

Multiple logistic analysis software usually does not provide error message for empty cells

In 1993 Landtblom et al (1) reported a case-referent study on multiple sclerosis and exposure to solvents, ionizing radiation, and animals. Data were obtained from 91 cases and 348 referents. Multiple logistic regression was used in the analysis of the data, and 14 predictors were included in the final model. The standard errors appear to be large, as reflected in the wide confidence intervals (CI). For example, the estimated odds ratio for occupational exposure to cats or dogs among men was 18 (95% CI 1.3–265). Despite the wide confidence interval the authors concluded that “The men had significantly elevated risks, determined from logistic odds ratios, for . . . occupational contact with dog or cats, . . . [p 399].” The odds ratio for X-ray treatment was reported to be ∞ for the women, 0 for the men, and 0 when both men and women were included in the model. Obviously there is a problem with the model, but the authors interpret the results in the following way “This study indicates that exposure to ionizing radiation might have an increased risk for multiple sclerosis, as observed both for patients treated with X rays and for radiological per-

sonnel [p 402].” In my opinion this example illustrates the danger of an uncritical use of the logistic regression analysis. The computer nicely calculates regression coefficients even if the number of empty cells is large and provides an error message only when the maximum number of iterations is reached. The presence of zero cells should be recognized before the multiple logistic regression is carried out. By collapsing categories and excluding predictors with low prevalence the problem with empty cells can be diminished.

References

1. Landtblom A-M, Flodin U, Karlsson M, Pålhagen S, Axelson O, Söderfeldt B. Multiple sclerosis and exposure to solvents, ionizing radiation and animals. *Scand J Work Environ Health* 1993;19:399–404.

Anders Knutsson, MD
Department of Occupational and Environmental Medicine
Umeå University Hospital
90185 Umeå
Sweden

Author's reply

Dr Knutsson calls attention to the pitfalls of using logistic regression analysis on a material with small numbers of exposed subjects. We share his opinion, and in our article (1) we may have caused some trouble by trying to display our material so clearly. For the women, the relation of exposed cases to referents for both radiological work and X-ray treatment appeared to be remarkable (table 3 of the article) with high Mantel-Haenszel rate ratios, even if based on small numbers. Similar results were obtained by logistic regression for radiological work, as presented in table 4 of the article. However, X-ray treatment was not included in this analysis, as can be seen from the equation underneath table 4. In this table we included an indication of the (formally and indefinitely) high risk for X-ray treatment among women; in retrospect this appears less appropriate.

For the men, the Mantel-Haenszel rate ratios (MH RR) on occupational exposure to cats (MH RR 15; 95% CI 2.3–115) and dogs (MH RR 9.9; 95% CI 1.4–77) in table 1 are reasonably compatible with the logistic odds ratio of 18.0 after exposure to cats or dogs (table 4).

Finally, given the results, our summary of the findings, as quoted by Knutsson, could hardly have been much different in spite of the uncertainties due to the small numbers involved.

References

1. Landtblom AM, Flodin U, Karlsson M, Pålhagen S, Axelson O, Söderfeldt B. Multiple sclerosis and exposure to solvents, ionizing radiation and animals. *Scand J Work Environ Health* 1993;19:399–404.

Anne-Marie Landtblom, MD,¹ Ulf Flodin, MD,²
Olav Axelson, MD²

¹ Department of Clinical Neuroscience
University Hospital
S-581 85 Linköping
Sweden

² Department of Occupational Medicine
University Hospital
S-581 85 Linköping
Sweden