



The Impact of Environmental Factors, Body Weight & Exercise on Fertility

RESOLVE: The National Infertility Association, through a generous grant from the Collaborative on Health and the Environment (CHE), has produced this comprehensive overview of environmental factors that may impact fertility, as well as the link of body weight and exercise to fertility.

Environmental Factors

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ENVIRONMENTAL TOXINS AND FERTILITY

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A growing body of scientific evidence is encouraging infertility patients and practitioners to pay more attention to environmental chemicals and their impacts on reproductive health. Most of this new science comes from animal studies, and it isn't yet clear in most instances how these results apply to fertility challenges people face. But human studies that build on clues from the animal research reveal cause for concern — and reason for hope. Scientific certainty on these complicated, controversial issues is likely to take many more years, but the weight of the evidence tells us that if some cases of infertility can be caused by environmental contaminants, they can also be prevented. It suggests further that reduction of chemical exposures generally may be important for safeguarding reproductive health in future generations.

The evidence comes from many and different sources. Following are some key pieces.

The number of couples treated for infertility has risen significantly in recent decades. This is often attributed to increased diagnosis and by the availability of assisted reproductive technologies — within a generation of baby boomers who have tended to delay childbearing. But there are indications that the actual incidence rate of infertility is rising too. A 1998 report of the US National Survey of Family Growth found that the rate of “impaired fecundity” (difficulty conceiving or carrying a child to term) rose significantly between 1982 and 1995 in all reproductive age groups. Surprisingly, and contrary to the “baby boomer” hypothesis, the biggest rate increase occurred in women under 25 years-old — 42% — compared to a 12% increase for 25- to 34-year-olds and a 6% increase for 35- to 44-year-olds.^{1,2}

Laboratory studies prove that many man-made chemicals cause fertility-related damage in animals, sometimes at very low doses. These substances can be found in wildlife and people at levels similar to those causing adverse effects in lab animals.

Numerous field studies link environmental contaminants to a whole range of reproductive abnormalities in wildlife, and to reduced reproductive rates/population size. These data come from many species, including birds, fish, mollusks and mammals.

There are upward trends, varying by region and over time, in human health conditions negatively affecting fertility: poor sperm quality and counts; increased incidence of several male genital birth defects; and apparent rises in endometriosis (which may or may not be due to increased diagnosis). These outcomes can be created in lab animals by exposing them to toxic chemicals. Given the exposures humans face, it isn't implausible manmade chemicals are influencing trends in some human reproductive health conditions. It must be noted, however, that there are likely

1 Chandra, A, and Stephen, E. 1988. Impaired fecundity in the United States: 1982 – 1995. *Family Planning Perspectives* 30(1):34-42.

2 Schettler, T. 2003. Infertility and Related Reproductive Disorders. Online at <http://www.protectingourhealth.org/newscience/infertility/2003-04peerreviewinfertility.htm>.

multiple explanations — not just chemical — for these trends and experts disagree about what might be causing them.

Some 85,000 synthetic chemicals have been registered for use in the US. Every year 1,000 – 2,000 more are added to the list. They’ve become inescapable, pervading air, water, food, homes — and our bodies. Actual measurements, called “body burden surveys,” of contaminants in people show that average Americans have hundreds of manmade chemicals in their tissues (including amniotic fluid and umbilical cord blood) at levels high enough to be of concern.^{3,4} Many of these compounds are known to undermine reproductive health. Some persist in the environment for years or decades. Many bypass the placenta and reach the developing fetus.

The vast majority of commercial chemicals have never been tested for health effects or reproductive toxicity. There is no requirement for manufacturers to do so, except for a few classes of chemicals. Most of the testing that has been done has been on adults at unrealistically high levels of exposure, one at a time. This approach ignores several important conclusions from research over the past decade and means toxicities could be underestimated:

- Exposures in the real world are never limited to one compound at a time, and contaminants interact as they cause effects;
- The fetus during development is vastly more sensitive to exposures than is an adult.
- Fetal exposures can have life-long consequences for reproductive health;
- Low level exposures can cause significant effects that can’t be predicted from high dose experiments because the former work through different mechanisms.⁵

Thousands of examples from the scientific literature show that chemical exposures cause reproductive damage in lab animals and wildlife populations.^{6,7} At high doses, this surprises no one. But within the last decade, new types of research have made it clear that even low levels of contamination can interfere with hormones and the processes they control.^{8,9,10} Hormone signals are one of the most important ways that genes get turned on and off. When a gene is switched off abnormally, or turned on at the wrong time, a wide range of negative effects can result. So the discoveries that chemical contaminants alter the expression of genes critical to reproduction in animals are worrisome — because animals and humans share many genes.

3 Environmental Working Group, 2003. Body Burden: The Pollution in People. Online at <http://www.ewg.org/reports/bodyburden/>
4 Physicians for Social Responsibility, January 2003. Bearing the Burden: Health Implications of Environmental Pollutants in Our Bodies. Online at <http://www.envirohealthaction.org/> Physicians for Social Responsibility, January 2003. Bearing the Burden: Health Implications of Environmental Pollutants in Our Bodies. Online at <http://www.envirohealthaction.org/>
5 Myers, JP. 2004. Gene expression and environmental exposures: new opportunities for disease prevention. *San Francisco Medicine* 77:29-31
6 Colborn, T, D Dumanoski and JP Myers. 1996. *Our Stolen Future*. Dutton, NY.
7 McLachlan JA. 2001. Environmental signaling: what embryos and evolution teach us about endocrine disrupting chemicals. *Endocrine Reviews* 22(3): 319-341.
8 Myers, JP. 2002. From Silent Spring to Scientific Revolution. *San Francisco Medicine* 75: 24-28
9 Myers, JP, LJ Guillette, Jr, P Palanza, S Parmigiani, SH Swan and FS vom Saal. 2003. The emerging science of endocrine disruption. In A. Zichichi (ed), *The Science and Culture Series: International Seminar on nuclear war and planetary emergencies*, 28th session
10 Myers, JP. 2004. Gene expression and environmental exposures: new opportunities for disease prevention. *San Francisco Medicine* 77:29-31

Virtually none of the toxicity testing of manmade chemicals upon which public health standards are based has taken the above vital factors into account. Fortunately, research efforts involving people are beginning to use these findings from the lab to guide the design of fertility-related investigations. It will take decades of carefully planned epidemiological studies to reach firm conclusions, just as it took decades to document the adverse effects of smoking. This is illustrated by a 2003 publication of a new evaluation involving the insecticide DDT. Using new analytical chemistry techniques on decades-old frozen samples of newborn umbilical cord blood, it was revealed that women whose cord blood at birth reflected higher DDT exposure while they were in the womb took longer to achieve pregnancy as adults.¹¹

There are two categories of impact where chemicals and fertility are concerned: The first involves adult exposures. Many of these should be reversible, depending upon the mechanism and severity of impact. (See Table 1 on page 5 for examples of exposures that have been shown to impair fertility in humans.) Some of these impacts are well established (confirmed by other studies), some less so.

The second category of impact involves fetal and early life exposures that affect the development of offspring up to reproductive maturity. Many of these impacts are irreversible, especially those involving abnormalities of the reproductive tract, impaired ability to respond to hormonal stimulation as an adult and decreased sperm production or function in the male offspring. Animal experiments show clear and consistent patterns of developmental impact. (See Table 2 on page 6 for examples of exposures to pregnant women that can affect offspring) Human studies are needed to confirm the effects of maternal exposure on the fertility of the offspring.

To better understand such problems over the long term, the US National Institutes of Health is planning a National Children's Study (www.nationalchildrensstudy.gov) that will enroll over 100,000 pregnant mothers, measure a range of important health factors including chemical exposures in the womb, and track the health of their babies through adulthood. The results, which won't be available for years, are expected to provide guidance to clinicians, parents and parents-to-be.

In the meantime, it is hard not to wonder if future generations might end up in "reproductive intensive care" if we aren't careful about chemicals research and regulation. It is troubling that while pharmaceutical manufacturers are required by the US Food and Drug Administration to investigate safety before marketing their products, for the most part chemical companies (and personal care and home cleaning product companies that use toxic chemicals) are not.

There are precautionary steps one might consider to reduce personal exposures (See *Steps to Take to Try to Reduce Exposures to Toxic Chemicals on page 7*). But some personal contamination is unavoidable, simply because toxic chemicals are so ubiquitous. As noted earlier, manmade chemicals permeate air, water, soil, food, homes, schools and workplaces. They are in our beauty, pet, home, lawn and garden care products. This means it is also important for individuals and infertility groups to consider supporting larger-level public policy improvements that could reduce harmful exposures more generally, such as enhanced research

11 Cohn, BA, PM Cirillo, MS Wolff, PJ Schwing, RD Cohen, RI Sholtz, A Ferrara, RE Christianson, BJ van den Berg and PK Siiteri. 2003. DDT and DDE exposure in mothers and time to pregnancy in daughters. *The Lancet* 361: 2205–06

agendas and funding; shifting the burden of proof regarding chemical safety from government and citizens after the fact to manufacturers before commercial introduction; improved disease tracking and toxic release reporting; and expanded surveys of human toxic chemical “body burdens.”

Promising news is that RESOLVE recently announced new headquarters in Washington, DC, where the organization intends to step up advocacy efforts on behalf of the infertile. What an opportunity for RESOLVE to have a voice in support of “environmental reproductive health.” As male infertility researchers Richard Sharpe and Stephen Franks wrote in a 2002 Nature Cell Biology review titled Environment, Lifestyle and Infertility: An Intergenerational Issue: “A failure of science to meet this challenge... will hand the poisoned chalice of infertility to the next generations.”

**Table 1 (adapted from Schettler, 2003)
Impact of Exposure to Toxins on Men and Women**

Exposure	Impact on women	Impact on men
Perchloroethylene (dry cleaning fluid)	Prolonged time to pregnancy ^{1,2} ; Miscarriage (conflicting data) ^{3,4,5,6}	
Toluene (inks, coatings, gasoline, cosmetics, glues)	Reduced fecundity ⁷ ; Miscarriage ⁸	Miscarriage in female partner ⁹ ; Hormonal changes ¹⁰ ; Decreased sperm count ¹¹
Phthalates (plasticizers added to plastics like polyvinyl chloride; also widely used in cosmetics)	Decreased fecundity ¹² ; Miscarriage, Pregnancy complications like preeclampsia ^{13,14}	Sperm damage ^{15,16}
Bisphenol A (monomer used to make polycarbonate plastic and various resins)	Meiotic aneuploidy (observed only in mice; no human studies ¹⁷)	Decreased sperm count (observed only in rodents; no human studies ¹⁸)
Formaldehyde (resins for particle board, plywood, insulation, cosmetics, labs, rubber production, dyes)	Menstrual irregularities, miscarriages ^{3,19} ; reduced fecundity ²⁰	
Glycol ethers (primarily short-chain) (electronics, deicing, inks, dyes, varnish, paint, printing, cosmetics, photography, some pesticides)	Miscarriage; infertility ^{21,2}	Decreased sperm count ²²
Solvent mixtures	infertility ²³ ; Reduced fecundity ² miscarriage, menstrual disorders ^{24,25} ; lowered LH ²⁶	abnormal sperm ²⁷ ; Miscarriage in female partner; infertility (conflicting data ³)

Lead (paint, batteries, electronics, ceramics, jewelry, printing, ammunition, PVC plastic)	Miscarriage ^{28,29}	Low sperm count, reduced fertility ^{30,31}
Chlorinated hydrocarbons (some pesticides, wood preservatives, dioxins, PCBs)	Spontaneous miscarriage; infertility ³² ; time to pregnancy ³³ Endometriosis ³⁴ ; Disrupted oocyte development and decreased blastocyte formation (animal study ³⁵)	Sperm damage ³⁶
Pesticides	Spontaneous miscarriage ³ fetal death ³⁷ ; low-dose pre-implantation embryo damage (animal research ³⁸)	Low sperm count (DBCP; EDB; 2,4D, alachlor, atrazine, diazinon) ^{39,40,41,42} ; delayed time to pregnancy in partner ⁴³
Cigarette smoke	Infertility, reduced fecundity ^{44,45}	Maternal smoking reduces sons sperm count ⁴⁶ , pregnancy loss ⁴⁷ ; conflicting data ⁴⁸

(References for Table 1 can be found on page 21)

Table 2
Exposure to Pregnant Women and the Effect on Offspring

Exposure type	Effects on female offspring	Effects on male offspring
Surfactants (nonylphenol, octylphenol)	Early puberty (pig ¹)	Reduced FSH, testis size (sheep; ²)
Bisphenol A (plastic monomer in polycarbonate; base of common resin in cans)	Early puberty, obesity ³ ; error in oocyte cell division (aneuploidy) ⁴ ; Masculinization of central nervous system ⁵	Altered prostate development ^{6,7,8} ; Feminization of central nervous system ⁵
Phthalates (additives to plastics, cosmetics)		Reproductive tract malformations; reduced testosterone; reduced sperm count ^{9,10,11,12,13} Testicular dysgenesis syndrome ¹⁴
Industrial chemicals (dioxin, furans, PCBs)	Reproductive tract malformations, reduced fertility and faster fertility loss with ageing (rodent ^{15,16,17,18} ; reduced follicle number (rodent, Heimler, Baldrige)	Reduced sperm count (human: ²¹ ; rodent: ^{22,23,24,25}); exposure in rodent while nursing their young ²⁶); decrease in sperm fertilizing ability (PCB; rodent ²⁷); altered reproductive organs (rodent; ²⁸)

Organochlorine pesticides	Increased time to pregnancy (human ²⁹)	Increased birth defects in offspring (DDT: human ³⁰); Reproductive tract malformations (rodent ⁹); testicular atrophy (rodent ³¹); impaired sperm production (rodent ³²)
Other Pesticides		Demasculinization (frogs ³³); Reproductive tract malformations (rodent ⁹); Delayed puberty and altered androgen function ³⁴
Diethylstilbestrol	Malformations of reproductive tract, vaginal cancer (humans, rodent ^{35,36,37}) altered hormonal responsiveness (rodent ³⁸)	Malformations of reproductive tract, reduced sperm count (rodent ³⁷)
Ethyl ether	Reduced fertility (rodent ³⁹)	
Byproducts of water disinfectants	Reduced follicle number (rabbit ⁴⁰)	
Smoking		Reduced sperm count (humans ⁴¹)
Arsenic	Ovarian tumors (rodent ⁴²)	

(References for Table 2 can be found on page 22)

Steps to Take to Try to Reduce Exposures to Toxic Chemicals

- Don't smoke, and minimize your exposure to second-hand smoke.
- Contact your county's water authority to find out what's in your drinking water.
- If necessary, filter drinking, cooking and bathing water. There are whole home filters as well as faucet mounted ones and pitchers (bottled water is unregulated).
- Reduce your consumption of fish species containing high levels of mercury, dioxin and PCBs such as swordfish and albacore tuna. But don't stop eating fish. Make informed choices. Consider certified contaminant-free brands of fish oil pills to get important omega fatty acids you and your baby need.
- If possible, buy organic foods. Wash (and peel where you can) non-organic produce before eating to remove agricultural chemicals they may have on them.
- Reduce or stop use of pesticides and herbicides for home, lawn, garden and pet care where possible. Try non-toxic alternatives.
- Avoid environments that have been recently treated with pesticides and herbicides. Depending upon the product and conditions in the environment, pesticides and herbicides have a half-life of between one day and one year.
- Exercise caution: Some candies from Mexico; some food colorings, make-up and ayurvedic medicines from India; some Chinese herbal remedies; and some gumball toys/jewelry dispensed in the US have been found to contain lead. There are few labeling requirements and only minimal regulation of these products.

- Avoid polycarbonate plastic baby and sports/water bottles, and other products made of polycarbonate that might come in contact with food, because they can leach bisphenol A.
- Make sure that PVC plastic “cling” wraps you put in contact with food do not contain phthalates (ask the manufacturer). Never microwave foods in plastic containers that might leach harmful compounds.
- Purchase personal care products (shampoos, make-up, lotions, etc) without phthalates and other toxicants.
- Use “green” carpet, dry cleaning and landscape/garden/lawn care services. If you can’t, air out dry-cleaned clothes before bringing them into your car/home, and be sure to ventilate well during and after carpet cleaning.
- Use non-toxic, earth-friendly home cleaning products.
- Keep your home well ventilated when vacuuming, cleaning, painting, doing arts and hobbies to clear out indoor air pollutants that get stirred up during these activities, and disperse vapors from glues, paints, resins and lacquers used in crafts and home projects.
- If pregnant, avoid pumping fuel, remodeling your home, painting, and hobbies that involve solvents and glues. Be careful to use non-toxic nail and hair products.
- Avoid use of synthetic chemical air fresheners, fabric softeners and fragrances.
- Consult an occupational/environmental medicine specialist if you are concerned about and want to pursue an evaluation of your personal exposures at work, home, school or in general.

COMMON ENVIRONMENTAL FACTORS THAT MAY IMPACT FERTILITY

By Claude L. Hughes, Jr., MD, PhD, Duke University Medical Center, Durham, NC

Q: How much daily caffeine is safe?

Dr. Hughes: Caffeine has clear-cut, prompt, readily-perceived effects and is widely used in our society. Adverse effects of caffeine have been difficult to demonstrate for general health as well as for fertility. While there has been a suggestion that caffeine may slightly increase the time needed to achieve pregnancy, this has not been confirmed by multiple studies. I have seen estimates that the typical North American adult ingests caffeine equal to that found in three or four cups of coffee per day; however, there are certainly individuals who unknowingly ingest much larger amounts of caffeine in tea, soft drinks, chocolate, medications, and other foods. I think it is reasonable for people to limit their caffeine intake to the equivalent of two to four cups of coffee per day.

Q: Which vitamins and minerals play a role in fertility?

A: All vitamins and trace minerals known to be essential to normal biochemical processes play a role in fertility through the mechanism of good general health. Everyone should regularly ingest adequate vitamins daily; excess vitamins are simply excreted. A number of trace minerals are essential components of complex protein structures within many body tissues, but the word "trace" is important. Many minerals (usually metals) can be both general and reproductive toxicants if their levels are too high. This has been determined in livestock species where various essential trace minerals such as copper or selenium are known to be fatally toxic at levels slightly above the

appropriate trace level. The prudent perspective is "moderation in all things." That rule certainly applies to vitamins and minerals.

Q: What does alcohol do to sperm quality? How much consumption is considered excessive?

A: Alcohol injures spermatozoa. It is clear that alcohol acts directly on the testes, lowering testosterone levels and decreasing the testes' response to signals from the pituitary gland. Alcohol ingestion exceeding one to two ounces per day (two to four drinks per day) over a period of 2 months or more is a cause for concern in relation to male reproductive capabilities. Sexual effects may include impotence, gynecomastia, hypogonadism (small sex organs), reduced prostatic size, and decreased beard and pubic hair. A study in *Fertility & Sterility* (February 2003) looked at the affects of drinking alcohol one year, one month and one week before the ART procedure. The authors speculate that abstaining from alcohol for one month prior to IVF may maximize success rates with IVF. The main findings included:

- Female drinking can affect egg retrieval, pregnancy rates and miscarriage rates. There was an increased miscarriage rate in women who drank one more drink per day, one week or one month before the IVF procedures.
- Men who drink one more drink per day, one month or one week prior to their partner having IVF increased miscarriage rates.

Q: Do video display terminals or electric blankets increase the risk of miscarriage?

A: This question raises the issue of the effects of electromagnetic fields on reproduction. There have been a few studies that suggest some increased incidence of spontaneous abortion related to exposure to video display terminals, and there has been a suggestion of an increased incidence of certain types of cancer related to low-frequency electromagnetic fields. Studies are under way at the National Institute of Occupational Safety and Health addressing some of these concerns. The idea is that certain electromagnetic fields might alter the surface charge composition on cells in the body, and that this could alter the properties of the cell membranes and thereby modify the way those cells function. These studies are very difficult to do properly, but these possibilities should be investigated since such fields arise from many sources and are all around us in varying strengths and frequencies.

Q: Should a woman avoid emptying cat boxes when she's undergoing infertility treatment because of the risk of toxoplasmosis?

A: The principal risk of acquiring toxoplasmosis is during pregnancy. It is reasonable and prudent for women to avoid exposure to cat boxes, digging in soil where cats may make their deposits or even introducing cats into the household once pregnancy is detected.

TOBACCO, MARIJUANA AND FERTILITY

By Diane Clapp, BSN, RN, Medical Information Director, RESOLVE

The link between cigarette smoking and infertility — in women and men — is getting stronger. The following are some key points that have become known in recent months:

- 30% – 35 % of men and women of reproductive age smoke cigarettes.
- As few as 10 cigarettes a day can impact fertility.
- Smoking can cause early menopause.
- Smoking can delay the time it takes to conceive.
- Women who smoke often require higher doses of ovarian stimulating drugs than non-smokers.
- Women who smoke may require twice the number of attempts at IVF or GIFT as non-smokers to be successful.
- A study of 221 couples reported by the Practice Committee of the ASRM, April 2004, found that for each year a woman smoked there was a 9% risk of having an unsuccessful IVF or GIFT cycle.
- Smoking increases a woman's risk of miscarriage or tubal pregnancy.
- Exposure to second-hand smoke can impact infertility almost as much as smoking does, both in men and women.
- A male's fertility may be impacted if his mother smoked while pregnant with him.
- Some studies report that there are changes in the shape and movement of sperm in men who smoke.
- Many of the reproductive risks associated with smoking can be reversed, often within one year of stopping.

Marijuana use clearly suppresses reproductive hormones. In males there is a direct testicular effect of both psychoactive (those that affect behavior) and nonpsychoactive cannabinoids. The major psychoactive constituent of marijuana, THC, does act within the brain to suppress pituitary hormone secretion (FSH, LH, and prolactin) in males and females. There is no doubt that feminizing changes occur in men, and gonadal function in both men and women is altered.

HOW THE ENVIRONMENT FITS INTO THE ENDOMETRIOSIS PUZZLE

Excerpted from Endometriosis: The Complete Reference for Taking Charge of Your Health, by Mary Lou Ballweg & The Endometriosis Association; Published by McGraw Hill 2003.

It has been established that endo is a disease related to environmental toxins. In fact, it is one of the first diseases (outside of cancers) to be linked to persistent organic pollutants like dioxin in humans. Since 1992, research findings have been showing that dioxins and polychlorinated biphenyls (PCBs) can cause the development of endo. This has shifted the previous perception of endo from an unexplained gyn disease to a disease that is most likely triggered or worsened by the environment in which we live. In addition, it may be possible that endo is just one part of a larger disease family resulting from exposure to these chemicals.

Moving beyond endo to view the big picture of diseases plaguing our society today, it is important to know that dioxin and other environmental toxins have also been linked to childhood cancers (at least preliminarily), attention deficit disorder, reproductive cancers, Parkinson's disease, chronic fatigue immune dysfunction syndrome (CFIDS), diabetes, and asthma. As we watch scientific evidence link more and more diseases to environmental toxins, we have to ask ourselves if this is why health issues are escalating out of control in our society. It is too early to know for sure which diseases are

linked to which toxins or how the diseases themselves are related, but it is never too early to educate ourselves on the key toxins.

Dioxins and PCBs

Dioxins are a class of seventy-five chemicals with similar properties that are known to be the most toxic chemicals ever produced. Dioxins are the by-products of industrial processes that involve chlorine or the burning or incineration of chlorinated material with organic matter. The most toxic form of dioxin is 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), a known carcinogen. This was the type of dioxin fed to rhesus monkeys in the groundbreaking study that first linked dioxin to endo. Monkeys that ingested TCDD in amounts as small as five parts per trillion developed the disease. 12

According to the U.S. EPA, the average American adult has enough dioxin in his or her body today to cause adverse health effects.

The top three sources of dioxin are municipal waste incineration, backyard burn barrels (individuals burning their trash in their yards), and medical waste incineration.¹³ Other sources include chemical and vinyl (PVC, or polyvinyl chloride plastic) manufacturing, metal smelting, and pulp and paper bleaching. Dioxin emissions from smokestacks and discharge pipes travel long distances in the atmosphere via air currents. After the dioxin falls to the ground, it is often consumed by livestock that graze on the dioxin-contaminated crops or soil. Dioxin is fat soluble and accumulates in the tissues of the animals. The higher an animal is on the food chain, the more dioxin it will accumulate. The EPA estimates that over 95 percent of human exposure to dioxin is through our food. People who live near incinerators or manufacturing plants are unfortunately exposed to additional dioxin through air, soil, and possibly water.

Certain types of PCBs behave similarly to dioxin in the environment and our bodies. PCBs are a group of nonflammable chemicals that were used as insulation and/or coolants in electrical transformers, as well as lubricants, hydraulic fluids, cutting oils, liquid seals, and in carbonless paper. In the United States, they were widely used between 1929 and 1977. Because PCBs are incredibly persistent chemicals, it can take 20 to 160 years for them to completely break down. Unfortunately, companies that manufactured PCBs for industrial use dumped millions of pounds of these toxins directly into rivers and lakes before the U.S. government banned them. They are now found in the body fat of almost every living creature on our planet and are especially concentrated in fish from polluted waterways.

Endocrine-Disrupting Chemicals

Certain types of dioxins and PCBs, in addition to many other types of chemicals, are known to be endocrine disruptors. The endocrine system is a complex system of glands (such as the thyroid, pituitary gland, and ovaries) and hormones that regulate activities such as reproduction in human beings and animals.

12 S.E. Rier et al., "Endometriosis in Rhesus Monkeys (*Macaca Mulatta*) Following Chronic Exposure to 2,3,7,8-tetrachlorodibenzo-p-dioxin," *Fundamental and Applied Toxicology* 21 (1993): pp. 433-441.

13 U.S. Environmental Protection Agency, National Center for Environmental Assessment, "Database of Sources of Environmental Releases of Dioxin-Like Compounds in the United States," March 2001.

“Endocrine disruptors” are substances that mimic hormones, fooling the body into overresponding, responding at inappropriate times, or blocking the effects of a natural hormone. Endocrine disruptors “may directly stimulate or inhibit the endocrine system, causing overproduction or underproduction” of the body’s hormones.¹⁴ They can mimic estrogen, block progesterone, or affect testosterone levels. Many chemicals are known endocrine disruptors, and more are being discovered every year. Many of them are in pesticides, detergents, cosmetics, and the plastics used to package food. Through the air we breathe, the water and food we consume, and the substances that touch our skin, our bodies are regularly exposed to endocrine-disrupting chemicals.

Endocrine disruptors can have negative effects on the female reproductive system, including increased risk of breast cancer, early puberty, altered menstruation, decreased fertility, increased miscarriages, and early menopause.¹⁵ For males, it has been found that exposure in the womb to a compound present in common plastics causes abnormality in the adult male prostate.¹⁶ A group of common chemicals called phthalates can “damage the developing testes[testicles] of animal offspring and cause malformations of the penis and other parts of the reproductive tract.”¹⁷

Endocrine disruptors and other persistent chemicals do not necessarily cause health effects overnight. There is often a long time lag between exposure and the health problem, which adds to our confusion about cause and effect. Exposure in the womb may not manifest in health problems until the child becomes an adult.

Things You Can Do Every Day

- You can improve the environment and your health through your purchasing practices. Everyday items such as detergent, toilet paper, and toothbrushes with “greener” ingredients or materials are available.
- Certain plastics (especially PVC) can leach toxic chemicals into food. Be especially careful to avoid letting plastic wrap touch food, and do not cook in plastic containers.
- Choose cosmetics, shampoos, and personal care products without harsh chemicals and phthalates.
- Request the use of PVC-free products for medical procedures involving IV bags, including laparoscopies.
- Replace chlorine-bleached materials such as paper, tampons, and coffee filters with unbleached or non-chlorine-bleached alternatives.
- Dioxin and many persistent toxins build up in meats and other animal products, particularly in the fatty portions. To minimize PCB and dioxin consumption, eat low-fat meats and dairy products, preferably certified organic ones.
- Avoid eating contaminated fish and game (such as ducks). Call your local health department to find out about any fishing advisories, and obey them.
- Remember to peel vegetables and fruit, because PCBs and pesticides concentrate in the lipid,

14 U.S. Environmental Protection Agency, Endocrine Disruptor Screening Program, Report to Congress, August 2000.

15 F.I. Sharara, D.B. Seifer, and J.A. Flaws, “Environmental Toxicants and Female Reproduction,” *Fertility and Sterility* 70(4)(1998): p.615.

16 J.P. Myers, “Environmental Threats to Women’s Health: Protecting a Human Right” (speech to United Nations Commission on the Status of Women, 1998).

17 J. Houlihan, C. Brody, and B. Schwan, “Not Too Pretty: Phthalates, Beauty Products and the FDA” (2002): nottoopretty.org

or fatty, layer of their skins.

- Avoid pesticides and herbicides, indoors and out, because they are toxic to adults, children, and pets. Try organic pest control, integrated pest management, and home remedies (for example, jalapeño pepper bug spray to repel ants).
- If you like to garden, consider growing your own organic food.
- Recycling is an important way of improving our environment. Plastics marked with numbers 1 (PETE) and 2 (HDPE) are the most commonly recycled. PVC (numbered 3) is not recycled, even if they pick it up at your curb, and can contaminate batches of other plastics. Plastics marked 6 (PS) and 7 are often not recyclable, either.
- Avoid using electrical devices and appliances, including old fluorescent lighting fixtures, TVs and refrigerators that were made before 1979. These items may leak small amounts of PCBs into the air when they get hot during operation.
- PCBs can be rapidly absorbed through the skin. Do not disturb or handle dirt near hazardous waste sites or in areas where there was a transformer fire.
- Reading labels and ingredient lists is more trustworthy than reading just the marketing slogans.

Join with Others to Make a Difference!

- Get involved in an environmental campaign through the Endometriosis Association (visit EndometriosisAssn.org or call 414-355-2200) or a local environmental group.
- Support the Center for Health, Environment and Justice (CHEJ), and get involved when you can. For more details about their campaigns, go to chej.org.
- Become a member of the Collaborative on Health and the Environment (CHE). CHE is a network of health-affected groups and patients, physicians, scientists, environmental health advocates, concerned citizens, and funders interested in working together to improve environmental health. For more information, visit cheforhealth.org.
- Support legislation that will increase research on environmental health issues, such as endocrine disruption.
- If you live in the United States, find out what companies are polluting your area by going to scorecard.org and entering your zip code.

The Endometriosis Association, an international nonprofit serves women with endometriosis and their families worldwide, as well as providing education and research on the disease. We appreciate the permission to excerpt from this chapter on the environment and endometriosis. The book, which appeared on bookstore shelves in October 2003 and went into the second printing in December, also carries groundbreaking chapters on prevention of endometriosis, new treatments for endometriosis, infertility and endometriosis, menopause, and teens and their issues related to endometriosis, and much more. The book is available in bookstores, both local and online, as well as from the Association (414-355-2200; www.EndometriosisAssn.org).

PREVENTIVE MEDICINE AND MALE FACTOR INFERTILITY: FACT AND FICTION

By Stanton Honig M.D, Assistant Clinical Professor of Surgery/Urology at the University of Connecticut School of Medicine in Farmington, Connecticut, and Staff Urologist at Yale New Haven Hospital and Hospital of St. Raphael in New Haven Connecticut.

Because male factor infertility accounts for approximately nearly half of all problems with infertility,

a early, thorough evaluation of the male is critical; there are many treatable, reversible and preventable causes of male factor infertility.

In 1994, Drs. Honig, Jarow and Lipshultz reported that in 1% of patients, a significant medical condition, sometimes life threatening (such as a cancer of the testis, brain tumor or spinal cord tumor) was the cause of the male infertility.. It is for this reason that early evaluation of the male should include a semen analysis and if abnormal, an early consultation with a urologist well-trained in male fertility related disorders.

What “preventive medicine” exists for male-factor infertility?

Avoid lifestyle issues that may be detrimental to sperm quality including the use of illicit drugs (marijuana, cocaine, etc.), heavy alcohol use, cigarette smoking, certain medications, excessive heat to the scrotal area and anabolic steroids used for body building, which have direct effects on the testis through lowering the body's ability to make its own testosterone.

Many medications used for treatment for unrelated conditions may have negative effects on sperm quality. Medications that may have an effect on sperm quality include:

- Calcium channel blockers (high blood pressure)
- Sulfasalazine, mercaptopurine (Crohn's disease, bowel disease)
- Colchicine/allopurinol (gout)
- Cimetidine (peptic ulcers)
- Cyclosporine (organ transplants)
- Spironolactone (hypertension)
- Ketoconazole (fungal infections)

Chemotherapy for cancer and other related diseases such as rheumatoid arthritis and renal disease can affect sperm quality. Important considerations include freezing sperm *prior* to starting any toxic drug regimen and asking your physician about the least toxic chemotherapy regimen that can be used with equal survival results.

Occupational exposure to toxins may also affect sperm quality. Agents such as pesticides, cadmium, lead and manganese may interfere with reproductive function. Therefore, checking with your employer regarding exposures at work and subsequent protection is important.

Heat can affect sperm quality. Most of these effects are seen with internal heat such as varicose veins around the testes (varicoceles) or high fevers as opposed to heat from outside the body. Varicoceles are one of the most common, causes of male factor infertility. Multiple studies have shown that scrotal temperature is increased in men with varicoceles. Simple repair of these veins can significantly improve the chances of pregnancy. External heat effects on the testis have not been well documented. But hot tubs greater in temperature than 96 degrees on a regular basis should be avoided., A recent study has shown that there is no difference in sperm quality in men who wear boxer shorts instead of briefs.

In addition, avoiding lubricants such as K-Y jelly, surgilube and lubrifax which are toxic to sperm is important. A natural lubricant such as "Replens" may be substituted.

Another area of preventive medicine addresses the use of vitamins, minerals and natural supplements on male factor infertility. Some supplements may affect semen quality as a side effect. Other supplements have been studied to determine if they will improve semen quality in patients with male infertility.

There is a large amount of literature evaluating the effects of antioxidant vitamins (vitamin C and E) on sperm. These studies have been performed on patients taking these vitamins by mouth as well as mixing them with semen. It appears clear that some male factor patients have an increase in the amount of "reactive oxygen species" or oxidants in their semen. Reactive oxygen species may affect sperm through both direct effects on the sperm and indirect effect of the sperm environment. Vitamin C and E are thought to be anti-oxidants and may serve to lower the level of these toxic agents.

Carnitine appears to play an important role in both function of the epididymis and possibly sperm energy/motility. Some studies from overseas have suggested some benefit in using this supplement (mostly with improvement in sperm motility), with no significant side effects. Formal studies are underway in this country to assess its overall value to male infertility patients.

A paper published in *Fertility and Sterility* has suggested that some nutritional supplements, including saw palmetto; ginkgo biloba; St. John's wort; and echinacea, may have adverse effects on sperm. Unfortunately, the studies looked at mixing the supplements in a dish directly with semen. It is not known what the effects might be when these supplements are taken by mouth since it is not known if they even enter the semen. At this point, there is no clear evidence that these supplements affect sperm in a negative fashion.

Saw palmetto does appear to have a negative effect on sperm production and ejaculate volume. It would be my recommendation that any patient trying to achieve a pregnancy stop using saw palmetto until further studies show that there are no deleterious effects on male infertility and pregnancy.

In summary, preventive medicine has an important role in male factor infertility. A thorough evaluation and physical examination by a physician familiar with male infertility is important to rule out treatable, reversible and potentially life-threatening medical conditions. Patients should seek out organizations like RESOLVE, the [American Society for Reproductive Medicine](#) (ASRM), [The Society for Male Reproduction and Urology](#) (SMRU), and the [American Urological Association](#) for information regarding qualified physicians. In addition, modification of lifestyle behaviors and avoiding toxic recreational drugs may improve chances of pregnancy. Avoiding supplements that may affect male infertility in a negative way and vitamins and supplements that may positively impact male fertility are important to consider as well.

EXERCISE AND FERTILITY

By Jody Miller, Exercise Physiologist with Women's Health and Support Services in Potomac, MD, Membership Secretary for the Washington, DC Metropolitan Area Chapter of RESOLVE.

Can staying fit throughout a woman's reproductive years improve her chances of pregnancy without advanced reproductive technology (ART) intervention? If the answer were a definitive yes, women might take more seriously the recommendation to exercise regularly. This article will provide insights as to why women who take good care of the health of their bodies through diet and exercise can help to preserve their fertility.

Physical health is often characterized by body composition expressed in terms of percent of body fat, or by body mass index (BMI), a weight-to-height ratio that determines appropriate weight or measures the degree of obesity. (See *A Healthy Body Composition: BMI and Percent Body Fat on page 17*)

There is evidence that extremes in BMI have an adverse effect on women's reproductive health.¹⁸ If body weight is below the 10th percentile for height or body fat content is less than 22%, abnormal menstrual cycles and ovulatory dysfunction can develop.¹⁹ The association between BMI and risk for ovulatory infertility (infertility due to ovulation problems) was also observed as part of the Nurses' Health Study II.²⁰ These findings suggest that 12% of ovulatory infertility may be due to being underweight and 25% to being overweight.

Therefore two populations of women are at risk for ovulatory infertility: those who are obese and those who are underweight.

Obesity, characterized by excessive body weight and body fat, may have several adverse effects on women's reproductive health. Obese women are believed to be at increased risk for miscarriage, and have reduced success with fertility therapies.²¹ In addition, obesity is strongly related to polycystic ovary syndrome.²² Although the reason is unclear, women with PCOS often have excess fat in the stomach area. This is believed to be at least partly responsible for insulin resistance resulting in abnormal insulin levels, which may lead to development of male sexual characteristics²³ such as excess facial and body hair and acne.

At the other end of the spectrum, women who are underweight and/or have a very low percentage of body fat may also jeopardize their reproductive health. Extremely low body fat is most common in athletes or women with anorexia nervosa. Here the risk may not be because of body composition alone but also a lack of proper nutrition. One study suggests that when calories consumed are less than what the body uses for energy, regardless of actual food intake, it can impact estrogen and progesterone production which helps regulate the reproductive process, and may cause temporary or permanent loss of menstrual periods.

18 Hu, F.B. 2003. Overweight and obesity in women: health risks and consequences. *J Womens Health*,12,2,163-172.

19 Sperolff, L., Glass, R.H., Kase, N.G. 1999. *Clinical Gynecologic Endocrinology and Infertility* (6th Edition). Baltimore: Lippincott, Williams and Wilkins.

20 Rich-Edwards, J.W., Spiegelman, D., Garland, M., et al. 2002. Physical activity, body mass index, and ovulatory disorder infertility. *Epidemiology*, 13,2,184-190.

21 American Society for Reproductive Medicine (ASRM). 2000. Optimal evaluation of the infertile female. A Practice Committee Report: A Committee Opinion, Birmingham, AL.

22 Gambineri, A., Pelusi, C., Vicennati, V., et al. 2002. Obesity and the polycystic ovary syndrome. *Rel Metab Disord*, 26,883.

23 Medscape Medical News 2003. Weight loss improves metabolic, endocrine, and clinical parameters in women with PCOS. *Medscape.com*;accessed July 12, 2004.

The key to preventing ovulatory dysfunction with regard to body composition would therefore be healthy weight maintenance and healthy eating habits throughout a woman's reproductive years.

Strategies for Establishing or Maintaining Healthy Body Composition

Making improvements in body composition involves the key strategies of exercise and healthy eating habits.

For women with amenorrhea (menstrual flow has stopped), the primary goal is to resume normal menstrual function. Strategies may include increasing caloric intake, eating a variety of foods, eating small meals four to six times a day and increasing dietary fat intake, specifically unsaturated fats. In addition, reducing the intensity and frequency of exercise should be encouraged. Suggestions include taking an extra day off from high intensity exercise each week and reducing intensity from high to moderate levels. Replace a cardiovascular/aerobic session with a stretch or yoga class.

Strategies for obese women should focus on body weight and body fat reduction to improve insulin action. One study suggests that weight loss of as little as 11 pounds consistently improves insulin resistance, ovulation and infertility in obese women.²⁴ Both diet and exercise should be combined for optimal results. Recommendations may include reducing overall caloric intake, reducing total fat intake to less than 30% of total calories and saturated fat intake to less than 10% of total calories, decreasing sugar intake, eating from a wide variety of foods, and maintaining a healthy balance of fats, proteins and carbohydrates. Exercise should be incorporated gradually into the daily routine. Walking is an excellent way to get started. Intensity should be low to moderate, starting with five minutes and slowly building to 30 – 60 minutes each day as tolerated.

These recommendations are very general and should only be used as a guideline. Specific and individual lifestyle plans for diet and exercise should be developed by a licensed dietitian and/or by an exercise specialist.

ART is improving each year. This is great news for those with infertility and with limited family building options. Because weight and exercise can impact fertility it is imperative for women of all ages, and especially those of reproductive age, to make an extra effort to stay fit and healthy.

A Healthy Body Composition: BMI and Percent Body Fat

Both BMI and percent body fat are important measurements in establishing healthy body composition, and should be viewed together to help women determine what is optimal.

The Quetelet index (kg/m²) is a widely accepted BMI method. Researchers from The Panel on Energy, Obesity, and Body Weight Standards have recommended the following classifications when using this index:²⁵

20-25 desirable range
kg/m²

24 Clark, A.M., Ledger, W., Galletly, C., et al. 1995. Weight loss results in significant improvement in pregnancy and ovulation rates in anovulatory obese women. *Hum Reprod*, 10, 2705-2712.

25 Jequier, E. (1987). Energy, obesity, and body weight standards. *Am J Clin Nutr*, 45, 1035-1047.

25-29.9 kg/m ²	Grade I obesity
30-40 kg/m ²	Grade II obesity
>40 kg/m ²	Grade III obesity (morbid obesity)

To determine your own BMI using the Quetelet index:

- 1) Divide weight in pounds by 2.2 — this is the kg
- 2) Multiply height in inches by 0.0254 and then multiply that number by itself — this is the m²
- 3) Divide the kg by the m² — this is your BMI

Percent body fat is also important and is determined by skinfold measurements. An exercise specialist or health care provider with experience using skinfold calipers can take these measurements and calculate percent body fat. A general guideline for women is to strive for is body fat between 20% and 25%; 25% is a desirable average for most women and 30% or higher is considered unhealthy.

RESOURCES

Books:

- *Endometriosis: The Complete Reference for Taking Charge of Your Health*, Mary Lou Ballweg; Contemporary Books, 2004.
- *Generations At Risk: Reproductive Health and the Environment*, Ted Schettler, M.D., Gina Solomon, M.D., Maria Valenti, Annette Huddle; MIT Press, 1999.
- *Having Faith: An Ecologist's Journey to Motherhood*, Sandra Steingraber, Perseus, 2001.
- *Our Stolen Future*, Theo Colborn, Dianne Dumanoski, John Peterson Myers, Penguin Books, 1996.
- Reid, Robert L., MD, guest editor. "Interactions between lifestyles, environment, and reproductive system." *Seminars in Reproductive Endocrinology*, 1990, 8:1.

Reports:

- Center for Ethics & Toxics, *Identifying Toxic Risks Before and During Pregnancy: A Decision Tree and Action Plan*, www.cetos.org/safepreg.html.
- Collaborative on Health and the Environment, *Infertility: What We Know and Infertility: A Peer-Reviewed Analysis*, www.protectingourhealth.org/newscience/infertility/infertilityknow.htm.
- Environmental Defense, "Scorecard," at www.environmentaldefense.org/system/templates/page/issue.cfm?subnav=20
- Scorecard is a powerful interactive web site that provides users with up-to-date information about polluters in their own neighborhood. Enter your zip code to find out estimated cancer risks or hazardous waste sites in your area. Includes a tutorial in English and Spanish.
- Environmental Working Group, *Body Burden: The Pollution in People*, www.ewg.org.

- Environmental Working Group, *Skin Deep: A Safety Assessment of Ingredients in Personal Care Products*, www.ewg.org.
- Greater Boston Physicians for Social Responsibility, *How Chemical Exposures Affect Reproductive Health* (Patient and Physician Fact Sheets), <http://psr.igc.org/gar-project.htm>
- National Institute for Occupational Safety and Health; *The Effects of Workplace hazards on Female Reproductive Health* DHHS, NIOSH publication No. 99-104, 1800-356-4674 IBID, *the Effects of Workplace Hazards on Male Reproductive Health*, DHHS NIOSH publication No. 96-132, !-800-356-4674
- NSF International, The Public Health and Safety Company , a not-for-profit, non-governmental organization, specializes in standards development, product certification, education, and risk-management for public health and safety. www.nsf.com/consumer
- Pesticide Action Network North America, *Chemical Trespass: Pesticides in Our Bodies and Corporate Accountability* and *Nowhere to Hide*, www.panna.org. See also pesticide database, fact sheets.
- Physicians for Social Responsibility, *Bearing the Burden: Health Implications of Environmental Pollutants in Our Bodies*, www.psr.org. See also multiple fact sheets, including a safe drinking water fact sheet and primer at www.envirohealthaction.org/water/health_effects/#To%20educate%20health%20care%20providers.
- Physicians for Social Responsibility, *Healthy Fish, Healthy Families*, www.mercuryaction.org/fish
- U.S. Centers for Disease Control and Prevention, *National Report on Human Exposure to Environmental Chemicals*, www.cdc.gov/exposurereport.
- Women's Foundation of California, *Confronting Toxic Contamination in Our Communities*, www.womensfoundca.org.
- World Wildlife Fund - UK, *Chemical Trespass: A Toxic Legacy*, www.wwf.org.uk. See also multiple fact sheets under "Chemicals and Health."

Websites, Databases and Fact Sheets:

Governmental:

- www.atsdr.cdc.gov - Agency for Toxic Substances and Disease Registry
- www.cdc.gov. US Centers for Disease Control and Prevention (CDC) and National Institute for Occupational Safety and Health (NIOSH) and National Center for Environmental Health (NCEH): Also:
- <http://cerhr.niehs.nih.gov> - National Toxicology Program Center for the Evaluation of Risks to Human Reproduction
- www.epa.gov - U.S. Environmental Protection Agency:
- <http://health.nih.gov/result.asp/369/19> - National Institutes for Health/NIEHS: Search Reproductive health; infertility; environmental health; Medline.
- www.nationalchildrensstudy.gov - The National Children's Study, examining the effects of environmental influences on the health and development of more than 100,000 children across the United States
- <http://toxnet.nlm.nih.gov> - National Library of Medicine/ToxNet:

Non-governmental:

- www.americanpregnancy.org – American Pregnancy Association
- www.checnet.org -Children's Health Environmental Coalition. Of particular interest: advice sheets and excellent chemical profiles and effects list.
- www.cheforhealth.org - The Collaborative on Health and the Environment
- www.endometriosisassn.org - The Endometriosis Association
- www.environmentalhealthnews.org - News compiled by Environmental Health Sciences
- www.ewg.org - The Environmental Working Group
- www.healthytomorrow.org - Alliance for a healthy tomorrow
- www.nrdc.org - Natural Resources Defense Council
- www.ourstolenfuture.org - Our Stolen Future
- www.panna.org - Pesticide Action Network North America. Of particular interest: the pesticide database.
- www.protectingourhealth.org - The science website for the Collaborative on Health and the Environment
- www.psr.org - Physicians for Social Responsibility
- www.saratogafoundation.org - Saratoga Foundation for Women Worldwide, Inc.
- www.sehn.org - Science and Environmental Health Network
- www.thegenesisfund.org/peh.htm – Pregnancy Exposure InfoLine
- www.worldwildlife.org - World Wildlife Fund

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