

Reproductive hazards and the workplace

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The most outstanding feature of reproductive hazards in the workplace is the lack of reliable information on how or even if most exposures are linked to infertility or to reproductive problems such as early miscarriage and birth defects. Speculations range from the view that a direct and obvious danger to male and female fertility exists in many workplaces to the view that there are no significant linkages between the workplace and reproductive problems.

There are two reasons why the evidence that we could use to make such judgements is not available. The first is simply the magnitude of the problem. It is estimated that there are between 50 000 and 100 000 chemicals and substances in the workplace today,¹ and more are being added continually. To study each of these with the appropriate scientific methods, looking for cause-and-effect relations, would require an army of epidemiologists and unlimited funding. Even this neglects all the possible combinations and permutations of these substances.

The second reason is more complicated: it is the definition of the problem of reproductive hazards in the workplace. We do not obtain the needed information because we set out to collect data that are based on certain implicit assumptions. We have "blind spots" — there are some questions we simply do not think to ask.

Understanding one of these blind spots in particular is vital to a constructive discussion of reproductive hazards in the workplace; it relates to gender. Until recently we have not seen — because we have not looked for — risks in the workplace to *male* fertility and reproduction. Studies have focused almost exclusively on women's exposure, particularly during pregnancy, and on subsequent impaired fertility or birth defects. We may lament the quantity and quality of data from such studies, but in comparison we have next to no in-

formation on the effects of workplace hazards on male reproduction.

There are different views on what underlies this neglect. Some researchers attribute the focus on women's reproduction to society's traditional identification of reproduction with women. Because so much more is known about the female than the male reproductive system the treatment of female infertility is more rewarding for physicians. Only recently is the male contribution to infertility coming to the fore and beginning to be understood.

Another view is that research on reproductive hazards to women is used to keep them out of more highly paid jobs, jobs that were at one time strictly for men.² Those of this view say that research does not look at whether men are at risk, because there is no underlying agenda to remove men from those particular workplaces. They claim that research has been used to justify discriminatory labour practices and policies. This claim cannot be made lightly, but its advocates say that it is supported by the observation that there has been less research about the effects of workplace hazards on women who work in traditionally female jobs.

Another aspect is the tendency to focus on the developing fetus, a concern that has led to less emphasis on the woman's reproductive system as a whole. One explanation for this focus is that companies are in danger of being sued for large amounts of money in damages if a child is born with grave defects.³

The response to suspected hazards

Responses to reproductive hazards in the workplace have, to a large extent, been conditioned by the way in which the problem has been defined. The primary response has usually been to remove the

individual and not the hazard. When the problem has been defined as one that affects women, then pregnant women (or even all women who could become pregnant) are the excluded workers. Intentionally or not this policy cannot fail to have a negative impact on women's goals of achieving equality, economic and otherwise.

Moreover, this approach is inadequate if *men* are affected by hazards in the workplace and if such hazards cause problems in their offspring. For example, in a case before the US Supreme Court⁴ a company manufacturing car batteries had the policy that women capable of bearing children could not work in jobs that exposed them to certain levels of lead. Women aged 50 years and under were transferred if any employee in their work area had had a blood lead level of more than 30 $\mu\text{g/dL}$ (1.45 $\mu\text{mol/L}$) during the previous year. The court upheld this policy. Yet some of the few studies⁵⁻¹⁰ that have focused on male reproduction over the past two decades have shown that concentrations of lead at this level have a permanent effect on male fertility, and reports from the University of Maryland have indicated that male rats exposed to low levels of lead produced progeny with abnormal brain development (*New York Times*, Mar. 1, 1991).

Stemming from the narrow focus on the danger to the conceptus is the policy of excluding from the workplace women who have the potential to become pregnant, not because of concerns about their long-term reproductive health but because it is possible for them to be pregnant for several weeks without knowing it. It is during early pregnancy that the major organs are laid down and are most vulnerable to substances causing malformations. However, if there is a danger to reproduction from exposure in a workplace it is likely that it exists at the level of both ova and sperm, and thus there is a need to protect the gametes of men and women as well as to protect the conceptus.

The results of a recent study are relevant, because it is one of the first to look at whether paternal exposure has a role in harm to offspring.¹¹ The study used data on more than 22 000 children — all those born with birth defects in British Columbia from 1952 to 1973. Children of firemen had a significantly higher risk of being born with atrial or ventricular septal defects than did the children of normal control subjects or policemen. Firemen are exposed to a wide range of toxic chemicals both during a fire and in the course of the investigation and cleanup afterward. Policemen were chosen as a comparison group because they were similar to firemen in socioeconomic status and in their job's hiring criteria, such as education, fitness and physical build. Fathers of children with atrial septal defect were 5.9 times more likely to be

firemen than to work in all other jobs combined and 3.8 times more likely to be firemen than policemen.

It is not known exactly how paternal exposure could cause a birth defect. Since a mechanism has not been clearly identified as yet, evidence of such a relation has not often been sought. However, one possible mechanism is the absorption through the skin and through inhalation of chemicals that affect sperm DNA. Animal studies suggest that toxic compounds may be transferred in the semen to a pregnant female.^{12,13} In humans one mechanism may be exposure of the woman to agents brought home on the man's clothes. Regardless of the mechanism, the possible link between paternal exposure and adverse outcomes in the offspring should be explored.

Testing as a response

Genetic knowledge and the capability for genetic screening have increased greatly in the past decade, but unfortunately this has led to a widespread exaggeration of what genetic science can accomplish, with not enough acknowledgement of its limitations. I think this is because there are two categories of genetic disease that are not separated in people's minds. The first category is of single-gene disorders, such as cystic fibrosis, Tay-Sachs disease and Duchenne muscular dystrophy. There are several thousand of these Mendelian disorders, each of which is rare individually. Currently over a hundred of them can be detected through prenatal testing. In this category, there is a 1:1 relation between genotype and phenotype: if the genotype for the disease is present, then the individual will have the disease.

The other category of genetic disorders includes "multifactorial" conditions. We are learning that these conditions are the result of complex interactions between genetic susceptibilities and environmental or lifestyle factors that we are only beginning to understand. In this type of genetic susceptibility the genotype has a much smaller influence on the phenotype than is the case in single-gene disorders.

Many genetic-based susceptibilities that would be tested for in the workplace fall into this second category. Whether a problem develops in people with the gene depends on their environmental experiences. It may simply not be possible to create a test that can take this complexity into account. Although tests have been greatly improved, the current ones for detecting a predisposition to harm from workplace exposures are usually not sufficiently refined to determine susceptibility to a particular substance.

An uncritical faith in genetic testing is unjustified not only because of the limitations of the tests

themselves but also because of the real dangers attached to any widespread use of testing and to the way test results might be applied. One danger already mentioned is the tendency to focus on the individual whose test results show him or her to be susceptible rather than to focus on the problem — that is, to remove the worker instead of cleaning up the workplace. Further, testing is a crude determinant of susceptibility, in part because there are other variables that cannot be appropriately weighed. Many of these, such as smoking, are related to lifestyle. There is a danger that emphasis on these factors could lead companies to try to control the behaviour of their employees not only while they are at work but also during the rest of their time. Testing done as a panacea is neither good science nor good policy. That is not to say that there are no situations in which testing might be useful. In itself testing is not immoral, but it should not be asked to deliver more than it can, and the potential consequences of a testing program should be very carefully thought through.

In evaluating situations in which testing might be appropriate it must be remembered that nothing is safe in an absolute sense. The poison lies not in the substance but in the dose. Given the marked differences in people's metabolic systems the level of safe exposure for 1 person in 100 000, for example, may be many times less than that for the rest of the population. There is evidence of a bimodal distribution of some susceptibilities in the population.¹⁴ Even if the concentration of a toxic agent is reduced to a level that is safe for most people there may always be a small group with heightened sensitivity for whom it will be next to impossible to make the level low enough.

In some cases a reduction to the level of a toxic agent that is "safe" for most people may be an appropriate way of minimizing reproductive and other health risks. In well-documented situations, once the workplace has been suitably cleaned up it may be necessary and acceptable to test for genetic susceptibility to much smaller dosages and to remove workers who are still at risk in this cleaned-up workplace. Such people would require protection and compensation in law for being thus excluded. Furthermore, this strategy should not be the first line of approach and is not usually applicable.

Public concern

Although we do not know how important the workplace is, the public is clearly anxious about the role that exposure in the workplace plays in causing reproductive problems, and arguments made by many assume a proven and definite linkage. These are very real perceptions and concerns that must be

addressed first through research and then through enlightened legislation and social policy based on the results of that research. We also need to consider the training that medical students receive; patients with fertility problems are often not asked about their occupation as part of the medical history-taking.

What can we do?

Given the impossibility of doing conclusive studies of the many substances in our workplaces, we must examine our current knowledge of the biologic and toxic properties of these substances and set priorities for research. Since few activities and substances are entirely risk-free, decisions about what kinds of risks are acceptable will be needed. Acknowledging risk does not avoid the obligation to clean up the workplace, and preselecting workers on the basis of their genetic predisposition or sex is not appropriate. Such actions are discriminatory and unacceptable in our society. Instead, it is a question of diminishing returns: At what point is the majority of the exposed work force safe? Where should we place the cutoff? These are questions that have many facets, including a basic economic one. In eliminating all hazards from the workplace we do not want to eliminate the workplace itself, because of the high costs involved. These issues need to be approached cooperatively and with full information by participants, employers and unions.

Second, we must make better use of the data that have already been collected. For instance, existing databases of workplace exposures and of health outcome could be investigated for correlations. Computer record linkage of databases is a tool that could be used at relatively low cost, since the expensive part — the data collection — has already been done. For this to be successful on a wide scale what is needed is a sympathetic attitude by unions, employers and government and a willingness to allow such linkages with — importantly — appropriate confidentiality guidelines.

Third, we should recognize the importance of prevention. One of the keys in prevention is information. Employers and unions must tell employees what is known and what is not known about existing hazards so that employees are able to make informed choices about the actions and precautions they want to take.

Fourth, the types of research questions that are being asked have to be examined for hidden assumptions, for our cultural biases. One of the best ways to do this is to solicit input from different groups with different points of view when setting out research questions.

The issues of reproductive hazards in the workplace are complex, and there are no simple solutions. Recognizing the complexity of the problems is vital if we are to reach solutions that meet the needs of both individuals and workplaces. It must be remembered that simple solutions are, too often, simply wrong solutions.

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