

Genes, Work and Health

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Occupational health has been aptly described as a two-way relationship between work and health.¹ This has served as a useful model emphasizing that workplace exposure has both adverse and positive effects on health as well as the health status of the worker having an impact on his work and workplace. Historically, mainstream occupational medicine has focused primarily on the adverse health effects of workplace exposure. A search of the July to December 2000 issues of four major occupational medicine journals (*American Journal of Industrial Medicine*, *Journal of Occupational and Environmental Medicine*, *Occupational and Environmental Medicine* and *Scandinavian Journal of Work, Environment and Health*) revealed that out of 203 original articles, 139 (68.5%) dealt with the adverse effects of workplace exposure.

The unravelling of the human genome, which President Clinton described as 'learning the language in which God created life', opens a new avenue of research and applications in occupational medicine. An example is the Environmental Genome Project of the National Institute of Environmental Health Sciences. On 7 December 2000, the National Center for Toxicogenomics was launched to study 'how genes interact and respond to environmental exposures during different stages of health and disease'.² Although the focus is on the general environment and on expression profiling, the results could be applied to the working population to determine and predict the true risks of occupational exposure as well as protecting susceptible workers.

There has been keen interest in identifying subjects who may be particularly susceptible to particular occupational exposures. If such susceptible individuals can be identified, they could be protected from exposure; the corollary being that the exposed subjects are more resistant to the workplace exposures. Occupational health physicians are generally not in favour of such an approach. It goes against the grain of the spirit of occupational health: 'to provide a safer and healthier work environment' rather than 'selecting a more resistant workforce'. Unfortunately, as more information on how genes and the work environment interact to affect health, we may very quickly lose the luxury of hiding behind this philosophical and moral high ground. Workers and employers will demand for information that this 'new science' can provide.

Commercial firms are developing gene arrays with fanciful names as "ToxChip" and "ToxBlot". These arrays are about the size of microscope slides and consist of thousands of orderly arranged DNA sequences corresponding to genes that may be affected by the putative toxic chemical. To analyse the gene expression, mRNA is first extracted from cell or tissue culture, which is exposed to the chemical. This is converted to short lengths cDNA, which is then amplified using PCR, and labelled. The cDNA sample binds to the DNA sequences on the microarray and the signals from the label are used to identify which gene has been turned on or off by the toxic chemical. Clearly, such an approach will yield voluminous data and validation of such a cocktail of markers for screening purpose is not going to be easy.³ The traditional approach of validating biomarkers for biological monitoring may be under threat. Pressure from consumers and commercial firms claiming the availability of such test kits will force occupational health professionals to re-evaluate their approach in biomarkers validation.

Perhaps, it is also time to take another look at the time-honoured two-way relationship of work and health. The time is right to introduce a third element into the model. Occupational medicine should be described as a three-way relationship between genes, work and health.

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