dren's health and development. Launched in response to the 1997 Miami Declaration issued by G8 environmental leaders, the MoEJ started preparation of the research project focusing on this topic. In 2010, MoEJ called universities and research institutes to participate for the research about the health effects by the early life environmental exposures. After evaluating the researches, human resource and geographical balance of the candidate organizations, 15 regional centers were selected and the recruitment of pregnant women at OB/GY hospitals and clinics started in January 2011. JECS is collaborating with WHO and international children's environmental health cohort study groups to harmonize the data and contribute for healthier society for future generations. **Methods:** The Program Office at the National Institute for Environmental Studies and the Medical Support Center at the National Center for Child Health and Development collaboratively oversee 15 Regional Centers throughout Japan, each conducting the study in its respective region. JECS boasts over 100,000 mother-child dyads registered in its Main Study between 2011 and 2014, with paternal involvement reaching 50%. The children are now aged 10-13, and the retention rate exceeds 90%. In 2022, the Ministry extended the follow-up period from age 13 to around 40 years to explore long-term effects of early-life environment on child health and development. The Main Study involves comprehensive biospecimen (maternal blood during pregnancy and at birth, maternal urine, umbilical cord blood, maternal and child hair, and breast milk) for the measurement of biological markers and environmental contaminants (immunoglobulins, toxic metals, metallic elements, PFAS, phenols, and etc.), medical records (during pregnancy and until 1 month after birth) collection, complemented by biannual questionnaires to collect environmental, genetic, social, and lifestyle information. Medical examination, developmental assessments, urine and blood samples are collected in the face-to-face check-ups at age 6 and 12 years. The Sub-Cohort Study, comprising 5% of the Main Study participants, involves environmental sampling at age 1.5 and 3 years, including assessment of indoor/outdoor $PM_{2.5}$ and PM_{10} dust chemicals, and volatile organic compounds. Child health and neurodevelopment have been evaluated through face-to-face check-ups, with blood samples collected at age 2,4,6,8, and 10 years. Furthermore, paternal risks are being explored under the framework of POHaD (Paternal Origins of Health and Disease). Specifically, the study is assessing pesticide exposure in paternal blood to investigate the potential impact of pesticide contamination on the condition of paternal germ cells, which may contribute to an increased risk of neurodevelopmental disorders in children. **Results:** The JECS Group is investigating various topics including the association between maternal/child health and metallic elements (Hg, Pb, Cd, Mn, and Se), PFAS, and air pollutants. For maternal metallic elements, higher blood Pb and Se levels were found to be associated with poor weight trajectories. For PFAS, 14 out of 28 PFAS were detected from maternal serum with 0.1 - 100% of detection frequency. Most dominant PFAS was PFOS followed by PFOA, PFNA, and PFUnDA. Any clear associations were found between prenatal exposure to PFAS and either childhood asthma/wheeze or Kawasaki diseases up to 4 years of age. For indoor air, exposure to m,p-and o-xylene at the age of 3 years was associated with lower development scores. Additionally, it was found that neonicotinoid pesticides were detected in paternal blood, and these were suspected to be associated with an increased risk of neurodevelopmental disorders in children. **Conclusions:** Ongoing JECS study will follow the children's environmental health until they become around at 40 years old, and possible be able to see the environmental health effects though three generations. The outcomes will be used to create healthier environment for future generations.

4574 Serum per- and polyfluoroalkyl substances and lipids: A systematic review and meta-analysis

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Background and Purpose: Exposure to per- and polyfluoroalkyl substances (PFAS) is associated with changes in serum lipid levels, yet geographic variations remain poorly understood. Therefore, we aimed to explore this relationship through systematic review and meta-analysis. **Methods:** We included 106 epidemiological studies, analyzing the impact of PFAS exposure on total cholesterol (TC), total triglycerides (TG), low-density lipoprotein cholesterol (LDL), and high-density lipoprotein cholesterol (HDL) worldwide. One-way ANOVA was used to compare the PFAS serum levels of people in different geographic regions and proximity to PFAS contamination sources. Meta-analysis was performed in at least three observational studies to determine the direction and significance of associations. Sign tests were used to compare the statistical significance of positive and negative associations. **Results:** Race/ethnicity and geographic variations had no impact on PFAS levels ($P > 0.05$). Serum PFAS levels were greater in high-exposure groups. Results from meta-analysis and sign tests show that the general population and high-exposure studies have positive associations of PFOA, PFOS, and PFNA with TC, HDL, and LDL. PFHxS and PFDA showed a positive association with HDL. Likewise, there were positive associations between PFOS and TC in children, but not in pregnant women. There was no clear evidence for associations between PFAS and TG. The high-exposure group exhibited higher β coefficients compared to the general population. **Conclusions:** Data gaps still exist in certain geographical regions, highlighting the need for further research and to investigate PFAS alternatives and mixtures. **Disclaimer**: The findings and conclusions in this presentation are those of the authors and do not necessarily represent the views of CDC/ATSDR.

4575 Cross-Seasonal Changes in the Levels of Inflammatory Biomarkers among Wildland Firefighters

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Background and Purpose: Wildfire activity is increasing in frequency and severity across the United States. Wildland firefighters are the first line of defense against this disaster situation. During firefighting, wildland firefighters are directly exposed to elevated levels of smoke. Exposure to air pollutants from wildland fire smoke, such as respirable particulate matter, can trigger a cascade of inflammatory responses in the lungs, subsequently resulting in systemic inflammation. Increased levels of systemic inflammatory biomarkers after single firefighting shifts and fire seasons have been observed among wildland firefighters. However, studies have rarely assessed how inflammation biomarkers change across and in between fire seasons. This study aims to investigate systemic inflammation status of wildland firefighters across two consecutive fire seasons (2018 and 2019). This research study is part of the Wildland Firefighter Exposure and Health Effects (WFFEHE) Study conducted by the Centers for Disease Control and Prevention (CDC) National Institute for Occupational Safety and Health (NIOSH). **Methods:** Venous blood was collected among 145 wildland firefighters (aged 28.7 ± 5.8 years, 92% male) at the beginning and end of the wildfire seasons in 2018 and 2019. A total of nine inflammatory biomarkers, including tumor necrosis factor (TNF-α), interleukin-6 (IL-6), interleukin-8 (IL-8), matrix metalloproteinase-9 (MMP9), C-C motif chemokine ligand 2 (CCL2), angiopoietin-2 (Ang2), receptor for advanced glycation end products (RAGE), surfactant protein D (SP-D), and uteroglobin (UG), were analyzed and quantified using multiplex ELISA. The values above the limit of detection (LOD) were handled by using the upper detection limit, while the values below the LOD were substituted by the square root of LOD. Most samples (~97%) had TNF-α and IL-6 serum concentrations below the LOD (6.6 and 3.7 pg/ml) and therefore these two cytokines were excluded from the following statistical analyses. Linear mixed model (LMM) using SAS MIXED with autoregressive 1 (AR1) variance-covariance matrix was used to determine the changes in the levels of biomarkers among the firefighters. Paired samples from the firefighters were analyzed as follows: 1) combined 2018 and 2019 post- minus pre-season changes; 2) off-season changes (pre-season 2019 minus post-season 2018); and 3) changes across follow-up period (post-season 2019 minus pre-season 2018). Age, smoking status, and the number of firefighting incidents during wildfire season were included as covariates in the model. A p-value < 0.05 was considered statistically significant. **Results:** There were 20% and 17% of IL-8 samples below the LOD (3.1 pg/ml) in pre- and post-season, respectively. For MMP9, 12% and 11% of serum samples were above the LOD (29.25 µg/ml) in pre- and post-season, respectively. Similarly, 19% and 36% of UG concentrations were higher than its LOD (10.63 µg/ml) in pre- and post-season, respectively. Testing values of all other biomarkers were within the detection range. CCL2, RAGE, SP-D, and UG significantly increased across the fire season when the 2018 and 2019 measurements were combined (0.06 ± 0.01 µg/ml, $p < 0.01$; 0.25 ± 0.07 µg/ml, $p < 0.01$; 1.17 ± 0.25 µg/ml, $p < 0.01$; 0.74 ± 0.13 µg/ml, $p < 0.01$, respectively). Overall Ang2 significantly decreased after the fire season (−0.30 ± 0.06 µg/ml, $p < 0.01$). MMP-9, CCL2, RAGE, SP-D, and UG significantly decreased during the off-season (−5.28 ± 1.10 µg/ml, $p < 0.01$; −0.07 ± 0.02 µg/ml, $p < 0.01$; −0.29 ± 0.10 µg/ml, $p = 0.01$; −2.01 ± 0.48 µg/ml, $p < 0.01$; −0.67 ± 0.15 µg/ml, $p < 0.01$, respectively). CCL2 and UG significantly increased from 2018 pre-season to 2019 post-season (0.06 ± 0.02 µg/ml, $p = 0.01$; 0.78 ± 0.30 µg/ml, $p = 0.01$, respectively), but MMP-9 and Ang2 significantly decreased during the same period (−5.08 ± 1.39 µg/ml, $p < 0.01$; −0.42 ± 0.12 µg/ml, $p < 0.01$, respectively). **Conclusions:** The results suggest wildland firefighting generally alters the levels of biomarkers across the wildfire season, reflecting systemic inflammatory response. As indicated by the reduction in the concentrations of most of biomarkers (MMP-9, CCL2, RAGE, SP-D, and UG) during the off-season period, a break from wildland firefighting seemed to alleviate the inflammatory response.

4576 Ambient air hydrogen sulfide in residential areas near mushroom composting operations in Chester County, Pennsylvania

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Background and Purpose: Hydrogen sulfide (H_2S) is a colorless gas and common environmental odor with a characteristic rotten egg smell. H_2S in ambient air comes from naturally occurring sources, such as the breakdown of plant and animal material, sewers, volcanoes, and hot springs, and industrial sources, such as oil refineries, pulp and paper mills, sewage treatment facilities, landfills, food processing plants, mines, and coke oven plants. H_2S is considered an irritant, especially for the eyes, nose, and throat, and several studies have suggested that inhalation exposure to H_2S can exacerbate asthma symptoms. Health effects associated with chronic low-level exposures have not been sufficiently studied, especially in the general population.

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