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PHARMACOLOGICAL AND EDUCATIONAL INTERVENTION FOR THE CONTROL OF INTESTINAL PARASITIC INFECTIONS IN PRE-SCHOOL CHILDREN IN LA PLATA, ARGENTINA

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ABSTRACT

This work compares the results of three years of pharmacological and educational intervention (2015-2018) to control intestinal parasites in preschool children from La Plata, Argentina. An exploratory ecological study was carried out. The clinical, socio-clinical-environmental conditions and detection of intestinal parasites were evaluated. After carrying out the therapeutic intervention of the parasitized children, educational workshops were implemented to avoid the return to the disease state and finally, the post-intervention control. In 2015, 45 preschoolers of the 65 enrolled (69.2%) in the Kindergarten completed all stages of the program, in 2018 40 of 62 preschoolers (64.5%) did so. In 2015 we registered 93.3% of parasitized children, of which 60% had helminthes and 93.3% protozoa. In 2018 we registered a decrease of about 51% of parasitized children; the impact being greater in protozoa with a decrease of 63% compared to helminthes whose reduction was 35%. The educational workshops had greater impact on risk behaviors those in children's hygiene habits. The strategies implemented have had good results with the pharmacological treatment and reduction of risk behaviors, but it has been deficient with respect to the modifications in the personal hygiene of the schoolchildren. Aspects that we must take into account to improve future interventions in the community.

KEYWORDS: Intestinal parasitoses. Therapeutic-educational intervention. School children. Argentina.

INTRODUCTION

Notwithstanding the scientific and technical revolution that has occurred globally, as well as the advanced diagnosis, treatment and management measures existing, intestinal parasites (IPs) present themselves as a challenge to contemporary medicine.[1,2] Although mortality due to these infections is relatively low, complications are common, being responsible for at least 10% of diarrheas and in some cases requiring hospitalization.[3] These intestinal pathologies are closely related to processes of economic and social development, since malabsorption, diarrhea, and loss of blood produce decreased ability to work in adults and reduced growth in children.[4] IPs can be acquired by individuals in all age groups and from all socioeconomic levels, but the population with the highest risk and prevalence is that with the greatest socio-economic marginalization, and children under 14 years old in particular, due to immunological immaturity and poor hygiene conditions.[5]

The number of people with IPs all over the world totals one billion,[6] and it is estimated in 3.5 million in Latin America.[7] IPs appear more often in children from low-income countries.[8] So the worrying educational situation of children in these communities has been the focus, where the diverse health and nutrition difficulties act like barriers conspiring against their normal development and growth.[9] The impact of macroeconomic policies causes inequalities in every nation, and poverty is a vulnerability factor in the face of parasitic infections.[10] Among other things, being poor means having no access to basic public services such as drinking water, fecal waste disposal and garbage collection. These deficiencies have an impact on the hygiene conditions of the community and household environment and, moreover, are usually associated with

the deficient consumption of food that is probably contaminated.[11]

IPs is a serious Public Health problem where high prevalence is linked to the lack of health education, hygiene habits and inadequate infrastructure.[12] However, not all populations in a state of poverty should accept meekly the presence of IPs, making the implementation of programs or projects to generate control actions and focused prevention relevant.

School performance depends on intellectual, motor and social development, which may be affected by malnutrition, iron deficiency and infections, including parasitoses, among other variables. There are obvious evidences of the benefits of interventions in pre-school health to approach these three issues.[13] Health improvement enhances children's abilities to benefit from education. The Program for the Control of Intestinal Parasitoses and Nutrition (PROCOPIN), University of La Plata (UNLP) School of Medical Sciences, approaches children's health as an important item in the cognitive development of the future adolescents and adults. One of the activities of the program is the intervention in children of low socioeconomic resources to prevent and manage the effects of IPs infections in childhood.

The PROCOPIN has been implemented since 2009 in vulnerable communities in the cities of La Plata and Berisso, province of Buenos Aires, Argentina. The program is carried out in four stages: 1) Evaluation of clinical-nutritional-socio-environmental conditions and detection of intestinal parasites; 2) Therapeutic intervention of children with clinical-nutritional disorders and/or parasites; 3) Educational intervention to avoid regression to the state of disease; and 4) Post-intervention monitoring.

The PPROCOPIN focuses on the problem of IPs with specific and individual therapeutic intervention and educational activities with the purpose of promoting changes in behavior through reflection-action processes.[14] The aim is to have people learn and modify their habits related to individual, familiar, community, and nutritional hygiene not just because of the "lecture" received, but mostly for their personal experience, and thus they will hopefully change their practices. Participatory strategies are used with the population, which increase the probability of achieving a greater willingness to change the risky behaviors.[15]

This article presents the comparative results obtained by PROCOPIN regarding the prevalence of intestinal parasites in preschool children from a vulnerable neighborhood in Argentina, after three years of therapeutic and educational intervention.

MATERIAL AND METHODS

Study design

The program was carried out in pre-school children attending a kindergarten in the outskirts of the city of La Plata (34º56' 00" S, 57º57' 00" O), located in the northeastern region of the province of Buenos Aires, Argentina (Figure 1) from 2015 to 2018.The comparative results of beginning and end of the study are shown. The number of children attending the school in 2015 was 65 and 62 in 2018. They live in a neighborhood in poor socioeconomic conditions (Figure 2).

Figure 1: Location of the city of La Plata in Argentina.

Figure 2: A photo of the neighborhood where the kindergarten is located.

Study procedure

An ecology-orientated exploratory study was carried out. Data was collected through surveys and samples taken for IPs detection. The analyzed variables were: socio-demographic characteristics of the household, sanitary conditions of the homes, gender, age, hygiene habits, signs and symptoms and presence of intestinal parasites in children.

To develop the community-based activities, the children's parents or guardians were invited to a meeting each year in April, carried out through the school,

according to WHO recommendations of approaching the communities through schools.[16]

Through a structured and closed survey applied to each child, the following was recorded:

1) Parents age, gender, origin, occupation, and level of education;
2) Sanitary characteristics of the home: walls (masonry/tin and/or wood); floor (dirt/concrete); bathroom (inside/outside the home); toilet (with/without water tank); water (pump/running); electricity (yes/no); gas supply (gas tank/natural gas); house garbage (with/without town collection); house wastewater (with/without sewage piping); ditch outside the door (yes/no); pavement (yes/no); water logging of the house after rainy periods (yes/no); and presence of pets (yes/no).
3) People per house; people per room where school-children sleep; people sharing child's bed;
4) Children's hygiene habits and risk behaviors: washing hands before meals and after using the toilet (often/sometimes); onychophagia (yes/no); thumb sucking (yes/no); playing with soil (yes/no); playing with pets (yes/no); playing with sand (yes/no); going barefoot (often/sometimes);
5) Presence of signs and symptoms in children: diarrhea, vomiting, anal itching, loss of appetite, lack of energy, abdominal pain, parasite removal, bruxism.

The parasitological study was carried out through fecal serial analyses and perianal swab. Oral and written directions were given to parents/guardians on how to take samples. For the fecal analysis, a daily collection of a portion of stools in a container with preservative material for 5 days was indicated. For the perianal swab, each parent/guardian had to rub a piece of gauze (10cm by 10cm), folded (and previously dampened with pure water) around the margins of the child's anus, every morning at waking up, for 5 days. They had to put the pieces of gauze in a second container with preservative material. Stools were processed through the modified Telemann technique and the obtained pellets were observed with an optical microscope (three smears per tube). The perianal swab samples were processed by cutting and homogenizing the pieces of gauze with the same preservant in the container. After transferring the whole container to a centrifuge tube, the contents were concentrated by centrifuging at 1000 g for 5 minutes. Finally, three smears per tube were observed through the optic microscope. All parasite-infected schoolchildren were referred to the Health Unit in the neighborhood, where they received individual and specific pharmacologic treatment with Mebendazol and/or Metronidazol. When children were diagnosed with *Enterobius vermicularis* and *Ascaris lumbricoides*, the other members of the household were pharmacologically treated too.

Table 1: Age and sex of adults attending the Health Meetings.

	2015 (n: 45)		2018 (n: 40)		
Age (years)	N	(%)	N	(%)	p
15-29	31	(68.9)	29	(72.5)	0.71
30-44	12	(26.7)	11	(27.5)	0.93
45+	2	(4.4)	0	(-)	-
Sex					
female	42	(93.3)	34	(85)	0.21
male	3	(6.7)	6	(15)	0.29

Ethics statement

Parents/guardians were informed, orally and in detail, about the study in group meetings held at kinder garden. They were asked to give their consent in writing. The protocols in place were approved by the Ethics Committee, School of Medical Sciences, UNLP. Personal information was kept confidential and obtained in accordance with the Declaration of Helsinki (1964), the Nuremberg Code (1947) and National Law #25326. The approval of school authorities and city authorities in the district was also obtained.

Statistical analyses

The results of 2018 were compared to those of 2015. Total and specific parasite infections were estimated, as well as the frequencies of the variables mentioned in Materials and Methods. The probable associations between variables were analyzed through the Chi-Square test and Fisher's exact test. For associations turning out to be significant ($P < .05$), odds ratio (OR) and 95% confidence interval (CI) were estimated. Statistical analyses were carried out through WinEpi (http://www.winepi.net) and EpiInfo (TM) 3.5.4 software.

RESULTS

In 2015, 45 pre-school children, 51.1% (23/45) of them female, of the 65 registered (69.2%) in the kindergarten completed all the program stages. In 2018, 40 out of 62 (64.5%) pre-scholars completed the program, 37.5% (15/40) of them being girls.

Socio-demographic characterization of parents/tutors as to age and sex is presented in the Table below.

As regards origin, we recorded 64.4% (29/45) of adults being born in Argentina and the rest in Bolivia (11), Paraguay (3), and Peru (2) in 2015. In 2018, there were 82.5% (33/40) Argentineans and the rest were foreigners (4 from Bolivia and 3 from Paraguay). Though the number of Argentineans is greater, the differences were non-significant. Considering occupation, we found that housewives decreased in 2018, since 73.5% of women

had reported being housewives, while 26.71% of the parents had reported having a job outside the home in 2015. In 2018, there were 30% housewives, 67.5% of the parents had other jobs, and 2.5% were unemployed.

Regarding level of education in parents, there were no significant differences since 88.9% had completed elementary and/or high school, 6.7% had further/college studies and 4.4% were illiterate in 2015. In 2018, 87.5% of adults had completed elementary and/or high school, 12.5% reported completed further/college studies, and no parents reported being illiterate.

In Figure 3 we present the comparison (2015-2018) of most health-related features in homes. There was no difference in recording of electrical supply since all homes in both 2015 and 2018 had the utility. As to gas supply, 93.3% in 2015 and 90% in 2018 had gas tanks (P = 0.7). Regarding pet presence, 75.6% of households in 2015 and 77.5% in 2018h ad one or more animals (P= 0.83), resulting in no significant difference but still with high frequency.

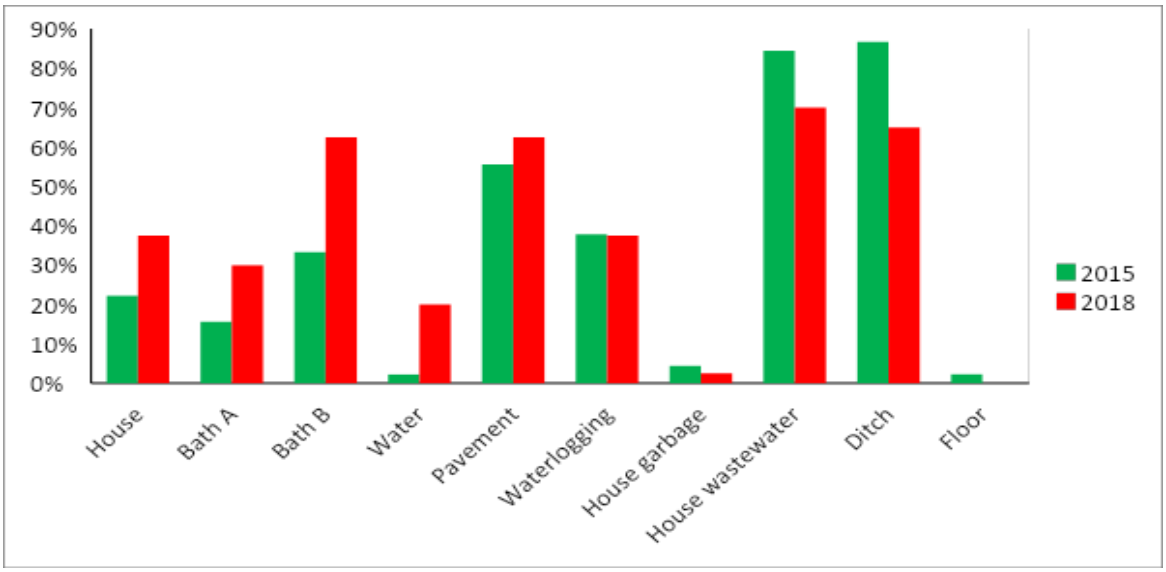

Figure 3: Health-related characteristics of households (2015-2018).

House: tin and wood construction. (P= 0.12).
Bath A: bathroom outside the home. (P= 0.11).
Bath B: toilet without water tank. (P= 0.007).
Water: drinking water by pump. (P= 0.01).
Pavement: no pavement in front (dirt road). (P= 0.51).
Water logging: flooding of the house after rainy periods. (P= 0.97).
House garbage: no town collection of garbage. (P= 1.0).
House wastewater: no sewers piping. (P= 0.11).
Ditch: ditch outside the home. (P= .01).
Floor: dirt floors inside house. (P= 1.0).

Of the thirteen variables evaluated in the homes, 38.5% were in worse conditions in 2018, but only one showed significant difference (toilet with no water tank), 30.8% remained unchanged, and 30.8% had no difference but with high prevalences in the registers: ditch (over 60%), flooding (37.5%), pet ownership (77.5%), and no sewage piping (70%). In Figure 4, we observe overcrowding conditions registered in the homes.

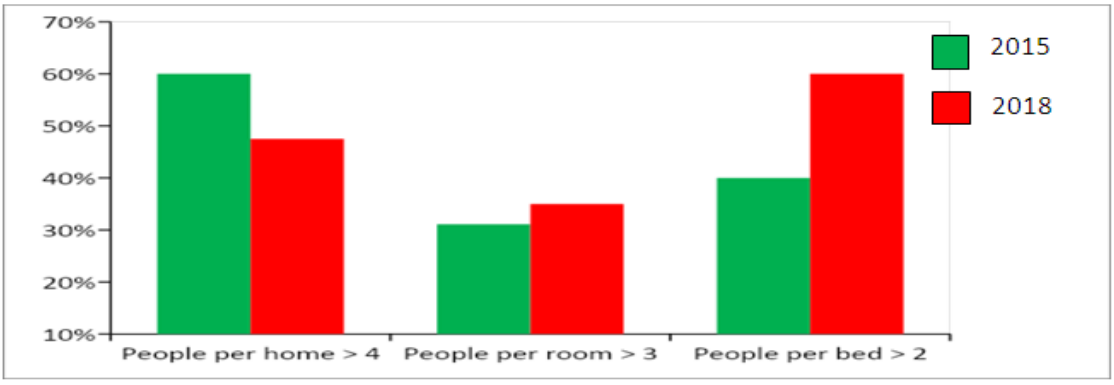

Figure 4: Overcrowding condition of homes (2015 - 2018).

People per home > 4 (P = 0.24). **People per room > 3** (P =0.7).
People per bed > 2 (P = 0.06)

As shown in the graphic, comparative analyses showed no significant differences. However, overcrowding is still high.

Regarding hygiene habits, we found that 62.2% of children washed their hands frequently before meals in 2015, while 47.5% of them did it in 2018 (P = 0.17); as for washing hands after using the toilet, the frequencies were 66.7% in 2015 and 52.5% in 2018 (P = 0.18). The differences did not reach significant levels, but this personal hygiene behavior has decreased in schoolchildren in 2018. The risk behaviors analyzed are shown in Figure 5.

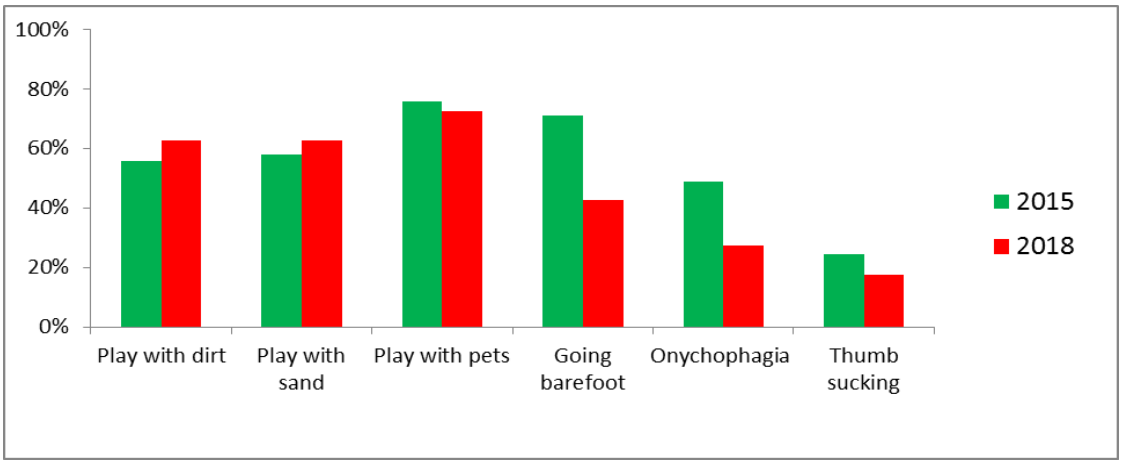

Figure 5: Risk behavior analysis (2015-2018)

Play with dirt (P = 0.51). **Play with sand** (P= 0.65). **Play with pets** (P= 0.74)
Going barefoot (P= 0.007). **Onychophagia** (P= 0.04). **Thumb sucking** (P= 0.43)

In Figure 5 we can see 66.6% of risk behaviors shown healthy changes in 2018 with significant differences in two of them (onychophagia and going barefoot).

Regarding the presence of signs and symptoms in children (2015-2018), we found that the frequencies of children with diarrhea increased (8.9% - 12.5%; P=0 .72) and also with lack of energy (15.6% - 20%; P= 0.59). There was a decrease in the registry of children with anal itching (55.6% - 40%; P = 0.15); bruxism (55.6 - 42.5; P = 0.22) and loss of appetite (46.7% - 25%; P = 0.038). The differences in vomiting (8.9% - 10%: P = 1) and abdominal pain (40% - 37.5%; P = 0.81) were minimal. Comparative results of parasitological analyses in school children are shown in Table 2.

Table 2: Results of parasitological analyses in schoolchildren. (2015-2018).

	2015 (n= 45)		**2018 (n= 40)**		
	N	(%)	N	(%)	P
With parasites	42	(93.3)	17	(42.5)	0.0001
Helminths	27	(60.0)	10	(25)	0.0012
E. vermicularis	26	(57.8)	10	(25)	0.0023
A. lumbricoides	1	(2.2	0	(-)	-
Protozoa	42	(93.3)	12	(30)	0.0023
B. hominis	27	(60)	9	(22.5)	0.0005
G. intestinalis	15	(33.3)	3	(7.5)	0.003

DISCUSSION

Parasitological results show lower prevalences after three years of pharmacological and educational intervention, but the possible differences between characteristics in both groups should be analyzed in order to rule out interference of any variable in these results.

Analyzing the variations between both groups, we observed that the percentage of children who entered the study with respect to enrollment decreased by 5% (from 69.2% in 2015 to 64.5% in 2018). There was also a difference regarding sex, since more girls participated in 2015 (51.1%) and in 2018 37.5% did. Statistical analysis was not significant for these variables.

Sociodemographic characterization of the parents also revealed variations between both studies. Among them, the sex of the people who attended the Health Meeting revealed a decrease in mothers in 2018 (from 93.3% to 85%). This situation could be related to the occupation of women; because in 2015 around 73% of housewives were registered and in 2018 it fell to 30%. We could consider that many mothers went to work outside the home and sent the fathers to the interview. An important issue for children's health care is the main activity carried out by mothers. In this study, most of them in 2015 reported dedicating themselves to household activities, which would mean they have more time for a healthier upbringing of their children.[12] However, the parasitic frequencies were very high in that year. While in 2018, we registered a decrease of IPS although the percentage of mothers who stayed at home had decreased. The "parents' origin" variable showed an increase in Argentineans in 2018 (64.4% to 82.5%). As to age ranges and level of education, differences were minimal. The level of formal education in parents is a factor that can indirectly affect children's health, particularly due to a higher access to information that may have parents with at least a high-school degree.[17] We found no differences in these variables in our study.

Access to public services is of interest in reference to the issue under study as hygiene is related to the availability of "safe" water, adequate excreta disposal and garbage collection, among others. Of the thirteen variables on household sanitary conditions, we made the following interpretation comparing the 2015 and 2018 records:

- Variables that worsened: "house construction" since in 2018 there was a greater quantity of tin and wood (from 22.2% to 37.5%), "bathroom outside the home" (from 15.6% to 30%), "drinking water by pump" (from 2.2% to 20%), "toilet without water tank" (from 33.3% to 62.5%) and "no pavement in front the home "(from 55.6% to 65%)
- Variables with low/no differences: "dirt floors inside the house" (from 2.2% to 0%), "household electrical supply" (100% in both groups), "gas tank supply" (from 93.3% to 90%) and "no town collection of household garbage" (from 4.4% to 2.5%).

We made up a third group with variables showing small differences but with still high prevalences in 2018, a situation affecting the transmission of IPs: "ditch in front of the house" (86.7% to 65%), "flooding of the home after rainy periods" (37.8% to 37.5%), "no sewage system" (84.4% to 70%), and "pet ownership" (75.6% to 77.5%).

As a summary of health-related characteristics, we recorded that 38.5% of the variables worsened, 30.8% had no differences, and 30.8% resulted with no significant differences but still persisted in high frequencies, favoring disease transmission.

The educational establishment to which the evaluated children attended presents safe water, adequate excreta disposal, environmental sanitation and availability of soap or sanitizer for the children and teachers. In this regard, Chard et al.[18] carried out a randomized study in 100 among Laos schools on communicable diseases comparing schools with safe water supply, adequate sanitation facilities and health education versus schools that did not received such intervention. They did not find any impact on the health of the students, inferring that the best sanitary conditions in the schools are not enough to overcome other routes of transmission at home or elsewhere in the community. In our intervention, there was a decrease in parasitic frequencies, but we must bear in mind that isolated pharmacological treatment does not break the cycle of infection and re-infection of the population. Although the administration of anti-parasitic is a short-term solution, the long-term solution will depend on sanitary improvements both in the domestic and public spheres, for the control of IPs.

From an ecologic and epidemiologic point of view, overcrowding is one of the factors favoring the transmission of IPs.[19] In our research, the variables related to overcrowding in the home ">4 people in the house" and "> 2 people sharing the bed" increased in 2018. Although the statistical analysis registered did not significant differences, we could infer that these conditions are relate to a greater risk of transmission of IPs, especially *E. vermicularis*. Therefore, deworming of all members of the household when this nematode was detected was the right decision to cut the transmission chain in overcrowded families.

Personal hygiene as well as public sanitation create an IP transmission barrier, preventing the infectious cycle to continue.[20] Because the most frequent form of contagion is the fecal-oral route, often hand washing is recommended, as well as safe supply of water and food.[21] Certain risk behaviors such as contact with soil and/or sand and/or pets may increase the possibility to get IPs, especially if there is no control of environmental pollution. Onychophagia and thumb-sucking have been related to parasite transmission, especially *E. vermicularis.* As to that, we observed that the personal hygiene variables in schoolchildren worsened in 2018, since frequent hand washing "before meals" and "after using the toilet" had lower levels, though differences were no significant. In this regard, we consider the modification of individual hygiene practices need to be reinforced in the house taking into account the age of the children assessed. Among the six risk behaviors, 66.6% of them were improved and two of them ("onychophagia" and "going barefoot frequently") being statistically significant. On the other hand, "playing with dirt" and "playing with sand" were increased, but with no statistical significance.

Of the seven signs/symptoms recorded in the survey, "lack of energy" and "diarrhea" were increased (28.6%); "anal itching" and "bruxism" were reduced, with no significant difference, and "loss of appetite" was significantly reduced (42.8%); "vomiting" and "abdominal pain" (28.6%) had minimal differences, but no association with "having parasites" was found. Limoncu et al.[22] consider the association between specific symptoms and parasite species has been inconsistent, since some authors have found no association between symptoms and parasite infection or have concluded that the presence of symptoms has low predictive value for the presence of pathogenic parasites. In a study carried out by Diaz et al.[23] in 172 Mexican children, they found clinical manifestations were less frequent in children under six years of age and more frequent in 6- to 12-year-old children. As to that, our work group published in 2018 a study on intestinal parasite detection and presence of clinical manifestations in 857 3-to 12-year-old schoolchildren, and we found no association between the presence of signs or symptoms and parasite infection.[24]

The results of parasitological analysis indicate a significant decrease occurred in IPs in children after a three-year therapeutic and educational intervention. Comparison of results revealed a decrease of around 51% in 2018, with the impact in protozoa being higher, with a 63% decrease in comparison to helminthes, which have a 35% reduction. In an assay carried out in 5- to 12-year-old school children in Bolivia, 75.2% protozoon infected and 24.8% helminthes infected were registered in 2016, and after a deworming was performed, they found a frequency of 85.2% protozoa and 14.8% helminthes in 2017, showing a ratio of six times more protozoa.[25] In a similar study, 50% helminthes and 19% protozoa were eliminated using Mebendazol.[26]

In our intervention, the decrease in protozoa was higher, probably related to the fact that in the mentioned studies only Albendazol or Mebendazol were administered, and we used Mebendazol and Metronidazol, the latter causing the reduction of unicellular parasites.

As regards parasite species, we observed that *E. vermicularis* had a decrease close 33%. This nematode is transmitted through direct contact with people or objects contaminated with its eggs. Because of this transmission process, children's personal hygiene, habits such as thumb sucking and onychophagia, crowded conditions, and inadequate environmental sanitation contribute to the transmission of this parasite. Generally, drug treatment is effective, however reinfection is frequent because the infective eggs remain viable in the household and school settings. Health education has been shown to be effective in reducing reinfection rates. In this regard, Kim et al.[27] compared two groups of schoolchildren, one of whom received pharmacological treatment and health education versus another that received only pharmacological treatment, finding a greater decrease in parasitoses in the first group. In our study, we observed that the decrease in this nematode coincided with a decrease in onychophagia and thumb sucking, which, associated with sustained pharmacological treatment for three years, must have had an impact on the decrease of this parasitoses. In addition, bruxism and anal itching, which are two signs associated with the presence of this nematode, decreased.

We were also able to observe in our study a significant decrease of the frequencies of *G.intestinalis* (25.8% reduction) and *B. hominis* (37.5% decline).

G. intestinalis has a worldwide distribution, with higher incidence in children from tropical and subtropical regions. The infection occurs due to the presence of cysts in untreated and poorly disinfected waters, which contaminate food and drink products, since cysts of this protozoan survive in the environment, particularly in aquatic settings. Also this infection can be given from person to person in groups with poor fecal-oral hygiene, as is the case in pre-school children. In our study, children's personal hygiene habits, such as washing hands before eating and after using the toilet, did not improve after the intervention, but there was an increase in the sewage network of the houses and a decrease in ditches that, together with the pharmacological treatment, they must have contributed to the reduction of the sources of infection of this protozoosis. Molecular studies of *Giardia* spp. have allowed the identification of various genotypes, some of which are zoonotic, since they have been found in dogs, cats, farm animals and humans. In an assay carried out in children and adults from Argentina, genotypes B and AII, both of zoonotic transmission, were isolated.[28] Considering the high frequency of pets (dogs and/or cats) that we register in the children studied, we can think that a transmission has occurred between animals and children. But it is clear that the children are the main reservoir, because despite continuing with a high number of pets in 2018, the prevalence declined after pharmacological and educational intervention in preschool children.

B.hominis is a protozoan with a wide worldwide distribution and is found in both children and adults. Its transmission is related to a lack of hygienic behavior, precarious living conditions and inadequate environmental sanitation. Its transmission occurs by fecal-oral route. Whether this transmission occurs between human-human, human-animal and/or animal-human remains in debate. *Blastocystis* has great genetic diversity. In this regard, a set of several distinct ribosomal lineages called subtypes (ST) has been reported that colonize humans, other mammals, and birds. So far, no strict associations between STs and hosts have been reported, although moderate specificity is observed. Humans are generally infected with ST 1, 2, 3, and 4. Information in Latin America is scarce and studies have shown that humans are primarily infected

with ST 1, 2, and 3.[29] We consider that its decline after our intervention was also associated with the variables mentioned in reference to *G.intestinalis*.

Grandes et al.[15] consider that population interventions that have the collaboration of professionals and/or people who work and/or live in the intervened community will probably have a greater impact on the results obtained. In this sense, the professionals of the Health Unit to which the schoolchildren infected with parasites were referred, expressed their support for this type of program, since they have a much harder job in their daily performance in clinical practice to diagnose IPs in children considered "apparently healthy" by their parents and therefore not taken to the medical consultation. And with respect to the children's parents, their collaboration in taking samples was very important and later, upon receiving the parasitological reports, they took their children to the Health Unit to receive pharmacological treatments.

The development of PROCOPIN in this community has managed to reduce parasitic frequencies in children. The strategies implemented have had good results with the pharmacological treatment and reduction of risk behaviors, but have not been enough to modify personal hygiene habits of the schoolchildren. We need to take these aspects into account to improve future community-based interventions. Schell et al.[30] state that programs generally need time to reach a certain level of maturity and allow health benefits to accrue.

CONCLUSION

This study provides data on the impact of community-based interventions in the field of child health in the area of intestinal parasites present in disadvantaged social groups. Our results indicate the specific and individual pharmacological treatment of pre-school children and their families made parasite frequencies decrease. However, it will be necessary to implement educational strategies in the community in order to engage the community in the control of these infections, since healthy habits in the households will be more willingly adopted by children. The long-term solution will depend on the municipal intervention to improve the sanitary conditions of the homes and their surroundings; taking into account that investment in child health reduces school dropout rates and increases the probability of completing basic education, allowing access to better jobs in the future.

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