PHYSICAL AGENTS AND REPRODUCTIVE HEALTH

The previous two parts in this series (see *Daily Hazard* No.39 and 40) dealt with the hazards to reproductive health created by chemicals and by VDU work. This final part describes the effects of physical agents: ionising and non-ionising radiation, vibration, temperature, noise, lifting and handling, and hours of work. Occupational exposure to infection is also covered and the series concludes with a look at changes in the law, recently introduced and prospective.

While the scientific evidence is inconclusive in most instances, a high proportion of workers, both men and women, are exposed to hazards that could affect their reproductive health and that of their off-spring. Careful assessment and action are needed to identify and eliminate risks.

Ionising radiation

Ionising radiation includes X-rays, alpha, beta and gamma rays and neutron irradiation. Such high-energy radiation is especially hazardous to the foetus in the early stage of pregnancy, the period between 6 and 15 weeks being the most vulnerable. The effects are increased foetal death rates and low birthweights, mental retardation, malformations and cancer, particularly leukaemia, in the off-spring. There is now strong evidence that exposure prior to conception by both men and women can result in damage to the next generation. A Health and Safety Executive study of men employed at Sellafield found a correlation with the fathers' exposure and leukaemia in their children.

The law is contained in the 1985 *Ionising Radiation Regulations* and a number of subsequent pieces of amplifying legislation. There are dose limits for pregnant women and for women of reproductive capacity and where these cannot be achieved, alternative work should be provided. Dose limits are subject to continuing controversy as evidence of harmful effects accumulates. Those most at risk are nuclear processing workers, people engaged in the manufacture and handling of radioactive substances, and health care personnel.

Non-ionising radiation

Microwave, radiofrequency and extra low frequency radiation are emitted to varying degrees by all types of electrical equipment. The particular case of VDUs is dealt with in *Daily Hazard* No.39. The effect on reproductive health is hotly debated and no consensus has emerged. There are reports of reduced sperm count and sterility in men exposed to microwave radiation and of a possible link between Down's Syndrome in children and paternal exposure to radar.

Exposure of women to microwave radiation may lead to menstrual disorders, increased miscarriages and retarded development and malformations in off-spring. The use of electric blankets by pregnant women has been related to changes in the frequency of spontaneous abortions and birth defects. There are reports of adverse reproductive effects for both men and women in the vicinity of high-voltage power lines. However the results are inconclusive as in other areas of non-ionising radiation.

Vibration

Exposure to occupational vibration has been reported to be linked to menstrual irregularities. It can also worsen conditions of pregnancy such as abdominal and low back pain. Low frequency vibrations can penetrate the abdominal wall and may harm the developing foetus. Whole body exposure to 4-8 Hz vibrations can induce resonances in the abdomen. There are reports of miscarriages and birth defects associated with vibration. Vehicle drivers are most at risk.

Noise

Pregnant women exposed to noise are prone to vaginal bleeding. Noise increases the risk of pregnancy-induced raised blood pressure. There are reports of reduced birthweights, hearing loss and malformations in the off-spring of noise-exposed mothers. While there are a number of studies on the effects of noise alone, it is more commonly suggested that noise reinforces the adverse effects of other factors on reproductive health, eg. vibration or temperature.

Temperature

Exposure of men to high work temperatures has been related to sperm abnormalities and delayed conception. Exposure of welders to radiant heat produced a reduction in sperm quality which was reversed when exposure ceased. There is an association between central nervous system defects in off-spring and high temperature exposure in the early part of pregnancy — high humidity also plays a role.

A study of workers in refrigerated stores indicated a connection between low temperatures and menstrual problems. There are reports of miscarriages and of low birthweights connected with low temperatures.

Physical work

Heavy physical work and exercise are known to have adverse effects on reproductive health. A significant increase in miscarriages has been found for those involved in lifting heavy loads more than 15 times per day. It appears that the risk may increase in the later stages of pregnancy. There is also an association between heavy physical work and preterm birth. An analysis of professional and unskilled workers indicated that the latter were twice as likely to give birth prematurely, even when other factors were taken into account.

A connection has been found between standing for lengthy periods and miscarriages. One study revealed twice the rate of miscarriages for standing compared with comparable sitting workers. A discernible risk has been measured for standing for more than three hours per day. Standing in the late stages of pregnancy can result in fatigue, shortness of breath and varicose veins and these symptoms can persist after delivery. Production line workers, shop workers and health care personnel are chiefly at risk.

Hours of work

There is an established relationship between adverse effects on reproductive health and both total hours of work and shift patterns. A discernible risk of low birthweight and premature birth can be found for a working week as short as 21 hours and the risk grows in proportion to the hours worked. For long working weeks, 45 hours or more, there is a link with birth defects and spontaneous abortions. Evidence has been found relating shift work to menstrual difficulties and vaginal bleeding.

A 1993 study found that women working evening or night shifts are up to four times more likely to miscarry than day shift workers.

Stephanie Henry/FORMAT

Hospital laundry work can be hot and physically demanding

Infectious agents

A wide range of infectious agents, from both animals and humans, have adverse reproductive effects for both men and women. Increased body temperature resulting from fever can harm the developing foetus. Some which can affect pregnancy outcome by maternal infection are herpes simplex, rubella, chicken pox, hepatitis, influenza, listeriosis, HIV and syphilis. Mumps, brucellosis and syphilis can cause infertility in men. Groups most at risk are teachers, hospital workers, agricultural and veterinary workers, and meat handlers.

Pregnancy protection and the law

While there has been longstanding legal protection for workers exposed to lead and ionising radiation, the law on pregnancy protection is now in flux. From 1996, employers will have to provide rest facilities, including facilities for lying down, for pregnant women and nursing mothers (Workplace Health, Safety and Welfare Regulations).

Dismissal or selection for redundancy on grounds of pregnancy is unfair. Where a pregnant women is suspended from work on health and safety grounds, the employer is obliged to offer alternative work, where possible. Women thus suspended are entitled to the remuneration they would otherwise have received (Trade Union Reform and Employment Rights Act). These rights will come into force in October 1994 along with the other provisions of a European Directive on improvements in the health and safety of pregnant workers, those who have recently given birth and nursing mothers. The main provisions still to be introduced into UK law are: a requirement on employers to assess the risks to pregnant and breast-feeding workers of certain agents, processes and conditions; prevention of exposure of listed physical, chemical and biological agents; a ban on night work.

The Health and Safety Executive is consulting internally at present on the preparation of draft regulations which will be issued for comment in the near future. In view of the hostility which the UK government has demonstrated throughout to the Pregnancy Directive and the poor track record for transposing European into British law, vigilance will be required in ensuring that the benefits of the Directive are wholly realised. Even if this is achieved, the law will not be a substitute for organisation and bargaining at workplace level.

WORKPLACE CHEMICALS AND REPRODUCTIVE HEALTH

Very little research on the reproductive hazards of chemicals was done before the mid-1970s and there is still intense debate about the reliability of available research techniques. However, there are at least 200 chemicals for which there is published evidence of reproductive hazards. This factsheet, the second in a series of three on reproductive hazards (see *Daily Hazards* 39 and 41) gives information on the main chemical hazards and how to avoid or reduce exposure.

Chemicals can affect the reproductive health of both men and women both before and after conception. There can be loss of libido, impotence, reduced sperm count and infertility in men. Women can suffer loss of libido, infertility and disturbances in ovulation, menstruation, implantation and placental development. Chemicals which can cause genetic damage in either men or women can lead to miscarriages, stillbirths, birth defects (low birth weights, deformities, chromosome abnormalities), genetic diseases and cancer in offspring, retarded physical and mental development in offspring and infant mortality. Some chemicals absorbed via breast milk may also result in infant mortality and retarded development. The following list of chemicals comprises those for which reproductive hazard is *proven* or highly likely. The list of *suspects* is much longer.

Anaesthetics

Anaesthetic gases, mainly nitric oxide and, less conclusively, halothane, are suspected of causing spontaneous abortions; to a lesser extent they are also implicated in congenital malformations in offspring. There is evidence that the pregnancies of the partners of men exposed to anaesthetics are also more prone to end in spontaneous abortions. Those most at risk are operating room personnel including cleaners, dentists and their assistants, and veterinary workers.

Carbon monoxide

Exposure to carbon monoxide affects fertility in women. Exposure during pregnancy can lead to foetal death or brain damage in survivors. Carbon monoxide fumes are the by-product of a number of fuel-burning processes such as petrol and diesel engines and gas heaters. It is formed in small amounts by photocopiers and laser printers. It is a significant product of tobacco smoking.

Carbon disulphide

Carbon disulphide is a solvent which is used in the manufacture of plastics and also in a number of other manufacturing processes. It causes sexual dysfunction in both men and women. It is toxic to foetuses and can pass into mother's milk producing neurological disturbances in offspring.

Formaldehyde

Evidence is accumulating that exposure to formaldehyde can cause sterility in women. There is also evidence of menstrual effects and effects on pregnancy. There are a large number of reports of harmful effects in animals. Those particularly at risk are hospital personnel, furniture workers, construction workers and those involved in the manufacture of plastics, paints, foams and resins.

Glycol ethers

Despite strenuous efforts at denial by the electronics industry, some glycol ethers (also known as cellosolves) have been shown to cause miscarriages by both inhalation and skin contact. They are also implicated in low birth weights and malformations. They also interfere with male reproductive capacity. Glycol ethers are used as degreasers in the manufacture of silicon chips. They are also used as solvents in a number of other manufacturing processes and as anti-freeze agents for petrol and other fuels.

Lead

Lead and its compounds are potent reproductive toxins for both men and women. They have been associated with sterility, menstrual disturbance, impotence, damage to sperm, miscarriages, stillbirths, increased infant mortality, low birthweight, slow infant development and infant retardation. Exposure before conception can result in reproductive failure and maldevelopment. Effects appear at low levels of exposure. In addition to workers involved in manufacturing processes, those at risk include welders, painters and people exposed to petrol fumes.

Metals

Many other metals in addition to lead are reproductive toxins. Particularly dangerous are cadmium and its compounds (kills or damages foetuses; affects postnatal development;

causes testicular damage) and mercury and its compounds (menstrual disturbances and reduced ovulation; possible cause of spontaneous abortions through both paternal and maternal exposure; central nervous system defects in offspring; reduced libido and potency in men). Other metals suspected of reproductive effects are arsenic, beryllium, manganese, selenium, tellurium and thallium.

Pesticides

A variety of pesticides are known reproductive toxins. A non-exhaustive list of common pesticides with some evidence of reproductive hazard is: dibromochloropropane, DDT, dieldrin, aldrin, lindane, malathion, parathion, carbaryl, 2,4-D, 2,4,5-T, paraquat, simazine, atrazine, zineb, captan and pentachlorophenol. The list is only limited by the lack of research. At risk are chemical manufacturing workers, farmworkers, parks and gardens workers, construction workers (and a host of other people subject to non-occupational exposure).

Pharmaceuticals

A large number of medicinal drugs are now known to have adverse reproductive effects. This can pose a risk for the workers who manufacture or handle them. Particular hazards are known for the manufacture of oral contraceptives and the handling of anti-cancer drugs.

Polychlorinated biphenyls

Polychlorinated biphenyls are electrically non-conducting fluids with a variety of industrial applications. High levels are found in breast milk and this has been related to underdevelopment in children. There are also reports of menstrual problems.

Solvents

Organochlorine solvents (e.g. trichloroethylene) are associated with spontaneous abortions and the development of cancer in offspring. Aromatic hydrocarbons are also associated with reduced fertility, spontaneous abortions, malformations and low birthweight. There is evidence for cancer in offspring resulting from paternal exposure. The commonly used thinner methyl ethyl ketone can damage embryos and foetuses. Groups particularly at risk are dry cleaning workers, painters and laboratory workers.

Vinyl chloride

Paternal exposure to vinyl chloride monomer can cause central nervous system defects in offspring. There are conflicting reports on whether paternal exposure can cause spontaneous abortions. Vinyl chloride monomer is a cancer-causing agent which is known to cross the placenta. The chemical is used in the production of plastics and process workers are most at risk but people living in the vicinity of plants may also be affected.

Protection in the workplace

The safe use of chemicals in the workplace is governed by the Control of Substances Hazardous to Health (COSHH) Regulations (see *Daily Hazard* 24) and by other legislation referring to particular chemicals (lead and vinyl chloride being examples of the latter). Employers are obliged to carry out an assessment of the risk of chemicals and processes and then either introduce safer materials and methods OR, if that is not possible, control the process OR, if that is not possible, provide protective equipment. In some cases health surveillance of exposed workers should be carried out. Union safety representatives should be consulted on assessments and on the safety procedures to be carried out. Try for substitution every time.

The key step in assessments is acquiring information on the hazards of chemicals. For reproductive hazards, never rely on the information in manufacturers' or suppliers' safety data sheets, always seek information from your union or other independent source. Try and obtain information about effects on women, men and offspring. Establish the safe conditions for a) pregnant women and b) both women and men planning to start a baby. Wherever possible, argue for the option of people in these categories to move off potentially hazardous processes onto safe work. Demand the management provides tests of exposure to known or suspected reproductive toxins.

Under the Workplace Health, Safety and Welfare Regulations and the Trade Union Reform and Employment Rights Act, there are general rights for pregnant women at work. These will be dealt with in the final factsheet in this series in *Daily Hazard* 41.

Key information sources

S.M. Barlow and F.M. Sullivan, *Reproductive Hazards of Industrial Chemicals*, Academic Press (1982).
A.C. Fletcher, *Reproductive Hazards at Work*, ASTMS/Equal Opportunities Commission (1985).