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Washing Hands in Hot Water Wastes Energy, Study Says

It doesn't kill germs better than cooler water, but turning tap temperatures high, the U.S. burns carbon equal to the emissions of Barbados.

People typically wash their hands seven times a day in the United States, but they do it at a far higher temperature than is necessary to kill germs, a new study says. The energy waste is equivalent to the fuel use of a small country.

PHOTOGRAPH BY GAETAN BALLY/KEYSTONE/CORBIS

Amanda R. Carrico, a research assistant professor at the Vanderbilt Institute for Energy and Environment in Tennessee, told National Geographic that hand washing is often "a case where people act in ways that they think are in their best interest, but they in fact have inaccurate beliefs or outdated perceptions."

Carrico said, "It's certainly true that heat kills bacteria, but if you were going to use hot water to kill them it would have to be way too hot for you to tolerate."

She explained that boiling water, 212°F (99.98°C), is sometimes used to kill germs-for example, to disinfect drinking water that might be contaminated with pathogens. But "hot" water for hand washing is generally within 104°F to 131°F (40°C to 55°C.) At the high end of that range, heat could kill some pathogens, but the sustained contact that would be required would scald the skin.

Carrico said that after a review of the scientific literature, her team found "no evidence that using hot water that a person could stand would have any benefit in killing bacteria." Even water as cold as 40°F (4.4°C) appeared to reduce bacteria as well as hotter water, if hands were scrubbed, rinsed, and dried properly.

In fact, she noted that hot water can often have an adverse effect on hygiene. "Warmer water can irritate the skin and affect the protective layer on the outside, which can cause it to be less resistant to bacteria," said Carrico.

Using hot water to wash hands is therefore unnecessary, as well as wasteful, Carrico said, particularly when it comes to the environment. According to her research, people use warm or hot water 64 percent of the time when they wash their hands. Using that number, Carrico's team calculated a significant impact on the planet.

"Although the choice of water temperature during a single hand wash may appear trivial, when multiplied by the nearly 800 billion hand washes performed by Americans each year, this practice results in more than 6 million metric tons of CO2 equivalent emissions annually," she said.

That's roughly equal to the emissions of two coal-fired power plants, or 1,250,000 passenger vehicles, over the course of a year. It's higher than the greenhouse gas emissions of small countries like El Salvador or Armenia, and is about equivalent to the emissions of Barbados. If all U.S. citizens washed their

hands in cooler water, it would be like eliminating the energy-related carbon emissions of 299,700 U.S. homes, or the total annual emissions from the U.S. zinc or lead industries.

Gauging Hand Washing

Carrico said she decided to look at hand washing after searching for easy ways to reduce climate change emissions. "Sometimes simply educating people can go a long way toward changing behavior and reducing emissions," she said.

By zeroing in on hot water, she focused on an important source of emissions and potential waste. After heating and cooling, water heating is typically the largest energy user in the home because it is necessary for so many domestic activities, says the American Council for an Energy-Efficient Economy (ACEEE). In both the United States and European Union, hot water heating accounts for 15 percent of home energy use. But homeowners often keep their hot water heaters turned up to a temperature far higher than is necessary for most household tasks, which efficiency experts says is no more than 120°F (48.9° C.) Every 10°F (5.6° C) reduction in water temperature will generally save 3 to 5 percent on water heating costs, says ACEEE. (How much can you save by switching lighting at repeated seven times a day among residents of the United States.

So Carrico teamed up with Micajah Spoden, a research analyst at Vanderbilt; Michael Vandenbergh, a professor of law and director of the Climate Chan e Research Network at

Vanderbilt; and Kenneth A. Wallston, a professor of psychology at the Vanderbilt School of Nursing. The researchers surveyed 510 American adults from around the country, and asked them questions about their hand washing behaviors and perceptions. Questions included how often they wash their hands, for how long, how hot the water is, and so on.

The researchers found that close to 70 percent of respondents said they believe that using hot water is more effective than warm, room temperature, or cold water, despite a lack of evidence backing that up, said Carrico. Her study noted research that showed a "strong cognitive connection" between water temperature and hygiene in both the United States and Western Europe, compared to other countries, like Japan, where hot water is associated more with comfort than with health.

The researchers published their results in the July 2013 issue of International Journal of Consumer Studies. They recommended washing with water that is at a "comfortable" temperature, which they noted may be warmer in cold months and cooler in hot ones.

Official Recommendations

In their official guidelines on hand washing, the Centers for Disease Control and Prevention and the World Health Organization don't actually specify a water temperature. The agencies do recommend using soap and water and scrubbing vigorously, for at least 20 seconds. (The CDC has even

suggested singing the song "Happy Birthday" to yourself in your head, to mark the time.) When you are done, dry your hands thoroughly, the agencies say.

The point, said Carrico, is to wash well and wash often, not to worry about the water temperature.

A problem, however, is that some public health organizations still recommend elevated water temperature. For example, the authors noted, the Food Code of the U.S. Food and Drug Administration (FDA), a model meant to guide the local authorities who enforce health standards in restaurants, recommends that hand-washing sinks be equipped to provide water at a temperature of at least 100°F (38°C.)

A doctor with the Florida-based American Association of Public Health Physicians, who asked not to be named because she isn't authorized to speak to the media, told National Geographic that the association does not have any guidelines home? Try the Light Bulb Savings Calculator.)

To address this issue, Carrico started looking at common activities like washing clothes and dishes. A 2011 study by Norwegian researchers found that washing clothes at 86°F (30°C) cleans clothing just as effectively as the more commonly used 104°F (40°C), uses 30 percent less energy, and reduces wear and tear on the garments.

But little study had been done on the energy and emissions impact of hand washing, an activity typically

on water temperature when it comes to washing hands. She said she is not surprised by the results of the Vanderbilt study, however. She added that, when it comes to food preparation, the FDA has also recommended that no bare skin touch food, regardless of hand washing, since no amount of scrubbing can eliminate all traces of norovirus and hepatitis-A.

Todd Sack, a Florida physician with the Council for Healthy Floridians of the Florida Medical Association, told National Geographic that he routinely tells doctors that they don't need to use hot water to wash their hands. Sack provides this information on his group's website and in seminars on how the health-care industry can go greener and save money.

"You don't need hot water, you need soap, water, and friction," said Sack. He added that the Escambia County Health Department in Pensacola, Florida, decided to turn off the hot water heaters in its five clinics two years ago, after a review of the literature provided no evidence that hot water was better.

"They are saving 2,500 dollars a year per clinic now, which they use to buy recycled paper, a Prius, and other environmental projects," he said. "They have full medical clinics, including an AIDS clinic, so they are serious about this. They have no hot water."

When asked if he has encountered much resistance from the medical community to turning down the water temperature, Sack said he hasn't encountered any pushback per se, just inertia. "It's hard to get doctors to talk about anything," he said.

Carrico admitted that "some people may have a negative reaction" to changing their hygiene routine. But, she added, "With any change you are going to have some small backlash effect, but most often it is not going to make up for the benefits that come from broader public education."

She added, "While behaviors like hand washing don't account for a large source of emissions, they do play a role in meeting emissions targets and they are one more example of something people can do."