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Childhood anemia in populations residing at different geographical altitudes of Arequipa, Peru: associated maternal factors

Anemia infantil en poblaciones residentes en diferentes altitudes geográficas de Arequipa, Perú: factores maternos asociados

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Declaration of interests

The authors declare that they have no competing financial interests or personal relationships that could have influenced the research or this paper.

Declaration of competing interest

None.

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ABSTRACT

Objective: Determine the relationship between socio-demographic characteristics, knowledge, and good practices in anemic children and anemic child healthcare in Arequipa, Peru. **Study design:** This is a cross-sectional survey. Participants were asked about their knowledge of childhood anemia, practices related to caring for anemic children, and adherence to treatment. **Methods:** This is a descriptive, transversal, relational field study. Three hundred mothers with anemic children were interviewed, from six districts of Arequipa, distributed at different geographic altitudes: medium-

altitude, great-altitude, and sea level. Studied variables were related to socio-demographic factors, level of knowledge, anemic children care-related practices, and treatment adherence. **Results:** 77.3% of children had mild anemia, 21.6% moderate, and 1% severe anemia. The number of children and disease severity were significantly related ($p<0.05$) to knowledge about anemia. Knowledge about anemia, living area, and geographic altitude were significantly correlated ($p<0.05$) with good practices in child anemia. **Conclusion:** the prevalence of anemia in the region of Arequipa is incremented by socio-economic factors, mother's education, number of children, altitude, and geographic zone. The implementation of mother-centered educational programs by the government is necessary. In this sense, the results suggest further studies in social representations to understand, analyze and deepen the knowledge of the subject.

Keywords: sociodemographic factors, knowledge, practices, mothers, childhood anemia, altitudes.

INTRODUCTION

Anemia is considered an alarming global public health issue. Worldwide, 42% of children under five years old are anemic¹. In Peru, the highest prevalence of anemia was found in the highlands, being the most affected Regions: Puno (69.9%), Cusco (57.4%), and Huancavelica (54.2%). In Arequipa, this proportion reaches a 33.9%².

As described by the causal model proposed by Balarajan, one of the causes of the prevalence of anemia is the lack of access to knowledge and education related to anemia³. Studies developed in developing nations like Indonesia, Ethiopia, Tanzania, Iraq, and Tunisia; showed that an adequate level of knowledge in anemia impacted iron-rich food intake, ferrous sulfate supplements, and the follow-up of treatments by healthcare professionals⁴⁻⁸. Several studies also recognize that anemia impairs growth speed and

cognitive function in children⁹; therefore, one of the prioritized interventions in the national prevention plan of the Peruvian's Health Minister's Office is educational sessions related to food intake for the prevention of anemia. In these sessions, families are reminded of the good practices and necessary knowledge to intake iron-rich food and iron supplements¹⁰. However, the reach of this initiative varied. Previous research in several Peruvian regions showed an impact between mothers' knowledge and the prevalence of anemic children; the level of knowledge was also poor or incomplete¹¹⁻¹³. Moreover, the knowledge level or social representations for preventing anemia in the Arequipa region is unknown. The present work aims to find a relationship between the level of knowledge and good practices for the prevention of anemia of mothers and the prevalence of anemia in children that have attended health centers belonging to the Arequipa-Caylloma Health Network.

MATERIAL AND METHODS:

Type and study design: This is an observational, relational field study. A cross-sectional survey.

Participants: Three hundred mothers of anemic children belonging to six districts from the Arequipa region were interviewed. The districts of different geographic altitudes of Arequipa region.

Sample and sampling: The sample consisted of 300 mothers of anemic children belonging to six districts of the Arequipa region. 50 mothers were chosen from each selected district of different geographical altitudes: medium altitude (Cerro Colorado,

Sachaca, Paucarpata), high altitude (Cabanaconde, Chivay) and altitude at sea level (Cocachacra).

Inclusion criteria: Mothers from 6 districts of Arequipa were invited, the criteria were to be mothers of children with anemia from 6 to 59 months of age, who have consented to be part of the study, who have completed all the interview questions.

Instrument: Two instruments were used: a form for the socio-demographic characteristics of mothers with anemic children; and a survey to test the knowledge level and good practices for handling children with anemia within 6 to 59 months of age. Previous studies have already validated the instruments.

Variables: As part of the socio-demographic characteristics of the mothers; the age, geographic altitude of the tested district (sea level, medium-altitude, great-altitude), marital status (single, cohabitant, married, divorced, widowed), level of instruction (primary school, secondary school, superior), employment (housewife, student, merchant, worker, etc.), area of residence (urban, marginal urban, rural), number of children, the severity of child anemia, age of the child with anemia, symptoms, treatment, as well as health record concerning child anemia were tested. For the comparison, the variable of marital status was recategorized with the term “without a couple” (for single, divorced, widowed) and “with a couple” (cohabitant and married).

The parameters proposed by the World Health Organization (OMS) for the anemia variable were used. In addition, a hemoglobin level under 11g/dl for anemia was considered, being classified as mild (10-10.9 g/dl), moderate (7.0-9 g/dl), and severe (<7 g/dl)¹³. For the analysis, the variable was dichotomized, considering two categories: mild and moderate/severe. A test with 12 questions was used to determine the knowledge level about child anemia. The questions were related to the definition of anemia, symptoms,

diagnosis, Hb levels, long-term consequences of anemia, prevention, and treatment adherence. The results were calculated by range: good (8-12 points), average (4-7 points), and poor (0-3 points).

Procedures: A survey of 15 questions was performed to evaluate the good practices in the care of child anemia. The survey was associated with breastfeeding introduction, care and measures on food for the anemic child, type and frequency of iron-rich food intake, iron supplements administration, and other practices associated with child healthcare. The answers were analyzed individually as adequate or not adequate.

Statistical analysis: The data was curated in an Excel systematization matrix according to the variables' nature. Subsequently, they were analyzed with the statistical program STATA v16. The categorical variables were accordingly presented as frequencies and percentages for the descriptive analysis. Given their categorical nature, the chi-square test or the Fisher test were used for the bivariate analysis.

The Poisson generalized linear model was developed to understand the associated factors to the level of good practices in child anemia, following a logarithmic link function and robust variance. The crude (cPR) and adjusted (aPR) prevalence ratios were calculated with the respective confidence interval (CI) of 95%. The adjusted analysis was performed considering confounding variables determined by statistical criteria ($p < 0.2$) used in the crude analysis. Collinearity was calculated with variance inflation factors considering a cut-off point of less than 5. A value of p under 0.05 was considered statistically significant for all the subsequent analyses.

Ethical aspects

This study is part of the research project “Anemia in children from Arequipa: molecular and epidemiological practices” approved by the research ethics committee with a favorable opinion, 330-2021 CIEI-UCSM. Informed consent was obtained from the participants.



RESULTS:

In total, 300 mothers of anemic children between 6 and 59 months of age from six districts at different geographical altitudes of Arequipa, Peru were interviewed, including 50 mothers per district.

Sample characteristics

Regarding children, 60.67% were 6 to 23 months of age, and mild anemia was the most frequent (77.33%). According to the mothers, 8.33% showed all symptoms related to child anemia; 11.33% showed several symptoms, being increased sleep (36%) and low appetite (30%) being the most frequent. A vast majority of children were undertaking treatment against anemia (99.67%). Concerning mothers, 39% were between 18 and 25 years of age, 83.33% had completed high school, 49.33% were cohabitants, 47.05% were homemakers, and 50% lived in districts located at medium geographic altitude, and only 40% had two children. The data on the knowledge level for child anemia showed that 79% had an average score; a large majority reported inadequate good practices for child anemia (55.76%). All the characteristics are shown in **Table N°1**.

Table N°1. General characteristics of mothers and children included in the study (N=300).

Characteristics	n	%
Children variables		
Age (months)		
6 to 23	182	60.67
24 to 59	118	39.33
Severity of anemia		
Mild	232	77.33
Moderate	65	21.67
Severe	3	1.00
Symptoms		
No symptoms	2	0.67
Increased sleep	108	36.00
Low appetite	90	30.00
Irritability	12	4.00
Fatigue	9	3.00
Dizziness	0	0.00
Headache	0	0.00

Growth alterations	4	1.33
Low school performance	2	0.67
Paleness	14	4.67
Other symptoms	34	11.33
All symptoms	25	8.33
Treatment for child anemia		
No	1	0.33
yes	299	99.67
Mother variables		
Age (years)		
18-25	117	39.00
26-30	83	27.67
31-35	61	20.00
36-40	39	13.00
Level of instruction		
Primary school	22	7.33
High school	250	83.33
Higher education	28	9.33
Marital status		
Single	59	19.67
Cohabitant	148	49.33
Married	71	23.67
Separated/divorced	21	7.00
Widowed	1	0.33
Occupation		
Housewife	141	47.15
Student	9	3.01
Merchant	62	20.74
Worker	42	14.05
Others	45	15.05
Area of residence		
Urban	25	8.33
Marginal urban	75	25.00
Rural	200	66.67
Geographic altitude		
Sea level	50	16.67
Medium altitude	150	50.00
Great Altitude	100	33.33
Number of children		
One	93	31.00
Two	120	40.00
Three or more	87	29.00
Anemia during pregnancy		
Not known/Don't remember	15	5.00
No	135	45.00
Yes	150	50.00
Treatment against pregnancy anemia		
Not known/Don't remember	41	13.66
No	125	44.67
Yes	134	41.67
Information received concerning child anemia by health establishment		
Not known/Don't remember	27	9.00
No	137	45.67
Yes	136	45.33

Housewife	30	50.00	109	46.18	2	66.67	
Student	1	1.67	8	3.39	0	0.00	
Merchant	11	18.33	50	21.19	1	33.33	
Worker	11	18.33	31	13.14	0	0.00	
Others	7	11.67	38	16.10	0	0.00	
Area of residence							0.309
Urban	7	11.67	18	7.59	0	0.00	
Marginal urban	17	28.33	56	23.63	2	66.67	
Rural	36	60.00	163	68.78	1	33.33	
Geographic altitude							0.306
Sea level	6	10.00	44	18.57	0	0.00	
Medium altitude	33	55.00	114	48.10	3	0.00	
Great altitude	21	35.00	79	33.33	0	0.00	
Number of children							0.033
One	12	20.00	80	33.76	1	33.33	
Two	33	55.00	85	35.86	2	66.67	
Three or more	15	25.00	72	30.38	0	0.00	
Pregnancy anemia							0.116
Doesn't know/remember	7	11.67	8	3.38	0	0.00	
No	26	43.33	108	45.57	1	33.33	
Yes	27	45.00	121	51.05	2	66.67	
Treatment against gestational anemia							0.469
Doesn't know/remember	10	16.67	31	13.08	0	0.00	
No	29	48.33	95	40.08	1	33.33	
Yes	21	35.00	111	46.84	2	66.67	
Received information about child anemia in a health establishment							0.588
Doesn't know/remember	6	10.00	21	8.86	0	0.00	
No	32	53.33	104	43.88	1	33.33	
Yes	22	36.67	112	47.26	2	66.67	

*Fisher's test

In addition, after performing the bivariate analysis according to the level of good practices in child anemia, a significant difference was found between anemia severity, level of knowledge about child anemia, place of origin, and geographic altitude (**Table N°3**).

Table N°3. General characteristics of mothers and children according to good practices in child anemia of mothers with anemic children.

Characteristics	Child anemia good practices				p-value
	Inadequate (n=167)		Adequate (n=133)		
	n	%	n	%	
Child variables					
Age (months)					0.133*
6 to 23	95	52.20	87	47.80	
24 to 59	72	61.02	46	38.98	
Severity of anemia					<0.001**

Mild	103	44.40	129	55.60	
Moderate	61	93.85	4	6.15	
Severe	3	100.00	0	0.00	
Treatment for child anemia					0.557**
No	1	100.00	0	0.00	
Yes	166	55.52	133	44.48	
Mother variables					
Knowledge of child anemia					0.011**
Poor	41	68.33	19	31.67	
Average	126	53.16	111	46.84	
Good	0	0.00	3	100.00	
Age (years)					0.826*
18-25	68	58.12	49	41.88	
26-30	44	53.01	39	46.99	
31-35	35	57.38	26	42.62	
36-40	20	51.28	19	48.72	
Level of instruction					0.601*
Primary school	14	63.64	8	36.36	
High school	136	54.40	114	45.60	
High education	17	60.71	11	39.29	
Marital status					0.154**
Single	36	61.02	23	38.98	
Cohabitant	86	58.11	62	41.89	
Married	31	43.66	40	56.34	
Separated	13	61.90	8	38.10	
Widowed	1	100.00	0	0.00	
Occupation					0.554**
Housewife	85	60.28	56	39.72	
Student	5	55.56	4	44.44	
Merchant	30	48.39	32	51.61	
Worker	24	57.14	18	42.86	
Others	23	51.11	22	48.89	
Area of residence					0.014*
Urban	7	28.00	18	72.00	
Marginal urban	43	57.33	32	42.67	
Rural	117	58.50	83	41.50	
Geographic altitude					0.003*
Sea level	31	62.00	19	38.00	
Medium altitude	69	46.00	81	54.00	
Great Altitude	67	67.00	33	33.00	
Number of children					0.332*
One	46	49.46	47	50.54	
Two	69	57.50	51	42.50	
Three or more	52	59.77	35	40.23	
Anemia in pregnancy					0.142*
Doesn't know/remember	12	80.00	3	20.00	
No	72	53.33	63	46.67	
Yes	83	55.33	67	44.67	
Treatment for pregnancy anemia					0.930*
Doesn't know/remember	23	56.10	18	43.90	
No	71	56.80	54	43.20	
Yes	73	54.48	61	45.52	
Received information about child anemia					0.916*

Doesn't know/remember	15	55.56	12	44.44
No	78	56.93	59	43.07
Yes	74	54.41	62	45.59

*Chi-square test; **Fisher's exact test.

Factors associated to good practices in child anemia

The adjusted multivariate analysis was used to determine the associated factors to good practices in child anemia. The factors: good level of knowledge about child anemia (aPR: 1.56; 95% CI: 1.02-2.39; p=0.038) and having a merchant occupation (aPR: 1.35; 95% CI: 1.03-1.78; p=0.029), were associated with a higher prevalence adequate practices in child anemia. On the contrary, a moderate/severe level of anemia (aPR: 0.10; 95% IC: 0.04-0.25; p<0.001) and a marginal urban household (aPR: 0.55; 95% CI: 0.40-0.77; p<0.001) were associated with a lower prevalence of adequate practices in child anemia (Table N°4).

Table N°4. Crude and adjusted models to evaluate the associated factors to adequate practices in child anemia in mothers with anemic children.

Exposition	Adequate practices in child anemia					
	Crude model ^a			Adjusted model ^{a,b}		
	PR	95% CI	p-value	PR	95% CI	p-value
Child variables						
Age (months)						
6 to 23	Ref.	---	---	Ref.	---	---
24 to 59	0.82	0.62-1.07	0.142	0.96	0.74-1.24	0.744
Severity of anemia						
Mild	Ref.	---	---	Ref.	---	---
Moderate/Severe	0.11	0.04-0.28	<0.001	0.10	0.04-0.25	<0.001
Mother variables						
Knowledge about child anemia						
Poor	Ref.	---	---	Ref.	---	---
Average	1.48	0.99-2.20	0.053	0.81	0.59-1.12	0.205
Good	3.16	2.18-4.58	<0.001	1.56	1.02-2.39	0.038
Age (years)						
18-25	Ref.	---	---			
26-30	1.12	0.82-1.53	0.471			
31-35	1.02	0.71-1.46	0.924			Not evaluated*
35-40	1.16	0.79-1.71	0.444			
Level of instruction						
Primary school	Ref.	---	---			Not evaluated*
High school	1.25	0.71-2.22	0.436			

Higher education	1.08	0.53-2.22	0.834			
Marital status						
Without couple	Ref.	---	---			Not evaluated*
With couple	1.22	0.89-1.66	0.216			
Occupation						
Housewife	Ref.	---	---	Ref.	---	---
Student	1.12	0.52-2.39	0.772	1.14	0.59-2.20	0.700
Merchant	1.30	0.95-1.78	0.104	1.35	1.03-1.78	0.029
Worker	1.08	0.72-1.62	0.712	1.19	0.84-1.70	0.330
Others	1.23	0.86-1.77	0.261	1.23	0.89-1.72	0.212
Area of residence						
Urban	Ref.	---	---	Ref.	---	---
Marginal urban	0.59	0.41-0.85	0.004	0.55	0.40-0.77	<0.001
Rural	0.58	0.43-0.77	<0.001	0.78	0.59-1.04	0.091
Geographic altitude						
Sea level	Ref.	---	---			
Medium attitude	1.42	0.97-2.09	0.073	1.45	0.98-2.15	0.064
Great altitude	0.87	0.55-1.36	0.540	1.13	0.74-1.73	0.559
Number of children						
One	Ref.	---	---	Ref.	---	---
Two	0.84	0.63-1.12	0.242	0.89	0.69-1.14	0.353
Three or more	0.80	0.57-1.10	0.170	0.81	0.60-1.09	0.170
Anemia in pregnancy						
No	Ref.	---	---	Ref.	---	---
Yes	0.96	0.74-1.23	0.470	1.03	0.82-1.29	0.778
Doesn't know/remember	0.43	0.15-1.20	0.107	0.46	0.17-1.28	0.139
Treatment for pregnancy anemia						
No	Ref.	---	---			
Yes	1.05	0.80-1.39	0.708			Not evaluated*
Doesn't know/remember	1.02	0.68-1.52	0.937			
Received information about child anemia						
No	Ref.	---	---			
Yes	1.06	0.81-1.38	0.675			Not evaluated*
Doesn't know/remember	1.03	0.65-1.64	0.894			

PR: Prevalence ratio, **95%CI:** 95% confidence interval

^a General lineal model from Poisson family with robust variances and logarithmic linked function. ^b Adjusted for child's age, severity of anemia, occupation, place of origin, geographic altitude, number of children and anemia during pregnancy.

* Not evaluated due to not fitting statistical criteria. No evaluado por no cumplir con criterio estadístico.

DISCUSSION

Anemia is a condition where the hemoglobin (Hb) level is below normal values of 11 g/dL¹⁴. In children, a prolonged state of anemia could significantly harm development and learning¹⁵. For this reason, it is essential to establish suitable prevention measures

among populations. Therefore, the present work aims to determine the relationship between the level of knowledge and good practices with the characteristics of mothers with anemic children and levels of anemia, evaluated in a sample of 300 mothers from 6 districts at different geographical altitudes of Arequipa, Peru.

Among the results shown, most families lived in rural areas, and the most frequent mother's occupations were housewife and merchant, which also showed an unstable income. Additionally, most mothers' instruction level was limited, not surpassing high school education. These results show an economic and educational disadvantage that is statistically significant to anemia prevalence. The study made by Yang et al, a higher prevalence of childhood anemia in countries with low resources was found, compared to those in development in 40%¹⁶, showing a similar tendency to the results found in this study. Likewise, the study of Dornea shows a high anemia prevalence in children that live in rural areas with poor living conditions¹⁷.

Mother's education also plays an important role. Only one out of ten interviewed mothers had higher education, while eight out of ten had finished high school. Even if there is no statistical significance, the assimilation of prevention methods, nutrition concepts, and overall knowledge could impact the prevention of anemia. Other studies performed in countries with isolated communities and low economic resources also showed that poverty and a low level of instruction determined the prevalence of child anemia¹⁸⁻²⁰.

Another variable with mixed results was the number of children. This parameter was found non-statistically significant for good practices in anemia but significant for knowledge of mothers in child anemia. In our study, 6 out of 10 mothers with inadequate practices had three or more children, and their level of knowledge varied from poor to fair. This tendency could be related to the government's poor implementation of

contraception methods. Consequently, large families' low resources are insufficient to feed all their children²¹, which translates to malnutrition and anemia. In the work of Asghari et al, a significant inverse correlation was found between hemoglobin concentration and the number of pregnancies, infants, and family members²²; thus, anemia was more prevalent in large families.

We found a significant impact between the place of origin, geographic altitude, and good practices in anemia. Six out of ten interviewed mothers lived in rural areas of Arequipa, mainly shanty towns. These areas reflect the lack of electric services, water, and sewage or health establishments, which could contribute to the prevalence of malnutrition and anemia. Likewise, the isolation and remoteness of these emplacements hinder the implementation of health programs, iron supplement treatments, follow-up, and mother's education in anemia prevention. Several studies show the same results, where the rural area presents a higher prevalence of child anemia^{17,23,24}, and the gap between rural and urban areas is the consequence of the socioeconomic factors described previously^{23,25-27}, it is necessary to remember that the high prevalence of anemia in high areas according to various studies, would be explained due to the adjustment criteria of geographic altitude

28.

Our study has limitations. First, the cross-sectional design does not allow for establishing causal relationships between the variables analyzed. However, the design does allow for establishing associated factors. Second, the study could have biases derived from surveys such as memory bias and social desirability bias. However, the interviews were conducted by trained personnel who urged the participants to be honest. Third, the surveyed areas were arbitrarily selected and could not represent the entire Arequipa region. Despite this, it is one of the first studies to study this health problem in various altitudinal floors of the

Arequipa region. Finally, it was impossible to obtain variables such as income, nutritional status, or characterization of the diet that could be taken into account for future research.

Socio-demographic and geographic factors impact knowledge related to anemia and adequate practices in child anemia in the Arequipa region. Children of large families with low resources are the most affected due to the inverse relation between access and distance to healthcare establishments, manifesting structural violence. Mother's education also impacts the acquisition of knowledge related to anemia and good practices in anemia prevention. Likewise, larger families are de most affected. These results demonstrate the need for an adjustment to government plans against anemia, concentrating on parents' education, the follow-up of treatments and uptake of iron supplements, and the support of rural areas and emplacements with low resources. It is also necessary to deepen de knowledge in the area with further research, specially related to social representations in anemia. Social representations constitute their own socio-cognitive constructions through common sense, representing a form of knowledge²⁹ socially elaborated and shared through mothers that is oriented to social and communal reality. In this sense, the study of these social representations could be important to understand, analyze and give more depth to the knowledge and practices of mothers related to anemia, aiming to generate future recommendations on the subject³⁰.

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