

be avoided if our aim is to create a good work environment. The exact meaning of words such as "adverse", "toxic", "disease", or "illness" is important but the process of defining them must not obstruct the improvement of the work environment.

- 1 Axelson O, Hogstedt C. On the health effects of solvents. In: Zenz C, ed. *Occupational medicine. Principles and practical applications*. Chicago: Year Book Medical Publishers, 1988:775-84.
- 2 Flodin U, Ekberg K, Andersson L. Neuropsychiatric effects of low exposure to styrene. *Br J Ind Med* 1989;46:805-8.
- 3 Yokoyama K, Araki S, Murata K. Effects of low level styrene exposure on psychological performance in FRP boat laminating workers. *Neurotoxicology* 1992;13:551-6.
- 4 Fallas C, Fallas J, Maslard P, Dally S. Subclinical impairment of colour vision among workers exposed to styrene. *Br J Ind Med* 1992;49:679-82.

### Coal mining, emphysema, and compensation revisited

Editor,—Journalists should always check their facts. The same principle presumably applies to higher forms of life. Morgan (1993;50:1051-2) criticises the Industrial Injuries Advisory Council (IIAC) for its decision to recommend the prescription of chronic bronchitis and emphysema for coal miners. He notes, presumably sardonically, that it was "perhaps coincidental" that the IIAC report was sent to the Secretary of State in November 1992, shortly after the announcement of large scale impending pit closures.

In fact it is plain from the face of the IIAC report<sup>1</sup> that it was sent to the Secretary of State in August 1992—that is, two months before the Government's announcement of pit closures. The report was not officially published until November. Delays of several months between submission and publication are quite usual and so a conspiracy theory (or at least one that implicates IIAC) seems entirely unwarranted. The present writer is not without criticisms of the role of the IIAC<sup>2</sup> but it does help to get one's facts right.

NJ WIKLEY  
University of Birmingham,  
Faculty of Law,  
Edgbaston, Birmingham  
B15 2TT, UK

- 1 Industrial Injuries Advisory Council. *Chronic Bronchitis and Emphysema* Cm 2091. (November 1993.) London: HMSO, 1993.
- 2 Wikeley NJ. *Compensation for industrial disease*. Aldershot, Hampshire: Dartmouth Publishing Company, 1993.

### The correction of urinary mercury concentrations in untimed, random urine samples.

Editor,—We note with interest the continuing number of reports defining dose-effect relations for occupational exposure to mercury (Hg) that have used urinary Hg concentrations from untimed, random samples (spot urines) either as a cumulative exposure dose<sup>1</sup> or a simple dose index.<sup>2</sup>

These studies often use spot urinary Hg concentrations readily available from routine biological monitoring strategies in the chloralkali and other Hg utilising industries. Diurnal variation in the metal's excretion has been noted,<sup>3,4</sup> but the higher concentrations found in morning samples compared with afternoon and evening samples have been suggested as being of no practical relevance in a biological monitoring scheme.<sup>4</sup> Urinary Hg concentrations are said to reflect integrated exposure over the preceding weeks or months in workers with long term exposure. There has been debate about whether creatinine or other forms of correction for urinary concentration are better in reducing intra individual variation of urinary Hg and thus making a single spot measurement more closely reflect true Hg excretion.<sup>5</sup> We present some data on the effect of suggested methods for the correction of spot urinary Hg samples in reducing within day and between day intraindividual variation.

Within day variation was studied in 17 workers with long term exposure to Hg vapour at a single factory. All spot urine samples were taken during a single day at the approximate times of before work, 1000, 1300, 1600, 1900, and 2200 hours. Mercury was measured by an automated method<sup>6</sup>; creatinine, specific gravity (SG), and osmolality were also measured. The total analytical imprecision (CV<sub>A</sub>) for urinary Hg corrected for either creatinine, SG or osmolality was between 5% and 6%. All Hg measurements were either uncorrected (nmol/l) or corrected per mM creatinine, to SG 1.016, and to 500 mosmol. The between day variation was studied in 10 workers with relatively constant, long term exposure to Hg vapour at a single factory. Spot urine samples were taken from each worker at the same time of day on each day of the working week (five days). The samples from this study were uncorrected or corrected for creatinine concentration or for an SG of 1.016.

The mean (range) urinary Hg concentrations in the workers from the within day and between day studies were 58 (4-268) and 32 (6-50) nmol/mmol creatinine respectively. The table shows the calculated mean and standard deviation (SD) of the intraindividual coefficients of variation (CV<sub>T</sub>) for urinary Hg results in the two studies and, the comparison by ANOVA, of the mean CVs of corrected urinary Hg results with uncorrected results. The data from the within day study confirmed the previously reported diurnal variation.<sup>3,4</sup>

A low mean and SD of intraindividual CVs derived from multiple spot urinary Hg values would imply that a single urine sample closely reflects the true Hg excretion in that individual subject. Creatinine correction of Hg concentration significantly reduced mean intraindividual variation, both between and within day, to about 50%

of the variation in uncorrected urine values.<sup>7</sup> Although the mean intraindividual CV<sub>T</sub>, both within and between day, was less with creatinine correction than with SG correction, the difference did not reach significance (ANOVA, Boniferroni multiple comparison test). There was some evidence from F tests, however, that creatinine correction may be more reproducible between subjects than SG correction. It should be noted that, even with creatinine correction, the mean CV<sub>T</sub> of around 15% with the imprecision of our method implies that two consecutive daily spot urine samples, taken at a time to reduce the influence of diurnal variation, could statistically be around 45%-50% apart ( $t \cdot \sqrt{2 \cdot CV_T}$ ). It has been widely accepted in clinical pathology that acceptable analytical imprecision should be less or equal to half the average intraindividual biological variation (CV<sub>B</sub>).<sup>8</sup> This value for urinary Hg corrected for creatinine can be derived from the formula  $CV_T^2 = CV_A^2 + CV_B^2$ . Thus we suggest that the combined analytical precision of any urinary Hg and creatinine method should be less than 7.3%.

Correction for creatinine and, perhaps slightly less satisfactorily, correction for SG reduce the uncertainty of a spot urinary Hg concentration in reflecting accurately the true Hg excretion in an individual subject. Corrected spot urinary Hg results have proved their use both in routine biological monitoring and in studies describing dose-effect relations that may aid in setting standards. It is important, however, that the limitations and errors associated with their use as dose measures are understood.

HJ MASON  
Occupational Medicine and Hygiene Laboratory,  
HSE, Sheffield  
IM CALDER  
HSE, Luton

- 1 Ellingsen DG, Morland T, Andersen A, Kjuus H. Relation between exposure related indices and neurological and neurophysiological effects in workers previously exposed to mercury vapour. *Br J Ind Med* 1993; 50:736-44.
- 2 Cardenas A, Roels H, Bernard AM, et al. Markers of early renal changes induced by industrial pollutants. I Application to workers exposed to mercury vapour. *Br J Ind Med* 1993;50:17-27.
- 3 Piotrowski JK, Trojanowska B, Mogilucka EM. Excretion kinetics and variability of urinary mercury in workers exposed to mercury vapour. *Int Arch Occup Environ Health* 1975;35:245-56.
- 4 Calder IM, Kelman GR, Mason HJ. Diurnal variations in urinary mercury excretion. *Human Toxicology* 1984;3:463-7.
- 5 Wallis G, Barber T. Variability in urinary mercury excretion. *J Occup Med* 1982;24:590-5.
- 6 Richardson RA. An automated method for the determination of mercury in urine. *Clin Chem* 1976;22:1604-7.
- 7 Barber T, Wallis G. Correction of urinary mercury concentration by specific gravity, osmolality and creatinine. *J Occup Med* 1986;28:354-9.
- 8 Elevation FR, ed. 1976 *Aspen conference on analytical goals in clinical chemistry*. Skokie, IL: College of American Pathologists, 1977.

### Comparison of mean CVs of corrected urinary Hg results with uncorrected results

	CV <sub>T</sub> Creatinine corrected mean (SD)	CV <sub>T</sub> SG(1.016) corrected mean (SD)	CV <sub>T</sub> Osmolality corrected mean (SD)	CV <sub>T</sub> Uncorrected// mean (SD)
Within day (17 subjects)	22.4 (7.9)% p < 0.001	32.2 (12.3)% p < 0.05	36.5 (15.1)% p > 0.05	47.3 (22.2)%
Between day (10 subjects)	15.6 (7.2)% p < 0.05	22.0 (14.0)% p > 0.05	—	37.3 (23.6)%