

First case of community acquired giardiasis in Nuuk, Greenland

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ABSTRACT

We report a case of community acquired giardiasis, in Nuuk, Greenland. Likely source of infection being consumption of untreated water from a local reservoir, alternatively through contact with sewage. *Giardia* is widespread worldwide but has not commonly been considered a cause of gastrointestinal distress in patients in Greenland, without relevant travel history. This may be due to under diagnosis, or historically low prevalence of *Giardia* in the region. Climate change with increasing temperatures, growing tourism and pet travel may influence the presence of *Giardia* in the region. This case highlights the need to include giardiasis as a differential diagnosis in patients presenting with suspected infectious gastroenteritis in Greenland.

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Giardiasis is caused by the protozoan parasite *Giardia lamblia* (syn. *Giardia duodenalis* and *Giardia intestinalis*). It is faecal-orally transmitted, often by ingestion of contaminated water or food, or by person-to-person contact. *Giardia* cysts are moderately resistant to inactivation by various disinfectants and environmentally stable. Worldwide, giardiasis is the most common protozoal intestinal infection in humans, and an important cause of diarrhoea not only in humans but also in a wide range of animals including pets, livestock, and wildlife. The parasite is prevalent in areas with poor sanitation and limited water treatment facilities, and the infection is frequently associated with drinking untreated surface water, poor hygiene in daycare facilities and ingestion of contaminated fruits and vegetables [1].

Based on variation in host specificity and genetics, eight morphologically identical assemblages (A to H) are recognised within the *G. lamblia* species complex. Of these, assemblages A and B are considered potentially zoonotic and can be further subtyped into the sub-assemblages AI-AIV and BI-BIV of which only some are zoonotic. The use of molecular diagnostics within recent years suggests that person-to-person transmission seems more common than previously thought [2].

Giardia infection produces a wide range of clinical outcomes, ranging from severe stomach cramps, diarrhoea, and urticaria to post infectious irritable bowel syndrome, but many infections are asymptomatic.

Giardiasis is associated with stunted growth in children living in middle and low-income countries [3].

Giardia is prevalent in the Arctic, including Alaska and Canada, both in humans and in wildlife [4], but little is known about the prevalence of the parasite in Nuuk, the capital of Greenland, as well as in the rest of the country. Until recently, stool samples from patients presenting with suspected infectious gastroenteritis in Nuuk were not routinely tested for *Giardia*.

This case report describes the first documented community acquired case of giardiasis in Nuuk. It is currently unknown if the absence of previous cases is due to lacking diagnosis, or historically low prevalence of *Giardia* in the area.

Nuuk is located in Southwest Greenland (Figure 1) and has a low arctic ecosystem characterised by a mean temperature of 7–12°C in July, low vegetation cover and partially ice free waters year round [5].

Nuuk is an urban city with a population of approximately 18,000. The area surrounding Nuuk has many hiking, skiing, and snow-mobiling routes. The water in creeks and streams is generally considered safe to drink without prior filtration.

Most homes in the city have running water, although some still use water tanks for storage. The primary drinking water supply is surface water, which is led from a reservoir to the water treatment facilities. Here the water is filtered through a sand filter, chlorinated, and treated with ultraviolet light. Water samples from

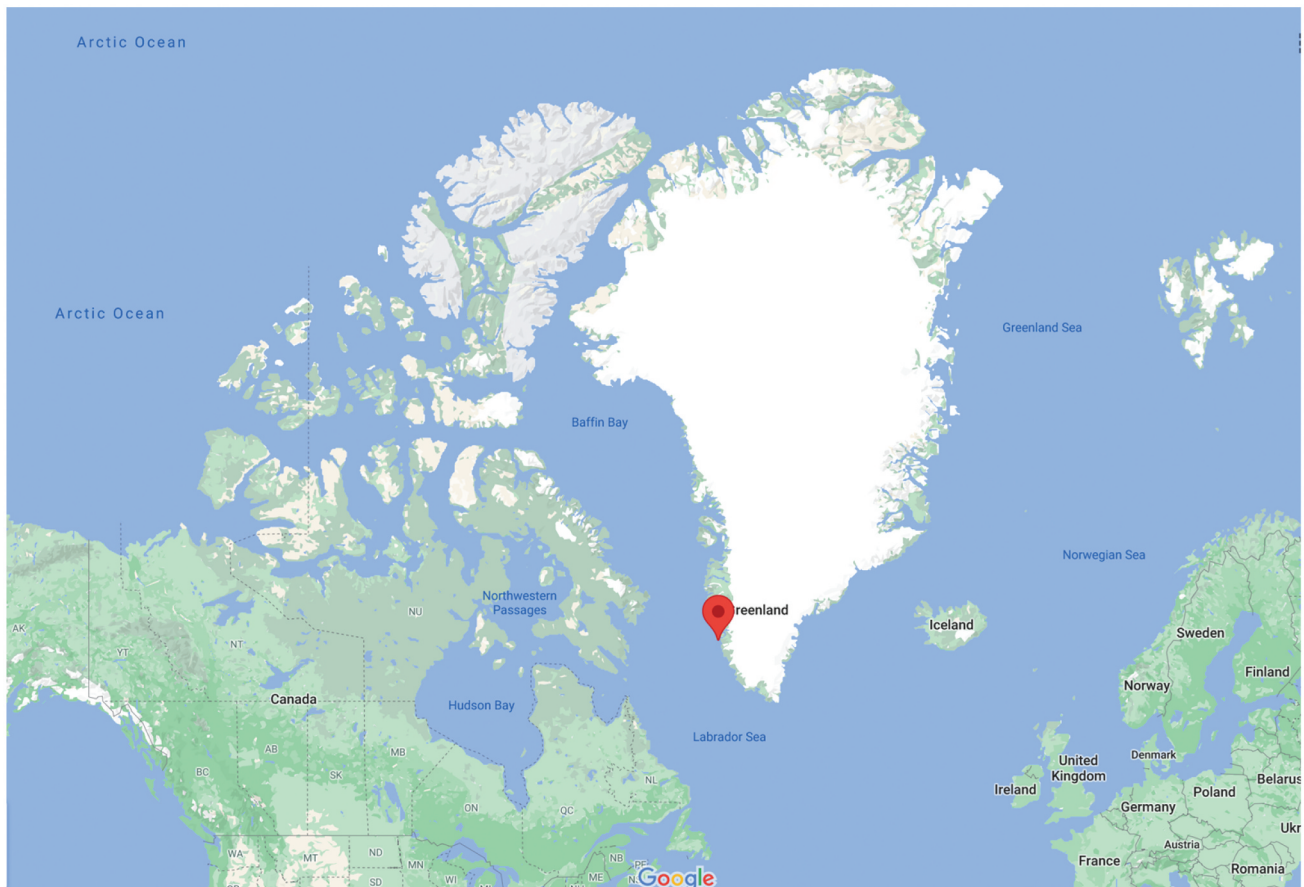


Figure 1. Map of Greenland, and surroundings. Nuuk is marked with the thumbnail [26].

18 sites across the city are tested for various contaminants at least four times a year to reflect seasonal variations, according to guidelines set out by the Greenlandic government. The water samples are tested for chemical and microbiological organisms, including *Clostridium perfringens*, *Escherichia coli* and other coliform bacteria, but not for *Giardia lamblia* [6].

The patient

In December 2020, the patient, a 38-year-old male, of Greenlandic descent, presented himself at Dronning Ingrid's Health Center, Nuuk, with complaints of abdominal pain, general fatigue and 3–4 loose, grey, non-bloody bowel movements a day. The symptoms had lasted the past month.

Upon physical examination he was in good general health, the abdomen was soft, without palpable masses, no hepatosplenomegaly and without guarding or point tenderness.

The patient had primarily resided in Greenland except for a seven month period in Denmark in 2018. He had last travelled to Denmark in December 2019, for a short vacation. No other

pertinent travel history. The patient was occupied as a plumber in Nuuk. When asked further about possible exposures, the patient admitted to drinking untreated water approximately a month prior to presenting with symptoms. The water was from a small waterfall, that drains from a larger reservoir/lake. This reservoir is located close to Nuuk and is a popular recreational area, commonly used for hiking, dog walking etc.

Bloodwork showed an elevated leukocyte count of $17.8 \times 10^9/L$ (normal $3.0\text{--}8.5 \times 10^9/L$), with a neutrophile predominance of 0,81 (normal 0.45–0.75). Thrombocytes were elevated to $482 \times 10^9/L$ (normal $135\text{--}400 \times 10^9/L$), whereas the lymphocyte differential count was slightly decreased to 0,12 (normal 0.15–0.50). C-reactive protein (CRP), haemoglobin, and differential counts of eosinophils, basophils, and monocytes were within the normal ranges. Faecal Calprotectin was elevated with levels between 50 and 200 microg/g.

As an incidental finding the bloodwork revealed lactose-intolerance, corresponding to the MCM6 gene. This is common in Inuit people, and specifically in the Greenlandic population [7,8].

Coprological samples were analysed for gastrointestinal (GI) pathogens using the BioFire FilmArray System (BioFire Diagnostics, Salt Lake City, UT, USA), a PCR-based system with a specific GI panel that checks for 22 bacterial, viral and parasitic causes of infectious gastroenteritis. This system has been found to have a sensitivity and specificity of 100 and 99,5, respectively, for *Giardia* [9]. *Giardia* was detected in our patient's stool sample, the remaining 21 pathogens tested by the Biofire FilmArray system were negative.

The patient was treated with metronidazole 500 mg, twice daily for 7 days. The patient experienced a marked improvement within 5 days of starting treatment and was without symptoms when contacted via telephone a month after presenting at the clinic.

The BioFire FilmArray system was acquired by the hospital laboratory in December 2019. Prior to that, the samples were analysed at Statens Serum Institute (SSI) in Denmark. Stool samples from areas outside of Nuuk are still submitted to SSI for diagnostic analyses. In 2020 a total of 342 stool samples from patients with various clinical symptoms were analysed using the BioFire FilmArray System in Nuuk, with this case being the only one that tested positive for *Giardia*.

Discussion

Here, we describe the first human case of giardiasis in Greenland. With no recent travel history, our patient most likely contracted the infection in Nuuk. The patient may have contracted giardiasis via several probable sources. Approximately 1 month prior to presenting with symptoms, and shortly before symptom debut, he drank unfiltered water from a waterfall at the base of a large water reservoir, which may have been contaminated by faeces from dogs, polar foxes, or hikers in the area. Furthermore, the patient's occupation as a plumber may have put him in contact with sewage, that might contain *Giardia* [10].

Domestic dogs can enter Greenland, but only south of the Arctic circle, outside the "sled-dog district". Imported dogs must be vaccinated against rabies and parvovirus and screened by a veterinarian prior to entering Greenland. However, anti-parasitic treatment or testing is not requested [11]. *Giardia* infections are common in dogs, particularly in puppies, and they may harbour zoonotic subtypes suggesting the possibility of interspecies transmission[12]. Yet, the prevalence of giardiasis in dogs and other pets in Greenland is unknown, and the veterinarians do not routinely test for *Giardia*. Regarding wildlife, a study from 1995 to 1996 found a *Giardia* prevalence of 20% in ringed seals in the Western Arctic [4], and *Giardia lamblia*

assemblage A has been found in Muskoxen across the Arctic [13,14].

While these sources all are possible in Nuuk, giardiasis has not previously been considered a common cause of infectious gastroenteritis in the area. As this case illustrates, this may be changing. The polar environment in general has large seasonal variations. The extreme cold during winters offers some protection against parasites, reducing or preventing transmission [15]. A Norwegian study from 2004 found that *Giardia* cysts in soil are unable to survive the freeze-thaw cycles that occur during winter [16].

Climate change and higher temperatures in the Arctic may shift the distribution of potentially climate-sensitive zoonotic pathogens, including *Giardia*, in the circumpolar region [17]. This may be correlated to migration of host animals but also due to raising temperature and precipitation, which may increase survivability of *Giardia*. Furthermore, more frequent storm events could increase water turbidity and risk of contamination of water supplies by runoff[18].

Giardia is commonly found in surface water throughout the world, and across varying climates, including the Arctic [19–22]. Consequently, there is reason to suspect that *Giardia* may also be present in the water reservoirs in Nuuk. Thus, *Giardia* should be taken into consideration in the planning of future drinking water treatment, and monitoring of the drinking water quality for *Giardia* is warranted.

Traditionally, giardiasis has only been suspected in patients with a history of recent travel, but several studies have documented that giardiasis is underreported and underdiagnosed in patients with no pertinent travel history, presenting with suspected infectious gastroenteritis [23]. Furthermore, food-borne infections are also underreported[24]. The Biofire FilmArray system used in Nuuk mitigates the problem to some extent, as it automatically tests all stool samples for 22 common pathogens including *Giardia*. However, the BioFire system is not used throughout Greenland, as mentioned above, and stool samples sent to SSI from the coastal towns and villages are not automatically tested for *Giardia*. This may lead to underdiagnosis of giardiasis in patients presenting with relevant symptoms, but no travel history.

During the preparation of this case, three additional cases of giardiasis were diagnosed in Nuuk. Currently, the source of infection has not been investigated in these cases and would require further testing as well as the use of more discriminatory methods such as e.g., multilocus micro-satellite sequencing [25]. Nevertheless, the detection of these cases signifies the importance of

the diagnostic routines. Giardiasis is easily treatable but must be diagnosed first. This case report highlights the value of including giardiasis as possible cause of non-bloody diarrhoea in patients in Nuuk.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Consent of the patient

This case report is published with the full consent of the patient.

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