,9}. It is a common pathology that significantly affects the quality of life of children and their families¹⁰. In the United States alone, the costs associated with this disease exceed 11.5 billion dollars annually, making it the second developmental disability with the highest personal and institutional expenditure in that country, which highlights the importance of identifying the associated risk factors as a preventive element^{2,9}.

Colombia does not currently have an epidemiological surveillance program for ICP, so associated risk factors, causes, and consequences are unknown. Additionally, the studies carried out on it are limited². Identifying the factors that may lead this population group to suffer from this disorder is essential. This information would allow the development of activities to prevent the disease and promote health, which in the long term would reduce the high costs used in its care⁹.

The objective was to determine the clinical and epidemiological profile of children with ICP from Colombia's Antioquia, Cauca, and Nariño departments.

METHOD

Study design

A descriptive study was conducted.

Participants

The study population consisted of 330 children diagnosed with ICP who attended outpatient clinics in different institutions, health, foundations, and different programs of the Colombian Institute of Family Welfare in Colombia's Nariño, Cauca, and Antioquia departments.

Procedure

Those who responded to the open call made through the communication channels of the participating universities during the years 2018 and 2019 with a confirmed medical diagnosis of ICP, were minors, and had informed consent signed by their parents or legal representative were included. Patients were evaluated at the care sites they attended regularly. The evaluations were carried out by physiotherapists trained to complete the instrument.

Instruments

Clinical data were obtained through the application of an instrument that investigated the following aspects: 1) personal data: sex and age; 2) medical diagnosis: type of ICP; 3) risk factors associated with the development of ICP: weeks of gestation, type of delivery, weight, height and head circumference at birth (head growth percentiles), prenatal, perinatal, postnatal and family history; 4) nutrition; 5) history of motor development achieved and 6) aspects of maternal health: number of pregnancies, number of abortions (induced and spontaneous). These instruments were applied to the minors' parents or caregivers (legal representatives), consulting the child's medical history as a secondary source. In the history component, both prenatal, perinatal, and postnatal were consulted in the clinical history of the minors; due to their diversity, the most frequent ones were presented, and categories called "others" were made to group those with less frequency.

Some of the background information at each stage is listed to generate greater understanding:

Prenatal: Oligohydramnios, general death, non-development of uterine arteries, emotional stress, asthmatic crisis, premature rupture of membranes, appendectomy in gestation, multiple pregnancy, hematoma, agenesis of the corpus callosum, placenta previa, malformation of the umbilical cord, placenta previa, irradiation due to traffic accident, fetal distress, gestational diabetes, preterm birth syndrome, premature birth, Help syndrome, hydrocephalus, substance abuse, depression, pre-infarction loss of amniotic fluid, and schizencephaly.

Perinatal: Hypoxia, cord circularity, low APGAR, placental abruption, prematurity, acute fetal distress, mechanical ventilation, home birth, non-dilation,

induced labor, preeclampsia, use of forceps, maternal fever, and encephalopathy.

Postnatal: Meningitis, anemia, encephalopathy, seizure syndrome, neonatal depression, cardiopulmonary arrest, bacterial infection, poisoning, hydrocephalus, pneumonia, Arnold Chiari syndrome, and falls.

Statistical analysis

The data were analyzed in the SPSS version 22 statistical package. Using univariate techniques, absolute and relative frequencies were estimated for the qualitative variables. In contrast, the normality distribution was tested using the Shapiro-Wilk test for the quantitative variables to explore the possibility of applying methods based on a normal distribution. All quantitative variables had a distribution other than normal, so they were presented through medians with their interquartile ranges (IQR).

Crude prevalence ratios were estimated to identify the strength of association of the independent variables on the type of ICP, and the Kruskal-Wallis test was used to analyze the independent data. Spearman's correlation hypothesis test was used to find correlations.

Statement on ethical aspects

This study complied with the bioethical principles established in the Declaration of Helsinki, the guidelines of Resolution 8430 of the Ministry of Health for Colombia and the research divisions, and the endorsement of the research ethics committee of the University of Cauca and CES University, all expressed in the informed consent. Each survey administered was given a numerical code to protect the confidentiality of the participants (Statutory Law 1581 of 2012).

RESULTS

This study included 330 participants with ICP, mostly male, represented by 62.1% (n=205), with a median age of 9 years (IQR=6.00-13.0). The most frequent clinical form of ICP was the spastic type, with 60% (n=198). 23.3% of ICPs in this study are not specified. The median birth weight was 2800 grams (IQR=1890-3210), while the median height

was 49cm (IQR=45-51). In one out of every three children, the head circumference was below the 50th percentile, and 31% were above it. Only one in every hundred children was born with an expected head circumference (at the percentile) for age. The median weeks of gestation were 38th week (IQR=35-39). The general characteristics of children with ICP are described below—more information in Table 1.

Regarding these variables, the correlation (Spearman) of birth weight and weeks of gestation was direct and substantial with a $Rho=0.77$ ($p<0.001$). Given that the variables weeks of gestation and birth weight did not show a normal distribution, the Kruskal-Wallis test was used, obtaining that in the study population, neither the

weeks of gestation ($p=0.68$) nor the birth weight birth ($p=0.19$) showed an association with a specific type of ICP.

Among the most common prenatal histories, prenatal infection (12.8%) and preeclampsia (8.8%) were found in perinatal history, prolonged labor (24.2%), and neonatal cyanosis (16.6%). Asphyxia (17.3%) and jaundice (11.5%) were the most common postnatal history. Regarding family history, it was found that 41.8% reported hypertension, diabetes mellitus in 28.2%, cancer in 28.8%, and epilepsy in 10.6%. See Table 2.

Table 1. Demographic and clinical characteristics of the participating population with Infantile Cerebral Palsy in Colombia.

Characteristics	Frequency	%	
Gender			
Male	205		62.1
Female	125		37.9
ICP Type			
Spastic	198		60.0
Dyskinetics	23		7.0
Hypotonic	19		5.8
Mixed	13		3.9
Not specified	77		23.3
Head circumference			
At the 50th percentile	90		34.4
Below the 50th percentile	82		31.3
Above the 50th percentile	27		10.3
Unspecified	63		24.0
Variable	Range	Median	IQR
Birth weight (gr)			
Minimum	500	2800.0	1890-2310
Maximum	4800		
Size at birth (cm)			
Minimum	13	49.0	45.0-51.0
Maximum	97		
Gestation (weeks)			
Minimum	20	38.0	35.0-39.0
Maximum	43		

IQR: Interquartile range. Gr: grams. Cm: centimeters.

In the exploration of possible associations of history on the types of ICP, it was found that compared with spastic type ICP, having prenatal infection can increase the risk of hypotonic ICP by 30% and of mixed ICP by 45%. Within the perinatal history, prolonged labor increases the risk of having hypotonic ICP by 2.49 times and the risk of having

dyskinetic type ICP by 39%. Neonatal asphyxia, as the most prevalent factor in postnatal history, was not associated with any of the forms of ICP. Table 3 shows the estimates of prevalence ratios for the most prevalent antecedents in each stage of the child: prenatal, perinatal, and postnatal.

Table 2. Risk factors of children with infantile cerebral palsy in Colombia.

Prenatal	Frequency	%
Others	77	22.3
prenatal infection	41	12.4
Preeclampsia	29	8.8
Medication consumption	18	5.5
Hemorrhage	17	5.2
Trauma	17	5.2
Hyperemesis	14	4.2
Poisoning	4	1.2
Perinatal		
prolonged labor	80	24.2
Others	79	23.9
Neonatal cyanosis	53	16.1
Cardiorespiratory arrest	28	8.5
Neonatal depression	20	6.1
Meconium aspiration	19	5.8
Breech presentation	11	3.3
Eclampsia	9	2.0
Postnatal		
Others	132	40.0
Neonatal asphyxia	57	17.3
Jaundice	38	11.5
Postnatal infection	22	6.7
Bronchoaspiration	19	5.8
Apnea	17	5.2
congenital defect	17	5.2
Hypoglycemia	9	2.7

DISCUSSION

The clinical profile of children with ICP allows us to recognize risk factors, identify the characteristics of this condition, and provide critical information for early diagnosis. Case identification ensures timely intervention and avoids further impact on the child's quality of life.

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Male sex is related to the prevalence of ICP in this study, a relationship that is confirmed in similar studies carried out worldwide¹¹. Population samples from Latin American studies in Mexico⁴, Ecuador¹², Argentina¹³, and Peru¹⁴ corroborate the prevalence of ICP in males, reporting a higher percentage. Although Colombia does not present specific data on ICP, it reports that motor disability in children is predominant in the male gender¹⁵; an isolated national study carried out in Cali in a pediatric population with a diagnosis of ICP showed predominance in the same gender¹.

Table 3. Association of the most prevalent antecedents in the minor stage with the type of ICP

Background	ICP Type			
	Hypotonic	Dyskinetic	Mixed	Spastic
	PR (p-value)	PR (p-value)	PR (p-value)	
Prenatal: Infection	1.3 (0.7)	0.6 (0.6)	1.4 (0.04)*	1.0
Perinatal: prolonged labor	2.4 (0.03)*	1.3 (0.02)*	1.9 (0.09)	1.0
Postnatal: asphyxiation	0.3 (0.3)	1.02 (0.9)	0.9 (0.9)	1.0

*Statistically significant.

The most common clinical type of ICP was spastic, a finding similar to those reported by other national and global studies^{7,11,12,14}. Wimalasundera *et al*⁸ reported that this type occurs more frequently when the damage is associated with prematurity, a cause with low frequency in the participating population.

On the other hand, in Uganda, a low-income country, dyskinetic ICP is the most common in children aged between 2 and 7 years¹⁶.

Head circumference is an essential measure in the evaluation of the child because it assesses brain

growth^{17,18}. However, it is crucial to consider that more than a third of the population participating in this study had head circumferences in the appropriate percentile, a fact similar to a study of nutritional status in children with ICP, where only 8.5% of the participants had alterations in the head circumference, which may indicate that the appropriate percentile does not rule out brain damage.¹⁹

Currently, in Colombia, the strategy used to evaluate the risk of morbidity and mortality during pregnancy, childbirth, and the postpartum period for the mother-child binomial, to intervene in risk factors early, is prenatal control, the start of these after the first trimester or having less than four are described as predictive of maternal and infant morbidity and mortality. Despite having insurance coverage of more than 87%, maternal morbidity and mortality continue to have a high incidence. Insurance, cost, educational level, socioeconomic stratum, geographic access, and social and family support have been recorded as barriers to access to prenatal control^{20,21}.

On the other hand, prenatal infection, a predominant finding in this study, is defined as one of the main risk factors associated with ICP^{2,3}. Riquelme-Heras *et al*⁴ found that urinary infection with 43% was the most frequent risk factor in a study of 230 people with ICP. Michael-Asalu *et al*³ stated that fever and maternal infection are associated with a significant risk of ICP since it causes damage to the white matter, and Korzeniewski *et al*⁹ stated that maternal infections could induce ICP by transmitting pathogens to the fetus and causing persistent systemic inflammation.

Premature birth is one of the most critical risk factors for ICP^{2-4,16,23}, mainly for those newborns with less than 28 weeks of gestation³. In developed countries, technological advances and the implementation of prevention strategies in perinatal care services have led to the more remarkable survival of newborns, especially very premature children with low birth weight, who are at greater risk of deficiencies and disability²³; however, gestational age predominated in the study population. The most common perinatal history was prolonged labor, which has direct repercussions on the health of the newborn^{2,23}. In Colombia, it was reported that 3.1% of total disabilities originated from complications during childbirth¹⁵, and studies conducted in Peru, India, and

Pakistan found an association between prolonged labor and perinatal asphyxia²³. This situation represents a health problem with high rates of maternal and neonatal morbidity and mortality in low-income countries^{24,25}.

In the US, 98% of women plan an institutionalized birth, given that they consider the hospital a safe and comfortable place to give birth²⁶. This information contrasts with the preference of some women to have a birth at home, in their autonomy and comfort, as well as according to their social representations and geographical contexts²⁷. In Latin American countries like Peru, home births mainly occur in poor rural areas, where there is difficult geographic access and late care for pregnant women²⁸. In Colombia, some ethnic minorities prefer home birth, such as the Nasa and Misak women of Cauca and Wayúu women, due to the absence of health services that correspond with their traditional practices and their identity values, as well as the difficult access to a hospital medical care promptly, excessive medicalization, and loss of humanized care during childbirth^{29,30}.

Regarding postnatal risk factors, it was found that neonatal asphyxia prevailed in the present study, unlike what was reported in other studies worldwide, where convulsive syndrome, jaundice, and craniocerebral trauma were the risk factors. In the postnatal period, it was found more frequently^{3,4}.

Regarding family history, chronic non-communicable diseases, including hypertension, were the most frequently found family history³¹. It can be stated that there is a relationship between the chronic illnesses of parents and risk factors associated with ICP, as stated by Buck *et al*.³²; they found that where the chronic illness of parents with the highest prevalence in the group of men was hypertension while in the group of women, it was mood and anxiety, in both cases the chronic disease was negatively associated with gestation and birth weight.

On the other hand, it is essential to remember that optimal intrauterine balance is vital for the development of the fetus and that this environment is highly vulnerable to pregnancy disorders, including pregnancy-induced hypertension and preeclampsia^{2,33}. Blair *et al*³⁴ found that the presence of these entities statistically significantly increased the frequency of ICP in term births and decreased it in preterm births in a statistically non-significant

manner in an Australian population. Likewise, a direct relationship can be established between the presence of preeclampsia and the decrease in birth weight, and in turn, the decrease in birth weight as an established risk for the development of cardiovascular diseases in the child³³. In another study on children with ICP carried out in Japan, it was stated that pregnant mothers who presented preeclampsia during pregnancy had more minor children in weight and gestational age³¹.

Related to socioeconomic level, a Korean study shows that the incidence of ICP was significantly lower among high social strata than low social strata, even more noticeable in the group of medical assistance beneficiaries³⁵. A similar situation occurred in an isolated study in Mexico, where 89% of the participants belonged to the low and lower-middle socioeconomic levels. In Colombia, it could be compared with the lower socioeconomic income and the beneficiaries of the System for the Identification of Potential Beneficiaries of Social Programs (SISBEN). According to the Ministry of Health statistics, 83% of people registered in the Registry of Location and Characterization of People with Disabilities belong to low socioeconomic income. However, no distinction was made by age group.

CONCLUSIONS

Most of the literature found that prematurity is a factor highly related to the development of ICP. However, the results obtained in this research indicate that most births were full-term. The most significant factor associated with ICP was prolonged labor. Further research is required to identify the main factors associated with prenatal, perinatal, and postnatal care to implement intervention measures that promote prevention, adequate care, and safe delivery.

More research is required on the clinical profile of children with ICP in Colombia and Latin American countries, identifying and associating sociodemographic factors that directly or indirectly influence this, allowing analysis and surveillance of health care models for children, pregnant mothers, and newborn children.

The epidemiological record of children with ICP, as well as its adequate follow-up, is necessary to

understand better this population's status and the risk factors that influence their condition. This knowledge can then generate public policies, improvements, or modifications in the health system that reduce the incidence of ICP and, consequently, the prevalence of childhood disability in the country.

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STATEMENT ON CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest in this research.

CONTRIBUTION OF THE AUTHORS

The **first author** participated in project coordination, data collection management, methodological design approach, administrative management before the University of Cauca, analysis of results, supervision, review, and editing.

The **second author** conducted the data analysis, wrote the draft, reviewed it, and edited it.

The **third author** designed and constructed the methodology, administrative management before the CES University, data processing, statistical analysis, review, and editing.

The **fourth author** participated in data collection, results analysis, and draft writing.

The **fifth author** conducted the data collection, results analysis, and draft writing.

The **sixth author** participated in data collection, results analysis, and draft writing.

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