

Early toilets reveal dysentery in Old Testament Jerusalem

May 25 2023



The toilet seat taken from the House of Ahiel, excavated in the Old City of Jerusalem. A domestic building made up of seven rooms, it would have housed

an upper-class family at the time. Date of construction is hard to pin down, with some placing it around the 8th century BCE. Credit: F. Vukasavovic

A new analysis of ancient feces taken from two Jerusalem latrines dating back to the biblical Kingdom of Judah has uncovered traces of a single-celled microorganism *Giardia duodenalis*—a common cause of debilitating diarrhea in humans.

A research team led by the University of Cambridge say it is the oldest example we have of this diarrhea-causing parasite infecting humans anywhere on the planet. The study is published in the journal *Parasitology*.

"The fact that these parasites were present in sediment from two Iron Age Jerusalem cesspits suggests that [dysentery](#) was endemic in the Kingdom of Judah," said study lead author Dr. Piers Mitchell from Cambridge's Department of Archaeology.

"Dysentery is a term that describes intestinal infectious diseases caused by parasites and bacteria that trigger diarrhea, abdominal cramps, fever and dehydration. It can be fatal, particularly for young children."

"Dysentery is spread by feces contaminating drinking water or food, and we suspected it could have been a big problem in early cities of the ancient Near East due to overcrowding, heat and flies, and limited water available in the summer," said Mitchell.

The [fecal samples](#) came from the sediment underneath [toilets](#) found in two building complexes excavated to the south of the Old City, which date back to the 7th century BCE when Jerusalem was a capital of Judah.

During this time, Judah was a vassal state under the control of the Assyrian Empire, which at its height stretched from the Levant to the Persian Gulf, incorporating much of modern-day Iran and Iraq. Jerusalem would have been a flourishing political and religious hub estimated to have had between 8,000 and 25,000 residents.

Both toilets had carved stone seats almost identical in design: a shallow curved surface for sitting, with a large central hole for defecation and an adjacent hole at the front for male urination. "Toilets with cesspits from this time are relatively rare and were usually made only for the elite," said Mitchell.

One was from a lavishly decorated estate at Armon ha-Natziv, surrounded by an ornamental garden. The site, excavated in 2019, probably dates from the days of King Manasseh, a client king for the Assyrians who ruled for fifty years in the mid-7th century.



The toilet seat from the estate at Armon ha-Natziv. The site, excavated in 2019, probably dates from the days of King Manasseh, a client king for the Assyrians who ruled for fifty years in the mid-7th century. Credit: Ya'akov Billig

The site of the other toilet, known as the House of Ahiel, was a domestic building made up of seven rooms, housing an upper-class family at the time. Date of construction is hard to pin down, with some placing it around the 8th century BCE.

However, its destruction is safely dated to 586 BCE, when Babylonian ruler Nebuchadnezzar II brutally sacked Jerusalem for a second time after its citizens refused to pay their agreed tribute, bringing to an end the Kingdom of Judah.

Ancient medical texts from Mesopotamia during the first and second millennium BCE describe diarrhea affecting the populations of what is now the Near and Middle East. One example reads: "If a person eats bread and drinks beer and subsequently his stomach is colicky, he has cramps and has a flowing of the bowels, setu has gotten him."

The cuneiform word often used in these texts to describe diarrhea was *sà si-sá*. Some texts also included recommended incantations for reciting to increase the chances of recovery.

"These early written sources do not provide causes of diarrhea, but they encourage us to apply modern techniques to investigate which pathogens might have been involved," said Mitchell. "We know for sure that *Giardia* was one of those infections responsible."

The team investigated the two-and-a-half-thousand year-old decomposed biblical period feces by applying a bio-molecular technique called "ELISA," in which antibodies bind onto the proteins uniquely produced by particular species of single-celled organisms.

"Unlike the eggs of other intestinal parasites, the protozoa that cause dysentery are fragile and extremely hard to detect in ancient samples through microscopes without using antibodies," said co-author and

Cambridge Ph.D. candidate Tianyi Wang.

The researchers tested for Entamoeba, Giardia and Cryptosporidium: three parasitic microorganisms that are among the most common causes of [diarrhea](#) in humans, and behind outbreaks of dysentery. Tests for Entamoeba and Cryptosporidium were negative, but those for Giardia were repeatedly positive.

Previous research has dated traces of the Entamoeba parasite, which also causes dysentery, as far back as Neolithic Greece over 4,000 years ago. Previous work has also shown that users of ancient Judean toilets were infected by other [intestinal parasites](#) including whipworm, tapeworm and pinworm.

This research was undertaken through a collaboration between the University of Cambridge, Tel Aviv University, and the Israel Antiquities Authority.

More information: Giardia duodenalis and dysentery in Iron Age Jerusalem (7th–6th century BCE), *Parasitology* (2023). [DOI: 10.1017/S0031182023000410](#)

Provided by University of Cambridge

Citation: Early toilets reveal dysentery in Old Testament Jerusalem (2023, May 25) retrieved 4 May 2024 from <https://phys.org/news/2023-05-early-toilets-reveal-dysentery-testament.html>

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