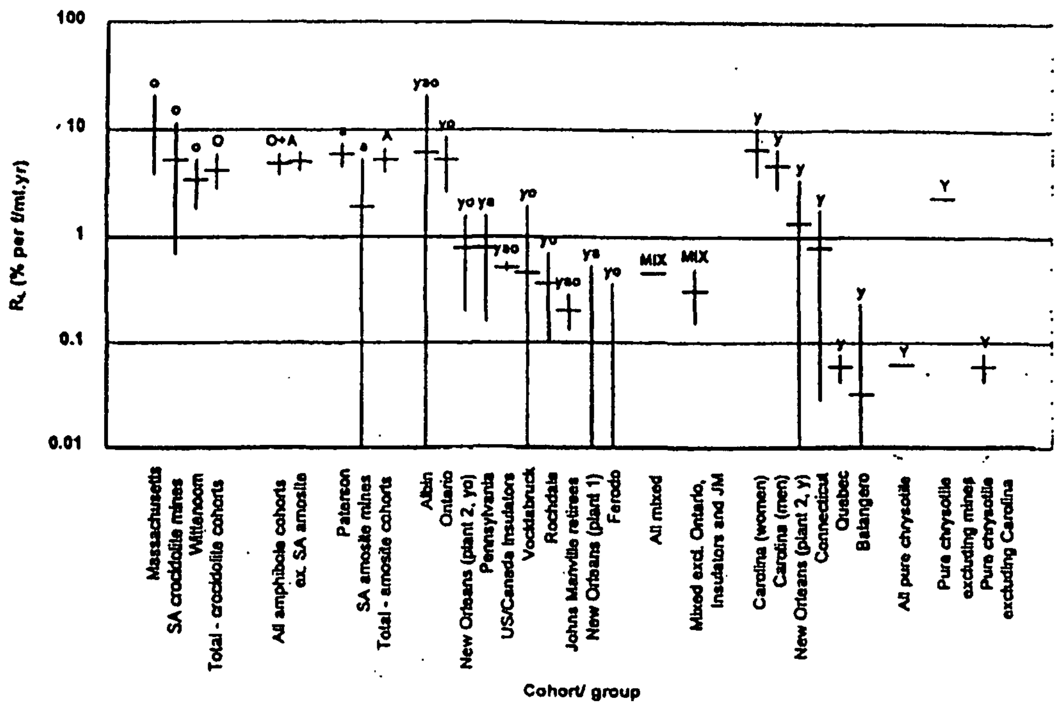

Fig. 3. Exposure-specific excess lung cancer mortality (R_L) by cohort and fibre type groupings, showing 95% confidence intervals. Group means labelled in capitals. Confidence intervals not shown for groups with very significant heterogeneity.

cohorts, but both groupings now show very significant heterogeneity ($P<0.001$).

Among the mixed cohorts, two stand out with particularly high values (Ontario and Albin). Both are asbestos cement cohorts, and both also had high levels of mesothelioma mortality. The values for R_L for these two cohorts are both more than six times the level of the next highest observation.

The heterogeneity among the mixed fibre cohorts is driven principally by three of them: Ontario, US/Canada Insulators and the Johns Manville retirees. Other reviewers (Doll and Peto, 1985; Hughes and Weill, 1986), have remarked on the unusually high risk estimate implied by the Ontario cohort and have suggested that the exposure estimates for this group may have been underestimated. Another potential contribution to the high risk of lung cancer in this cohort is exposure to silica: 8 out of 26 workers with post mortem examinations showed signs of silicosis (Finkelstein and Vingilis, 1984). There are clearly considerable uncertainties in the estimation of average exposures for the US/Canada Insulators cohort, since this is averaged over a very large cohort with no doubt very variable exposure experiences and over a long time period. The size of this group means that the value adopted for it will determine statistically the average risk in this group. The study of retirees from the Johns Manville asbestos products company is unusual in basing its estimates exclusively on follow-up of retired individuals from the age of 65. There is no obvious theoretical reason why this should produce a seriously biased estimate of risk, though asbestos related mortality at ages below 65 will be missed. This cohort has been followed up almost to extinction, and if the impact of asbestos exposure on mortality eventually declines after the cessation of exposure, then cohorts with near complete lifetime follow up will tend to show rather lower excess mortalities than those where survivors form a substantial proportion of the cohort. In addition, the Johns Manville cohort was one where the authors had not suggested a conversion factor from particles to fibres, and this review has used the most commonly used value of 3 f/ml=1 mppcf. If this conversion implies higher exposure than in fact took place (the recent review by Lash *et al.* (1997), used a value of 1.4 borrowed from the New Orleans cohort), then the risk coefficient implied here would be too low. If these three cohorts are excluded from the group the remaining eight are just statistically consistent (P=0.056), and their joint mean is 0.32 (95% CI 0.16–0.50).

The six chrysotile cohorts fall into two groups: the two Carolina cohorts give values around 6% per f/ml.yr; the other four, including the two mines cohorts and dominated by the large Quebec cohort, are consistent with a joint R_L estimate of 0.06% per f/ml.yr (95% CI 0.043–0.079). The Connecticut and New Orleans (chrysotile only) cohorts give central estimates of R_L substantially above this value, (0.80