

A Deep Dive into Parasitic Infections, Symptoms, and Treatment Options

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Info from the CDC and other National Experts:	1
Quick Statistics according to the CDC:	1
Note On Citations	1
High Parasitic Load	1
Problems with High Parasitic Load Methodology	2
Common Types of Parasites and Infection Locations	2
Most Common General Parasites	2
Most Common GI Parasites	3
Uncommon Parasitic Diseases	3
Other Parasitic Diseases	3
Neurocysticercosis	3
Treatment and Prevention	4
Empirical Treatment	4
Anti-Parasitics	5
Secondary Medications	5
Secondary Medications May Include	6
Activities and Symptom Cycling:	6
Symptoms of a Parasitic Infection	7
Lab Findings	10
Causes of False Negatives	11
Abnormal Lab Values can include:	11
Transmission	12
Common Transmission Methods and Risk Factors	12
Conclusion	13

Info from the CDC and other National Experts:

According to experts at Baylor University College of Medicine, Division of Parasitic Diseases and Malaria:

- “There is an urgent need to reduce the impact of Neglected Parasitic Infections in the United States”.¹

This is because:

- “in the United States, these parasitic infections are acquired in their own immediate environment; for example, exposure to feces from domestic dogs or cats puts children at risk for toxocariasis and toxoplasmosis.”²

Unfortunately:

- “We know much less than we should about the health and economic burden and impact of parasitic diseases in developed countries, including the United States.”²

Quick Statistics according to the CDC:

- **1 in 6 Americans** (17.5%) are **chronically** infected with *Toxoplasma gondii*, the parasite that causes toxoplasmosis.³
- **1 in 7 Americans** (14%) have been exposed to *Toxocara*, the parasite that causes toxocariasis.⁴
- There are over 280 species of parasitic helminths that have been found to infect humans.⁵

Note On Citations

Due to how Google Documents formats and insert footnotes you may see the same sources used multiple times throughout the paper but listed under a difference reference number each time.

High Parasitic Load

Since a large number of Americans have a parasitic infection, most doctors are taught not to treat for parasites unless the individual exhibits symptoms or risk factors for a “High parasitic load”, such as:

- Recent infection of a family member (only for certain infections)
- Worms, eggs, or larvae are visible in the stool (or coughed up)
- Stomach pain has persisted for more than 2 weeks
- Vomiting or Diarrhea that lasts for more than 2-3 days
- Creeping eruption of the skin
 - Something that appears to move underneath the skin

¹ “Neglected Parasitic Infections in the United States: Needs and ...” 7 May. 2014, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4015562/>

² “Neglected Parasitic Infections in the United States: Needs and ...” 7 May. 2014, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4015562/>

³ “Parasitic Infections also occur in the United States | CDC Online ...” <https://www.cdc.gov/media/releases/2014/p0508-npi.html>

⁴ “Parasitic Infections also occur in the United States | CDC Online ...” <https://www.cdc.gov/media/releases/2014/p0508-npi.html>

⁵ “History of Human Parasitology .” <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC126866/>

However, increasing evidence shows that even a low to mild parasitic load can cause a variety of health issues. Additionally, there are many flaws to the high parasitic load methodology of treating parasites.

Problems with High Parasitic Load Methodology

For example:

1. "Infections are frequently underestimated by standard parasite tests"⁶
2. "Most parasitic disease research has focused on organ- specific (symptoms and methods of infection"⁷ and consequently ignores how a parasite can affect the whole body or how they can spread.
3. "Many parasites can evade the immune system"⁸ thus allowing a parasite to spread to multiple organs before the body begins to recognize the infection is present.
4. There are many cases where the high parasitic load is not seen until an autopsy is completed.⁹
 - a. When this does **parasites** are often seen to be **blocking blood vessels to the brain**.^{10 11}

Common Types of Parasites and Infection Locations

Below you will find a list of the most common types of parasites found in the United States and in surrounding countries. The surrounding countries are included due to transmission factors associated with immigration, business travel, vacation related travel, and commerce between these regions.

The global prevalence of these infections ranges from 300,000 to 1.7 billion persons infected globally.^{12 13}

Most Common General Parasites

These parasites may show up in many places including the gastrointestinal tract however their symptoms expand far beyond gastrointestinal symptoms.¹⁴

- Toxoplasma Gondii¹⁵
- Toxocara¹⁶
- Hookworm¹⁷
- Ascaris lumbricoides¹⁸
- Taenia saginata & Taenia solium¹⁹

⁶ "Health Metrics for Helminth infections ." 12 Dec. 2013, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4055550/>

⁷ "Health Metrics for Helminth infections ." 12 Dec. 2013, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4055550/>

⁸ "Immune defence, parasite evasion strategies and their ..." 17 Oct. 2008, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2666695/>

⁹ "Quantitative Assessment of Multiorgan Sequestration of ..." 7 Apr. 2015, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4577044/>

¹⁰ "Quantitative Assessment of Multiorgan Sequestration of ..." 7 Apr. 2015, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4577044/>

¹¹ "Human schistosomiasis ." 1 Apr. 2014, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4672382/>

¹² "Epidemiology and control of human gastrointestinal ... - NCBI - NIH." <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2851163/>

¹³ "Epidemiology and clinical features of soil-transmitted helminths - NCBI." 25 Sep. 2017, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5652059/>

¹⁴ "Human Intestinal Parasites" <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2754014/>

¹⁵ "Toxoplasmosis - Epidemiology & Risk Factors - CDC." <https://www.cdc.gov/parasites/toxoplasmosis/epi.html>

¹⁶ "Toxocariasis FAQs - CDC." https://www.cdc.gov/parasites/toxocariasis/gen_info/faqs.html

¹⁷ "Hookworm - CDC." <https://www.cdc.gov/parasites/hookworm/index.html>

¹⁸ "Ascariasis - CDC." <https://www.cdc.gov/parasites/ascariasis/index.html>

¹⁹ "Taeniasis FAQs - CDC." https://www.cdc.gov/parasites/taeniasis/gen_info/faqs.html

Most Common GI Parasites

These parasites primarily show up with gastrointestinal symptoms and can hide deep in the GI tract at times may only be visible to capsule endoscopy. ²⁰

- Giardia ²¹
- Cryptosporidium ²²

Uncommon Parasitic Diseases

- Chagas disease ²³

Other Parasitic Diseases

- Trichomona ²⁴
 - This can only be transmitted:
 - Through sexual activity
 - Congenitally from mother to child if untreated before childbirth.

Neurocysticercosis

Neurocysticercosis - is the most common parasitic infection of the brain. ²⁵

In most cases the only time antiparasitic treatment may not be pursued is if there are any suspected or confirmed parasitic brain cysts or lesions. If there are brain cysts or lesions present the medication can still be administered, however additional medication may be required to prevent any temporary neurological side effects that may occur from the dying brain parasite. ²⁶

²⁰ "Human Intestinal Parasites" <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2754014/>

²¹ "General Information | Giardia | Parasites | CDC." <https://www.cdc.gov/parasites/giardia/general-info.html>

²² "CDC Works to Improve Cryptosporidium Tracking in the United States" <https://www.cdc.gov/parasites/crypto/cryptonet-public.html>

²³ "Chagas Disease - Epidemiology & Risk Factors - CDC." 8 Apr. 2019, <https://www.cdc.gov/parasites/chagas/epi.html>

²⁴ "Trichomoniasis Statistics - CDC." <https://www.cdc.gov/std/trichomonas/stats.htm>.

²⁵ "Antiepileptic drugs for seizure control in people ... - Cochrane Library." <https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD009027.pub2/epdf/full>.

²⁶ "Antiepileptic drugs for seizure control in people ... - Cochrane Library." <https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD009027.pub2/epdf/full>.

Treatment and Prevention

Most anti-parasitics have very limited and very infrequent side effects. Often the side effects are just the result of the parasite either dying or being expelled from the body.²⁷

Ivermectin is an antiparasitic that may soon earn the title of wonder drug, due to the lack of side effects and its safety in mass drug administration programs.

Prophylactic (preventative) treatment with anti-parasitics is generally considered safe and is frequently practiced in developing nations in mass drug administration programs especially in children.^{28 29}

Empirical Treatment

Empirical treatment is the treatment of a disease based on the patient's signs and symptoms, even if the blood and stool tests come back negative for any abnormalities.

Recently, some studies have shown that a massive improvement in patient outcome is possible in patients who had Persistent Abdominal Symptoms (PAS). These patients' experienced severe fatigue, abdominal pain, and diahrea that occurred despite negative stools test. When these 102 patients were treated for parasites with antiparasitic medication, within one week of treatment:³⁰

- 69% experienced a significant improvement in their stomach pain
- 70% reported a significant improvement in energy levels and fatigue.

²⁷ "Treatment Options and Considerations for Intestinal ..." 28 Apr. 2014, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5990147/>

²⁸ "The public health benefit and burden of mass drug ... - Plos." 12 Nov. 2018, <https://journals.plos.org/plosntds/article?id=10.1371/journal.pntd.0006954>.

²⁹ "Mass Deworming Programs in Middle Childhood and ..." <https://www.ncbi.nlm.nih.gov/books/NBK525254/>

³⁰ "The effectiveness of empirical anti-parasitic treatment in ... - NCBI." 1 Jan. 2018, <https://www.ncbi.nlm.nih.gov/pubmed/29232458>

Anti-Parasitics

Examples of some common prescription antiparasitic medications include: ³¹

- **Ivermectin**
 - Paralyzes the parasite so it can be expelled by the body's natural processes. Since the parasite is paralyzed it NOT continue to burrow deeper or spread further.
 - Is the ONLY medication that can treat internal & external parasites, but can NOT tapeworms.
 - Is NOT capable of negatively affecting humans as it targets a molecular pathway that is ONLY found in invertebrates (animals without backbones) the glutamate-gated chloride ion channel.
 - Additionally in believed NOT to be capable of crossing the blood brain barrier
- **Mebendazole -**
 - Inhibits the parasites glucose uptake
 - 1st line of treatment for Giardia
 - Currently it is approved for various infections, but for some reason there are NO US based manufacturers. Most Mebendazole currently in use is from an India based drug manufacturer.
- **Albendazole**
 - Essentially the successor to Mebendazole (for most but not all parasite treatments)
 - Inhibits the parasites glucose uptake
- **Nitazoxanide**
 - The only antiparasitic medication to be classified as in pregnancy safety category B.
 - This means controlled studies have proven no harm to a pregnancy animal or offspring. So it may be safe to use if necessary, but long term human controlled trials have yet to be done.
 - Note: US FDA no longer uses pregnancy safety categories. Instead the FDA requires manufacturers to list any birth defects that been reports or associated with their medication.
- **Praziquantel**
 - Mainly approved for Fish tapeworm
 - Only one US manufacturer and the supply is somewhat limited.
 - Often can use Nitazoxanide as a replacement if Praziquantel is unavailable.

Secondary Medications

Antibiotics may be used - with various antiparasitic drugs to help kill bacteria released by the parasite's metabolic processes or by the death of the parasite itself. ³²

Corticosteroids and anti-seizure medications are also used and to prevent side effects of neurocysticercosis treatment. These medications are generally prescribed at the same time and the patient is instructed to take them either at the same time as the anti-parasitic medications or if they begin to experience seizures or other neurological symptoms. ^{33 34}

³¹ "Antiparasitic Drugs - StatPearls - NCBI Bookshelf." 11 Jul. 2019, <https://www.ncbi.nlm.nih.gov/books/NBK544251/>

³² "Antiparasitic Drugs - StatPearls - NCBI Bookshelf." 11 Jul. 2019, <https://www.ncbi.nlm.nih.gov/books/NBK544251/>

³³ "Corticosteroid use in neurocysticercosis - NCBI - NIH." <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3721198/>.

Accessed 31 Jul. 2019.

³⁴ "Current Consensus Guidelines for Treatment of Neurocysticercosis."

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC126865/>. Accessed 31 Jul. 2019.

In general, the patient is told to seek medical attention if the symptoms do not improve, if they get worse, or the medication does not seem to reduce the symptoms of the dying parasitic infection.

Secondary Medications May Include

- **Antibiotics** ³⁵
 - Sulfur or Phosphate based Antibiotics
 - Metronidazole
 - Amoxicillin
 - Doxycycline
 - Cephalexin
- **Corticosteroids** ³⁶
 - To reduce swelling caused by dying parasite
 - Also may help speed healing by reducing swelling and allowing anti-parasitic medication to reach the parasite more effectively.
 - Must be careful because if corticosteroids are used and insufficient antiparasitic treatment is administered, then an increase in the overall parasite load can occur. ³⁷
 - Such as: Prednisone or Prednisolone
- **Anti-seizure or Anti-epileptic medications** ³⁸
 - To prevent seizure activity that may be caused by:
 - Toxins released from the neuro-parasitic infections.
 - Increased intracranial pressure that can occur with dying neuro-parasitic infections.

Activities and Symptom Cycling:

- Parasites carry out most of their common activities inside their host, this includes:
 - Eating
 - Pooping
 - Reproducing
 - Migrating
 - And eventually
 - Death of the parasite
- Certain parasites are only capable of certain activities in their human host.
- Certain parasites carry out ALL of the activities listed above in a human host.

Sometimes a symptom only manifests during a certain activity performed by the parasite. If symptoms appear by seem to cycle every few days or every 2-3 weeks, this can be a good indication that symptom is only occurring during a certain phase of the parasite's life cycle or during a specific activity. ³⁹

³⁵ "Why Metronidazole Is Active against both Bacteria and Parasites - NCBI."

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC89320/>. Accessed 31 Jul. 2019.

³⁶ "Neuroparasitic Infections: Nematodes - NCBI - NIH." <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2678030/>.

Accessed 31 Jul. 2019.

³⁷ "Corticosteroid treatment increases parasite numbers in murine"

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1419257/>. Accessed 31 Jul. 2019.

³⁸ "Neurocysticercosis - NCBI." <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1176337/>. Accessed 31 Jul. 2019.

³⁹ "The Life and Times of Parasites: Rhythms in Strategies for ..." 27 Aug. 2017,

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5734377/>

Symptoms of a Parasitic Infection

1. **Chronic or recurring bacteria infection** ^{40 41 42 43 44}
 - a. Especially if the infection seems to be resistant to antibiotics
 - b. This is often due to the parasites waste products
 - i. This occurs because parasites are structured a lot like other bugs and animals.
 - ii. Therefore it has a mouth, stomach, anus, and skin and as it eats it will eventually produce waste OR also known as parasite poop.
 - c. Or the parasites could have weakened the body's immune system
 - d. **This is one of the least known and least studied effects of parasites, but it can be part of what causes a variety of symptoms related to a parasitic infection.**
 - e. One example is the bacteria released from the demodex brevis and demodex folliculorum parasite, which studies have shown may be in part responsible for normal or cystic acne.
2. **Reduced mental capacity** ⁴⁵
 - a. The ability to make decisions for yourself ⁴⁶
(definition taken from British MCA act of 2005 and the Singapore Medical Journal)
 - b. Reduced from the individuals normal ability
3. **Slow thinking / problem solving** ⁴⁷
 - a. Slower than normal for the individual
4. **Pallor** ⁴⁸
 - a. Pale complexion
5. **Facial Swelling (Facial edema / Angioedema)** ^{49 50}
 - a. Facial swelling (often creating an appearance of weight gain)
 - b. This can be caused by either:
 - i. Location of the parasites
OR
 - ii. Sodium retention caused by the parasite (see Symptom # 6 below)
 - c. **Intermittent Facial Edema** Intermittent Facial Edema is only known to occur with gnathostomiasis infection

⁴⁰ "Manipulation of the host cell response to infection with Toxoplasma gondii" Jun. 2006, <http://theses.gla.ac.uk/71024/1/10390589.pdf>.

⁴¹ "Host cell manipulation by the human pathogen Toxoplasma gondii." 30 Mar. 2009, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2662853/>

⁴² "Protozoa: Pathogenesis and Defenses - Medical Microbiology ..." <https://www.ncbi.nlm.nih.gov/books/NBK8043/>

⁴³ "Neutrophils Clear Bacteria Associated with Parasitic ..." <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2288648/>

⁴⁴ "Human Permanent Ectoparasites; Recent Advances on Biology ..." - NCBI." <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5522688/>. Accessed 6 Aug. 2019.

⁴⁵ "Toxoplasmosis Infection and Cognitive Deficit after ..." <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3939729/>.

⁴⁶ "Importance of mental capacity: time for greater attention and ..." <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4678401/>.

⁴⁷ "PARASITE PREVALENCE AND THE WORLDWIDE ..." <https://www.ncbi.nlm.nih.gov/books/NBK62514/>.

⁴⁸ "Enteric Nematodes of Humans - Medical Microbiology - NCBI Bookshelf." <https://www.ncbi.nlm.nih.gov/books/NBK8261/>

⁴⁹ "Skin manifestations in parasite infection. ." <https://www.ncbi.nlm.nih.gov/pubmed/12561678>.

⁵⁰ "Migratory facial swelling due to gnathostomiasis. ." Dec. 2001, <https://www.ncbi.nlm.nih.gov/pubmed/1640131>.

6. Swollen Lymph Nodes ^{51 52 53}**7. Sodium disturbances** ^{54 55 56}

- a. More often presents as sodium retention.
BUT
- b. Can also present as sodium deficiency.
- c. This can also occur cyclically between deficiency and retention.
- d. Cyclic patterns are often due to the life cycle of the parasite, causing retention when alive, and deficiency when dead.
- e. Because many parasites disrupt the body's natural systems for maintaining sodium homeostasis.

8. Vitamin and Mineral Deficiencies

- a. Damage to stomach lining prevents some nutrients from being properly absorbed.
- b. Parasite causes deficiency due to the parasites demand for similar vitamins & nutrients.
- c. See "Lab Findings" section at the end of this document

9. Anemia

- a. Low Hemoglobin and / or Hematocrit ⁵⁷
- b. Many parasites survive on the blood of their host
- c. See "Lab Findings" section at the end of this document

10. Stomach Pain / Symptoms of IBS ^{58 59}

- a. Sudden and severe - impacting ability to function in daily life
- b. Minor to mild pain - lasting longer than 2 weeks

11. Loss of Appetite / Easily Full ^{56 60}

- a. Feel full after eating just a small portion of food
- b. This occurs due to either the parasite reproducing in the GI tract or due to the ingestion of a large number of parasites or parasite eggs that are not maturing and continuing to grow.

12. Diarrhea ⁵⁶

- a. One of the most common symptoms, but ABSENCE of diarrhea does NOT RULE OUT infection.

13. Malnutrition ⁵⁶

- a. Physical and mental changes due to insufficient nutrient absorption.

14. Appendicitis ⁶¹

- a. One main risk factor appears to be if a pinworm infection has gone on untreated.

⁵¹ "Neuroparasitic Infections: Cestodes, Trematodes, and.. - NIH."

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2683840/>

⁵² "Lymph Node Enlargement in Neck Filariasis as a Rare Cause ."

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5722968/>

⁵³ "Multiple cysticerci as an unusual cause of mesenteric lymph ..." 6 Jun. 2008,

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2440388/>

⁵⁴ "Effects of red blood cell potassium and hypertonicity ..." <https://www.ncbi.nlm.nih.gov/pubmed/3518266>.

⁵⁵ "Syndrome of Inappropriate Antidiuretic Hormone ..." <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3982351/>

⁵⁶ "Congenital toxoplasmosis presenting as central diabetes ..." 28 Mar. 2014,

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3986852/>

⁵⁷ "Iron Deficiency Anemia: A Common and ..." <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3685880/>

⁵⁸ "Hookworm - Frequently Asked Questions ..." https://www.cdc.gov/parasites/hookworm/gen_info/faqs.html

⁵⁹ "Enteric Nematodes of Humans - Medical Microbiology - NCBI Bookshelf."

<https://www.ncbi.nlm.nih.gov/books/NBK8261/>

⁶⁰ "An Extremely Uncommon Case of Parasitic Infection ..." 12 Apr. 2011,

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3088738/>

⁶¹ "Parasitic Appendicitis - NCBI." <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3910418/>

15. Dehydration ⁶²

- a. More frequent in hookworm infections

16. Fatigue ⁶³

- a. Common in most infections (at most stages)

17. Fever ⁶⁴

- a. Common in most infections (in later stages or if infection load is high)

18. Sleeplessness ⁶⁵

- a. Or frequently waking at night

19. Irritable ⁶⁶

- a. Often due to lack of sleep due to itching or general discomfort.
- b. If severe could indicate neuro-parasitic infection

20. Itching (technical term: Pruritus) ^{67 68 69}

- a. On and round the feet or buttocks.
- b. On area of bare skin that was in direct contact with dirt longer than a couple of seconds.

21. Anal Itch ⁷⁰

- a. Primarily common with pinworms
- b. Pinworms are capable of spreading and can often cause issues with liver enzymes, the pancreas, and the appendix.

22. Anal Pain (or general pain near anus) ⁷¹

- a. Often this is actually anal itching. Younger kids have a hard time differentiating itch from pain.

23. Recurrent urinary tract infections or Pelvic Pain ⁷²**24. Bed Wetting (general new bladder control issues)** ⁷³

- a. In all kids who had previously had been potty trained

25. Fertility Issues ⁷⁴

- a. This can affect both men and women.

⁶² "Strongyloides stercoralis: Systematic Review of Barriers to ..." 25 Sep. 2014,

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4177786/>

⁶³ "Neuroparasitic Infections: Cestodes, Trematodes, and Protozoans."

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2683840/>

⁶⁴ "Neuroparasitic Infections: Cestodes, Trematodes, and Protozoans."

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2683840/>

⁶⁵ "Enteric Nematodes of Humans - Medical Microbiology - NCBI Bookshelf."

<https://www.ncbi.nlm.nih.gov/books/NBK8261/>

⁶⁶ "Enteric Nematodes of Humans - Medical Microbiology - NCBI Bookshelf."

<https://www.ncbi.nlm.nih.gov/books/NBK8261/>

⁶⁷ "Parasites Induced Skin Allergy: A Strategic Manipulation of the

..." <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3194028/>

⁶⁸ "Controlled Human Hookworm Infection: Accelerating Human ..." 19 Apr. 2018,

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5952933/>

⁶⁹ "Skin manifestations in parasite infection." <https://www.ncbi.nlm.nih.gov/pubmed/12561678>. ..."

⁷⁰ "Pinworms (Enterobius Vermicularis) - NIH." <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2306321/>

⁷¹ "Enteric Nematodes of Humans - Medical Microbiology - NCBI Bookshelf."

<https://www.ncbi.nlm.nih.gov/books/NBK8261/>

⁷² "Enteric Nematodes of Humans - Medical Microbiology - NCBI Bookshelf."

<https://www.ncbi.nlm.nih.gov/books/NBK8261/>

⁷³ "Prevalence and symptoms of Enterobius vermicularis infections ..." <https://www.ncbi.nlm.nih.gov/pubmed/1801349>.

⁷⁴ "Can Helicobacter pylori infection influence human reproduction?" 21 May. 2014,

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4024765/>

26. Rash or Hives ^{75 76 77}**27. Acne or Subcutaneous Cysts** ^{78 79 80}

- a. Normally appear as acne, acne cysts, or nodules on face, arms, chest, back
- b. Often due to demodex infestation

28. Kidney Cysts ^{81 82}

- a. May appear to be a kidney stone on MRI or CT imaging

29. Neurocysticercosis (aka Neurologic Cysts / Lesions) ^{83 84}**30. Visual disturbances / difficulties** ^{85 86 87}

- a. Changes in vision such as: Blurry vision
 - i. Flashers / floaters / dots
- b. Posterior subretinal cysts (eye ulcers on back of eye)

31. Development or worsening of any autoimmune diseases ^{88 89}**32. Joint Pain** ⁹⁰

- a. Evidence here is limited compared to other presentations however in older patients this should be considered as they are 33% more likely to be infected with Toxoplasma Gondii. ⁹¹

Lab Findings

There are several common findings that tend to be present when blood work is performed on the patient. The lab values and data listed here does NOT include parasite antigen / antibody presence because if an antigen / antibody test comes back positive, it is obvious that the person is infected.

⁷⁵ "Parasites Induced Skin Allergy: A Strategic Manipulation of the ..."
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3194028/>

⁷⁶ "Skin manifestations in parasite infection." <https://www.ncbi.nlm.nih.gov/pubmed/12561678>

⁷⁷ "Cercarial Dermatitis - Frequently Asked Questions (FAQs) - CDC."

<https://www.cdc.gov/parasites/swimmersitch/faqs.html>

⁷⁸ "Human Demodex Mite: The Versatile Mite of Dermatological Importance."

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3884930/>

⁷⁹ "Characterization of Demodex musculi Infestation, Associated ..."

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5557203/>

⁸⁰ "Demodex spp. as a possible aetiopathogenic factor of acne and ..." 24 Apr. 2018,

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5949547/>

⁸¹ "Parasites of Urological Importance." <https://www.karger.com/Article/PDF/137633>.

⁸² "Unexpected hosts: imaging parasitic diseases" 23 Nov. 2016,

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5265192/>

⁸³ "Unexpected hosts: imaging parasitic diseases" 23 Nov. 2016,

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5265192/>

⁸⁴ "Neurocysticercosis" <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4212415/>

⁸⁵ "Fungal and Parasitic Infections of the Eye ." <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC88956/>

⁸⁶ "Zoonotic helminths affecting the human eye ." 23 Mar. 2011,

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3071329/>

⁸⁷ "Characterization of the parasite-induced lesions in the posterior ..."

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4784073/>

⁸⁸ "Rheumatic manifestations of parasitic diseases." <https://www.ncbi.nlm.nih.gov/pubmed/11836656>

⁸⁹ "Emerging Infectious Determinants of Chronic Diseases - CDC."

<https://wwwnc.cdc.gov/eid/article/12/7/pdfs/06-0037.pdf>

⁹⁰ "Rheumatic manifestations of parasitic diseases." <https://www.ncbi.nlm.nih.gov/pubmed/11836656>

⁹¹ "Toxoplasmosis seroprevalence in rheumatoid arthritis patients" 5 Jun. 2018,

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6003687/>

Causes of False Negatives

There are many cases where healthcare providers test for a specific parasite and the test comes back negative and may not do any further testing. However, there are many reasons for a negative test result:

- Poor sample collection
- Testing too soon
- Heavy infections (if only testing stool)
 - Thus preventing natural expulsion of the parasite
- **The parasites ability to evade the immune system and still cause damage / symptoms.** ⁹²

Often CBC and differential lab values can be normal or slightly abnormal and this can indicate the possibility of a parasitic infection as often ...

parasites "infect and replicate in human monocytes, neutrophils, dendritic cells, and lymphocytes." ⁹³

Additionally low vitamins and nutrients can also be found as the parasite competes for some of the same vitamins and nutrients that the human body requires. Unfortunately, healthcare providers will often treat the deficiency assuming it is due to some genetic cause.

This is often done without reviewing ANY genetics data and without doing any testing or treatment to rule out parasites.

Abnormal Lab Values can include:

33. Low Hemoglobin ^{94 95 96}
34. Low Vitamin A ⁹⁷
35. Low Iron ⁹⁸
36. Low Zinc ⁹⁹
37. Lower than average Vitamin B12 ¹⁰⁰

⁹² "Immune defence, parasite evasion strategies and their ... - NCBI." 17 Oct. 2008, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2666695/>. Accessed 6 Aug. 2019.

⁹³ "Note: Differential Infectivity and Division of Toxoplasma gondii in ..." <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC98447/>

⁹⁴ "Hemoglobin concentration of intestinal parasites infested children in ..." 1 Sep. 2017, https://www.researchgate.net/publication/269792026_Hemoglobin_concentration_of_intestinal_parasites_infested_children_in_Okada_Edo_state_Nigeria.

⁹⁵ "Caught on Capsule: Iron-deficiency Anemia Due to Hookworm Infection." 20 Aug. 2015, [https://www.amjmed.com/article/S0002-9343\(15\)00773-1/fulltext](https://www.amjmed.com/article/S0002-9343(15)00773-1/fulltext).

⁹⁶ "Prevalence of intestinal parasitic infection and its association ..." 30 May. 2019, <https://bmcinfectdis.biomedcentral.com/articles/10.1186/s12879-019-4135-8>.

⁹⁷ "Intestinal Parasitic Infections and Micronutrient ... - Semantic Scholar." <https://pdfs.semanticscholar.org/b3b8/67a679ff2edc8aa7601445c94916e2807e31.pdf>.

⁹⁸ "Iron Deficiency Anemia: A Common and ..." <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3685880/>

⁹⁹ "Crosstalk between Zinc Status and Giardia Infection: A New ..." 3 Jun. 2015, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4488794/>

¹⁰⁰ "Vitamin B12 and folic acid in children with intestinal parasitic ..." <https://www.ncbi.nlm.nih.gov/pubmed/11999537>.

- 38. Lower than average Folic Acid ¹⁰¹
- 39. Increased Monocyte / Lymphocyte ratio => 0.40 (+- 0.02) ¹⁰²
- 40. Elevated Serum IgA ¹⁰³
- 41. Elevated Serum IgE ¹⁰⁴
- 42. Elevated Neutrophils ¹⁰⁵
- 43. Elevated Monocytes ¹⁰⁶
- 44. Elevated Eosinophils ¹⁰⁷ - this can be indicative of a burst cyst if it is accompanied by fever

Transmission

A large number of doctors are quick to dismiss parasitic infections because for a long time it was believed they did NOT really affect those in the developed world.

This is not true and the fact that we are in a developed country only slightly lessens the risk of infection. ¹⁰⁸

Common Transmission Methods and Risk Factors

In the USA common transmission risk factors include: ¹⁰⁹

- Current and past pets including: cats, dogs, rabbits, and rodents (mice / rats) ¹¹⁰
- Relative increased rate of migration from underdeveloped nations
- International travel to underdeveloped nations
 - Including travel of close friends and family
- Congenital infections passed down from mother to child. ^{111 112 113}
 - Very common in Toxoplasma Gondii
 - Risk factors for this are also commonly associated with difficulty conceiving due to the mother being infected with the parasite.
 - This puts children at risk of ocular defects or general vision difficulties.

¹⁰¹ "Serum Levels of Zinc, Copper, Vitamin B12, Folate and ..." 1 Dec. 2012, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3640781/>

¹⁰² "The Ratio of Monocytes to Lymphocytes in Peripheral Blood ..." 20 Feb. 2013, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3577721/>

¹⁰³ "Serum Levels of Zinc, Copper, Vitamin B12, Folate and ..." 1 Dec. 2012, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3640781/>

¹⁰⁴ "Serum Levels of Zinc, Copper, Vitamin B12, Folate and ..." 1 Dec. 2012, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3640781/>

¹⁰⁵ "Neutrophils Clear Bacteria Associated with Parasitic ..." <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2288648/>

¹⁰⁶ "Regulatory monocytes in helminth infections: insights from the ..." 8 Apr. 2017, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5385058/>

¹⁰⁷ "Eosinophilia ." 14 Oct. 2016, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5293177/>

¹⁰⁸ "Global change, parasite transmission and disease control ..." 13 Mar. 2017, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5352815/>

¹⁰⁹ "Parasites - Parasitic Transmission - CDC." <https://www.cdc.gov/parasites/transmission/index.html>

¹¹⁰ "Toxocariasis: Clinical Aspects, Epidemiology, Medical Ecology, and ..." <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC153144/>

¹¹¹ "Congenital Toxoplasmosis" <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4164182/>

¹¹² "Congenital toxoplasmosis: Clinical features, outcomes ..." 19 Sep. 2016, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5048697/>

¹¹³ "Congenital toxoplasmosis: eye manifestations in infants and ..." - NCBI." <https://www.ncbi.nlm.nih.gov/pubmed/12369484>. Accessed 2 Aug. 2019.

Many doctors will dismiss the idea of any infection as they claim you have to consume parasite eggs which is commonly transmitted through fecal matter. Which they view believe to be a rare occurrence.

BUT that is only partially true because:

- This assumes everyone washes their hands perfectly every time.
 - While this is a nice thought it is not based in reality especially when considering the differences from hygiene due the 10+ factors affecting hygiene habits such as: ^{114 115}
 - Age of the individual
 - Social class
 - Type of career / job
 - Improper facilities available to encourage proper hygiene, such as occurs with the use of “port-a-potty” at public events or on the job site of certain manual labor professions.
- Some parasite eggs can live on the surface of the ground, a doorknob, or under fingernails (if poor hygiene) for up to 3 weeks and in some cases up to 1-2 years. ^{116 117}
- Many parasites have multiple avenues of transmission. ^{118 119}

These survivability periods of eggs combined with the relatively poor hygiene among young children gives rise to plenty of opportunities to spread or acquire an infection of any type including parasites.

Conclusion

Please keep in mind that many of these symptoms can obviously apply to a variety of other illnesses, infections, and diseases. I hope this document is helpful in diagnosing, treating, and preventing parasitic infections in you, your family, your friends, or any patients you treat if you are a healthcare provider.

Additionally, some common symptoms of a parasitic infection may not have been included as they can be found with a cursory Google search when looking up “parasitic infections”. So please keep in mind common symptoms when talking to your healthcare provider or your patients.

**** ALL INFORMATION AND DATA PRESENTED HERE is for educational purposes only and should not be construed as medical advice. I am not a medical doctor, I am just an engineer and researcher. Please talk with your doctor before making any decisions or changes regarding your health or before pursuing any treatment options. ****

¹¹⁴ "Factors influencing hand washing behaviour in primary schools - NCBI." 22 May. 2012, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3797645/>. Accessed 6 Aug. 2019.

¹¹⁵ "The Determinants of Reported Personal and Household ... - NCBI." 19 Aug. 2016, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4991820/>. Accessed 6 Aug. 2019.

¹¹⁶ "Global change, parasite transmission and disease control ..." 13 Mar. 2017, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5352815/>

¹¹⁷ "Outside-Host Growth of Pathogens Attenuates Epidemiological ..." 30 Nov. 2012, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3511454/>

¹¹⁸ "Enteric Nematodes of Humans - Medical Microbiology - NCBI Bookshelf." <https://www.ncbi.nlm.nih.gov/books/NBK8261/>

¹¹⁹ "Parasite transmission modes and the evolution of virulence. ." <https://www.ncbi.nlm.nih.gov/pubmed/11831655>.