UNDER SECRETARY OF DEFENSE
4000 DEFENSE PENTAGON
WASHINGTON, D.C. 20301-4000

PERSONNEL AND READINESS

OCT 30 2023

The Honorable Patty Murray
Chair
Committee on Appropriations
United States Senate
Washington, DC 20510

Dear Madam Chair:

The Department's response to House Report 117–388, page 57, accompanying H.R. 8236, the Department of Defense (DoD) Appropriations Bill, 2023, "Perfluorinated Chemicals Contamination and First Responder Exposure," is enclosed.

The report includes DoD firefighter population-level summation statistics for Fiscal Year (FY) 2022, a comparison with FY 2021 results, and describes ongoing efforts to improve the Department's tracking and trending. The Department will continue to collaborate with various Federal agencies and others regarding analytical methods and to better understand exposure pathways and potential adverse health effects from per- and polyfluorinated chemicals.

Thank you for your continued strong support for the health and well-being of our Service members, veterans, and DoD civilian workforce. I am sending a similar letter to the House Appropriations Committee.

Sincerely,

[redacted]

Ashish S. Vazirani
Acting

Enclosure:
As stated

cc:
The Honorable Susan Collins
Vice Chair

UNDER SECRETARY OF DEFENSE
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PERSONNEL AND
READINESS

OCT 30 2023

The Honorable Kay Granger
Chairwoman
Committee on Appropriations
U.S. House of Representatives
Washington, DC 20515

Dear Madam Chairwoman:

The Department's response to House Report 117–388, page 57, accompanying H.R. 8236, the Department of Defense (DoD) Appropriations Bill, 2023, "Perfluorinated Chemicals Contamination and First Responder Exposure," is enclosed.

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Thank you for your continued strong support for the health and well-being of our Service members, veterans, and DoD civilian workforce. I am sending a similar letter to the Senate Appropriations Committee

Sincerely,

[redacted]

Ashish S. Vazirani
Acting

Enclosure:
As stated

cc:
The Honorable Rosa L. DeLauro
Ranking Member

Report to the Committees on Appropriations of the Senate and the House of Representatives

Perfluorinated Chemicals Contamination and First Responder Exposure

October 2023

The estimated cost of this report or study for the Department of Defense (DoD) is approximately $12,000 for the 2023 Fiscal Year. This includes $0 in expenses and $12,000 in DoD labor. Generated on 09/27/2023 (1-C74682C)

A. CONGRESSIONAL REPORT REQUEST

This report is in response to House Report 117–388, page 57, accompanying H.R. 8236, the Department of Defense (DoD) Appropriations Bill, 2023, which requests that the Assistant Secretary of Defense for Health Affairs provide a report to the Committees on Appropriations of the Senate and the House of Representatives not later than 180 days after the enactment of the Appropriations Act on the Department's ongoing efforts to test and track potential first responder exposure to perflourinated chemicals (PFCs) [Per- and Polyfluoroalkyl Substances, PFAS] as part of existing, annual medical surveillance exams.

B. TEST AND TRACK POTENTIAL FIRST RESPONDER PFAS EXPOSURE

"First responders" include law enforcement, fire services, emergency medical services, and emergency management officials.[1] Of the first responders, only DoD firefighters regularly worked with aqueous film-forming foam (AFFF), known to contain PFAS. Other first responders (non-firefighters) likely experience very limited or no AFFF exposures. Occupational medical surveillance examination content and frequencies are based on exposure to recognized occupational health hazards[2].

DoD is currently focused on offering blood testing to its firefighters as required by section 707 of the National Defense Authorization Act (NDAA) for Fiscal Year (FY) 2020.

C. DOD FIREFIGHTER BLOOD TESTING AND TRACKING UPDATE

In FY 2022 (October 2021-September 2022), DoD records indicate 9,305 DoD firefighters[3] chose to have their blood tested as part of their DoD annual medical exam. Firefighters who chose to have their blood tested were provided their test results and a medical fact sheet.

As described in House Report 117–388, "the Department is developing firefighter population-level summation statistics for PFCs [PFAS] blood sampling of firefighters." These summary statistics are included for the FY 2022 blood testing for PFAS in DoD firefighters in the attached surveillance report (Attachment 1).

[1] Source: Department of Homeland Security accessed at: https://www.dhs.gov/science-and-technology/first-responders on March 17, 2021

[2] In accordance with Department of Defense Manual 6055.05, "Occupational Medical Examinations: Medical Surveillance and Medical Qualification," July 27, 2022.

[3] Firefighter is defined as a DoD Service member, DoD civilian, Foreign National, retiree, or others not identified with a PFAS direct care laboratory record in the Military Health System. While firefighters are the only group currently authorized to have PFAS testing performed, this report may include testing on patients with concerns about PFAS exposure. DoD policy defines firefighter as personnel who hold an occupational specialty as a firefighter (e.g., DoD civilian job series 0081, Army Military Occupational Specialty 12M, Air Force Specialty Code 387X1, Navy Enlisted Classification Code 786B, Marine Corps Military Occupational Series 70) and who receive an annual occupational medical (OM) examination and who perform firefighting duties. This includes local national firefighters where the DoD has the responsibility to administer their firefighter OM examinations. Personnel who hold an occupational specialty as a firefighter but do not receive an annual OM examination are excluded.

C.1. Overview of the DoD Exposure Surveillance Report

The Defense Centers for Public Health – Portsmouth (DCPH-P) used the DoD's electronic heath records (EHRs) to identify 6,790 firefighters who had their blood sampled and analyzed during FY 2022. Results not uploaded into one of the DoD EHRs were not captured in the surveillance report. Of the total number of firefighters identified in FY 2022, 2,954 firefighters were also identified in EHRs as being tested in FY 2021.

Samples were analyzed for the presence of six PFAS compounds: perfluorooctanoic acid (PFOA); perfluorooctane sulfonate (PFOS); perfluorohexanesulfonic acid (PFHxS); perfluorononanoic acid (PFNA); perfluoroheptanoic acid (PFHpA); and perfluorobutanesulfonic acid (PFBS). Individual PFAS blood (serum) levels are reported in nanograms per milliliter (ng/mL).[4]

The PFAS detected most often in the serum was PFHxS (99.8 percent of samples) followed by PFNA (99.5 percent), PFOS (99.3 percent of samples), PFOA (94.9 percent), PFHpA (16.5 percent), and PFBS (2.5 percent).

Overall PFAS geometric mean blood concentrations ranged from a high for PFOS at 2.73 ng/mL followed by PFHxS (2.36 ng/mL), PFOA (1.03 ng/mL), and PFNA (0.36 ng/mL). Since 40 percent or more of the total proportion of results were below the limit of detection (0.05 ng/mL) for both PFHpA and PFBS, their geometric means were not calculated.[5]

The spread of the sampling results (95th percent confidence limits) for each PFAS was relatively small. However, due to outlier values, the range for test results for individual PFAS was large, ranging from non-detectable (<0.05 ng/mL) to a maximum of 65 ng/mL for PFHxS, 63 ng/mL for PFOS, 25 ng/mL for PFOA, 8.2 ng/mL for PFNA, 1.9 ng/mL for PFHpA, and 0.8 ng/mL for PFBS.

Of the DoD firefighters sampled in FY 2022, 44 percent (n = 2,954) were identified as being tested in FY 2021. An initial comparison with only 2 years of data (FY 2021 and FY 2022) shows a statistically significant reduction in total and individual PFAS (PFHxS, PFNA, PFOA, and PFOS) serum concentrations in firefighters who were tested in both sampling periods.

C.2. Discussion

The surveillance report identified 6,790 DoD firefighters through the DoD EHRs. This value is less that the total number of DoD firefighters tested, since EHRs exist for all military members, but may not exist for DoD civilian employees whose test results are often recorded solely at the local level in employee medical records (i.e., hard copies). In addition, there are challenges to the DoD's ability to efficiently access data within the medical files of DoD civilian employees and data uploaded into Reserve and National Guard member EHRs.

[4] Equivalent to micrograms per liter (µg/L) used by Centers for Disease Control and Prevention (CDC).
[5] Using methodology found in Centers for Disease Control and Prevention. National Report on Human Exposure to Environmental Chemicals. Last reviewed August 15, 2023. Accessed August 29, 2023. https://www.cdc.gov/exposurereport/index.html.

Although blood sampling indicates the level of (or concentration of) PFAS present in an individual's blood at a point in time, it cannot by itself be used to define the source, timing, frequency, magnitude, or possible health effects of PFAS exposures.[6] While the DCPH-P surveillance report provided information on overall PFAS levels in DoD firefighters, all of the results were combined (pooled together), because information on demographics (age, sex, etc.) and potential PFAS exposures (e.g., years working with AFFF) are unavailable. The DoD is developing a DoD firefighter PFAS exposure questionnaire that may allow us to obtain demographic and PFAS exposure related information with the objective of better evaluating whether results from the PFAS blood testing are associated with DoD firefighter activities.

An initial comparison between firefighter PFAS levels in blood between FY 2021 and FY 2022 reveals a downward trend in total and individual PFAS; however, it only reflects 2 years of data. Additional years of analyses are necessary to understand potential trends in DoD firefighter blood levels.

There are differences between the analytical method used to analyze DoD blood samples and the method used by the Centers for Disease Control and Prevention (CDC) to determine PFAS levels in the general population through the National Health and Nutrition Examination Survey (NHANES). Therefore, the DoD firefighter PFAS levels in blood cannot be directly compared to those found in the general population.

Over the past year, the DoD worked with the supporting contract lab to expand their capability to use the CDC's analytical method. This resulted in the expansion of PFAS analytes tested in the blood of DoD firefighters and a broader target PFAS analyte list to better align with PFAS being analyzed by the CDC and PFAS used in AFFF. Beginning on May 1, 2023, all DoD firefighter blood is being evaluated with the CDC analytical method and an expanded list of PFAS analytes to include: PFOA (linear and branch isomers); PFOS (linear and branched isomers); PFHxS; PFNA; PFHpA; PFBS; Perfluorodecanoic acid; Perfluoroundecanoic acid; Perfluorododecanoic acid; Perfluoroheptanesulfonic acid; Dodecafluoro-3H-4,8-dioxanonanoate; Perfluorohexanoic acid; and 2-(N-methyl-perfluorooctane sulfonamido) acetatic acid; Perfluorooctanesulfonamide. This provides a more robust determination of PFAS exposures and allows for future comparisons of DoD firefighter PFAS levels in blood to levels found in the general public by the CDC (i.e., NHANES).

D. CONCLUSION

The DoD will continue to offer PFAS testing to DoD firefighters as required by section 707 of the NDAA for FY 2020 and will develop annual surveillance reports including firefighter population-level summation statistics for DoD firefighter PFAS blood sampling results. While preliminary results from 2 years of data suggest a downward trend in the levels of PFAS in DoD firefighters, future annual evaluations will include trend analyses to evaluate changes in firefighter blood PFAS levels over time and assist in understanding whether DoD firefighters are

[6] CDC scientists found four specific PFAS (PFOS, PFOA, PFHxS, and PFNA) in the blood of nearly all of the people tested, indicating widespread exposure to these PFAS in the U.S. population. CDC data suggest that over 97 percent of Americans have detectable levels of PFAS in their blood (Source: https://www.atsdr.cdc.gov/pfas/health-effects/us-population.html and https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4483690/)

experiencing PFAS exposures from their ongoing work with AFFF and other firefighting activities.

The Department continues to collaborate with various Federal agencies and other organizations to improve our understanding of potential occupationally-related PFAS exposures and health effects. DoD collaborates regularly with the Department of Veterans Affairs to discuss potential current and future PFAS exposures and health effects to Service members. The Department is reaching out to the CDC's National Center for Environmental Health and National Institute for Occupational Safety and Health regarding the development of PFAS analytical methods and various occupational exposure and health effects inquiries. Additionally, DoD supports and relies on the Department of Health and Human Services's Agency for Toxic Substances and Disease Registry for ongoing environmental exposure assessments and health studies to better understand exposure pathways and potential adverse health effects from PFAS.

Attachment 1

Attachment 1

Department of Defense (DoD) Firefighter Per- and Polyfluoroalkyl Substances (PFAS) Blood (Serum) Surveillance Report

01 October 2021 to 30 September 2022

DCPH-P-EDC-TR-220-2023

EpiData Center

Prepared August 2023

Contents

Key Points

- In this report firefighter is defined as a DoD service member, DoD civilian, Foreign National, retiree, or others not identified with a PFAS direct care laboratory record in the Military Health System (MHS). While firefighters are the only group currently authorized to have PFAS testing performed[1], this report may include testing on patients with concerns about PFAS exposure.

- DoD electronic health records (EHR) identified 6,790 firefighters who had their blood sampled and analyzed during the reporting period of 01 October 2021 through 30 September 2022 (FY22). Of the total number of firefighters identified in FY22, 2,954 firefighters were also identified in EHRs as being tested in FY21.

    - Laboratory analyses of firefighter blood samples looked for the presence of six PFAS compounds: perfluorobutanesulfonic acid, PFBS; perfluoroheptanoic acid, PFHpA; perfluorohexanesulfonic acid, PFHxS; perfluorononanoic acid, PFNA; Perfluorooctanoic acid, PFOA; and perfluorooctane sulfonate, PFOS.

    - PFAS serum levels, reported in nanograms per milliliter (ng/mL) are equivalent to micrograms per liter (µg/L).

- Of the total valid tests performed, the PFAS detected most often in the serum was PFHxS (99.8%), followed by PFNA (99.5%), PFOS (99.3%), PFOA (94.9%), PFHpA (16.5%), and PFBS (2.5%).

- The PFAS with the highest geometric mean blood concentration was PFOS (2.73 ng/mL), followed by PFHxS (2.36 ng/mL), PFOA (1.03 ng/mL), and PFNA (0.36 ng/mL). PFHpA and PFBS geometric mean serum levels were below the limit of detection (LOD) of 0.05 ng/mL.

- The maximum level of each PFAS compound measured in an individual firefighter's blood was 65 ng/mL for PFHxS, 63 ng/mL for PFOS, 25 ng/mL for PFOA, 8.2 ng/mL for PFNA, 1.9 ng/mL for PFHpA, and 0.8 ng/mL for PFBS.

- Currently available information does not allow for differentiation between occupational and non-occupational exposures or the determination of the source, magnitude, frequency, and timing of possible PFAS exposures.

- DoD firefighter serum PFAS levels are not directly comparable to the U.S. Centers for Disease Control and Prevention (CDC) National Health and Nutrition Examination Survey (NHANES) levels reported in the serum of the general public because of differences in the analytical methodologies employed.

- A limited trend analysis of both total and individual PFAS serum levels in participating firefighters who were sampled in both FY21 and FY22 reveals a downward trend.

Background

Per- and Polyfluoroalkyl Substances (PFAS) refers to a large and complex class of manmade chemicals. Of the multiple chemicals categorized as PFAS, PFOS and PFOA were historically the most widely used throughout the U.S. and are the best studied PFAS. Because PFAS increase resistance to heat, stains, water, and grease they have been used in many industrial and consumer products. Commercial and consumer use of PFAS, which began in the 1950s, included keeping food from sticking to cookware, certain food packaging, making sofas and carpets resistant to stains, and making clothes and mattresses waterproof. PFAS are not uniquely attributable to Department of Defense (DoD) activities.

In the 1970s, the DoD began using aqueous film forming foam (AFFF) fire suppressants that contained PFAS including PFOS and, in some formulations, PFOA. AFFF is mission critical for the DoD because it quickly extinguishes petroleum-based and liquid fuel fires, saving lives and materials. Additional DoD products that have mission critical uses include the aerospace, automotive, building and construction, and electronics industries.

Information concerning exposures to PFAS can be found on the United States Environmental Protection Agency's (EPA) website at: https://www.epa.gov/pfas/basic-information-pfas#exposed and on the Centers for Disease Control and Prevention's (CDC) Agency for Toxic Substances and Disease Registry (ATSDR) website at https://www.atsdr.cdc.gov/pfas/pfas-exposure.html.

Many PFAS compounds are known to be extremely persistent in the environment, which means they don't break down readily and can accumulate over time. Because of potential health concerns, PFOS and PFOA were voluntarily removed from commercial products more than 10 years ago and DoD adopted policy limiting the use of AFFF-containing PFAS. PFAS are present at low levels in some foods, consumer products, and in the environment (air, water, soil, etc.). CDC scientists have found four PFAS (PFOS, PFOA, PFHxS, and PFNA) in the serum of nearly all the people tested.

Scientists are still studying the health effects of exposure to PFAS. A large research effort is underway to determine whether there are potential health effects for people from PFAS exposures. There are currently no established health-based reference levels for PFAS in blood, blood plasma, or blood serum. Although more research is needed, some observational studies have reported an association between high levels of certain PFAS in blood and the occurrence of adverse health outcomes (e.g., decreased vaccine efficacy, increases in serum cholesterol levels, thyroid disease, and certain cancers). While test results reporting the amount of PFAS in the blood are a useful measure of an individual's exposure to PFAS, they cannot identify the timing, magnitude, frequency, source of exposure, or determine the likelihood of developing any possible adverse health effects. Additional information

concerning PFAS health effects are available from the ATSDR website at: https://www.atsdr.cdc.gov/pfas/PFAS-health-effects.html

Purpose

This report summarizes PFAS blood (serum) analytical results collected from the Composite Health Care System (CHCS) and Military Health System (MHS) GENESIS Health Level 7-formatted (HL7) databases from DoD firefighters tested between 01 October 2021 and 30 September 2022 (FY22). An additional goal is to perform a limited trend analysis of both total and individual PFAS serum levels in participating DoD personnel who were sampled in both FY21 and FY22.

Methods

EpiData Center (EDC) obtained MHS laboratory serum sample results, with a collection date occurring between 01 October 2021 and 30 September 2022, from the CHCS and MHS GENESIS laboratory databases. Tests ordered or test names indicating performance of a PFAS panel, were identified and retained for analysis. All DoD firefighter blood PFAS sample analyses were performed by Clinical Laboratory Improvement Amendments of 1998 (CLIA) certified NMS Labs (NMS); each PFAS compound assessed to a limit of detection (LOD) of 0.05 ng/mL.

Viable PFAS serum levels, identified in CHCS and MHS GENESIS laboratory records, were analyzed using univariate statistics (total test performed, geometric mean, ±95% confidence limits, the 95th percentile and maximum levels) for each of the six target PFAS compounds consistent with that used by the CDC.[2] Analytical results below the LOD (0.05 ng/mL) were reported as "< LOD" which includes records reported as "None Detected". Using the CDC methodology, the geometric means for concentrations less than the LOD (0.05 ng/mL) were assigned a value equal to the LOD divided by the square root of two (0.035 ng/mL). If 40% or more of the total proportion of results for each PFAS compound was below the LOD, a geometric mean was not calculated.

In addition to reporting PFAS serum levels for DoD firefighters, PFAS serum levels are reported by service branch (Army, Air Force, Marine Corps, Navy) and "Other Personnel" (i.e., DoD civilians, Foreign Nationals, and others not identified). Appendices A through D report the serum levels of individual PFAS by service for active-duty service members and non-active-duty service members (i.e., retirees, Reservists, and National Guard). Appendix E reports the serum levels of individual PFAS for "Other Personnel" (i.e., DoD civilians, Foreign Nationals, and others not identified).

For the purpose of assessing an overall trend, an estimate of total PFAS exposure to DoD firefighters, both occupational and non-occupational exposures, is provided by the sum of the six PFAS measured in each firefighter's serum. For a variety of reasons, an individual's blood PFAS levels may have been sampled and analyzed more than once during the reporting period, with all analytical results reported in the laboratory data.

For firefighters who participated in both FY21 and FY22 blood PFAS testing, a limited trend analysis of serum PFAS levels was performed. This trend analysis indicates a downward trend (n = 2 years of data) but does not include sufficient information from which to perform a meaningful statistical analysis of trend.

FY22 Results

Tables 1 through 3 provide the results queried from CHCS and MHS GENESIS laboratory databases among the 6,790 firefighters whose blood was sampled and analyzed during the surveillance period. Table 1 displays the unique number of participating DoD personnel tested for PFAS by service branch. Table 2 displays general information about the number of valid PFAS laboratory serum samples tested, the percentage of tests below and above the LOD, and the total number of DoD firefighters for which the laboratory reported analytical results, including those identified by service and "Other Personnel". Table 3 displays the number of serum samples with a numeric test result, which were then used to generate univariate statistics (geometric mean, ±95% confidence limits, a 95th percentile, and maximum concentration levels) for each of the six target PFAS compounds.

Figures 1 through 6 provide a graphical representation of the DoD firefighter blood testing results for each of the six PFAS compounds assayed. Figure 7 displays the distribution of the total PFAS concentration in an individual's blood serum sample (i.e., the sum of all six PFAS compounds measured in a participant's blood). Table 4 displays the geometric means of PFAS in firefighters who were sampled in both FY21 and FY22.

PFAS Testing by Branch

Table 1. Participating DoD Firefighters Tested for PFAS by Service Branch, 01 October 2021 to 30 September 2022

Service Branch	Total Participants Tested	Percent (%)
Air Force	2,425	35.7
Army	337	5.0
Marine Corps	431	6.3
Navy	346	5.1
Other	3,251	47.9
Total	6,790	100.0

Data from Composite Health Care System (CHCS) Chemistry and Military Health System (MHS) GENESIS laboratory databases.
"Other" is defined as DoD civilians, Foreign Nationals, and others not identified.
Prepared by the EpiData Center (EDC), Defense Centers for Public Health-Portsmouth (DCPH-P) on August 15, 2023.

PFAS Univariate Statistics by Compound- Overall

Table 2. Total PFAS Laboratory Testing among Participating DoD Firefighters, 01 October 2021 to 30 September 2022

Compound	Total Valid Tests	Below Limit of Detection (%) [a]	Above Limit of Detection (%) [b]
PFBS	6,859	97.5	2.5
PFHpA	6,816	83.5	16.5
PFHxS	6,687	0.2	99.8
PFNA	6,787	0.5	99.5
PFOA	6,925	5.1	94.9
PFOS	6,859	0.7	99.3

Data from Composite Health Care System (CHCS) Chemistry and Military Health System (MHS) GENESIS laboratory databases.
a. Percent of samples with a value below the limit of detection (0.05 ng/mL).
b. Percent of samples with a numeric value grater than the limit of detection (0.05 ng/mL).
Includes service members (SMs) and non-military personnel.
Values are not directly comparable to NHANES or CDC Per - and Polyfluoroalkyl reporting.
Prepared by the EpiData Center (EDC), Defense Centers for Public Health-Portsmouth (DCPH-P) on August 15, 2023.

PFAS Measures of Central Tendency by Compound- Overall

Table 3. Uni-variate Statistics for PFAS Blood Testing among Participating DoD Firefighters, 01 October 2021 to 30 September 2022

Compound	Count	Geometric Mean[a]	95th Percentile[b]	No. of Firefighters > 95th Percentile	Maximum Value
PFBS	6,859	*	<LOD	171	0.8
PFHpA	6,816	*	0.1	332	1.9
PFHxS	6,687	**2.36** (2.31-2.41)	9.7	329	65.0
PFNA	6,787	**0.36** (0.36-0.37)	0.9	328	8.2
PFOA	6,925	**1.03** (1.01-1.06)	2.8	317	25.0
PFOS	6,859	**2.73** (2.68-2.78)	10.0	267	63.0

Data from Composite Health Care System (CHCS) Chemistry and Military Health System (MHS) GENESIS laboratory databases.
[a]±95% Confidence Limits were calculated for the geometric mean.
[b]Represents the point at which 5% of the serum samples in the cohort exceeds that value.
<LOD means less than the limit of detection (0.05 ng/mL).
*Not calculated: proportion of results below limit of detection was too high to provide a valid result.
Includes number of serum samples with a numeric test result.
All result values are in ng/mL.
Includes service members (SMs) and non-military personnel.
Values are not directly comparable to National Health and Nutrition Examination Survey (NHANES) or Centers for Disease Control (CDC) Per- and Polyfluoroalkyl reporting.
Prepared by the EpiData Center (EDC), Defense Centers for Public Health-Portsmouth (DCPH-P) on August 15, 2023.

Percent Distribution of PFAS Analytical Results by Compound- Overall

Relative distributions of test result values within the participating population of firefighters are displayed in Figures 1 through 7. The percent distribution of individuals with a specific blood PFAS concentration were arbitrarily determined by concentration bin. For PFHxS, PFOS and Total PFAS levels, additional resolution of DoD firefighter blood levels around the LOD is provided in an expanded histogram.

Figure 1. Percent Distribution of PFBS Analytical Results among Particpating DoD Firefighters, 01 October 2021 to 30 September 2022 (n=6,859)

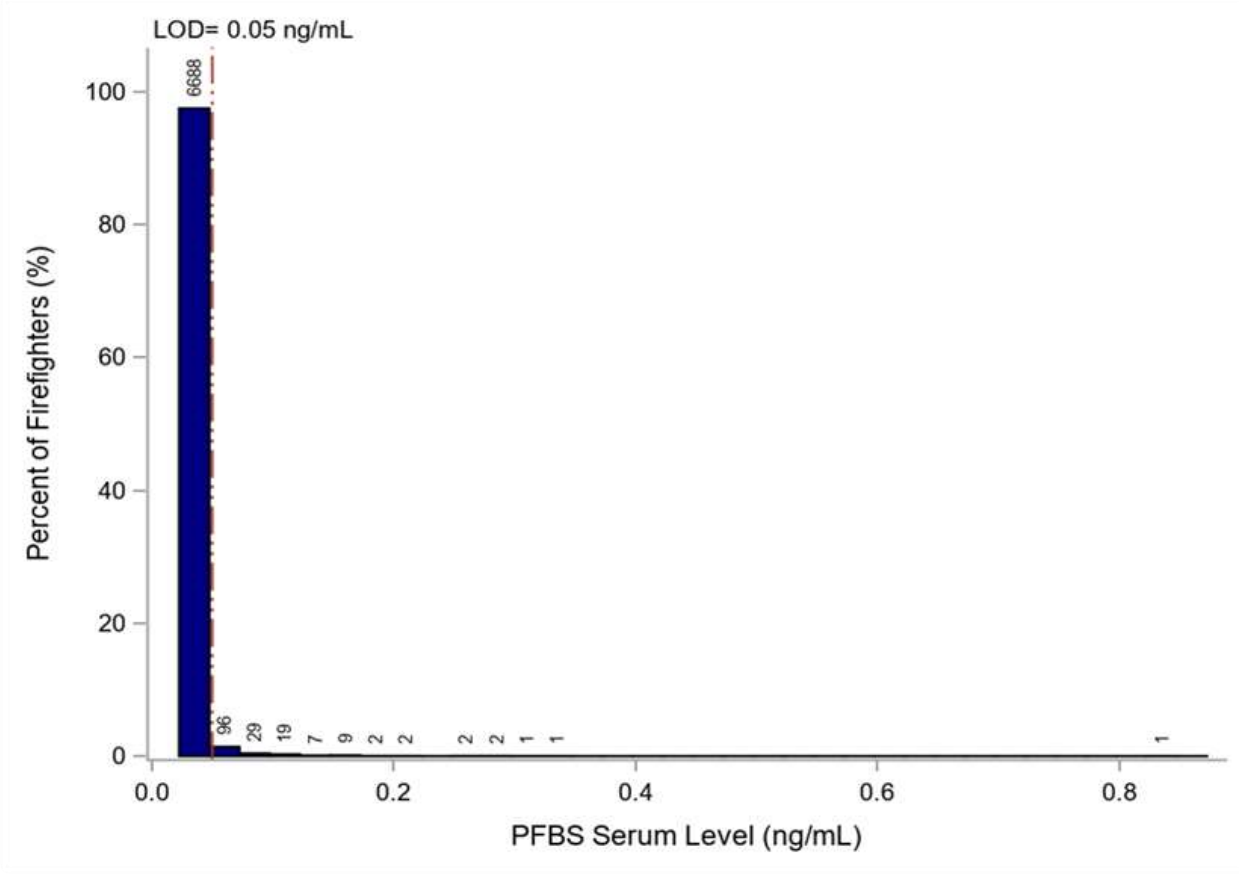

Figure includes Service Members (SMs) and non-military Personnel.

The number of records below the LOD = 6,688. The limit of detection is < 0.05 ng/ml.

Serum Concentrations are not directly comparable to National Health and Nutrition Examination Survey (NHANES) or Centers for Disease Control (CDC) Per- and Polyfluoroalkyl reporting.

Data from Composite Health Care System (CHCS) Chemistry and Military Health System (MHS) GENESIS laboratory databases.
Prepared by the EpiData Center (EDC), Defense Centers for Public Health-Portsmouth (DCPH-P) on August 15, 2023.

Figure 2. Percent Distribution of PFHpA Analytical Results among Participating DoD Firefighters, 01 October 2021 to 30 September 2022 (n=6,816)

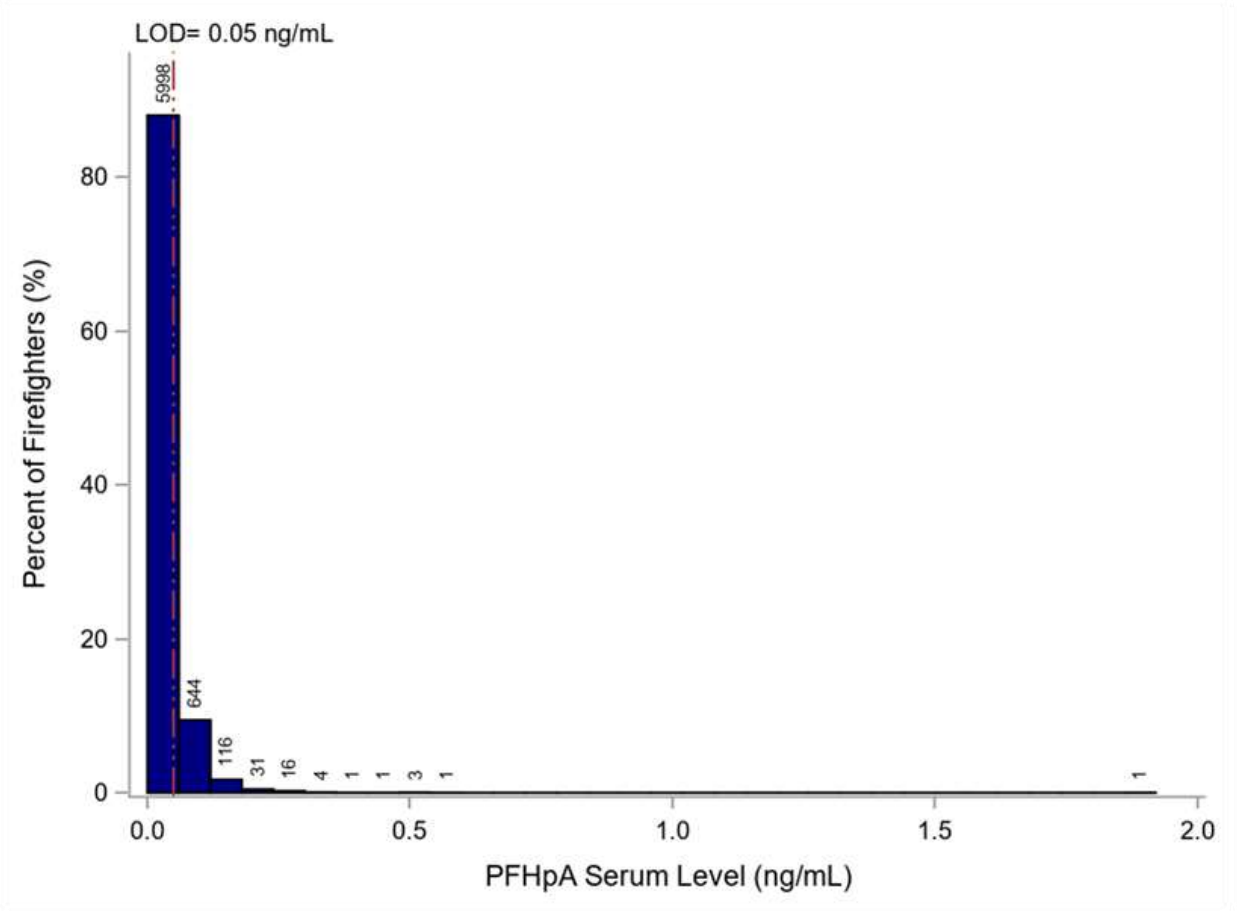

Figure includes Service Members (SMs) and non-military Personnel.

The number of records below the LOD = 5,691. The limit of detection is < 0.05 ng/ml.

Serum Concentrations are not directly comparable to National Health and Nutrition Examination Survey (NHANES) or Centers for Disease Control (CDC) Per- and Polyfluoroalkyl reporting.

Data from Composite Health Care System (CHCS) Chemistry and Military Health System (MHS) GENESIS laboratory databases.

Prepared by the EpiData Center (EDC), Defense Centers for Public Health-Portsmouth (DCPH-P) on August 15, 2023.

Figure 3. Percent Distribution of PFHxS Analytical Results among Participating DoD Firefighters, 01 October 2021 to 30 September 2022 (n=6,687)

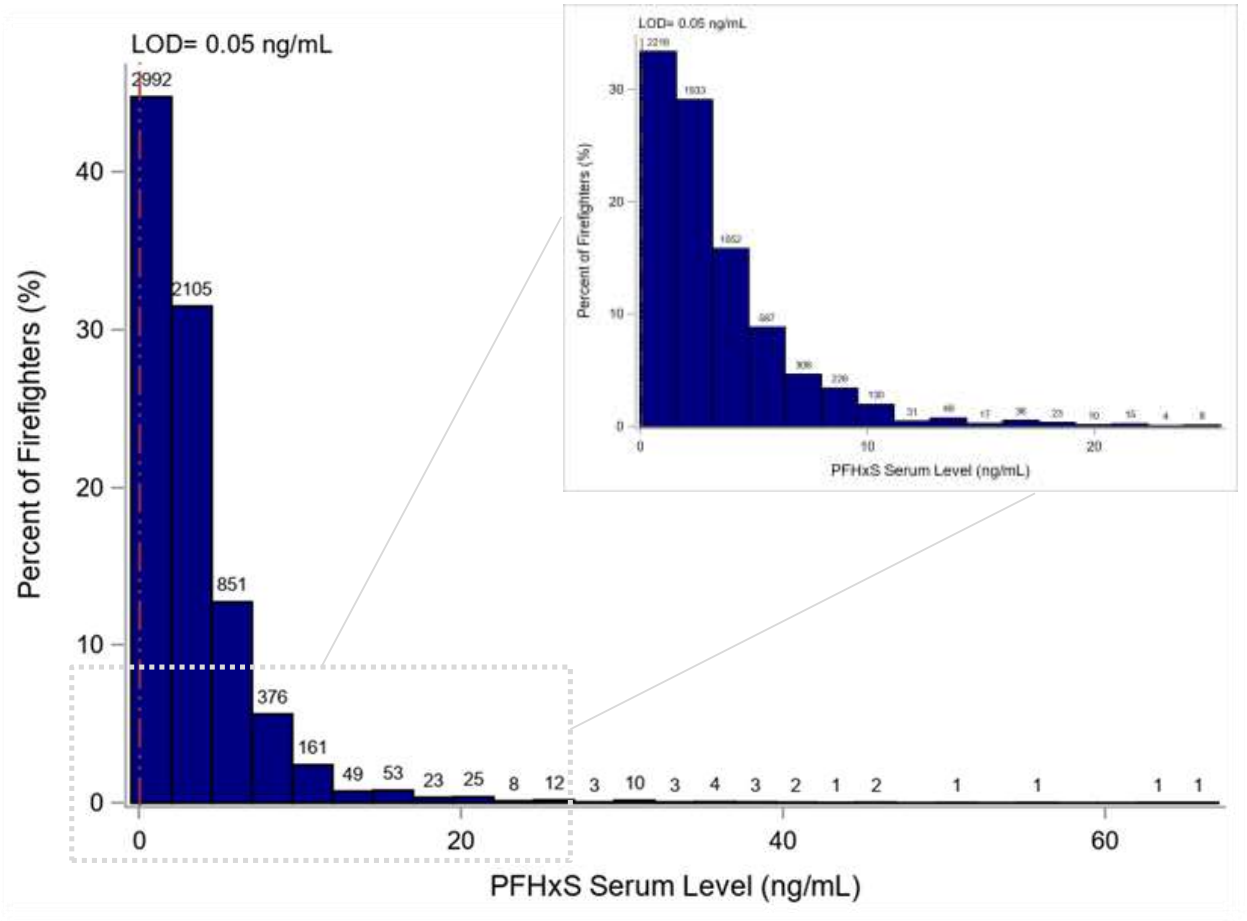

Figure includes Service Members (SMs) and non-military Personnel.
The distribution of PFHxS result values equal to 25 ng/mL or less is provided in the expanded histogram.
The number of records below the LOD = 15. The limit of detection is < 0.05 ng/ml.
Serum Concentrations are not directly comparable to National Health and Nutrition Examination Survey (NHANES) or Centers for Disease Control (CDC) Per- and Polyfluoroalkyl reporting.
Data from Composite Health Care System (CHCS) Chemistry and Military Health System (MHS) GENESIS laboratory databases.
Prepared by the EpiData Center (EDC), Defense Centers for Public Health-Portsmouth (DCPH-P) on August 15, 2023.

Figure 4. Percent Distribution of PFNA Analytical Results among Participating DoD Firefighters, 01 October 2021 to 30 September 2022 (n=6,787)

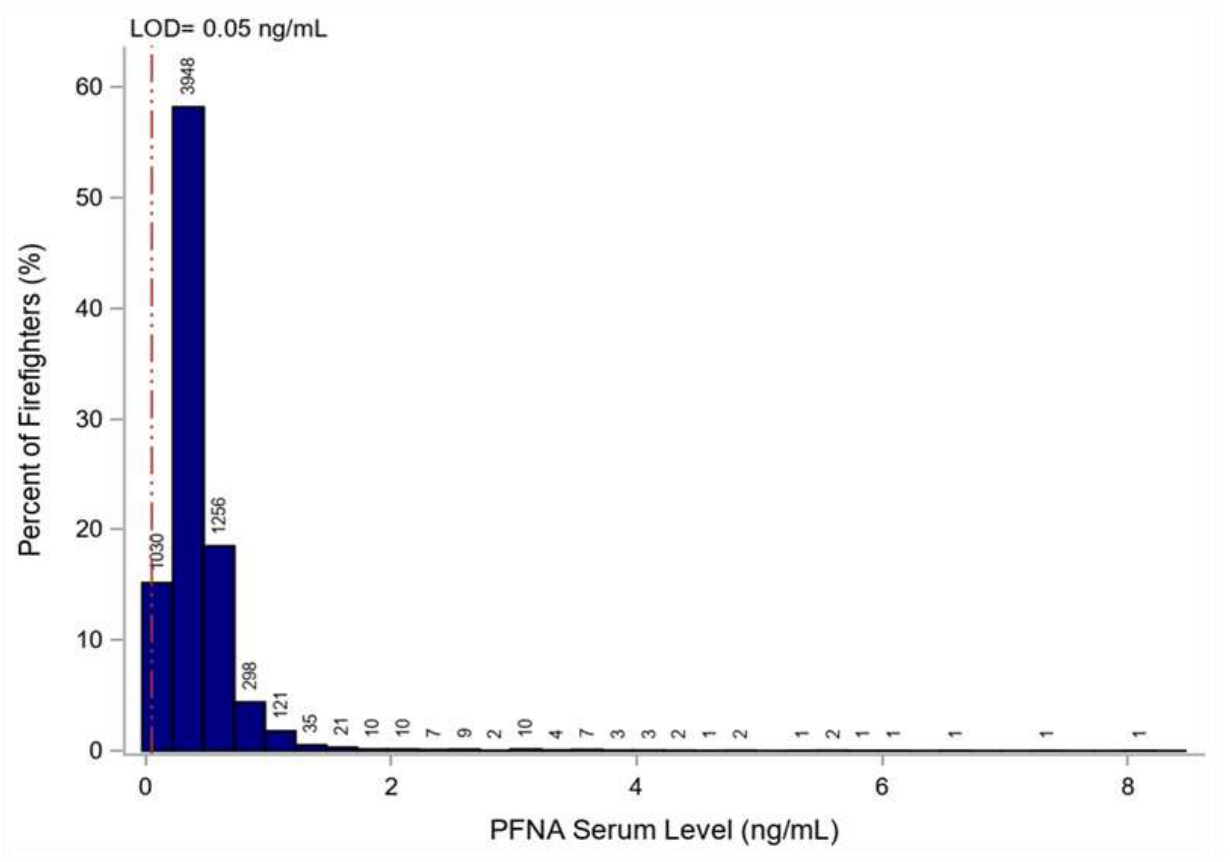

Figure includes Service Members (SMs) and non-military Personnel.

The number of records below the LOD = 31. The limit of detection is < 0.05 ng/ml.

Serum Concentrations are not directly comparable to National Health and Nutrition Examination Survey (NHANES) or Centers for Disease Control (CDC) Per- and Polyfluoroalkyl reporting.

Data from Composite Health Care System (CHCS) Chemistry and Military Health System (MHS) GENESIS laboratory databases.
Prepared by the EpiData Center (EDC), Defense Centers for Public Health-Portsmouth (DCPH-P) on August 15, 2023.

Figure 5. Percent Distribution of PFOA Analytical Result Values among Participating DoD Firefighters, 01 October 2021 to 30 September 2022 (n=6,925)

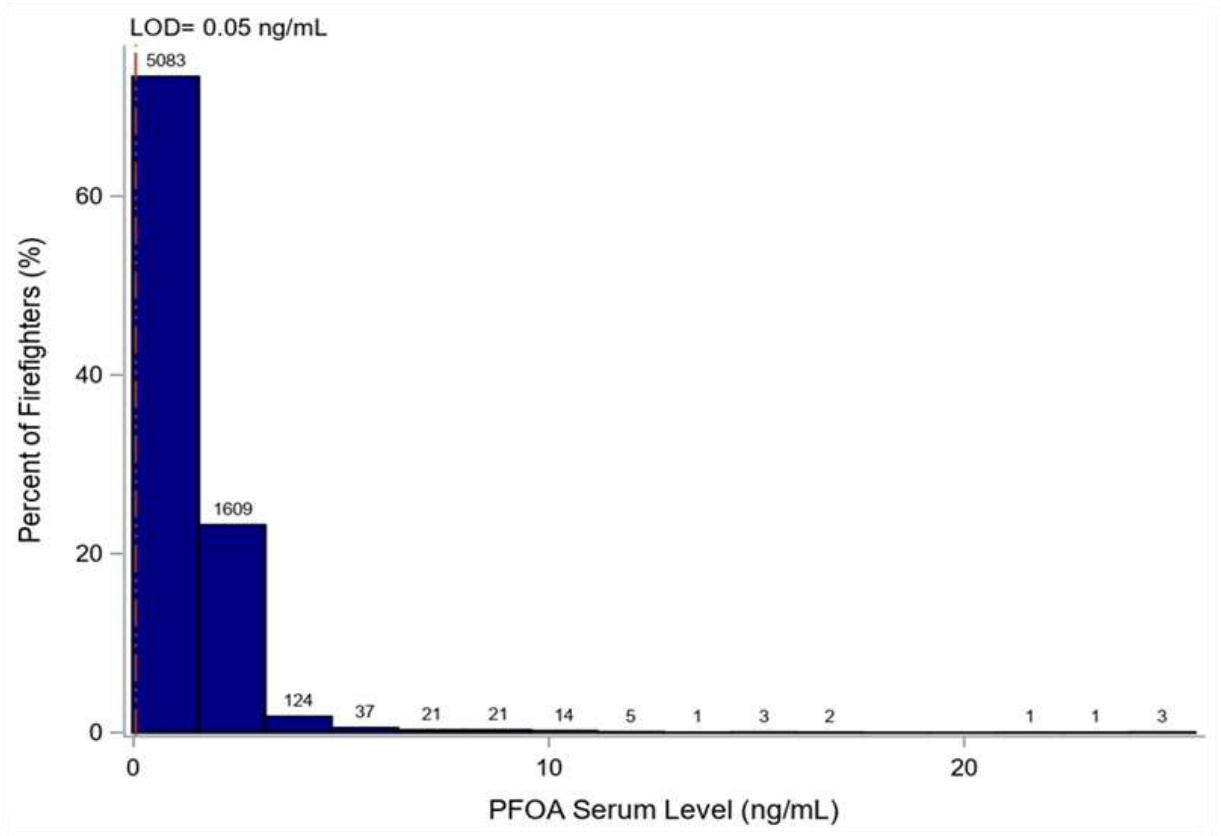

Figure includes Service Members (SMs) and non-military Personnel.

The number of records below the LOD = 353. The limit of detection is < 0.05 ng/ml.

Serum Concentrations are not directly comparable to National Health and Nutrition Examination Survey (NHANES) or Centers for Disease Control (CDC) Per- and Polyfluoroalkyl reporting.

Data from Composite Health Care System (CHCS) Chemistry and Military Health System (MHS) GENESIS laboratory databases.
Prepared by the EpiData Center (EDC), Defense Centers for Public Health-Portsmouth (DCPH-P) on August 15, 2023.

Figure 6. Percent Distribution of PFOS Analytical Results among Participating DoD Firefighters, 01 October 2021 to 30 September 2022 (n=6,859)

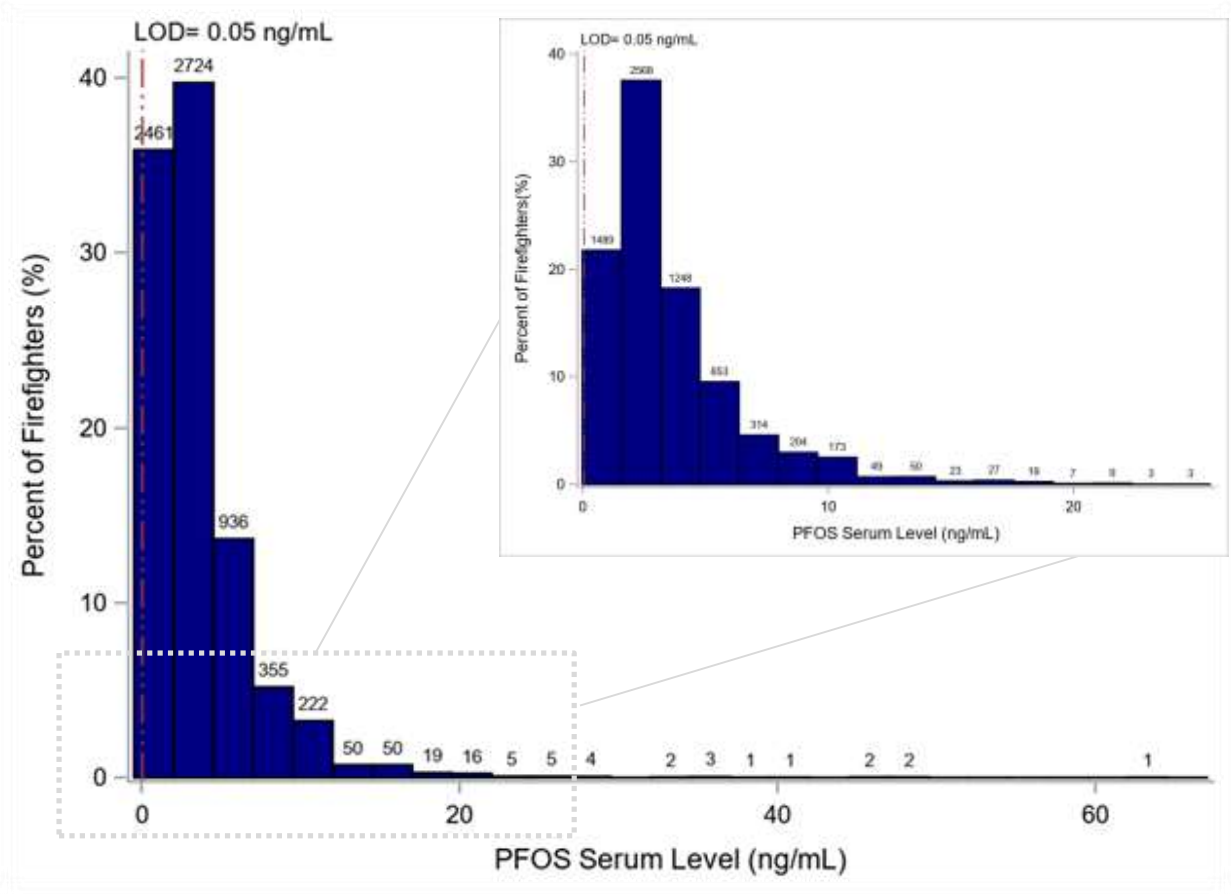

Figure includes Service Members (SMs) and non-military Personnel.

The distribution of PFOS result values equal to 25 ng/mL or less is provided in the expanded histogram.

The number of records below the LOD = 48. The limit of detection is < 0.05 ng/ml.

Serum Concentrations are not directly comparable to National Health and Nutrition Examination Survey (NHANES) or Centers for Disease Control (CDC) Per- and Polyfluoroalkyl reporting.

Data from Composite Health Care System (CHCS) Chemistry and Military Health System (MHS) GENESIS laboratory databases.
Prepared by the EpiData Center (EDC), Defense Centers for Public Health-Portsmouth (DCPH-P) on August 15, 2023.

Figure 7. Percent Distribution of Total PFAS Analytical Results among Participating DoD Firefighters, 01 October 2021 to 30 September 2022 (n=6,687)

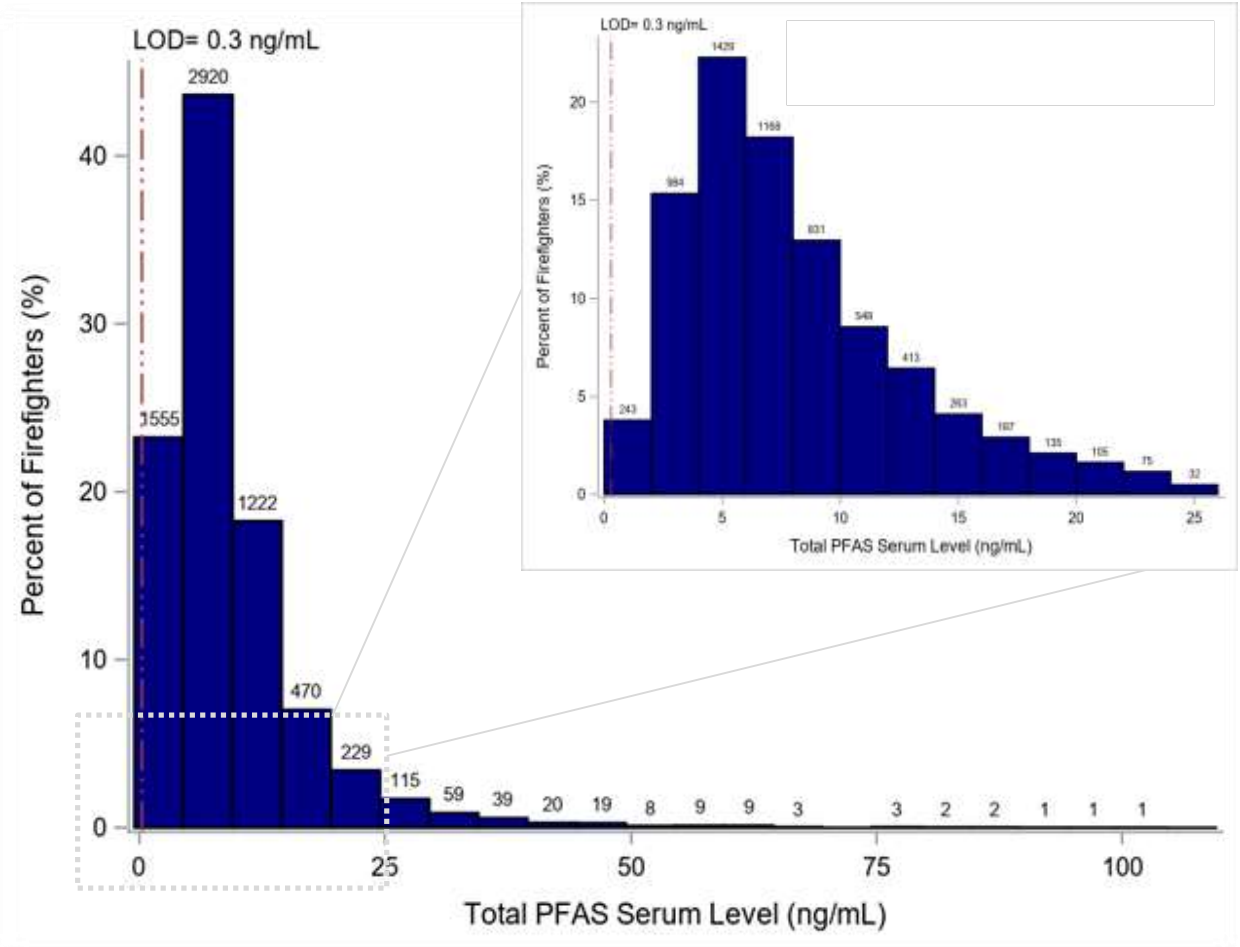

Figure includes Service Members (SMs) and non-military Personnel.
The distribution of total PFAS result values equal to 25 ng/mL or less is provided in the expanded histogram.
The number of records below the LOD = 31. The limit of detection is < 0.3 ng/ml.
Serum Concentrations are not directly comparable to National Health and Nutrition Examination Survey (NHANES) or Centers for Disease Control (CDC) Per- and Polyfluoroalkyl reporting.
Data from Composite Health Care System (CHCS) Chemistry and Military Health System (MHS) GENESIS laboratory databases.
Prepared by the EpiData Center (EDC), Defense Centers for Public Health-Portsmouth (DCPH-P) on August 15, 2023.

Trend Analysis FY21- FY22

Table 4. Uni-variate Statistics for PFAS Blood Testing among Participating DoD Firefighters with records in both FY21 and FY22

	FY21	FY22
Compound	**Geometric Mean (n)** [a]	**Geometric Mean (n)**[a]
PFBS	* (n= 3,035)	* (n= 2,981)
PFHpA	* (n= 3,014)	* (n = 2,964)
PFHxS	**2.96** (2.88-3.05); n = 2,923	**2.61** (2.53-2.69); n= 2,933
PFNA	**0.44** (0.43-0.45); n=3,015	**0.38** (0.37-0.39); n = 2,952
PFOA	**1.22** (1.18-1.25); n= 3,075	**1.10** (1.07-1.14); n = 3,024
PFOS	**3.21** (3.12-3.30); n= 3,045	**2.93** (2.85-3.01); n=2,981
Total PFAS	**8.5** (8.27-8.70); n= 2,954	**7.6** (7.41-7.80); n= 2,954

Data from Composite Health Care System (CHCS) Chemistry and Military Health System (MHS) GENESIS laboratory databases.
[a]±95% Confidence Limits were calculated for the geometric mean.
*Not calculated: proportion of results below limit of detection was too high to provide a valid result.
Includes number of serum samples with a numeric test result.
All result values are in ng/mL.
Includes service members (SMs) and non-military personnel.
Values are not directly comparable to National Health and Nutrition Examination Survey (NHANES) or Centers for Disease Control (CDC) Per- and Polyfluoroalkyl reporting.
The limit of detection for total PFAS is <0.3. Total PFAS is the sum of all six PFAS compounds measured in a participant's blood. Total PFAS was sampled by a SMs unique identification to extract the number of unique firefighters with records in both FY21 and FY22.
The limit of detection for PFAS compound is <0.05.
The number of SMs by individual PFAS compound is not comparable to the number of SMs by Total PFAS.
Prepared by the EpiData Center (EDC), Defense Centers for Public Health-Portsmouth (DCPH-P) on August 15, 2023.

Discussion

The number of firefighters sampled during FY22 totaled 6,790. Of these, firefighters' records with a test result of 'TNP', 'Test Not Performed' or 'Not Tested' (n=120) were classified as 'Test Not Performed'. Health Artifact and Image Management Solution (HAIMS) records could not be accessed through CHCS (n=29). Both 'Test Not Performed' and HAIMS records were not included in the univariate statistical analysis.

The figures in this report, which illustrate the analytical results from DoD firefighter records in CHCS and MHS GENESIS, generally show undetectable (below the LOD) or low levels of individual PFAS in blood. The geometric mean PFAS levels reported in DoD firefighters should not be directly compared to the those identified in the general population (CDC's NHANES). While these results are generally of the same order of magnitude as those of the general population, laboratory analytical method differences exist between NMS and CDC blood PFAS measures.

The figures in this report depict the distribution of blood PFAS levels in DoD firefighters. This includes DoD firefighters that have PFAS serum levels that exceed the 95th percentile blood concentration in the DoD firefighters tested. The reason(s) why individual firefighters have higher serum PFAS levels cannot be determined from the available analytical data alone. Higher PFAS exposures may come from the workplace (e.g., historical use of AFFF) or from another source (e.g.,

use of a commercial PFAS products at home or from the consumption of PFAS-impacted drinking water).

The number of unique firefighters with PFAS records in CHCS or MHS GENESIS laboratory records increased from FY21 to FY22 (1.1% (n=6,715 versus n=6,790 persons)). Of the DoD firefighters sampled in FY22, 44% (n= 2,954 firefighters) were identified as being tested in FY21. A comparison of FY21 data to FY22 data shows a reduction in total PFAS serum concentration in firefighters who were tested in both sampling periods. This comparison reveals the average downward trend in total PFAS from FY21 to FY22 is statistically significant [Wilcoxon paired test, p=<0.0001 (data not shown, but only reflects 2 years of data.)].

Of all valid tests performed, although PFNA is the second most detected compound with 99.5% of the serum sample above the limit of detection, it has the lowest geometric mean when compared to the other PFAS compounds. The computed geometric mean is the highest for "Other Personnel" (Appendix E2) when compared to all service branches (Appendices A2 – D2) and to the overall measures of central tendency (Table3).

The computed geometric mean for total PFAS was lower by 0.9 ng/mL in FY22 than in FY21 (7.6 ng/ml, 8.5 ng/ml, respectively), which suggests a downward trend in total PFAS levels. Additionally, the computed geometric mean for each PFAS compound is consistently lower in FY22 when compared to FY21. The statistical analysis of the four PFAS compounds frequently detected in firefighter blood samples, PFHxS, PFNA, PFOA and PFOS, reveals a downward trend in PFAS blood levels from FY21 to FY22 in firefighters sampled during both years. These changes were statistically significant [One Sample T-test, p=<0.0001 (Data not shown and only reflect 2 years of data.)].

In FY23-24, the DoD is considering implementation of a firefighter questionnaire for the purpose of collecting demographic information to allow for a more detailed analysis of firefighter PFAS exposures.

Conclusions

The DoD firefighter blood PFAS analytical results do not allow determination of the magnitude, the timing of exposure (frequency and duration), or likely source of PFAS exposures. Annual surveillance reports will track and trend levels of PFAS in DoD firefighter serum. A limited trend analysis of firefighters sampled in both FY21 and FY22 shows a downward trend in total and individual PFAS serum levels. Across all service branches, the computed geometric mean for each PFAS compound is consistently lower in FY22 when compared to FY21 for DoD firefighters sampled in both FY21 and FY22.

Of the unique number of participating DoD personnel tested for PFAS by military service branch during FY22, Air Force accounted for 35.7% (n =2,425), followed by Marine Corps (6.3%, n=431), Navy (5.1%, n=346) and Army (5.0%, n=337).

When the DoD firefighter data is coupled with future firefighter exposure questionnaires, annual surveillance reports may support more refined PFAS exposure and trend analyses.

Limitations

The available records do not contain any information about the individual's potential for exposure to PFAS (e.g., job duties, length of employment, or contact with AFFF) or other information required to identify and assess potential firefighters PFAS exposures. While this report references "firefighters", EDC could not confirm an individual's occupation for those tested. As a result, this report may include blood PFAS analyses from individuals in other occupations or beneficiaries who were tested for blood PFAS based on potential exposure concerns.

The EDC routinely generates, formats, and maintains laboratory data collected from MHS GENESIS and CHCS. The CHCS laboratory records originate from DoD medical treatment facilities (MTFs) that transcribed information into the legacy CHCS/Armed Forces Health Longitudinal Technology Application (AHLTA) electronic health record (EHR) system. The MHS began transitioning MTFs to a new EHR system in February 2017, named MHS GENESIS. The EDC is now receiving an electronic feed of MHS GENESIS data and is evaluating its reliability and integrity. As a result, EDC's analysis of MHS GENESIS laboratory records was performed with caution. CHCS and MHS GENESIS data do not include records from HAIMS, shipboard facilities, battalion aid stations, purchased care providers, in-theater facilities or for many of the Reserve and National Guard firefighters. Future access to direct electronic laboratory data is anticipated to include these missed sources of information and reduce transcription and other data entry errors.

The categorization and validation of firefighter blood PFAS data is reliant on the data that the MTF received from NMS and subsequently uploaded into CHCS or MHS GENESIS. The EDC used validation steps to reduce potential misclassification errors in the available data. The accuracy of the laboratory data records in CHCS and MHS GENESIS depend on correct, accurate, and uniform uploading practices. The EDC classified chemistry tests through extensive searching of free-text test result fields for use in capturing PFAS data for analyses and inclusion in this report. The data presented in this report and the conclusions derived from the EDC's analysis are based on FY21 and FY22 data collected in this manner.

Meaningful statistical trend analysis is not possible at this time given that there are only two data points (FY21 and FY22).

References

1. Assistant Secretary of Defense for Readiness. Memorandum for: blood testing for DoD firefighters to determine exposure to per- and poly-fluoroalkyl substances. September 29, 2020. Available at https://media.defense.gov/2021/May/27/2002730762/-1/-1/0/BLOOD-TESTING-FOR-DOD-FIREFIGHTERS-TO-DETERMINE-EXPOSURE-TO-PFAS.PDF. Accessed August 29, 2023.

2. Centers for Disease Control and Prevention. National Report on Human Exposure to Environmental Chemicals. Last reviewed August 15, 2023. Accessed August 29, 2023. https://www.cdc.gov/exposurereport/index.html.

Appendix A: Air Force

Appendix A1. Total PFAS Laboratory Testing among Participating Air Force Personnel, 01 October 2021 to 30 September 2022

Compound	Total Valid Tests	Below Limit of Detection (%) [a]	Above Limit of Detection (%) [b]
PFBS	2,495	98.0	2.0
PFHpA	2,485	84.7	15.3
PFHxS	2,423	0.4	99.6
PFNA	2,463	0.6	99.4
PFOA	2,497	5.8	94.2
PFOS	2,494	0.8	99.2

Data from Composite Health Care System (CHCS) Chemistry and Military Health System (MHS) GENESIS laboratory databases.

a. Percent of samples with a value below the limit of detection (0.05 ng/mL).

b. Percent of samples with a numeric value grater than the limit of detection (0.05 ng/mL).

Laboratory Testing among Participating Space Force Personnel is included with Air Force Personnel data.

Includes service members (SMs) and non-military personnel.

Values are not directly comparable to NHANES or CDC Per - and Polyfluoroalkyl reporting.

Prepared by the EpiData Center (EDC), Defense Centers for Public Health-Portsmouth (DCPH-P) on August 15, 2023.

Appendix A2. Univariate Statistics for PFAS Blood Testing in Participating Air Force Personnel, 01 October 2021 to 30 September 2022

Compound	Count	Geometric Mean[a]	95th Percentile[b]	No. of Firefighters > 95th Percentile	Maximum Value
PFBS	2,495	*	<LOD	50	0.8
PFHpA	2,485	*	0.1	120	0.6
PFHxS	2,423	**2.19** (2.12-2.28)	8.9	121	32.0
PFNA	2,463	**0.33** (0.32-0.34)	0.7	122	7.3
PFOA	2,497	**0.93** (0.89-0.96)	2.4	105	11.0
PFOS	2,494	**2.73** (2.64-2.82)	9.6	123	49.0

Data from Composite Health Care System (CHCS) Chemistry and Military Health System (MHS) GENESIS laboratory databases.

[a]±95% Confidence Limits were calculated for the geometric mean.

[b]Represents the point at which 5% of the serum samples in the cohort exceeds that value.

<LOD means less than the limit of detection (0.05 ng/mL).

*Not calculated: proportion of results below limit of detection was too high to provide a valid result.

Includes number of serum samples with a numeric test result.

All result values are in ng/mL.

Laboratory Testing among Participating Space Force Personnel is included with Air Force Personnel data.

Includes service members (SMs) and non-military personnel.

Values are not directly comparable to National Health and Nutrition Examination Survey (NHANES) or Centers for Disease Control (CDC) Per- and Polyfluoroalkyl reporting.

Prepared by the EpiData Center (EDC), Defense Centers for Public Health-Portsmouth (DCPH-P) on August 15, 2023.

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Appendix A3. Uni-variate Statistics for PFAS Blood Testing among Participating Air Force Personnel, 01 October 2021 to 30 September 2022

Compound	Type	Count	Geometric Mean[a]	95th Percentile[b]	No. of Firefighters > 95th	Maximum Value
PFBS	ACTIVE DUTY	1,556	*	<LOD	30	0.83
	NON-ACTIVE DUTY	939	*	<LOD	20	0.34
PFHpA	ACTIVE DUTY	1,550	*	0.08	75	0.56
	NON-ACTIVE DUTY	935	*	0.09	46	0.31
PFHxS	ACTIVE DUTY	1,495	**1.95** (1.86-2.04)	8.5	73	32.0
	NON-ACTIVE DUTY	928	**2.67** (2.51-2.83)	9.6	45	26.0
PFNA	ACTIVE DUTY	1,533	**0.30** (0.29-0.31)	0.6	76	4.8
	NON-ACTIVE DUTY	930	**0.39** (0.37-0.40)	0.9	45	7.3
PFOA	ACTIVE DUTY	1,556	**0.83**(0.79-0.87)	2.1	68	6.2
	NON-ACTIVE DUTY	941	**1.11** (1.06-1.17)	2.6	47	11.0
PFOS	ACTIVE DUTY	1,555	**2.55** (2.45-2.66)	8.9	77	35.0
	NON-ACTIVE DUTY	939	**3.05** (2.89-3.21)	10.0	36	49.0

Data from Composite Health Care System (CHCS) Chemistry and Military Health System (MHS) GENESIS laboratory databases.
[a]±95% Confidence Limits were calculated for the geometric mean.
[b]Represents the point at which 5% of the serum samples in the cohort exceeds that value.
<LOD means less than the limit of detection (0.05 ng/mL).
*Not calculated: proportion of results below limit of detection was too high to provide a valid result.
Includes number of serum samples with a numeric test result.
All result values are in ng/mL.
Laboratory Testing among Participating Space Force Personnel is included with Air Force Personnel data.
Includes Active Duty service members and Non-Active Duty service members.
Values are not directly comparable to National Health and Nutrition Examination Survey (NHANES) or Centers for Disease Control (CDC) Per- and Polyfluoroalkyl reporting.
Prepared by the EpiData Center (EDC), Defense Centers for Public Health-Portsmouth (DCPH-P) on August 15, 2023.

Appendix A4. Univariate Statistics for PFAS Blood Testing in Participating Air Force Personnel with records in both FY21 and FY22

	FY21	FY22
Compound	Geometric Mean (n) [a]	Geometric Mean (n)[a]
PFBS	* (n= 850)	* (n= 847)
PFHpA	* (n= 846)	* (n =845)
PFHxS	**3.03** (2.86-3.21); n = 810	**2.54** (2.38-2.71); n= 832
PFNA	**0.40** (0.39-0.42); n=837	**0.34** (0.33-0.36); n = 833
PFOA	**1.08** (1.02-1.14); n= 851	**0.98** (0.92-1.04); n = 849
PFOS	**3.34** (3.16-3.52); n= 850	**2.98** (2.82-3.16); n=847

Data from Composite Health Care System (CHCS) Chemistry and Military Health System (MHS) GENESIS laboratory databases.
[a]±95% Confidence Limits were calculated for the geometric mean.
*Not calculated: proportion of results below limit of detection was too high to provide a valid result.
Includes number of serum samples with a numeric test result.
All result values are in ng/mL.
Includes service members (SMs) and non-military personnel.
Values are not directly comparable to National Health and Nutrition Examination Survey (NHANES) or Centers for Disease Control (CDC) Per- and Polyfluoroalkyl reporting.
Prepared by the EpiData Center (EDC), Defense Centers for Public Health-Portsmouth (DCPH-P) on August 15, 2023.

Appendix B: Army

Appendix B1. Total PFAS Laboratory Testing among Participating Army Personnel, 01 October 2021 to 30 September 2022

Compound	Total Valid Tests	Below Limit of Detection (%) [a]	Above Limit of Detection (%) [b]
PFBS	332	95.2	4.8
PFHpA	331	81.6	18.4
PFHxS	322	0.3	99.7
PFNA	332	0.6	99.4
PFOA	339	4.4	95.6
PFOS	333	0.9	99.1

Data from Composite Health Care System (CHCS) Chemistry and Military Health System (MHS) GENESIS laboratory databases.

a. Percent of samples with a value below the limit of detection (0.05 ng/mL).

b. Percent of samples with a numeric value grater than the limit of detection (0.05 ng/mL).

Includes service members (SMs) and non-military personnel.

Values are not directly comparable to NHANES or CDC Per - and Polyfluoroalkyl reporting.

Prepared by the EpiData Center (EDC), Defense Centers for Public Health-Portsmouth (DCPH-P) on August 15, 2023.

Appendix B2. Uni-variate Statistics for PFAS Blood Testing among Participating Army Personnel, 01 October 2021 to 30 September 2022

Compound	Count	Geometric Mean[a]	95th Percentile[b]	No. of Firefighters > 95th Percentile	Maximum Value
PFBS	332	*	<LOD	16	0.1
PFHpA	331	*	0.1	13	0.2
PFHxS	322	**2.01** (1.82-2.21)	8.1	15	46.0
PFNA	332	**0.37** (0.35-0.39)	0.9	16	3.2
PFOA	339	**1.11** (1.01-1.22)	3.2	16	8.6
PFOS	333	**2.32** (2.13-2.52)	8.4	15	24.0

Data from Composite Health Care System (CHCS) Chemistry and Military Health System (MHS) GENESIS laboratory databases.

[a]±95% Confidence Limits were calculated for the geometric mean.

[b]Represents the point at which 5% of the serum samples in the cohort exceeds that value.

<LOD means less than the limit of detection (0.05 ng/mL).

*Not calculated: proportion of results below limit of detection was too high to provide a valid result.

Includes number of serum samples with a numeric test result.

All result values are in ng/mL.

Includes service members (SMs) and non-military personnel.

Values are not directly comparable to National Health and Nutrition Examination Survey (NHANES) or Centers for Disease Control (CDC) Per- and Polyfluoroalkyl reporting.

Prepared by the EpiData Center (EDC), Defense Centers for Public Health-Portsmouth (DCPH-P) on August 15, 2023.

Appendix B3. Uni-variate Statistics for PFAS Blood Testing among Participating Army Personnel, 01 October 2021 to 30 September 2022

Compound	Type	Count	Geometric Mean[a]	95th Percentile[b]	No. of Firefighters > 95th Percentile	Maximum Value
PFBS	ACTIVE DUTY	140	*	0.1	7	0.12
	NON-ACTIVE DUTY	192	*	<LOD	7	0.09
PFHpA	ACTIVE DUTY	140	*	0.11	7	0.18
	NON-ACTIVE DUTY	191	*	0.11	7	0.16
PFHxS	ACTIVE DUTY	135	**1.83** (1.57-2.14)	8.5	6	46.0
	NON-ACTIVE DUTY	187	**2.14** (1.89-2.43)	7.6	9	39.0
PFNA	ACTIVE DUTY	140	**0.34** (0.31-0.37)	0.86	7	1.9
	NON-ACTIVE DUTY	192	**0.40** (0.38-0.43)	0.81	9	3.2
PFOA	ACTIVE DUTY	142	**0.99** (0.83-1.18)	3.4	7	8.5
	NON-ACTIVE DUTY	197	**1.20** (1.08-1.34)	3.1	9	8.6
PFOS	ACTIVE DUTY	140	**2.11** (1.84-2.42)	7.4	7	21.0
	NON-ACTIVE DUTY	193	**2.48** (2.23-2.76)	8.5	9	24.0

Data from Composite Health Care System (CHCS) Chemistry and Military Health System (MHS) GENESIS laboratory databases.
[a]±95% Confidence Limits were calculated for the geometric mean.
[b]Represents the point at which 5% of the serum samples in the cohort exceeds that value.
<LOD means less than the limit of detection (0.05 ng/mL).
*Not calculated: proportion of results below limit of detection was too high to provide a valid result.
Includes number of serum samples with a numeric test result.
All result values are in ng/mL.
Includes Active Duty service members and Non-Active Duty service members.
Values are not directly comparable to National Health and Nutrition Examination Survey (NHANES) or Centers for Disease Control (CDC) Per- and Polyfluoroalkyl reporting.
Prepared by the EpiData Center (EDC), Defense Centers for Public Health-Portsmouth (DCPH-P) on August 15, 2023.

Appendix B4. Uni-variate Statistics for PFAS Blood Testing among Participating Army Personnel with records in both FY21 and FY22

	FY21	FY22
Compound	Geometric Mean (n) [a]	Geometric Mean (n)[a]
PFBS	* (n= 137)	* (n= 129)
PFHpA	* (n= 137)	* (n = 129)
PFHxS	**2.67** (2.34-3.05); n = 132	**2.35** (2.03-2.72); n= 127
PFNA	**0.45** (0.41-0.49); n=136	**0.39** (0.36-0.43); n = 129
PFOA	**1.39** (1.22-1.59); n=139	**1.30** (1.13-1.50); n = 132
PFOS	**2.75** (2.39-3.18); n= 137	**2.53** (2.19-2.92); n=129

Data from Composite Health Care System (CHCS) Chemistry and Military Health System (MHS) GENESIS laboratory databases.
[a]±95% Confidence Limits were calculated for the geometric mean.
*Not calculated: proportion of results below limit of detection was too high to provide a valid result.
Includes number of serum samples with a numeric test result.
All result values are in ng/mL.
Includes service members (SMs) and non-military personnel.
Values are not directly comparable to National Health and Nutrition Examination Survey (NHANES) or Centers for Disease Control (CDC) Per- and Polyfluoroalkyl reporting.
Prepared by the EpiData Center (EDC), Defense Centers for Public Health-Portsmouth (DCPH-P) on August 15, 2023.

Appendix C: Marine Corps

Appendix C1. Total PFAS Laboratory Testing among Participating Marine Corps personnel, 01 October 2021 to 30 September 2022

Compound	Total Valid Tests	Below Limit of Detection (%) [a]	Above Limit of Detection (%) [b]
PFBS	431	97.7	2.3
PFHpA	427	81.7	18.3
PFHxS	421	0.0	100.0
PFNA	424	0.0	100.0
PFOA	433	4.4	95.6
PFOS	431	0.0	100.0

Data from Composite Health Care System (CHCS) Chemistry and Military Health System (MHS) GENESIS laboratory databases.

a. Percent of samples with a value below the limit of detection (0.05 ng/mL).

b. Percent of samples with a numeric value grater than the limit of detection (0.05 ng/mL).

Includes service members (SMs) and non-military personnel.

Values are not directly comparable to NHANES or CDC Per - and Polyfluoroalkyl reporting.

Prepared by the EpiData Center (EDC), Defense Centers for Public Health-Portsmouth (DCPH-P) on August 15, 2023.

Appendix C2. Uni-variate Statistics for PFAS Blood Testing among Participating Marine Corps Personnel, 01 October 2021 to 30 September 2022

Compound	Count	Geometric Mean[a]	95th Percentile[b]	No. of Firefighters > 95th Percentile	Maximum Value
PFBS	431	*	<LOD	10	0.1
PFHpA	427	*	0.1	25	0.3
PFHxS	421	**1.69** (1.57-1.82)	6.0	21	19.0
PFNA	424	**0.34** (0.33-0.35)	0.7	20	1.6
PFOA	433	**0.97** (0.89-1.04)	2.1	20	8.0
PFOS	431	**2.38** (2.24-2.53)	7.4	21	21.0

Data from Composite Health Care System (CHCS) Chemistry and Military Health System (MHS) GENESIS laboratory databases.

[a]±95% Confidence Limits were calculated for the geometric mean.

[b]Represents the point at which 5% of the serum samples in the cohort exceeds that value.

<LOD means less than the limit of detection (0.05 ng/mL).

*Not calculated: proportion of results below limit of detection was too high to provide a valid result.

Includes number of serum samples with a numeric test result.

All result values are in ng/mL.

Includes service members (SMs) and non-military personnel.

Values are not directly comparable to National Health and Nutrition Examination Survey (NHANES) or Centers for Disease Control (CDC) Per- and Polyfluoroalkyl reporting.

Prepared by the EpiData Center (EDC), Defense Centers for Public Health-Portsmouth (DCPH-P) on August 15, 2023.

Appendix C3. Uni-variate Statistics for PFAS Blood Testing among Participating Marine Corps Personnel, 01 October 2021 to 30 September 2022

Compound	Type	Count	Geometric Mean[a]	95th Percentile[b]	No. of Firefighters > 95th Percentile	Maximum Value
PFBS	ACTIVE DUTY	349	*	<LOD	10	0.11
	NON-ACTIVE DUTY	82	*	<LOD	0	<LOD
PFHpA	ACTIVE DUTY	347	*	0.10	17	0.26
	NON-ACTIVE DUTY	80	*	0.09	4	0.12
PFHxS	ACTIVE DUTY	340	**1.70** (1.57-1.85)	6.2	17	19.0
	NON-ACTIVE DUTY	81	**1.65** (1.41-1.93)	4.6	4	9.3
PFNA	ACTIVE DUTY	346	**0.33** (0.32-0.35)	0.7	15	1.6
	NON-ACTIVE DUTY	78	**0.38** (0.34-0.41)	0.7	3	0.8
PFOA	ACTIVE DUTY	351	**0.93** (0.85-1.02)	2.1	17	8.0
	NON-ACTIVE DUTY	82	**1.13** (1.01-1.26)	1.8	4	3.3
PFOS	ACTIVE DUTY	349	**2.44** (2.27-2.61)	7.5	17	21.0
	NON-ACTIVE DUTY	82	**2.16** (1.92-2.44)	6.0	4	8.8

Data from Composite Health Care System (CHCS) Chemistry and Military Health System (MHS) GENESIS laboratory databases.
[a]±95% Confidence Limits were calculated for the geometric mean.
[b]Represents the point at which 5% of the serum samples in the cohort exceeds that value.
<LOD means less than the limit of detection (0.05 ng/mL).
*Not calculated: proportion of results below limit of detection was too high to provide a valid result.
All result values are in ng/mL.
Includes number of serum samples with a numeric test result.
Includes Active Duty service members and Non-Active Duty service members.
Values are not directly comparable to National Health and Nutrition Examination Survey (NHANES) or Centers for Disease Control (CDC) Per- and Polyfluoroalkyl reporting.
Prepared by the EpiData Center (EDC), Defense Centers for Public Health-Portsmouth (DCPH-P) on August 15, 2023.

Appendix C4. Uni-variate Statistics for PFAS Blood Testing among Participating Marine Corps Personnel with records in both FY21 and FY22

	FY21	FY22
Compound	Geometric Mean (n) [a]	Geometric Mean (n)[a]
PFBS	* (n= 153)	* (n= 146)
PFHpA	* (n=152)	* (n = 143)
PFHxS	**2.17** (1.93-2.45); n = 145	**1.92** (1.70-2.16); n= 145
PFNA	**0.41** (0.38-0.44); n=153	**0.36** (0.34-0.39); n = 146
PFOA	**1.14** (1.03-1.27); n= 153	**1.08** (0.96-1.21); n = 146
PFOS	**2.76** (2.44-3.11); n=153	**2.72** (2.46-2.99); n= 146

Data from Health Level 7 (HL7) Chemistry and Military Health System (MHS) GENESIS Laboratory Results.
[a]±95% Confidence Limits were calculated for the geometric mean.
*Not calculated: proportion of results below limit of detection was too high to provide a valid result.
Includes number of serum samples with a numeric test result.
All result values are in ng/mL.
Includes service members (SMs) and non-military personnel.
Values are not directly comparable to National Health and Nutrition Examination Survey (NHANES) or Centers for Disease Control (CDC) Per- and Polyfluoroalkyl reporting.
Prepared by the EpiData Center (EDC), Defense Centers for Public Health-Portsmouth (DCPH-P) on August 15, 2023.

Appendix D: Navy

Appendix D1. Total PFAS Laboratory Testing among Participating Navy Personnel, 01 October 2021 to 30 September 2022

Compound	Total Valid Tests	Below Limit of Detection (%) [a]	Above Limit of Detection (%) [b]
PFBS	349	98.6	1.4
PFHpA	347	86.2	13.8
PFHxS	339	0.0	100.0
PFNA	348	0.3	99.7
PFOA	351	6.3	93.7
PFOS	349	0.6	99.4

Data from Composite Health Care System (CHCS) Chemistry and Military Health System (MHS) GENESIS laboratory databases.

a. Percent of samples with a value below the limit of detection (0.05 ng/mL).

b. Percent of samples with a numeric value grater than the limit of detection (0.05 ng/mL).

Includes service members (SMs) and non-military personnel.

Values are not directly comparable to NHANES or CDC Per - and Polyfluoroalkyl reporting.

Prepared by the EpiData Center (EDC), Defense Centers for Public Health-Portsmouth (DCPH-P) on August 15, 2023.

Appendix D2. Uni-variate Statistics for PFAS Blood Testing among Participating Navy Personnel, 01 October 2021 to 30 September 2022

Compound	Count	Geometric Mean[a]	95th Percentile[b]	No. of Firefighters > 95th Percentile	Maximum Value
PFBS	349	*	<LOD	5	0.3
PFHpA	347	*	0.1	19	0.21
PFHxS	339	**1.96** (1.79-2.14)	9.7	15	20.0
PFNA	348	**0.34** (0.33-0.36)	0.7	17	1.4
PFOA	351	**0.94** (0.85-1.04)	2.5	16	7.7
PFOS	349	**2.35** (2.17-2.54)	8.0	17	63.0

Data from Composite Health Care System (CHCS) Chemistry and Military Health System (MHS) GENESIS laboratory databases.

[a]±95% Confidence Limits were calculated for the geometric mean.

[b]Represents the point at which 5% of the serum samples in the cohort exceeds that value.

<LOD means less than the limit of detection (0.05 ng/mL).

*Not calculated: proportion of results below limit of detection was too high to provide a valid result.

Includes number of serum samples with a numeric test result.

All result values are in ng/mL.

Includes service members (SMs) and non-military personnel.

Values are not directly comparable to National Health and Nutrition Examination Survey (NHANES) or Centers for Disease Control (CDC) Per- and Polyfluoroalkyl reporting.

Prepared by the EpiData Center (EDC), Defense Centers for Public Health-Portsmouth (DCPH-P) on August 15, 2023.

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Appendix D3. Uni-variate Statistics for PFAS Blood Testing among Participating Navy Personnel, 01 October 2021 to 30 September 2022

Compound	Type	Count	Geometric Mean[a]	95th Percentile[b]	No. of Firefighters > 95th Percentile	Maximum Value
PFBS	ACTIVE DUTY	264	*	<LOD	2	0.13
	NON-ACTIVE DUTY	85	*	<LOD	3	0.30
PFHpA	ACTIVE DUTY	262	*	0.09	13	0.21
	NON-ACTIVE DUTY	85	*	0.07	4	0.19
PFHxS	ACTIVE DUTY	256	**1.89** (1.72-2.10)	9.2	12	19.0
	NON-ACTIVE DUTY	83	**2.15** (1.76-2.64)	10.0	4	20.0
PFNA	ACTIVE DUTY	263	**0.34** (0.33-0.36)	0.66	11	1.4
	NON-ACTIVE DUTY	85	**0.34** (0.30-0.38)	0.69	4	1.0
PFOA	ACTIVE DUTY	265	**0.94** (0.84-1.06)	2.4	13	7.7
	NON-ACTIVE DUTY	86	**0.94** (0.76-1.15)	2.5	4	5.6
PFOS	ACTIVE DUTY	264	**2.36** (2.17-2.57)	8.0	13	63.0
	NON-ACTIVE DUTY	85	**2.32** (1.93-2.78)	7.8	4	35.0

Data from Composite Health Care System (CHCS) Chemistry and Military Health System (MHS) GENESIS laboratory databases.
[a]±95% Confidence Limits were calculated for the geometric mean.
[b]Represents the point at which 5% of the serum samples in the cohort exceeds that value.
<LOD means less than the limit of detection (0.05 ng/mL).
*Not calculated: proportion of results below limit of detection was too high to provide a valid result.
Includes number of serum samples with a numeric test result.
All result values are in ng/mL.
Includes Active Duty service members and Non-Active Duty service members.
Values are not directly comparable to National Health and Nutrition Examination Survey (NHANES) or Centers for Disease Control (CDC) Per- and Polyfluoroalkyl reporting.
Prepared by the EpiData Center (EDC), Defense Centers for Public Health-Portsmouth (DCPH-P) on August 15, 2023.

Appendix D4. Uni-variate Statistics for PFAS Blood Testing among Participating Navy Personnel with records in both FY21 and FY22

	FY21	FY22
Compound	Geometric Mean (n) [a]	Geometric Mean (n)[a]
PFBS	* (n= 130)	* (n=124)
PFHpA	* (n= 129)	* (n = 123)
PFHxS	**2.65** (2.31-3.05); n = 123	**2.42** (2.08-2.81); n= 123
PFNA	**0.39** (0.37-0.41); n=128	**0.34** (0.32-0.36); n = 123
PFOA	**1.13** (0.99-1.28); n= 130	**1.02** (0.88-1.19); n = 124
PFOS	**2.82** (2.49-3.18); n= 130	**2.57** (2.28-2.89); n=124

Data from Health Level 7 (HL7) Chemistry and Military Health System (MHS) GENESIS Laboratory Results.
[a]±95% Confidence Limits were calculated for the geometric mean.
*Not calculated: proportion of results below limit of detection was too high to provide a valid result.
Includes number of serum samples with a numeric test result.
All result values are in ng/mL.
Includes service members (SMs) and non-military personnel.
Values are not directly comparable to National Health and Nutrition Examination Survey (NHANES) or Centers for Disease Control (CDC) Per- and Polyfluoroalkyl reporting.
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Appendix B: Other

Appendix E1. Total PFAS Laboratory Testing among Participating Other Personnel, 01 October 2021 to 30 September 2022

Compound	Total Valid Tests	Below Limit of Detection (%) [a]	Above Limit of Detection (%) [b]
PFBS	3,252	97.2	2.8
PFHpA	3,226	82.7	17.3
PFHxS	3,182	0.1	99.9
PFNA	3,220	0.4	99.6
PFOA	3,305	4.6	95.4
PFOS	3,252	0.7	99.3

Data from Composite Health Care System (CHCS) Chemistry and Military Health System (MHS) GENESIS laboratory databases.

a. Percent of samples with a value below the limit of detection (0.05 ng/mL).

b. Percent of samples with a numeric value grater than the limit of detection (0.05 ng/mL).

Includes non-active duty service members (i.e., DoD civilians, foreign nationals, and others not idenitified).

Values are not directly comparable to NHANES ar CDC Per - and Polyfluoroalkyl reporting.

Prepared by the EpiData Center (EDC), Defense Centers for Public Health-Portsmouth (DCPH-P) on August 15, 2023.

Appendix E2. Uni-variate Statistics for PFAS Blood Testing among Participating Other Personnel, 01 October 2021 to 30 September 2022

Compound	Count	Geometric Mean[a]	95th Percentile[b]	No. of Firefighters > 95th Percentile	Maximum Value
PFBS	3,252	*	<LOD	90	0.3
PFHpA	3,226	*	0.1	109	1.9
PFHxS	3,182	**2.69** (2.61-2.78)	12.0	144	65.0
PFNA	3,220	**0.39** (0.39-0.40)	1.0	145	8.2
PFOA	3,305	**1.13** (1.09-1.17)	3.1	162	25.0
PFOS	3,252	**2.87** (2.79-2.95)	10.0	155	49.0

Data from Composite Health Care System (CHCS) Chemistry and Military Health System (MHS) GENESIS laboratory databases.

[a]±95% Confidence Limits were calculated for the geometric mean.

[b]Represents the point at which 5% of the serum samples in the cohort exceeds that value.

<LOD means less than the limit of detection (0.05 ng/mL).

*Not calculated: proportion of results below limit of detection was too high to provide a valid result.

Includes number of serum samples with a numeric test result.

All result values are in ng/mL.

Includes non-active duty service members (i.e., DoD civilians, foreign nationals, and others not idenitified).

Values are not directly comparable to National Health and Nutrition Examination Survey (NHANES) or Centers for Disease Control (CDC) Per- and Polyfluoroalkyl reporting.

Prepared by the EpiData Center (EDC), Defense Centers for Public Health-Portsmouth (DCPH-P) on August 15, 2023.

Appendix E3. Uni-variate Statistics for PFAS Blood Testing among Participating Other Personnel, 01 October 2021 to 30 September 2022

Compound	Type	Count	Geometric Mean[a]	95th Percentile[b]	No. of Firefighters > 95th Percentile	Maximum Value
PFBS	ACTIVE DUTY	--	--	--	--	--
	NON-ACTIVE DUTY	3,252	*	<LOD	90	0.29
PFHpA	ACTIVE DUTY	--	--	--	--	--
	NON-ACTIVE DUTY	3,226	*	0.10	156	1.9
PFHxS	ACTIVE DUTY	--	--	--	--	--
	NON-ACTIVE DUTY	3,182	**2.69** (2.61-2.78)	12.0	144	65.0
PFNA	ACTIVE DUTY	--	--	--	--	--
	NON-ACTIVE DUTY	3,220	**0.39** (0.38-0.40)	1.0	145	8.2
PFOA	ACTIVE DUTY	--	--	--	--	--
	NON-ACTIVE DUTY	3,305	**1.13** (1.09-1.17)	3.1	162	25.0
PFOS	ACTIVE DUTY	--	--	--	--	--
	NON-ACTIVE DUTY	3,252	**2.87** (2.79-2.95)	10.0	155	49.0

Data from Composite Health Care System (CHCS) Chemistry and Military Health System (MHS) GENESIS laboratory databases.
[a]±95% Confidence Limits were calculated for the geometric mean.
[b]Represents the point at which 5% of the serum samples in the cohort exceeds that value.
<LOD means less than the limit of detection (0.05 ng/mL).
*Not calculated: proportion of results below limit of detection was too high to provide a valid result.
Includes number of serum samples with a numeric test result.
All result values are in ng/mL.
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Appendix E4. Uni-variate Statistics for PFAS Blood Testing among Participating Other Personnel with records in both FY21 and FY22

	FY21	FY22
Compound	Geometric Mean (n) [a]	Geometric Mean (n)[a]
PFBS	* (n= 1,765)	* (n= 1,735)
PFHpA	* (n= 1,750)	* (n = 1,724)
PFHxS	**3.05** (2.94-3.18); n = 1,713	**2.75** (2.64-2.86); n= 1,706
PFNA	**0.47** (0.45-0.48); n=1,761	**0.41** (0.39-0.42); n = 1,721
PFOA	**1.29** (1.25-1.34); n= 1,802	**1.16** (1.11-1.21); n = 1,773
PFOS	**3.26** (3.15-3.38); n= 1,775	**2.98** (2.88-3.09); n=1,735

Data from Health Level 7 (HL7) Chemistry and Military Health System (MHS) GENESIS Laboratory Results.
[a]±95% Confidence Limits were calculated for the geometric mean.
*Not calculated: proportion of results below limit of detection was too high to provide a valid result.
Includes number of serum samples with a numeric test result.
All result values are in ng/mL.
Includes non-active duty service members (i.e., DoD civilians, foreign nationals, and others not idenitified).
Values are not directly comparable to National Health and Nutrition Examination Survey (NHANES) or Centers for Disease Control (CDC) Per- and Polyfluoroalkyl reporting.
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Contact Us

For more than a decade, the EpiData Center (EDC) has provided timely, actionable data surveillance and analysis for the Department of the Navy and Department of Defense in support of military health and readiness. The EDC's epidemiological and technical expertise informs a comprehensive, evidence based suite of public health products regarding reportable and emerging infections, healthcare associated infections and patient safety, behavioral and operational health, exposure and injury analysis, and application development and data systems support.

For questions about this report or to inquire about project support, please contact the EDC at **usn.hampton_roads.navmcpubhlthcenpors.list.nmcphc_epi_plls@health.mil**.