

confounding by other occupational exposures may further affect the results.

It is important to point out that most asbestos-exposed occupations showing a substantial increase in risk of asbestos-related lung cancer are expected to show an even higher elevated risk of mesothelioma. For this reason, it would be difficult to conclude that motor vehicle mechanics may be at risk for developing lung cancer from asbestos given the absence of any increase in risk of mesothelioma. Importantly, the only epidemiological study that used an IH-based exposure assessment (Gustavsson *et al.*, 1990), among persons employed at a bus garage, found no dose-response relationship between the level of asbestos exposure and the risk of lung cancer.

The role of meta-analyses in observational epidemiology is the focus of ongoing discussion. By combining several studies, meta-analyses have an inherent ability to show relatively small statistically significant departures from null. However, these relatively precise meta-RR estimates may not accurately reflect the magnitude of the association unless the analyses take into consideration potential sources of systematic error. It is perhaps more useful to view meta-analysis as a formal way of understanding and quantitatively describing the level of consistency and inconsistency among studies and to identify potential sources of error that may affect the result.

One source of error that warrants consideration in a meta-analysis is publication bias, which tends to occur because studies with statistically significant positive findings are more likely to be published than studies with null results (Easterbrook *et al.*, 1991). Publication bias can be evaluated through identification of unpublished research or by calculating the fail-safe N , defined as the number of studies with a non-significant result that would bring a statistically significant meta-RR estimate to non-significant levels (Rosenthal, 1979). However, in this case the results are essentially null and thus publication bias would not be expected to affect our findings.

The search for sources of error inevitably leads to evaluation of study quality. Several authors recommend formalizing such evaluations by using quantitative scoring of individual studies (Jenicek, 1989; Downs and Black, 1998). Others view the use of scoring schemes as somewhat arbitrary and advise against using them (Juni *et al.*, 1999). We would agree that both points of view have merit. Using a quality score as a method of weighting study results or as a variable in a regression model may introduce a subjective element into an analysis (Greenland, 1998). On the other hand, it is important to consider and take into account methodological strengths and weaknesses that are likely to affect the results. For these reasons, we feel that the use of quality tiers is justified as long as the methodology of assigning studies to a particular tier is transparent to the

readers. It would be difficult to ensure such transparency without some kind of formal scoring approach. The particular scoring method used in this study reflects the consensus of its authors, but we realize that other approaches may also exist.

It is important to point out that if one were to compare the meta-analyses of all studies combined with those of individual tiers, the results would appear somewhat different. The meta-RRs for mesothelioma based on all three tiers is 0.67, with a 95% CI between 0.53 and 0.84, while the meta-RR for Tier I is 0.92 (95% CI 0.55–1.56). The corresponding results for lung cancer are 1.16 (95% CI 1.13–1.19) and 1.07 (95% CI 0.88–1.31). These comparisons indicate that the statistically significant departures from null (down for mesothelioma and up for lung cancer) in a meta-analysis of all studies combined could be explained by methodological problems of individual studies.

CONCLUSIONS

The available epidemiological data show that employment as a motor vehicle mechanic does not increase the risk of developing mesothelioma. Although some studies showed a small increase in risk of lung cancer among motor vehicle mechanics, the epidemiological data on balance do not support a conclusion that lung cancer in this occupational group is related to asbestos exposure from vehicle repair.

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APPENDIX

Meta-analysis calculations

Using the fixed effects assumption, the general formula for the weighted average effect size of k studies is:

$$\bar{T} = \frac{\sum_{i=1}^k w_i T_i}{\sum_{i=1}^k w_i} \quad (1)$$

where T_i is the effect size estimate of the i th study and w_i is the weight associated with it. The weights that minimize the variance of T are given by:

$$w_i = \frac{1}{v_i} \quad (2)$$