Validation of five industrial hygienists' assessments of motor exhaust exposure in 36 occupations in Stockholm during 1945-1994 – development of a job-exposure matrix

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Introduction

A job-exposure matrix for occupational motor exhaust exposure was developed by a group of five industrial hygienists to be used in a population based case-control study of myocardial infarction in Stockholm (SHEEP). The matrix was developed by a consensus method.

We investigated how initial and independent assessments made by each of the five hygienists differed from the consensus assessments, considered as a "golden standard". Further we investigated the reliability of the assessments by repeating them four years later.

The aim of the study was to evaluate how much the individual assessments of each of the hygienist differed from the golden standard, and how much the consensus discussions held at the first occasion influenced the assessments made four years later.

Method

The life-time occupational history was obtained from 3973 cases of myocardial infarction and population referents (1). Occupations involving motor exhaust exposure during any period from 1945 to 1994 were identified. In all, 36 occupations, classified by the Swedish ISCO code (on 5-digit level), were associated with motor exhaust exposure (diesel, gasoline or mixed exhausts).

Five industrial hygienists, each with 20 years of professional experience, assessed independently the average exhaust exposure in each occupation during six time periods (1945-49, 1950-59, 1960-69, 1970-79, 1980-89, 1990-94). Four exposure intensity levels were used: no exposure (<1/30 of TLV), low exposure (1/30-1/10) of TLV, medium exposure (1/10-1/3 of TLV), or high exposure (>1/3 of TLV). Carbon monoxide (CO) and nitrogen dioxide (NO_2) were used as indicators.

After having performed exposure assessments individually, the group of hygienists met and made a consensus assessment for each combination of occupation and decade, based on all available knowledge and information from different sources including measurement records/reports (set I).

The individual classifications were repeated by the same five industrial hygienists four years later (set II). No consensus discussions were held at that time.

The concordance in the agreements between the five hygienist was investigated, as well as each of the hygienists concordance with the golden standard. The kappa index (2), expressing the relation of observed agreement and agreement expected by chance, was calculated. To investigate the variability in single links (occupation/decades) we used assessed agreement (pA) for the intensity.

Results

There were 190 links to classify (36 occupations and 6 decades). Some occupations as "work conductor, bicycle delivery man, car delivery man etc." had not occurred during all the six decades (= 26 links missing).

Five industrial hygienists have classified exhaust exposure intensity in four levels for 36 occupations during six decades. The 950 assessments were distributed as follows: 92 (9.7 %) not exposed, 412 (43.4 %) low exposed , 359 (37.8 %) median exposed and 87 (9.2 %) high exposed. Only 23 out of 190 links (12,1 %) had pA=1, which means full agreement; all five industrial hygienists assessed the same exposure level for that link. Four of these 23 (pA=1) were found for no exposure, eleven for low exposure, eight for medium and none for high exposure level.

Each industrial hygienist's estimation for 36 occupation during six decades versus consensus gave a κ range of 0.22-0.53 (mean κ=0.39) for the first set of observations and 0.10-0.59 (mean κ=0.36) for the second set. Average p(A) was 0.62 at the first set and 0.63 at thesecond set.

Each industrial hygienist's total assessment set I versus set II had a κ range of 0.17-0.81.

Industrial hygienists assessed agreement p(A) during the six decades was fairly constant (0.41-0.54 with increased agreement during later decades. The agreement varied more between the 36 occupations with a range (p(A) 0.25-0.78) with best agreement for ambulance drivers, farmers, truck drivers and park workers.

Discussion

A kappa index above 0.75 represents an excellent reliability, values between 0.4 and 0.75 represent a fair to good reliability while values below 0.4 represent poor reliability. The kappa index in this study did not increase at the second time of estimation, and thus, the consensus discussions held at the first occasion had no or small influence on the estimation at the second time. One industrial hygienist has increased his/her p(A) from set I to set II by 18 %, another 4 %, while three other decrease their p(A) with 17%, 11% respectively 1%. The time between those estimations was long (four years) and the result indicate that the basic knowledge did not change.

Assessed agreement gave higher values than kappa value. Assessed agreement take into consideration both deviation from the consensus as well as the level of deviation of steps in our four scale exposure level ranking.

Conclusion

To use one industrial hygienist instead of a group of five industrial hygienists increased the misclassification by about 40% (a factor 1.4). On a four scale intensity exposure level this corresponded to one step on a four digit scale of exposure intensity. Reliability test after four years indicated only small changes in the assessment.

Literature references

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