Pioneering Study Links Testicular Cancer Among Military Personnel to 'Forever Chemicals'

Study shows link between testicular cancer and perfluoroalkyl and polyfluoroalkyl substances, or PFAS, in firefighting foam.

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Gary Flook served in the Air Force for 37 years, as a firefighter at the now-closed Chanute Air Force Base in Illinois and the former Grissom Air Force Base in Indiana, where he regularly trained with aqueous film forming foam, or AFFF — a frothy white fire retardant that is highly effective but now known to be toxic.

Flook volunteered at his local fire department, where he also used the foam, unaware of the health risks it posed. In 2000, at age 45, he received devastating news: He had testicular cancer, which would require an orchiectomy followed by chemotherapy.

Hundreds of lawsuits, including one by Flook, have been filed against companies that make firefighting products and the chemicals used in them.

And multiple studies show that firefighters, both military and civilian, have been diagnosed with testicular cancer at higher rates than people in most other occupations, often pointing to the presence of perfluoroalkyl and polyfluoroalkyl substances, or PFAS, in the foam.

But the link between PFAS and testicular cancer among service members was never directly proven — until now.

A new federal study for the first time shows a direct association between PFOS, a PFAS chemical, found in the blood of thousands of military personnel and testicular cancer.

Using banked blood drawn from Air Force servicemen, researchers at the National Cancer Institute and Uniformed Services University of the Health Sciences found strong evidence that airmen who were firefighters had elevated levels of PFAS in their bloodstreams and weaker evidence for those who lived on installations with high levels of PFAS in the drinking water. And the airmen with testicular cancer had higher serum levels of PFOS than those who had not been diagnosed with cancer, said study co-author Mark Purdue, a senior investigator at NCI.

“To my knowledge,” Purdue said, “this is the first study to measure PFAS levels in the U.S. military population and to investigate associations with a cancer endpoint in this population, so that brings new evidence to the table.”

In a commentary in the journal Environmental Health Perspectives, Kyle Steenland, a professor at Emory University’s Rollins School of Public Health, said the research “provides a valuable contribution to the literature,” which he described as “rather sparse” in demonstrating a link between PFAS and testicular cancer.

More studies are needed, he said, “as is always the case for environmental chemicals.”

Not ‘Just Soap and Water’

Old stocks of AFFF that contained PFOS were replaced in the past few decades by foam that contains newer-generation PFAS, which now also are known to be toxic. By congressional order, the Department of Defense must stop using all PFAS-containing foams by October 2024, though it can keep buying them until this October. That’s decades after the military first documented the chemicals’ potential health concerns.

A DoD study in 1974 found that PFAS was fatal to fish. By 1983, an Air Force technical report showed its deadly effects on mice.

But given its effectiveness in fighting extremely hot fires, like aircraft crashes and shipboard blazes, the Defense Department still uses it in operations. Rarely, if ever, had the military warned of its dangers, according to Kevin Ferrara, a retired Air Force firefighter, as well as several military firefighters who contacted KFF Health News.

“We were told that it was just soap and water, completely harmless,” Ferrara said. “We were completely slathered in the foam — hands, mouth, eyes. It looked just like if you were going to fill up your sink with dish soap.”

Photos released by the Defense Visual Information Distribution Service in 2013 show personnel working in the foam without protective gear. The description calls the “small sea of fire retardant foam” at Travis Air Force Base in California “non-hazardous” and “similar to soap.”

“No people or aircraft were harmed in the incident,” it reads.

There are thousands of PFAS chemicals, invented in the 1940s to ward off stains and prevent sticking in industrial and household goods. Along with foam used for decades by firefighters and the military, the chemicals are in makeup, nonstick cookware, water-repellent clothing, rugs, food wrappers, and a myriad of other consumer goods.

Known as “forever chemicals,” they do not break down in the environment and do accumulate in the human body. Researchers estimate that nearly all Americans have PFAS in their blood, exposed primarily by groundwater, drinking water, soil, and foods. A recent U.S. Geological Survey

study estimated that at least 45% of U.S. tap water has at least one type of forever chemical from both private wells and public water supplies.

Health and environmental concerns associated with the chemicals have spurred a cascade of lawsuits, plus state and federal legislation that targets the manufacturers and sellers of PFAS-laden products. Gary Flook is suing 3M and associated companies that manufactured PFAS and the firefighting foam, including DuPont and Kidde-Fenwal.

Congress has prodded the Department of Defense to clean up military sites and take related health concerns more seriously, funding site inspections for PFAS and mandating blood testing for military firefighters. Advocates argue those actions are not enough.

“How long has [DoD] spent on this issue without any real results except for putting some filters on drinking water?” said Jared Hayes, a senior policy analyst at the Environmental Working Group. “When it comes to cleaning up the problem, we are in the same place we were years ago.”

On a Mission to Get Screening

The Department of Veterans Affairs does not recommend blood testing for PFAS, stating on its website that “blood tests cannot be linked to current or future health conditions or guide medical treatment decisions.”

But that could change soon. Rep. Dan Kildee (D-Mich.), co-chair of the congressional PFAS Task Force, in June introduced the Veterans Exposed to Toxic PFAS Act, which would require the VA to treat conditions linked to exposure and provide disability benefits for those affected, including for testicular cancer.

“The last thing [veterans] and their families need to go through is to fight with VA to get access to benefits we promised them when they put that uniform on,” Kildee said.

Evidence is strong that exposure to PFAS is associated with health effects such as decreased response to vaccines, kidney cancer, and low birth weight, according to an expansive, federally funded report published last year by the National Academies of Sciences, Engineering, and Medicine. The nonprofit institution recommended blood testing for communities with high exposure to PFAS, followed by health screenings for those above certain levels.

It also said that, based on limited evidence, there is “moderate confidence” of an association between exposure and thyroid dysfunction, preeclampsia in pregnant women, and breast and testicular cancers.

The new study of Air Force servicemen published July 17 goes further, linking PFAS exposure directly to testicular germ cell tumors, which make up roughly 95% of testicular cancer cases.

Testicular cancer is the most commonly diagnosed cancer among young adult men. It is also the type of cancer diagnosed at the highest rate among active military personnel, most of whom are male, ages 18 to 40, and in peak physical condition.

That age distribution and knowing AFFF was a source of PFAS contamination drove Purdue and USUHS researcher Jennifer Rusiecki to investigate a possible connection.

Using samples from the Department of Defense Serum Repository, a biobank of more than 62 million blood serum specimens from service members, the researchers examined samples from 530 troops who later developed testicular cancer and those of 530 members of a control group. The blood had been collected between 1988 and 2017.

A second sampling collected four years after the first samples were taken showed the higher PFOS concentrations positively associated with testicular cancer.

Ferrara does not have testicular cancer, though he does have other health concerns he attributes to PFAS, and he worries for himself and his fellow firefighters. He recalled working at Air Combat Command headquarters at Joint Base Langley-Eustis in Virginia in the early 2010s and seeing emails mentioning two types of PFAS chemicals: PFOS and perfluorooctanoic acid, or PFOA.

But employees on the base remained largely unfamiliar with the jumble of acronyms, Ferrara said.

Even as the evidence grew that the chemicals in AFFF were toxic, “we were still led to believe that it’s perfectly safe,” Ferrara said. “They kept putting out vague and cryptic messages, citing environmental concerns.”

When Ferrara was working a desk job at Air Combat Command and no longer fighting fires, his exposure likely continued: Joint Base Langley-Eustis is among the top five most PFAS-contaminated military sites, according to the EWG, with groundwater at the former Langley Air Force Base registering 2.2 million parts per trillion for PFOS and PFOA.

According to the EPA, just 40 parts per trillion would “warrant further attention,” such as testing and amelioration.

The Defense Department did not provide comment on the new study.

Air Force officials told KFF Health News that the service has swapped products and no longer allows uncontrolled discharges of firefighting foam for maintenance, testing, or training.

“The Department of the Air Force has replaced Aqueous Film Forming Foam, which contained PFAS, with a foam that meets Environmental Protection Agency recommendations at all installations,” the Air Force said in a statement provided to KFF Health News.

Both older-generation forever chemicals are no longer made in the U.S. 3M, the main manufacturer of PFOS, agreed to start phasing it out in 2000. In June, the industrial giant announced it would pay at least $10.3 billion to settle a class-action suit.

Alarmed over what it perceived as the Defense Department’s unwillingness to address PFAS contamination or stop using AFFF, Congress in 2019 ordered DoD to offer annual testing for all

active-duty military firefighters and banned the use of PFAS foam by 2024.

According to data provided by DoD, among more than 9,000 firefighters who requested the tests in fiscal year 2021, 96% had at least one of two types of PFAS in their blood serum, with PFOS being the most commonly detected at an average level of 3.1 nanograms per milliliter.

Readings between 2 and 20 ng/mL carry concern for adverse effects, according to the national academies. In that range, it recommends people limit additional exposure and screen for high cholesterol, breast cancer, and, if pregnant, high blood pressure.

According to DoD, 707 active and former defense sites are contaminated with PFAS or have had suspected PFAS discharges. The department is in the early stages of a decades-long testing and cleaning process.

More than 3,300 lawsuits have been filed over AFFF and PFAS contamination; beyond 3M's massive settlement, DuPont and other manufacturers reached a $1.185 billion agreement with water utility companies in June.

Attorneys general from 22 states have urged the court to reject the 3M settlement, saying in a

filing July 26 it would not adequately cover the damage caused.

For now, many firefighters, like Ferrara, live with anxiety that their blood PFAS levels may lead to cancer. Flook declined to speak to KFF Health News because he is part of the 3M class-action lawsuit. The cancer wreaked havoc on his marriage, robbing him and his wife, Linda, of “affection, assistance, and conjugal fellowship,” according to the lawsuit.

Congress is again trying to push the Pentagon. This year, Sen. Jeanne Shaheen (D-N.H.) reintroduced the PFAS Exposure Assessment and Documentation Act, which would require DoD to test all service members — not just firefighters — stationed at installations with known or suspected contamination as part of their annual health checkups as well as family members and veterans.

The tests, which aren’t covered by the military health program or most insurers, typically cost from $400 to $600.

In June, Kildee said veterans have been stymied in getting assistance with exposure-related illnesses that include PFAS.

“For too long, the federal government has been too slow to act to deal with the threat posed by PFAS exposure,” Kildee said. “This situation is completely unacceptable.”

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