Are we underestimating the Relative Risk in cohort studies?

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Summary

Relative Risk (RR) is classically calculated as the ratio of Cumulative Incidences of exposed and non-exposed groups. Cumulative Incidence is the proportion of new cases in an initially healthy population, but in some cases it is recommended and adjusted of population at risk. So we calculated what happen if this adjustment is applied for calculation of RR and the result was that unadjusted RR underestimated the adjusted RR.

Methodology

Assuming a population size of 1000 individuals, we have calculated contingency tables rounding values corresponding to different unadjusted RR (1.2, 1.4, 1.6, 1.8, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5 & 5.0) and unadjusted CI in exposed group (1%, 2%, 3%, 4%, 5%, 10%, 15%, 20%, 25%, 30%, 35%, 40%, 45%, 50%, 60%....).

Taking into account contingency table, unadjusted CI were recalculated, and also adjusted CI, and therefore calculation of both RR were carried out. Then relative variation between them was calculated taking as base line de unadjusted RR.

Calculations were carried out with Microsoft Excel 2010 for Windows.

Objective

To assess the relative differences on RR estimation depending on method to calculate cumulative incidences.

Theoretical concepts

Cohort studies are the most powerful epidemiological surveys that we can use in order to assess risk factors. The **Relative Risk (RR)** is the measure of association used to check the strength of the relationship between a disease and a risk factor. RR is calculated as the ratio between incidence in the exposed group and the incidence in the non-exposed group (Thrusfield, 2005).

$$Relative\ Risk = \frac{Cumulative\ Incidence_{exposed}}{Cumulative\ Incidence_{non\ exposed}}$$

Cumulative Incidence (CI) is classically defined as the proportion of healthy animals at the beginning of the period that they have been became diseased during the study (Thrusfield, 2005).

$$CI_{unadjusted} = \frac{new\ cases}{initial\ healthy\ population}$$

However this calculation is not valid when the population at risk varies a lot during the period of study. In these cases an adjustment of population at risk should be applied as the average population of population at risk (Thrusfield, 2005) or subtracting the half of new cases from initial population at risk (Dohoo et al, 2003).

$$CI_{adjusted} = \frac{new\ cases}{initial\ healthy\ population - \frac{new\ cases}{2}}$$

Results

The figure shows the relative increment of RR when it is adjusted for different unadjusted RR (from 1.2 to 5) and CI (from 1% to 60%) Taking into account that adjusted CI among exposed animals is greater than 100% when unadjusted CI is greater than 66.6%, and for this reason values for unadjusted CI greater than 60% were discarded.

When CI is low, the difference between unadjusted and adjusted RR is below 5%, but with high values of CI the underestimation of unadjusted RR could be important (especially when RR has also great values).
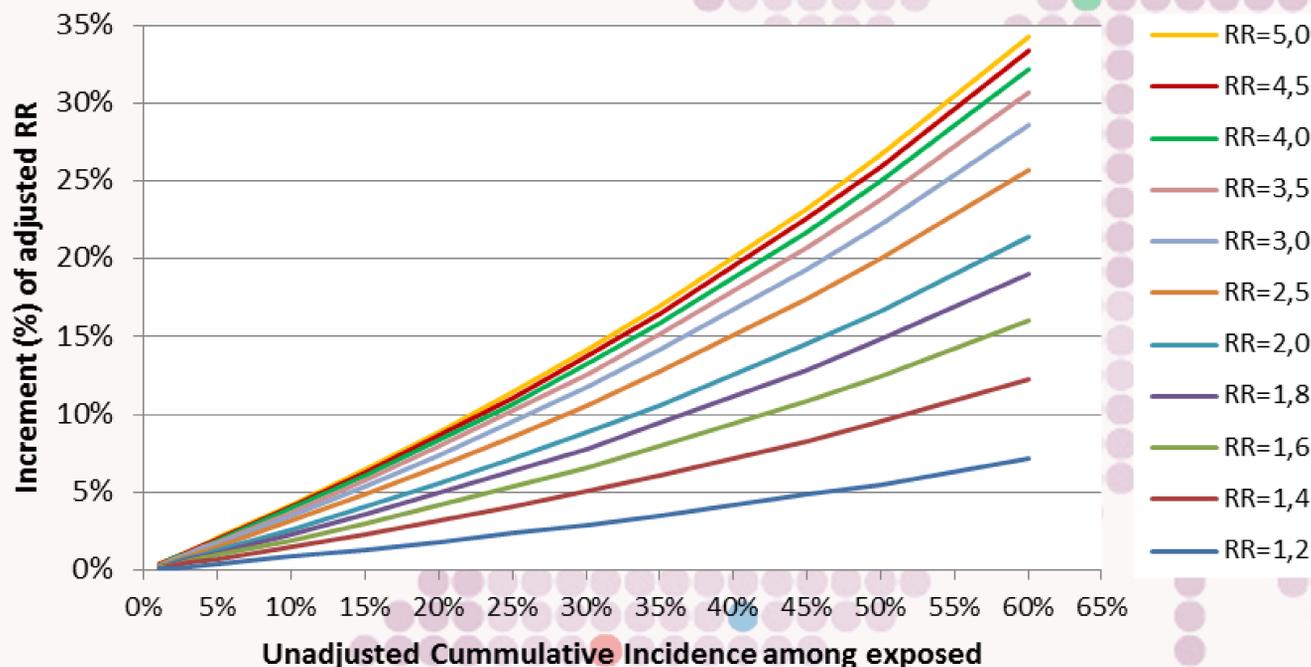
Conclusion

In conclusion, for cohort studies that involve diseases with high incidence, the RR could be underestimated if population at risk is not adjusted.

References

Dohoo, I., Martin, W., Stryhn, H. (2003). Veterinary Epidemiology Research. AVC Inc, Charlottetown, Canada. 706 pp
Thrusfield, M. (2005). Veterinary Epidemiology (3rd edition). Blackwell Science Ltd, Oxford, United Kingdom. 624 pp

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