

Rachel's Environment & Health News

#647 - Solvents: All-Purpose Poisons

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In all industrialized societies, both men and women are often exposed to organic solvents at work and in the home. Gasoline contains a mixture of organic solvents, and solvents are major components of lighter fluid, spot removers, many aerosol sprays, paints, paint thinners, paint removers, fingernail polish and remover, glues, and floor and tile cleaners.

In the past year or so, half a dozen studies have implicated solvents in several serious health problems, including major birth defects, immune system disorders (such as rheumatoid arthritis, scleroderma, and lupus erythematosus), and several kinds of cancer, including breast cancer.

Chemicals in the "organic solvent" class include aliphatic hydrocarbons (mineral spirits, varnish, kerosene), aromatic hydrocarbons (benzene, toluene, xylene), chlorinated hydrocarbons (carbon tetrachloride, trichloroethylene, tetrachloroethylene [also known as perchloroethylene, or perc]), aliphatic alcohols (methanol), glycols (ethylene glycol), and glycol ethers (methoxyethanol). There are hundreds of different organic solvents on the market and it is rare to be exposed to only one at a time; mixtures are common.

BIRTH DEFECTS

Several occupations dominated by women have potential exposure to organic solvents: health care professions, work in the clothing and textile industries, and the graphic arts, among others.

In 1998, an analysis of five previous studies showed that women exposed to organic solvents during pregnancy had a 64% increased chance of giving birth to a baby with a major birth defect.[1] A major birth defect was defined as "potentially life-threatening or a major cosmetic effect." However, all five studies were retrospective in design -- that is, women were asked after the birth of their child whether they had been exposed to solvents during pregnancy. All retrospective studies can suffer from "recall bias." For example, people who give birth to defective babies may have a heightened or otherwise distorted recollection of what chemicals they were exposed to during pregnancy, compared to women who gave birth to normal children.

Just last month, a "prospective" study of solvents and birth defects was published in the JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION (JAMA).[2] The study was "prospective" because women were asked about their solvent exposure during pregnancy before they gave birth. Thus a "prospective" study avoids the problem of "recall bias."

The JAMA study found that women occupationally exposed to solvents during pregnancy have a 13-fold increased chance of giving birth to a child with a major birth defect. A major birth defect was defined as "any anomaly that has an adverse effect on either the function or the social acceptability of the child." Defects that occurred in babies born to women in the solvent-exposed group included heart valve defects; soft cartilage in the larynx; micropenis [abnormally small penis]; deafness; clubfoot; neural tube defect [opening to the spinal cord at the base of the brain]; and hydronephrosis [a serious kidney defect].

The JAMA study examined 125 women who were occupationally exposed to organic solvents during pregnancy and an equal number of pregnant controls matched for age, number of previous pregnancies, smoking and drinking habits. In addition, the control group had been exposed to chemicals known not to produce birth defects.

All the exposed women worked with organic solvents for at least the first 13 weeks of pregnancy. The most common occupations were factory worker; laboratory technician; professional artist or graphic designer; and printing industry worker. Other solvent-exposed occupations included chemist; painter; office

worker; veterinary technician; funeral home worker; carpenter; social worker; and car cleaner.

The two groups of pregnant women differed in several noteworthy respects. Both groups had had an equal number of pregnancies, but the solvent-exposed women had had significantly more miscarriages (and thus fewer children born). Babies born to solvent-exposed women weighed an average of 168 grams (5%) less than babies born to the control group. Eight babies born to solvent-exposed women fell in the category "low birth weight" (defined as less than 2500 grams [5.5 pounds].) Among non-exposed women, 3 babies had low birth weight. Among the solvent-exposed group, 17 babies suffered "fetal distress" at birth vs. 6 with fetal distress among the unexposed group. Fetal distress was defined as fetal intestinal discharge during delivery and/or abnormal fetal heart rate during delivery, or the requirement of resuscitation or a neonatal intensive care unit.

Among the 125 women occupationally exposed to solvents, 75 reported symptoms temporarily associated with their exposure, 43 had no symptoms of exposure, and for 7 such information was missing. Twelve of the 13 major birth defects occurred among the group reporting symptoms of exposure. The exposed women were further divided into two groups -- those exposed for 7 months or longer; and those exposed for 3 to 7 months. Sixteen women exposed more than 7 months had labor with fetal distress vs. only one among those with shorter exposure.

Organic solvents can readily pass from the mother to the fetus in the womb, by passing through the placenta. The authors conclude that pregnant women are endangered by occupational exposure to solvents, and so are their babies, particularly if the mother has symptoms of solvent exposure herself.

CONNECTIVE TISSUE DISEASE

Rheumatoid arthritis, lupus, and scleroderma are "rheumatoid" disorders affecting the body's connective tissues. These are all "autoimmune" diseases in which the body's immune system makes too many antibodies, which are proteins usually directed against invaders. In the case of autoimmune diseases, the antibodies are mistakenly directed against the self.

If a person has several of the symptoms of these three "rheumatoid" diseases but not enough of the symptoms of any one disease to be diagnosed with that disease, they will be diagnosed as having "undifferentiated connective tissue disease" (UCTD). For reasons that are unknown, rheumatoid diseases strike women somewhat more than men.

A recent case-control study of 205 women in Ohio and Michigan with UCTD, and 2095 controls, revealed that the women with UCTD were 3 times as likely as controls to have been exposed occupationally to paint thinners and paint removers.[3] Paint thinners include mineral spirits, white spirit, naphtha, VM & P naphtha, Stoddard Solvent and Varsol, all of which are petroleum distillates. Furthermore, women with undifferentiated connective tissue disease were twice as likely as controls to have been exposed on the job to mineral spirits.

Women in specific solvent-related occupations had a greatly-increased chance of getting UCTD, compared to controls. Women in the furniture refinishing industry had a 9-fold increased chance of getting UCTD; women in perfume, cosmetic or drug manufacturing had a 7-fold increased chance; women in rubber product manufacturing had a nearly 5-fold increased chance of getting UCTD.

The causes of rheumatoid diseases are not known, but something triggers the immune system to attack the self instead of restricting its attack to non-self invaders such as bacteria and viruses. This carefully-done study indicates that petroleum-based solvents may

be one such trigger.

CANCER

Benzene, toluene, xylene and styrene are the cornerstones of the petrochemical industry. They serve as the feedstock for the manufacture of many other solvents, chemical intermediates, dyes, explosives, and resins for the manufacture of plastics, elastomers, and textiles. Many solvents contain benzene, toluene and/or xylene in varying proportions.

Of these four large-volume chemicals, only benzene has been clearly established as a human carcinogen. Benzene can cause leukemia (cancer of the blood-forming cells) in exposed workers and perhaps in others who have lesser exposures.

Based on studies of laboratory animals, styrene is a suspected human carcinogen, but toluene and xylene fall in the "unknown" category, chiefly because they have hardly been studied.

Last year a large case-control study in Canada examined the experience of 3730 patients with 15 different kinds of cancer. The authors of the study reported finding "limited evidence" of an association between xylene and colon cancer; between benzene, toluene and styrene and cancer of the rectum; and between styrene and prostate cancer.

Most interestingly, a 1997 study examined the relationship between breast cancer and solvents. There is evidence from studies of laboratory animals that solvents can cause breast cancer in some species. In humans, the evidence is spotty. Out of 17 studies of occupational solvent exposure and cancer, 12 have shown no relationship while 5 have indicated that breast cancer and solvents are related.[5] On the other hand, only one of the 17 studies was specifically designed to look for breast cancer, and women often make up a tiny proportion of an occupational cohort so most studies do not have the necessary power to reveal a relationship even if one exists.

Canadian researchers France P. Labreche and Mark S. Goldberg have offered a formal hypothesis linking breast cancer to solvents.[5] They point out that the breasts of women in industrialized countries contain numerous solvents dissolved in the fatty tissues. Breast milk contains acetaldehyde, benzaldehyde, benzene, carbon disulfide, carbon tetrachloride, chlorobenzene, chloroethane, ethyl chloride, chloromethane, chloropentane, crotonaldehyde, cyclohexane, cyclopentane, dichlorobenzene, 1,2-dichloroethane, dichloroethylene; ethyl alcohol, ethylbenzene, and perhaps other solvents as well.[5] (Despite the presence of these industrial poisons in breast milk, breast feeding is still the best way to nourish an infant; all alternatives are worse.) Often these solvents are present in breasts at higher concentrations than in a woman's blood stream.

These solvents remain in breast tissue for long periods, in contact with the very cells where cancers originate, Labreche and Goldberg point out. Some of these solvents have estrogenic properties, but Labreche and Goldberg are mainly concerned that many solvents and their metabolic byproducts are, themselves, capable of initiating, or promoting cancers. Labreche and Goldberg, and perhaps others, have studies underway now to test the solvents-cause-breast-cancer hypothesis.

--Peter Montague (National Writers Union, UAW Local 1981/AFL-CIO)

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[1] Kristin I. McMartin and others, "Pregnancy Outcome Following

Material Organic Solvent Exposure: A Meta-Analysis of Epidemiologic Studies," AMERICAN JOURNAL OF INDUSTRIAL MEDICINE Vol. 34 (1998), pgs. 288-292.

[2] Sohail Khattak and others, "Pregnancy Outcome Following Gestational Exposure to Organic Solvents," JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION Vol. 281, No. 12 (March 24/31 1999), pgs. 1106-1109.

[3] James V. Lacey, Jr., and others, "Petroleum Distillate Solvents as Risk Factors for Undifferentiated Connective Tissue Disease (UCTD)," AMERICAN JOURNAL OF EPIDEMIOLOGY Vol. 149, No. 8 (1999), pgs. 761-770.

[4] Michel Gerin and others, "Associations Between Several Sites of Cancer and Occupational Exposure to Benzene, Toluene, Xylene, and Styrene: Results of a Case-Control Study in Montreal," AMERICAN JOURNAL OF INDUSTRIAL MEDICINE Vol. 34 (1998), pgs. 144-156.

[5] France P. Labreche and Mark S. Goldberg, "Exposure to Organic Solvents and Breast Cancer in Women: A Hypothesis," AMERICAN JOURNAL OF INDUSTRIAL MEDICINE Vol. 32 (1997), pgs. 1-14.

Descriptor terms: women; solvents; birth defects; cancer; connective tissue disease; uctd; scleroderma; rheumatoid arthritis; immune system; lupus erythematosus; breast cancer; colon cancer; cancer of the rectum;