Soil-Transmitted Helminth's

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## Summary of Parasitic Disease Prevalence-2011

<table>
<thead>
<tr>
<th>Disease</th>
<th>Infections/Year</th>
<th>Deaths/Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malaria</td>
<td>225 million</td>
<td>781,000</td>
</tr>
<tr>
<td>Schistosomiasis</td>
<td>207 million</td>
<td>200,000</td>
</tr>
<tr>
<td>Ascariasis</td>
<td>1 billion</td>
<td>20,000</td>
</tr>
<tr>
<td>Hookworm</td>
<td>740 million</td>
<td>50-60,000</td>
</tr>
<tr>
<td>Trichurasis</td>
<td>795 million</td>
<td>low</td>
</tr>
<tr>
<td>Filarialisis</td>
<td>120 million</td>
<td>low</td>
</tr>
<tr>
<td>Onchocerciasis</td>
<td>37 million</td>
<td>low</td>
</tr>
<tr>
<td>Trypanosomiasis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>− South American</td>
<td>10 million</td>
<td>10,000</td>
</tr>
<tr>
<td>− African</td>
<td>70,000</td>
<td>5,000</td>
</tr>
<tr>
<td>Leishmaniasis</td>
<td>12 million</td>
<td>5,000</td>
</tr>
</tbody>
</table>
Soil-Transmitted Nematodes Human Infections

• *Ascaris lumbricoides*
• *Trichuris trichiura*
• Hookworms
  – *Ancylostoma duodenale*
  – *Necator americanus*
• *Strongyloides stercoralis*
Soil-Transmitted Nematodes Risk Factors

• Poverty and poor living conditions
• Inadequate sanitation and water supplies
• Soil quality and climate
• Poor personal and environmental hygiene
• Poor health awareness
Layers of Soil
From Bottom to Top

• Heavier elements – stones, pebbles, gravel
• Progressively lighter elements of gravel
• Loose structure with incorporation of clay
• Very light clay particles – shimmering layer
• Topmost layer – vegetation, plant detritus
• Lack of vegetation; sandy layer
Cut Away of Soil
Soil Qualities and Textures

- Soil Qualities
  - texture
  - structure
  - consistency
- Soil Textures
  - sandy
  - loam
  - clay
## Various Soils and Clay Composition

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Clay Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Sandy</td>
<td>0.5-3%</td>
</tr>
<tr>
<td>Ordinary Sandy</td>
<td>3-10%</td>
</tr>
<tr>
<td>Sandy Loam</td>
<td>10-15%</td>
</tr>
<tr>
<td>Clay Loam</td>
<td>15-25%</td>
</tr>
<tr>
<td>Clay</td>
<td>25-35%</td>
</tr>
<tr>
<td>Heavy Clay</td>
<td>35-45+%</td>
</tr>
</tbody>
</table>
Important Soil Interactions

- Temperature
- Rainfall
- Humidity
- Poor Sanitation
Soil-Transmitted Nematodes Environmental Interactions

- Feces- containing eggs
- Soil- properties and characteristics
- Rain
- Temperature
- Human behavior
NEMATODE DEVELOPMENT

Egg → 1st stage larva → molt → 2nd stage larva → molt → 3rd stage larva → molt → 4th stage larva → molt → 5th stage Adult worm
Examples of Human Roundworm

*Ascaris lumbricoides*

- Most common soil-transmitted nematode
  - 1-2 billion people infected in the world
- Eggs become infective in the soil in 2-3 weeks
- Transmitted by ingestion of infective eggs
- Larvae migrate from intestine to liver to lungs and grow
- Larvae return to intestine from lungs and grow to adults
- Takes about 60 days from ingestion of infective eggs until adult worms develop and mate in intestine
- Large numbers of eggs excreted in feces
- Worms can live in intestine for about a year
Life Cycle of *Ascaris lumbricoides*
Trichuris trichiura
“Whipworm”
Trichuris trichiura
Lifecycle

1. Unembryonated eggs passed in feces.
2. 2-cell stage
3. Advanced cleavage
4. Embryonated eggs are ingested.
5. Larvae hatch in small intestine
6. Adults in cecum

CDC
http://www.dpd.cdc.gov/dpdx
Hookworms

*Ancylostoma duodenale*
“Old worm hookworm”

*Necator americanus*
“New world hookworm”
Strongyloides stercoralis
Clinical manifestations
Strongyloidiasis

• Disseminated disease
  – Gastrointestinal manifestations
    • Diarrhea
    • Abdominal pain
    • Paralytic ileus
  – Extraintestinal manifestations
    • Pneumonia
    • Pulmonary hemorrhage
    • Meningitis
    • Peritonitis
    • Sepsis
    • Shock
    • Granulomatous hepatitis
Strongyloides stercoralis
Life cycle
Strongyloides stercoralis
Global Distribution
Risk Factors
Severe Strongyloidiasis

• Age- the very young and those over 50

• Co-morbidities
  – Autoimmune diseases
  – Malignancies (esp. hematologic)
  – Chronic infections (TB, leprosy)
  – Previous gastric surgery
  – Severe malnutrition

• Immunosuppresion
  – Organ transplantation
  – Corticosteroid therapy
  – Irradiation
  – HIV/AIDS

• Miscellaneous
  – Alcoholism
  – Antacid therapy
  – Pregnancy
Intestinal Nematodes
As Neglected Tropical Diseases

- Norman Stoll – 1947, This Wormy World
- Infect more than one billion people today
- Quality of prevalence or absence data
- Morbidity is related to intensity of infection
- Specific morbidity estimates problematic:
  - role of light, moderate, heavy infections
  - co-infections of various other parasites
  - co-morbidity assessment
Intestinal Nematodes
As Neglected Tropical Diseases

Global distribution of soil-transmitted helminth infections

Areas where STH are a public health problem
Areas where STH are transmitted
Estimates of High Intensity Intestinal Nematode Infections

- **Ascariasis** – age dependent, 20-40 worms
- **Trichuriasis** – age dependent, 250-500 worms
- **Hookworm** – age dependent, 80-160 worms
Specific Results of Intestinal Nematode Infections

• Ascariasis -
  - cognitive abilities, ages 5-14 years
  - blockage of intestine from worm mass
• Trichuriasis -
  - cognitive abilities, ages 5-14 years
  - dysentery, rectal prolapse
• Hookworm -
  - cognitive impairment, psychomotor development, anemia
Useful Current References- 1
Neglected Nematode Diseases

1. Brooker S. Estimating the global distribution and disease burden of intestinal nematode infections: Adding up the numbers – A Review.
   Internat J Parasitol, 2010, 40:1137-1144

   doi:10.1371/journal.pntd.0000779
Useful Current References – 2

Neglected Nematode Diseases