PHC 6010
EPIDEMIOLOGY METHODS I

POPULATION-ATTRIBUTABLE RISK

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Population-Attributable risk (PAR)

- PAR is the portion of the incidence of a disease in the population (exposed and un-exposed) that is due to the exposure.
- It is the incidence of the disease in the population that would be eliminated if exposure were eliminated.
- PAR is computed by subtracting the incidence in the unexposed (I_o) from the incidence in the total population (exposed and unexposed) [I_p].

$$PAR = I_p - I_0$$

Population-Attributable risk (PAR)

- Population-attributable risk percent: is the % of the incidence of a disease in the population (exposed and unexposed) that is due to the exposure.
- It is the percent of the incidence of a disease in the population that would be eliminated by removal of the exposure
- $\text{PAR\%} = \frac{I_p - I_0}{I_p} x100 = \frac{PAR}{I_p}$

Population-Attributable risk (PAR)

- However, a more useful and more commonly employed formula is one that utilizes the level of the exposure in the population and the relative risk (magnitude of the association) for the outcome given the exposure.
- PAR could also be coined thus:
  - Number of cases due to risk factor / Total number of cases

Population-Attributable risk (PAR)

- The numerator could also be re-written as

  (Number of exposed persons) × (risk difference)

- The formula then becomes:

  (Number of exposed persons) × (risk difference) / Total number of cases

  (Number of exposed persons) × (I_e-I_0) / Total number of cases

Population-Attributable risk (PAR)

- = (I_e-I_0)/Total number of cases/(Number of exposed persons)
- Now, Total number of cases in the population is given by:
- (number of exposed persons) × (risk in the exposed)
  + (number of unexposed persons) × (risk in the unexposed)

Let N be the total number of persons in that population, and let P_e be the prevalence of the exposure.

$$PARP = (I_e - I_0)/(N P_e) I_e + (1 - N P_e) I_0 / N P_e$$

Population-Attributable risk (PAR)

PARP = $(I_e-I_0)/N\ [P_eI_e + (1- P_e)\ I_0/\ N\ P_e$

= $(I_e-I_0)/\ [P_eI_e + (1- P_e)\ I_0/\ P_e$

= $(I_e-I_0)/\ P_eI_e - P_e\ I_0 + I_0/\ P_e$

= $(I_e-I_0)/\ P_e(I_e - I_0)+ I_0/\ P_e$

= $P_e(I_e-I_0)/\ P_e(I_e - I_0)+ I_0$

Now divide numerator and denominator by I_0

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PARP = $P_e(I_e-I_0)/I_0\ /\ [P_e(I_e - I_0)+ I_0]/I_0$

= $P_e(RR-1)/\ P_e(RR-1)+ 1$

$$\text{PARP} = \frac{P_e(RR-1)}{1+[P_e(RR-1)]}x100$$

Population-Attributable risk (PAR)

- Question: What if the RR is an odds ratio and the disease is not rare?
- Simply: correct the bias in the odds ratio and use the corrected RR using the formula we are by now used to, namely:

Population-Attributable risk (PAR)

- What if you have more than one level of exposure levels.
- For example: it is easy to compute the PARP if you have obese and non-obese individuals and your outcome is coronary heart disease (CHD).
- In such a case you need only two parameters (namely, the RR and the Prevalence of obesity)

Population-Attributable risk (PAR)

- Now assuming you would like to know the PARP across obesity sub-types (Class 1; Class 2; and Class 3 obesity).
- The formula is:

$$\text{PARP} = \frac{P_1(RR_1-1)+P_2(RR_2-1)+P_3(RR_3-1)}{1+[P_1(RR_1-1)+P_2(RR_2-1)+P_3(RR_3-1)]}$$

Where P_1, P_2 and P_3 are the prevalence of class 1, class 2 and class 3 obesity subtypes, and RR_1 RR_2 and RR_3 are their respective relative risks

Class Quiz

- In a study of adverse effects of VIAGRA among elderly people, 10,834 male individuals between the ages of 60-80 were identified from original treatment records and matched to 10,834 non-treated comparison subjects selected from the general population. Person-years of observation were: VIAGRA-treated subjects 279,901; comparison subjects 280,561. During the follow-up, there were 49 cases of total blindness from the VIAGRA-group and 44 in the non-VIAGRA comparison subjects. Based on this information, answer the following questions:

Class Quiz (contd)

1. What are the rates of total blindness for the two groups?
2. Calculate the IDR and 95% confidence interval
3. Assuming causality, estimate how many cases of total blindness per 100,000 person-years of follow-up of VIAGRA-treated persons were due to the effect of VIAGRA?
4. Again assuming causality, what proportion of total blindness among VIAGRA-treated subjects were due to VIAGRA
5. If 10% of the elderly population had consumed VIAGRA, what proportion of all total blindness within this relevant age span would be due to VIAGRA?

Solutions

- 17.51/100,000 person-years (VIAGRA group) and 15.68/100,000 in the non-VIAGRA group
- IDR = 1.12; 95% CI = 0.74-1.68
- 1.83
- AR% = 10.45%
- PAR% = 1.19%