CMED 305

Practical Exercise on: Odds ratio & Minimizing Bias

Definition: Odds ratio is a measure of association between exposure and disease occurrence which shows the odds of developing disease risk in the exposed group when compared with unexposed group.
Case-control: we start with outcome, we can't calculate attack rate, use odds ratio instead of RR, and the population is unknown (**differentiate between it and retrospective cohort**)

Formula of Odds ratio = AD/BC.

Interpretation:
If the OR is = 1 there is no association between exposure and outcome
If the OR is < 1 there is negative association (exposure is a protective factor)
If the OR is >1 there is positive association between exposure and outcome (exposure is a risk factor)

Calculation of Odds ratio Example: The number of fatal and survived cases of a standard and new treatment regimen is given below.

Outcome / Exposure	Died	Survived	Total
Standard treatment	150 (A)	250 (B)	400 (A+B)
New treatment	20 (C)	100 (D)	120 (C+D)
Total	170 (A+C)	350 (B+D)	520 (A+B+C+D)

Odds ratio = AD/BC.
Where, AD= 15000, BC = 5000 and OR= 15000/5000 = 3

Interpretation: The odds of death is 3 times greater in the standard treatment compared to the new treatment regimen.

Exercise 1: Data from a case-control study of 198 esophageal cancer cases and 754 community-based controls are shown below in the table. The exposure factor under study is smoking and details of smokers are as shown under. Calculate the odds of risk for the given scenario.

outcome / exposure	Esophageal cancer +	Esophageal cancer -	Total
Smokers	96 (A)	104 (B)	200 (A+B)
Non-smokers	102 (C)	650 (D)	752 (C+D)
Total	198 (A+C)	754 (B+D)	952 (A+B+C+D)

Solution:
Odds ratio = 5.88
Interpretation: The odd of development of esophageal cancer is 5.9 times greater in smokers compared to non-smokers

Exercise 2: A case control study taking 200 subjects as cases and 400 controls was done to study the effect of tobacco smoke on coronary heart disease. About 112 developed CHD who also smoked and 88 who developed CHD had no exposure to smoking while 176 among the controls smoked but did not develop the disease. Draw a 2*2 table and calculate the odds of risk for the given data.

Solution:

Outcome / Exposure	CHD +	CHD -	Total
smokers	122	176	288
Non-smokers	88	224	312
Total	200	400	800

Odds ratio = 1.619

Interpretation: The odd of development of CHD is 1.6 times greater in smokers compared to non-smokers

Exercise 3: Two classes consisting of 100 students in each were studied to determine the exposure of TV viewing and binge eating on obesity. A total of 75 obese cases were studied, among whom 50 had TV viewing with binge eating habit. Also 50 students from among the controls too had the habit. Draw the 2*2 table and determine the risk associated with the habit.

Solution:

Outcome / Exposure	Obese +	Obese -	Total
TV viewing with binge eating habits +	50	50	100
TV viewing with binge eating habits -	25	75	100
Total	75	125	200

Odds ratio = 3

Interpretation: The odd of development of Obesity is 3 times greater in TV viewing with binge eating habits compared to No TV viewing with binge eating habits

Bias in epidemiological studies - Minimizing Bias

Epidemiological studies are prone to bias; hence it is the duty of every epidemiologist to minimize bias in every step of design, planning and execution of studies.

Types of bias: the three types of common bias studied in the earlier session were:

- Recall bias
- Selection bias
- Interviewer bias

Recall bias

Recall bias is a major problem in case control studies as the subjects may face difficulties in recalling the vital information leading to serious distortion or errors in recording details.

	Mothers of Leukemic Children	Controls
Coffee consumption	a ⇩	b
Did not take	c	d

Difficulty in recalling the information has led to under estimation of 'a' i.e., cases with exposure. Hence it leads to under estimation of OR.

Methods to reduce recall bias:

- Time interval between the study and event of interest must be short i.e., minimize the recall period.
- Questionnaire must be designed to contain accurate questions to aid in quick recall.
- Using information from medical records, employment records, and other reliable sources of health department in order to reduce recall bias.
- Careful selection of controls with similar cultural and geographical features as that of cases, but different disease under study
- Confirming the recorded information by verifying with close family members.

Selection bias

Errors during recruiting study subjects may introduce selection bias. Selection of cases from a single hospital, or same economic strata or selection of complicated cases may distort results

Selection bias may be reduced by careful selection of cases and controls in the following ways:

- The study population should be clearly defined.
- Case definition and exposure definition must be clearly defined.
- Selection of subjects must strictly adhere to selection criteria.
- Selection of proper control or the unexposed group is of primary importance.
- Controls can be matched from the unexposed general population
- Controls can be recruited from hospitals, neighborhood or relatives who do not have the disease under study.

Interviewer bias: Bias can be introduced into the study by the interviewer at the time of recording information.

For example, consider the following example

	Cancer	Controls
Exposure to pesticides	600	250
No Exposure to pesticides	400	750

OR = (600*750)/ (400*250) = 4.5

Calculate Odds Ratio

	Cancer	Controls
Exposure to pesticides	660	250
No Exposure to pesticides	340	750

Calculate Odds Ratio

Excessive probing has increased the exposed cases. So OR =

(660*750)/ (340*250) = 5.8

With introduction of interviewer bias the OR has been overestimated from 4.5 to 5.8

This type of bias can be minimized by paying close attention to the following:

- Training the interviewers in recording accurate data.
- Reducing inter observer variation by using small number of interviewers
- Following a validated closed ended questionnaire.
- Blinding the interviewers to exposure status/outcome of the study participant.
- Blinding the subjects by not revealing the minute research details.

Questions on how to overcome bias

1. Consider the following scenario. A survey was done to probe the pesticide exposure to study the association with cancer. The interviewer excessively probed on the exposure to pesticide history and thereby increased the number of cancer cases with exposure history leading to overestimation of odds ratio. **Determine the type of bias introduced here and mention the methods to overcome it.**

outcome / exposure	Esophageal cancer +	Esophageal cancer -	Total
Smokers	96	104	200
Non-smokers	102	650	752
Total	198	754	952

outcome / exposure	Esophageal cancer +	Esophageal cancer -	Total
Smokers	126⇧	104	239
Non-smokers	72	650	722
Total	198	754	952

Solution:

OR has been overestimated from 5.8 to 10.9

Type of bias: Interviewer bias

Method to overcome it:

- Training the interviewers in recording accurate data
- Reducing inter observer variation by using small number of interviewers
- Following a validated closed ended questionnaire
- Blinding the interviewers to exposure status/outcome of the study participants
- Blinding the subjects by not revealing the minute research details

2. Mothers of children with congenital defects fail to recollect the dietary or drug history during pregnancy leading to underestimation of OR. What is type of bias that is related to this scenario and provide its solution.

outcome / exposure	Congenital defect babies +	Congenital defect babies -	Total
drug history +	60	50	
drug history -	30	65	
Total			

outcome / exposure	Congenital defect babies +	Congenital defect babies -	Total
drug history +	40 ⇩	50	
drug history -	50	65	
Total			

Solution:

OR has been underestimated from 2.5 to 1.04

Type of bias: Recall bias

Method to overcome it:

- Time interval between the study and event of interest must be short i.e., minimize the recall period.
- Questionnaire must be designed to contain accurate questions to aid in quick recall.
- Using information from medical records, employment records, and other reliable sources of health department in order to reduce recall bias.
- Careful selection of controls with similar cultural and geographical features as that of cases, but different disease under study
- Confirming the recorded information by verifying with close family members.