

BRIEF REPORT

An Assessment of Coliform Bacteria in Water Sources Near Appalachian Trail Shelters Within the Great Smoky Mountains National Park

Brian C. Reed, MD; Mark S. Rasnake, MD

From the Department of Medicine, University of Tennessee Graduate School of Medicine, Knoxville, TN.

Objective.—Hikers and campers are exposed to risks while in the wilderness. One of these risks is the possibility of contracting an illness, including infectious diarrhea. This project tested for coliform bacteria in water samples taken near popular Appalachian Trail shelters.

Methods.—Water was collected from access points within the Great Smoky Mountains National Park. Samples were collected in sterile bottles and inoculated on a commercially available coliform detection kit for quantitative determination of total coliform and *Escherichia coli* counts.

Results.—Water samples were taken during summer and fall seasons. During summer, 7 of 10 samples were positive for coliform bacteria and 6 of those 7 for *E coli*. The most probable number (MPN) of colony-forming units (CFU) for coliform bacteria ranged from 0 to 489 CFU/100 mL, with the MPN for *E coli* varying from 0 to 123 CFU/100 mL. These data differed from the fall collection, revealing 3 of 7 samples positive for coliform bacteria and 1 of those 3 for *E coli*. The MPN of CFU for coliform bacteria in fall samples varied from 0 to 119 CFU/100 mL and 0 to 5 to CFU/100 mL for *E coli*.

Conclusions.—Environmental Protection Agency drinking water standards set the standard of 0 CFU/100 mL to be considered safe. This analysis of water samples along the Appalachian Trail emphasizes that the majority of water access points require treatment during the summer season. Coliform burden was not as high through the fall months. These data suggest one infectious disease risk for wilderness travelers.

Key words: water, hiking, coliform, bacteria, *E coli*

Introduction

Many Americans enjoy spending time outdoors. The National Survey on Recreation and the Environment estimated that during the 12 months before the survey, 24.5 million people age 16 or older backpacked once or more.¹ The number of those enjoying hiking within the United States is increasing.² One of the most popular hiking trails in the nation is the Appalachian Trail, especially the segment within Great Smoky Mountains National Park (GSMNP). In 2011, the US Department of Agriculture deemed the use of the entire Appalachian Trail in 2007 was 1,948,701 visitors.³

Hikers generally understand the risks of venturing into the wilderness, including potential musculoskeletal, skin, and gastrointestinal problems. Few studies regarding health risks and the overall healthcare of hikers have been conducted.² With the growing public health implication, investigating the water quality of Appalachian Trail shelters is of interest.

Methods

To determine the current infectious risk of water along the Appalachian Trail in the GSMNP, a total of 10 evenly distributed shelters were selected. Appalachian Trail shelters may provide a piped water source from a creek or spring similar to the one at Davenport Gap in the [Figure](#). During May and June (summer) and again in October and November (fall) of 2012, samples were collected directly into 500-mL sterile bottles without disturbing the surroundings (National Park Service

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Corresponding author: Brian C. Reed, MD, Methodist Medical Center of Oak Ridge, 990 Oak Ridge Turnpike, Oak Ridge, TN 37831-2529 (e-mail: brian_reed@teamhealth.com).



Figure. Water source at Davenport Gap.

Approval GRSM-2012-SCI-1112). The water was allowed to pour directly into the bottle without touching the pipe, and the bottle was not dunked within the collection of water under the source. All of the bottles were labeled and then transported at ambient temperature to the microbiology laboratory at the University of Tennessee Medical Center in less than 4 hours.

On arrival at the laboratory, the water was poured directly onto commercially available culture plates that specifically select for coliform bacteria (Coliplate, Bluewater Biosciences, Inc, Mississauga, Ontario, Canada). Enough sample water was poured over the culture plate to fill every well, with some unmeasured water remaining. These plates were incubated for 24 hours at 37°C. After incubation, the number of wells seen under visible

and ultraviolet (UV) light was counted. These media allowed detection of coliform bacteria based on a green to blue coloration within the wells under visible light. The addition of a UV light source provided identification of *Escherichia coli* among the wells that fluoresce.

Results

Seven of 10 samples were positive for coliform bacteria, and 6 of those 7 were also positive for *E coli* during summer months. The results for fall months were 3 of 7 samples positive for coliform bacteria and 1 of those 3 for *E coli*. Once the number of wells seen under visible and UV light was observed, correlation with a table provided by Bluewater Biosciences allowed estimation of the most probable number (MPN) of colony-forming units (CFU) per 100 mL of water. There was a wide variation between samples during the summer months, with MPN ranging from 0 to 489 CFU/100 mL, and varying from 0 to 123 CFU/100 mL for *E coli*. The MPN in fall months varied from 0 to 119 CFU/100 mL and 0 to 5 to CFU/100 mL for *E coli*. The Table provides the results for each shelter tested.

Discussion

A large and increasing number of Americans enjoy spending time in the outdoors.² Hikers are exposed to health dangers while in the wilderness. Greater exposure to untreated, contaminated water increases a hiker's risk of acquiring a diarrheal illness. The prevalence of undifferentiated gastrointestinal illness among hikers of the Long Trail in Vermont from 1986 through 1998 was 7% (11 of 155 persons).⁴ A study on medical problems during expedition activities at various National Outdoor

Table. Results from summer (May/June) and fall (Oct/Nov) collection

<i>Shelter name</i>	<i>Mileage^a</i>	<i>MPN of coliform in summer (CFU/100 mL)</i>	<i>MPN of E. coli in summer (CFU/100 mL)</i>	<i>MPN of coliform in fall (CFU/100 mL)</i>	<i>MPN of E. coli in fall (CFU/100 mL)</i>
Mt Collins	200.2	0	0	0	0
Derrick Knob	186.7	0	0	—	—
Silers Bald	192.2	339	123	—	—
Double Springs	193.9	19	0	0	0
Tricorner	220.3	182	19	—	—
Cosby Knob	228	0	0	0	0
Davenport	235.1	271	33	119	0
Russell Field	177.5	317	3	83	0
Spence Field	180.4	489	5	69	5
Icewater Spring	207.7	59	13	0	0

CFU, colony-forming units; MPN, most probable number.

^a Mileage from Springer, GA.

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