

Relating risk factors to health - Assignment solutions

1. Definitions:

- a. Cumulative incidence ratio (CIR) - a measure of association equal to the ratio of two cumulative incidences, or the proportion of one group who experience an event relative to the proportion of another group who experience the event.
- b. Incidence density ratio (IDR) - a measure of association equal to the ratio of two incidence densities, or the magnitude of the incidence rate in one group relative to the incidence rate in another.
- c. Odds ratio - a measure of association based on the odds of disease or exposure in two groups; the odds ratio often estimates or approximates the IDR and/or CIR

2. a. The overall quit rate was 17.6% (331/1887).

b. The quit rate is the proportion of abstainers among participants who provided data at their 16-months follow-up. In this sense, the quit rate is the prevalence of abstinence at a point in time, with time being expressed relative study enrollment. In fact, the smoking cessation literature sometimes refers to this type of quit rate as "abstinence prevalence". Since all participants were smokers at baseline, the quit rate can also be regarded as the cumulative incidence for becoming a nonsmoker during 16 months of follow-up. The problem with using cumulative incidence to measure quitting smoking is that abstinence is a reversible state, so the "cases" (quitters) in this study may shortly thereafter revert to "noncases" (smokers). The proportion of participants who quit for 24 hours at some time during the 16-months of follow-up is more clearly a cumulative incidence, but it does not quite tell us what we want to know.

c. Although quitting smoking is an "event", or at least a change of status, it is difficult to translate into a conventional incidence measure. It would be possible to compute an incidence rate based on the number of quits divided by the number of participant-months of follow-up. However, such an incidence rate has no useful interpretation, since a low incidence rate could mean few participants quit or that participants quit and stayed quit. A high rate could mean that many participants quit or that participants kept quitting and relapsing.

Although it's difficult to know when permanent nonsmoking status has been achieved, the longer the period of continuous abstinence the greater the probability of remaining smoke-free. Since quitting smoking for good has an "extended risk period", an incidence rate of

number of "permanent" quits (defined on the basis of some duration of nonsmoking) per participant-year of observation might be appropriate for measuring the effect of a continuing quit-smoking intervention (e.g., a prolonged advertising campaign). For the most part, though, experimental interventions take place over a fairly short period of time, and their effect is assumed to take place either during the intervention or shortly afterward, a situation argues for a cumulative incidence quit rate during the expected period of effect. Given the conceptual complexities as well as the limitations of biochemical verification, continuous abstinence from the completion of an intervention and abstinence prevalence appear to be the measures most commonly used.

- d. Quit rates ranged from 14.2% to 23.0%, with the highest rate in the MST group and the lowest rates in the M and MS groups. The control group had an intermediate quit rate. Although the differences in absolute quit rates were modest, the MST group was clearly the highest. On the assumption that the control group received the least intervention, it is surprising that its quit rate appeared to be higher than the two mail-only intervention groups. (Indeed, one can speculate whether the quitting manual and/or social support brochures by themselves actually depressed quitting below what would have happened; conversely, the controls may have been more likely to obtain quitting assistance from other sources. (Note: the quit rates can be read from the bottom line (Col Pct) of the upper row or computed by dividing the number of quitters in each condition by the total for that condition.)
- e. The CIR for quitting for MST vs. MS groups is $0.230/0.142 = 1.62$; i.e., the MST group quit rate was 60% higher than or 1.6 times the rate for the MS group. The OR for quitting for MST vs. MS groups is $(0.230/0.770 \text{ divided by } 0.142/0.858) = (.230*.858)/(.142*.770) = 1.8$. As always, the OR is farther from 1.0 than the CIR. The OR approximates the CIR when the outcome is rare, which is not quite the case here (quit rates of 14%-23%). However, when the CIR is not far from 1.0, as is the case here, the OR will be only modestly larger.
- f. The "attributable risk" (quit rate difference) is $23.0\% - 14.2\% = 8.8\%$ (absolute). As a percentage of the quit rate in the "exposed" (ARP or EF_1), the impact of the telephone component would be AR/I_1 or $8.8/23.0 = 38\%$. Thus, the telephone component appeared to account for nine percentage points or 38% of the quit rate in the MST group.

3. (For this question, we are ignoring the distinction between rates and risks)

Duration	Relative risk	Attributable risk**	Attributable risk proportion
1 year or less	1*		
4 years	9	$(9-1) (0.06) = 0.48$	$(9-1)/9 = 0.89$
4-7 years	120	$(120-1) (0.06) = 7.1$	$(120-1)/120 = 0.99$
8+ years	500	$(500-1) (0.06) = 30.0$	$(500-1)/500 = \sim 1.00$

* Reference level (includes none)

** per 100,000

There is an extremely strong association between OC use (4 years or longer) and hepatocellular adenoma, and the attributable risk proportion is nearly 1.0 for OC use above 4 years. The excess risk incurred by OC users, however, is miniscule at 4 years of OC use, and quite modest until 8 or more years. The implication is that the association is likely to be causal (due to the strength of the ratio measure of effect) but the resulting increase in risk does not become important until more than 4 years of OC use.

4. a. Irradiated subjects: $ID = 49/279,901$ person-years

$$= 0.000175, \text{ or } 17.5 \text{ cancer deaths per } 105 \text{ person-years}$$

Comparison subjects: $ID = 44/280,561$ person-years

$$= 0.000157, \text{ or } 15.7 \text{ cancer deaths per } 105 \text{ person-years}$$

b. $IDR = ID_1/ID_0 = (17.5 \text{ per } 105 \text{ person-years}) / (15.7 \text{ per } 105 \text{ person-years}) = 1.1$. The rate of cancer deaths in the exposed population is 1.1 times that in the non-exposed comparisons.

c. Rate difference = $ID_1 - ID_0 = 17.5 - 15.7 = 1.8$ cancer deaths per 100,000 person-years.

d. Rate fraction = $(ID_1 - ID_0) / ID_1 = (17.5 - 15.7) / 17.5 = 0.10$

or 10% of the cancer deaths in the exposed group are due to radiotherapy.

e. Population attributable risk proportion = $p_1(IDR - 1) / [1 + p_1(IDR - 1)]$

$$= 0.10(1.11 - 1) / [1 + 0.10(1.11 - 1)] = 1.08\% \text{ of cancer deaths (ignoring the distinction between risk and rate)}$$

5.

a. Begin with:

$$\frac{\text{"Attributable cases"}}{\text{All cases}} = \frac{(I_1 - I_0)n_1}{I_1n_0 + I_1n_1}$$

Then remove the parenthesis in the numerator, add and subtract I_0n_0 , and rearrange terms:

$$= \frac{I_1 n_1 - I_0 n_1 + I_0 n_0 - I_0 n_0}{I_0 n_0 + I_1 n_1} = \frac{I_1 n_1 + I_0 n_0 - I_0 n_1 - I_0 n_0}{I_0 n_0 + I_1 n_1}$$

The crude rate (I) is a weighted average of the stratum-specific rates (I_1, I_0), weighted by the proportions in each stratum, so $I_1 n_1 + I_0 n_0 = I n$. Divide numerator & denominator by $n (= n_1 + n_0)$:

$$= \frac{(I n) - I_0 (n_1 + n_0)}{(I x n)} = \frac{I - I_0}{I}$$

b. Begin again with:
$$\frac{\text{"Attributable cases"}}{\text{All cases}} = \frac{(I_1 - I_0)n_1}{I_1 n_0 + I_1 n_1}$$

(i) Add and subtract $I_0 n_1$ in the denominator,

(ii) rearrange numerator and denominator, and

(iii) divide by $n I_0$, recalling that $n = (n_1 + n_0)$, $RR = I_1/I_0$, and $p_1 = n_1/n$:

$$\frac{\text{I} \quad (I_1 - I_0) n_1}{I_0 n_0 + I_1 n_1 - I_0 n_1 + I_0 n_1} = \frac{\text{ii} \quad n_1(I_1 - I_0)}{(n_0 + n_1) I_0 + n_1 (I_1 - I_0)} = \frac{\text{iii} \quad p_1(RR - 1)}{1 + p_1(RR - 1)}$$

c. The formula:
$$\frac{1}{1 + 1/[p_1(RR - 1)]}$$
 is obtained by dividing numerator and denominator in the preceding formula by the numerator, $p_1(RR - 1)$.