# Pinworm Infestation Control: A County-wide Program in Taiwan

Long-Teng Lee[1,2] and Yue-Cune Chang[3]

**Objectives:** A county wide campaign of mass screening and medication for pinworm infestation control was conducted for school children in the northern Taiwan in 2001.

**Methods:** A total of 309,446 (response rate 95.2%) children at 215 primary schools, with parental consents, received the adhesive thin cellophane tape swab examination, 13,166 (8.2%) boys and 11,729 (7.9%) girls were found to have pinworm infestation. All the children received one dose of Mebendazole 100 mg and an additional dose two weeks after the first medication with parental consents.

**Results:** Approximately 6 months after the mass medication, 294,917 children received re-screening using the same method, and 442 (0.15%) were found to be positive. The reduction rates of pinworm infestation by the mass screening and medication campaign was 99.0%. The cost of medication was 300,000 New Taiwan dollars (10,000 US dollars), only 1% of annual budget spent in previous 10 years average. There were no significant differences in reduction rates between boys and girls, and among students living in urban, suburban, and rural areas. Higher graders had lower infection rate and lower reduction rate.

**Conclusion:** This mass screening and medication campaign is a cost-effective strategy for pinworm control and may be useful for the pinworm control in other countries and areas with high prevalence.

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**Key words:** county-wide control, enterobiasis, Taiwan

## INTRODUCTION

Pinworm (*Enterobius vermicularis*) is found worldwide the common human infection in children [1]. Humans are the only known host, and about 209 million persons worldwide are infected. More than 30 percent of children worldwide are infected [2]. The infection is more prevalent in populations living in the cool and temperate areas, where people tend to bathe less often and change their underclothes less frequently. But even in Nigeria, 7.5% of children aged 5-14 years were found to have

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enterobiasis [3]. Pinworm is also the most prevalent nematode in China [4] and Korea [5]. The pinworm infection is relatively innocuous, with the female worm migrates to the anus and deposit eggs causing perineal, perianal, and vaginal irritation [6]. It can lead to sleep disturbance arising from itching, and rarely cause weight loss, urinary tract infection [7], omental mass [8], pelvic inflammatory disease [9], pediatric intussusception [10], salpingitis [11], eosinophilic ileocolitis [12], and allergy [13].

Taiwan had been once an area endemic with a high prevalence of nematode intestinal parasites among children. The helminth infection rate among primary-school-age children in 1971 was as high as 73% and the pinworm screening data suggested an apparent parasite re-infection phenomenon [14]. A three-year community control program of pinworm was conducted by Lee et al in a rural township in Taiwan from 1983 to 1985 [15]. The results revealed that mass screening and medication is a successful strategy for pinworm control in a highly prevalent area. The Taiwan Provincial Health Department also conducted twice the provincial wide 5-year plan aiming for thorough control of intestinal helminthes from 1977 to 1986. The pinworm infestation in primary-school-children in Taipei County remained a public health concern and the county government spent 60 million New Taiwan dollars (2 million US dollars) every year between 1990 and 2000 to control the infestation (from Taipei County Government Annual Budget Report). We conducted a mass screening- medication campaign against pinworm infestation from 2001 to 2002 for primary school children in Taipei County, and to explore the effectiveness of control and the differences of reduction rates between sex and age groups.

## MATERIALS AND METHODS

Taipei County is located at the northern part of Taiwan, with a population of 3.68 million in 2000, living in an area of nearly 2,052 km square in size. There were 215 primary schools with 325,003 school children in 29 townships (Table 1),

Table 1. Distribution of Primary-school Children by Grade and Urban Status, Taipei County in 2001

| Grade | Urban | | Suburban | | Rural | | Total | |
|---|---|---|---|---|---|---|---|---|
| | boys | girls | boys | girls | boys | girls | boys | girls |
| 1 | 21,873 | 20,566 | 4,593 | 4,251 | 1,186 | 1,059 | 27,590 | 25,876 |
| 2 | 22,628 | 20,544 | 4,601 | 4,097 | 1,186 | 1,099 | 28,415 | 25,740 |
| 3 | 22,758 | 20,770 | 4,672 | 4,166 | 1,099 | 1,057 | 28,529 | 26,118 |
| 4 | 22,526 | 20,770 | 4,467 | 4,012 | 1,013 | 1,044 | 28,006 | 25,826 |
| 5 | 22,726 | 20,760 | 4,516 | 3,918 | 984 | 936 | 28,226 | 25,614 |
| 6 | 23,395 | 21,351 | 4,292 | 4,065 | 967 | 993 | 28,654 | 26,409 |
| All | 135,906 | 124,886 | 27,141 | 24,509 | 6,373 | 6,188 | 169,420 | 155,583 |

including 10 urban townships, 7 suburban townships, and 12 rural townships. With their parental consent for the mass screening and mass medication for pinworm infestation, an adhesive thin cellophane tape swab was applied to the perianal area on children for pinworm eggs. All the students received one dose of mebendazole 100 mg after the first screening and a second dose two weeks apart. All the students had follow-up examination 6 months after medication. The medicine was delivered to students in the morning by the teacher responsible for the class from October 1 to October 31, 2001. All teachers at these 215 primary schools were trained by the Health Bureau of Taipei County Government to conduct health education and to advise students of personal hygiene for pinworm prevention.

Data analyses first compared the infection rate at the first swab screening by students' grade and sex among urban, suburban and rural areas. Similar comparison was conducted for the second screening among the first screening positive students after the medication campaign. The multiple logistic regression analysis was used to estimate the relative risk of pinworm infection associated with gender, grade, and living townships.

## RESULTS

Table 1 shows the study population distribution of primary schools expected to participate in the pinworm control campaign, including 260,792 (80.2%) children living in urban areas, 51,650 (15.9%) in suburban areas, and 12,561 (3.9%) in rural townships. A total of 309,446 (response rate 95.2%) children participated in the first screening examinations, and overall 8.2% boys and 7.9% girls were found pinworm infection positive (Figure 1). The infection rate decreased as grade

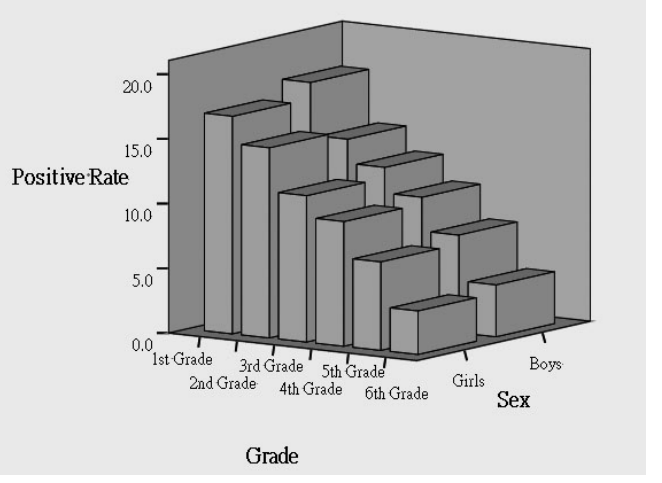


Figure 1. Distribution of positive rate of pinworm infestation before mass medicationunexpected hospitalization.

increased, and approximately 3.3% greater among students in rural schools than students in urban schools. Table 2 shows the odds ratios of infection before medication were significantly greater for girls than in boys, 1.43 times higher in rural students than in urban students, and much lower for the 6th graders than for the first graders (OR=0.091, 95% CI 0.085, 0.099).

Figure 2 shows students remained infection in the second screening examination after the two consecutive medications. The overall positive rates reduced to 0.16% in boys and 0.13% in girls, representing reduction rate of more than 99.0%. Children living in rural townships still had the highest positive rate. The cost spent on medication was 300,000 New Taiwan dollars (10,000 US dollars), only less than 1 % of the annual budget of the annual budget of previous 10 years.

Table 2. Odds Ratios of Pinworm Infestation at Baseline before Mass Medication Using Multiple Logistic Regression Analysis

| | | | | | 95% CI for Odds Ratio | |
|---|---|---|---|---|---|---|
| Factor | Coefficient | Std. Error | *p*-value | Odds Ratio | Lower | Upper |
| Girls vs. Boys | -0.033 | 0.0134 | 0.015 | 0.968 | 0.943 | 0.994 |
| Grade 2 vs. 1 | -0.123 | 0.0184 | <0.001 | 0.884 | 0.853 | 0.917 |
| Grade 3 vs. 1 | -0.370 | 0.0194 | <0.001 | 0.691 | 0.665 | 0.718 |
| Grade 4 vs. 1 | -0.757 | 0.0215 | <0.001 | 0.469 | 0.450 | 0.489 |
| Grade 5 vs. 1 | -1.544 | 0.0278 | <0.001 | 0.213 | 0.202 | 0.225 |
| Grade 6 vs. 1 | -2.393 | 0.0387 | <0.001 | 0.091 | 0.085 | 0.099 |
| Suburban vs. urban | 0.185 | 0.0176 | <0.001 | 1.204 | 1.163 | 1.246 |
| Rural vs. urban | 0.360 | 0.0314 | <0.001 | 1.433 | 1.348 | 1.524 |

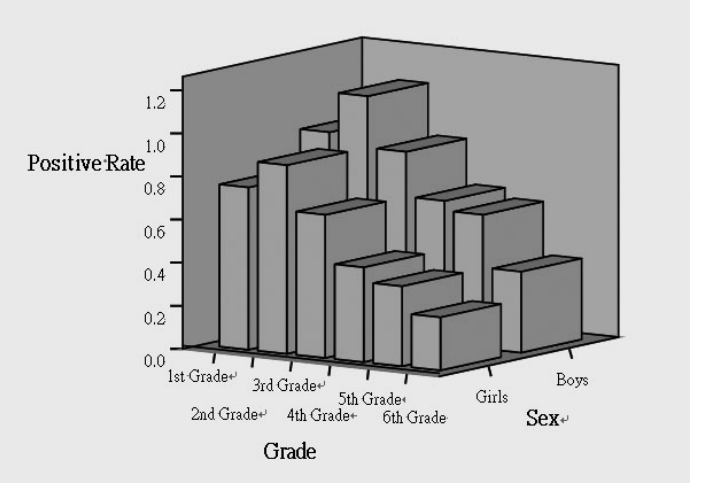


Figure 2. Distribution of positive rate of pinworm infestation after mass medication

## DISCUSSION

*Enterobius vermicularis* is a helminth that is difficult to control, is found globally, especially in crowded conditions. Cranston et al had found that 16.6% of school children had helminth eggs on the hands, and with *Enterobius vermicularis* most commonly identified [16]. The Taiwan Provincial wide pinworm control campaign in 1977-1986 reduced the infection rate from 10% to 1.0% or lower for the first graders in almost six years [19]. But in Taipei County there were still 8.1 % of primary school children had pinworm infestation and the government spent 60 million New Taiwan dollars (2 million US dollars) every year to control the infestation. Our campaign took only six months with two dosages of mebendazole 100 mg and accomplished a 99.0% of reduction in the infection. Intestinal parasite disease prevention and control is an issue of less concerned in most developed countries, although pinworm is the most common worm infection.

Pinworm infestation is associated with poor personal hygiene, inadequate environmental sanitation, overcrowd and/or poverty. These factors must be considered in developing a parasite prevention program. Also adequate medication interval and adequate dosage of antihelmintic used to cover the life cycle of pinworm have an effective contribution to the control of pinworm infestation [15]. There are many prescriptions available for pinworm medication, including albendazole [18], pyrantel pamoate [19] and nitazoxanide [20]. We found mebendazole 100 mg was a good choice for our campaign. The first dose was supposed to control the adult worms and the second dose was supposed to control the embryonated eggs ingested by the children.

The prevalence rate of pinworm infection is still an issue of concern in many countries [21-24], in addition to the education [25]. Mass screening campaigns and re-medication for parasite infection may cost, but treatment of pinworm infection improves the quality of life for children. Our mass screening and medication campaign has saved the Taipei County 60 million New Taiwan dollars (2 million US dollars) annually for the pinworm control in the following years after the campaign. We consider this is a cost effective model can be adapted for the pinworm control in areas with high prevalence, especially in developing countries.

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## REFERENCES

1. Garcia LS: *Diagnostic Medical Parasitology. 5th ed*. Washington, D.C.: ASM. Press, 2007.
2. Goldman DA, Wilson CM: Pinworm

infestations. In: Hoekelman RA ed. *Primary Pediatric Care. 3rd ed*. St Louis: Mosby, 1997: 1519.

3. Otu-Bassey IB, Ejezie GC, Epoke J, Useh MF: Enterobiasis and its relationship with anal itching and enuresis among school-age children in Calabar, Nigeria. Ann Trop Med Parasitol 2005; 99: 611-66.
4. Chen YD, Wang JJ, Zhu HH, et al: Enterobius vermicularis infection status among children in 9 provinces/autonomous regions/ municipalities of China. Zhongguo Ji Sheng Chong Xue Yu Ji Sheng Chong Bing Za Zhi 2013; 31: 251-5.
5. Chai JY, Yang SK, Kim JW, et al: High prevalence of Enterobius vermicularis infection among schoolchildren in three townships around Yangon. Korean J Parasitol 2015; 53: 771-5.
6. Macpherson DW: Intestinal parasites in returned travelers. Med Clin North Am 1999; 83: 1053-75.
7. Patel B, Sharma T, Bhatt GC, Dhingra Bhan B: Enterobius vermicularis: an unusual cause of recurrent urinary tract infection in a 7-year-old girl: case report and review of thr literature. Trop Doct 2015; 45: 132-4.
8. Kilic S, Ekinci S, Orhan D, Senocak ME: Enterobius granuloma: an unusual cause of omental mass in an 11-year-old girl. Turk J Pediatr 2014; 56: 189-91.
9. Mentessidou A, Theocharides C, Patoulias I, Panteli C: Enterobius vermicularis-associated pelvic inflammatory disease in a child. J Pediatr Adolesc Gynecol 2016; 29: e25-7.
10. Tjaden BL Jr, Schropp KP: Pediatric intussusception associated with Enterobius vermicularis. J Pediatr 2014; 165: 1272.
11. Erhan Y, Zekiou O, Ozdemir N, Sen S: Unilateral salpingitis due to Enterobius vermicularis. Int J Gyn Pathol 2000; 19: 188-9.
12. Peixoto A, Goncalves R, Silva M, et al: Eosinophilic ileocolitis due to Enterobius vermicularis infection: a rare cause of anemia. Int J Colorectal Dis 2016; 31: 743.
13. Boas H, Tapia G, Rasmussen T, Ronningen KS: Enterobius vermicularis and allergic conditions in Norwegian children. Epidemiol Infect 2014; 142: 2114-20.
14. Parasite Control Association: Statistics on Parasite Infection, 1976-1995. Taipei: Taiwan Parasite Control Association, 1997.
15. Lee LT, Lai MS, Hsieh WC, Wu YC: An investigation of the prevention and treatment of enterobiasis of the children in Shuang-His district. J Natl Public Health Assoc (ROC) 1987; 7: 1-11.
16. Cranston I, Potgieter N, Mathebula S, Ensink JHJ: Transmission of Enterobius vermicularis eggs through hands of school children in rural South Africa. Acta Tropica 2015; 150: 94-6.
17. Sung JFC, Lin RS, Huang KC, Wang SY, Lu YJ: Pinworm control and risk factors of pinworm infection among primary-school children in Taiwan. Am J Trop Med Hyg 2001; 65: 558-62.
18. Horton J: Albendazole: a review of antehelmintic efficacy and safety in humans. Parasitol 2000; 121 (Suppl): S113-S132.
19. Zhang D, Zhang X, Tang Z, et al: Field trials on the efficacy of albendazole composite against intestinal neomatodiasis. Chin J Parasitol Parasit Dis 1998; 16: 1-5.
20. Romero Cabello R, Guerrero LR, Muñóz

García MR, Geyne Cruz A: Nitazoxanide for the treatment of intestinal protozoan and helminthic infections in Mexico. Transact Roy Soc Trop Med Hyg 1997; 91: 701-3.

21. Rim HJ, Chai JY, Min DY, et al: Prevalence of intestinal parasite infections on a national scale among primary schools in Laos. Parasitol Res 2003; 9: 267-72.
22. Changsap B, Nithikathkul C, Boomtan P, Wannapinayosheep S, Vonvanich N, Poister C: Enterobiasis in primary schools in Bang Khun Thian District, Bangkok, Thailand. Southeast Asian J Trop Med Publ Health 2002; 33(Suppl 3): 72-5.
23. Tomaso H, Dierich MP, Allerberger F: Helminthic infestations in the Tyrol, Australia. Clin Microbiol Infect 2001; 7: 639-41.
24. Pezzani BC, Minvielle MC, de Luca JA, Cordoba MA, Apezteguia MC, Basualdo JA: Enterobius vermicularis infection among population of General Argentina. World J Gastroenterol 2004; 10: 2535-9.
25. Le Hung Q, de Vries PJ, Giao PT, Biah TQ, Nam NV, Kager PA: Intestinal helminth infection in ethnic minority commune in Southern Vietnam. Southeast Asian J Trop Med Publ Health 2005; 36: 623-8.

# 蟯蟲防治：以台灣某縣全縣防治爲例

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**目的：**本研究分析 2001 年台灣北部某縣市進行大規模學童蟯蟲篩檢及治療之成效。

**方法：**總共有 215 所小學 309,446 位學童（參與率 95.2%）之父母同意接受學童蟯蟲肛門貼紙篩檢，13,166 位(8.2%)男生，11,729 位(7.9%)女生被檢出有蟯蟲感染。所有學童在父母親同意下均接受口服一劑 100 毫克 Mebenazole 治療，兩週後接受第二劑治療。

**結果：**在大規模治療六個月後，294,917 位接受再次檢查，442 位(0.15%)仍有感染，大規模篩檢與治療使蟯蟲感染率下降了 99%。治療總成本爲新台幣 30 萬元，爲該縣過去十年蟯蟲防治預算的 1%。男童與女童的蟯蟲感染下降率沒有顯著的不同，此下降率也沒有城鄉之別。高年級的學童感染率較低但下降率也比較低。

**結論：**此大規模蟯蟲感染篩檢與治療計畫證明具有成本效益，可提供給其他高蟯蟲感染盛行率國家或地區做蟯蟲感染防治之參考。

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**關鍵詞：**蟯蟲、全縣控制、台灣

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