Anthropometry in 5- to 9-Year-Old Greenlandic and Ukrainian Children in Relation to Prenatal Exposure to Perfluorinated Alkyl Substances.

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Abstract: BACKGROUND: In some animal studies, perfluorinated alkyl substances are suggested to induce weight gain. Human epidemiological studies investigating these associations are sparse.

OBJECTIVE: We examined pregnancy serum concentrations of perfluorooctanoate (PFOA) and perfluorooctane sulfonate (PFOS) and the prevalence of offspring overweight (> 1 SD) and waist-to-height ratio (WHtR) > 0.5 at 5-9 years of age.

METHODS: Sera from 1,022 pregnant women enrolled in the INUENDO cohort (2002-2004) from Greenland and Kharkiv (Ukraine) were analyzed for PFOA and PFOS using liquid chromatography-tandem mass spectrometry. Relative risks (RR) of being overweight and having WHtR > 0.5 in relation to continuous and categorized (tertiles) PFOA and PFOS were calculated at follow-up (2010-2012) using generalized linear models.

RESULTS: Pooled PFOA median (range) was 1.3 (0.2-5.1) and PFOS median (range) was 10.8 (0.8-73.0) ng/mL. For each natural logarithm-unit (ln-unit) increase of pregnancy PFOA, the adjusted RR of offspring overweight was 1.11 [95% confidence interval (CI): 0.82, 1.53] in Greenlandic children. In Ukrainian children, the adjusted RR of offspring overweight was 1.02 (95% CI: 0.72, 1.44) for each ln-unit increase of pregnancy PFOA. Prenatal exposure to PFOS was not associated with overweight in country-specific or pooled analysis. The adjusted RR of having WHtR > 0.5 for each ln-unit increase of prenatal exposure to PFOA was 1.30 (95% CI: 0.97, 1.74) in the pooled analysis. For 1-ln-unit increase of prenatal exposure to PFOS, the adjusted RR of having a WHtR > 0.5 was 1.38 (95% CI: 1.05, 1.82) in the pooled analysis.

CONCLUSIONS: The results indicate that prenatal PFOA and PFOS exposures may be associated with child waist-to-height ratio > 0.5. Prenatal PFOA and PFOS exposures were not associated with overweight.

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Blood serum concentrations of perfluorinated compounds in men from Greenlandic Inuit and European populations.

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Abstract: Perfluorinated compounds (PFCs), such as perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA), are used in large quantities. They are persistent and found in measurable levels in human serum around the world. They have been associated with developmental, hepatic, and carcinogenic effects in animal studies. The aim of the present study was to describe levels of PFCs in serum among Inuits from Greenland and inhabitants from Warsaw, Poland and Kharkiv, Ukraine. Furthermore, the aim was to define social- and lifestyle related determinants of exposure for these compounds. Serum levels of seven PFCs were analyzed by liquid chromatography/tandem mass spectrometry (LC/MS/MS). The concentrations of PFOS and PFOA were the highest of all PFCs in all three populations with a total amount of almost 90% of the PFCs. The mean levels of PFOS and PFOA were in the Greenlandic Inuits 52 and 4.8 ng mL\(^{-1}\), in Poland 19 and 5.2 ng mL\(^{-1}\), and in Ukraine 8.1 and 1.9 ng mL\(^{-1}\), respectively. Thus, levels of PFCs in the serum of Inuits on Greenland were among the highest described in a general population whereas the levels in Poland were similar to other industrialized countries. The exposure in Ukraine was rather low. In the Greenlandic Inuit population, intake of seafood, tea, age and area of living were significant determinants of PFOS concentrations and explained about 22% of the variation. For the other populations no strong determinants were found.

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OBJECTIVE: To investigate the association between maternal pregnancy and estimated postnatal serum concentrations of the organochlorines 2,2',4,4',5,5'-hexachlorobiphenyl (CB-153) and 1,1-dichloro-2,2-bis(p-chlorophenyl)ethylene (p,p'-DDE) and body mass index (BMI) z-scores in 5- to 9-year-old children.

METHODS: Maternal sera from the INUENDO birth cohort (2002-2004) comprising mother-child pairs (N=1109) from Greenland, Warsaw (Poland), and Kharkiv (Ukraine) were analysed for CB-153 and p,p'-DDE, using gas chromatography-mass-spectrometry, and were grouped into tertiles for statistical analyses. A toxicokinetic model was used to estimate the first 12 months cumulative exposure to the compounds. Associations between these compounds and child age- and sex-specific BMI z-scores were calculated at follow-up (2010-2012), using multiple linear regression analysis.

RESULTS: No clear associations between pregnancy CB-153 and p,p'-DDE and child BMI were observed (the pooled differences in BMI z-score (95% confidence interval) comparing 3rd tertile to 1st tertile were -0.07 (-0.32 to 0.18) and -0.10 (-0.30 to 0.10) kg/m², respectively). For postnatal CB-153 and p,p'-DDE and BMI, the overall differences in BMI z-score comparing 3rd tertile to 1st tertile were 0.12 (-0.15 to 0.39) and -0.03 (-0.20 to 0.27) kg/m², respectively.

CONCLUSIONS: This follow-up study of Greenlandic, Polish and Ukrainian populations showed no clear association between pregnancy and postnatal exposure to p,p'-DDE and CB-153 and BMI at the age of 5-9 years.
OBJECTIVES: It is important to know the starting point when describing changes in Inuit in transition. STUDY DESIGN: The original charts of 1,852 individuals from the epidemiological investigation in East Greenland around 1963 performed by Littauer and colleagues were recovered recently. They included height, weight and a physical investigation. METHODS AND RESULTS: The focus of this paper was adult Inuit body proportions in 1963 by ten-year age groups excluding participants with disabilities affecting body build. Relatively stable values were seen in both genders with age. Median values in men/women aged 20 years and above were: height 164/153.5 cm, weight 64/54 kg and BMI 23.7/23.1. Men aged 50 years and above had a little lower height and weight than young men. Women aged 40-49 years had a higher weight and BMI, but this evened out in the older age groups. Median BMI was relatively high compared to WHO definition. CONCLUSIONS: The data from 1963 gives a starting point for evaluating changes in Inuit body build and the prevalence of overweight. Furthermore, they indicate a need for Inuit-specific normal BMI delineation.
Exposure to perfluorinated compounds and human semen quality in Arctic and European populations.

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Europe
Female
BACKGROUND: Perfluorinated compounds (PFCs) have been suspected to adversely affect human reproductive health. The aim of this study was to investigate the associations between PFC exposure and male semen quality.

METHODS: PFCs were measured in serum from 588 partners of pregnant women from Greenland, Poland and Ukraine who provided a semen sample, using liquid chromatography tandem mass spectrometry. Perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), perfluorohexane sulfonic acid (PFHxS) and perfluorononanoic acid (PFNA) could be detected in >97% of the samples. The associations between levels of these compounds and semen volume, sperm concentration, total sperm count, motility and morphology were assessed.

RESULTS: Across countries, sperm concentration, total sperm count and semen volume were not consistently associated with PFOS, PFOA, PFHxS or PFNA levels. The proportion of morphologically normal cells was 35% lower (95% confidence interval (CI): 4-66%) for the third tertile of PFOS exposure as compared with the first. A similar reduction was found in relation to increasing PFHxS levels. At the third PFOA exposure tertile, the percentage of motile spermatozoa was 19% (95% CI: 1 to 39%) higher than in the first.

CONCLUSIONS: The most robust finding in the present study was the negative associations between PFOS exposure and sperm morphology suggesting adverse effects of PFOS on semen quality, possibly due to interference with the endocrine activity or sperm membrane function. It cannot be excluded that this association and the positive association between PFOA and semen motility, which was not consistent across countries, might represent a chance finding due to the multiple statistical tests being performed.

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**Exposure to perfluoroalkyl substances and sperm DNA global methylation in Arctic and European populations.**

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Perfluoroalkyl substances (PFASs) are widely used in a variety of industrial processes and products, and have been detected globally in humans and wildlife. PFASs are suspected to interfere with endocrine signaling and to adversely affect human reproductive health. The aim of the present study was to investigate the associations between exposure to PFASs and sperm global methylation levels in a population of non-occupationally exposed fertile men. Measurements of PFASs in serum from 262 partners of pregnant women from Greenland, Poland and Ukraine, were also carried out by liquid chromatography tandem mass spectrometry. Perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA), perfluorohexane sulfonic acid (PFHxS), and perfluorononanoic acid (PFNA) were detected in 97% of the blood samples. Two surrogate markers were used to assess DNA global methylation levels in semen samples from the same men: (a) average DNA methylation level in repetitive DNA sequences (Alu, LINE-1, Sata) quantified by PCR-pyrosequencing after bisulfite conversion; (b) flow cytometric immunodetection of 5-methyl-cytosines. After multivariate linear regression analysis, no major consistent associations between PFASs exposure and sperm global methylation endpoints could be detected. However, since weak but statistically significant associations of different PFASs with DNA hypo- and hyper-methylation were found in some of the studied populations, effects of PFASs on sperm epigenetic processes cannot be completely excluded, and this issue warrants further investigation.
Abstract: Persistent organic pollutants (POPs), such as PCBs (polychlorinated biphenyls) and DDT [1,1,1-trichloro-2,2-bis(4-chlorophenyl)ethane], are environmental contaminants with potential endocrine disrupting activity. DNA methylation levels in peripheral blood lymphocytes have been associated with serum concentrations of POPs in Greenland Inuit and Korean populations. Greenland Inuits are characterized by the highest worldwide POP levels. In this cross-sectional study we evaluated the relationship between serum POP concentrations and DNA methylation levels in sperm of non-occupationally exposed fertile men from Greenland, Warsaw (Poland), and Kharkiv (Ukraine). Serum levels of PCB-153 [1,2,4-trichloro-5-(2,4,5-trichlorophenyl)benzene], as a proxy of the total PCBs body burden, and of p,p'-DDE [1,1-dichloro-2,2-bis(4-chlorophenyl)ethylene], the main metabolite of DDT were measured. Sperm DNA methylation level was assessed globally by flow cytometric (FCM) immunodetection of 5-methyl-cytosines and at specific repetitive DNA sequences (Alu, LINE-1, Sata) by PCR-pyrosequencing after bisulfite conversion. Multivariate linear regression analysis was applied to investigate correlations between serum POP concentrations and DNA methylation. No consistent associations between exposure to POPs and sperm DNA methylation at repetitive DNA sequences were detected. A statistically significant global decrease in methylation was associated with exposure to either POP by FCM analysis. This is the first study to investigate environmental exposure to POPs and DNA methylation levels considering sperm as the target cells. Although POP exposure appears to have a limited negative impact on sperm DNA methylation levels in adult males, the global hypomethylation detected by one of the methods applied suggests that further investigation is warranted.

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Exposure to polybrominated diphenyl ethers and male reproductive function in Greenland, Poland and Ukraine.

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Animal and a few human studies suggest that polybrominated diphenyl ethers (PBDEs) may affect male reproductive function. The aim of the present study was to evaluate if male reproductive function was associated with serum level of PBDEs. We evaluated, in a cross-sectional study, the effects of environmental exposure to BDE-47 and BDE-153 on reproductive hormones and semen quality, including markers of DNA damage and apoptosis, in 299 spouses of pregnant women from Greenland, Poland and Ukraine. Adjusted linear regression models indicated no strong associations between BDE-47 or BDE-153 exposure and markers of male semen quality or reproductive hormones. In the largest study to date we demonstrate that BDE-47 and BDE-153 exposure was not associated with altered semen characteristics or reproductive hormones, indicating that male reproductive function is not affected by the exposure level of these compounds in fertile European or Arctic populations.

Hazard quotient profiles used as a risk assessment tool for PFOS and PFOA serum levels in three distinctive European populations.

https://arctichealth.org/en/permalink/ahliterature302409
Perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) blood levels are commonly used as biomarkers of human environmental exposure to these compounds. Many biomonitoring studies indicate 100% detection for PFOS and PFOA thus justifying a concern of possible risk for the most exposed individuals. This study addresses the predictive value of hazard quotients (HQs) calculated on the basis of serum PFOS and PFOA in male and female populations of reproductive age in Greenland, Poland and Ukraine. Overall, 2026 results of PFOS and PFOA serum concentrations (589 males, 1437 females) were obtained from the INUENDO database. HQs were calculated from the actual biomonitoring results and literature-based animal data linking toxicological outcomes and critical PFOS/PFOA serum levels. HQs for serum PFOS were calculated based on Points of Departure (PoD) at 13µg/mL (-1) (cynomolgus monkeys, 183days, changes in TSH and T3) and for PFOA at 7.1µg/mL(-1) serum (male rats, 90days, hepatocellular necrosis, increased liver weight). Uncertainty factors were applied to reflect interspecies differences and human variability. Serum HQs were expressed as a ratio relative to the point of departure for each PFOS and PFOA. Only in the three cases of males in Greenland were there serum PFOS levels showing HQ values exceeding 1, so indicating that such serum levels may be of concern. The mean serum concentration of PFOS was significantly higher in male than in female populations. Despite significant differences between HQ profiles for PFOS and PFOA in donors from Greenland, Poland and Ukraine, the concentrations of these perfluoroalkylated compounds do not indicate a cause for concern, except for the three aforementioned cases from Greenland. This study demonstrates that the HQ approach can help to interpret human biomonitoring data and thus serve as a valuable tool in further risk assessment priority settings and may also be used as a basis for taking decisions in risk management.
**Abstract:** We believe that public health should take a life-course approach, starting at conception, or at best before, at the time of pregnancy planning, and focus upon living conditions for children. Most of the determinants of life expectancy are established early in life.

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**Documents**

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