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Persistence of intestinal parasitic infections during the national de-worming campaign in schoolchildren of northwestern Mexico: a cross-sectional study

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Abstract

Background Intestinal parasitism remains a public health challenge in northwestern Mexico even when a twice yearly single dose of albendazole (400 mg) is administered to schoolchildren. We aimed to determine the current prevalence of intestinal parasitic infections in schoolchildren of northwestern Mexico.

Methods The Faust and Kato Katz techniques were used to detect and identify the intestinal parasite species. One thousand two hundred and seventy eight children from 12 public schools were invited to participate in this study; 312 children participated in September 2003.

Results Sixty eight percent of the subjects had intestinal parasites, 63% had protozoan infections, and 29%, 16% and 10% were infected with *Giardia duodenalis*, *Hymenolepsis nana*, and *Entamoeba histolytica/dispar/moshkovskii* respectively. Fifty children excreted eggs of *Hymenolepsis nana*.

Conclusion Educational strategies should be considered to support the national de-worming campaign, because albendazole alone will not sufficiently improve the health conditions of vulnerable populations.

Keywords Intestinal parasitic infections, de-worming campaign, albendazole, schoolchildren, northwestern Mexico

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Introduction

Intestinal parasitism remains a public health problem worldwide [1,2]. Thus, effective programs for controlling intestinal infections by helminths with regular treatment were introduced worldwide after an informal consultation on intestinal helminths [3]. Some of these programs have effectively reduced the prevalence and intensity of infections and chronic morbidity in Seychelles, Zanzibar, and Sri Lanka, using mebendazole and albendazole [3].

In Mexico, intestinal parasitic infections remain associated with high morbidity in the general population [4]. In 1987, the Mexican schoolchildren were revealed to be the age group most affected by these infections [5]. A Mexican de-worming campaign was implemented in 1993 based on the worldwide effectiveness of the helminth control programs and it was determined that the program should provide albendazole to 95% of children aged 2-14 years, to reduce primarily helminth infections by hookworms, *Ascaris lumbricoides* (*A. lumbricoides*), *Trichuris trichiura* (*T. trichiura*), and *Hymenolepis nana* (*H. nana*), predominant in southern Mexican regions [6].

In 1995 the prevalence of *Giardia duodenalis* (*G. duodenalis*) was estimated at 32% in Mexico [7] and it remained the most important pathogenic intestinal protozoa causing infection in northwestern Mexico, with prevalence ranging from 14% to 49% during the recent years [8-12]. Another important pathogenic protozoa is *Entamoeba histolytica* (*E. histolytica*) that can achieve a prevalence of up to 50% in the south of the country [13] although it may be less predominant than giardiasis in the northwestern region [9-12]. Up to date, the Ministry of Health continues to administer a twice-yearly single dose of albendazole to the child population, however, the

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prevalence of intestinal parasitic infections in schoolchildren of northwestern Mexico remains currently unknown and health authorities demand this information in order to establish supporting strategies to the campaign.

Materials and Methods

Study area and population

This cross-sectional study was conducted in September 2003 in the state of Sonora in northwestern Mexico. Sonora borders to the east the state of Chihuahua, to the south the state of Sinaloa, to the west the Gulf of California, and to the north the American state of Arizona. The total population of Sonora was estimated in October 2004 to be 2,336,574; the subsets of the population aged 6-12 years old and 13-17 years old were estimated to be 320,824 and 222,912, respectively [14]. Twelve governmental primary schools from four Sonoran municipalities (Nogales, Empalme, Cajeme, and Ures) were selected on the basis of a high gastrointestinal infections rate in the general population of the community [15,16], low socioeconomic level in the areas of the schools [17] and presence of the national campaign [15]. No epidemiological study to investigate the prevalence of intestinal parasitic infections has ever been carried out in the study sites, despite the fact that all the selected schools regularly receive albendazole [15].

The purpose of this study was described to personnel from health services, city councils, schools, parents and schoolchildren. One thousand two hundred and seventy eight schoolchildren were officially enrolled in the selected primaries in September 2003 [18]. All children were invited to participate while plastic containers were distributed with requests for fecal samples (three samples from each subject were to be collected in each school during a five-day period). Our study population consisted of 312 schoolchildren representing around 24.5% of the voluntarily enrolled population. Information about names, ages and genders of the children were obtained from school registers. School authorities confirmed the administration of albendazole during visits by the de-worming campaign.

Written consent from parents or guardians was obtained for all children willing to participate. Six hundred and eighty six children who were unwilling to participate, or were disabled (n=5), supplemented (n=11), medicated (n=13), de-wormed with drugs other than albendazole (n=27), who dropped out of school (n=134) or moved away from the study sites (n=88), were excluded or not recruited during the study time. The ages and non-school-assistance of the non-recruited children were not recorded. Approval to conduct this study was granted by the ethical committee of the Centro de Investigación en Alimentación y Desarrollo A.C.

Stool collection and parasitology

Stool samples were collected from each subject and transported properly to the laboratory of parasitology at the Centro de Investigación en Alimentación y Desarrollo in Hermosillo. Samples were stored between 5 °C and 7 °C for 24-72 h until analysis by the Faust and Kato-Katz techniques [19]. Covered slides with fecal material in a drop of iodine solution were observed using 10x and 40x objectives for identification of protozoan cysts of *G. duodenalis*, *E. histolytica/dispar/moshkovskii* [20], *Entamoeba coli* (*E. coli*), and *Endolimax nana* (*E. nana*) which have shown high prevalence in northwest Mexico [8-12] and helminths eggs (hookworms, *A. lumbricoides*, *T. trichiura*, and *H. nana*). In addition, the Kato-Katz cellophane thick smears for helminths were used to count the number of eggs per gram of feces (epg) and the final value was the epg average found in the number of samples (3, 2, or 1) provided by each child. The epg was calculated multiplying twenty times the number of eggs counted in 50 mg of feces. Infection was defined as the status with one or more parasit species (sp.), polyparasitism with two or more parasite sp., helminth infection only with helminth parasite sp., and protozoan infection only with protozoan parasite sp.

Data analysis

Infection prevalence was expressed as the percentage of schoolchildren found positive for the parasite sp. detected in any of the fecal samples provided. Chi-square tests were used to test differences in the proportions of infections between males and females. The intensity of helminth sp. was defined in epg and was reported as the arithmetic mean intensity ± standard deviation. Statistical significance was set at $p < 0.05$. Data were analyzed using Number Crunch Statistical System 2001 (Version 1.6.0. 329 North 1000 East Kaysville, Utah 84037.com, USA).

Results

A total of 312 schoolchildren participated voluntarily in this study and half of them (n = 155) were girls. The mean age of the total of children recruited in this study was 8.3 (±1.3) years. No differences were found between the proportion of genders ($p = 0.989$). A total of 813 fecal samples (serials of 3, 2 and 1 samples were provided by 224, 53 and 35 children respectively) were collected and analyzed during the sampling period. More than half of these children exhibited intestinal parasitic (68%) and protozoan (63%) infections (Table 1); the prevalence of helminth infections was 16% (Table 1). *G. duodenalis* and *H. nana* showed a substantial prevalence (29% and 16%, respectively; Table 1); a high prevalence was also detected for non-pathogenic amebas such as *E. coli* and *E. nana*. In contrast, *E. histolytica/dispar/moshkovskii* had a low prevalence. Helminth infections by *A. lumbricoides* and *T. trichiura* as well as hookworm infections were not detected in this study. The prevalence of parasitic infections did not significantly differ by gender ($p > 0.05$; data not shown). Fifty children excreted a mean of 63 (± 354) epg of *H. nana*.

Table 1 Prevalence of intestinal parasites in a total of 312 schoolchildren of northwestern Mexico in September 2003

Sampling Time	September 2003
Number of children	312
	% (CI)ɣ
Infection*	68 (62-73)
Polyparasitism**	41 (36-47)
Helminth infection†	16 (12-20)
Protozoan infection‡	63 (57-68)
H. nana+	16 (12-20)
G. duodenalis+	29 (24-34)
E. histolytica/dispar/moshkovskiiΔ	10 (7-13)
E. coli	26 (21-31)
E. nana	37 (31-42)

**Infection with one or more parasites; **Infection with two or more parasites; †Infection only with helminths species; ‡Infection only with protozoan species; ɣConfidence interval; + Pathogens; No pathogens; Δ Pathological status not defined*

H. nana, Hymenolepis nana; G. duodenalis, Giardia duodenalis; E. histolytical, Entamoeba histolytical; E. coli, Entamoeba coli

Intensities of ≤ 100 and ≥ 1000 epg were found in twenty two (44%) and five (10%) of these children, respectively.

Discussion

We estimated the prevalence of intestinal parasitism in 12 primary schools in four communities of northwestern Mexico. We confirm that these schools had been treated by the de-worming program since 1993, in agreement with an official school list based on treatment priority of intestinal infections. Although, all of the recruited children had recently received albendazole (March 2003), the intestinal parasitic infections were highly prevalent in this study against our expectations (Table 1).

G. duodenalis has been recognized as the predominant protozoan affecting the general population in northwest Mexico [8-12, 21]. In addition, although these previous studies identified *H. nana* as the most important infection-causing helminth infection, with lesser *T. trichiura* and *A. lumbricoides*, our study found that *G. duodenalis* remains the predominant protozoan and *H. nana* the only detected helminth (Table 1).

The national prevalence and intensities of ascariasis and trichuriasis have significantly decreased in the schoolchildren's population associated probably with the de-worming campaign [6] and this may also underlie the absence of these infections in our study (Table 1).

In addition, the prevalence of these infections in the study sites remains high even when our study children are periodically receiving albendazole (last treatment was March 2003) which may reflects poor health and hygiene education in their families. We must mention that this study was not designed to assess the effectiveness of the de-worming campaign, and probably the sample size is not representative of the schoolchildren's population of the state of Sonora. However, the reality is that our study population at the study sites is probably at high risk of infection by giardiasis and hymenolepiasis. Results of this study suggested that educational strategies on health and hygiene should be integrated into the national de-worming campaign, since the antiparasitic treatment alone will not improve the health conditions of these most vulnerable communities. In addition, this is the first study to determine the current prevalence of intestinal parasitic infections in that regional area, and results are required from health program developers and policymakers to justify further studies to assess the effectiveness of the national de-worming campaign in the study sites in order to design and to integrate educational strategies to the program to achieve maximal benefits in a short term and to explore natural alternative treatments at a local level.

Summary Box

What is already known:

- Effective programs for controlling helminth infections with regular treatment have been introduced worldwide and some of them have effectively reduced these infections
- In 1993, a de-worming campaign to provide albendazole to children was implemented to reduce primarily helminth infections, the predominant parasitic infections in southern Mexico
- In contrast, earlier studies have shown that protozoan intestinal infections are the major parasitic infections in northwestern Mexico
- In spite of a de-worming campaign which remains active, the current prevalence of these infections is not well known in that part of the country

What the new findings are:

- Our results suggest that the population of our study sites is still at high risk to be affected for infection by intestinal parasitic infections parasites, particularly giardiasis and hymenolepiasis
- Our observation of high prevalence of infection after the regular antiparasitic treatment suggests that educational strategies on health and hygiene must be integrated into the national de-worming campaign
- This is the first study to determine the prevalence of intestinal parasitic infections in that region, and results are required by the health authorities to consider further alternatives to support the national campaign in order to achieve maximal benefits

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References

1. Albonico M, Crompton DW, Savioli L. Control strategies for human intestinal nematode infections. *Adv Parasitol* 1999; **42**:277-341.
2. Crompton DW. How much human helminthiasis is there in the world? *J Parasitol* 1999; **85**:397-403.
3. WHO. Informal consultation on the use of chemotherapy for the control of morbidity due to soil-transmitted nematodes in humans. Geneva: World Health Organization; 1996.
4. SINAIS. Sistema Nacional de Información en Salud. Diez Principales causas de mortalidad en edad preescolar del 2005. Indicadores de salud 2005 [cited Febrary 23 2011]; Available from: http://www.sinais.salud.gob.mx/basesdedatos/index.html
5. Martuscelli QA. Frecuencia de helmintiosis en niños de la República Mexicana. *Rev Mex Ped* 1987;**36**:111.
6. Velasco C, Escobar G, Valdespino G. Epidemiología de las helmintiasis intestinales en México. Mexico, D. F.: Secretaria de Salud; 1993, Report No. 24.
7. Tay J, Ruiz A, Schenone H, et al. Frequency of intestinal protozoosis in the Mexican Republic. *Bol Chil Parasitol* 1994; **49**:9-15.
8. Gomez RN, Mada VJ, Durazo GN, Matty OM, Vazquez PE, Robles MG. Helmintiasis en los Ninos, Informe de 543 Casos. Hermosillo, Sonora, Mexico: Clin Hosp Infant Edo Son 1996.
9. Secretaria de Salud. Informe de casos nuevos de enfermedades en el Estado de Sonora. Hermosillo, Sonora, Mexico: Departamento de Estadística y Evaluación, Dirección de Planeación y Desarrollo. 2009.
10. Valencia ME, Astiazarán H, Grijalva MI, et al. Evaluación y diagnóstico del estado de nutrición de la Tribu Yaqui. Reporte Tecnico. Hermosillo, Sonora. Mexico: Centro de Investigacion en Alimentacion y Desarrollo, A.C; 1995.
11. Valencia ME, Jardines RP, Noriega GE, Higuera I. Estudio Nutricional en la Zona Serrana del Estado de Sonora. Hermosillo, Sonora, Mexico: Instituto de Investigaciones y Estudios Superiores del Noroeste, A. C.; 1980.
12. Valencia ME, Jardines RP, Noriega GE, Higuera I. Estudio nutricional en centros urbanos marginados de Sonora. Hermosillo, Sonora, Mexico: Instituto de Investigaciones y Estudios Superiores del Noroeste, A. C. Sonora; 1981.
13. Morales-Espinoza EM, Sanchez-Perez HJ, Garcia-Gil Mdel M, Vargas-Morales G, Mendez-Sanchez JD, Perez-Ramirez M. Intestinal parasites in children, in highly deprived areas in the border region of Chiapas, Mexico. *Salud Publica Mex* 2003;**45**:379-88.
14. Secretaria de Educacion y Cutura. Información de niños escolares inscritos durante el ciclo 03-04 en las escuelas públicas primarias en el Estado de Sonora. Sonora, Mexico: Secretaría de Educación y Cultura; 2003.
15. Secretaria de Salud. Informe annual de casos nuevos de enfermedades de la semana 1 hasta la semana 52 en el Estado de Sonora. Hermosillo, Sonora, Mexico: Secretaria de Salud. Departamento de Estadística y Evaluación, Dirección de Planeación y Desarrollo; 2003.
16. Secretaria de Salud. informe annual de casos nuevos de enfermedades de la semana 1 hasta la semana 52 en el Estado de Sonora. Hermosillo, Sonora, Mexico: Secretaria de Salud. Departamento de Estadistica y Evaluacion. direccion de Planeacion y Desarrollo; 2004.
17. Instituto Nacional de Estadistica y Geografía. Encuesta Nacional del Empleo. 2004 [cited January 7 2011]; Available from: http://www.estadisticasonora.gob.mx/.
18. Secretaria de Educacion y Cutura. Información de niños escolares inscritos durante el ciclo 04-05 en las escuelas públicas primarias en el Estado de Sonora. Sonora, Mexico: Secretaria de Educación y Cultura; 2004.
19. Markell E, Voge M. Medical Parasitology. 4ta ed.: W.B. Saunders; Philadelphia; 1976.
20. Cheng XJ, Yoshihara E, Takeuchi T, Tachibana H. Molecular characterization of peroxiredoxin from Entamoeba moshkovskii and a comparison with Entamoeba histolytica. *Mol Biochem Parasitol* 2004;**138**:195-203.
21. Hermida RC, Ayala DE, Arroyave RJ. Comparative circannual pattern in the incidence of giardiasis in different states of Mexico. *Bioquimia* 1995; **20**:279-89.