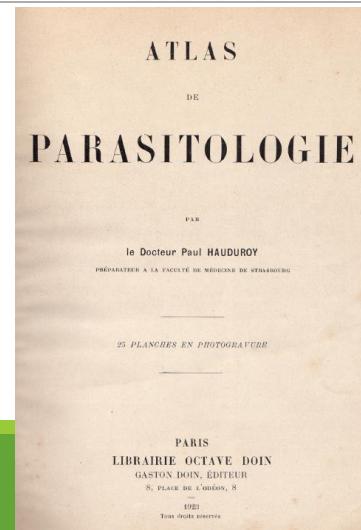
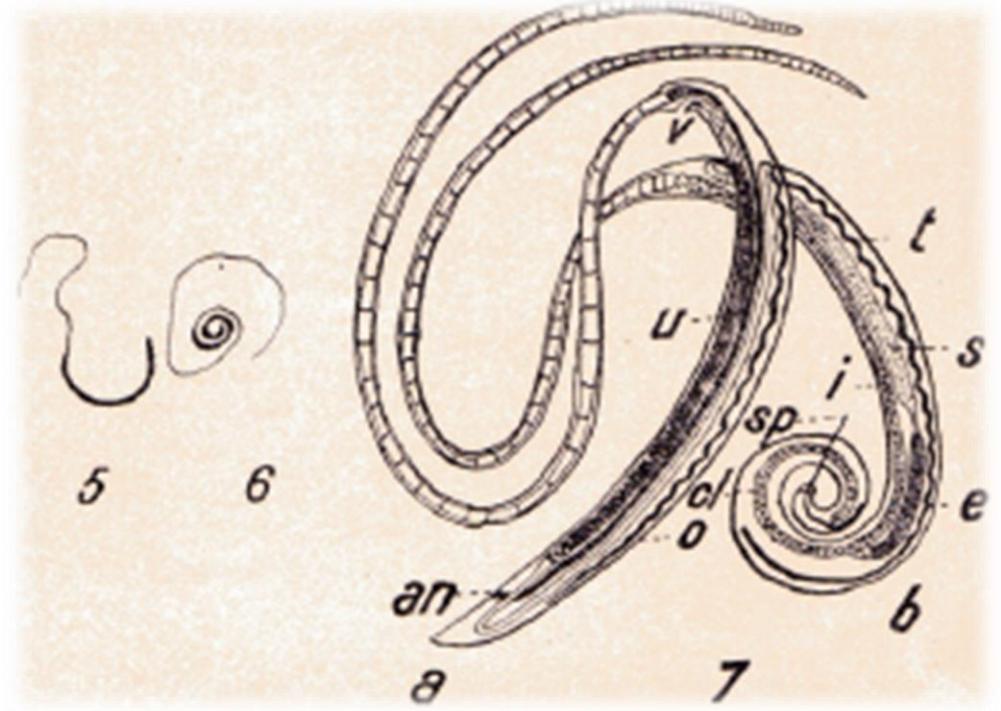


# Trichuriasis

PROF. ALFONSO J. RODRÍGUEZ-MORALES  
PARASITOLOGÍA GRUPOS 4 Y 5  
SEMESTRE I-2015



# Phylum

## Classes

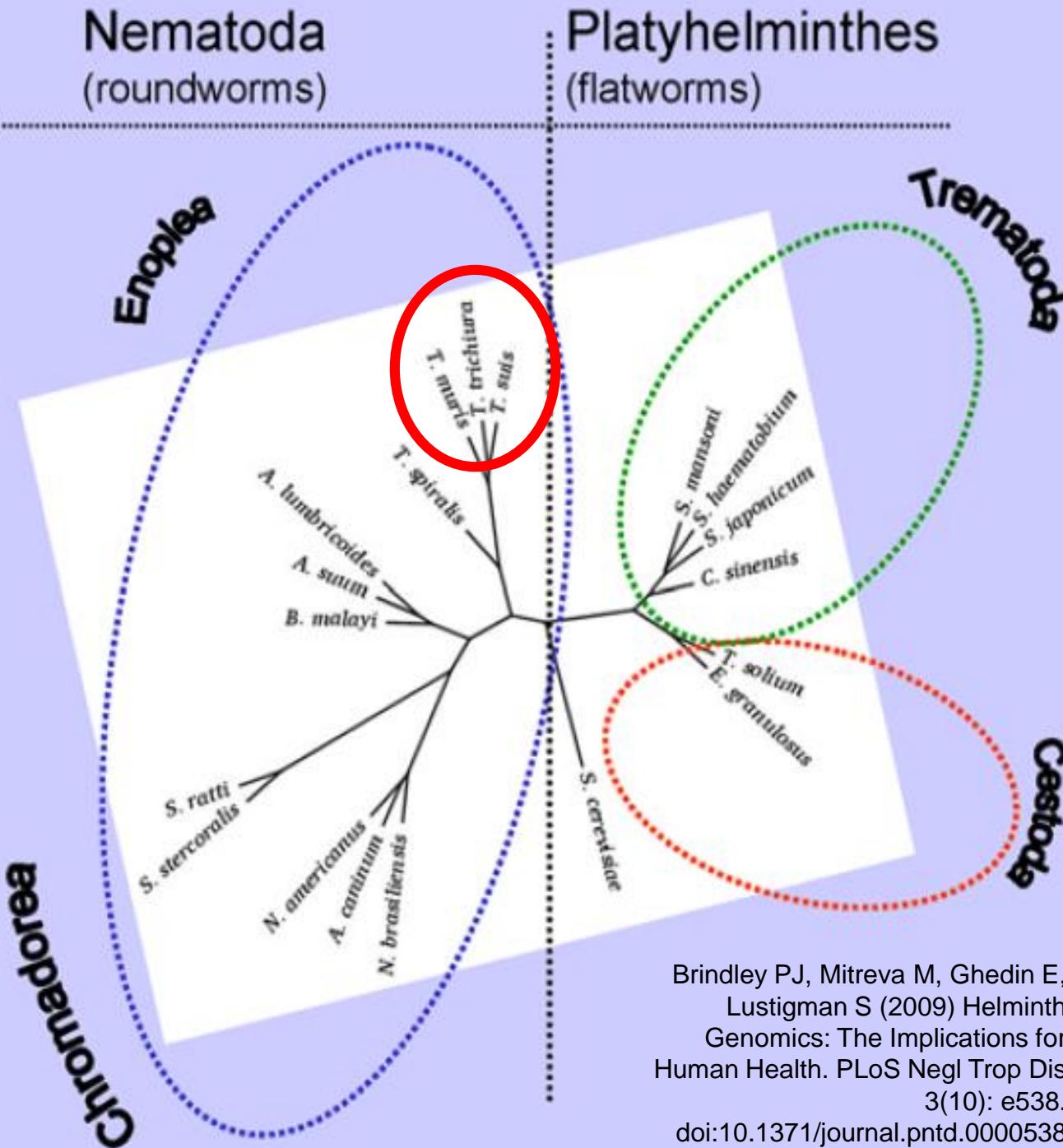


Figure 2. Phylogeny of the major taxa of human helminths—nematodes and platyhelminths—as established by maximum likelihood (ML) analysis of 18S ribosomal RNA from 18 helminth species.

Brindley PJ, Mitreva M, Ghedin E, Lustigman S (2009) Helminth Genomics: The Implications for Human Health. PLoS Negl Trop Dis 3(10): e538. doi:10.1371/journal.pntd.0000538

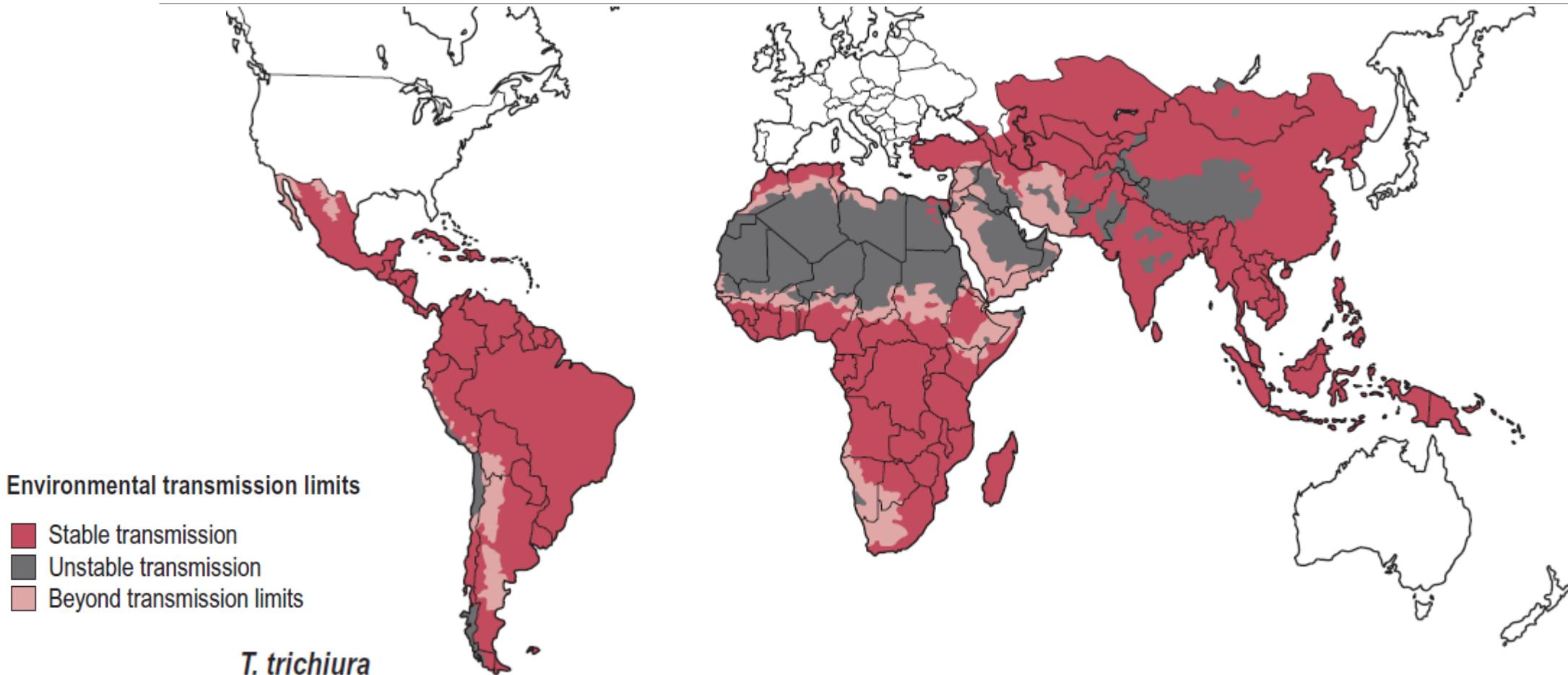
## Introducción a las Geohelmintiasis

### Helmintiasis como NTDs (Enfermedades Desatendidas u Olvidadas)

- Enfermedades Olvidadas, Desatendidas, de la Pobreza (*neglected tropical diseases*)
  - 13 infecciones bacterianas y parasitarias:
    1. [Ascariasis](#)
    2. [Anquilostomiasis](#)
    3. [Trichuriasis](#)
    4. [Filariasis linfática](#)
    5. [Oncocercosis](#)
    6. [Dracunculiasis](#)
    7. [\*\*Esquistosomiasis\*\*](#)
    8. [Enfermedad de Chagas](#)
    9. [Tripanosomiasis Africana Humana](#)
    10. [Leishmaniasis](#)
    11. [Ulcera de Buruli](#)
    12. [Lepra \(Enf. de Hansen\)](#)
    13. [Tracoma](#)

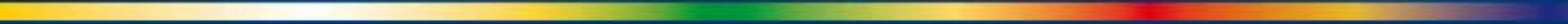


# Importancia mundial



# ENTEROPARASITOSIS

## Prevalencia Mundial



<i>Ascaris lumbricoides</i>	<i>1,300 millardos</i>
<i>Trichuris trichiura</i>	<i>1,049 millardos</i>
<i>Anquilostomideos</i>	<i>1 millardo</i>
<i>Complejo E. histolytica/dispar</i>	<i>500 millones</i>
<i>Enterobius vermicularis</i>	<i>400 millones</i>
<i>Schistosoma mansoni</i>	<i>200 millones</i>
<i>Giardia lamblia</i>	<i>200 millones</i>
<i>Strongyloides stercoralis</i>	<i>100 millones</i>
<i>Taenia sp</i>	<i>70 millones</i>

# ¿Nuevos efectos de las protozoosis?

Rodríguez-Morales AJ, Barbella RA, Case C, Arria M, Ravelo M, Perez H, Urdaneta O, Gervasio G, Rubio N, Maldonado A, Aguilera Y, Viloria A, Blanco JJ, Colina M, Hernández E, Araujo E, Cabaniel G, Benítez J, Rifakis P. **Intestinal parasitic infections among pregnant women in Venezuela.** *Infect Dis Obstet Gynecol.* 2006;2006:23125.

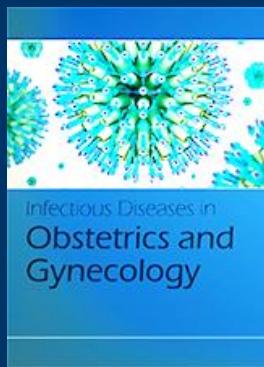


TABLE 1: Parasite positivity in stool specimens examined from pregnant women studied.

	Number	(%)	Helminths		
Protozoans					
Nonpathogenic					
<i>Entamoeba coli</i>	44	5.7	<i>Ascaris lumbricoides</i>	437	57.0
<i>Endolimax nana</i>	30	3.9	<i>Trichuris trichiura</i>	276	36.0
Pathogenic			<i>Necator americanus</i>	62	8.1
<i>Giardia lamblia</i>	108	14.1	<i>Enterobius vermicularis</i>	48	6.3
<i>Entamoeba histolytica/dispar</i>	92	12.0	<i>Strongyloides stercoralis</i>	25	3.3
<i>Cryptosporidium spp</i>	2	0.3			

TABLE 2: Relative risk for anemia at pregnancy according to the presence of intestinal parasitosis.

Variable (risk for anemia)	Anemia	Normal			$\chi^2_{\text{Yates}}$	P
		Hb	RR			
Intestinal parasitosis at pregnancy						
Present	594	173	2.56	194.24	< .0001	
Absent	82	189	—	—	—	
Helminth infection at pregnancy						
Present	322	61	1.56	94.63	< .0001	
Absent	354	301	—	—	—	
Protozoan infection at pregnancy						
Present	179	23	1.49	59.65	< .0001	
Absent	497	339	—	—	—	

# Helmintiasis

## Epidemiología

**Table 1**

Prevalence of intestinal helminths and protozoa in individuals from North Central Venezuela (May 2007 to December 2008)

Parasite	n <sup>a</sup>	% (95% CI)
Helminths	209 845	4.49 (4.47–4.51)
<i>Ascaris lumbricoides</i>	174 257	3.73 (3.71–3.74)
<i>Trichuris trichiura</i>	53 031	1.13 (1.12–1.14)
<i>Enterobius vermicularis</i>	18 177	0.39 (0.38–0.40)
<i>Strongyloides stercoralis</i>	15 743	0.34 (0.33–0.35)
Hookworms	7 817	0.17 (0.16–0.18)
<i>Hymenolepis nana</i>	2 979	0.06 (0.05–0.07)
Protozoa	2 675 384	57.22 (57.18–57.27)
<i>Blastocystis hominis</i>	2 176 703	46.56 (46.51–46.60)
<i>Giardia duodenalis</i>	358 538	7.67 (7.64–7.69)
<i>Iodamoeba bütschlii</i>	150 032	3.21 (3.19–3.23)
<i>Dientamoeba fragilis</i>	76 086	1.63 (1.62–1.64)
<i>Entamoeba histolytica/dispar</i>	42 396	0.91 (0.90–0.92)
<i>Trichomonas hominis</i>	8 416	0.18 (0.17–0.19)
<i>Chilomastix mesnili</i>	4 675	0.10 (0.09–0.11)

<sup>a</sup> n = number of positives in the population.



# ¿Pobreza y helmintiasis?

Quintero K, Durán C, Duri D, Medina F, García J, Hidalgo G, Nakal S, Echeverría-Ortega M, Albano C, Nino Incani R, Cortez J, Jiménez S, Díaz M, Maldonado C, Matute F, Rodriguez-Morales AJ. Household social determinants of ascariasis and trichuriasis in North Central Venezuela. *International Health* 2012 Jun; 4(2): 103-110.



**Table 4**

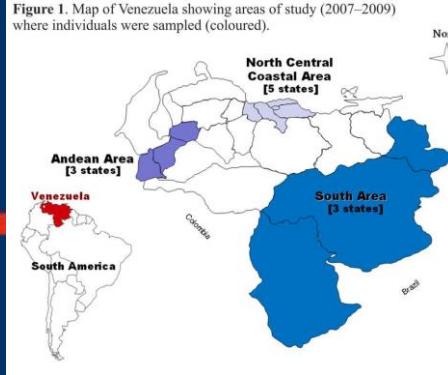
Univariate and multivariate analysis of household risk factors for ascariasis and trichuriasis in individuals from North Central Venezuela (May 2007 to December 2008)

Variable	Ascariasis		Trichuriasis	
	Crude OR (univariate) (95% CI)	Adjusted OR (multivariate) (95% CI)	Crude OR (univariate) (95% CI)	Adjusted OR (multivariate) (95% CI)
Vulnerable house				
Yes	4.242 (4.198–4.287)	1.479 (1.428–1.532)	2.598 (2.547–2.650)	10.519 (9.971–11.097)
No	1.000	1.000	1.000	1.000
In a rural area				
Yes	5.597 (5.543–5.652)	2.067 (2.035–2.101)	2.610 (2.564–2.657)	1.918 (1.868–1.970)
No	1.000	1.000	1.000	1.000
Near to small rivers or wetlands				
Yes	4.928 (4.838–5.020)	NS	NS	NS
No	1.000			
Rudimentary wall materials				
Yes	4.097 (4.055–4.139)	NS	1.598 (1.564–1.634)	NS
No	1.000		1.000	
Soil floor				
Yes	13.283 (13.127–13.440)	5.027 (4.895–5.162)	3.726 (3.630–3.825)	5.190 (4.944–5.448)
No	1.000	1.000	1.000	1.000
Tap water access				
No	8.719 (8.626–8.809)	2.512 (2.465–2.560)	3.014 (2.950–3.080)	NS
Yes	1.000	1.000	1.000	
Collection of water in inappropriate receptacles				
Yes	1.734 (1.708–1.759)	NS	1.453 (1.417–1.490)	1.118 (1.089–1.149)
No	1.000		1.000	1.000
Appropriate disposal of sewage waters				
No	6.728 (6.597–6.862)	2.315 (2.254–2.378)	1.091 (1.023–1.163)	NS
Yes	1.000	1.000	1.000	
Appropriate waste disposal				
No	3.061 (3.031–3.091)	1.798 (1.775–1.820)	1.700 (1.671–1.729)	NS
Yes	1.000	1.000	1.000	

NS: not significant.

# Helmintiasis

## Epidemiología



**Epidemiology of intestinal parasitosis in eleven states of Venezuela:  
partial results of an ongoing national survey  
(N=7.120.744)**

Parasite	Prevalence (%)	95%CI	Parasite	Prevalence (%)	95%CI
<i>B. hominis</i>	45.632	45.596-45.669	<i>T. trichiura</i>	1.569	1.560-1.578
<i>E. nana</i>	12.573	12.548-12.597	<i>Hookworms</i>	0.664	0.658-0.670
<i>E. coli</i>	11.745	11.722-11.769	<i>S. stercoralis</i>	0.381	0.376-0.385
<i>G. intestinalis</i>	7.426	7.406-7.445	<i>E. vermicularis</i>	0.264	0.260-0.268
<i>A. lumbricoides</i>	3.974	3.959-3.988	<i>H. nana</i>	0.257	0.253-0.261
<i>I. bütschlii</i>	3.211	3.198-3.224	<i>C. mesnili</i>	0.246	0.242-0.249
<i>E. histolytica</i>	1.632	1.623-1.642	<i>T. hominis</i>	0.118	0.116-0.121

# Helmintiasis

## Epidemiología en Colombia

**Tabla 1.** Prevalencia de parásitos intestinales en población general del corregimiento de Loma Arena Santa Catalina. 2004

Especie parasitaria	Nº	%
<i>Entamoeba coli</i>	210	60
<i>Entamoeba histolytica/dispar</i>	191	54
<i>Endolimax nana</i>	125	36
<i>Blastocystis hominis</i>	103	29
<i>Iodamoeba butschlii</i>	72	21
<i>Giardia duodenalis</i>	61	17
<i>Trichomonas hominis</i>	3	0,9
<i>Cyclospora sp</i>	2	0,6
<i>Ascaris lumbricoides</i>	196	56
<i>Trichuris trichiura</i>	185	53
<i>Uncinaria</i>	21	6
<i>Hymenolepis nana</i>	14	4
<i>Strongyloides stercoralis</i>	11	3
<i>Taenia sp</i>	3	0,9
<i>Enterobius vermicularis</i>	2	0,6

# Importancia nacional

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Rev. salud pública. 7(3): 327-338, 2005

ARTÍCULOS/INVESTIGACIÓN

## **Prevalencia de Giardiasis y Parásitos Intestinales en Preescolares de Hogares atendidos en un programa estatal en Armenia, Colombia**

**Jorge M. Giraldo-Gómez<sup>1</sup>, Fabiana Lora<sup>2</sup>, Luz H. Henao<sup>3</sup>, Shirley Mejía<sup>4</sup> y Jorge E. Gómez-Marín<sup>5</sup>**

**Tabla 1.** Prevalencia de parásitos intestinales en 328 niños de 1 a 7 años de 35 hogares de ICBF de la ciudad de Armenia. 2003- 2004

Parásito	Frecuencias	%
<i>Levaduras</i>	93	28,9
<i>Entamoeba coli</i>	51	15,5
<i>Endolimax nana</i>	43	13,1
<i>Giardia lamblia*</i>	42	12,8
<i>Comp. E. histolytica/dispar</i>	30	9,1
<i>Blastocystis hominis*</i>	20	6,1
<i>Iodamoeba butschlii</i>	20	6,1
<i>Ascaris lumbricoides*</i>	8	2,4
<i>Trichuris trichura*</i>	7	2,1
<i>Hymenolepis nana*</i>	2	0,6

\*= Parásito patógeno



### 403. Letrina pública en Gedi (Kenya)

Esta letrina pública, consistente en un simple agujero, fue construida en el siglo XIV en la ciudad afroárabe de Gedi, cerca de Malindi, en la costa swahili de Kenya. El valor de una medida básica de salud pública de este tipo fue aparente incluso para los médicos del Imperio romano, una época en que los baños públicos bien dotados y con agua corriente eran concurridos lugares de reunión y de debate. El uso de este tipo de letrina en África oriental representó una contribución significativa para la limitación de las helmintiasis descritas en este capítulo, así como también de las infecciones causadas por los virus, las bacterias y los protozoos patógenos adquiridos a través del tracto gastrointestinal (v. cap. 4).

# Cycles and transmission

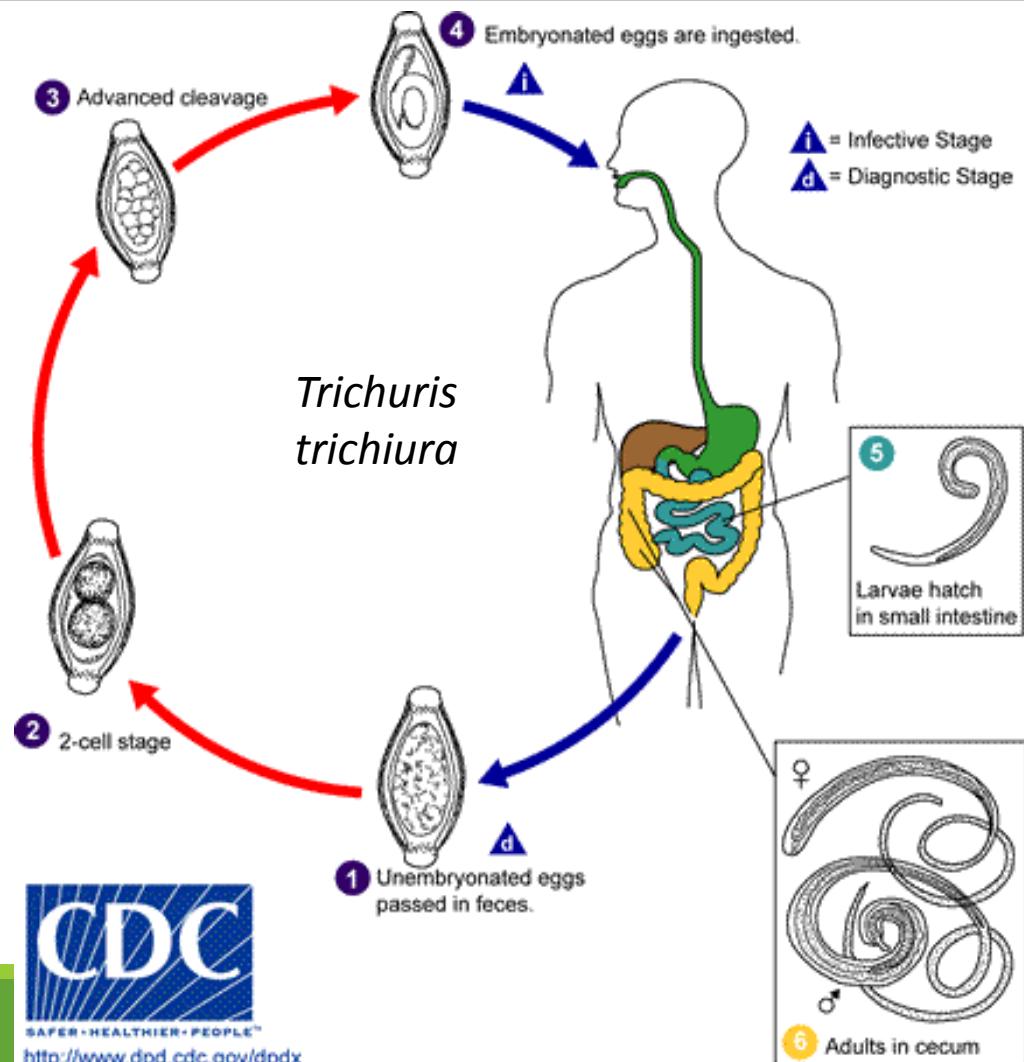
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- ❖ Type 1: Direct (*Enterobius vermicularis*, *Trichuris trichiura*)
- ❖ Type 2: Modified Direct (*Ascaris lumbricoides*, *Toxocara spp.*)
- ❖ Type 3: Penetration of the Skin (*Ancylostoma*, *Necator*,  
*Strongyloides*, *Trichostrongylus*)

# Type 1: Direct (*Enterobius vermicularis*, *Trichuris trichiura*)

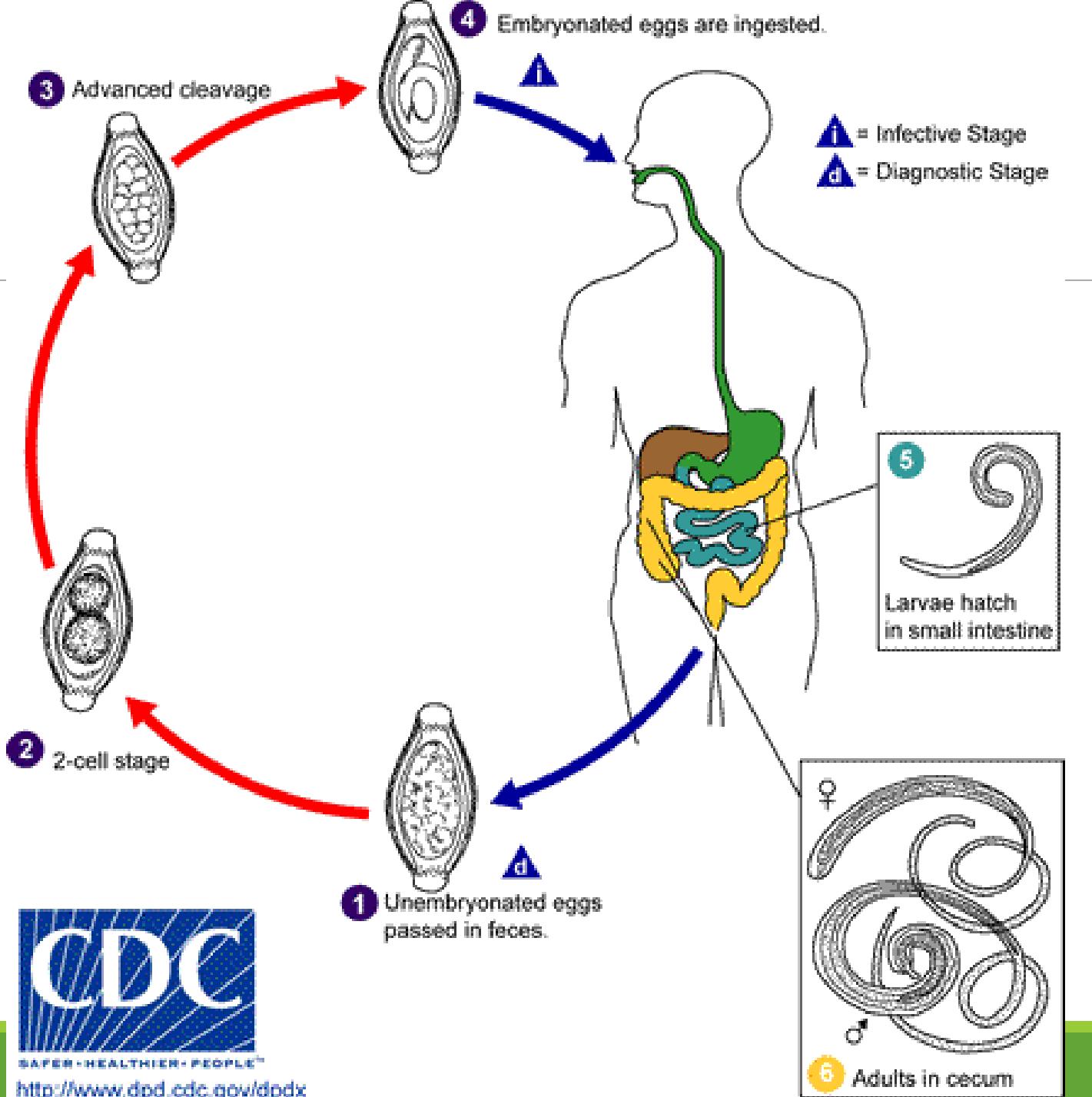
Embryonated eggs are passed; they hatch and **reinfect** within **2–3 hours** by being carried from the anal margin to the mouth and either do not reach the soil or, if they do, do not require a period of development there.

This group includes *Enterobius vermicularis* (pinworm) and ***Trichuris trichiura*** (whipworm).



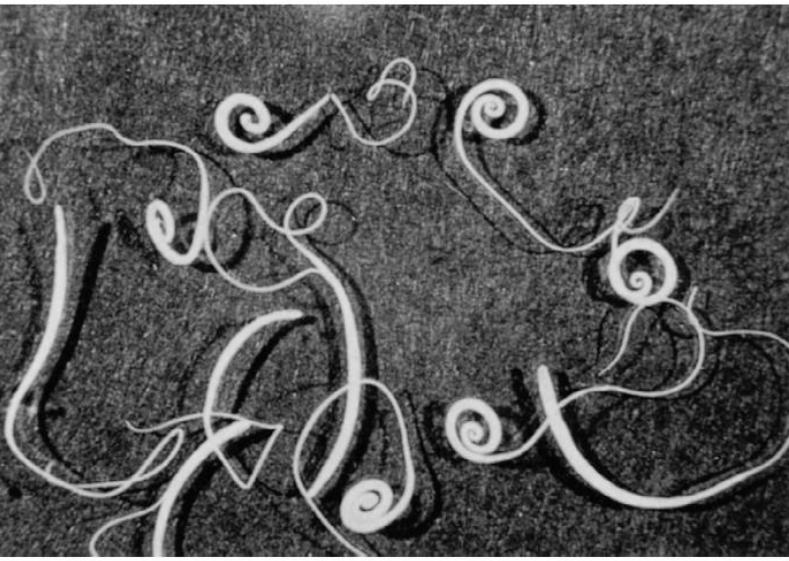
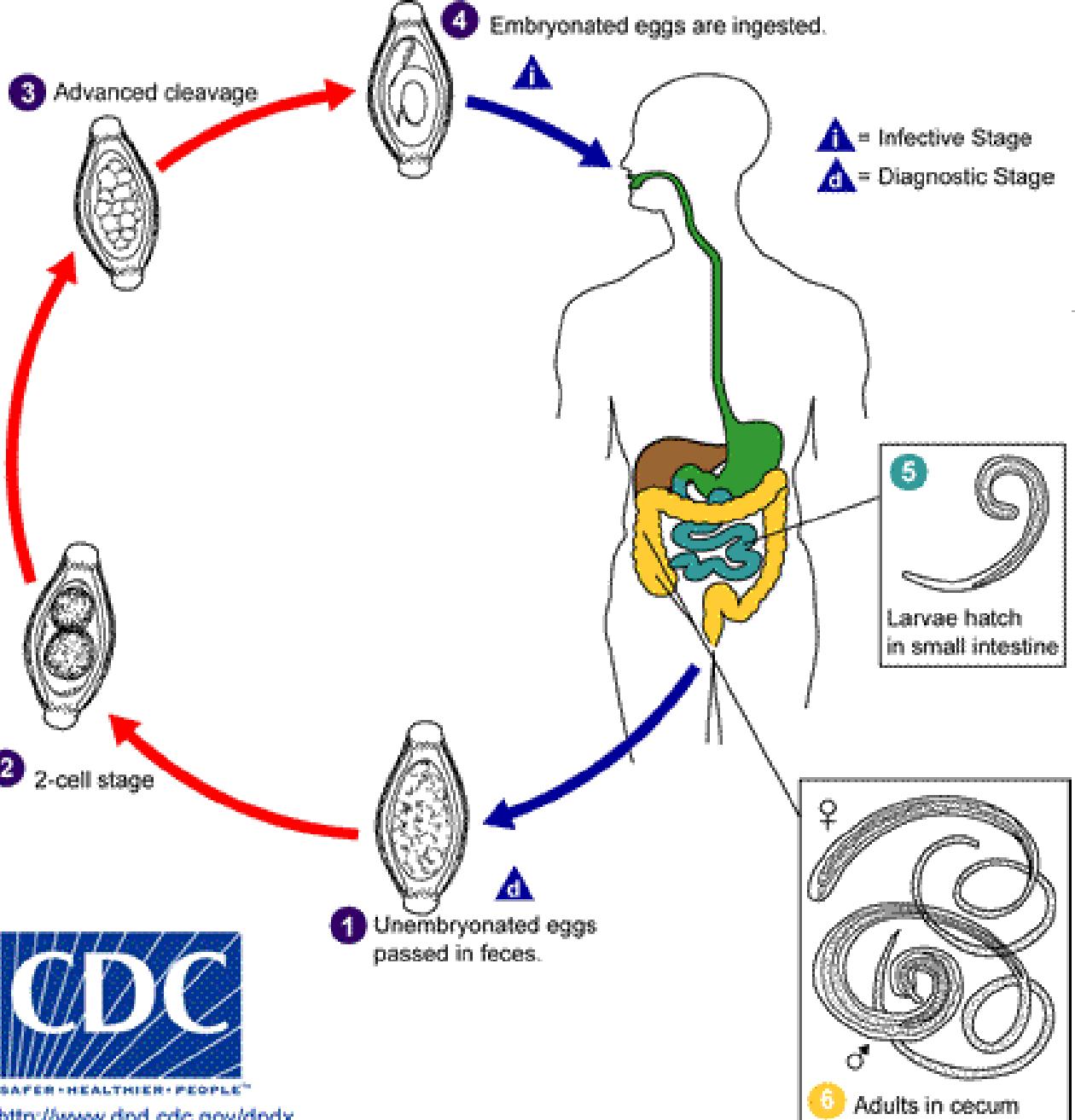
## Ciclo de Vida

*Trichuris trichiura*



<http://www.dpd.cdc.gov/dpdx>

## Ciclo *T. trichiura*



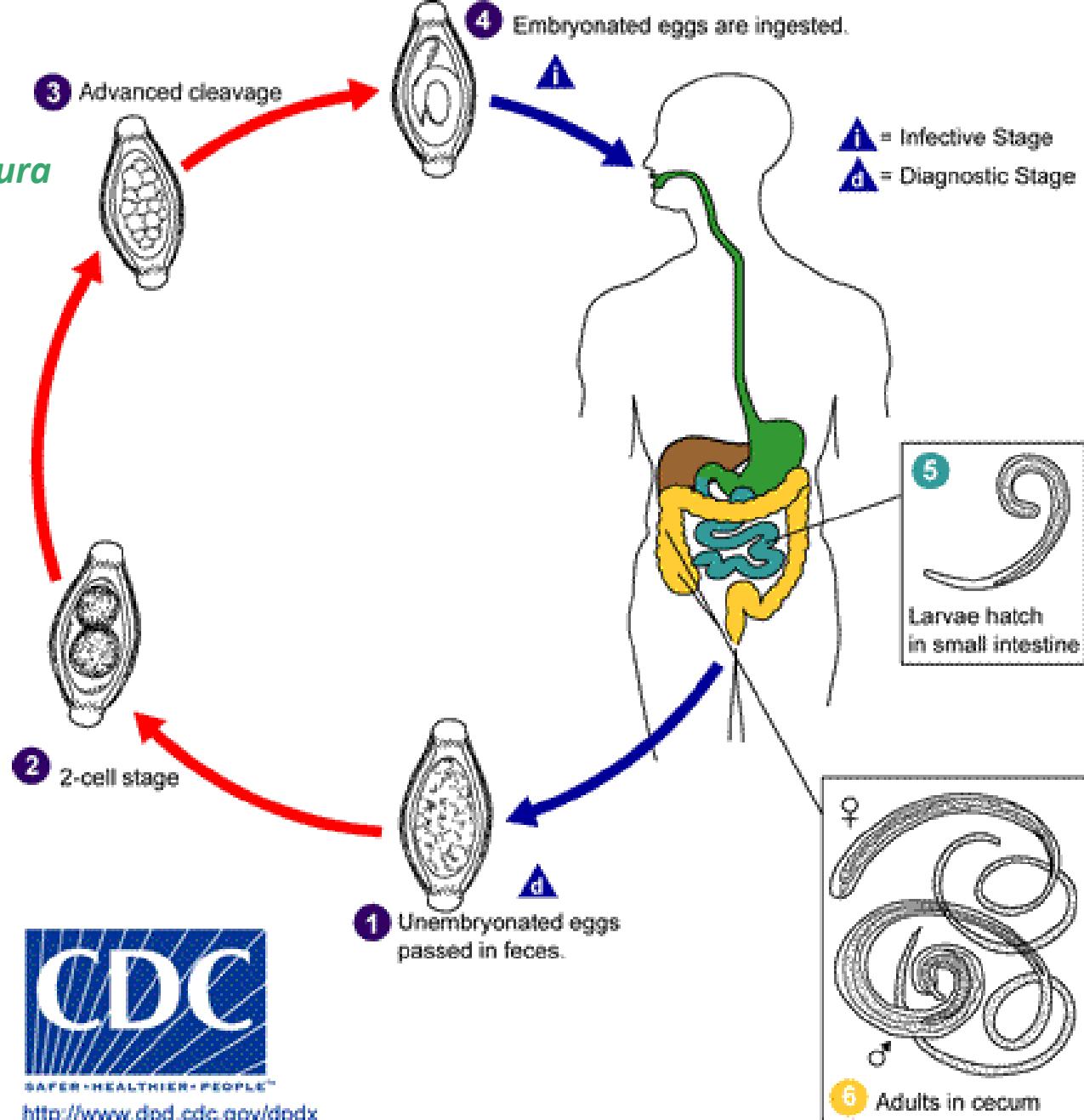
**Figure 55.4** Adult *Trichuris trichiura* (whipworms), male and female. (Courtesy H. Zaiman.)



**Figure 55.5** Egg of *Trichuris trichiura*. (Courtesy of Tropical Resources Unit.)

## Ciclo

### *T. trichiura*



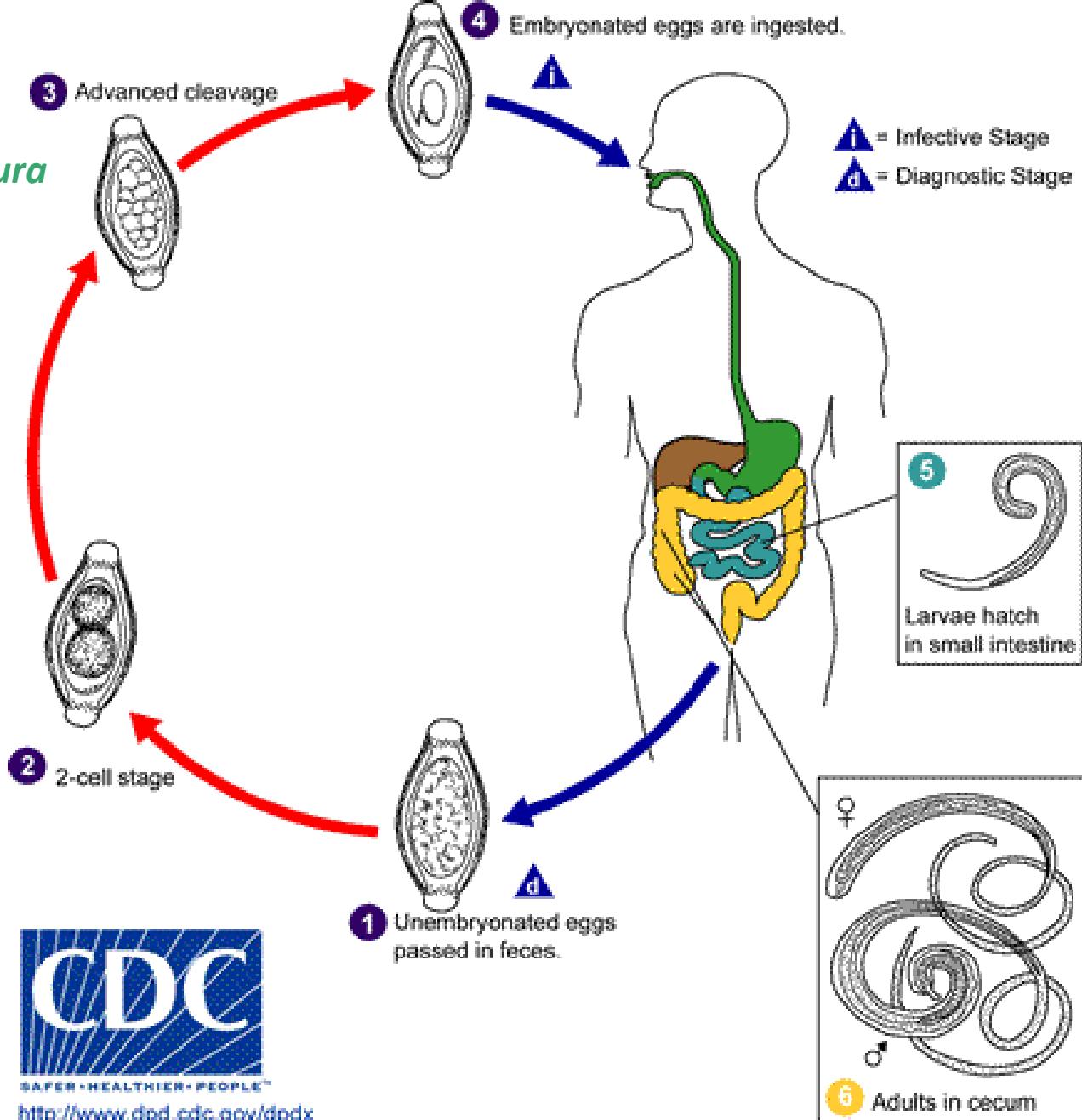
<http://www.dpd.cdc.gov/dpdx>



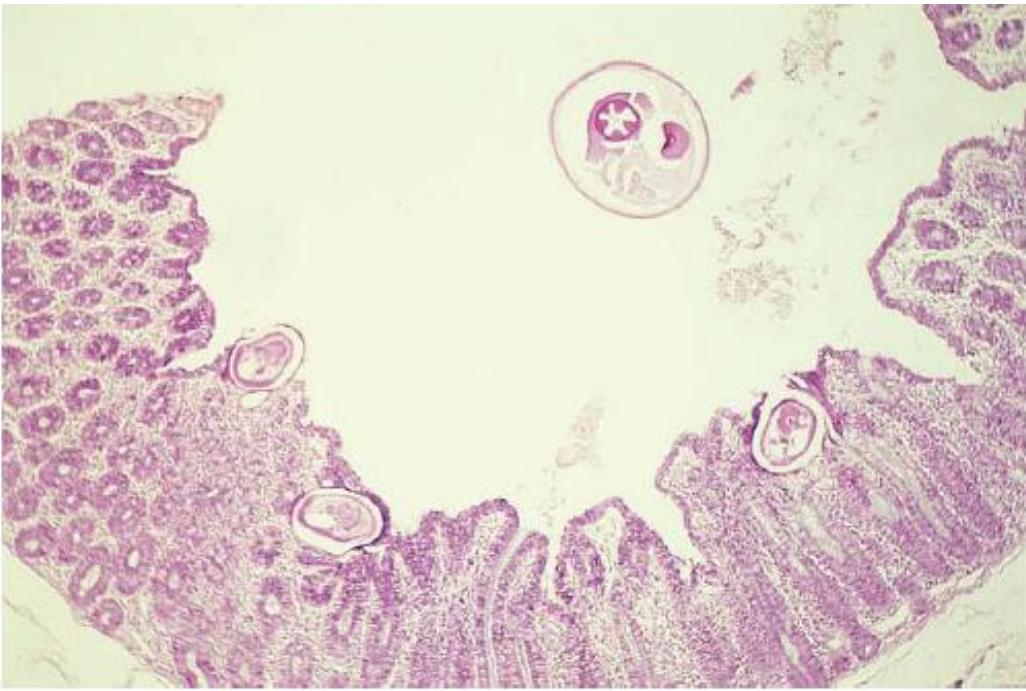
#### 474. Morfología de los gusanos adultos, hembras y machos

De 3 a 10 días después de ingeridos los huevos, los gusanos jóvenes alcanzan el ciego, donde introducen en la mucosa su porción anterior, similar a un látigo. Los gusanos adultos tienen una longitud aproximada de 3-5 cm y las hembras son ligeramente mayores que los machos (que están enrollados). Los gusanos adultos (un macho y varias hembras) de la imagen se hallan en el interior de la mucosa del ciego. (× 2) (AFIP n.º 69-3583.)

Ciclo  
*T. trichiura*

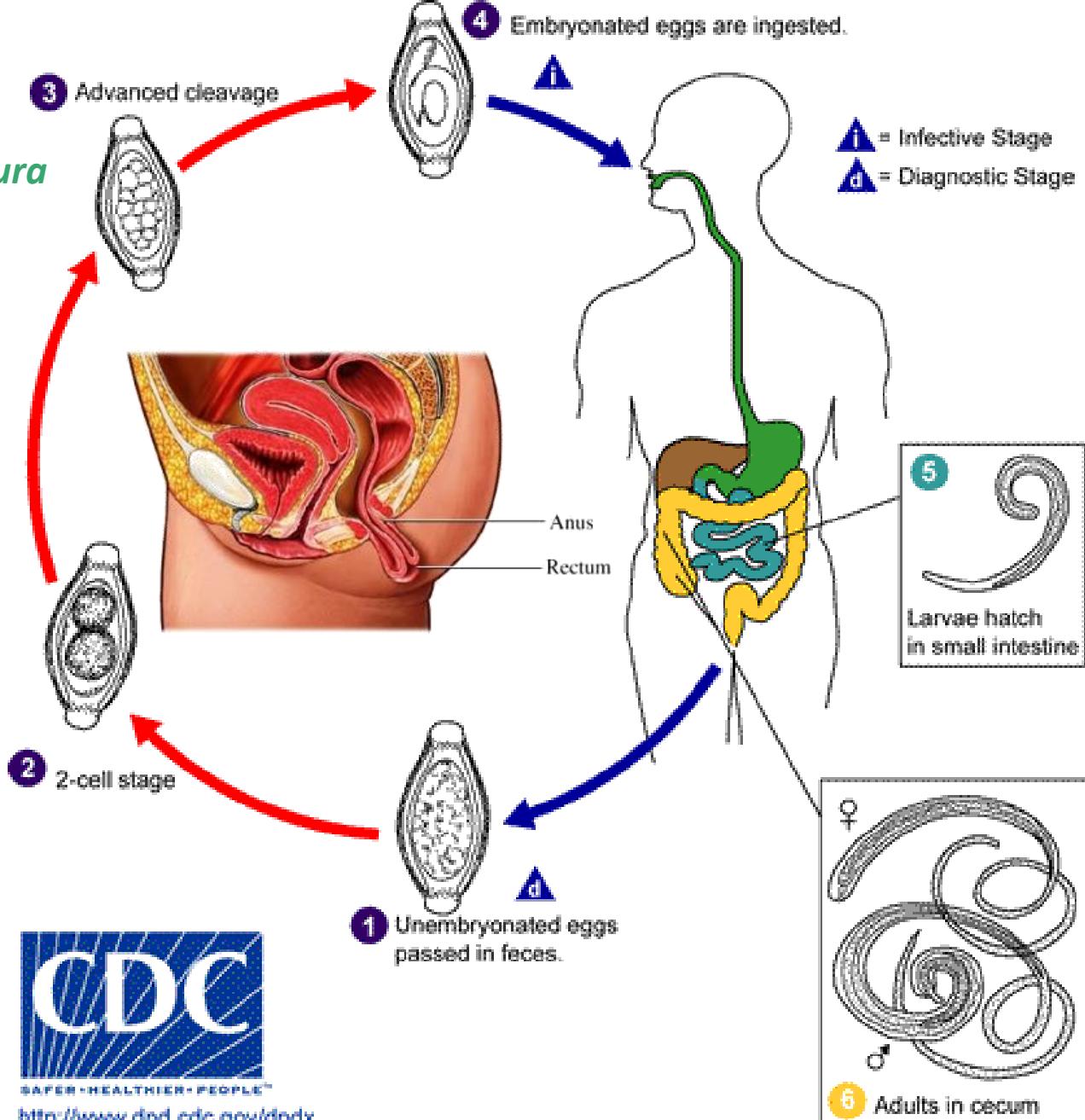


<http://www.dpd.cdc.gov/dpdx>



**475. Corte transversal de *Trichuris trichiura* en el ciego**  
En este corte histológico se observa un corte transversal de un gusano adulto libre en la luz, así como varios cortes de su extremo anterior fino aparentemente introducido en la mucosa.  
(Hematoxilina y eosina,  $\times 13$ )

Ciclo  
*T. trichiura*

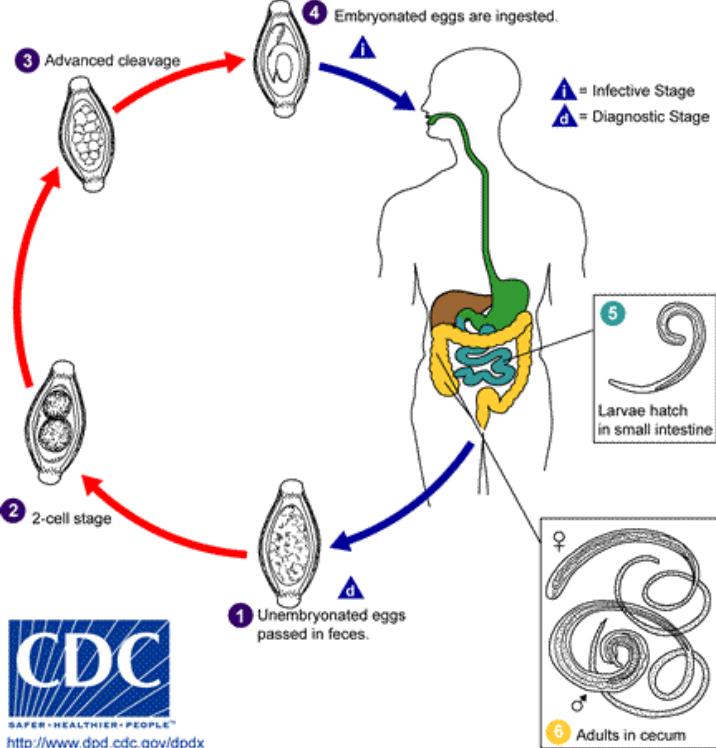


<http://www.dpd.cdc.gov/dpdx>



#### 476. Prolapso rectal

Las infestaciones intensas pueden causar en los lactantes y los niños prolapso rectal tras una diarrea hemorrágica crónica con dolor abdominal, especialmente si también sufren malnutrición.



Species	Length (mm)	Daily egg output per female worm	Location in host	Lifespan (years)
<b>Large common roundworm</b>				
<i>Ascaris lumbricoides</i>	150–400	200 000	Small intestine	1
<b>Whipworm</b>				
<i>Trichuris trichiura</i>	30–50	3000–5000	Caecum and colon	1.5–2.0
<b>Hookworms</b>				
<i>Necator americanus</i>	7–13	9000–10 000	Upper small intestine	5–7
<i>Ancylostoma duodenale</i>	8–13	25 000–30 000	Upper small intestine	5–7

**Table 2: Characteristics of the soil-transmitted helminths: adult worms of greatest public-health significance**

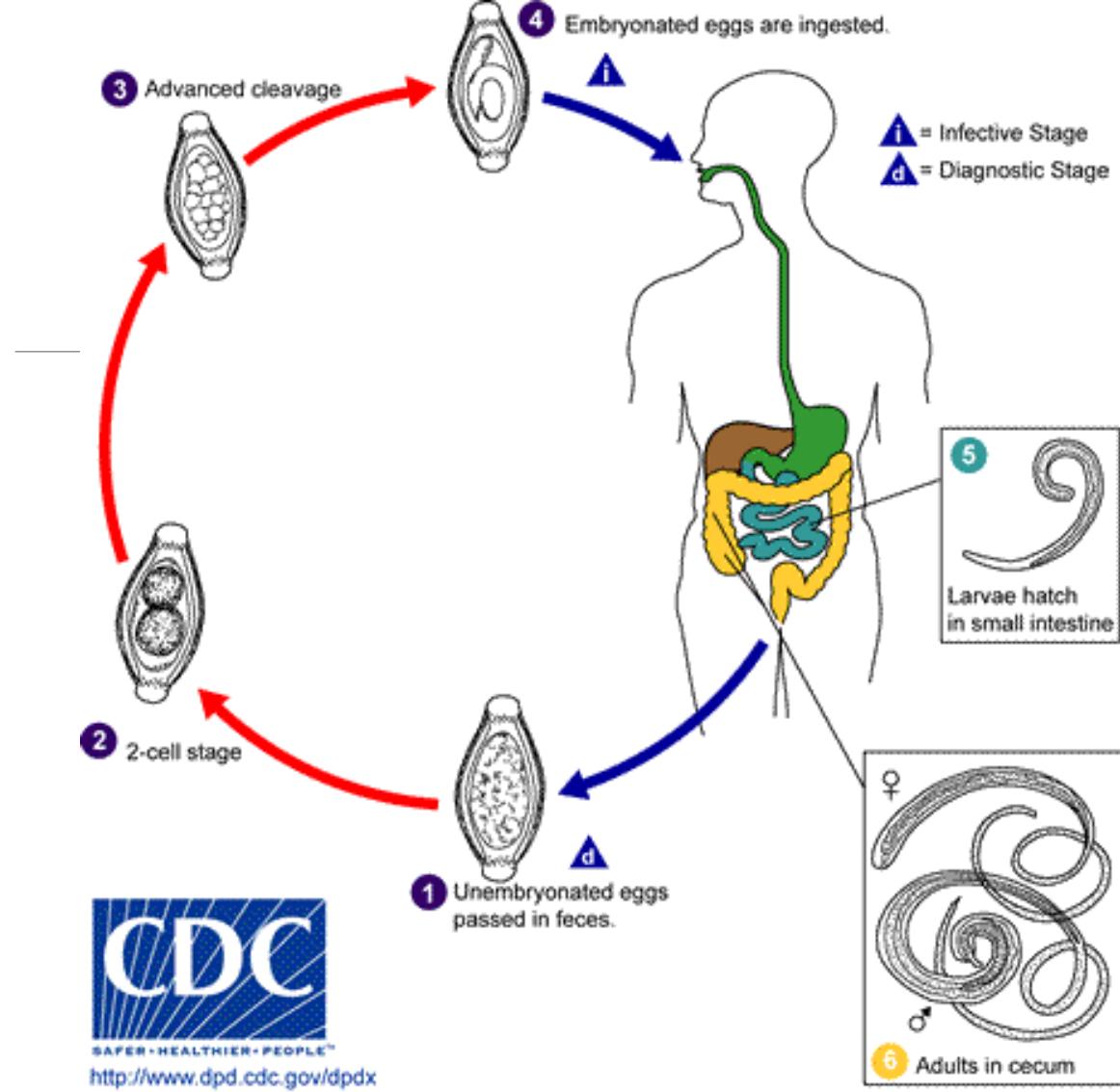
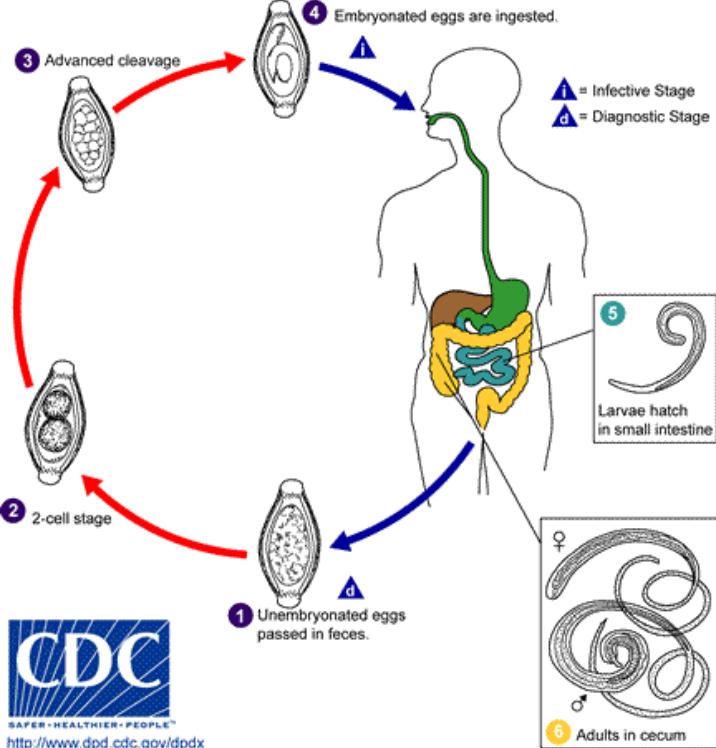
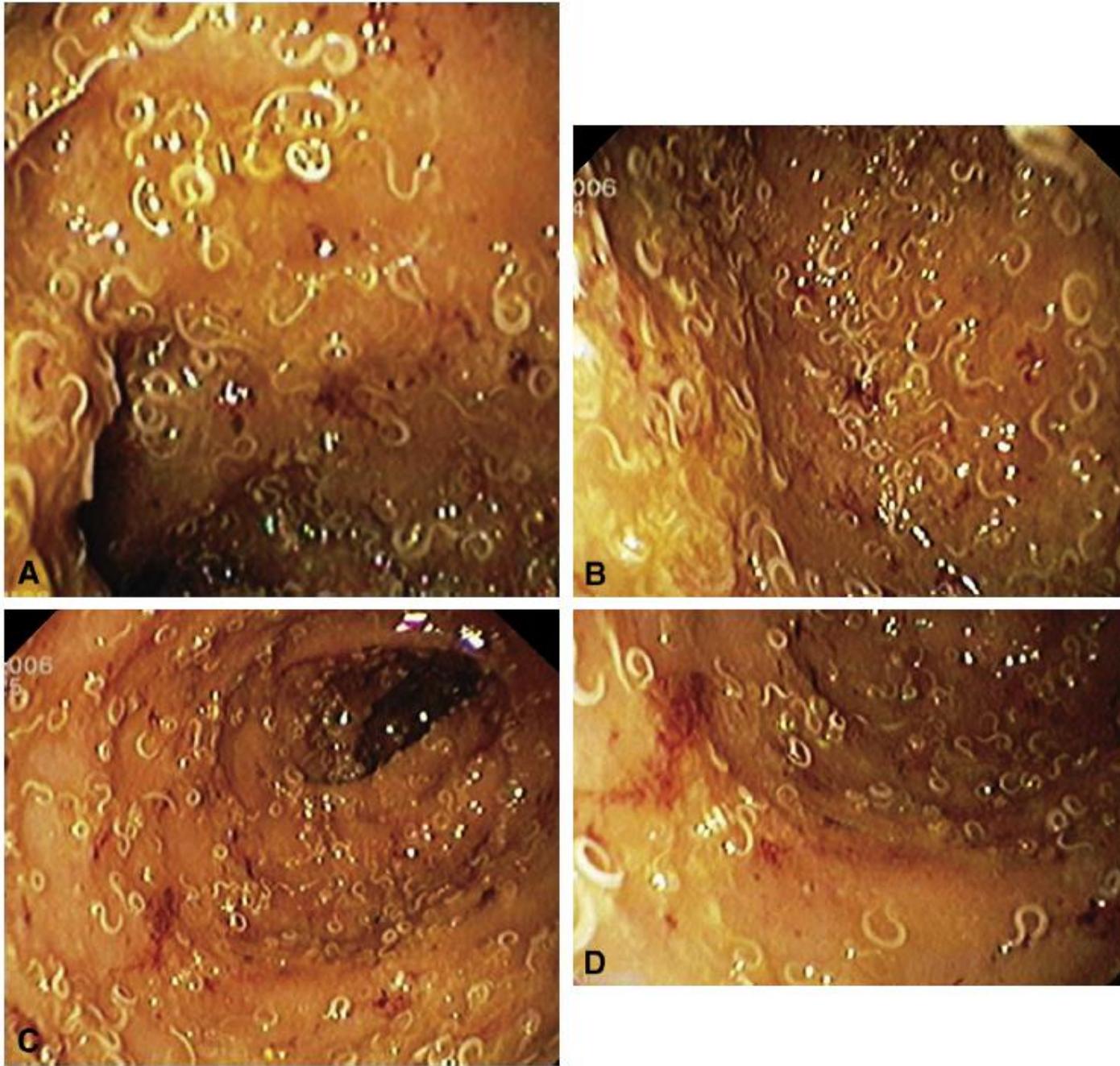


Figure 1: Adult male and female soil-transmitted helminths



	Specific clinical features/syndromes		General features
	Larval migration	Adult gastrointestinal parasitism	
Ascariasis	Verminous pneumonia	Lactose intolerance Vitamin A malabsorption Intestinal obstruction Hepatopancreatic ascariasis	Impaired growth Impaired physical fitness Impaired cognition Reductions in school attendance and performance
Trichuriasis	None	Colitis Trichuris dysentery syndrome Rectal prolapse	
Hookworm	Ground itch Cough Wakana disease	Intestinal blood loss Iron-deficiency anaemia Protein malnutrition	

**Table 6: Specific and general clinical features or syndromes of the soil-transmitted helminth infections of major medical importance**



**Figure 1.** Colonoscopic images of TDS. A 15-year-old female patient presenting with progressive iron deficiency anemia (hemoglobin 6 g/dL) and abdominal pain, diarrhea, and hematochezia. Colonic mucosa showed carpeting with curved *Trichuris trichiura* (posterior segment) worms. Note associated petechial lesions, blotchy mucosal hemorrhages, and mucosal edema.

Gastrointest Endosc. 2010  
Jan;71(1):200-4. doi:  
10.1016/j.gie.2009.08.002. Epub  
2009 Oct 31.  
Trichuris dysentery syndrome: a  
common cause of chronic iron  
deficiency anemia in adults in an  
endemic area (with videos).  
Khuroo MS1, Khuroo MS, Khuroo NS.

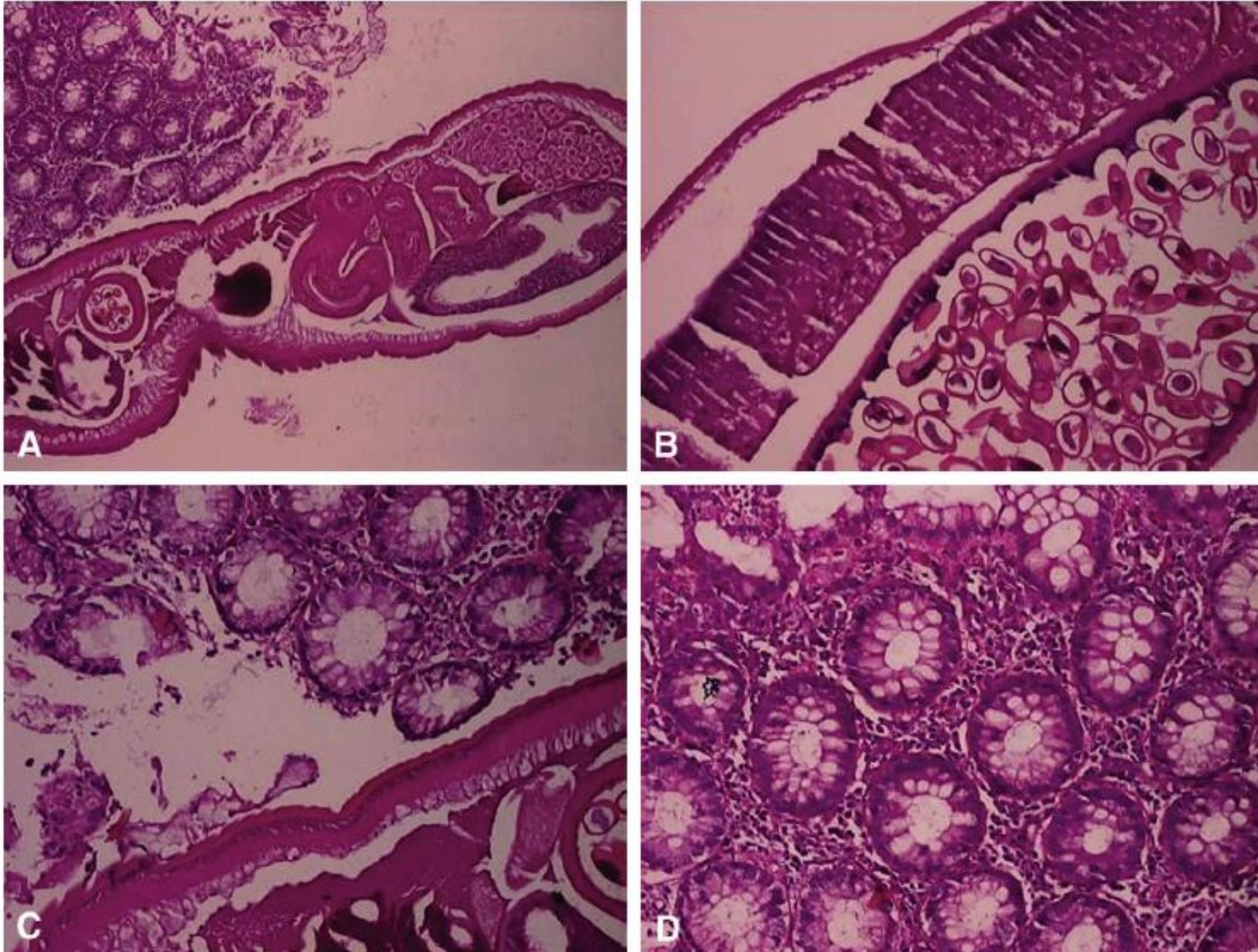
# Endoscopia en trichuriasis

En caso de estar viendo un PDF, el video se encuentra en (hacer click):

<http://www.sciencedirect.com/science/MiamiMultiMediaURL/1-s2.0-S001651070902327X/1-s2.0-S001651070902327X-mmcl.mpg/273305/FULL/S001651070902327X/e9f2f2ba016e2d7379da35a99c91fdb1/mmc1.mpg>



Gastrointest Endosc. 2010 Jan;71(1):200-4. doi: 10.1016/j.gie.2009.08.002. Epub 2009 Oct 31. Trichuris dysentery syndrome: a common cause of chronic iron deficiency anemia in adults in an endemic area (with videos). Khuroo MS1, Khuroo MS, Khuroo NS.



**Figure 2.** TDS. Microphotographs of colonic mucosa. **A**, The posterior segment of a female adult worm containing a gravid uterus with numerous characteristic *Trichuris trichiura* eggs. **B**, Gravid uterus of the worm with *T trichiura* eggs. **C, D**, Colonic mucosa showing increased lymphoplasmacytic infiltrates. There were no cryptitis, crypt abscess, or mucosal ulcerations (H&E, orig. mag.  $\times 100$ ).

Gastrointest Endosc. 2010  
Jan;71(1):200-4. doi:  
[10.1016/j.gie.2009.08.002](https://doi.org/10.1016/j.gie.2009.08.002).  
Epub 2009 Oct 31.  
Trichuris dysentery  
syndrome: a common cause  
of chronic iron deficiency  
anemia in adults in an  
endemic area (with videos).  
Khuroo MS1, Khuroo MS,  
Khuroo NS.



Huevos de *Ascaris* (arriba), *Trichuris* (centro) y *Anquilstoma* (abajo) en el mismo campo microscópico. Obsérvense las diferencias de tamaño.



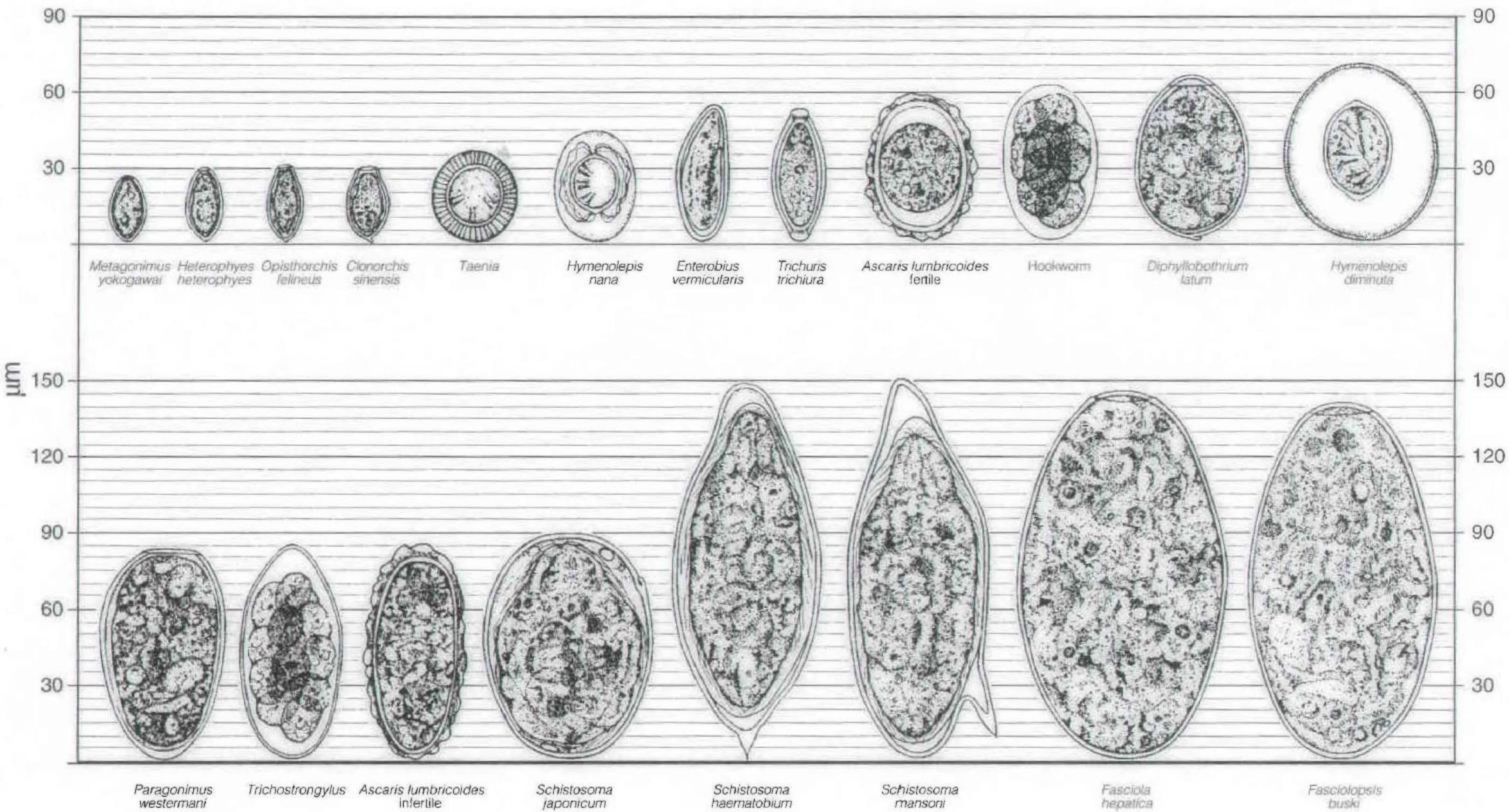
Los huevos típicos de *Trichuris trichiura* miden 50-55 µm por 22-24 µm, tienen una cubierta parda y lisa con prominencias (tapones) bipolares y contienen un ovum monocelular.



En una preparación de Kato-Katz, los huevos de *Trichuris* pueden aparecer hinchados y de mayor tamaño, con un contenido degenerado. Las prominencias bipolares y las capas de la cubierta no están claramente definidas.

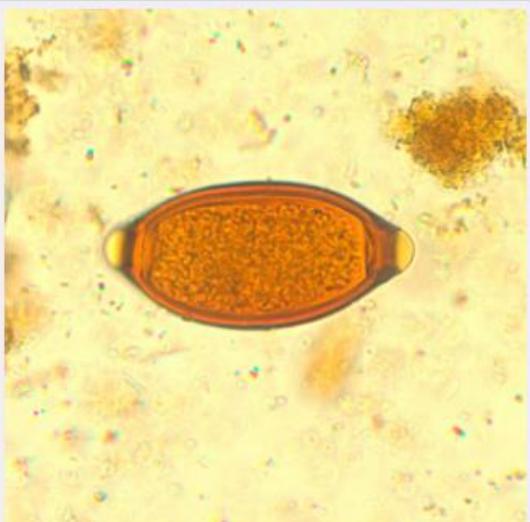


## Tamaño relativo de los huevos de helmintos\*



**▼ *T. trichiura* eggs.**

*Trichuris trichiura* eggs are 50-55 micrometers by 20-25 micrometers. They are barrel-shaped, thick-shelled and possess a pair of polar "plugs" at each end. The eggs are unembryonated when passed in stool.



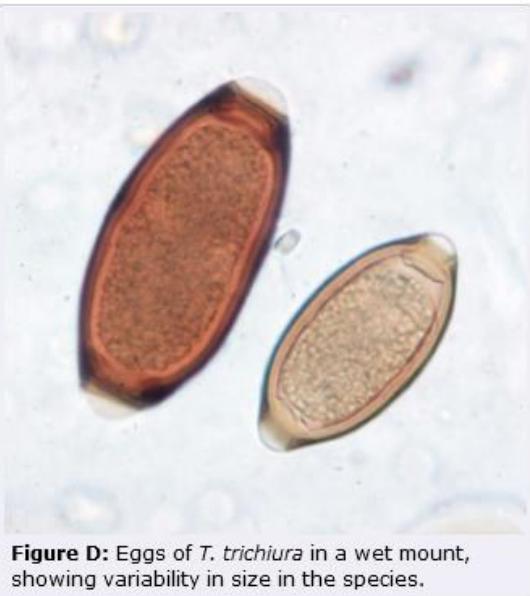
**Figure A:** Egg of *T. trichiura* in an iodine-stained wet mount.



**Figure B:** Egg of *T. trichiura* in an unstained wet mount.



**Figure C:** Egg of *T. trichiura* in an unstained wet mount.



**Figure D:** Eggs of *T. trichiura* in a wet mount, showing variability in size in the species.



**Figure E:** Egg of *T. trichiura* viewed with UV microscopy.



**Figure F:** Egg of *T. trichiura* in an unstained wet mount of stool. Notice also the presence of a cyst of *Entamoeba coli* (arrow).

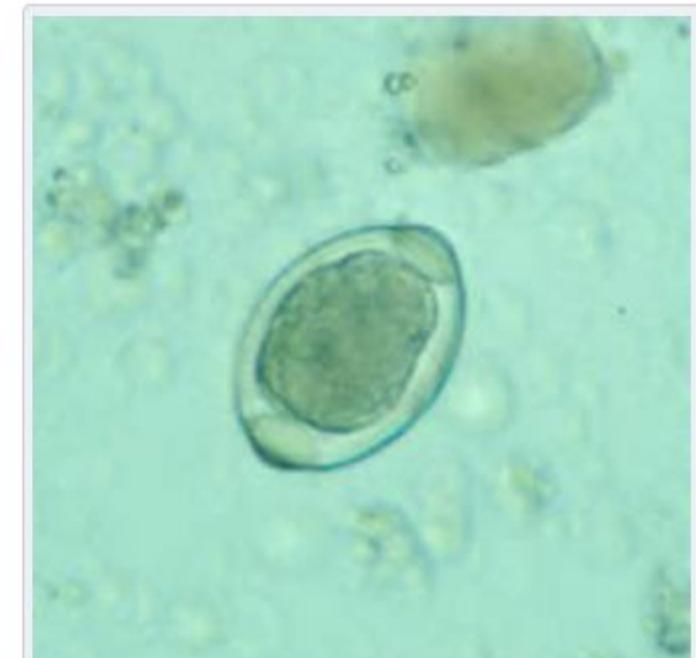
▼ Atypical *T. trichiura* eggs.



**Figure A:** Atypical egg of *T. trichiura*.

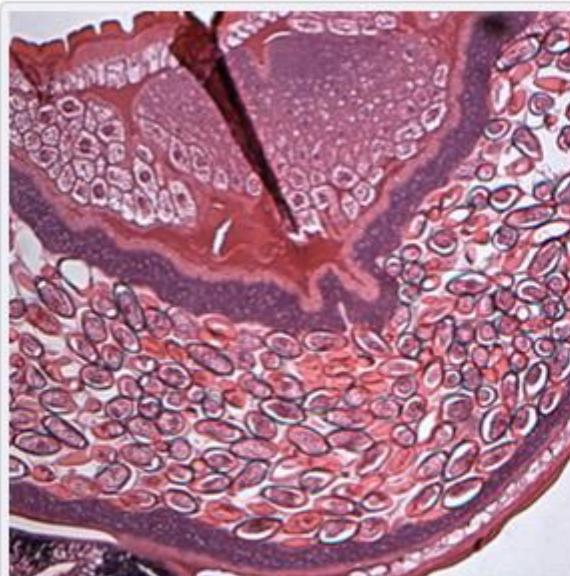


**Figure B:** Atypical egg of *T. trichiura*

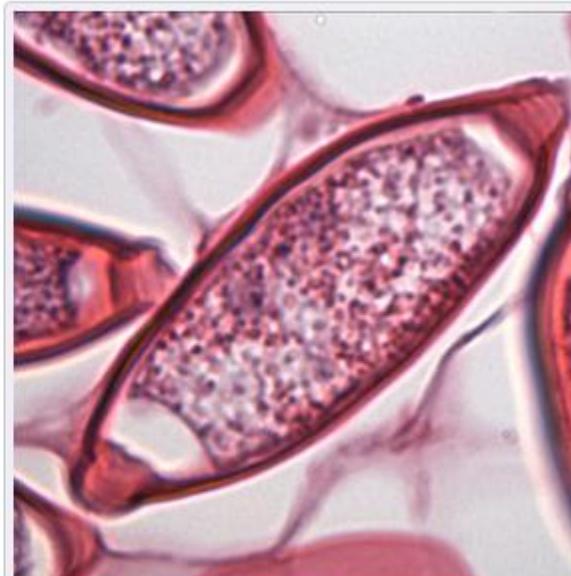


**Figure C:** Atypical egg of *T. trichiura*.

▼ **Cross-sections of *T. trichiura* stained with hematoxylin and eosin (H&E).**  
Cross sections of *Trichuris trichiura* stained with hematoxylin and eosin (H&E).



**Figure A:** Cross-section of a gravid female *T. trichiura* stained with H&E, showing numerous eggs. Magnification at 100x. Image courtesy of the Oregon State Public Health Laboratory.



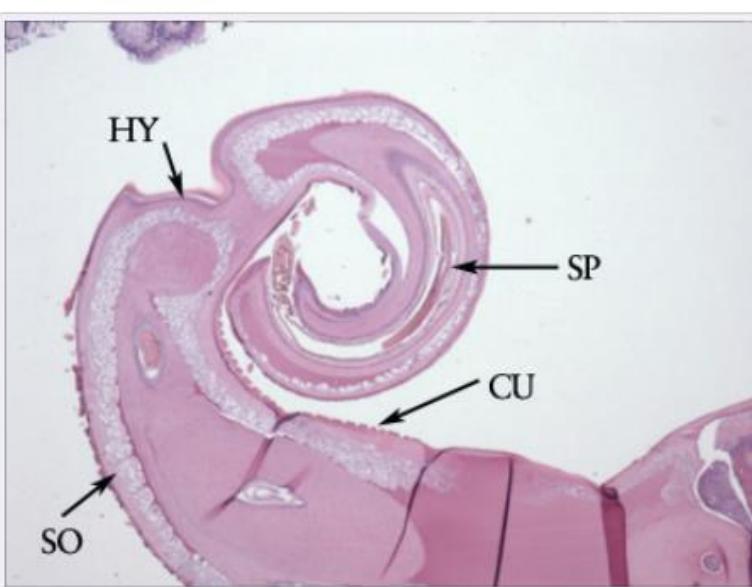
**Figure B:** Same specimen as in **Figure A** but at 1000x magnification, showing a close-up of one of the eggs.

TABLE  
55.2

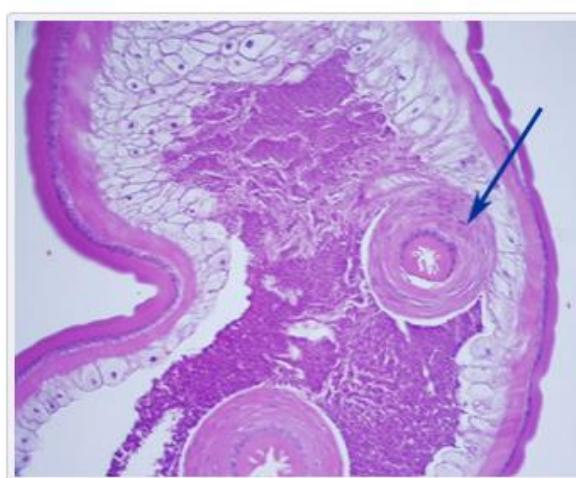
**Classification of Intensity of Infection for STH Species Based on WHO Guidelines**

	Light	Moderate	Heavy
<i>Trichuris trichiura</i>	1–999	1 000–9 999	≥10 000
<i>Ascaris lumbricoides</i>	1–4 999	5 000–49 999	≥50 000
Hookworm	1–1 999	2 000–3 999	≥4 000

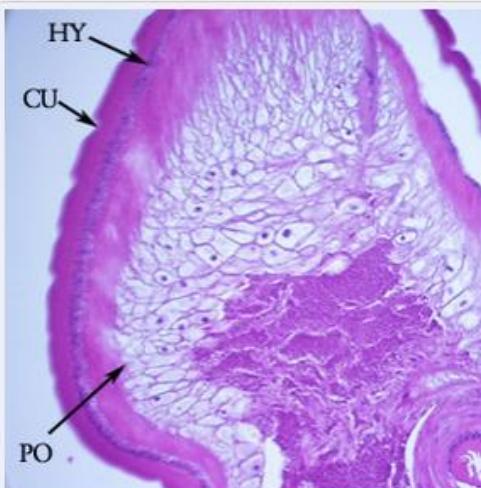
Manson's Tropical Infectious Diseases (Twenty-third Edition)  
Editor: Jeremy Farrar ISBN: 978-0-7020-5101-2, 2014.



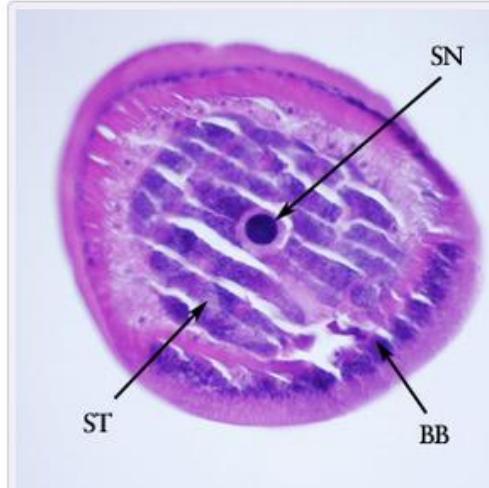
**Figure C:** Cross-section of the posterior end of an adult *T. trichiura*, from a colonoscopy specimen stained with H&E. Note the presence of the thick cuticle with annulations (**CU**). Below the cuticle is the thin hypodermis (**HY**), and below the hypodermis is a layer of somatic muscle cells (**SO**). The presence of a spicule (**SP**) indicates the specimen is a male. Image courtesy of the Michael E. DeBakey V. A. Medical Center, Houston, TX.



**Figure D:** Section of an adult *T. trichiura*, stained with H&E. Notice the thick-muscled cloaca (arrow). Image courtesy of Cambridge Health Alliance, Cambridge, MA.



**Figure E:** Another image from the specimen in **Figure D**. Notice the thick cuticle with annulations (**CU**), a thin nucleate hypodermis (**HY**) and layers of polymyarian muscle cells (**PO**).



**Figure F:** Cross-section of the anterior end of the specimen in **Figures D** and **E**. Notice the bacillary band (**BB**), a stichocyte (**ST**) and stichosome nucleus (**SN**).

▼ *T. trichiura* adults.

Adult males of *Trichuris trichiura* are 30-45 millimeters long, with a coiled posterior end. Adult females are 35-50 millimeters with a straight posterior end. Both sexes have a long, whip-like anterior end. Adults reside in the large intestine, cecum and appendix of the host.



**Figure A:** Posterior end of an adult *T. trichiura*, taken during a colonoscopy. Image courtesy of Duke University Medical Center.



**Figure B:** Adult if *T. trichiura* removed during a colonoscopy.



**Figure C:** Higher magnification of the anterior end of the specimen in **Figure B**.



**Figure D:** Higher magnification of the posterior end of the specimen in **Figure B**. Notice the prominent spicule.

# Pathology

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The pathology caused by *T. trichiura* is strongly related to the size of the worm **burden: the intensity of infection**. When individuals harbour only a **few worms these are confined to the caecum and ascending colon, causing little damage**. However, with heavy infections they spread throughout the colon to the **rectum, where they cause haemorrhages (anemia), mucopurulent stools and symptoms of dysentery with rectal prolapse**.

The Trichuris **dysentery** syndrome (TDS) associated with heavy infections is thought to be due in part to the acute-phase immune response and a **specific elevation of plasma fibronectins** and plasma viscosity, as well as low admission plasma levels of **insulin growth factor-1 (IGF-1)**, low type of procollagen and high serum levels of **tumour necrosis factor  $\alpha$  (TNF- $\alpha$ )**.

Trichuris-related mucosal damage may facilitate the invasion of other infections, including shigellosis and ***Entamoeba histolytica***, causing further ulceration. Infection can exacerbate colitis caused by infection with ***Campylobacter jejuni***.



# Burden of anemia associated to helminthiases: partial results from an ongoing Venezuelan survey



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## Abstract

**Objective:** Helminthiases are known aetiological factors in tropical anemia; however the extent to which their presence might interact to further enhance the risk of anaemia is poorly understood. The aim of this study was to determine the prevalence of helminthiases-associated anemia in asymptomatic individuals from 11 states in the context of a national survey of growth and development (2007–2009).

**Methods:** In the context of a Venezuelan Study on Human Growth and Development (SENACREDH, 2007–2011), a cross-sectional, probabilistic study, of 4,779 asymptomatic children and adults (<60 y-old) was done. Sampling was random, adjusted for age, sex and location. Results represented population weighted estimates (5,295,762 pop.), 2,935,070 male, 2,360,692 female. Study area was 71 municipalities in 11 states of North Central Coastal, South and Andean Venezuelan regions. Intestinal parasites were diagnosed in stool samples after being preserved in MIF media. Anemia was classified according WHO criteria after measure haemoglobin in blood samples.

**Results:** Hookworms (*Necator americanus/Ancylostoma duodenale*) and whipworm (*Trichuris trichiura*) were significantly associated with anemia. Whipworm prevalence was 1.35% (71,540) (95%CI 1.34–1.36%). Hookworm was 0.57% (30,153) (95%CI 0.56–0.58%). Anemia prevalence was 12.92% (684,054) (95%CI 12.88–12.95%), being significantly higher in those with hookworm infection (26.9%, 95%CI 26.42–27.42%) (p<0.001) (OR=2.5, 95%CI 2.4–2.6). Similarly was found for whipworm (16.4%, 95%CI 16.36–16.43%) (p<0.001) (OR=1.3, 95%CI 1.2–1.4).

**Conclusions:** Anemia is one of the most widespread and common health conditions afflicting individuals living in the tropics. The consequences of anemia are particularly severe for children and pregnant women. For these reasons multiple level preventive interventions at national scope should consider intestinal parasite surveys as this study shown.

**Key words:** anemia, intestinal parasites, Venezuela.

## Introduction and Purpose

Anemia is one of the major public health problem in tropical countries, where this condition occurs at its highest prevalence. Especially there, anemia causes are multifactorial. Anemia is responsible for significant morbidity and mortality, and would be related to other secondary conditions and complications. Understanding causes of anemia and potential mechanisms are crucial to our ability to intervene to reduce this burden.(1)

One of the significant causes of anemia in tropical countries is infectious diseases, such as malaria, (2) some bacterial infections, (3) HIV infection, (4) some other viral infections (e.g. parvovirus, influenza)(5,6) and intestinal parasites (particularly helminthiases), among others. (7,8)

Today, helminthiases are well-known aetiological factors in tropical anemia; (7–9) however the extent to which their presence might interact to further enhance the risk of anemia is poorly understood. (10)

The aim of this study was to determine the prevalence of helminthiases-associated anemia in asymptomatic individuals from 11 states in the context of a national survey of growth and development (2007–2009).

## Methods

This report constitutes part of a national parasitological survey that is being doing in the context of a large national representative assessment, the Second National Study of Human Growth and Development of the Bolivarian Republic of Venezuela (*Segundo Estudio Nacional de Crecimiento y Desarrollo Humano*, SENACREDH, 2007–20011).

The SENACREDH is a cross-sectional, probabilistic study, which for this report included an analysis of 4,779 asymptomatic children and adults (<60 y-old) assessed. Sampling was random, adjusted for age, sex and location.

Results represented population weighted estimates (5,295,762 pop.), 2,935,070 male, 2,360,692 female.

Study area was 71 municipalities in 11 states of North Central Coastal, South and Andean Venezuelan regions (2007–2009) (Figure 1). Human Development Index for North Central Coastal area ranged in 2008 from 0.827 to 0.887, Andean from 0.731 to 0.812 and South from 0.778 to 0.807.

Intestinal parasites were diagnosed in stool samples after being preserved in MIF media. Anemia was classified according the World Health Organization (WHO) criteria after measure haemoglobin in blood samples.

## Results

Hookworms prevalence was 0.569% (30,153/5,265,609) (95%CI 0.563–0.576%).

Whipworm prevalence was 1.35% (71,540/5,265,609) (95%CI 1.341–1.361%).

Anemia prevalence was 12.92% (684,054) (95%CI 12.88–12.95%).

Hookworms (*Necator americanus/Ancylostoma duodenale*) and whipworm (*Trichuris trichiura*) were significantly associated with anemia.

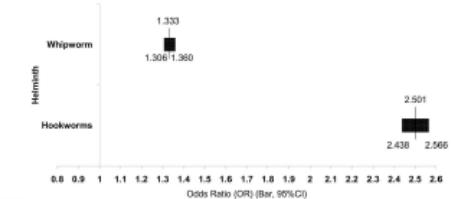
Anemia was significantly higher in those with hookworm infection (26.91%, 95%CI 26.42–27.42%) compared to those free of infection (12.832%, 95%CI 12.803–12.861%) (p<0.001) (Table 2) (OR=2.501, 95%CI 2.438–2.566) (Figure 2).

Similarly was found for whipworm, higher anemia prevalence with it (16.4%, 95%CI 16.36–16.43%) compared to those free of infection (12.869%, 95%CI 12.840–12.897%) (p<0.001) (Table 2) (OR=1.3, 95%CI 1.2–1.4) (Figure 2).

Figure 1. Map of Venezuela showing areas of study (2007–2009) where individuals were sampled (coloured).



Figure 2. Odds ratio of helminth infections for anemia.



## Conclusions

Anemia is one of the most widespread and common health conditions afflicting individuals living in the tropics.(2;7;8;10;11) The consequences of anemia are particularly severe for children and pregnant women.(1;2;7) For these reasons national studies revealing its prevalence as well their associated factors, such as has been shown herein, helminthiases, should be periodically done.

In this national ongoing assessment context (SENACREDH), this population study partial report shows the importance of hookworm infections with double and half times chances of be found with anemia compared to those free of infection. However, anemia is a multifactorial problem and other factors in this study have been not specifically addressed.

Further multivariate analyses with complete national data are deserved and expected in the near future.

However the importance of the problem reflects the need for diffusion of results as well short- and long-term interventions.

For these reasons, multiple level preventive interventions at national scope should consider intestinal parasite surveys as this study shown. From a public health policy, successful interventions to reduce the burden of such neglected diseases will require greater attention to prioritization of iron-promoting actions, including long-term low dose iron supplementation (12) and deworming, among community participation and health education. (13) Additionally, especially in tropical countries, food fortification have proved to be efficacious and effective, and therefore should be considered as part of an integral strategy, to combat micronutrient deficiencies, including anemia.(14;15)

The World Health Organization recommends deworming of children aged 12–24 months in highly endemic areas, given the fact that different studies have shown results that support the implementation of deworming programs aimed at young children in highly endemic areas.(16)

Table 1. Relation between hookworms infection (*Necator americanus/Ancylostoma duodenale*) and anemia in three regions of Venezuela, SENACREDH (2007–2009).

Hookworms Infection ( <i>Necator americanus/Ancylostoma duodenale</i> )	Anemia		
			Total
	Positive	N (%)	N (%)
Positive	N	8,117	22,036
Positive	%	26.91%	73,081
Positive	(95%CI)	(26.417–27.422)	(75,578–73,583)
Negative	N	675,937	4,589,672
Negative	%	12,832	87,130
Negative	(95%CI)	(12,803–12,861)	(87,101–87,159)
TOTAL	N	684,054	4,611,708
TOTAL	%	12,917	87,083
TOTAL	(95%CI)	(12,888–12,946)	(87,054–87,112)

x<sup>2</sup>=5,285.891; p<0.001; OR=2.501, 95%CI 2.438–2.566.

Table 2. Relation between whipworm (*Trichuris trichiura*) infection and anemia in three regions of Venezuela, SENACREDH (2007–2009).

Whipworm Infection ( <i>Trichuris trichiura</i> )	Anemia		
			Total
	Positive	N (%)	N (%)
Positive	N	11,766	59,774
Positive	%	16,447	83,553
Positive	(95%CI)	(16,174–16,719)	(83,281–83,826)
Negative	N	672,288	4,551,934
Negative	%	12,869	87,131
Negative	(95%CI)	(12,840–12,897)	(87,103–87,160)
TOTAL	N	684,054	4,611,708
TOTAL	%	12,917	87,083
TOTAL	(95%CI)	(12,888–12,946)	(87,054–87,112)

x<sup>2</sup>=803.239; p<0.001; OR=1.333, 95%CI 1.306–1.360.

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Flores J. et al.

Clinical Microbiology and Infection 2011 May; 17(Supplement S4):S209.

Design by: José Antonio Moreno Ruiz



## Burden of anemia associated to helminthiases: partial results from an ongoing Venezuelan survey

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**Table 2.** Relation between whipworm (*Trichuris trichiura*) infection and anemia in three regions of Venezuela, SENACREDH (2007-2009).

		Anemia			<b>Total</b>
		<b>Positive</b>	<b>Negative</b>		
<b>Whipworm Infection</b> <i>(Trichuris trichiura)</i>	<b>Positive</b>	<b>N</b>	11,766	59,774	71,540
		<b>%</b>	<b>16.447</b>	83.553	100
		<b>(95%CI)</b>	(16.174-16.719)	(83.281-83.826)	
		<b>N</b>	672,288	4,551,934	5,224,222
	<b>Negative</b>	<b>%</b>	<b>12.869</b>	87.131	100
		<b>(95%CI)</b>	(12.840-12.897)	(87.103-87.160)	
<b>Total</b>		<b>N</b>	684,054	4,611,708	5,295,762
		<b>%</b>	12.917	87.083	100
		<b>(95%CI)</b>	(12.888-12.946)	(87.054-87.112)	

$\chi^2=803.239$ ;  $p<0.001$ ; OR=1.333, 95%CI 1.306-1.360.



**Figura 4-26.** *Colitis amebiana* asociada a tricoccefalosis. (Cortesía: Departamento de Patología, Universidad de Antioquia, Medellín, Colombia).

# Clinical Features

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## Natural History.

In the vast majority of infections, which are light and asymptomatic, the worms live harmlessly in the caecum and appendix but when the infection is heavy (with worm burdens exceeding 500 worms), there can be marked and often severe symptoms and signs. In children, however, even symptomless infections may have subtle and insidious effects on nutritional status, and physical and intellectual growth.

## Incubation Period.

The prepatent period from ingestion of eggs to the appearance of eggs in the stool is 60–90 days.

# Symptoms and Signs

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The pattern and severity of symptoms and signs is positively correlated with the ***intensity of infection***.

In light infections there are no discernable symptoms, but when associated with ***Ascaris lumbricoides or hookworm*** mild symptoms occur.

These include

- epigastric pain,
- vomiting,
- distension,
- flatulence,
- anorexia and
- weight loss, which often may occur.

Pain in the epigastrium and right iliac fossa is common. When associated with ***E. histolytica***, ***Balantidium coli*** or shigellosis, symptoms are highly aggravated and dysenteric symptoms occur.

There is usually no eosinophilia which, if pronounced, usually denotes a concurrent ***Toxocara*** infection, with which it is often associated.

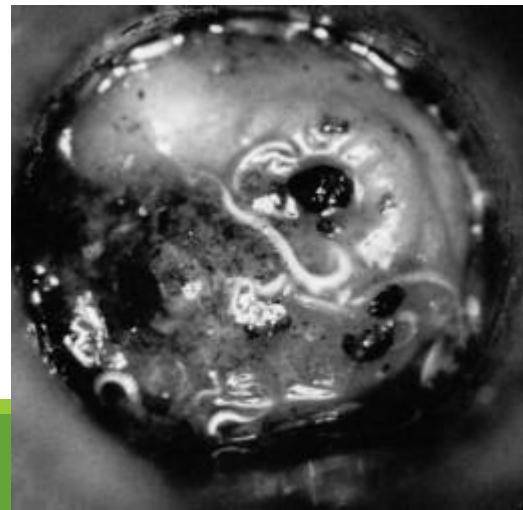
# Symptoms and Signs

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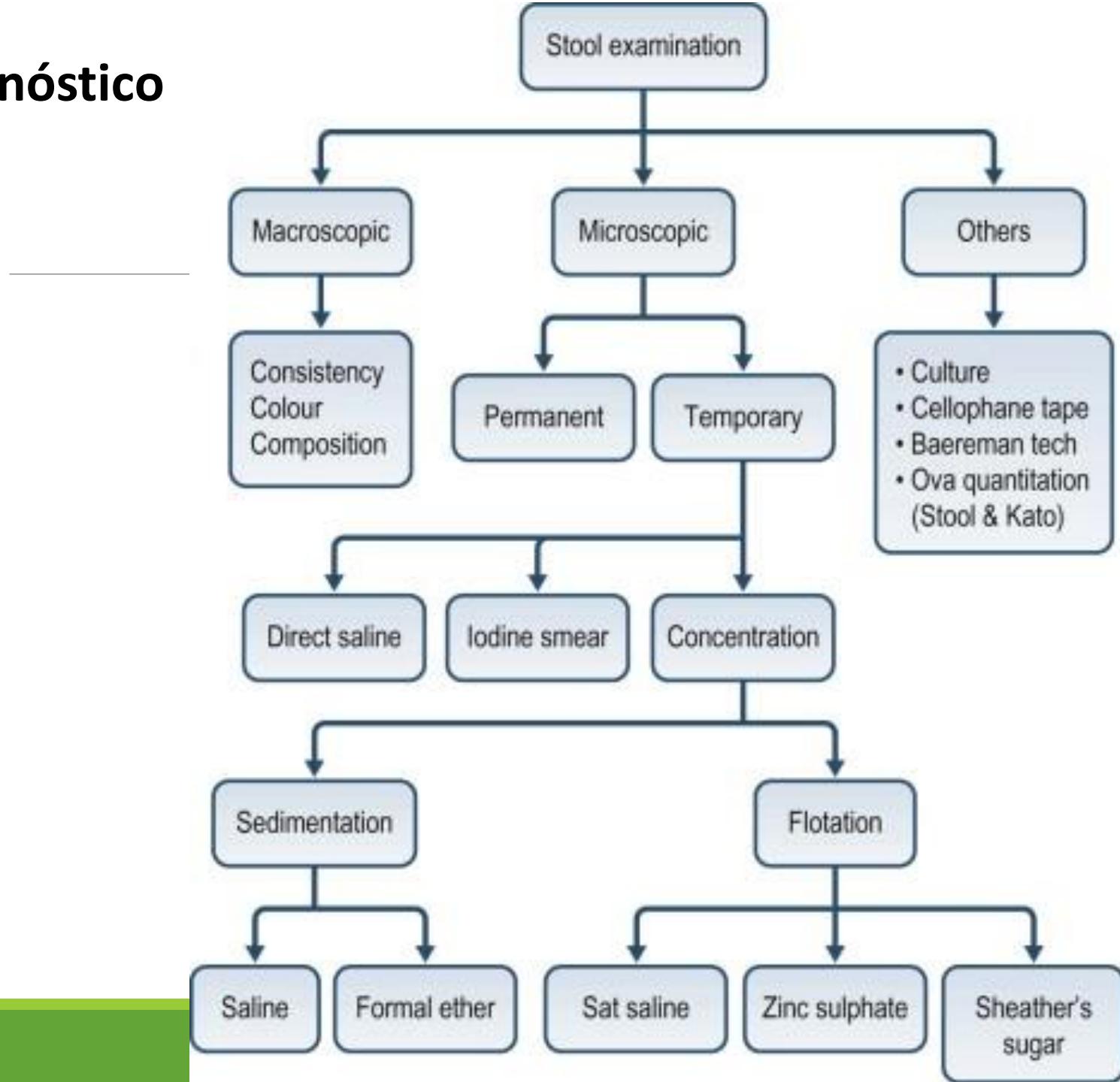
Moderate *T. trichiura* infections can result in **chronic *Trichuris colitis***, while heavy infection can cause **Trichuris dysentery syndrome (TDS) and massive infantile trichuriasis**.

Typical symptoms and signs of TDS include severe dysentery with blood and mucus in the stools and prolapse of the rectum.

In severe massive infantile trichuriasis, which typically occurs in children between 3 and 10 years, **hypoproteinaemia, severe anaemia** and clubbing of the fingers are common. Both colitides can result in **growth retardation and anaemia**, but treatment results in impressive catch-up growth. Chronic heavy infection during childhood can also have a detrimental effect on **cognition, educational achievement and school attendance**.

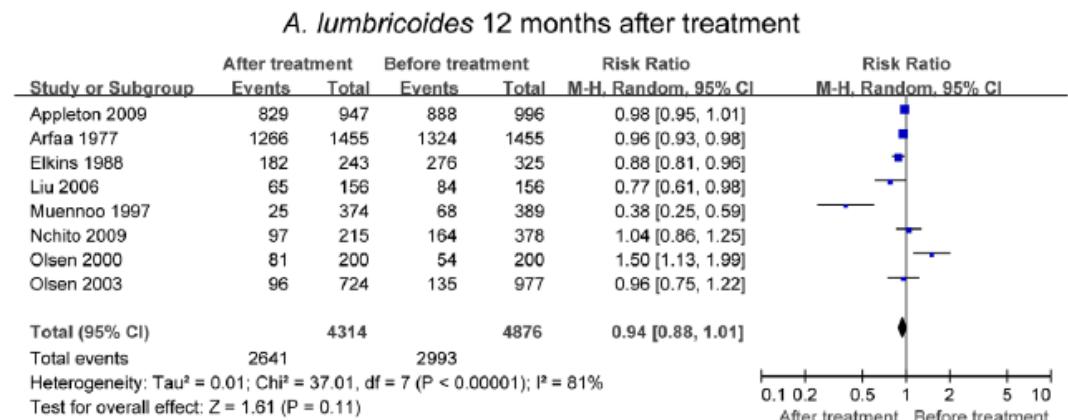
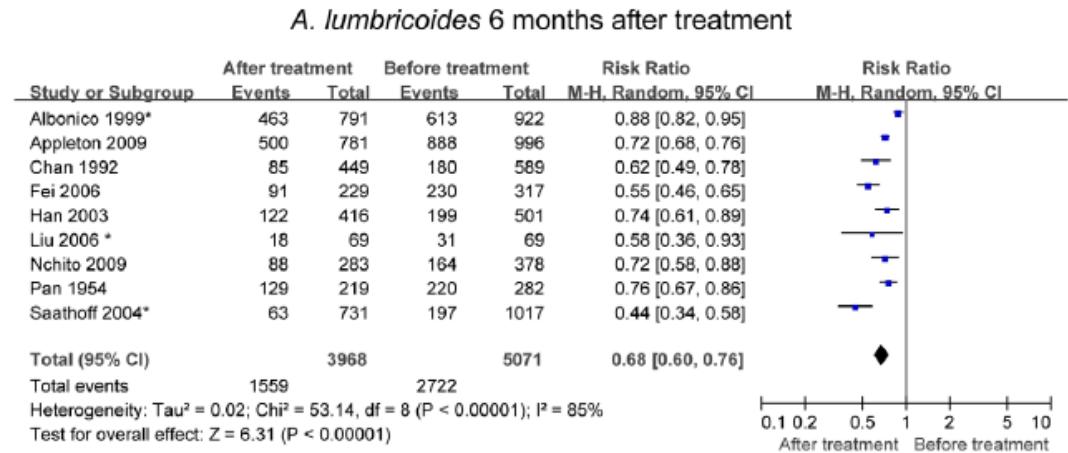
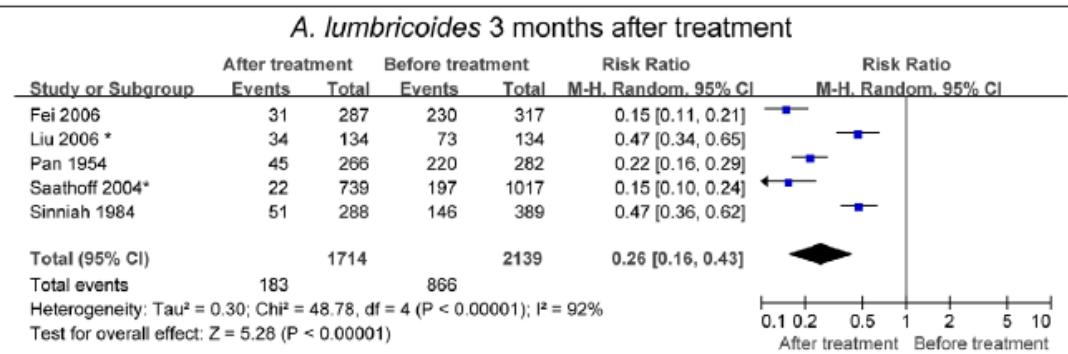


# Diagnóstico



**TABLE 55.1 Recommended Treatments for Soil-Transmitted Helminths. Note All Treatment are Administered Orally**

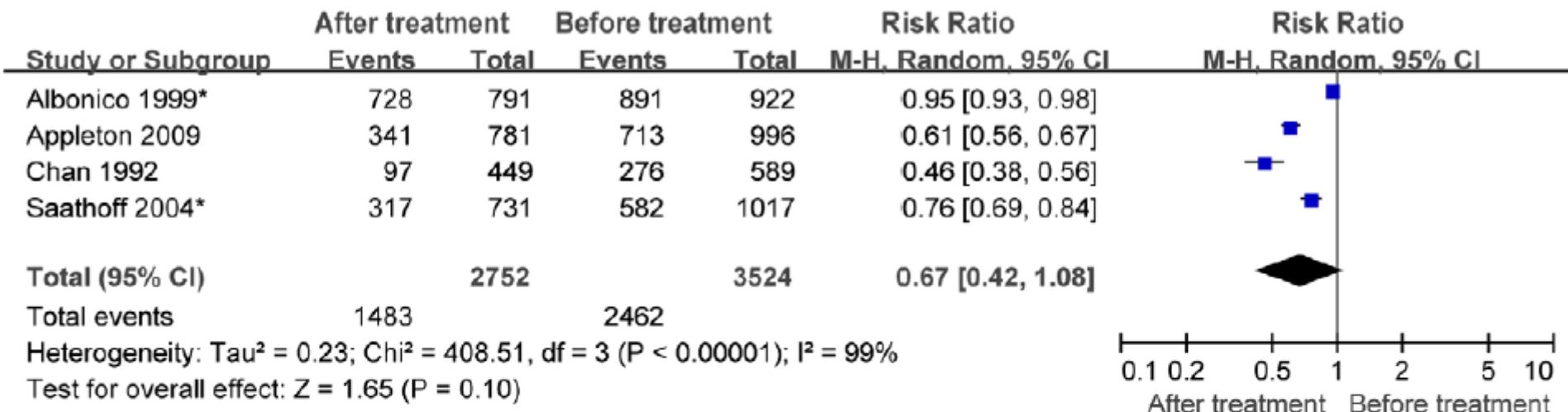
Infection	Drugs	Dose	Duration
<b><i>ENTEROBIUS</i></b>			
Drugs of choice	Albendazole Mebendazole Pyrantel pamoate	400 mg 100 mg 10 mg/kg	Single dose <sup>a</sup> Single dose <sup>a</sup> Single dose <sup>a</sup>
<b><i>TRICHURIS</i></b>			
Drugs of choice	Albendazole Mebendazole	400 mg 500 mg	Single dose <sup>b</sup> Single dose <sup>b</sup>
Alternatives	Nitazoxanide	500 mg or 200 mg for children 4–11 years or 100 mg for children 1–3 years	Daily for 3 days
<b><i>ASCARIS</i></b>			
Drugs of choice	Albendazole	400 mg or 200 mg for children 2–5 years	Single dose
	Mebendazole	500 mg	Single dose
	Levamisole	2.5 mg/kg	Single dose
	Pyrantel pamoate	10 mg/kg	Single dose
Alternatives	Nitazoxanide	500 mg or 200 mg for children 4–11 years or 100 mg for children 1–3 years	Daily for 3 days



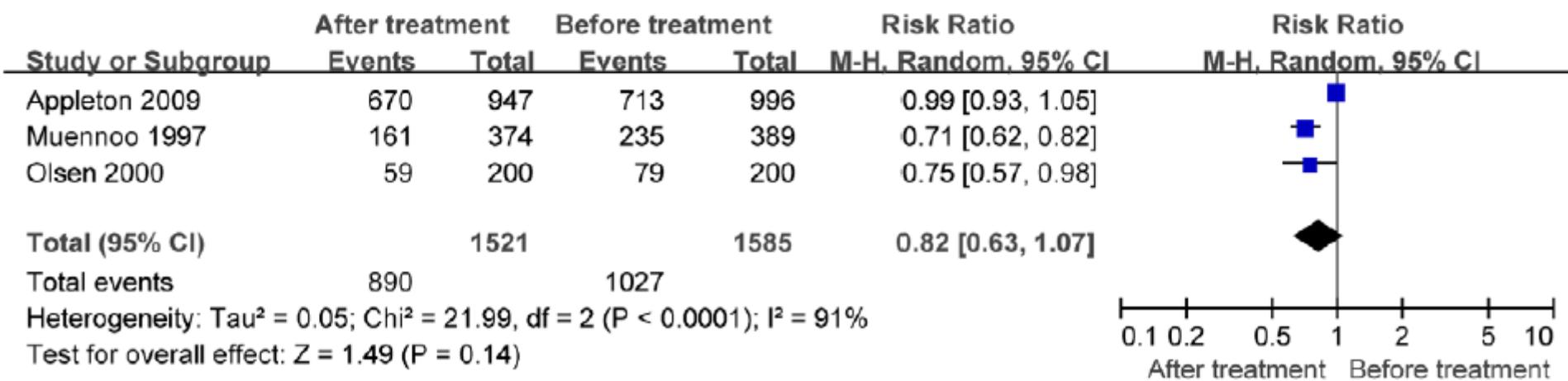
Jia T-W, Melville S, Utzinger J, King CH,  
Zhou X-N (2012) Soil-Transmitted  
Helminth Reinfection after Drug Treatment:  
A Systematic Review and Meta-  
Analysis. PLoS Negl Trop Dis 6(5): e1621.  
doi:10.1371/journal.pntd.0001621

**Figure 2. Forest plot of prevalence of *Ascaris lumbricoides* 3, 6, and 12 months posttreatment.** A random relative risk (RR) value of less than 1 indicates a lower infection rate after treatment compared to the initial level. Diamonds represent the pooled estimate across studies. See Table S1 for full references. \*The infection rate 3 or 6 months after the last round of treatment was abstracted (Table S3).  
doi:10.1371/journal.pntd.0001621.g002

## *T. trichiura* 6 months after treatment

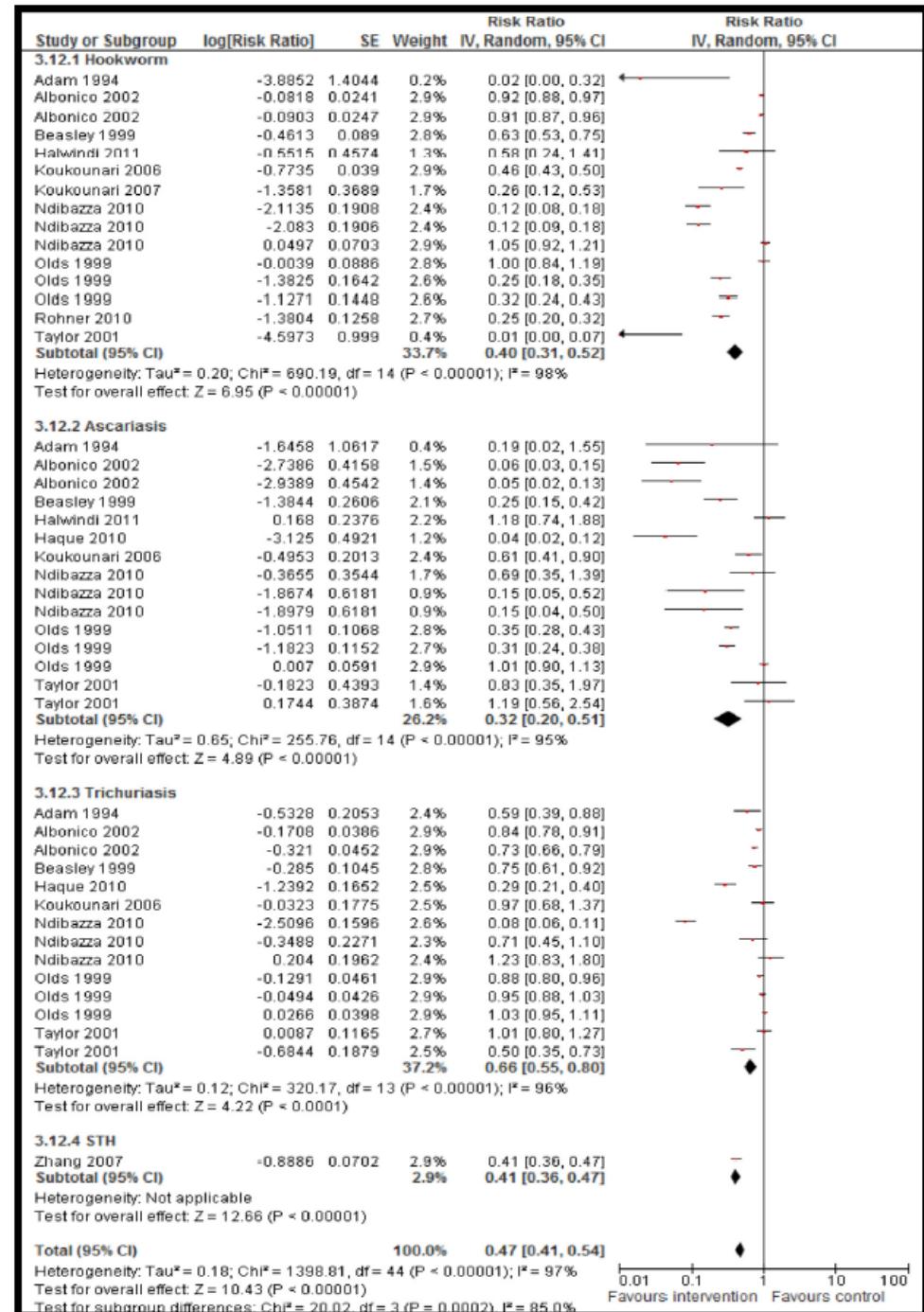


## *T. trichiura* 12 months after treatment



Jia T-W, Melville S, Utzinger J, King CH, Zhou X-N (2012) Soil-Transmitted Helminth Reinfection after Drug Treatment: A Systematic Review and Meta-Analysis. PLoS Negl Trop Dis 6(5): e1621.

doi:10.1371/journal.pntd.0001621

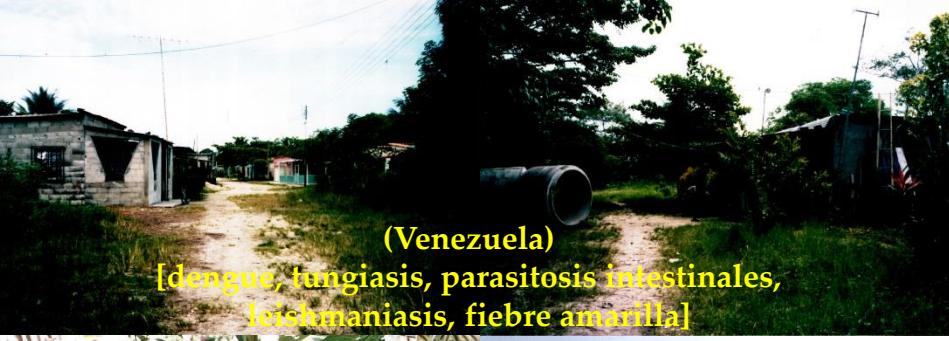


Infect Dis Poverty. 2014 Jul 31;3:23. doi: 10.1186/2049-9957-3-23. eCollection 2014.

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Salam RA1, Maredia H2, Das JK1, Lassi ZS1, Bhutta ZA3.

Figure 2 Forest plot for the impact of CBIs on STH prevalence.



# Prevención y Control

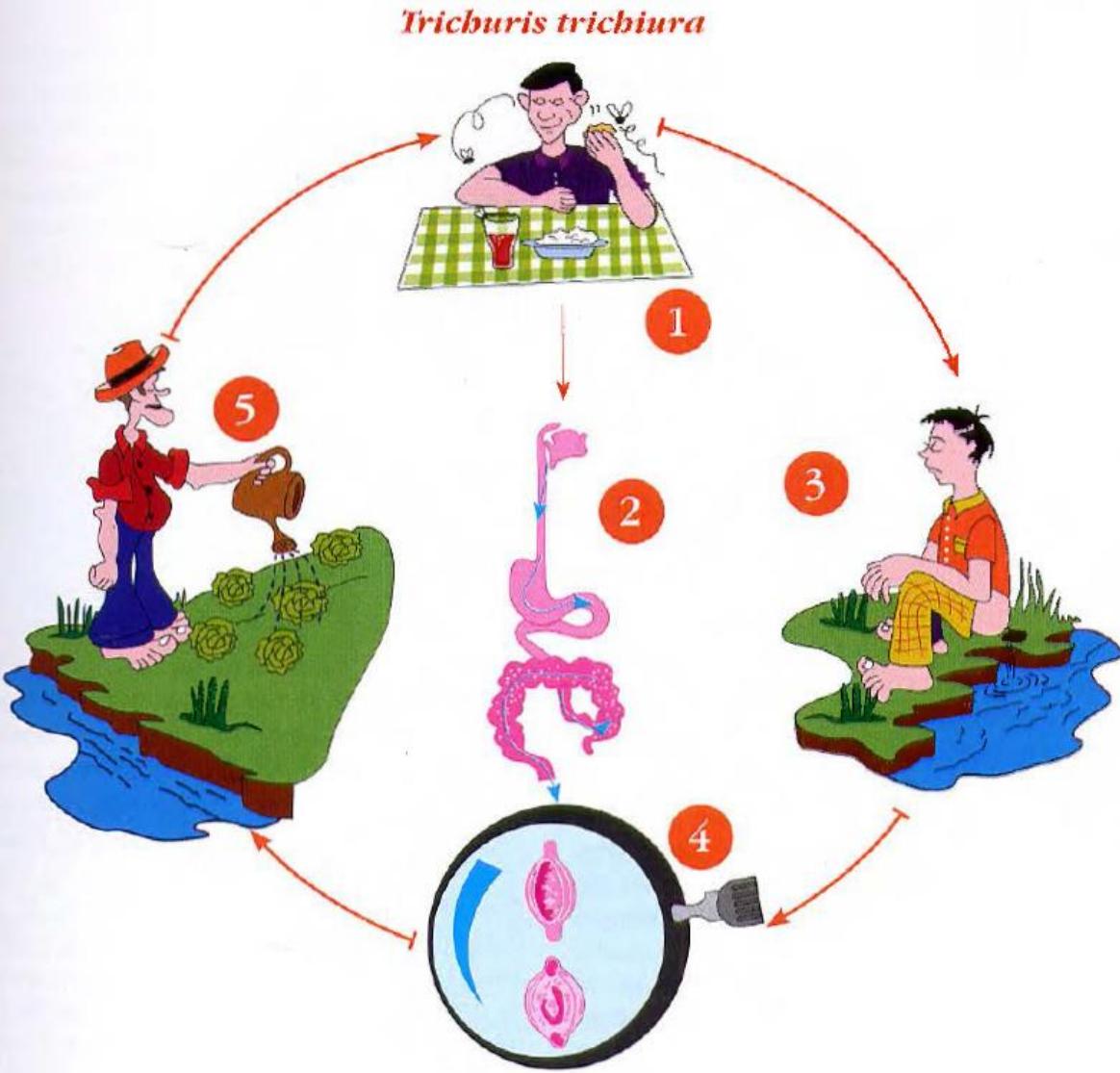
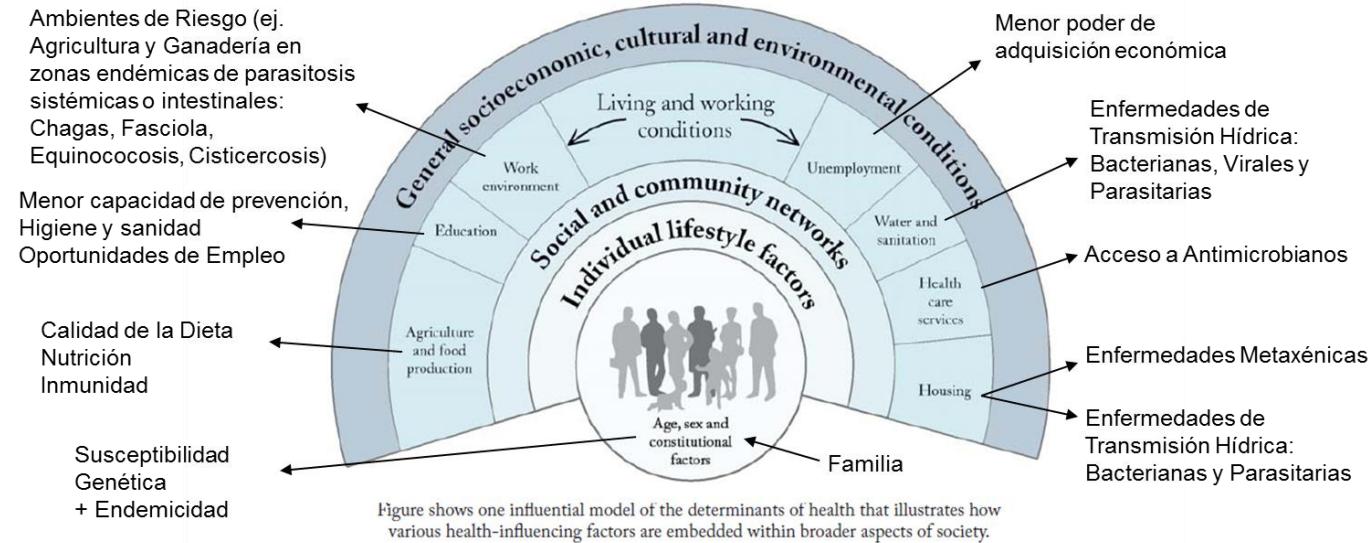


Figure 1.1 A Model of the Determinants of Health



Source: Dahlgren, G. and Whitehead, M. (1991). Policies and Strategies to Promote Social Equity in Health. Stockholm: Institute for Futures Studies.

# Conclusiones

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- ❖ Patología de gran importancia, la cual a pesar de su frecuencia, no es objeto de vigilancia epidemiológica en Colombia y en otros países
- ❖ Alta frecuencia en población infantil, especialmente rural y asociado con pobreza y condiciones medioambientales
- ❖ Fácil tratamiento, de importancia prevención y educación, tratamiento colectivo más que individual
- ❖ Clínicamente, pensar en los diagnósticos diferenciales, pero también en presentaciones atípicas que pueden complicarse
- ❖ Poliparasitismo
- ❖ Relación con desnutrición y alteraciones del crecimiento
- ❖ Necesidad de incrementar la investigación epidemiológica en la región y el país



Catia, Caracas, Venezuela, 2010

