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ORIGINAL ARTICLE

PREVALENCE OF NUTRITIONAL DEFICIENCIES AND MORBIDITY BY INFECTIOUS DISEASES IN CHILDREN 0-5 YEARS OF AGE IN IÑAPARI IN THE PERUVIAN AMAZON

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ABSTRACT

Introduction: Iñapari is a town located in Peru, on the border of Brazil, between the Amazonian states of Acre and Amazonas. The local Peruvian children under five years of age present moderate anemia while the percentage of chronic child malnutrition is a major public health problem in the country as a whole. Goals: The purpose of this study was to identify the prevalence of major childhood morbidities caused by anemia, malnutrition, intestinal parasites, toxocariasis, and hepatitis A, and identify connections with the socioeconomic and environmental conditions found in Iñapari. *Methods*: Interviews with questionnaires; anthropometric measurements, collection of feces and venous blood samples. *Results*: A 20% prevalence of anemia and 8.5% prevalence of chronic malnutrition (height for age deficiency) was found. A pathogenic intestinal parasite was noted in 24.5% of the samples, where *Giardia intestinalis* (14.7%) was the most frequent. The seroprevalence of toxocariasis was 33.8% and hepatitis A was 21.2%. *Conclusion*: There is a connection between the results found and the poor living and sanitary conditions of the population. The low income noted is also linked to the malnutrition and anemia detected.

KEY WORDS: Anemia; child nutrition disorders; intestinal parasites; toxocariasis; hepatitis A; child health.

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RESUMO

Prevalência de deficiências nutricionais e morbidade por doenças infecciosas em crianças de 0 a 5 anos de idade no município de Iñapari, na Amazônia Peruana

Introdução: A cidade de Iñapari localiza-se no Peru e faz fronteira com a região Amazônica brasileira pelos estados do Acre e Amazonas. As crianças peruanas menores de 5 anos padecem com moderado percentual de anemia e a desnutrição crônica infantil constitui um dos principais problemas de saúde pública no país. O objetivo deste estudo foi levantar a prevalência das principais morbidades da infância, como anemia, desnutrição infantil, parasitoses intestinais, toxocaríase e hepatite A, e investigar a associação entre elas e as condições socioeconômicas e ambientais encontradas em Iñapari. *Métodos*: Foram realizadas entrevistas com base em questionários, assim como a relação das medidas antropométricas, a coleta de amostra de fezes e a coleta de sangue venoso. *Resultados*: Dentre os resultados encontrados, destaca-se a prevalência de anemia de 20%, desnutrição crônica avaliada pelo déficit de altura para a idade de 8,5%, presença de patógenos em 24,5% das amostras de fezes tendo como principal patógeno *Giardia intestinalis* (14,7%), prevalência de toxocaríase de 33,3% e de hepatite A de 23,3%. *Conclusão*: Neste estudo ficou evidenciada a associação entre os desfechos e as más condições de moradia e higiene da população. A baixa renda mostrou-se claramente associada à presença de desnutrição e anemia.

DESCRITORES: Desnutrição infantil; toxocaríase, hepatite A; parasitoses intestinais; anemia; Amazônia.

INTRODUCTION

Children are susceptible to various diseases. Mainly anemia (Albanto, 2012), malnutrition (Albanto, 2012), intestinal parasites, and diseases transmitted through water, such as hepatitis (Franco et al., 2012).

Anemia, defined as an insufficient amount of hemoglobin (World Health Organization, 2011), is more frequent in children with iron deficiency (Albanto, 2012). Among the groups most vulnerable to iron deficiency anemia are children aged 6 to 24 months, especially in their first year of life, when starting complementary feeding (Hadler et al., 2009).

Malnutrition is the result of an inadequate intake of food, and can impair child development. The height for age index, which measures linear growth, is the most frequently used indicator for the assessment of chronic malnutrition, and when off standard, indicates that growth has been impaired. This method is routinely used in studies on malnutrition (Araújo, 2010; Cobayashi et al., 2013; Souza et al., 2012).

Children are most susceptible to intestinal parasites due to deficiencies in personal and environmental hygiene. Intestinal parasitic infections in children need special attention because of the alterations these can cause, such as malnutrition, anemia, iron deficiency, diarrhea which, along with other factors, may delay child development (Araújo, 2010). The main intestinal parasites are *Giardia intestinalis, Entamoeba histolytica / dispar*, and helminths. Toxocariasis is also prevalent in children.

The hepatitis A virus is the most common form of viral hepatitis in children. Transmission is fecal-oral and its prevalence is associated with socioeconomic indicators, sanitation and hygiene, as well as access to clean drinking water (Franco et al., 2012).

Peru, a country that borders Brazil, was ranked 82nd out of 187 countries in the global Human Development Index in 2014 (Programa das Nações Unidas para o Desenvolvimento, 2013). In Peru, 30.7% of under-five children had anemia in 2011, and there was a higher prevalence in children living in the countryside (38.6%) and in the Andean mountains (39.9%) (Instituto Nacional de Estadistica e Informatica, 2011). Chronic child malnutrition is a major public health problem in Peru, and in 2011 was present in 15.2% of the Peruvian children under five. In the region of the Peruvian Jungle, the prevalence was 21.2% in 2011. (Instituto Nacional de Estadistica e Informatica, 2011).

The hepatitis A virus infects 212 million people each year, including 55 million symptomatic cases and 35,245 deaths in 2011 (World Health Organization, 2011). The prevalence of hepatitis A in some Latin American countries was over 50% in children aged 1 to 5. A study in Peru in 2000 showed a 46.3% seroprevalence of hepatitis A virus in 1-14 year-old children (Tanaka, 2000).

The purpose of this study was to identify the prevalence of major childhood morbidities such as anemia, child malnutrition, intestinal parasites, toxocariasis, and hepatitis A, and detect associations with the socioeconomic and environmental conditions found in Iñapari in Peru, a region that borders the Brazilian state of Acre.

MATERIALS AND METHODS

Study Area

The study was performed in Iñapari, located on the border of Acre, Brazil and Bolpebra, Bolivia. Iñapari, is the capital of the 21,126 km^2 Tahuamanu province located in the department of Madre de Dios, 241 km from Puerto Maldonado. The population was 996 inhabitants in 2007, and the estimated population for 2010 was 1,434 (Instituto Nacional de Estadística y Informática, 2010).

Study design and population

In this population-based census, the population investigated consisted of all the children living in the urban area of Iñapari, Peru, in 2011 (Figure).

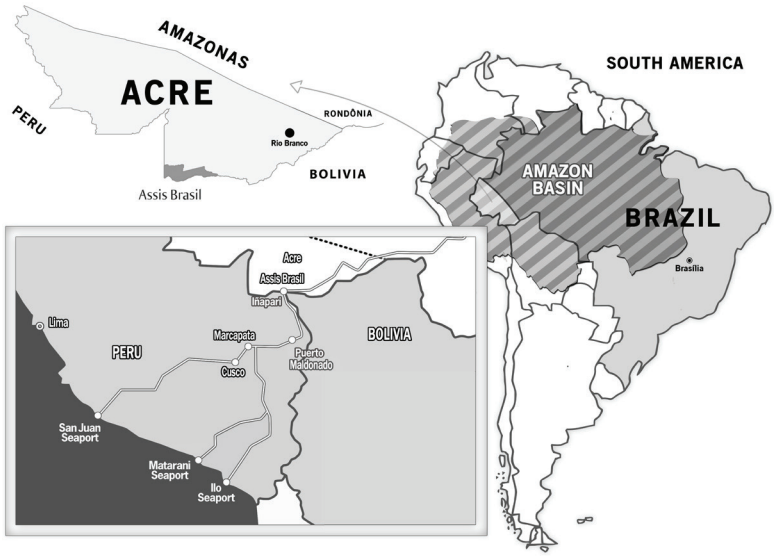

Figure. Map of the Brazilian and Peruvian border, showing the location of Iñapari.

The children were located using the census records of the local community health workers. All 108 children aged 0 to 59 months of age living in the urban area of the town participated. Data was collected in January and February 2011, by means of family interviews using structured questionnaires to investigate the following: Family socio-economic status, i.e., family income, age and education of parental figures, whether or not benefiting from social assistance, household ownership and number of persons living in the house; sanitation and housing conditions (type of construction and house flooring, household connection to the sewer system, source and treatment of water supply, piped water supply, waste collection and disposal, presence of open sewers near the home, type of toilet, presence of electric power, susceptibility to rain floods, presence of animals in the house); child demographic information (age, gender, ethnicity); quality of child care (attending a day care center or school, living with one or both biological parents, being breastfed), occurrence and treatment of previous or present intestinal parasitosis, occurrence of previous morbidities in the family in the past 12 months, and in the past 15 days, and access to health care over the previous year.

The interviews were conducted by medical students, a Peruvian medical doctor, a Peruvian biologist with a Master degree in Public Health, under the supervision of a project coordinator. 108 children 0 to 59 months of age residing in the urban area of Iñapari were studied after their parents or guardians signed the informed consent authorization papers.

Anemia

The haemoglobin level was evaluated using venous blood tested in a portable hemoglobinometer (Hemocue, Angelholm®). Anemia was defined by hemoglobin levels lower than 11 g/dL in children between 6 and 59 months of age, according to the Brazilian Ministry of Health guidelines (Ministério da Saúde , 2013).

Nutritional evaluation

A digital pediatric weighing machine (Soehnle®) with 10g accuracy and a maximum capacity of 16 kg was used for weighing children under 2 years of age. For children over 2, a portable digital scale (Plenna®) with 100g accuracy and maximum capacity of 150 kg was used. The length of children under 2 was obtained by a portable infantometer with 1cm accuracy, placed on a flat surface. The height of children over 2 years of age was measured by using a wooden stadiometer with 0.1 cm accuracy fixed to a wall with no skirting boards at a 90° angle to the floor. All anthropometric measurements were performed in duplicate. When the two measurements were discrepant, a third measurement was taken, and the two closest were selected. The mean value of duplicates generated indicators in the form of height-for-age (HAZ) Z-scores. Values from the World Health Organization (World Health Organization 2006) were used as a reference and calculated by using WHO Anthro software v.3.2.2 (Department of Nutrition, WHO, Geneva). The cut-off points were the following: for undernutrition $\leq$ -2 HAZ and for overweight $\geq$ +2 WHZ (World Health Organization, 1995). The same routine was applied for children over 2 years and was also used for measuring the mothers' weight and height. The body mass index value established by the World Health Organization was used as reference (World Health Organization, 1998). The anthropometric examination was performed by a nutritionist.

Stool sample examination

All children included in the study received a sample collector with 10% formalin. Up to three house visits were performed to collect stool samples. Stool samples were examined for intestinal parasite eggs, cysts, and larvae according to a standard sedimentation-concentration method (Hoffman et al., 1934). Logistic limitations prevented the collection of more than one stool sample from each subject. Although parasite prevalence rates derived from the examination of a single stool sample are likely to be underestimated, this bias is considered to be relatively small for most common intestinal nematodes in humans (Gyorkos et al., 1989) except for *Strongyloides stercoralis*.

Sample collection and Antibody detection

Venous blood was collected in sterile vacuum tubes containing a clot activator. Samples were centrifuged and serum was separated and stored at –20°C for testing. Venous blood was collected from children aged 6 to 59 months only (n = 93 children). Only children whose parents agreed to the procedure had their blood taken, resulting in 83 samples collected.

Antigen preparation, preincubation of sera with Ascaris suum *adult worm extract (AWE) and Antibody detection for* Toxocara

Excretory-secretory larval antigen for ELISA was prepared as described by Elefant et al. (2006). To remove antibodies elicited by exposure to *Ascaris*, which could cross-react with *Toxocara* antigens (Romasanta et al., 2003) test samples were preincubated with an adult worm extract (AWE) of *Ascaris suum* (Elefant et al., 2006). Serum samples were tested for IgG antibodies to *Toxocara* excreted-secreted larval antigens by ELISA, at a dilution of 1:320 essentially as described (Elefant et al., 2006). Polystyrene 96-well microplates (Corning, Costar, New York, NY) were coated for 1 hour at 37°C, followed by 18 hours at 4°C with 1,9µg/mL of solid-phase antigen dissolved in 0.06 M carbonate-bicarbonate buffer, pH 9.6 (100µL/well), and subsequently blocked for 2 hours at 37°C with PBS-T containing 2.5% bovine serum albumin (Sigma, St. Louis, MO®). After a 40-min incubation at 37°C, serum samples were removed and horseradish peroxidase-conjugated goat anti-human IgG (Sigma) was added at a 1:10,000 dilution (40 min at 37°C), followed by the phenylenediamine substrate (0.4 mg/mL, Sigma). Absorbance readings were made at 492 nm; a cut-off absorbance value was defined as the mean absorbance reading for 96 negative control sera plus three standard deviations. Antibody levels were expressed as reactivity indices (RIs), which were calculated as the ratio between the absorbance values of each test sample and the cut-off value; positive samples had RIs greater than 1.

Antibody detection for hepatitis A virus

Serum samples were tested for total Ig antibodies to Hepatitis A virus using ELISA commercial kits (Diasorin ETI-AB-HAVK Plus, Diasorin, Italy®), following manufacturer´s instruction. Samples were classified as either positive or negative for the presence of antibodies against HAV. Only children older than 12 months were tested.

Statistical analysis

A database was created with SPSS 19.0 software (SPSS Inc., Chicago, IL). The distribution of the independent variables was identified using the Anova test to compare means, and Chi-square or Fisher tests for comparing frequencies or proportions with $\alpha = 0.05$ critical level.

Ethical considerations

This research was approved by the Ethics Committee in Research at the Federal University of Acre and by Instituto Nacional de Salud de Peru, under registration numbers 23107.008153/2010-92 UFAC and 2010-CI-59 – INS, respectively.

RESULTS

Child demographic characteristics and family socioeconomic characteristics

This study was performed with 108 children living in the urban area of Iñapari. There were 53.7% males and 46.3% females, with a mean age of 2.11 years. About 38.9% of the children were of brown ethnicity ("pardos"), 7.4% of them were white, 2.8% were indigenous, and 50.9% were of mixed races. 82.4%, of the children were Peruvian and 17.6%. were born in Brazil. The average length of time they had been living in Iñapari was 1.7 years.

77.8% of the children lived with both biological parents. About 15.7% lived only with their biological mother and 6.5% lived only with their biological father or with neither parent. The average age of the mothers was 28.3 years.

As for maternal education, 1.9% of the mothers had never been to school; 10.2% had attended primary school, 33.3% had attended high school and 5.6% had a university degree. Regarding the paternal figure, 2.8% of the fathers attended only primary school, 45.4% had a high school degree, and 7.4% had a university degree.

Regarding the ownership of the home, about 52.8% of the families owned a house, while 47.2% lived in a house that was rented, borrowed or had been informally taken over. 27.1% of the mothers and 94% of the fathers had had paid employment in the last 30 days. About 72.2% of the mothers did not have a personal income, 18.2% received less than two minimum wages (MW, equivalent to 650 US dollars), and 6.5% received between 2 and 5 MW. Only 3.7% of the fathers did not have any income in the previous 30 days. When asked if the family income was enough, 71.3% of the families stated that it was sometimes sufficient and sometimes insufficient, while 21.7% reported that their monthly income was more than sufficient.

Sanitary and housing conditions

77.8% of the houses were made of wood while only 22.2% were made of brick. 67.6% of the flooring was wood, while 32.4% was made of brick, cement or ceramic. 93.5% of the homes had electric power.

A bathroom with running water and flushing system was present in 32.4% of homes; 65.7% had a latrine, and 1.9% did not have any type of sanitary system. In 87.7% of the households the bathroom was only used by household members, while 12.3% shared with another family.

Only 43% of the children lived in a house connected to the public sewer system, 52.3% lived in houses that used a latrine for sewage disposal, and 4.7% disposed of waste directly into the environment. 89.8% of the children were living in a house with public garbage collection.

76.9% of the houses were connected to the public water system; 21.3% obtained water from a well and from the public system, and 1.9% from other sources. 64.8% of the children had access to piped water inside their houses; 26.9% had access to piped water outside their houses, and 8.3% had no access to piped water.

As for the drinking water used in the home, 47.2% of the children drank water from the public network, 20.4% drank mineral water, 13.5% drank water from wells, and 18.5% drank water from various sources.

About 56.5% of the children had access to filtered or boiled water, 25.9% received natural mineral water, 9.3% drank chlorinated water at home, and 8.3% had access to non-mineral water without any treatment. About 47.7% of the children lived in houses that were flooded when it rained; 44.4% and 28.7% lived in houses with dogs and cats, respectively.

Anemia

Hemoglobin levels were measured in 85 children aged 6 to 59 months. 20% presented anemia. Factors associated with the presence of anemia were drinking unboiled water (p=0.037), and monthly family income lower than R$ 689 (equivalent to US $ 415 at that time) (p=0.042) (Table 1).

Malnutrition

Chronic malnutrition, detected in height for age deficiency in 106 children, was present in 8.5%. Factors associated with the presence of malnutrition were drinking unboiled water (p=0.01), drinking chlorinated water (p=0.004) and monthly income lower than one minimum wage (R$ 540 or US $ 325) (p=0.019). There was an association between anemia and malnutrition (p=0.049). (Table 2).

Table 1. Prevalence of anemia and associated factors in children aged 6 to 59 months of age, Iñapari, Peru, 2011.

Variables (n = 85)	N	% anemia	p-value
Child age			
<2 y.o.	34	32.4%	
>= 2 y.o.	51	11.8%	0.02
Boiling of drinking water			
Yes	49	12.2%	
No	36	30.6%	0.037
Household ownership			
Owned	44	29.5%	
Rented/borrowed/invaded	41	9.8%	0.023
Family income			
<= 689 reais (~US$ 415)	18	38.9%	
> 689 reais (~US$ 415)	67	14.9%	0.042

Table 2. Prevalence of Height for age deficiency (HAD) and associated factors in children aged 6 to 59 months of age, Iñapari, Peru, 2011.

Variables (n = 106)	N	% HAD	p-value
Boiling of drinking water			
Yes	59	1.7%	
No	47	17%	0.01
Treatment of drinking water with chlorine			
Yes	16	31.2%	
No	90	4.4%	0.004
Household ownership			
Owned	44	29.5%	
Rented/borrowed/invaded	41	9.8%	0.023
Household income			
Income is sometimes not enough for living	76	5.3%	
Income is more than enough for living	24	20.8%	0.034
Family income			
<= 689 reais (~ 415 US dollars)	25	24%	
> 689 reais (~ 415 US dollars)	81	3.7%	0.005
Family income in the last 30 days			
Up to 1 BMW (~325 US dollars) *	14	28.6%	
More than 1 BMW (~325 US dollars)*	88	5.7%	0.019

*BMW = Brazilian Minimum Wage

Intestinal Parasitosis

The stool test was performed in samples from 102 children. Intestinal parasites were identified in 31.4% of the samples (n=70), but only 26.5% of the patients harbored a pathogenic intestinal parasite. 10.8% presented intestinal helminthes, (*Ascaris lumbricoides* in 3.9% and Ancilostomatidae in 6.9%); while the prevalence of *Giardia intestinalis* was 15.7%.

The presence of pathogens in the faeces was associated to factors such as age above 2 (p=0.001), having been treated for 'worms' in the last 6 months (p = 0.017), and the shared use of a sanitary facility with other families (p=0.017). Only age was connected to helminths, (p=0.004). As for *G. intestinalis*, the following factors were associated with the presence of the pathogen in the faeces: age older than 2 years (p=0.05), living in a wood house (p=0.036), and sharing a sanitary facility with other households (p=0.004). (Table 3).

Toxocariasis

The presence of toxocariasis antibody was tested in 71 children, with seroprevalence of 33.8%. The positive serology was associated with age above 2 years (P = 0.005), family income that was sometimes insufficient (p=0.036), drinking tap water or water from wells (p=0.001), drinking boiled, filtered or strained water (p=0.045) and the presence of helminths in the stool test (p=0.002). (Table 4).

Hepatitis A

66 children between 1 and 5 years of age were tested for hepatitis A virus antibody. The prevalence of positive serology for hepatitis A (total Ig) was 21.2%. The variables that were associated with positive serology were families receiving some government assistance (p=0.019), and sharing sanitary facilities with other households (p=0.023). (Table 5).

Table 3. Prevalence of intestinal parasites and associated factors in children aged 6 to 59 months, Iñapari, Peru, 2011.

Variables (n = 102)	N	% of positive outcome	p-value
Outcome: Positive fecal test for intestinal parasites			
Child age			
<2 y.o.	51	9.8%	
>= 2 y.o.	51	39.2%	0.001
Has received treatment for intestinal parasites in the last 6 months?			
Yes	39	38.5%	
No	63	15.9%	0.017
Sanitary facility use			
Exclusive of own family	87	20.7%	
Shared with other families	13	53.8%	0.017
Outcome: presence of helminths in the fecal test			
Child age			
<2 y.o.	51	2%	
>= 2 y.o.	51	19.6%	0.004
Outcome: presence of *Giardia intestinalis* in the fecal test			
Child age			
<2 y.o.	51	7.8%	
>= 2 y.o.	51	21.6%	0.05
House type			
Brick	21	0%	
Wood or others	81	18.5%	0.036
Sanitary facility use			
Exclusive of own family	87	10.3%	
Shared with other families	13	46.2%	0.004

Table 4. Prevalence of positive serology for *Toxocara* spp. and associated factors in children aged 6-59 months old, Iñapari, Peru, 2011.

Variables (n = 71)	N	% positive serology	p-value
Child age			
<2 y.o.	21	9.5%	
>= 2 y.o.	50	44.0%	0.005
Household income			
Income is sometimes not enough for living	51	39.2%	
Income is more than enough for living	17	11.8%	0.036
Source of drinking water			
Only bottled water	13	7.7%	
Only water from public system	34	50.0%	
Only water from wells	13	46.2%	
Several sources	11	0%	0.001
Treatment of drinking water			
Non-bottled, untreated water	7	42.9%	
Bottled, untreated water	15	6.7%	
Boiling, filtering or straining	43	44.2%	
Only chlorine addition	6	16.7%	0.045
Intestinal parasite in the fecal exam			
No	40	17.5%	
Yes	28	53.6%	0.002

Table 5. Prevalence of positive serology for hepatitis A virus and associated factors in children aged 6 to 59 months, Iñapari, Peru, 2011.

Variables (n = 66)	N	% positive serology	p-value
Receives any type of governamental financial aid			
Yes	42	31.0%	
No	24	4.2%	0.010
Sanitary facility use			
Exclusive of own family	57	17.7%	
Shared with other families	8	55.6%	0.037

DISCUSSION

The sociodemographic characteristics of Iñapari are common in Amazonian municipalities. Ramalho et al. (2013) studied the socioeconomic characteristics of families with children under 5 in Assis Brazil, a town on the Brazilian side of the border. Both towns present a predominance of wood floor houses with latrines and the ingestion of non-filtered bottled water, boiled water or untreated water. These characteristics show the predominance of both low income and education levels, which are usual in families living in the Amazon. Also, the frequency of unemployed mothers is high in both towns (32.2% in Assis Brazil and 27.1% in Iñapari).

The prevalence of anemia in this study was 20%, lower than that found in a national survey in Peru (30.7%) with children under five years of age (Instituto Nacional de Estadistica e Informatica, 2011). Castro et al. (2011) detected 29.2% of anemia in a study conducted in two towns in the state of Acre (Assis Brazil and Acrelandia). Oliveira et al. (2011) reported a prevalence of 57.3% of anemia in children in Jordão (Acre), a Brazilian town also on the Peruvian border which presented the second lowest Human Development Index (HDI) in Brazil in 2000 (PNUD, 2000). Carvalho-Costa et al (2007) also described a prevalence of 51.1% of anemia in Santa Isabel do Rio Negro, in the State of Amazonas in the Brazilian Amazon, reflecting general poor health conditions in small Amazonian towns.

Several studies (Castro et al., 2011; Instituto Nacional de Estadistica e Informatica, 2011; Oliveira et al., 2011) noted an association of anemia with the below two age group. This can be explained, in part by early weaning and poor health conditions resulting in morbidities (Garcia et al., 2011), and is also due to an incorrect diet of starch and powdered milk. The lack of gender differences in the anemic children analyzed is consistent with other studies (Onis et al., 2000), demonstrating that the disease manifests itself equally in both sexes.

Castro et al. (2011) also found an association between lower values for height/age with anemia and iron deficiency anemia. In fact, anemia affects growth and physical development of children and can lead to decreases in stature. Also, malnutrition can alter the concentration of hemoglobin as an adaptive mechanism because of dietary deprivation.

Malnutrition remains an important public health problem, especially in the developing world. Latin America presents 12.6% chronic child malnutrition (Rissin et al., 2006). The prevalence of malnutrition in Iñapari (8.5%) was similar to that in other Amazonian towns in the state of Acre such as Acrelândia (Cobayashi et al., 2013) and Assis Brazil (Ramalho et al., 2013). In addition, Carvalho-Costa et al. (2007) suggests that family income strongly influences the nutritional condition of children, contributing to food deficiency, which was also noted in Iñapari.

The Amazon has undergone unplanned urbanization processes without the development of adequate sanitation systems, often causing conditions for the onset and spreading of diseases. Moreover, the ingestion of untreated water can cause infectious diseases such as diarrhea, leading to malnutrition (Komagome et al., 2007).

Intestinal parasitism has social and environmental determinants, with a high prevalence in areas with lack of proper sanitation and potable water, low levels of education and lack of adequate housing. Carvalho-Costa et al. (2007) revealed a high prevalence (77,2%) of parasitism in the Amazon. In Iñapari, the prevalence was not as high (24.5%), but there was a significant association between the parasite *Giardia duodenalis* with the precariousness of the households. Peruvian studies have shown the existence of precarious home environments (with untreated water and use of shared toilets) (Gyorkos et al., 1989).

As in other studies (Jimenez et al., 2013; Roldán et al., 2010; Teixeira et al., 2007) in Iñapari a higher incidence of intestinal parasites among pre-school children aged 2 – 5 was noted in comparison with children under 2 years of age. This can be explained by greater autonomy and increased contact with soil in older children, together with the ingestion of unwashed raw food and untreated water.

Oliart-Guzman et al. (2014) conducted a study in the neighbouring town of Assis Brazil, and detected 28% of anti -*Toxocara* antibodies in children 0-5 years old, where for each year of life the chances of having a positive test increased by 114%. Roldán et al. (2010) also conducted a study analyzing the prevalence of anti-*Toxocara* antibodies in the general population of the Peruvian town Yurimaguas, and found that the overall frequency of antibodies was 35.7%, with a significantly higher proportion of positivity in 1 – 10 year-old children. In this study there was an incidence of 33.8% toxocariasis, associated with ages older than two years (P = 0.012), which is similar to the toxocariaris epidemiology noted in Assis Brazil, Acre.

Oliart-Guzman et al. (2014) also reported that previous history of intestinal helminths was an important factor associated with the presence of antibodies to *Toxocara* spp. This study noted that the presence of helminths in stools is similarly associated with positive antibodies against *Toxocara* spp. ($p<0.001$). Roldán et al. (2010) stated that 56.1% of his population study presenting positive serology for Toxocara was infected with at least one intestinal parasite, but the association did not prove significant (chi-square = 0.93; p = 0.334; OR = 1.26).

In populations where there is an intermediary prevalence of the hepatitis A virus (HAV), infection occurs on average between 6 and 7 years of age (Heriberto et al., 2002). In children from Iñapari the prevalence of positive serology for hepatitis A (total Ig) was 21.2%. Heriberto et al. (2002) also found, in a study performed in Huanuco, Peru with preschoolers and schoolchildren,

that there was a high prevalence of anti-HAV antibodies among children (95.2%), with a strong association to age (prevalence of 50% in children 4-5 years).

In Iñapari, the presence of HAV antibodies was associated with low family income and variables related to poor hygiene. Undoubtedly, as also noted by other authors, further improvements in personal and family hygiene and, in particular, clean drinking water supplies would reduce the long term prevalence of anti-HAV antibodies (Heriberto et al., 2002).

This study demonstrated that poor housing conditions and insufficient sanitation, lack of toilets with running water, lack of exclusive sanitary systems within the homes, and the lack of treated drinking water are associated with the presence of intestinal parasites, and positive serology for toxocariasis and hepatitis A.

Low income levels are associated with both anemia and chronic malnutrition. Therefore, better living conditions and hygiene, and the implementation of educational programs on hygiene and food handling could improve the quality of life of the population of Iñapari.

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