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Full Length Research Paper

Intestinal parasitism in school children periodically treated with albendazole in 2 sampling periods

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This transversal study estimated the prevalence of intestinal parasitic infections in school children twice yearly treated by the national campaign of albendazole during two consecutive years in Northwestern Mexico. 450 and 389 children showed prevalences of 46 and 35% for intestinal parasites, 42 and 30% for protozoa, and 11 and 12% for helminths in 2005 and 2006, respectively. *Giardia duodenalis* and *Entamoeba histolytica*/*dispar*/*moshkovskii* showed high and low prevalences, respectively. The prevalence of infection increased with age. 50 (September 2005) and 42 children (September 2006) excreted medians of 520 and 630 of eggs per gram (epg) of *Hymenolepis nana*, respectively. Albendazole alone is not sufficient approach to overcome intestinal parasitic infections in school children. Educational strategies should be integrated to the national deworming campaign in Northwest Mexico to obtain more effective results.

Key words: Intestinal parasitism, albendazole, de-worming campaign, school children, Northwest Mexico.

INTRODUCTION

Intestinal parasitism has been recognized as a public health problem worldwide for several years (Albonico et al., 1999; Crompton, 1999), because they are associated with malabsorption and growth disturbances (Brown et al., 1980; Solomons, 1993). Therefore, intervention programs were introduced for the control of parasitic helminth infections in different regions. They have significantly reduced the prevalence, intensity and morbidity of chronic infections in Seychelles, Zanzibar, and Sri Lanka, using mebendazole and albendazole (WHO, 1996). In Mexico, intestinal infections remain a serious public health problem, associated with high morbidity in the general population (SINAIS, 2005). In 1987, Mexican school children were considered the most vulnerable group to vulnerable group to these infections, and 35.2 and 83.2 million Mexicans were affected by helminths and protozoa, respectively (Martuscelli, 1987). This motivated the launch of a Mexican deworming campaign in 1993 influenced by the effectiveness of global programs for control of helminths, the recommendation by the World Health Organization, the political will of the Mexican government and the infrastructure provided by the Health National Week (Velasco et al., 1993). The Ministry of Health determined that albendazole was provided to 95% of children (ages 6 to 14 years old) to reduce not only the prevalence and excretion of helminth eggs, but also re-infection rates and morbidity (Velasco et al., 1993). Evaluations between 1993 and 1998 in more than 90,000 Mexican children demonstrated the effectiveness of the program, reducing the national prevalence of *Ascaris lumbricoides* and *Trichuris trichiura* from 20 to 8% and 15 to 11%, respectively (Velasco et al., 1993). In 1995, the prevalence of *Giardia duodenalis* was estimated at 32%

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in Mexico (Tay et al., 1995) and remained the most important protozoan infection in Northwestern Mexico with prevalences ranging from 14 to 49% (Gomez et al., 1996; SS, 2006). *Entamoeba histolytica* is another pathogen protozoan capable of presenting a prevalence up to 50% in Southern Mexico (Morales-Espinoza et al., 2003) but appears to be less predominant than giardiasis in Northwestern Mexico (Gomez et al., 1996; SS, 2006). Currently, the Ministry of Health continues to administer a single dose of albendazole twice a year to school children in Mexico, but the intestinal parasites are possibly contributing to the high gastrointestinal infections rates in the childhood population of Northwestern Mexico (SS, 2006). Therefore, the aim of this study was to investigate the current prevalence of intestinal parasites in children who are receiving periodical albendazole in Northwest Mexico.

MATERIALS AND METHODS

Study area and population

This cross-sectional study was conducted in two consecutive years (September 2005 and September 2006) in the State of Sonora Northwest Mexico. Sonora is bordering to the east with the state of Chihuahua, south to the state of Sinaloa, west to the Gulf of California, and north to the US state of Arizona. Ninety-six percent of the region of Sonora is dry and semidry. The summer average temperature is 38°C (June to August) and 5 to 30°C from September to January. In 2005, the total population of Sonora was estimated in 662,000 and 60% of this population were under 15 years of age (INEGI, 2011). Ten public primary schools of 3 municipalities of Sonora [Guaymas, Hermosillo, and Navojoa] were selected based on high rates of gastrointestinal infections in the population (SS, 2006): low socioeconomic status in areas around the schools (Alvarez et al., 2009) and the administration of twice a year of a single dose (400 mg) of albendazole by the national de-worming campaign (Velasco et al., 1993). To date, no epidemiological surveillance to investigate the prevalence of intestinal parasitic infections has been conducted in the study sites. A total of 2152 children were enrolled in the primary schools selected between September 2005 to September 2006 (SEC, 2005). The purpose of this study was described to the personnel of health services, municipalities, schools, parents and students. All children were invited to participate while plastic containers were distributed for stool sample collection (three per subject). A total of 839 out of the 2152 children, participated in September 2005 and 2006, and they represented 39% of the enrolled population. Academic personnel confirmed the administration of albendazole during official visits of the de-worming campaign.

Ethical consideration

A written consent was obtained from parents or guardians of all participating children. From the remaining 1313 of the total 2152 children, and who did not take part in this study, 1159 children were unwilling to participate and 154 who did not meet the study criteria (disabled, supplemented or medicated). Approval to conduct this study was granted by the Ethical Review Committee of the Research Center for Food and Development. Children infected with intestinal parasites were referred to the Ministry of Public Health for the appropriate treatment.

Collection of feces and parasite analysis

Stool samples were collected and transported to the parasitology laboratory of the Research Center for Food and Development in Hermosillo. Samples were stored at 5 and 7°C for 24 to 72 h prior to analysis by the techniques of Faust and Kato-Katz (Markell et al., 1976). The technique of Faust was used for identification of protozoan cysts of *G. duodenalis*, *E. histolytica/dispar/moshkovskii* (Cheng et al., 2004), *Entamoeba coli*, *Endolimax nana* and *Iodamoeba butschlii* and helminth eggs of *A. lumbricoides*, *T. trichiura* and *Hymenolepis nana*. The intensity of infection was estimated indirectly by Kato-Katz, counting the number of eggs per gram of feces (epg) of helminth infections using the 40x objective, the final value was the average of epg divided per the sample number provided (3, 2 or 1) per child. The epg was calculated by multiplying twenty times the number of eggs counted in 50 mg of feces. Infection was defined as the state with one or more species of parasites, poliparasitism with two or more species of parasites, helminth infection only with species of helminth parasites, protozoa infections only species of protozoan parasites.

Statistical analysis

The prevalence of intestinal parasitism was expressed as the percentage of children with parasitic species in any of the fecal samples provided. The Fisher exact test was used to test the differences between proportions (prevalence of intestinal parasites). The intensity of infection was defined as epg of helminth species expressed as a median with confidence interval and Kruskal Wallis to test the difference between the age-intensity (epg) data. Data was analyzed using the Number Crunching Statistical System 2001, Version 1.6.0. (329 North 1000 East Kaysville, Utah 84037.com. USA).

RESULTS

A total of 450 and 389 school children participated voluntarily in September 2005 and 2006, respectively. The mean ages of the children were 7.7 (± 1.2) and 8.1 (± 1.3) in both sampling periods, respectively. 220 (49%) and 217 (56%) were girls in 2005 and 2006, respectively. No differences were found between the proportions of boys and girls (χ^2 = 2.342, df = 1, P = 0.7003 in 2005; χ^2 = 3.476, df = 1, P = 0.6231 in 2006). The overall prevalence of intestinal parasites in boys and girls was 48 versus 44% (P = 0.708) in 2005; and 29 versus 35% (P = 0.357) in 2006. In addition, no difference was found between the prevalence of parasites species by gender (data not shown). A total of 1231 and 861 fecal samples were collected in September 2005 and 2006, respectively. 62 and 26% of the children provided 3 and 2 stool samples in September 2005, and 47 and 26% of the children provided 3 and 2 samples in September 2006. High prevalence for intestinal parasitic infections and protozoan infections were found in 2005 and 2006, respectively (Table 1). *H. nana* and *G. duodenalis* also

Table 1. Prevalence of intestinal parasites in 450 and 389 school children in September 2005 and 2006, respectively of 3 municipalities in Northwestern Mexico.

Sample time	September 2005		September 2006	
	Prevalence		Prevalence	
	450	% (CI)	389	% (CI)
Infection	207	46 (41-51)	136	35 (32-38)
Poliparasitism	87	20 (16-23)	70	18 (13-21)
Helminthiases	55	11 (9-15)	47	12 (10-14)
Protozoasis	187	42 (37-46)	117	30 (37-46)
Hymenolepis nana+	55	11 (9-15)	47	12 (10-14)
Entamoeba histolytica/dispar/moshkovskii Δ	28	6 (4-9)	15	4 (2-5)
Giardia duodenalis+	107	24 (20-28)	78	20 (17-23)
Endolimax nana-	68	15 (12-19)	39	10 (7-13)
Entamoeba coli-	62	14 (11-17)	74	19 (15-23)
Iodamoeba butschlii-	20	5 (3-7)	12	3 (1-5)

(CI) Confidence interval at 95%; +Pathogens, -No pathogens, ΔParasite species not identified.

Table 2. Prevalence of intestinal parasites by age group in 839 school children of 10 public primary schools of 3 municipalities of northwest Mexico.

Age (years)	September 2005				September 2006			
	Prevalence				Prevalence			
	Infected		No infected		Infected		No infected	
	n	% (CI)	n	% (CI)	n	% (CI)	n	% (CI)
6-7.9	94	42 (35-48)	132	58 (52-65)	50	32 (25-40)	106	68 (60-75)
8-9.9	96	50 (42-57)	90	50 (39-61)	62	34 (27-41)	120	66 (59-73)
10-11.9	21	55 (38-71)	17	45 (29-62)	22	39 (21-64)	29	66 (50-80)

CI: Confidence interval.

showed important prevalence, but *E. histolytica*/*dispar*/*moshkovskii* showed a low prevalence in both periods. Non-pathogenic parasites such as *E. nana*, *E. coli* and *I. butschlii* were also detected.

Prevalence of intestinal parasitism with age

The prevalence of intestinal parasites showed an increased trend with age (groups 6 - 7.9 *vs.* 8 - 9.9, P = 0.6060; groups 6 - 7.9 *vs.* 10 - 11.9, P = 0.5103 in 2005; groups 6 - 7.9 *vs.* 8 to 9.9, P = 1.000; groups 6 - 7.9 *vs.* 10 - 11.9, P = 0.6262 in 2006) (Fisher exact test) (Table 2).

Intensity of *H. nana* by age

During the study, 50 of 450 (September 2005) and 42 of 389 children (September 2006) excreted a median of 520 and 630 epg of *H. nana*, respectively. From these children, 16 (32%) and 16 (32%) children in 2005, and 20 (48%) and 8 (19%) children in 2006 showed intensities ≤ 100 and ≥ 1000 epg, respectively. The intensity of infection with *H. nana* showed an increased tendency with age in both sampling periods (Table 3).

DISCUSSION

Almost half of our study children were suffering from intestinal parasites. Earlier epidemiological records by the Ministry of Health and published information by research studies recognized *G. duodenalis* as the predominant pathogenic protozoan (SS, 2006) and *H. nana* as the persistent helminth species causing infections in the school children of Northwest Mexico. Our study confirms that *G. duodenalis* is the predominant protozoan species and revealed that *H. nana* is the only helminth detected in the study sites. Our results have shown that prevalence

Table 3. Distribution of *H. nana* eggs per gram (eggs $g^{-1)}$ of feces in 50 school children in September 2005 and 42 school children in September 2006 by age-group of 3 municipalities of Northwest Mexico.

Age group (years)	September 2005		September 2006	
	Eggs g^{-1}			
	n	Median (CI)	n	Median (CI)
6-7.9	21	743 (354-1100)	18	597 (270-960)
8-9.9	24	721 (341-1232)	17	695 (275-1054)
10-11.9	5	1436 (543-2143)	7	604 (345-1450)

CI: Confidence interval.

of intestinal parasites remains unchanged in albendazole treated school children of the study sites. Before the national campaign was established in 1993, prevalences of 58.9% in 1957 and 19.5% in 1968 for ascariasis (Tay et al., 1976) and prevalences of 39.7% in 1957 and 19.5% in 1978 for trichuriasis were observed in some Mexican regions (Bayona et al., 1968; del Villar Ponce et al., 1978). Similarly, the prevalence of giardiasis and amebiasis showed prevalences ranging from 14 to 16% and from 12 to 21%, respectively from 1982 to 1984 in children under 15 years of age (Alonso Guerrero, 1983; Duarte-Zapata et al., 1984; Salazar Schettino et al., 1981). After 1993 (Guevara et al., 2003; Gutierrez-Rodriguez et al., 2007; Martínez et al., 1998; Rodríguez et al., 1997), the prevalences of *T. trichiura*, *A. lumbricoides*, *H. nana*, *G. duodenalis* and *E. histolytica* were peaking around 16, 8, 15, 24 and 60%, respectively in the general population. A substantial reduction of trichuriasis and ascariasis, but persistent giardiasis, hymenolepiasis and amebiasis were found in Southern Mexico. Probably this pattern is associated with the deworming campaign and this may explain the absence of ascariasis and trichuriasis in our study. Furthermore, no differences were found in the prevalence of intestinal infections between our girls and boys. Studies in Mexico and other Latin American countries have also found similar findings. Probably the children in our study are developing the same transmission risk activities related to poor hygiene (Sánchez de la Barquera et al., 2010). On the other hand, the prevalence of intestinal parasites showed an increase with age in our study. Khosrow et al. (2011) published a similar finding in 405 Iranian school children with ages of 6 to 10 years without identifying the causative associated factors. This probably reflects the major attention from parents to young children neglecting the fact that the older children are infected more easily. It is also probable that, the higher the prevalence of *H. nana*, the greater the intensity of *H. nana* in this study. In spite of the deworming campaign, the persistence of intestinal parasites may be a reflection of poor hygiene practices of our participating children's families and the limited basic services in the study areas where they are living. This study was not designed to evaluate the effectiveness of the deworming campaign, due to inappropriate sample size and lack of a methodological strategy of sampling. We recognized that the Mexican campaign is aimed primarily at the soil-transmitted helminthiasis, and albendazole is the drug of choice. However, it is evident that our study site's population is at high risk of acquiring giardiasis and hymenolepiasis. The school children in this study had received 400 mg of albendazole in April 2005 and 2006 and our findings have suggested that health education strategies should be integrated into the deworming campaign, since albendazole alone will not improve health conditions of our study children. In addition, this is the first study conducted to investigate the prevalence of intestinal parasitism in the study sites where a deworming campaign is implemented. Our results encouraged the design of a study to assess the effectiveness of the campaign in the study sites and to identify the causative factors responsible of the persistent prevalence of parasitic infections in our study children.

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