



Incidence of chronic malnutrition and associated factors in a cohort of children under five years of age: A multicenter observational study

Andres Fernando Alulema Moncayo ¹, Karina Paola Vacas Paredes ¹ *, Maria Fernanda Rivadeneira ¹, Ana Lucia Moncayo ¹

1. Postgraduate Department of Pediatrics, Faculty of Medicine, Pontifical Catholic University of Ecuador, Quito, Ecuador.

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Abstract

Introduction: Chronic malnutrition is a complex problem to eradicate, with significant repercussions for the child population. In Ecuador, 1 in 5 children under five years of age have chronic malnutrition. This study aimed to determine the incidence and factors associated with the development of chronic malnutrition in a cohort of children under five years of age during a one-year follow-up period in the province of Chimborazo from 2018-2019.

Methods: A prospective cohort study was conducted, with follow-up from 2018-2019. The population consisted of 1228 children, of which a sample of 138 children was taken. Variables such as age, sex, geographic location, socioeconomic level, access to health services, essential services and land, feeding practices, anthropometry, chronic malnutrition, mother's height, infections, and parasitosis were considered. Relative risks (RRs) and their respective 95% confidence intervals were calculated using generalized linear models (binomial family).

Results: The incidence of chronic malnutrition was 20.3%. The associated factors were difficulty in accessing health services [RR: 4.87; 95% CI: 1.89-12.55] and EBF < 6 months [RR: 3.44, 95% CI: 2.14-5.55].

Conclusions: The incidence of chronic malnutrition in children under five years of age in Chimborazo Province is high. Therefore, interventions are needed to guarantee access to health services and nutritional education to eliminate this health problem.

Keywords: DeCS: Chronic malnutrition, risk factors, children under five years of age, indigenous population.

Introduction

A child's nutritional status is influenced by three main factors: food, health, and care or attention.

Approximately 200 million children between the ages of 0 and 5 suffer from chronic malnutrition, of which 90% are on the continents of Asia and Africa.

* Corresponding author.

Eighty percent of chronically malnourished children are found in 24 countries. Of the ten countries that contribute the most to this figure, six are Asian: Bangladesh, China, the Philippines, India, Indonesia, and Pakistan, secondary to their large population. Out of 10 malnourished children, three live in India [1].

In Latin America, the countries most severely affected by chronic child malnutrition are those of the Andean region. Ecuador, Peru, and Bolivia present a prevalence of approximately 26%; in Colombia, this figure decreases to 15% [2].

The indigenous population is the most affected, with a prevalence of chronic malnutrition that is approximately 42.3% higher than that of other ethnic groups due to living conditions [3].

The latest data from the National Health and Nutrition Survey (ENSANUT) reveal that the rate of chronic malnutrition in children under five years of age in the country dropped just one percentage point from 2014 to 2018, from 23.9 to 23%. However, in the same years (from 2014 to 2018), the prevalence of chronic malnutrition in children under two years of age increased from 24.8 to 27.2%. The Ecuadorian Institute of Statistics and Censuses (INEC) has described this difference as "not statistically significant with the last period" [4].

Sociocultural support is fundamental in the family's role in feeding the child. The level of education of the mother is also essential since it has been described that a low educational level is associated with food restrictions during weaning; in addition, the social responsibility of maintaining family cohesion falls on them, being in charge of multiple aspects of education and home care [5].

It has been shown that the higher the mother's level of education is, the lower the probability of developing chronic malnutrition in her children. Thus, the children whose mothers completed a higher education level grew chronic malnutrition at 5.4% in contrast to the children of mothers without education who developed the pathology at 53.7% [6].

Regarding food practices, it should be considered that adequate nutrition is essential for the health and development of children; this is how the type of food, the frequency of food, and the age of its introduction influence [7]. Breastfeeding is another crucial factor in developing child malnutrition; several studies indicate that adequate, early, and long-term breastfeeding could prevent its early appearance [8, 9].

In addition, it has been shown that exclusive breastfeeding (EBF) during the first six months of life is the optimal diet for infants since breast milk in its composition has numerous immunological, cellular, anti-infectious, and hormonal factors that become the essential and unique food at this stage of life [10].

Another important factor is access to health services; in a study carried out in the indigenous population of Peru, it was found that there is less control of care for healthy children and noncompliance with the vaccination schedule, evidenced in the lower frequency of presentation of the health care and that during the prenatal stage, their mothers had fewer controls than the nonindigenous population, as well as less access to institutional delivery [11].

This study aimed to determine the incidence and factors associated with the development of chronic malnutrition in a cohort of children under five years of age during a one-year follow-up period in the province of Chimborazo from 2018-2019.

Materials and methods

Type of Study

The present study is a nonexperimental longitudinal cut database analysis.

Database

The database is an investigation in the province of Chimborazo, in rural areas of the Riobamba, Guamate, Guano, and Colta cantons, of the research project "Determinants of malnutrition in children under five years of the Ecuadorian indigenous population: a study based on secondary school at the national and

longitudinal level in four cantons of the Chimborazo province, from January 2018 to December 2020, -Wawapak-kausay- which included 1,232 indigenous children from rural areas in five cantons of the Chimborazo province [12].

Universe and Sample

Sample

The sample consisted of 138 indigenous children under five years of age, without malnutrition at the beginning of the study, who underwent a 1-year follow-up after their parents' consent. The sampling was nonprobabilistic for all possible and analyzable cases.

Sampling

The sampling was carried out by the discard method, taking into account the inclusion and exclusion criteria.

Inclusion and exclusion criteria

Indigenous children residing in the province of Chimborazo who participated in the study, who at the time of the survey were less than five years old, agreed to participate in the follow-up and were without chronic malnutrition at the beginning of the study. Children who had a physical or motor disability that made it challenging to take anthropometric data, if the child had been sick since the last week if the mother or caregiver had a disability that prevented them from responding to the module, or if the mother or caregiver (a) was sick (o) or unwell (o) to answer the Malnutrition module. Likewise, children whose mothers or caregivers did not agree to participate in the research and declined to sign the informed consent were excluded.

Variables

The variables were age, sex, socioeconomic level, geographic location, access to health services, vaccinations received, access to essential services, exclusive breastfeeding (LME), anthropometry, head circumference, weight, height, body mass index, height of the mother, and infections (diarrheal disease and parasitic sis).

Instrument

The "Questionnaire for nutritional diagnosis and health determinants" was used, which is based on UNICEF's Multiple Indicator Cluster Surveys (MICS), the National Health and Nutrition Survey (ENSANUT 2), and the Latin American and Caribbean Safety Scale. Food Service (ELCSA) and consists of the following structure: Section 1. Health and nutrition of children, Information on children under five years of age, Geographical location of the home, History of children under five years of age, lactation and dietary intake, history of the mother, maternal and newborn health, postnatal health check-ups, care for diseases, immunization, history of conditions and hygiene, child discipline, attitude toward domestic violence, family and respect, information panel of the anthropometry module, anthropometry. Section 2: Identification of the household and characteristics of the dwelling, income, land use, and tenure questionnaire, questionnaire on social capital, communication and networks, participation and association, and social cohesion.

For the anthropometric data, the weight was taken with a previously calibrated scale; two measurements were made, and a third in case the difference between the first two measurements was more significant than 0.5 kg. One person was in charge of the measurement, and another was to write down the data obtained.

The technique for measuring height/height depends on the child's age. If the child was under two years old, they were asked to lie down to take the measurements, and if the child was two years or older, they had to stand up. Two measurements were made, and a third was made if the difference between the first two measurements was more significant than 0.5 cm.

To measure the upper arm circumference, the tape measure was placed between the shoulder and elbow joints of the left arm, with the arm flexed at 90°, avoiding excessive adjustment or, on the contrary, the tape being loose. Two measurements were made, and a third was made if the difference between the first two measurements was more significant than 0.5 cm.

Head circumference in children under two years of age was measured with a tape measure that passes at the level of the browbone, above the ears, and over the occipital prominence. Two measurements were made, and a third was made if the difference between the first two measurements was more significant than 0.5 cm.

Chronic malnutrition was considered to exist if the Z score for height was less than 2 (MINUS TWO) standard deviations concerning the median size of the reference population according to the corresponding curves of the World Health Organization.

Results analysis plan

Univariate descriptive analysis of the qualitative and quantitative variables was performed using frequency and percentage calculations. First, a bivariate analysis was performed between the independent variables and chronic malnutrition. Relative risks (RRs) and their respective 95% confidence intervals were calculated using generalized linear models (binomial family). Variables that were statistically significant with a *P*-value <0.02 were selected for the final multivariate model. Finally, the variables significantly associated with chronic malnutrition with a *P* value <0.05 remained in the model. The STATA v.15 program was used for data analysis.

Procedure to guarantee bioethical aspects

Once the purpose of the research was disclosed and with prior authorization, the information collected was used solely for the analysis and development of the study. The clinical histories were obtained confidentially and were not disclosed to people outside this project.

Biases

To avoid possible interviewer, information, and memory biases, the principal investigator always kept the data with a guide and records approved in the research protocol. Observation and selection bias was avoided by applying the participant selection criteria. All the clinical and paraclinical variables of the previous

period were recorded. Two researchers independently analyzed each record in duplicate, and the variables were recorded in the database once their concordance was verified.

Results

Participants

A total of 138 children entered the study.

General characteristics of the population

In the population analyzed, the female sex predominated (n=77; 55.8%); 42% (n=58) of the cases were in the age range between 25 and 48 months; 35.5% (n=49) belonged to the Riobamba canton. Regarding the characteristics of the mothers, up to 50.8% (n=66) were between 13 and 25 years of age, and the level of education was basic in 51.5% (n=67) of these women. See Table 1. The incidence of chronic malnutrition in the population analyzed was 20.3%.

Chronic malnutrition and demographic and socioeconomic characteristics

When analyzing the relationship between the sociodemographic characteristics of the population and chronic malnutrition, it was observed that 27.9% of the boys and 14.3% of the girls had chronic malnutrition, as well as 22.4% of those in the age range of 25-48 months. A total of 25.8% of the children whose mothers were between 13 and 25 years old, 23.9% of the children of women with a basic initial educational level, and 28.6% of those who belonged to families with more than five living children also had chronic malnutrition. See Table 2. Similarly, 36.4% of children with chronic malnutrition had parents with a higher level of education; in 22.9% of the cases, the mother had a formal job, and in 33.9% of the cases of chronic malnutrition, the father did not have a proper job.

Concerning monthly economic income, 27.9% of children with chronic malnutrition belonged to families in quartile 1, and 20% lived in overcrowded homes. In

none of these cases was a statistically significant association established (Table 2).

Table 1. Sociodemographic variables in the study group.

Sociodemographic variables		Frequency No.=138	Percentage
Sex	Man	61	44.2%
	Women	77	55.8%
Age group	0-24 months	45	32.6%
	25 - 48 months	58	42.0%
	49 - 59 months	35	25.4%
Canton of residence	Riobamba	49	35.5%
	Guamote	33	23.9%
	Alausi	26	18.8%
	Colta	16	11.6%
	Guano	14	10.1%
Mother's age	13 to 25 years	66	50.8%
	26 to 35 years	49	37.7%
	>36 years	15	11.5%
Mother's instruction	Superior	11	8.4%
	Baccalaureate	52	40.0%
	Basic/initial	67	51.6%
Chronic malnutrition*	Absent	110	79.7%
	Present	28	20.3%

* Presence of malnutrition at one year of follow-up.

Chronic malnutrition and biological characteristics

There were no statistically significant differences between the biological variables, such as the mother's height, history of acute diarrheal disease (ADD), and intestinal parasitism (Table 2).

Malnutrition and access to primary and health services

Chronic malnutrition was not associated with the type of health service, type of water, water treatment, access to prenatal care, healthy child control, possession of a health card, or kind of transportation to access the health center.

On the other hand, access time to health services more significant than 31 minutes was associated with a higher frequency of chronic malnutrition (39.1%) compared to children who accessed in 15-30 minutes (17.7%) and those who accessed in less than 15 minutes (14.3%). Children who lived more than 31 minutes from the health center were up to 2.7 times more likely to develop chronic malnutrition than those who lived less

than 15 minutes from the health center [RR: 2.73; 95% CI: 1.11-6.76]; ($P < 0.05$) (see Table 3).

When analyzing the relationship of chronic malnutrition with feeding practices, it was observed that half of the children who did not receive EBF had chronic malnutrition (50%). In comparison, those who received EBF had a lower frequency of chronic malnutrition (18.5%). Children who were not exclusively breastfed had almost three times the risk of chronic malnutrition compared with children who were solely breastfed [RR: 2.7; 95% CI: 1.23-5.91]; ($P = 0.012$) (Table 3).

There was no statistically significant association between age at cessation of lactation or the number of meals per day and chronic malnutrition ($P > 0.05$).

Multivariate analysis

In the multivariate analysis, the following were identified as factors that increase the risk of chronic malnutrition: time greater than 31 minutes to access a health center [RR: 3.28; 95% CI: 1.40-7.67]; ($P = 0.006$), EBF up to six months [RR: 3.09; 95% CI: 1.55-6.16]; ($P = 0.001$) and male sex [RR: 0.41; 95% CI: 0.22-0.79]; ($P = 0.008$) (see Table 4).

Discussion

In this study, an incidence of chronic malnutrition of 20.3% was determined, which affected 27.9% of children and 14.3% of women. The risk factors associated with chronic malnutrition were a time of access to health services more significant than 31 minutes and EBF of less than six months. These findings indicate that chronic malnutrition is frequent, which is consistent with that reported in a similar study in the same geographical area carried out by Guamán and his collaborators (2020), in which it was determined that up to 52.6% of men and 46.7% of women had chronic malnutrition [12]. However, there are differences between both investigations: in this work, the study population was higher ($n = 1228$), and with a cross-sectional design, the factor most associated with

chronic child malnutrition was the lack of parental education [12]. In another investigation carried out with the indigenous population of the Ecuadorian Amazon, an incidence of chronic child malnutrition similar to that of this investigation (21.8%) was described. It was

associated with factors such as extreme poverty, difficulty accessing quality food (food insecurity), and local cultural customs, which favor the early introduction of unsafe foods that do not meet nutritional requirements, such as breast milk [13].

Table 2. Demographic, socioeconomic, and biological characteristics associated with malnutrition in the study group.

variables	Total No.=138	Chronic malnutri- tion No.=28	RR (95% CI)	P	
Sex	Man	61 (44.2%)	17 (27.87%)	Reference	0.05
	Women	77 (55.8%)	11 (14.29%)	0.512 (0.25-1.01)	
Age	12-24 months	45 (32.6%)	9 (20.0%)	Reference	0.77
	25-48 months	58 (42.0%)	13 (22.4%)	1.12 (0.52-2.38)	
	49-59 months	35 (25.4%)	6 (17.1%)	0.85 (0.33-2.18)	
Mother's age	13-25 years	66 (50.8%)	17 (25.8%)	Reference	0.15
	26-35 years	49 (37.7%)	7 (14.3%)	0.55 (0.25-1.23)	
	>36 years	15 (11.5%)	4 (20.0%)	0.77 (0.26-2.31)	
canton of residence	riobamba	49 (35.5%)	8 (16.3%)	Reference	0.27
	alusí	26 (18.8%)	7(26.9%)	1.64 (0.7-4.0)	
	Colta	16 (11.6%)	3 (18.8%)	1.14 (0.3-3.8)	
	Guamote	33 (23.9%)	7 (21.2%)	1.29 (0.5-3.2)	
	Guano	14 (10.1%)	3 (21.4%)	1.31 (0.4-4.3)	
Mother's educational level	Superior	11 (8.5%)	2 (18.8%)	Reference	0.94
	Bacallaureate	52 (40.0%)	9 (17.3%)	0.95 (0.23-3.81)	
	Basic/Initial	67 (51.5%)	16 (23.9%)	1.31 (0.34-4.93)	
Number of children	1 to 2	92 (69.2%)	18 (19.6%)	Reference	0.89
	3 to 4	34 (25.6%)	7 (20.6%)	1.05 (0.48-2.29)	
	5 or more	7 (5.3%)	2 (28.6%)	1.46 (0.42-5.05)	
Father's educational level	Superior	11 (8.6%)	4 (36.4%)	Reference	0.10
	Bacallaureate	61 (47.7%)	10 (16.4%)	0.45 (0.17-1.18)	
	Basic/Initial	56 (43.8%)	11 (19.6%)	054 (0.21-1.38)	
mother works	No	69 (53.1%)	13 (18.8%)	Reference	0.56
	Yeah	61 (46.9%)	14 (22.5%)	1.21 (0.62-2.38)	
the father works	No	27 (21.4%)	9 (33.3%)	Reference	0.05
	Yeah	99 (78.6%)	17 (17.7%)	1.94 (0.97-3.85)	
Monthly economic income	Q4	42 (32.0%)	5 (12.2%)	Reference	0.64
	Q3	18 (14.1%)	3 (16.7%)	1.36 (0.36-5.11)	
	Q2	26 (20.3%)	4 (15.2%)	1.26 (0.37-4.27)	
	Q1	43 (33.6%)	12 (27.9%)	2.28 (0.88-5.92)	
overcrowding	Present	58 (45.0%)	12 (20.7%)	Reference	1
	Absent	71 (55.0%)	13 (18.3%)	1.12 (0.55-2.28)	
mother's size	>150 cm	72 (52.2%)	16 (22.2%)	Reference	0.55
	< 150 cm	66 (47.8%)	12 (18.2%)	0.81 (0.41-1.59)	
Diarrheal disease (last 6 months)	0 episodes	65 (47.1%)	16 (24.6%)	Reference	0.61
	1 episode	44 (31.9%)	9 (20.5%)	0.83 (0.40-1.17)	
	2 or more	29 (21.0%)	3 (10.3%)	0.42 (0.13-1.33)	
Parasitosis	No	75 (59.5%)	14 (18.7%)	Reference	0.68
	Yeah	51 (40.5%)	11 (21.6%)	1.15 (0.57-2.23)	

Similarly, Bubak and his collaborators (2018) [14] also reported an incidence of chronic malnutrition in 555

indigenous children in Paraguay higher than that found in this research (41.7%). The risk factors are age under

three years, not knowing how to speak Spanish, lack of health insurance, home delivery, low birth weight, illiteracy of the mother, history of acute diarrheal disease in the last three months and access to unsafe drinking water.

The high incidence of chronic malnutrition in the indigenous child population in Latin America has been widely documented in the specialized literature. In two investigations carried out in the Peruvian Amazon, an incidence of chronic malnutrition in children under five years, 56.2%, was described [11] as associated with housing conditions, age over 36 months, and difficult

access to services. In both cases, the reported incidence is higher than that obtained in this investigation, but this could be related to the number of the population analyzed.

Regarding the determinants of chronic child malnutrition in indigenous populations, in this investigation, it was determined that this was related to the difficult access to health services because they are remote communities, which in turn prevents a care chain, adequate follow-up, and EBF up to six months.

Table 3. Association between chronic malnutrition with the characteristics of access to basic services and health services of children under 5 years of age.

Variables	Total No.=138	Chronic malnutri- tion No.=28	RR (95% CI)	P	
Toilet service	toilet/public network	48 (36.4%)	9 (18.8%)	Reference	0.61
	toilet/septic tank	48 (36.4%)	11 (22.9%)	1.22 (0.55-2.67)	
	toilet/cesspool	24 (18.2%)	3 (12.5%)	0.66 (0.19-2.23)	
	Latrine/does not have	12 (9.1%)	2 (25.0%)	1.33 (0.42-4.18)	
Water	Drinking/domestic	76 (57.6%)	14 (18.4%)	Reference	0.53
	Drinking/public network	10 (7.6%)	1 (10.0%)	0.54 (0.08-3.69)	
	Intubated	36 (27.3%)	8 (22.2%)	1.20 (0.55-2.61)	
Water treatment	river, spring	10 (7.6%)	3 (30.0%)	1.62 (0.56-4.69)	0.36
	Noils	78 (59.1%)	17 (21.8%)	Reference	
	Chlorination	13 (9.9%)	1 (7.7%)	0.35 (0.05-2.43)	
Pregnancy controls	Nothing or just filter	41 (31.1%)	8 (19.5%)	0.89 (0.42-1.89)	0.77
	9 or more	17 (14.2%)	3 (17.7%)	Reference	
	5 to 8 controls	74 (61.7%)	14 (18.9%)	1.07 (0.69-3.4)	
Well-child checkup	0 to 4 controls	29 (24.2%)	6 (20.7%)	1.17 (0.33-4.09)	0.80
	2 times or more	78 (56.9%)	16 (20.5%)	Reference	
	1 time	19 (13.9%)	6 (31.6%)	1.53 (0.69-3.40)	
NHS card	None	40 (29.2%)	6 (15.0%)	0.73 (0.31-1.72)	0.47
	Yes	104 (76.5%)	22 (21.2%)	Reference	
Time to get to the Health Center	Not	32 (23.5%)	6 (18.8%)	0.96 (0.73-1.25)	0.77
	<15 min	42 (31.6%)	6 (14.3%)	Reference	
	15 to 30 minutes	68 (51.1%)	12 (17.7%)	1.23 (0.50-3.04)	
Transport to get to the health center	>30 min	23 (17.3%)	9 (39.1%)	2.73 (1.11-6.73)	0.02*
	Private	11 (8.3%)	3 (27.3%)	Reference	
	Public	74 (55.6%)	13 (17.6%)	0.64 (0.21-1.90)	
Exclusive breastfeeding	Walking	48 (36.1%)	11 (22.9%)	0.84 (0.28-2.51)	0.75
	Yes	130 (94.2%)	24 (18.5%)	Reference	
Age at the end of lactation	No	8 (5.8%)	4 (50.0%)	2.70 (1.23-5.91)	0.012*
	Continue in lactation	54 (39.1%)	12 (22.2%)	Reference	
	<6 months	1 (0.7%)	0 (0%)	1.0	
	6-12 months	15 (10.9%)	4 (26.7%)	1.20 (0.45-3.18)	
Meals per day	>12 months	68 (49.3%)	12 (17.7%)	0.79 (0.38-1.62)	0.52
	4 or more	120 (90.2%)	24 (20.0%)	Reference	
	1 to 3	13 (9.8%)	3 (23.1%)	1.15 (0.40-3.31)	0.79

Table 4. Association of chronic malnutrition with sex, time of arrival at the health center, and LME.

Variable		RR (95% CI)	P
Sex	Women	Reference	
	Man	0.41 (0.22-0.79)	0.008
Time to the health center	<15 min	Reference	
	15 to 30 minutes	1.52 (0.65/3.54)	0.333
	>15 min	3.28 (1.40-7.76)	0.006
SCI	Yes	Reference	
	No	3.09 (1.55-6.16)	0.001

LME: exclusive breastfeeding up to 6 months. RR: relative risk.

This means that families in more remote geographical situations, which makes it difficult for them to access primary health care services, had a higher risk of their children under five years of age developing chronic malnutrition. In the multivariate analysis, EBF for less than six months was a determining factor of chronic child malnutrition. These results agree with those of Fernández Palacios and his collaborators (2017), who, in an investigation carried out in rural communities in Honduras, determined an incidence of abandonment of breastfeeding before six months greater than 68%, which was significantly related to chronic malnutrition in children under five [16].

In another investigation carried out with the child population of Nepal, a direct relationship was described between inappropriate practices, less than eight times a day or for a period of fewer than six months, and child malnutrition, both acute and chronic. This, together with extreme poverty and the impossibility of accessing health services, were considered determinants of child malnutrition in indigenous and rural populations, which is consistent with the findings of this research [17].

There is research that places the practice of EBF in indigenous populations below the WHO recommendations, with less than 35% exclusive breastfeeding in children under six months, which is significantly related to early weaning, the consumption of foods with low nutritional quality, predisposition to digestive tract infections and child malnutrition [18].

This research presents, among its limitations, that it considered only a small sample of the Ecuadorian indigenous population from the central highlands, without including people from the Amazon or northern highlands of the country, with significant indigenous populations, which probably prevented the identification of other statistically significant associations.

In addition, the possibility that a memory bias may have occurred when questioning the mothers could constitute another limitation of this research. On the other hand, many of the patients initially evaluated could not be followed up due to changes in address and the impossibility of locating them again, which resulted in lost data.

Conclusions

The incidence of chronic malnutrition in this cohort of children under five years of age was 20.3%, which is considered high. The factors associated with chronic malnutrition in this population were the time to access a health center greater than 31 minutes and EBF for less than six months, which coincides with some of the factors described in the specialized literature. Difficult access to health services due to living in remote areas is a factor that proved to be decisive in the presence of chronic child malnutrition; in addition, this was more frequent among those who received fewer prenatal and healthy child check-ups, reinforcing this finding.

Abbreviations

CD: Conical malnutrition
LME: exclusive breastfeeding.

Supplementary information

No supplementary materials are declared.

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Author contributions

Andres Fernando Alulema Moncayo: Conceptualization, data curation, formal analysis, fundraising, research, writing - original draft.
Karina Paola Vacas Paredes: Conceptualization, data curation, formal analysis, fundraising, research, writing - original draft.

Maria Fernanda Rivadeneira: Methodology, project administration, resources, software, supervision, validation, visualization, writing - revision and editing.
Ana Lucia Moncayo: Methodology, project administration, resources, software, supervision.

All authors read and approved the final version of the manuscript.

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Availability of data and materials

data and files are not publicly available due to patient confidentiality but are available through the corresponding author upon clearly justified academic request.

Statements

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Ethics committee approval and consent to participate

The Research Committee and the Ethics Committee of the Faculty of Medicine of the Pontificia Universidad Católica del Ecuador approved this study.

Publication Consent

Not required when patient-specific images, radiographs, and studies are not published.

Conflicts of interest

The authors declare they have no conflicts of interest.

Author Information

Not declared.

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