The Impact of Foodborne Parasitic Diseases on Human Health

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Parasites – the neglected pathogens

- Generally, foodborne illness is equated with acute enteric disease – usually bacterial
- Some foodborne parasites can result in acute enteric disease.
- Others may result in acute, non-enteric illness
- Many more have a more insidious, long-term effect that can have a profound impact on human health, including fatalities
- Important that the impact of parasites – the neglected pathogens – is not overlooked.
Parasites – the neglected pathogens

20 NTD
- 2 viral
- 5 bacterial or fungal
- 1 non infectious
- 12 parasitic

Of the 12 parasites, most (7) can be transmitted via food and/or water
Parasites: a plethora of foodborne pathogens

Protozoa (single-celled)

Enteric
- Cryptosporidium spp.
- Cyclospora cayetanensis
- Entamoeba histolytica*
- Giardia duodenalis

Systemic
- Toxoplasma gondii
- Trypanosoma cruzi (Chagas Disease)

Worms and flukes
- Echinococcus granulosus
- Echinococcus multilocularis
- Taenia saginata
- Taenia solium (inc. cysticercosis)
- Anisakidae
- Ascaris
- Toxocara spp.
- Clonorchis & Opisthorchis
- Fasciola and Fasciolopsis
- Paragonimus spp.
- Small intestinal flukes
Cryptosporidium

Several species that may infect humans
Most common: *C. hominis* and *C. parvum*
*C. hominis* more important in African and Asian countries
*C. parvum* is zoonotic – important cause of acute diarrhoea in calves.
Transmission routes: water, food, direct (hand-to-mouth).
Foodborne outbreaks reported in Europe & N. America – waterborne more common.
Transmission route not always obvious (days between infection and symptoms).
Unexpected leading cause of paediatric diarrhoea in GEMS countries (2nd most common; Kotloff et al\(^a\)); also associated with increased mortality in children < 2 years
Including effect of growth faltering – increased DALY burden by 153% on top of acute effects (Khalil et al\(^b\)).
Treatment options limited; nitazoxanide not licensed for very young (< 1 year) or immunosuppressed.

\(^{b}\)Khalil et al. Lancet Glob Health 2018 Jul;6(7):e758-e768
Foodborne parasites: acute non-enteric disease

- **Trypanosoma cruzi**
  - Cause of Chagas Disease (often fatal)
  - Around 7 million affected globally - largely limited to Latin America
  - Previously considered to be almost entirely vectorborne (reduviid bugs)
  - Not included in FERG-1
  - Increasing reports of foodborne transmission, including extensive outbreaks.

Reduviid bugs (*Rhodnius prolixus*) – nymphs and adults From Wikimedia Commons, the free media repository

Açaí (palm berry) juice extractor in the streets of Belém, next to Ver-o-Peso market.

From Wikimedia Commons, the free media repository
Foodborne parasites: acute non-enteric disease

- *Trypanosoma cruzi*
  - Vectorborne route - largely associated with long-term effects (acute effects: usually mild – sometimes including fever)
  - Foodborne route – both acute and long-term effects, with notably higher morbidity and mortality than vectorborne infection.
  - Foodborne route - acute disease: fever (100%). Myalgia, headache, leg and/or facial oedema, pericardial effusion, abdominal pain.
  - Cardiac arrhythmias, congestive heart failure that may progress to cardiogenic shock, pericardial effusion, and pleural effusions
  - May result in mortality.
  - Various reasons suggested for greater clinical severity with oral infection:
    - higher dose, greater infection efficiency, treatment less effective, more virulent subtype
  - Health burden higher for foodborne infection than vectorborne.
<table>
<thead>
<tr>
<th>Parasite</th>
<th>Long-term / chronic symptoms</th>
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<tbody>
<tr>
<td><strong>Toxoplasma gondii</strong> (subtype dependent)</td>
<td>Uveitis, myalgia, psychiatric issues, reactivation and transplacental transmission</td>
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<tr>
<td><strong>Trypanosoma cruzi</strong></td>
<td>Long-term cardiac or gastrointestinal dysfunction</td>
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<tr>
<td><strong>Echinococcus granulosus</strong></td>
<td>Depends on hydatid location: liver - abdominal pain, nausea, vomiting; lung - chronic cough, chest pain</td>
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<td><strong>Echinococcus multilocularis</strong></td>
<td>Hydatid cysts metastasise to different locations - weight loss, abdominal pain, general malaise, hepatic failure</td>
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<tr>
<td><strong>Taenia solium cysticercosis</strong></td>
<td>Headaches, seizures; confusion, balance problems, brain swelling, and excess fluid around the brain</td>
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<tr>
<td><strong>Ascaris lumbricoides</strong></td>
<td>Significant nutritional &amp; growth deficits; impaired cognitive development</td>
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<tr>
<td><strong>Toxocara spp.</strong></td>
<td>Inflammatory responses: generalised lymphadenopathy, granulomatous hepatitis, endomyocarditis, asthma</td>
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<td><strong>Clonorchis &amp; Opisthorchis</strong></td>
<td>Hepatobiliary inflammation, especially periductal fibrosis, often leads to cholangiocarcinoma (bile duct cancer)</td>
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<tr>
<td><strong>Paragonimus spp.</strong></td>
<td>Resembles chronic bronchitis or tuberculosis - coffee-colored sputum, chest pain and/or shortness of breath</td>
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Conclusions

- **Foodborne parasites – important and often neglected**
  - A huge diversity of protozoa, worms and flukes
  - The human burden is high - but parasites are often overlooked
  - Clinical disease can be acute enteric or acute systemic
  - Also associated with numerous serious long-term or chronic conditions
  - For many diseases, symptoms are severe and potentially fatal
  - Often associated with disadvantaged communities
  - FERG should provide an evidence-based picture of the burden
  - Should assist in reminding us of the importance of these often-overlooked pathogens and providing focus for interventions.
Thank you for your attention

Many thanks to the WHO Foodborne Disease Burden Epidemiology Reference Group (FERG)

Parasitic Diseases Task Force (PDTF)