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File PCB Sperm Density

FYI: J. C. Weber
[redacted]
J. Ortiz
R. C. Isham
E. L. Head
M. M. Liebman
J. C. McPhillips
F. A. Krovorny
J. S. Metcalf

FROM: Glynn Young

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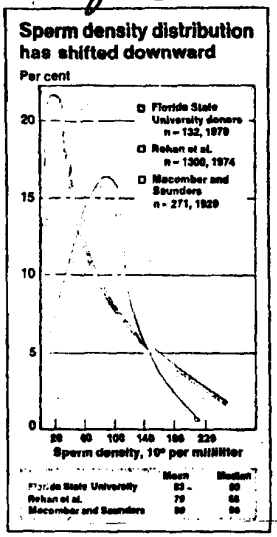
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Sperm density tied to toxic substances level

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The data are somewhat limited. But what there is suggests that sperm density distributions for U.S. males have shifted to lower values over the past 30 years. And a Florida State University researcher has evidence that part of the cause may be toxic substances in the environment.

More specifically, Florida State chemistry professor Ralph G. Dougherty has so far found a correlation between lower sperm densities and the presence of polychlorinated biphenyls (PCB's) with five to eight chlorines. He presented details of this work at a Division of Environmental Chemistry symposium on environmental health chemistry.



There have been three studies of sperm density distribution. One study in 1929 involved 271 men. Another study in 1974 had 1300 donors. The most recent study is one begun by Dougherty a year ago that had 132 participants.

The maximum in the sperm density distribution for the 1929 study was 100 million per ml. This had shifted by the 1974 study to 60 million per ml. And in Dougherty's study, the maximum was at 20 million per ml—a level, he says, many consider to be evidence of functional sterility.

There has been considerable discussion in the scientific community about the causes for the shift in sperm density, Dougherty says. It's possible that the variation is due partially to differences between the populations sampled in the three studies. The donors in the 1929 study were men whose wives were pregnant at the time. Those in the 1973 study were prevasectomy patients in a fertility control clinic. And those in the current study were primarily college-age males at Florida State.

Dougherty doubts that the men in his study are representative of the population as a whole. But he feels they are representative of male college students.

It's also conceivable, Dougherty says, that sociological and behavioral factors may be partially responsible for the shape of the sperm density distribution curve. Increased use of tight-fitting underpants and increased frequency of ejaculation are examples.

But whatever the constellation of other causes, Dougherty did find toxic substances in the student seminal plasma samples.

Dougherty points out that there is reason to believe that a study of sperm density and toxic substances in humans could provide useful information concerning environmental health problems. The formation of sperm in the seminiferous tubules requires a sequence of eight cell divisions. Thus, inhibitors of cell division will have an n^8 effect on sperm density where n is less than 1.

Thus, Dougherty says, there should be, by this mechanism, a substantial magnification in the effect of inhibitors of cell division when sperm density is examined, compared to other biological parameters. Inhibitors of cell division, he notes, are generally mutagenic agents, with the exception of certain alkaloidal poisons. And most of the well-known carcinogenic substances inhibit cell division.

To analyze for toxic substances in seminal fluid, Dougherty turned to a technique that he has been developing for analyzing toxic chemicals in the presence of biomolecules, negative chemical ionization mass spectrometry. The technique takes advantage of the fact that toxic substances, with the exception of alkaloidal analogs, are virtually all either oxidizing agents or alkylating agents or both. Oxidizing agents or alkylating agents will capture either thermal electrons or thermalized gas-phase nucleophiles to form anionic complexes in the gas phase—something biomolecules don't, in general, do.

For the work with seminal fluid, Dougherty used steam distillation from an acidified sample for cleanup and isobutane/oxygen as the reagent for the negative chemical ionization mass spectrum.

All of the seminal plasma samples examined were contaminated with toxic substances at levels that exceeded background, Dougherty says. The most commonly occurring were pentachlorophenol, hexachlorobenzene, PCB's, and DDT metabolites.

Data from the analyses were fed to a computer and a regression analysis carried out. The PCB's with five to eight chlorines gave the correlation with sperm density decrease. PCB's appear to account for 25% of the decrease in sperm density, Dougherty says. There also are a number of unknowns, Dougherty says, that have very significant negative correlation coefficients, but he doesn't know yet what they are. □