Identification of Human Intestinal Parasites in Open Areas of Wastewater in Rural Alabama

Lauren Nicholas Herrera1, Megan McKenna1, Catherine Flowers2, Rojelio Mejia1
1National School of Tropical Medicine, Baylor College of Medicine
2Alabama Center for Rural Enterprise
3Baylor College of Medicine, Department of Internal Medicine

Objectives

1) Identify the increasing emergence of parasitic infections found in developed countries
2) Identify the prevalence and burden of parasites found in the environment in resource-poor areas in Lowndes County, Alabama

Introduction

• Gastrointestinal parasitic infections lead to morbidity1
  • Stunting in children
  • Diarrhea
  • Malnutrition
  • Anemia (most commonly caused by hookworm)
• Poor sanitation systems and poverty in rural Alabama
  • “Black-belt” soils required expensive septic systems-unaffordable by majority of residents
  • Molecular diagnostics study is warranted to determine current prevalence of parasitic infections
• Recent study in Lowndes County using molecular diagnostics identified 34% of study participants’ stool were positive for Necator americanus, 7.7% positive for Strongyloides stercoralis, and 1.7% positive for Entamoeba histolytica (Figure 1). There was 5.2% Toxocara serology positives in this study.2
• This study was intended to evaluate the parasitic burden found in potential environmental sources including open wastewater systems and the soil.

Methods

• Areas with poor sanitation were selected in Lowndes County, Alabama
  • Per capita income $12,457
  • 31.4% live below poverty line
• 28 soil samples (near sewage runoff) and 10 open wastewater samples were collected
• Multi-parallel qualitative real-time PCR were run for the following parasites:
  - Ascaris lumbricoides
  - Strongyloides stercoralis
  - Ancylostoma duodenale
  - Giardia lamblia
  - Necator americanus
  - Cryptosporidium species
  - Trichuris trichiura
  - Blastocystis hominis
  - Toxocara canis/cati
  - Entamoeba histolytica

Wastewater and soil DNA extraction was performed with a novel flotation and filtration technique.

Results

• Soil samples: (28)
  - 5 (17.9%) positive samples of Blastocystis hominis
  - 2 (7.1%) positives for Toxocara canis
  - 2 (7.1%) positives for Entamoeba histolytica
  - 1 (3.6%) positive for Toxocara cati.

• Wastewater samples: (10)
  - There were 9 (90%) positives of Blastocystis hominis in the “wet pellet” samples
  - No other positive samples were found in the wastewater samples.

Discussion

• Using multi-parallel qualitative real-time PCR, several gastrointestinal parasites known to be endemic to developing countries have now been identified in a resource poor county in Alabama, among those who have never traveled abroad.

• This small study has identified environmental risk factors for developing GI parasitic infections in the soil and open wastewater with lack of sterile septic systems.

• Blastocystis was not tested in the human stool samples.

• Dirt samples matched what was previously detected in human participants (Toxocara, Entamoeba).

• Wastewater samples had high prevalence of Blastocystis and correlates with its fecal-oral life cycle.

• This continues to shift the idea behind global health - many of the world’s neglected tropical diseases (NTDs) are paradoxically found in some of the wealthiest countries, especially in these regions of extreme poverty.

• Future directions:
  - Nanopore whole genome sequencing of all DNA from environmental samples.
  - Broaden study to other resource-poor areas in the Southern United States

Acknowledgments

Funding provided by the Texas Children’s Hospital Center for Vaccine Development, and the National School of Tropical Medicine, Baylor College of Medicine. Thrasher Early Career Award 2018.

References