Anemia in Children Aged Four to Eight from a Semirural Community in Central East Area of Argentina

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Abstract

We present the results of the first stage of the Program for the Control of Intestinal Parasitosis and Nutrition, analyzing the frequency of anemia and its relation with intestinal parasitic infections and socio-cultural and environmental factors present in school children from a semirural community of Argentina. A total of 123 children aged 4–8 years were interviewed; 93 (75.6%) of them showed up for blood extraction and a fecal sample was taken properly. The frequency of anemia was 33.3%; 45.0% in children aged 4–5 years and 24.5% in those aged 6–8 years (p=0.038). Intestinal parasites were found in 83.9% of the children; 75.0% in children aged 4–5 years and 90.6% in those aged 6–8 years (p=0.043). No statistical differences were found when relating parasitic infections, social/cultural variables and housing characteristic with anemia, probably of nutritional origin. This study reveals the coexistence of anemia and parasitic infections in apparently healthy children who were unnoticed by the conventional public health system.

Introduction

An adequate nutritional status in mother and child population is a critical factor in favouring children's growth and development, preventing adverse conditions in the medium and long term and, ultimately, achieving optimal quality of life. Nutritional disturbances have causes ranging from environmental and production factors to the influence of disease and inadequate ingestion, leading to malnutrition and its consequences (Duran et al. 2009).

The Argentinean Pediatrics Society defines anemia as the "reduction of the red cell mass or the concentration of hemoglobin below the second standard deviation in relation to average age and sex" (Donato et al. 2009). Iron-deficiency anemia (IDA) is the most common nutritional deficiency worldwide. It affects vulnerable communities with lowest socioeconomic levels in particular, though this condition is not exclusive. It is the prototype of hidden malnutrition (Uicich et al. 2007). In South and Central America, IDA affects approximately 50% of children (Ianicelli et al. 2012). IDA causes a negative impact on mental, cognitive, motor and socio-emotional development, revealed by numerous studies conducted in several populations in the world, mainly in children (Jukes 2007). According to the UNICEF, within the micronutrients, iron is vital to prevent anemia. Adequate breastfeeding for each age of the child and consumption of nutritious complementary foods and timely medical care are essential to avoid the deficit of this mineral. Giving children a good start in nutrition has positive consequences for life, in regard to the mental, physical and social development (UNICEF 2015).

In Argentina, there is little information on the frequency of anemia in different age and risk groups. Even though it is a common issue in childhood and even in adolescence, most research in Argentina has been conducted in children under two years (Ianicelli et al. 2012; Ministerio de Salud de la Provincia de Buenos Aires 2012; Uicich et al. 2007; Winocur et al. 2004). In our country, the most representative data derive from the 2005 National Nutrition and Health Survey (Encuesta Nacional de Salud 2005). The results of the survey showed 16.5% of anemia in children aged 6–72 months and the highest frequency in those aged 6 to 23 months, 34.1% versus 8.9% in those aged 2–5 years.

In the province of Buenos Aires, the Ministry of Health reports high frequencies (between 34.9% and 48.3%) in children aged under 2 years from the Conurbano (districts surrounding Buenos Aires, capital city of Argentina) (Duran et al. 2009; Ministerio de Salud de la Provincia de Buenos Aires 2012).

The Program for the Control of Intestinal Parasitosis and Nutrition (PROCOPIN, by its acronym in Spanish), from the National University of La Plata, develops secondary prevention, focused on the diagnosis of early disease (without clinical manifestations). It searches diseases in "apparently healthy" school children (3–12 years old). It includes actions in distressed communities that are hyper-endemic of parasites and nutritional disorders. It is developed in four stages: (1) evaluation of the nutritional and parasitic condition of children; (2) therapeutic intervention in children with nutritional disorders and/or parasites; (3) educational intervention to avoid their return to the diseased state; and (4) post-intervention control.

The main objective of this work is to present the results of the first phase of a public health program called PROCOPIN, including the frequency of child anemia. The secondary objective is to explore potential relationship between anemia and intestinal parasitic infections in school children and other contextual factors such as country of origin, level of education and age of their parents and housing characteristic.

Materials and Methods

A cross-sectional, descriptive and analytical study was carried out in the town of Abasto (34° 59'12.84" S; 58° 5'20.04" W), province of Buenos Aires, Argentina, 64.2 km SE from the city of Buenos Aires. The 2001 National Population and Housing Census registered 6,799 inhabitants in the area; 50.6% of the homes have running water utility, 22% have natural gas and only 20% have sewer utility. Three areas can be distinguished: urban, semirural and rural (Municipalidad de La Plata 2014). A cross-sectional, descriptive and analytical study was developed.

Two educational facilities attended by children from the semirural area were selected. We worked with children aged between 4 and 8 years attending kindergarten (4 and 5 years old) and first and second grade (6 to 8 years old) in a primary school in the area selected. As school authorities and health professionals in the Healthcare Unit in the area reported, many families lack drinkable water supply and sewer systems, their houses are precarious and there is high overcrowding. The houses are settled around vegetable and fruit orchards where adults, and many times children also, work. Water comes from pumps shared by several families, and bathrooms are mostly latrines away from water supply.

The study was initiated with conferences held at the schools where the children's parents and guardians were interviewed and demographic, socio-cultural and environmental data were recorded. The information gathered was as follows: country of origin; level of education and age of the parents; and housing characteristic of the children – type of construction, indoor floor, bathroom inside or outside the house, toilet with/without water flushing system, type of water supply, flooding of area around housing, electricity, natural gas, waste collection and sewerage. This information was collected by researchers in a personal interview with the parents/guardians of the children prior to sampling.

For the hematological study, following an explanation of the procedure to parents/guardians and children and after obtaining informed consent, 5 mL of blood from a peripheral vein was extracted, with prior antisepsis of the area. Hemoglobin concentration was determined through the cyanmethemoglobin method (Hemocian B, Laboratorio Brizuela®, Argentina). Lower limit to define anemia was 11.5 g/dL, as set by the Argentinean Pediatrics Society in 2009 (Donato et al. 2009).

Severity of anemia was evaluated according to World Health Organization differential values (WHO 2011).

For the parasitological study, serial stool analysis and serial anal scraping were done. Instructions for sample-taking were imparted orally, and written instructions were given to parents/guardians. For the serial stool analysis, a daily collection of a portion of stools in a container with preservative for 5 days was indicated. For the anal scraping, each parent/guardian had to dab a folded piece of gauze previously soaked in water around the margins of the child's anus every morning after waking up, for 5 days, and put the gauze pieces in a second container with preservative. Stools were processed by the modified Telemann technique, and the obtained pellets were observed through an optical microscope (three smears per tube). The serial anal scraping samples were processed by cutting and homogenizing the gauze pieces with the same preservative in the container. After transferring the whole contents to a centrifuge tube, it was concentrated by centrifugation at 1,000 g for 5 minutes. Finally, three smears per tube were observed through the optical microscope.

Ethical aspects: parents/guardians were informed orally and in detail about the study in group meetings held at the school. They were requested to give their consent in writing and to be present at the moment of blood extraction. The children whose parents/guardians had given consent were informed about the study and the blood-extraction procedure using age-adjusted vocabulary, and their consent to participate was requested. Protocols developed were approved by the University National of La Plata School of Medical Sciences Ethics Committee (№ 0800-001483/09-000). Personal information remained confidential and was obtained in accordance with the Declaration of Helsinki (1964), the Nuremberg Code (1947) and National Act #25326. Approval of school and municipal authorities in the district was also obtained.

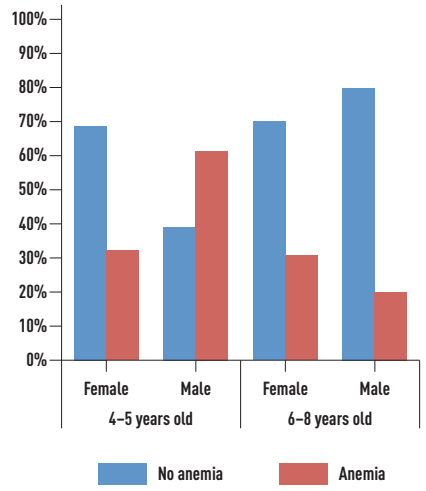
For the statistical analysis, anemia frequencies, total and specific parasitic infections and registered variables were estimated. The possible associations were analyzed using the chi-square test and Fisher's exact test. In the associations that turned out to be significant ($p \leq 0.05$), the odds ratio (OR) and 95% confidence interval (CI) were estimated. Statistical analysis was done through the SPSS19 program (SPSS 2013).

Results

A total of 123 children participated in the survey, 93 (75.6%) of them showed up for blood extraction and had appropriately handed in the samples for parasitological analysis. The children aged 4 and 5 years totalled 40/93 (43.1%); 22 of them (55.0%) were girls. Among the 53 children aged 6 to 8 years, 23 (43.4%) were girls.

The frequency of anemia was 31/93 (33.3%) (95% CI:[23.8&, 42.9%]). It was 45.0% in the 4–5-year age group and 24.5% in the 6–8-year age group ($p=0.038$; OR=2.52; 95% CI:[1.04, 6.09]). Figure 1 shows the distribution of anemia by sex and age group. Females had a frequency of 31.1% and males 35.4% (no significant difference). In those aged 4–5 years, the frequency in males (61.1%) was higher than in females (31.8%) ($p=0.064$; OR=3.37; 95% CI:[0.91, 12.42]).

Figure 1. Frequency of anemia by sex and age



The mean of hemoglobin level among non-anemic children was 12.12 g/dL (SD=0.48) and among the anemic children was 10.98 g/dL (SD=0.36).

Intestinal parasites were found in 78/93 (83.9%) children; 82.2% in females and 85.4% in males; 75.0% were found in those aged 4–5 years and 90.6% in those aged 6–8 years (p=0.043; OR=3.20; 95% CI:[1.00, 10.17]). Specific frequencies in 93 children were as follows: *Blastocystis hominis* (58.1%), *Enterobius vermicularis* (40.9%), *Giardia intestinalis* (20.5%), *Hymenolepis nana* (1.1%) and *Uncinaria* (1.1%). Among 78 parasitized children, the parasitic diversity registered per individual was as follows: 43.6% presented only one, 39.8% two, 15.4% three and 1.2% four.

Of the children with parasites, 35.9% showed anemia, while 20.0% of the non-infected children had it (p=0.232). No statistical differences were found when relating anemia to the number of parasite species or to each species in particular. The only child infected with *Uncinaria* had mild anemia.

Analyzing adult data, 35.7% of children with foreign parents/guardians and 29.7% of those with Argentinean parents/guardians showed anemia. No differences were registered in relation to their age. Of those children whose parents/guardians were included in the uneducated, incomplete primary school, attending primary school and completed primary school categories (n=60), 38.3% were anemic, while anemia appeared in 24.2% of children whose parents had a higher level of education (n=33) (p=0.168).

Tables 1 and 2 show the characteristics of the variables registered in the survey. Electricity is not shown among the variables, as 100% of the children had this utility at home. The sanitary survey of housing conditions of children revealed that over 50% of households were of sheet metal and/or wood, with the bathroom outside, no running water and no sewer, but no housing-related characteristic was associated with the variables "presence of anemia" and/or "presence of parasitic infections."

Table 1. Social and cultural variables of parents/guardians in the 93 studied children

	n	%
Origin		
Bolivia	43	46.2
Argentina	37	39.8
Paraguay	13	14.0
Level of education		
No education	4	4.3
Primary school, incomplete	34	36.6
Primary school, attending	1	1.1
Primary school, complete	21	22.6
High school, incomplete	12	12.9
High school, attending	0	0
High school, complete	19	20.4
Further education, attending	0	0
Further education, complete	1	1.1
No answer	1	1.1
Age		
21–30 years	48	51.6
+30 years	45	48.4

Discussion

According to WHO data, the global prevalence of anemia is 24.8%, and the more vulnerable groups are pregnant women and children (WHO 2008). Data provided by the National Nutrition and Health Survey show a prevalence of anemia of 8.9% in children aged 2–5 years in Argentina (Encuesta Nacional de Salud 2005). The percentage found in our study, close to 34% in children aged 4–8 years, is higher than the national mean for the age group considered and the average frequency in each province, except for Chaco (36.2%). We should note that for WHO and ENNyS, the cut-off limit for hemoglobin in children aged 6 months to 4.9 years is 11.0 g/dL and for older children is 11.5 g/dL. We have conducted the study taking into account the level recommended by the Argentina Society of Pediatrics since 2009, which is based on physiopathological aspects and expert reviewers of our country.

The frequency found is also higher than the one reported in the city of Rosario (Argentina), where the prevalence found in children aged 24–42 months was 32.5% using HemoCue test (Christensen et al. 2013). The methods recommended in studies to establish the prevalence of anemia in the population are cyanmethemoglobin and HemoCue® (WHO 2011). Our data also show higher values than those published in other Latin American countries. In Brazil, a study conducted in 945 children aged 6–59 months showed a frequency of 21.8% in children aged over 2 years (Albuquerque Silva de Paula et al. 2014). In Peru, according to 2011 official records, frequency in children aged under 5 years was 30.7% (Sobrino et al. 2014). Our results showed values close to those published by Sirdah et al. in a study in children aged 4 and 5 years attending kindergartens in peripheral areas in Palestine, with 33.5% (Sirdah et al. 2014). Anemia appeared with a higher frequency and in mild and moderate levels in males aged 4–5 years, according to the reference values of WHO for these age groups (WHO 2011).

While no corroboration tests were done in this study for iron deficiency as recommended by the National Hematology Committee, taking into account the national and international literature on this subject, we can consider the most frequent cause for anemia in these children is iron deficiency (Donato et al. 2009; WHO 2001, 2008). The tested children's parents/guardians work in vegetable- and fruit-producing orchards, and the main component of their diet are those foods. Consequently, their iron-rich food intake is probably insufficient. On the other hand, we must take into account what Angelova et al. reported when comparing children aged up to 3 years with IDA and control children: they found disturbances in their zinc, copper and cobalt levels contributing to the etiology of anemia through iron deficiency, and these disturbances were associated with an inadequate diet (Angelova et al. 2014).

The "Anemia Prevention and Treatment in Mother and Child Population Guidelines," issued by the Province of Buenos Aires Ministry of Health, lists the following vulnerable groups, sorted by significance: children aged under 2 years, pregnant women, fertile women, adolescents and children aged over 2 years (Ministerio de Salud de la Provincia de Buenos Aires 2012). The results found in this study show that children aged over 2 years from semirural communities working in vegetable and fruit production could be included among the "significantly vulnerable."

Table 2. Housing characteristics of the 93 studied children

	n	%
Type of construction		
Masonry	43	46.2
No masonry (metal sheet, wood)	50	53.8
Indoor floor		
Dirt	6	6.5
Concrete	87	93.5
Bathroom		
Indoors	38	40.9
Outdoors	55	59.1
Toilet		
With water flush device	39	42.0
Without water flush device	54	58.0
Drinking water		
From a pump	61	65.6
From supply system	32	34.4
Flooding of area around housing		
Yes	41	44.1
No	52	55.9
Natural gas		
Cylinder	90	96.8
From supply system	3	3.2
Town-managed waste collection		
Yes	58	62.4
No	35	37.6
Sewerage		
Yes	24	25.8
No	69	74.2

Parasite frequency was close to 84% of children, reaching 90% in the 6–8-year age group. Literature published in the past years indicates that the frequency of intestinal parasites in the province of Buenos Aires is between 23% and 86% (Gamboa et al. 2009, 2011; Minvielle et al. 2004; Molina et al. 2011; Pezzani et al 2004, 2009, 2012). Our results, like those of other field studies in the central region of Argentina, show that geohelminthiases are less frequent and of lower relevance than other parasite species infections, contrary to what occurs in the northern area of our country. Most frequently detected parasites were *B. hominis*, *E. vermicularis* and *G. intestinalis*, showing equal results to those found by other authors in Argentina (Bracciaforte et al. 2010; Milano et al. 2007; Soriano et al. 2005; Zonta et al. 2007). Our results also prove *B. hominis* to be the highest prevalence protozoa in diverse regions in the country (Gamboa et al. 2009; Menghi et al. 2007; Soriano et al. 2005). In Iran, of 6,851 people infected with *B. hominis* and 3,615 controls, an association was found between serum iron decrease and a higher frequency of occult blood in stools and the presence of this parasite (Javaherizadeh 2014). In our study, no association was registered between anemia and presence of intestinal parasitic disease, number of parasite species or with each species in particular, strengthening the concept of dietary origin for anemia.

Morales et al. state there is extensive literature supporting the relationship between a mother's low level of education and a poor nutritional status of children, but Pan American Health Organization, based on a study conducted in five Latin American countries, found that relationship in three/five of the cases (Morales et al. 2004; OPS 2009). In Brazil, anemia was associated to a higher number of people in the household, mothers aged under 20 years and children aged under 2 years (Alburquerque Silva de Paula et al. 2014). In Palestine, anemia was associated with parents' low level of education and smoking (Sirdah et al. 2014). In our study, the presence of anemia was not found to be associated with the housing characteristics or with parents/guardians' data, an outcome consistent with the nutritional origin of the disorder.

The Remediar Program provides to sick people antiparasitic drugs and/or ferrous sulfate for free in our country (Programa Remediar 2014). A study conducted by anthropologist Sanmartino G. in several healthcare centres in Argentina, including interviews to health professionals and mothers, detected the existence of professionals who do not consider important to give children iron supplements, therefore not prescribing it, as instructed by the regulations. In the group she studied, the reason why doctors do not prescribe iron supplements was they state that iron is better absorbed through nutrients supplied by food intake, especially meat, so they do not make an effort to determine whether patients can afford the appropriate nutrition (Sammartino 2010).

Considering these children had never had a blood panel done, health professionals underestimate anemia as a condition, and health regulations place them in the lowest rank among the vulnerable populations; this population should be reassessed and repositioned by public health agencies, as an early intervention facilitates reverting mild- and moderate-level anemia in the short term (Duran et al. 2009).

Limitations of this study are descriptive nature of the results, the small sample size and the lack of data about child growth. Taking into account the local nature of the results, the need arises to develop a larger number of studies in populations of similar characteristics.

Conclusions

This study reveals the coexistence of anemia and parasitic infections in apparently healthy children who were unnoticed by the conventional public health system.

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